Final
Plan of Operations

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio

Contract Number: W91237-10-C-0002

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DEFINITIONS AND ACRYNYMS

2-ADNT	**2-amino-4,6-dinitrotoluene**
4-ADNT	**4-amino-2,6-DNT**
AOC	**Area of Contamination**
COC	**Contaminants of Concern**
COR	**Contracting Officer Representative**
CY	**Cubic Yards**
DNT	**Dinitrotoluene**
DOT	**Department of Transportation**
DRO	**Diesel Range Organics**
GSA	**General Service Administration**
HAZWOPER	**Hazardous Waste Operations and Emergency Response**
HI	**Hazard Index**
HSWA	**Hazardous and Solid Waste Amendments**
HTF	**Hypersonic Tunnel Facility**
HTRW	**Hazardous, Toxic, and Radioactive Waste**
ICLR	**Incremental Lifetime Cancer Risk**
IQCT	**Independent Quality Control Team**
IDW	**Investigation Derived Waste**
LDR	**Land Disposal Restrictions**
MDL	**Minimum Detection Limit**
mg/kg	**Milligrams per Kilogram**

MSDS	**Material Safety Data Sheet**
NASA	**National Aeronautics and Space Administration**
NIOSH	**National Institute for Occupational Safety and Health**
OEPA	**State of Ohio Environmental Protection Agency**
OSHA	**Occupational Safety & Health Administration**
PAH	**Polynuclear Aromatic Hydrocarbons**
PARCCS	**Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity**
PBOW	**Plum Brook Ordnance Works**
PBS	**Plum Brook Station**
PCBs	**Polychlorinated Biphenyls**
PEL	**Permissible Exposure Limit**
POC	**Point of Contact**
PPE	**Personal Protective Equipment**
QA	**Quality Assurance**
QAP	**Quality Assurance Plan**
QC	**Quality Control**
QCO	**Quality Control Officer**
QCP	**Quality Control Plan**
RA-C	**Remedial Action Construction**
RCRA	**Resource Conservation and Recovery Act**
RI/FS	**Remedial Investigation/Feasibility Study**

RGs	**Remediation Goals**
RPDs	**Relative Percent Differences**
SOW	**Scope of Work**
SSHO	**Site Safety and Health Officer**
SSHP	**Site-Specific Safety and Health Plan**
TCLP	**Toxicity Characteristic Leaching Procedure**
TMG	**TMG Services, Inc.**
TNT	**Trinitrotoluene**
TNTA	**TNT Area A**
TNTB	**TNT Area B**
TNTC	**TNT Area C**
TPH	**Total Petroleum Hydrocarbons**
TWA	**Time Weighted Average**
USACE	**United States Army Corps of Engineers**
USEPA	**United States Environmental Protection Agency**

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1.0 PROJECT DESCRIPTION

1.1 Introduction and Site History

The site of the former Plum Brook Ordnance Works (PBOW) is located approximately 4 miles south of Sandusky, Ohio and 59 miles west of Cleveland, Ohio. Although primarily in Perkins and Oxford Townships, the eastern edge of the site extends into Huron and Milan Townships. PBOW is bounded on the north by Bogart Road, on the south by Mason Road, on the west by County Road 43, and on the east by U.S. Highway 250. The surrounding area is mostly agricultural and residential.

The 9,009-acre PBOW site was built in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives at PBOW began in December 1941 and continued until 1945. It is estimated that more than 1 billion pounds of nitroaromatic explosives were manufactured during the 4-year operating period. The three explosive manufacturing areas were designated TNT Area A (TNTA), TNT Area B (TNTB), and TNT area C (TNTC). Twelve process lines were used in the manufacture of TNT, four lines at TNTA, three lines at TNTB, and five lines at TNTC. The work to be performed under this project deals primarily with the TNTC area.

The TNTC manufacturing site consisted of widely scattered buildings of wood frame construction with asbestos and sheet metal coverings. It also included a series of buried and/or overhead flumes and pipes used to transport various liquids associated with the manufacturing process. After plant operations ceased, TNT C's manufacturing lines were decontaminated by the War Department in late 1945. During decontamination, all structures, equipment, and manufacturing debris were either removed and salvaged, or removed and burned by the War Department in 1945. After the property was certified decontaminated by the US Army, the property was initially transferred to the Ordnance Department and then to the War Assets Administration. In 1949, PBOW was transferred to the General Services Administration (GSA). In 1955, the GSA completed further decontamination of TNTC. This effort supposedly focused on surface contamination detected by visual inspection. It is unknown whether the underground flumes were addressed by this decontamination effort

The National Aeronautics and Space Administration (NASA) acquired the property on March 15, 1963 and currently utilizes the site. GSA performed further decontamination efforts during the 1963 transfer. The decontamination process included removing contaminated surface soils above the drain tiles, flumes, etc., destruction of buildings by fire, and the removal of soil, debris, sumps, and concrete foundations. All materials, including the soil in those areas, were flashed. The area was then rough graded. The decontamination process also included the burning of excavated nitroaromatic filled flumes. Although efforts to remove the residuals from the manufacturing process were completed in the 1963 timeframe, today, some wooden flumes and concrete foundations remain in-place and are the subject of current investigation under different projects. Those investigations are not part of this TNTC remediation effort.

NASA currently operates the Plum Brook Station (PBS) of the John Glenn Research Center at Lewis Field. Most of the aerospace testing facilities built in the 1960's at the site are in standby or inactive status. On April 18, 1978, NASA declared approximately 2,152 acres of PBOW as excess. The Perkins Township Board of Education acquired 46 acres of the excess acreage and uses this area as a bus transportation area. GSA retains ownership of the remaining excess acreage and currently has a use agreement with Ohio National Guard for 604 acres of the land. NASA presently controls approximately 6,400 acres and is using the site to conduct space research as a satellite operation of the John Glenn Research Center at Lewis Field.

The TNTC area occupies approximately 119 acres of land in the western portion of PBOW. Currently the area is heavily vegetated and overgrown with trees and brush. Several aboveground features that indicate former PBOW facilities are still evident at TNTC. These features include roads, fire hydrants, water valves, a water valve control well, railroad beds, and former building pad foundations. Below-ground features are also present, including manholes, drains, and underground lines (indicated by aboveground water valves). NASA does not currently use the area, and no NASA buildings exist in TNTC. One building present on the site was constructed and used by the USEPA to perform noise abatement testing in the 1980s. This building is located near a former wash house (Building 606) along former Process Line 10. Based on this use, there is no reason to expect that USEPA contributed in any way to contamination at TNTC.

The former TNTC site consisted of widely scattered buildings of wood-frame construction with asbestos and sheet metal coverings. The area also included a series of buried and/or overhead flumes and pipes used to transport various liquids associated with the manufacturing process.

1.2 Overview of Remedy

To provide a basis for taking an action at this site, Remedial Investigation (RI) activities were conducted for TNTC soils (415 samples), surface water (10 samples), and sediment (15). Groundwater was investigated under Project 1826 and therefore not addressed in the RI. During the RI, TNTC soil was investigated by process line or process type, and the associated 29 building areas. As part of the RI, human health and ecological risk assessments were conducted

for TNTC. Out of the 29 building areas investigated, 14 building areas and 1 drainage ditch area (total of I5 areas) were identified as having contaminants above the identified Remedial Goals (RGs). Thirteen contaminants of concern (COCs) were identified in surface, subsurface soil and sediment. Five of those COCs are nitroaromatics (2-amino-4,6-dinitrotoluene (2-ADNT), 4-amino-2,6-DNT (4-ADNT), 2,4-DNT, 2,6-DNT, and 2,4,6-TNT). The remaining 8 COCs are polychlorinated biphenyls (PCBs) (Aroclor 1254 and 1260), polynuclear aromatic hydrocarbons (PAHs) (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenze(a,h)anthracene, and indeno(l,2,3-c,d)pyrene) and lead. Sediment has only 3 COCs: nitroaromatics (2-ADNT, 4-ADNT, and 2,4,6-TNT).

The proposed approach for this RA-C is to excavate all the areas in which the concentration of the COCs in soil exceeds the RGs. The estimated volume of contaminated soil from the TNTC excavations is 9,205 CY. Following excavation of the contaminated soil, representative soil samples from each area of contamination (walls and floor) will be analyzed for "totals" to ensure the AOC has been remediated to meet the "clean-up" requirements set forth in the RI/FS. Additional removal of soil to a greater depth is not anticipated as virtually all of the excavations are expected to extend to either bedrock or the water table, whichever is encountered first.

Based on the RI/FS data, the estimated volume of soil is 9,205 CY. Of this, an estimated 6,805 CY are targeted for disposal, without treatment, at a regulated non-hazardous landfill. The soil disposed of at the landfill is designated to be used as daily cover. Pursuant to the Scope of Work, the Erie County Landfill already has an agreement with OEPA to accept soils from PBOW TNTC. The remaining 2,310 CY are anticipated to be a characteristic hazardous waste based on toxicity as determined by TCLP testing. This hazardous soil will require treatment prior to disposal at a non-hazardous waste landfill or on-site placement. Approximately 2,103CY are estimated to be hazardous prior to treatment based on elevated 2,4-DNT concentrations. Thus nearly half of the lead-contaminated soil is expected to require treatment. The actual volumes of hazardous and non-hazardous soil may be less or more depending on the disposal analyses results.

Section 6.1 of this plan provides a brief description of each area and the COCs in those areas. Pursuant to the Scope of Work, the soil will be excavated from each area and “stockpiled” next to the excavation pit in that specific area. Subsequently, representative soil samples from the stockpile(s) generated from each excavation will be analyzed for full toxicity characteristic leaching procedure (TCLP).

The selected alternative stated in the approved Decision Document was not designed to treat PCBs. None of the soil or sediment samples in the RI had PCB concentrations near 50 mg/kg. However, there are several scenarios for handling soils with PCBs as referenced in the chart on the following page.

TABLE 1-1: PCB Contaminated Soil Handling Options

PCB Concentrations	Nitroaromatic Concentrations	Soil Handling
<50 mg/kg	>RGs and <TCLP	No treatment, disposal at non-hazardous landfill
<50 mg/kg	>TCLP	Treatment to reduce nitroaromatics to <TCLP, disposal at non-hazardous landfill or on-site placement
>50 mg/kg	>RGs and <TCLP	Disposal at TSCA-approved landfill
>50 mg/kg	<RGs and <TCLP	Disposal in TSCA-approved landfill
>50 mg/kg	>RGs and >TCLP	May need to treat before disposal at TSCA landfill – confirm with TSCA landfill. No treatment required if TSCA landfill accepts hazardous

Based on the TCLP tests, the excavated stockpiled soil may either be treated and used as backfill (if Land Disposal Restrictions are met) or disposed of in an off-site, non-hazardous waste landfill, in this case the disposal location would be Erie County Landfill. Any soil that is identified as hazardous waste will require treatment using either alkaline hydrolysis, windrow composting, metals stabilization or a combination of either to achieve non-hazardous classification prior to on-site or off-site disposal. Although available, disposal of materials at a hazardous waste landfill is a last resort.

Based on the results of the Human Health Risk Assessment, specific RGs were selected for soil and sediment. COCs were identified for TNTC soil and sediment as those chemicals that contributed most to an additional incremental lifetime cancer risk (ICLR) of $1x10^{-5}$ (or 1E-5) or an additional non-cancer Hazard Index (HI) of 1. In addition to the ICLR and HI requirements, the RGs presented in Tables 1-2 and 1-3 have been approved for cleanup of soils and sediment in TNTC.

TABLE 1-2: Chemicals of Concern for Soils

Chemicals of Concern for Soils	Remedial Goal (RG) Concentration Milligram per kilogram (mg/kg)
Nitroaromatics	
2-amino-4,6-DNT (2-ADNT)	1.7
4-amino-2,6-DNT (4-ADNT)	1.3
2,4-DNT	6.5
2,6-DNT	1.0
2,4,6-TNT	8.0
Polychlorinated Biphenyls	
Aroclor 1254	1.0
Aroclor 1260	1.0
Polynuclear Aromatic Hydrocarbons	
Benzo(a)anthracene	1.0
Benzo(a)pyrene	1.0
Benzo(b)fluoranthene	1.0
Dibenzo(a,h)anthracene	1.0
Indeno(1,2,3-cd)pyrene	1.0
Metals	
Lead (Pb)	400

TABLE 1-3: Chemicals of Concern for Sediment

Chemicals of Concern for Sediment	Remedial Goal (RG) Concentration Milligram per kilogram (mg/kg)
Nitroaromatics	
2-amino-4,6-DNT (2-ADNT)	5.0
4-amino-2,6-DNT (4-ADNT)	5.0
2,4,6-TNT	41.0

The RGs were developed as not-to-exceed criteria for the purpose of identifying areas at TNTC requiring soil remediation. The RGs will be used statistically during the excavation and confirmation sampling to determine whether additional soil removal is required. Analytical data from each excavation will be averaged and compared to the respective RG. Pursuant to the SOW, the exceedance of an individual RG will be acceptable for an excavation as long as the overall OEPA risk goals (ILCR </=1E-5 and HI </= to 1) are not exceeded for the area represented by those samples. Also for the selected alternative (Alternative 5 from the Feasibility Study (FS)) the RGs would serve as cleanup criteria. If an individual RG is exceeded for a batch of treated material, the material may be placed on site as long as the overall OEPA

risk goals were not exceeded for that batch and land disposal restrictions (LDRs) requirements were met.

The soil RGs and sediment RGs were derived assuming future unrestricted land use. The area surrounding the former PBOW is rural and residential, and the assumption is consistent with the remedial objectives of other PBOW sites that have been remediated by USACE.

1.3 Tasks

TMG Services, Inc. (TMG) will be responsible for all equipment, labor, materials and supervision necessary for the remediation of the TNTC project site. The remediation activities consist of excavation of the contaminated soil and sediment from the 15 AOCs, soil characterization and TCLP testing, segregation of the hazardous lead-contaminated soil, segregation of the hazardous 2,4-DNT contaminated soil and sediment, on-site treatment of contaminated soil using alkaline hydrolysis or windrow composting (or a combination of both, if necessary), neutralization of the treated soil (if necessary), chemical stabilization of the lead contaminated soil, and the off-site disposal of the non-hazardous untreated soil at a non-hazardous solid waste landfill and/or on-site placement of the treated material. To accomplish these objectives, the project has been segregated into the following tasks:

Task 1 Preparation/Submittal of a SSHP

Task 2 Preparation/Submittal of a QCP

Task 3 Preparation/Submittal of a Plan of Operations

Task 4 Field Activities/Utilities

Task 5 Site Survey

Task 6 Excavation

Task 7 Treatment (Alkaline Hydrolysis and/or Windrow Composting, if necessary)

Task 8 Stabilization, if necessary

Task 9 Disposal/Investigative Derived Waste (IDW)

Task 10 Confirmation Sampling

Task 11 Preparation/Submission of Draft and Final Construction Completion Report

Task 12 Public Meeting Support

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The collection of quality data and the completion of any given project are strongly affected by the project organization. A project that is properly organized with personnel responsibilities well-delineated results in a successful project conclusion. A listing of functional areas and qualified personnel are given for this project.

A. Government Technical POC - This is the technical POC representing the USACE who will serve as a liaison between the USACE and the contractor.

USACE POC	Contact Information
Lisa Humphreys	Office (304) 399-5953
	Mobile (304) 617-1461
	Lisa.A.Humphreys@usace.army.mil

B. NASA POC - This is the technical POC representing NASA.

NASA POC	Contact Information
Robert Lallier	Office (419) 621-3234
	Robert.F.Lallier@NASA.gov

C. Contractor's Senior Project Manager - TMG's Senior Project Manager provides technical insight and provides corporate level supervision for the project. The Project Manager has overall responsibility to see that the project is completed in accordance with the Scope of Work.

TMG Services, Inc. Senior Project Manager	Contact Information
Rodney Bumgardner	Office (304) 722-6015
	Mobile (304) 545-4481
	rbumgardner@tmgservicesusa.com

D. On-Site Project Manager - The On-Site Project Manager will be in charge of on-site field activities in coordination with the Contractor's Senior Project Manager.

On-Site Project Manager	Contact Information
Helen Owens	Mobile (419) 504-8008
	Mobile (937) 478-2322
	howens@tmgservicesusa.com

E. **On-Site Project Superintendent** - The On-Site Project Superintendent will be in charge of on-site field activities when the On-Site Project Manager is away from the site. It is anticipated that the On-Site Project Manager will be on-site for the majority of the project.

On-Site Project Superintendent	Contact Information
Dan Cashbaugh	Mobile (216) 404-8109
	dcashbaugh@tmgservicesusa.com

F. **Site Safety and Health Officer** - The SSHO is responsible for safety on site. This person has the authority to stop work if unsafe conditions warrant.

TMG Services, Inc. SSHO	Contact Information
Dan Cashbaugh	Mobile (216) 404-8109
	dcashbaugh@tmgservicesusa.com

G. **Quality Control Officer** - This person is responsible QC at the site. This person has the authority to stop the work if QC is not being met. The QC Officer shall be responsible for sampling activities.

TMG Services, Inc. QC Officer	Contact Information
James Russell	Mobile (216) 857-1112
	jrussell@tmgservicesusa.com

H. **Health and Safety Manager** - The Health and Safety Manager provides oversight of the Safety and Health Program. The Health and Safety Manager will be responsible for all analytical data coordination as well as the HI and ILCR calculations to verify the "hot spot" has been remediated.

TMG Services, Inc. Health and Safety Manager	Contact Information
Matthew Ford	Mobile (304) 389-5112
	mford@tmgservicesusa.com

I. **Field Personnel** - These personnel are responsible for assisting the Project Manager in completing the tasks required under this contract.

TMG Services, Inc. Field Personnel	Contact Information
Dan Cashbaugh	Mobile (216) 644-5817
James Russell	Mobile (216) 323-9864
Delmar Hartness	Mobile (216) 215-2875

J. **TMG Services, Inc.'s Independent Quality Control Team -** An internal quality control team will independently review the work plans and reports to ensure that they meet requirements of the Scope of Work.

TMG Services, Inc.'s Independent Quality Control Team	Contact Information
Kimberlie Bumgardner	(304) 201-2205 Mobile (304) 215-0099 kchambers@mctechreadymix.com
Richard Armstrong	(304) 201-2205 Mobile (304) 932-5490 rarmstrong@mctechreadymix.com

K. **TestAmerica, Inc. -** Samples will be sent to the following USACE QSM-certified laboratory. Test America, Inc. located in North Canton, Ohio.

TestAmerica Contact	Contact Information
Kenneth Kuzior	(330) 966-9374 Ken.Kuzior@testamericainc.com
Deborah Dunn	(330) 966-9292 Deborah.Dunn@testamericainc.com

L **Disposal Facility for Contaminated Soil -** Non-hazardous soil removed from the site will be disposed of at the Erie County Landfill.

Erie County Landfill	Contact Information
Fred Dubbert – Landfill Superintendent	Office (419) 433-9760 Mobile (419) 433-3624 fdubbert@erie-county-ohio.net
Bob Sennish – Waste Approvals	Office (419) 433-9760 Mobile (419) 656-0554 bsennish@erie-county-ohio.net

M **Barnes Nursery –** Barnes Nursery will be used for the transportation of any non-hazardous materials to the Erie County Landfill and to transport clean backfill material to the site. In addition, Barnes Nursery will provide the compost turning equipment plus an operator.

Barnes Nursery Contact	Contact Information
Jarrett Barnes	Mobile (419) 656-3652 jsbarnes@barnesnursery.com

N. **John Hancock and Associates, Inc. -** Personnel from John Hancock and Associates, Inc. will perform a survey of the excavations and measure the volume of material excavated from the excavations.

John Hancock and Associates, Inc. Contact	Contact Information
Alex Etchill	(419) 625-7838 aettchill@Hancockengineers.com

O. **Tetra Tech -** Personnel from Tetra Tech will perform soils treatment, including lead stabilization and alkaline hydrolysis. The Tetra Tech contact is Mikael Spangberg. Mr. Spangberg is not expected to be on-site; however, one or more of the other personnel listed from Tetra Tech will be on-site.

Tetra Tech Project Manager	Contact Information
Mikael Spangberg	Office (860) 461-0189 Mobile (860) 478-9658 Mikael.Spangberg@tetratech.com

TetraTech On-Site Representatives	Contact Information
Bobby Bobo	(865) 384-5469
Bryn Howze	(865) 771-9398

P. **Midwest Environmental Services, Inc.** - Midwest will be the primary provider of waste characterization, waste profiling, transportation and disposal services for hazardous (soil and liquid), non-hazardous wastes, and if necessary, PCB-contaminated soils (>50 mg/kg).

Midwest EPA ID Nos.

Cincinnati Ohio Facility – OHD980821862
Charlestown Indiana Facility – INR000006506
Transportation – ID181353806

Midwest Environmental Services, Inc. Contact	Contact Information
Greg Wilfong	Office (513) 681-9990 Mobile (513) 368-4105 gwilfong@midwestenvironmentalservices.com
Doug Gronauer	Office (513) 681-9990 Mobile (513) 535-5047 dgronauer@midwestenvironmentalservices.com

Q. **EQ Environmental -** The hazardous disposal facility for the contaminated soil is EQ Environmental located in Michigan.

EQ EPA ID No. – MID000724831

EQ Environmental Contact	Contact Information
Debbie Ferrari	(800) 592-5489

R. **Enviro-Clean Inc**. - Non-hazardous IDW containing liquids will be transported to Enviro-Clean Inc. located in Wooster, Ohio for ultimate disposal.

Enviro-Clean EPA ID No. – OHR000033951

Enviro-Clean Inc.	Contact Information
David Stroh	(330) 264-8080

S. **Dart Trucking** - In the event that some of the soil does not pass the TCLP test for disposal at the Erie County Landfill then Dart Trucking will be available for the transportation of material to EQ Environmental located in Michigan. Dart is a backup transportation contractor.

Dart Trucking EPA ID No. – OHR000159129

Dart Trucking Contact	Contact Information
Debbie Celli	(800) 541-8206, extension 192

T. **McTech Corp** - TMG will rent heavy equipment from McTech Corp during this project. McTech Corp will also provide logistical support to the project.

McTech Corp Contact	Contact Information
Kimberlie Bumgardner	(304) 201-2205
	Mobile (304) 215-0099
	kchambers@mctechreadymix.com

U. **Tuffman Equipment and Supply** - TMG will rent a variety of equipment from Tuffman Equipment and Supply.

Tuffman Equipment and Supply Contact	Contact Information
Mike Spear	(800) 622-7052
	Mobile (419) 656-3683

3.0 APPLICABLE AND RELEVANT, AND APPROPRIATE REQUIREMENTS

3.1 Site Remedial Investigation

RI fieldwork was conducted in 2001 in order to provide a basis for taking an action at the site. As part of the RI, a human health risk assessment was conducted for TNTC. Thirteen COCs were identified in the soil and three COCs were identified for sediment. Based on the results of the human health risk assessment, it was determined that remedial actions were to be taken to prevent human exposure via any exposure route (ingestion, inhalation, or dermal contact) to soil and sediment that exceeds the RGs. Table 3-1 and 3-2 summarize the COCs for this project. Additional information on the ARARs are presented in the TNT Area C Remedial Investigation.

Table 3-1: Chemicals of Concern for Soils

Chemical of Concern	Remedial Goal (RG) Concentration Milligram per kilogram (mg/kg) [1]
Nitroaromatics	
2-amino-4,6-DNT (2-ADNT)	1.7
4-amino-2,6-DNT (4-ADNT)	1.3
2,4-DNT	6.5
2,6-DNT	1.0
2,4,6-TNT	8.0
Polychlorinated Biphenols	
Aroclor 1254	1.0
Aroclor 1260	1.0
Polynuclear Aromatic Hydrocarbons	
Benzo(a)anthracene	1.0
Benzo(a)pyrene	1.0
Benzo(b)fluoranthene	1.0
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-cd)pyrene	1.0
Metals	
Lead (Pb)	400

1 - mg/kg is equal to parts per million (ppm)

TABLE 3-2: Chemicals of Concern for Sediment

Chemicals of Concern for Sediment	Remedial Goal (RG) Concentration, mg/kg
Nitroaromatics	
2-amino-4,6-DNT (2-ADNT)	5.0
4-amino-2,6-DNT (4-ADNT)	5.0
2,4,6-TNT	41.0

3.2 Resource Conservation and Recovery Act

Subtitle C of the Federal Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984, authorizes USEPA to regulate the management of hazardous wastes. The designation of a waste as hazardous subjects all those charged with managing that waste to the stringent "cradle-to-grave" requirements of RCRA Subtitle C. It is crucial, therefore, for all those managing wastes to properly identify them and determine whether or not those wastes are in fact "hazardous". There are four kinds of hazardous wastes as defined by Subtitle C of RCRA:

- Solid wastes, which exhibit hazardous characteristics (i.e., ignitability, corrosivity, reactivity, or toxicity).
- Solid wastes specifically listed by the Agency as being hazardous.
- A waste that is considered a declared waste.
- A waste mixed with a known hazardous waste.

The toxicity characteristic identifies wastes that are likely to leach hazardous concentrations of certain toxic contaminants into groundwater under improper storage conditions. The toxicity of a waste can be determined by applying the toxicity characteristic leaching procedure (TCLP), a test designed to simulate the leaching of toxic constituents. Full TCLP analysis (volatiles, semi-volatiles, metals, herbicides, and pesticides) will be performed on all soil and investigation derived waste (IDW) that is to be removed from the project site. Analytical data from the TCLP analysis will be compared to the RCRA regulatory levels for TCLP constituents.

4.0 FIELD ACTIVITIES

4.1 Borrow Area

Upon approval of the SSHP, QCP and this Plan of Operations, TMG Services, Inc. will mobilize to the borrow site to collect samples of the borrow material for analysis. The borrow site is located on Barnes Nursery property. The borrow area will be sampled and analyzed to ensure that the borrow material is not contaminated and all parameters (Tables 3-1 and 3-2) are below the RGs. Samples will be collected using a gloved-hand to collect a 5-point composite sample and composite the soil into a plastic bag. It is anticipated that approximately 4,000 - 6,000 CY of borrow soil will be needed to fill the 15 excavations, depending on the amount of material that can be placed on-site in TNTC after remediation. That volume includes like-material for the sediment area, if remediation is required for that area. The borrow material will be considered appropriate for use in backfill of excavated pits if all chemical constituents are below the RGs and pose no residential risk issues. RGs are listed in Table 3-1 and 3-2, Section 3.1 of this plan. The analytical requirements for the borrow material are presented in Section 8.0 of this plan.

4.2 Excavation Area Preparation

TMG will notify the USACE POC and receive approval of the planned project schedule prior to mobilizing to the NASA PBS site. TMG will set-up an office trailer on-site to be used by TMG, Tetra Tech, and USACE project personnel throughout the duration of the project. The trailer will be sized sufficiently to provide space for office functions, sample preparation and treatment unit process control. The trailer will be located on the paved area to the north of the former Building 679 and east of the sediment area.

Surveying the excavation areas was completed in spring slightly ahead of the spring growing season. The areas are currently staked and upon approval of the project plans, TMG will begin

"outlining" the excavation areas so the limits of the excavation area are visible to the equipment operator. In addition, TMG will designate an area immediately adjacent to the excavation where the contaminated soil will be segregated by contaminant and stockpiled.

At several of the excavation sites there are large trees that will need to be removed, as well as honeysuckle, multiflora rose, dead and rotting wood, stones, and other debris. TMG will clear this material from the excavation areas and the adjacent stockpile areas and move the material to an area outside the work zone. The material will be piled in an "out of the way" location near the work zone to provide habitat for wildlife.

As briefly discussed above, TMG proposes to stockpile the contaminated soil adjacent to the excavation. At each excavation area, there will be one stockpile designated for nitroaromatic-contaminated soil only. Four of the excavation areas (Building Areas 629, 682, 686, and 696) and will have two stockpile areas, one for nitroaromatic-contaminated soil and one for lead / PCB –contaminated soil. The stockpile areas will be constructed by clearing the vegetation and topsoil, keeping the cleared area to a minimum. A 6-millimeter plastic liner will be placed on top of the excavated and the area will be surrounded with straw bales. A single opening will allow equipment access. The stockpiles will be covered with plastic to prevent or minimize exposure to stormwater.

4.3 Treatment Area

The on-site treatment will be conducted at the existing compost area near the Pentolite Road Red Water Ponds Area. The site will be prepped (repairs or upgrades), including rolling the roads and replacing the degraded straw bales along the perimeter of the pad. Following the last treatment effort in 2008 (PRRWP compost effort), the pad was confirmed clean through sampling and analysis and both sumps were emptied. The accumulated water in the sumps consisted of rainwater and was considered clean.

TMG will pump the accumulated rain water from the sumps into a vacuum truck or water tank and discharge the water into the West Area Red Water Ponds. All repairs and water removal will be completed before bringing soil from the TNT Area C excavations onto the pad.

The treatment process used for reduction of nitroaromatic contaminants, alkaline hydrolysis, involves the use of caustic material, in this case NaOH. The high pH is used to chemically degrade the nitroaromatics. To reduce the potential for elevated pH levels of the pad surfaces following removal of the windrows, TMG will place a synthetic barrier or soil barrier (clay) to reduce the leaching effect of high pH materials into the pad surface.

5.0 SITE SURVEY

The RI/FS documents included the survey data that was provided in the SOW for this project. USACE provided the survey coordinates and TMG contracted with John Hancock and Associates (JHA) to provide surveying services and to locate and stake the coordinates for each excavation. Working with the surveyors, TMG performed limited clearing in the areas to be excavated, the clearing was sufficient to allow JHA to utilize GPS technology to stake the locations. Prior to excavating the soil in the AOCs, TMG will "outline" or mark or a line between consecutively numbered stakes to designate the area to be excavated.

Upon completion of the excavation to the limits of the coordinates, JHA will survey the stockpiles to calculate the volume of excavated soil from each AOC. Soil disposed at the landfill will be measured by weight, therefore, TMG will obtain weight tickets to verify the quantity of soil disposed at the landfill.

6.0 EXCAVATION AREAS and CONFIRMATION SAMPLING

6.1 Excavation

TMG shall not perform any excavation activities at the site until NASA PBS approves the digging and excavation permit for the site. The digging and excavation permit was prepared concurrently with the Plan of Operations and was submitted to NASA in mid-May 2010.

Once the digging and excavation permit is approved by NASA, TMG will begin the excavation of contaminated soil from the designated areas using a track-mounted excavator to remove contaminated soils. TMG intends to excavate all of the areas that have only nitroaromatic contamination first, then progress to the areas with nitroaromatics, lead, PAHs and PCBs.

As the excavation begins, the soil will be stockpiled adjacent to the excavation pit, maintaining the stockpiles in 500 ton "batches". There may be multiple 500 ton stockpiles per excavation area. The stockpiled material will be placed on plastic liner material to prevent contaminants from contacting the surface soil under the stockpile. The stockpiles will be covered with plastic and surrounded with silt-fence to prevent precipitation from contacting the material and carrying contaminants onto adjacent clean areas.

Once the excavation has been made to remove the volume specified in the Scope of Work, the removal of soil from the excavation will be considered complete. There will be no excavations beyond the staked boundaries of the excavations. The excavated pits will be secured using the orange demarcation fencing.

Based on the information provided in the SOW (based on the detailed RI), following is the list of areas to be excavated, including the former building identification, size of excavation, and

pollutants. Large-scale (11”x17” or larger) drawings of each excavation area will be maintained in the office trailer and at each site during excavation activities. The following is a list of areas to be excavated:

Building Area 602 Bi-Tri House, Process Line 10

- Excavate approximately 89 CY of material
- Dimensions are 20’ x 20’x 6’
- Contaminants – nitroaromatics (primary), possibility of lead and low-levels of PCBs
- Groundwater noted at 6’ depth
- Bedrock was not encountered

Building Area 603 Fortifier House, Process Line 10

- Excavate approximately 119 CY of material
- Dimensions are 20’x 20’x 8’
- Primary contaminants – nitroaromatics
- Groundwater noted at 8’ depth
- Bedrock was not encountered

Building Area 606 Wash House, Process Line 10

- Excavate approximately 104 CY of material
- Dimensions are 20’x 20’ x 7’
- Primary contaminants – nitroaromatics
- Groundwater was noted at 6’
- Bedrock encountered at 8’

Building Area 616 Wash House – Process Line 11

- Excavate approximately 480 CY of material with excavation depth at 8’
- Dimensions – irregular
- Primary contaminants – nitroaromatics and PAHs
- Groundwater noted at 8’
- Bedrock encountered at 16.55’

Building Area 626 Wash House – Process Line 12

- Excavate approximately 119 CY of material, excavation depth at 8’
- Dimensions are 20’x 20’ x 8’
- Primary contaminants – nitroaromatics; lead at 134 ppm
- Groundwater was noted at 8’ and bedrock at 8.5’

Building Area 629 Acid and Fume Recovery – Process Line 12

- Excavate approximately 1,333 CY of material
- Overall dimension is 60’ x 60’ x 10’, a smaller area (280 CY) is present within this excavation that is to be segregated, if possible

- Contaminants – nitroaromatics (1053 CY), and lead and PCBs (280 CY)

Building Area 657 Wastewater Disposal Settling Tank

- Excavate approximately 104 CY of material
- Dimensions are 20’ x 20’ x 7’
- Primary contaminants are PAHs
- Groundwater was not encountered during investigation
- Bedrock noted at 7’
- Adjacent well measured groundwater at 13.3’

Building Area 682 Bi-Tri House – Process Line 8

Area I – consists of two excavations, a smaller excavation within the larger excavation – total excavation is approximately 540 CY

- Excavate approximately 483 CY at a depth of 4’ – contaminated with nitroaromatics
- Excavate approximately 57 CY from within the larger excavation – contaminated with lead
- Segregate the lead contaminated soil from the nitroaromatic soil and treat accordingly (alkaline hydrolysis for nitroaromatics and stabilization for lead)

Area II – consists of excavation of drainage ditch and surrounding area to two different depths

- Total excavation approximately 996 CY
- Drainage ditch – excavate approximately 141 CY at a depth of 5’
- Area surrounding ditch – excavate approximately 855 CY at a depth of 8’
- Primary contaminants are nitroaromatics

Building Area 683 Fortifier House – Process Line 8

- Excavate approximately 1,200 CY
- Dimensions are 60’ X 60’ X 9’
- Groundwater noted at 9’
- Bedrock encountered at 15’
- Primary contaminants are nitroaromatics

Building Area 686 Wash House – Process Line 8

- Excavate approximately 1226 CY of material at a depth of 4’
- Dimensions are irregular with internal excavation area within total area
- Smaller excavation area dimensions are 30’ x 30’ x 4’
- Primary contaminant is nitroaromatic (1092 CY)
- Internal excavation area contaminant is lead and low-level PCBs
- Groundwater was noted at 3.0’-3.5’
- Bedrock was encountered at 12’

Building Area 689 Acid Fume and Recovery – Process Line 8

- Excavate approximately 119 CY of material
- Excavation depth is 8’
- Dimensions are 20’ x 20’ x 8’
- Primary contaminant is nitroaromatics
- Lead was detected at 335 parts per million (ppm)
- Groundwater was noted at 8’
- Bedrock encountered at 15’

Building Area 692 Bi-Tri House – Process Line 9

- Excavate approximately 845 CY of material
- Dimensions are irregular
- Excavation depth is 8’
- Primary contaminants are nitroaromatics
- Groundwater was noted at 8’
- Bedrock encountered at 15’

Building Area 693 Fortifier House – Process Line 9

- Excavate approximately 147 CY of material
- Dimensions are approximately 26’ x 21’ x 7’
- Primary contaminants are nitroaromatics
- Groundwater was noted at 7’
- Bedrock was below 10’

Building Area 696 Wash House – Process Line 9

- Excavate approximately 1,740 CY (total) from two designated areas
- Area I – estimated volume 1,467 CY (total)
- Excavation depth is 12’
- Primary contaminants are nitroaromatics (498 CY) and nitroaromatics, lead and PAHs (969 CY)
- Area II – estimated volume 273 CY
- Excavation depth is 5’
- Primary contaminant is lead

Drainage Ditch – Sediment Only -Location TNTC-SD009

This area will be sampled to determine if remediation is required. One composite sample will be collected from the area and analyzed for 2,4,6-TNT, 2-ADNT, and 4-ADNT. The results will be compared to the sediment RG values, based on that comparison, the contractor will confirm that no remediation is required or proceed with remediation. Should remediation be required, approximately 44 CY of material will be excavated from the area.

- Dimensions area 60’ x 10’ x 2’

- Primary contaminants are nitroaromatics
- Groundwater is not expected within the 2' depth of the excavation
- Bedrock is not expected within the 2' depth of the excavation.

If remediation of the sediment is required, the top "seed bank" layer will be peeled back and set aside to be used as vegetative cover for the backfill. The area will be backfilled with similar materials to similar elevations; the backfill material will be graded to match the existing ditch bottom's grade in order to maintain current hydrological conditions. No clay-like materials will be used as backfill in this area. TMG will keep the disturbance to the trees on the uplands surrounding the ditch to a minimum so the area remains a forested wetland and also to prevent erosion along the steep ditch banks.

6.2 Confirmation Sampling of Excavated Areas

Following the excavation of the contaminated soil from a pit, confirmation samples will be collected from the walls and floor of the pit. The samples will be submitted to the laboratory for analysis to determine if the walls and floor of the excavation are "clean" or if additional excavation will be required. Pursuant to the SOW, TMG will collect a minimum of five samples from each individual excavation pit for confirmation analysis using SW-846 Methods for nitroaromatics, lead, PCBs, and PAHs. The specific SW-846 Methods are listed below:

<u>SW-846 Methods for soils</u>
SVOC – 3540C/8270C
PCBs – 3540B/8082
TAL Metals – 3050B/6010B/7471A
Nitroaromatics - 8330

<u>SW-846 Methods for sediment</u>
SVOC – 8270B
PCBs – 3540B/8082
TAL Metals – 3050B/6010B/7471A
Nitroaromatics – 8330 (modified, if necessary)

One confirmation sample shall be collected from each of the sidewalls near the midpoint of the excavation and at the floor near the midpoint of the excavation. For those areas where the length exceeds 20'-25', 2 samples will be collected along the length (whether on a sidewall or floor). If the walls are longer than 50', then a sample will be collected within each 25' length in order to get representative samples along the wall length. In the event the bottom of the excavation encounters groundwater or bedrock, no confirmation sample will be collected.

Upon receipt of the results from the confirmation sampling, and it is determined the remaining soil is still contaminated; TMG will contact USACE to outline additional excavation activities. However, under this Plan of Operations, excavations will not exceed those outlined in the SOW.

7.0 SAMPLING OF STOCKPILES, SOILS TREATMENT, AND DISPOSAL OF SOILS

7.1 Sampling of Stockpiles

As discussed above, the material excavated from each pit will be placed in approximately 500-ton stockpiles. At each excavation area, the stockpiles will be sampled by collecting a 12-point composite. The composite sample will be thoroughly blended in a zip-lock-type bag. Sufficient quantities of the soil will be placed in glass jars. The samples will be submitted to the laboratory (Test America, North Canton) for full TCLP analysis. The stockpiled material is expected to remain at the point of excavation until the laboratory results from the TCLP analysis are received. However, to minimize the impact of additional clearing in the excavation area to accommodate the number of stockpiles, the soil may be transported to, and stockpiled on the treatment pad.

Based on the results of the TCLP tests, non-hazardous soil above RG levels will either be treated and used as backfill or disposed off-site at the Erie County Landfill. The scenarios for stockpiled soil handling are summarized in the chart below.

Table 7-1: Lead Contaminated Soil Handling Options

Nitroaromatic Concentrations	Lead (Pb) Concentrations	Soil Handling
>RGs	>TCLP	Treatment (lead stabilization) and landfill disposal (Erie Co.)
>RGs	<TCLP	Treatment (AH) and backfill on-site or landfill disposal (Erie Co.)
<RGs	>TCLP	Treatment (lead stabilization) and landfill disposal (Erie Co.)
<RGs	<TCLP	Backfill on-site

In the event soils are disposed in the Erie County Landfill, the landfill will require analysis for hazardous constituents TCLP, Total Petroleum Hydrocarbons (TPH) diesel range organics (DROs), pH, and paint filter test. Sampling for these parameters is required on every 500 tons of soil going to the landfill. For every 500 tons, a 12-point composite will be collected and analyzed for each of the parameters listed above. Soil that is hazardous will require treatment to reduce the contaminants and render the soil non-hazardous.

The Erie County Landfill has a daily limit of 200 tons/day on the materials they can accept from this project. TMG will coordinate disposal of soils at the landfill to assure the volume of material for disposal does not exceed the daily limits.

7.2 Soils Treatment and Stabilization

Based on the chart above, there are several soil handling/treatment strategies, depending on the contaminants. The treatment alternatives are discussed in the sections below.

Treatment - Alkaline Hydrolysis Process

TMG will utilize the services of Tetra Tech to treat the soil using Alkaline Hydrolysis to reduce the nitroaromatics in the soil. Tetra Tech has developed a proprietary process to treat nitroaromatics which includes the alkaline hydrolytic process to destroy these contaminants. The process will include the addition of design quantities of a caustic reagent to soil treatment batches combined with the addition of an iron catalyst. These additives will be mixed into the soil using conventional equipment. Water will be added to the soil as needed to bring the soil moisture content to design levels for the destruction process. The quantities of reagents to be added will be based on a laboratory treatability study to be performed onsite prior to field treatment.

The alkaline hydrolysis process is a destruction process in which aromatic compounds with a low ring electron density undergo nucleophilic substitution in the presence of abundant quantities of a strong nucleophile. Caustic reagents and other high pH enhances contain hydroxyl ions that are strong nucleophiles. The pH needs to be raised to an upper threshold level to make the alkaline hydrolytic reaction feasible. The nitrite functional groups on TNTs and DNTs are good leaving groups and are substituted with the hydroxyl ion. Iron catalysts enhance the rate of the reaction. The process renders TNT and DNT rings unstable, thereby resulting in ring cleavage. The end product of alkaline hydrolysis is generally the formation of formates, acetates, oxalates and other benign alkanes which ultimately form carbon substrates for native microorganisms. The major inorganic end product is nitrite or nitrate, which can be mineralized via the process of denitrification, if necessary, via the addition of a carbon substrate such as citric acid.

Tetra Tech will provide on-site consulting support for the storage and handling of chemical amendments, implementation of the alkaline hydrolysis process, and safety operations. The first batch of soil treatment will be the test batch to define site-specific implementation procedures for the remainder of soil treatment. Additional information on the alkaline hydrolysis process is provided in Appendix C.

Treatment - Composting

Alkaline hydrolysis is the primary treatment alternative to reduce the nitroaromatic concentrations to below the RGs. However, an option for composting is included in this plan in the event the AH process in unable to adequately reduce the nitroaromatic concentrations below the TCLP.

The composting process will be implemented if the AH process is unable to reduce the nitroaromatic concentrations. TMG will follow the composting process used in a 2008 composting project at Pentolite Road Red Water Ponds.

To accomplish the further reduction of nitroaromatics in the TNT C soils, bioremediation treatment in the form of ex-situ windrow composting will be used to reduce the 2,4-DNT concentrations to non-hazardous levels. Assuming worst-case scenario, approximately 2300 cubic yards of contaminated soil that has been treated using alkaline hydrolysis may require additional ex-situ treatment prior to off-site disposal at a non-hazardous landfill. Windrow composting will be accomplished by mixing contaminated soil and amendments to biodegrade the 2,4-DNT. The amendments will consist of chicken manure and straw to promote the bacterial growth necessary for the bioremediation. Approximately 600 cubic yards of manure and 3500 bales of straw will be used in the composting process.

With the soil already in the windrows used for the AH treatment, composting amendments will then be added to the windrows. The amendment recipe is based on previous composting projects at PBOW and will consist of a recipe of 25% soil, 72.1% straw, and 2.9% chicken manure. Each windrow shall be approximately 12 feet wide and 6 feet high. The windrows shall not end any closer than 15 feet from the ends of the treatment pad to allow for the maneuvering of the windrow turner. The spacing (minimum of 15 feet width) between the parallel windrows shall be sufficient to prevent impeding windrow turning and materials handling equipment. It is expected that each windrow will be turned at least once daily; however, when temperatures drop near the end of the composting processing the windrow turning may be performed every other day.

It is anticipated based on the bench scale testing in progress that five to six weeks will be required for composting to be completed; however, the batch may be completed faster or slower. Laboratory analysis will determine when the batch is completed.

Prior to the windrow being turned (i.e. aerated), temperature and moisture data will be collected daily from each windrow at several points (10 equal distant points) along each windrow. Moisture data will be collected using a soil moisture meter equipped with a two-foot solid probe that can be pushed into the windrows. Temperature data shall be collected using a stainless steel probe equipped with a thermocouple attached to a digital thermometer. The probe is approximately 8 feet long and should be easy to insert deeply into the windrows.

For sample collection purposes, personnel shall collect composted material (after turning) at roughly 10 equally distanced points along each windrow and place the soil in a 1-gallon zip-lock bag to constitute a composite sample. Composite samples from each windrow will be submitted to the laboratory for analysis for nitroaromatics using Method 8330.

It is estimated that five to six weeks will be required for composting to be completed; however, the batch may be completed faster or slower. The composting process will conclude when nitroaromatic levels in all soils have been reduced to levels suitable for off-site disposal at a non-hazardous landfill. Completion of composting shall be determined by laboratory analysis.

Stabilization - Lead Treatment Process

TMG Services, Inc. will utilize the services of Tetra Tech to treat lead contaminated soils at the site. Tetra Tech will provide on-site consulting support for the storage and handling of chemical amendments, implementation of the lead stabilization process, and safety operations. The first batch of soil treatment will be the test batch to define site-specific implementation procedures for the remainder of soil treatment.

Soil that is impacted by lead (separately or in combination with nitroaromatic co-contamination) will be treated using a biotic/abiotic process under the guidance of Tetra Tech consulting personnel. This process will involve the addition of mushroom compost or other suitable slow release organic substrate with the optional addition of simple sulfate salts such as sodium sulfite or sodium sulfate if needed. The amount of additives will be based on a laboratory treatability test to be performed onsite. Lead treatment will be performed following the alkaline hydrolytic process for soils co-contaminated with explosives and lead. The addition of mushroom compost provides a carbon source for biotic conversion of native sulfate (or sulfate which is often incorporated into the mushroom compost or via sodium salts) to sulfide. Once sulfide becomes the predominant sulfur species, lead sulfide or galena is the preferred form of lead and remains so over a wide pH range. Lead sulfide is one of the most stable lead species that prevents its mobilization in soil. Additional information on the lead stabilization process is included in Appendix C.

Treatment will be performed as necessary until the soil passes TCLP analysis. Non-hazardous soil will be transported to the Erie County Landfill for disposal. Soil that fails the TCLP analysis for any TCLP constituent may be further treated on-site, if appropriate, or it may be disposed at EQ Environmental's Wayne Disposal Facility in Michigan. The soil will be stored on-site until all excavated soils have been characterized and approved for disposal.

Bench-scale Laboratory Testing – AH and Lead Stabilization

Two bench-scale tests will be performed onsite with the goal of providing design information and reagent quantities for field soil treatment. The first test will be for nitroaromatics destruction and the second test for lead treatment. Soil tests will be performed in plastic/glass pans with suitable covers in an on-site building at room temperature. Soil will be collected from a known contaminated area and will be sampled for baseline concentrations. An optimization test using different dosages of caustic reagents and catalysts will be examined to arrive at the required field dosage. Water will be added and mixed into the soil to attain saturation. Samples will be collected periodically over a two-week period and analyzed for constituents of concern and inorganic parameters such as nitrite, nitrate, and pH. Results will be used to confirm the process, obtain scale-up information for dosing in the field, and provide an initial estimate of the timeframe of treatment for each batch.

Lead treatment treatability studies will be performed on soils which need metals treatment separately or following alkaline hydrolysis. These studies will also be performed in plastic/glass pans with suitable covers following the bench-scale tests of nitroaromatic-contaminated soils. Design amounts of biotic (mushroom compost or other carbon substrate) amendments along with abiotic amendments as needed (sulfate or sulfite) will be added in a range of concentrations in each pan to arrive at the optimal amount for field treatment. Samples will be collected periodically for a two-week period and analyzed for TCLP and other parameters such as pH. Results of the test will be used to confirm site-specific design parameters the biotic/abiotic process for lead treatment, obtain scale-up information for dosing in the field, and provide an initial estimate of the timeframe of treatment for each batch. In the event Tetra Tech identifies a more effective lead treatment process that varies from the process described above, an amendment to this Plan of Operations that describes the revised treatment process will be submitted to USACE.

Land Disposal Restrictions

The table on the following page outlines how the applicable LDRs will be met for the COCs in TNTC.

Table 7-2: Land Disposal Restrictions

CoC	RG mg/kg	TCLP mg/L	LDR	
			UTS mg/kg	ATS mg/kg
Nitroaromatics				
2-ADNT	1.7	NA	NA	NA
4-ADNT	1.3	NA	NA	NA
2,4-DNT	6.5	0.13	140	1400
2,6-DNT	1.0	NA	28	280
2,4,6-TNT	8.0	NA	NA	NA
PCBs				
Aroclor 1254	1.0	NA	10	100
Aroclor 1260	1.0	NA	10	100
Semivolatile Organic Compounds				
Benzo(a)anthracene	1.0	NA	3.4	34
Benzo(a)pyrene	1.0	NA	3.4	34
Benzo(b)fluoranthene	1.0	NA	6.8	68
Dibenz(a,h)anthracene	1.0	NA	8.2	82
Indeno(1,2,3-cd)pyrene	1.0	NA	3.4	34
Metals				
Lead	400	5.0	0.75	7.5

COC - Chemical of Concern
RG – Remedial Goal
TCLP – Toxic Characteristic Leachate Procedure
LDR – Land Disposal Restrictions
UTS – Universal Treatment Standards
ATS – Alternate Treatment Standard for Soil

The remediation efforts in TNTC will need to meet RG, TCLP and ATS requirements before placement on-site. For disposal off-site at Erie County Landfill, the COC must meet TCLP limits.

8.0 ANALYTICAL REQUIREMENTS

TMG will use Test America, located in North Canton, Ohio to perform the analytical testing for the confirmation and waste characterization samples associated with this project. Test America is a USACE QSM-certified laboratory (as required by USACE). Test America's detection and quanitation limits are based upon their minimum detection limit (MDL) studies and are specific for each media and the instrumentation used. The laboratory shall follow the most currently promulgated USEPA methods. Test America's QAPP and Certificate of Accreditation are

included in Appendix E. An example of the Test America's Chain-of-Custody form is included in Appendix D.

8.1 Borrow Area

TMG shall collect representative samples of the borrow material and have it analyzed for the parameters listed in Table 8-1.

The borrow material is located on the Barnes Nursery property at the corner of Hull Road and Camp Road in Huron, Ohio which is in close proximity to the site. It will not be necessary to access PBOW to conduct sampling of the borrow material. The borrow material will be sampled and analyzed to ensure that the borrow material is not contaminated. One sample per 1000 cubic yards of material estimated for backfill will be collected. It is estimated that a maximum of approximately 4000 cubic yards of borrow soil will be needed for backfilling the excavations. Therefore, a total of 4 samples will be collected and analyzed. The samples will be 5 point composite samples, collected using dedicated disposable sampling equipment. The borrow material will be considered appropriate for use in backfill of excavated pits if all chemical constituents are below the RGs listed in Section 3.1, Tables 3-1 and 3-2, and the samples pass the TCLP. Table 8-1 summarizes the analytical requirements for the borrow material.

Table 8-1: Chemical Analyses of Borrow Material

Analytical Parameter	Number of Samples	Method	Size & Container Type	Preservative	Maximum Holding Time
Target analyte list (TAL) metals	4	SW846/3050B, 6010B, 7471A	1 9-ounce glass	Ice 4°C	28 days for mercury, 6 months for other metals
Volatiles	4	SW846/8260B	3 glass vials (1 kit)	Ice 4°C, no headspace	Delivery within 48 hours, 14 day hold time
Semi-volatiles	4	SW846/8270C	1 9-ounce glass	Ice 4°C	7 days until extraction, analyze within 40 days of extraction
Polychlorinated biphenyls (PCBs)	4	SW846/8082~~A~~	1 4-ounce glass	cool to 4ºC	7 days until extraction; analyze within 40 days of extraction
Total Nitroaromatics	4	SW-846/8330	1 9-ounce glass	Ice 4°C	Extract 7 days Analyze 40 days

8.2 Confirmation Sampling of Excavated Areas

TMG will excavate 15 areas to the horizontal and vertical limits described in Task 6 of the SOW and reiterated in Section 1.2.1 of this plan. These excavation requirements were defined in the RI/FS. Once these limits have been reached, TMG will use the confirmation sample results to determine if the excavation limits have been reached for each excavation. Personnel will not enter the excavation areas to perform sampling. Samples will be collected from the backhoe bucket using a trowel or shovel. Pursuant to the SOW, confirmation sample shall be collected as described previously in Section 5.2 of this plan. Refer to the site maps in Appendix B for the configuration of each excavation area. Larger scale maps will be used to identify the location of each confirmation sample. Each confirmation sample location will be marked on the map for each AOC. The maps will be maintained in the trailer. Following the excavation of the contaminated soil from a pit, confirmation samples will be collected from the walls and floor of the pit. The samples will be submitted to the laboratory for analysis to determine if the walls and floor of the excavation are "clean" or if additional excavation will be required. Pursuant to the SOW, TMG will collect a minimum of five samples from each individual excavation pit for confirmation analysis using SW-846 Methods for nitroaromatics, lead, PCBs, and PAHs.

One confirmation sample shall be collected from each of the sidewalls near the midpoint of the excavation and at the floor near the midpoint of the excavation. For those areas where the length exceeds 20'-25', 2 samples will be collected along the length (whether on a sidewall or floor). If the walls are longer than 50', then a sample will be collected within each 25' length in order to get representative samples along the wall length. In the event the bottom of the excavation encounters groundwater or bedrock, no confirmation sample will be collected.

Initially, each of the samples collected from an excavation shall be placed in individually labeled 1-gallon zip lock bags and placed on ice. The zip lock bags shall be properly labeled (i.e. excavation area, wall ID, time, and date). The samples soil will be transferred from the bag to an individually corresponding laboratory-supplied sample container and sent to the laboratory for confirmatory analysis. Analytical data from the confirmatory samples sent to the laboratory will be used to determine if the excavation has resulted in the removal of the contaminated soils to below the RGs. Upon receipt of the results from the confirmation sampling, and it is determined the remaining soil is still contaminated, TMG will notify USACE. Under this Plan of Operations, excavations will not exceed those outlined in the SOW.

8.3 Confirmatory Analysis

Refer to Table 8-2 below, which specifies the analytical method, sample containers, preservation procedure, and holding time requirements for the confirmation samples collected for this project

8.4 Evaluation of Confirmation Sample Results

Upon receipt of the results of the confirmation samples, TMG will calculate the Hazard Index (HI) and Incremental Lifetime Cancer Risk (ILCR) for each excavation. The HI must be </= 1 and the ILCR must be </= $1x10^{-5}$. Exceedance of an individual RG within an excavation will be acceptable as long as the HI and ILCR meet the criteria above.

Table 8-2: Analysis of Confirmatory Samples

Analytical Parameter	Method, SW-846		Size & Container Type	Preservative	Maximum Holding Time
	Soils	Sediment			
Nitroaromatics	8330	8330 (modified, if necessary)	1 9-ounce glass bottle with Teflon lined lid	Ice 4°C	Extract 7 days Analyze 40 days
TAL Metals	3050B/6010B/7471A	3050B/6010B/7471A	1 9-ounce glass	Ice 4°C	28 days for mercury, 6 months for other metals
PCBs	3540B/8082	3540B/8082	1 9-ounce glass jar	Ice 4°C	
SVOCs	3540C/8270C	3540C/8270C	1 9-ounce glass jar	Ice 4°C	

8.5 Waste Characterization

Waste characterization for disposal of the contaminated soil and the investigation derived waste (PPE, equipment decontamination water, etc.) is required. TCLP methods will be utilized to characterize the waste from this site. Holding times for the samples shall not be exceeded.

For soils disposed in the Erie County Landfill, soil samples will be collected with a 12-point composite for every 500 tons of soil. The samples will be submitted to the laboratory for analysis. Table 8-3 specifies the analytical method, sample containers, preservation procedure, and holding time requirements for samples collected for this project.

Table 8-3: Chemical Analysis for Waste Characterization Purposes

Analytical Parameter	Method	Size & Container Type	Preservative	Maximum Holding Time
Contaminated Soil				
Toxicity Characteristic Leaching Procedure (TCLP) metals	SW846/1311, 6010B, 7470A	250 grams/glass	Ice 4°C	28 days for mercury, 6 months for other metals
TCLP volatiles	SW846/1311, 8260B	250 grams/glass	Ice 4°C, no headspace	14 days
TCLP semi-volatiles	SW846/1311, 8270C	250 grams/glass	Ice 4°C	7 days until extraction, analyze within 40 days of extraction
TCLP herbicides and pesticides	SW846/1311, 8081A, 8151A	250 grams/glass	Ice 4°C	7 days until extraction, analyze within 40 days of extraction
Flashpoint /pH	SW846/1030	250 grams/glass	Ice 4°C	7 days
Paint Filter	SW846/9095A	250 grams/glass	None required	7 days

Table 8-3: Chemical Analysis for Waste Characterization Purposes (Continued)

Total Petroleum Hydrocarbons (DRO)	8015B	4 oz. glass	Ice – 4C	14 days
Total Petroluem Hydrocarbons (GRO)	8015B	4 oz. glass	Ice	14 days
Investigation Derived Waste				
Toxicity Characteristic Leaching Procedure (TCLP) metals	SW846/1311, 6010B, 7470A	250 grams/glass	Ice 4°C	28 days for mercury, 6 months for other metals
TCLP volatiles	SW846/1311, 8260B	4 oz./glass	Ice 4°C, no headspace	14 days
TCLP semi-volatiles	SW846/1311, 8270C	250 grams/glass	Ice 4°C	7 days until extraction, analyze within 40 days of extraction
TCLP herbicides and pesticides	SW846/1311, 8081A, 8151A	250 grams/glass	Ice 4°C	7 days until extraction, analyze within 40 days of extraction
Flashpoint /pH	SW846/1030	250 grams/glass	Ice 4°C	7 days
pH (water)	SW846/9045C	250 grams/glass	None required	Upon arrival at lab

8.6 Waste Manifesting

The contractor is not authorized to sign any type of waste manifest, either hazardous or non-hazardous. The contractor must have the manifests completed properly using the NASA-provided manifest numbers and must provide the completed manifest to the NASA FUDS POC, Bob Lallier. The NASA FUDS POC will review the manifest to verify the information is complete and provide the authorized signature. The contractor will coordinate with Mr. Lallier to allow sufficient time for Mr. Lallier to review the information and to obtain his signature on the manifest.

9.0 CONTRACTOR CHEMICAL QUALITY CONTROL

9.1 Data Quality Objectives

that is generated. Next, the actual type of data that is required to meet these objectives is determined, along with the appropriate data collection methodologies and quality control procedures. The methodologies for collecting quality data must be consistent with accepted practices and standard operating procedures that have been developed for the specific type of data collection to insure quality chemical data. Generally, these steps have been predetermined by the USACE for this project and are delineated in the Scope of Work.

Quality controls are incorporated into both the sample collection and analytical procedures. Quality controls utilized in sample collection include, but are not limited to, following the approved plans and procedures for sample collection, proper documentation of sample collection activities and site conditions, reporting and resolving any problems during sampling activities, and proper handling, preserving, packaging, and shipment of samples. In addition, quality control samples (duplicates and trip blanks) are collected to check the accuracy, completeness, precision, and comparability of the actual field samples. The contract analytical laboratory will follow its internal quality control procedures to insure analytical data quality. The laboratory will use the precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) defined below to insure that their internal quality control objectives have been successfully met.

After the samples have been analyzed and the data reports have been generated, the resulting data will be reviewed, and compared. To assess the quality of the field activities, quality control samples (i.e. duplicates, trip blanks, matrix spikes) will be evaluated for completeness and duplicate relative percent differences (RPDs). The calculation of RPDs from field sample and field duplicate sample data indicates the precision of the sampling efforts as well as the sample media. RPDs are calculated by the following equation:

$$RPD = (Cf – Cd)/\{(Cf + Cd)/2\} X\ 100$$

Where Cf is the concentration of the compound found in the field sample and Cd is the concentration of the compound found in the field duplicate (QC) sample. The RPDs should equal 35% or lower for soils to indicate homogeneity of the sample and the reproducibility of the analytical data (a measure of precision). If the data does not meet the desired RPDs it may be necessary to re-analyze the samples in question, or re-sample if problems cannot be resolved. Decisions to re-analyze or to re-sample will be made with the joint input of the USACE, TMG, and the contract laboratory. In this process the PARCCS of the data will be evaluated and a joint determination of the data quality will be made accordingly.

Once all data has been received and analyzed in accordance with the above requirements, the results and recommendations will be forwarded onto USACE. The USACE will then use this information to make decisions regarding specific properties as they relate to project implementation.

The laboratory will use the following PARCCS to insure that their internal quality control objectives have been successfully met.

Accuracy:	This is the degree to which a measurement agrees with the actual value. The accuracy of an analytical procedure is determined by addition of a known amount of spike standard to a field sample matrix or a laboratory control matrix.
Precision:	This is a measure of the degree of reproducibility of an analytical value and it is used as a check of the quality of the sampling and analytical procedures. Precision is determined by analyzing replicate samples. Duplicate samples will be collected in the field for this project.
Completeness:	Completeness is a measure of the amount of the data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The minimum level of completeness expected is 95% for each analytical method requested. This level is met in the laboratory by ensuring proper sample extraction procedures. This level is met in the field by collecting enough sample that the laboratory has an ample amount in case they need to reanalyze the sample.
Representativeness:	Representativeness expresses the degree to which sample data accurately and precisely represents actual conditions. Representativeness is a qualitative determination. The representativeness objective of the quality assurance program is to eliminate conditions that may result in non-representative data. Maintaining sample integrity is of the utmost importance.
Comparability:	Comparability is the confidence with which one data set can be compared with another. When traceable standards and standard methodology are used, the analytical results can be compared to other laboratories with similar operating procedures. Quality Assurance samples will not be collected for this project.

All field activities will be performed in accordance with the protocols outlined in this Plan of Operations. Samples will be kept in ice filled coolers until they are shipped via overnight express or hand delivered to the laboratory.

9.2 Lab Quality Assurance for Chemical Data Measurement

The overall QA objective is to ensure that data of known and acceptable quality is generated from both field and laboratory activities. Test America will be responsible for ensuring that their personnel adhere to their laboratory Quality Assurance Plan (QAP). The number and types of internal QC checks for each analytical method are defined in the laboratory's QAP, which is contained in Appendix E. The laboratory must follow the quality objectives for precision, accuracy, representativeness, comparability, completeness, and method detection limits as set forth in their laboratory QAP. The USACE QA laboratory will be responsible for ensuring that their personnel adhere to their laboratory Quality Assurance Plan (QAP).

All data generated from the chemical analysis will be reported in accordance with the Scope of Work. Any sample failing the method or laboratory quality control limit may be re-analyzed. The analytical laboratory, TMG, and the USACE will jointly make the decision regarding re-analysis. Internal QC results should include information about agreement between replicate analyses, spike and surrogate recoveries.

The Remedial Action Summary Report shall include analytical results and a Level 3 Quality Control data report from the laboratory. The Level 3 data package shall include the following:

- Case Narrative (information shall include the number and type of samples received, analysis of those samples, any problems that occurred, whether quality control was within acceptable limits, etc.)
- Analytical Report (summary of all sample analysis information including surrogates for organic methods.) Detection limits/reporting limits shall be included.
- Chain-of-Custody
- Summary of Quality Control (a summary shall be included of all quality control specific to the project.) This may include method reagent blanks, mid-level calibration checks, spike and spike duplicates, sample duplicates, laboratory control samples, laboratory control sample duplicates (if applicable), and surrogate recoveries (if applicable). All QC shall include acceptance criteria and relative percent data where applicable.

9.3 Field Quality Control for Chemical Data Measurement

Field quality control is as vital to a project as is quality control within the laboratory. Proper execution of each project task is needed in order to yield consistent reliable information that is representative of the media and conditions being measured. The overall quality assurance objective is to ensure that data of known quality is generated so that it will be useful in meeting the intended project objectives. The Project Manager will be responsible for seeing that field personnel (TMG Services, Inc. and subcontractors) adhere to TMG's QCP.

QC field oversight checklists to be used for field activities are provided in Appendix D. The field oversight checklists should be completed for each project site. The Project Manager shall

provide an explanation on the QC field oversight sheets for any items that he marks were not completed. The Project Manager will review the following items with the field crew prior to beginning on-site operations.

- Scope of Work
- Contents of this Plan of Operations
- Contents of Site-Specific Safety and Health Plan (SSHP)
- Contents of Quality Control Plan (QCP)
- Field equipment to be used at project sites
- Sample collection equipment
- Labeling for sample containers
- Chain-of-custody forms
- Laboratory information
- Proper preservation methods for samples
- Proper packaging and shipping procedures for samples
- Proper equipment decontamination procedures
- Proper use of field screening and/or field monitoring equipment

10.0 EQUIPMENT DECONTAMINATION

Disposable equipment (spoons/gloves/trowels/bags) will be used for sampling the windrows. The excavator bucket will be used to sample the floors and walls of the excavations. Any non-disposable equipment associated with sampling or excavation will require decontamination.

All non-disposable sampling equipment will be thoroughly cleaned. Decontamination of all the sampling equipment will be accomplished prior to and between sampling. All decontamination activities for the backhoe bucket will be set up at a temporary decontamination pad. The steps of the decontamination process for the backhoe bucket will be as follows:

Brush off the backhoe bucket to remove gross contamination
Wash equipment with soap and water
Rinse equipment with distilled water

Table 10-1 outlines the general decontamination procedures for sampling equipment that will be reused at the site.

Table 10-1: Decontamination Procedures

Parameter	Alconox® Wash	Tap Water Rinse	Deionized Water Rinse	Air Dry
Nitroaromatics Lead PAHs PCBs	yes	yes	yes	yes

In cases of gross contamination on sampling equipment, a tap water wash may first be performed to remove clumps of dirt in order to make the detergent wash more effective. The detergent wash shall be a non-phosphate detergent solution, which will be used with brushing or circulating techniques to remove gross contamination. Potable tap water will be used as a rinse for the equipment. The analytical laboratory performing the analysis shall be consulted prior to sampling to ensure that decontamination procedures do not affect the subsequent analysis. A triple rinse with deionized water shall follow all other decontamination reagents.

All rinsates will be collected and properly disposed. Drums, buckets, water, detergent, and brushes will be located in the work area. Drums will be available for containerizing the decontamination waste.

Transportation and Disposal of Investigation Derived Waste

IDW (PPE, decontamination liquids, and all waste/media generated from the investigation activities) from the site shall be disposed in accordance with this Plan of Operations and in compliance with USEPA's off-site disposal policy, Resource Conservation and Recovery Act (RCRA) regulations including the RCRA land disposal restrictions for on-site and off-site waste disposal, and the Department of Transportation's (DOT) regulations. TMG will arrange for all services necessary for transport and disposal of the waste at an appropriate disposal facility. Analysis of the waste will be performed to identify potential hazardous constituents prior to disposal. Personnel will adhere to the safety procedures as outlined in the Site-Specific Safety and Health Plan. Personnel will wear, at a minimum, Level D PPE when performing waste sampling activities. Representative samples of the IDW shall be collected for characterization prior to disposal and analyzed for the parameters shown in Table 8-3.

Non-hazardous liquid waste may be transported by Midwest Environmental Services, Inc. or other permitted waste transporter to a designated disposal facility. Non-hazardous solid waste may be disposed at Erie County Landfill. All hazardous IDW will be transported to an appropriate disposal facility (EQ Environmental in Michigan) by Midwest Environmental Services, Inc., or other licensed and permitted hazardous waste transporter.

TMG will be responsible for laboratory analyses and proper disposal of the IDW in accordance with applicable state and federal laws. The contractor must have the manifests completed properly using the NASA-provided manifest numbers and must provide the completed manifest to the NASA FUDS POC, Bob Lallier. The NASA FUDS POC will review the manifest to verify the information is complete and provide the authorized signature. The contractor will coordinate with Mr. Lallier to allow sufficient time for Mr. Lallier to review the information and to obtain his signature on the manifest.

TMG will provide the USACE with the following documentation concerning the disposal of all IDW from the site:

- Laboratory analysis
- Copies of waste profiles which include land disposal restriction notifications
- Signed manifests (hazardous and non-hazardous)
- Weigh slips for bulk transport

11.0 FIELD DOCUMENTATION PROCEDURES

The following sections outline the standard practices and procedures for proper documentation of activities for this project. Standard documentation required on all USACE projects, including daily reports and field logs will be completed by the Project Manager.

11.1 Daily Quality Control Report, Field Logbook/Field Activity Forms

The daily Quality Control Reports (QCRs) will be maintained in bound notebook located in TMG's office trailer. The QCRs will include daily records of significant events, observations, and measurements during field investigations. In addition, the QCR will include information on any soil sampling conducted during the course of the day's activities. All pertinent information regarding the site and sampling procedures must be documented in indelible ink. Notations should be made in logbook fashion, noting the time and date of all entries. The QCRs and the field records will include the following information:

- Site Location
- Project Number or Work Order Authorization
- Name and title of author
- Names and responsibilities of field personnel on site
- Names and titles of site visitors
- Sampling location and number of samples taken
- Sample description (color, odor etc.)
- Sample collection method and sample preservation methods
- Sample ID numbers

- Dates and times
- Matrix of sample
- Photograph logs
- Sampling changes, modifications or change orders
- Weather conditions
- Other applicable comments

11.2 Photographs

Photographs will be taken of all site activities. For each photograph taken, the following items should be noted in the field logbook or as the name of the electronic file:

- Date and time
- General direction faced and description of the subject taken

11.3 Sample Identification Labeling

Sample labels are required to properly identify the samples. All samples will be labeled in the field and care will be taken to assure that each sample container is properly labeled. Once the label is applied to the bottle and sample identification and other required information is placed on the label, the label will be covered with clear tape to prevent damage or accidental removal. The samples will be wrapped with bubble wrap and placed in sealed plastic bags. Labels will contain the following information:

- Site location and project number
- Sample Identification number assigned in accordance with the Scope of Work
- Description of the sample
- Time and date sample was taken
- Notation of whether preservatives were added to the sample and type of preservative
- Type of sample (such as a grab or composite)
- Type of analysis requested

All field documentation should be done in indelible ink. Errors in field sampling documents will be corrected by drawing a single line through the error, writing in the correction, and initialing and dating.

The sample nomenclature for this project will be as follows:

(Project Number)-(Building Number)-(Confirmation (C) or Disposal (D)-001, for example: 0922-696-C-001

11.4 Chain-of-Custody

Chain-of-custody procedures provide documentation of the handling of each sample from the time it is collected until analysis is completed. Chain-of-custody procedures are implemented so that a record of sample collection, transfer of samples between personnel, sample shipping, and receipt by laboratory that will analyze the sample is maintained. The chain-of-custody record serves as a legal record of possession of the sample. To simplify records and eliminate potential litigation problems, as few people as possible should handle the samples during the investigation.

The chain-of-custody should be filled out on-site and shall include the following information:

- Project number
- Project manager
- Site location
- Client contact
- Description of the sample
- Time and date sample was taken
- Notation of whether preservatives were added to the sample
- Type of preservative
- Type of sample such as a grab or composite
- Matrix of sample
- Amount of sample being transported to the laboratory
- Sample number or ID assigned in the field
- The appropriate analytical parameters to be tested
- Custody seals shall be placed on the sample cooler and covered with tape
- Any other information that the sampler feels is pertinent to the analysis of the sample(s).

The sampler must sign the chain-of-custody and all sample containers will be transported with a chain-of-custody form. Shipping containers will be sealed for shipment to the laboratory. The original chain-of-custody form will accompany the shipment and TMG will retain copies. A sample chain-of-custody form is located in Appendix D.

11.5 Weekly Equipment Checklists

TMG will conduct weekly inspections of the heavy equipment that is on-site. An example of the checklist is included in Appendix D.

11.6 Daily Safety Meeting

TMG will conduct daily “tailgate” safety meeting to review the work to be performed during the day and to discuss any potential workplace hazards that may be encountered, and to act as a

reminder to maintain levels of hydration and to take frequent breaks during heat and cold conditions. An example of the Daily Safety Meeting form is included in Appendix D.

11.7 Corrections to Documentation

All original data recorded in field logbooks, on sample labels, and chain-of-custody records are to be written in indelible ink. If an error is made on any document related to this project, corrections should be made by drawing a single line through the error and entering the correct information. The erroneous information will not be obliterated. Any error discovered on a document should be corrected by the person who made the entry. All corrections will be initialed and dated.

12.0 SAMPLE PACKING AND TRANSPORTATION

The following are procedures for packaging and shipping of samples for this project:

- All samples will be chilled immediately after collection.
- Each sample container will be placed in a separate plastic bag and sealed.
- A cooler will be used as the shipping container. In preparation for shipping samples, the drain plug on the cooler will be taped shut from the inside and outside, and a large plastic bag will be used as a liner for the cooler. Inert packing material will be placed in the bottom of the liner.
- The sample containers will be placed upright in the lined cooler and secured to prevent breakage in shipment.
- All samples will be shipped to the laboratory on ice and chilled to 4 ºC.
- Plastic ice packs or ice placed in double plastic bags will be placed around, among, and on top of the sample containers.
- The Chain-of-Custody will accompany the samples and will be placed inside a sealed plastic bag taped to the inside lid of the cooler.
- The cooler will be taped shut with strapping tape.
- At least two signed custody seals will be placed on the cooler (one in front, the other on the side).

13.0 DAILY QUALITY CONTROL REPORTS

During the field investigation and excavation activities, Quality Control Reports (QCR) will be prepared daily, dated, and signed by the On-site Supervisor or the QC Officer. TMG will utilize the USACE QCR Report Form (see Appendix D). The following information will be recorded on the QCR:

- Weather information
- Field instrument measurements
- Departures from the approved plans (any deviation that may affect data quality objectives must be conveyed to the USACE immediately)
- Personnel on-site and their job activities
- Any problems encountered
- Instructions from government personnel
- Photographs

Photographs will be date stamped to correspond with the daily QCRs. This will allow for cross-referencing the daily activities and to observe the activity in the photograph.

14.0 SPILL PREVENTION, CONTAINMENT, AND COUNTERMEASURE PLAN

In cases of spills it is very important to make sure that the area is secured and that the situation is assessed quickly. Ventilation, vapor suppression, and dust suppression may be required prior to cleaning up a site. Trained personnel shall clean up spills quickly unless safety reasons prevent it. The on-site TMG personnel have been trained in hazardous waste operations and emergency response, and will be trained in the spill prevention procedures for this project. The Project Manager/On-site Supervisor will immediately report the spill to the appropriate agencies with notification to USACE POC. Additionally, it may be appropriate to contact the OEPA, Northeast District Office (330-963-1200).

Based on the information in this plan, the chemicals that will be used for the alkaline hydrolysis and lead stabilization listed below with the Reportable Quantities (RQs).

Chemical	Chemical Abstracts Service Registry Number (CASRN)	RQ	Notification Requirements
Sodium Hydroxide	1310-73-2	1000 lbs.	See note (a) below
Ferric Chloride	7705-08-0	1000 lbs	See note (a) below
Citric Acid	Not Applicable	No RQ (49 CFR Part 172.101)	Document estimated amount spilled.
(a) Any person in charge of a vessel or an offshore or an onshore facility shall, as soon as he or she has knowledge of any release (other than a federally permitted release or application of a pesticide) of a hazardous substance from such vessel or facility in a quantity equal to or exceeding the reportable quantity determined by this part in any 24-hour period, immediately notify the National Response Center ((800) 424–8802; in Washington, DC (202) 426–2675 or (202) 267–2675; the facsimile number is (202) 267–2165; and the telex number is 892427).			

14.1 Potential Spills

Potential sources for spills on this project are:

- Spills or leaks of decontamination liquids from equipment decontamination activities.
- Spills or leaks of decontamination liquids from personnel decontamination activities.
- Petroleum leaks from trucks or heavy equipment used at the site.
- Chemical spills (alkaline hydrolysis process-related)

Material Data Safety Sheets (MSDS) for the products that may be brought onsite will be maintained in a notebook at the site. Chemicals/petroleum products will not be stored onsite without a current MSDS being provided and kept onsite. Petroleum products will not be stored on-site. PPE and small amounts of lab waste (less than 5 gallons of lab waste) are the only waste materials to be accumulated and stored for subsequent disposal.

14.2 Spill Prevention

This plan represents a written commitment by TMG and their contractors to supply the manpower, equipment, and materials required to expeditiously control and remove any potential harmful spills that may occur at the NASA PBS site due to project activities. The following are spill prevention procedures that will be implemented at the site:

- All drums used to store liquids that would be harmful to the environment if spilled will be checked on a weekly basis. The Site Superintendent will perform the weekly inspections.
- Heavy equipment (trucks, excavators, etc.) shall be inspected daily prior to use to ensure that they are not leaking.
- A secure area will be used for the storage of decontamination fluids.
- Personnel will be instructed as to their particular requirements as described in this Spill Control Plan

14.3 Spill Response

In the event of a spill or a leak, site personnel will:

- Inform the Project Manager and Site Superintendent immediately. The PM or SS will immediately inform the USACE of any spills, regardless of the spill location and/or amount. All nonessential personnel will be cleared from the area. Personnel trained in emergency response and spill control measures will be utilized to contain any spillage of materials.
- Personnel will isolate the area.
- If spill occurs outside of the exclusion (hot) zone, then personnel must designate the spill area as an exclusion zone to limit potential exposure to onsite personnel.

- Trained personnel will attempt to locate the source of the spillage and stop the flow if it can be done safely.
- Trained personnel will begin containment and recovery of the spilled materials.
- PPE required during spill response for this project will at a minimum be Level D PPE. Level C or higher PPE may be used if spill conditions so warrant.
- Spill clean up shall be performed only by personnel who are trained with spill response procedures.
- Material safety data sheets (MSDS) shall be posted for any potential hazardous materials that are expected to be encountered or used.
- Spills will be reported to the USACE and NASA POCs. If appropriate, the OEPA, Northwest District Office (330) 963-1200 and the National Response Center (800) 424-8802 may be notified.
- Fire extinguishers will be available on-site and ready for use.
- This Spill and Emission Control Plan will be posted at the site

14.4 Spill Containment

Spill containment equipment will be located on-site. Materials used for cleanup shall be placed in drums for proper disposal according to appropriate state and federal regulations. Spill containment material that will be on-site is:

- Absorbent pads, booms, or rolls (sufficient number to absorb a minimum of 200 gallons of spilled liquids)
- Drums containing IDW waste or other materials will be stored within in a lined dike area capable of containing any spills or leaks.

The following are requirements for handling drummed materials on-site:

- All drums and containers used will meet Department of Transportation (DOT), Occupational Safety and Health Administration (OSHA), and USEPA regulations for the waste that they contain.
- Drums and containers will be inspected and their integrity assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions, shall be positioned in an accessible location and inspected prior to further handling.
- Operations for the site will be organized so as to minimize the amount of drum or container movement.
- Employees involved in the drum container operations shall be warned of the hazards associated with the containers.
- Where spills, leaks or ruptures may occur, adequate quantities of spill containment equipment (absorbent, pillows, etc.) will be stationed in the immediate area.

- Drums or containers that cannot be moved without failure shall be emptied into a structurally sound container.

14.5 Spill Reporting

TMG personnel are to immediately report any imminent or actual spills to the TMG Project Manager and/or On-site Superintendent. The TMG Project Manager or On-Site Superintendent will report the information to the National Response Center (800) 424-8802 and Ohio EPA Northwest District Office (330) 963-1200 if the spill is a reportable quantity. Subsequently, TMG (Project Manager or On-Site Superintendent) will notify USACE POC. It is of great importance for personnel to gather the following information if they encounter an imminent or actual spill.

- The location of the release or imminent release.
- The name and quantity of the material involved, to the extent known.
- The possible source or cause of the release.
- The date and time of the release.
- A description of any emergency response actions taken or currently being taken by others.

The reportable quantities and requirements are listed in the table in Section 14.0. After the cleanup of a spill, the Project Manager will investigate to determine the possible cause of the spill. The Project Manager shall implement corrective actions to prevent a reoccurrence of the spill.

14.6 Contingency

In the event that on-site field personnel cannot handle the spill, TMG will dispatch an Emergency Response Team. The Emergency Response Team has been trained and has sufficient equipment to perform spill cleanup for this project.

15.0 PROTECTION OF RIVERS, STREAMS, AND IMPOUNDMENTS

15.1 Erosion and Silt Control

TMG shall exercise every reasonable precaution throughout the life of the project to prevent silting of ditches and streams at the site. Erosion and silt control measures shall include, but is not limited to, the following:

- Prior to suspension of excavation operations for any appreciable length of time, TMG shall shape the top of earthwork in such a manner as to permit the runoff of rainwater and shall construct earth berms along the top edges of embankments to intercept runoff water.

The berm construction shall not be permitted to decrease the stability of the embankment section.

- Preventive measures taken to adequately control any run-off or run-on of water to excavation areas or to the storage/staging areas. Should such preventive measures fail and an appreciable amount of material begins to erode into a waterway, TMG shall act immediately to bring the silt under control.

- Excavated soil shall not be deposited in or so near to waterways that it will be washed away by high water or runoff.
- Diversion ditches will be constructed around areas where running or standing water is present.
- No erosion control measures that are constructed on-site will allow migration of contamination onto adjacent "clean" soil.

16.0 AIR EMISSION CONTROLS

If necessary, water will be used for dust control in areas of excavation and on haul roads. The Project Manager/On-site Superintendent and the Quality Control Officer (QCO) will make visual observations of dust levels to determine if water suppression is necessary and/or working.

17.0 PREPARATION AND SUBMISSION OF DRAFT AND FINAL CONSTRUCTION COMPLETION REPORT

Upon completion of the field activities, TMG will prepare a Construction Completion Report which details all of the activities associated with the project efforts, including in-house and field activities. TMG will follow the formats established in the previous reports for TNT Area B and Pentolite Road Red Water Ponds Area. The draft and final reports will include, at a minimum the following details:

- Introduction
- Site Location and Description
- History
- Regulatory History
- Background Soils Information
- Construction Activities (site preparation, excavation, sampling, treatment, stabilization, disposal, erosion control, backfilling, site restoration, grading and seeding, manifesting, analytical results, etc.)
- Performance Standards and Construction QC
- Final inspection checklists
- Conclusions and recommendations

TMG will address the items that pertain to this project. The draft report will be submitted to USACE for review and comment. TMG will respond to the comments and incorporate the responses into the final report. Comments and responses generated from TMG's internal review and USACE reviewers will also be included in the QC appendix of the final report.

18.0 GRADING AND SEEDING OF THE AOCS

Upon completion of the excavations, and receipt of the confirmation laboratory analysis, calculation of the HI and ICLR to document that the COCs have been removed from the pit and the walls are clean, TMG will begin backfilling the excavations. Clean soil from the borrow site or soil excavated from TNT Area C activities that have been treated will be used for backfilling the excavation pits. Once a pit has been backfilled, it will be graded to a slope consistent with the surrounding area.

TMG will consult with John Blakeman, Prairie Grass Biologist who is knowledgeable in the native prairie grasses, to verify which grasses should be planted in the TNT C area. TMG will work with Mr. Blakeman to make sure the seeding is accomplished during the proper season to assure a successful start to growing the specific vegetation.

19.0 PUBLIC MEETING SUPPORT

TMG will support the USACE Technical Manager and Project Manager during PBOW Team and Restoration Advisory Board and public meetings. TMG will prepare slides and handouts as necessary to convey information about the project and present the information highlighting the requirements and results/recommendations of the project.

20.0 THREATENED AND ENDANGERED SPECIES SURVEY

USACE conducted a vegetation survey in September 2000 with Davey Resource Group during which time *Gentiana clause* located. USACE conducted another survey in September 2009, supported by Davey Resource Group. Based on the findings of the 2009 survey, TNT C area contains mostly moderate to dense shrub thickets with scattered trees. There are also a few forested areas, and some upland old field, primarily associated with roads, buildings and formerly disturbed areas. The Gentiana clause, or Closed Gentian could not be relocated. Based on the surveyor's efforts, no Threatened and Endangered species were located within the TNTC area and therefore does not pose an issue during the construction efforts. The report from Davey Resources Group is included as Appendix F of this plan.

21.0 WETLANDS

The entire TNT C area was evaluated for wetlands and of the ones found, only one was found to be within an AOC. This area is one of the 15 AOCs in TNTC and is designated as the Drainage Ditch. Davey Resources Group stated that the area is a man-made drainage ditch along the edge of an access road. The ditch is a wetland based upon vegetation, hydrology, and soils. The ditch has a direct surface water connection with the small intermittent stream to the west. This is a non-isolated wetland subject to federal regulation. Because the wetland is artificial, there should be minimal amount of mitigation required for any impact. USACE wetlands experts stated that the area is well below the minimum acreage ($1/10^{th}$ acre) that would require mitigation, impact would be minimal in the absence of mitigation, the area would self-mitigate from the natural carry-down action of the upstream seed bank.

As part of the project, the area will be sampled again to determine the 2,4,6-TNT, 2-ADNT, and 4-ADNT concentrations. These COC were documented in the FS as being above the RG values. TMG will sample the sediment in the area and provide the results to USACE POC for their evaluation as to if remediation is still required.

22.0 ROAD REPAIR

The roads in the area of TNTC are currently in “rough” condition. The roads leading to the AOCs have some asphalt underlying a soil cover which has accumulated over the years. Damage to the roads in the area of the excavations is not anticipated, but in the event ruts or holes develop as a result of the project activities, they will be repaired by grading the ruts, rolling and filling holes with gravel.

The roads leading to the treatment pad or to the exit of PBOW from the treatment pad appear to be in passable condition with some holes where the asphalt has wash away or degraded by age or traffic. The roads will be restored to the current condition using gravel where appropriate and asphalt patch where appropriate. If damage by project-related traffic impacts the road severely, beyond current conditions, the road will be brought back to their current condition.

23.0 PROJECT SCHEDULE

The proposed project schedule is as follows:

Submission of 8 copies of the Draft SSHP, the Draft QCP, and the Draft Plan of Operations	May 2010
Submission of 6 copies of the Final SSHP, QCP, and Plan of Operations	10 days after approval of response to comments but prior to beginning intrusive fieldwork
Submission of Draft Construction Completion Report	450 days (15 months) after approval of work plans
Submission of Final Construction Completion Report	30 days after approval of response to comments

24.0 REFERENCES

The following reference materials were used in compiling the information contained in this Plan of Operations and/or will be used in other documents associated with this project.

EM-200-1-3, “*Requirements for the Preparation of Sampling and Analysis Plans*,” U.S. Army Corps of Engineers, February 2001

EM-200-1-6, "*Chemical Quality Assurance for Hazardous, Toxic and Radioactive Waste*

Projects (HTRW)," U.S. Army Corps of Engineers, October 1997

ER-1110-1-263, "*Chemical Data Quality Management for Hazardous Waste Remedial Activities,*" U.S. Army Corps of Engineers, April 1998

CELRHR 5-2-7, "*Quality Management Plan*," U.S. Army Corps of Engineers, May, 1999

ER 385-1-92, "*Safety and Health Document Requirements*," U.S. Army Corps of Engineers, March 1994

EM 385-1-1, "*Safety and Health Requirements Manual*," U.S. Army Corps of Engineers, September 1996

EM 200-1-2, "*Technical Project Planning Process*," U.S. Army Corps of Engineers, August 1998

EM 200-1-1, "*Validation of Analytical Chemistry Labs*," U.S. Army Corps of Engineers, July 1994

ER 1165-2-132, "*HTRW Guidance for Civil Works Projects*," U.S. Army Corps of Engineers, June 1992

"*Final Plan of Operations, Former Plum Brook Ordnance Works, Pentolite Road Red Water Ponds, Sandusky, Ohio*", McTech Corp., July 2007

"Final Plan of Operations Addendum – TNT Area B and Pentolite Road Redwater Pond Area – Bioremediation of Contaminated Soil, Plum Brook Ordnance Works, Sandusky, Ohio", WTI, October 2003

"TNT Areas A and C Remedial Investigation, Former Plum Brook Ordnance Works, Sandusky Ohio – Volume 1 – Part 1". Shaw Environmental, Inc., August 2003

"TNT Areas A and C Remedial Investigation, Former Plum Brook Ordnance Works, Sandusky Ohio – Volume 1 – Part 2". Shaw Environmental, Inc., August 2003

"TNT Areas A and C Remedial Investigation, Former Plum Brook Ordnance Works, Sandusky Ohio – Volume 1 – Part 3". Shaw Environmental, Inc., August 2003

"TNT Areas A and C Remedial Investigation, Former Plum Brook Ordnance Works, Sandusky Ohio – Volume II, Baseline Human Health Risk Assessment and Volume III, Ecological Risk Assessment". Shaw Environmental, Inc., August 2003

"Final TNT Areas A and C Remedial Investigation, Former Plum Brook Ordnance Works, Sandusky, Ohio – Volume 4 – Focused Feasibility Study for Soil and Sediment". Shaw Environmental, Inc., August 2003

"Feasibility Study Addendum, TNT Area C – Former Plum Brook Ordnance Works, Sandusky, Ohio". Shaw Environmental, Inc., January 2009

"*Final Proposed Plan for Soils and Sediments – TNT Area C – Former Plum Brook Ordnance Works, Sandusky, Ohio*". Shaw Environmental, Inc., March 2009

"Addendum to Plan of Operations, Interim Soil Removal Action Continuation, Soil Excavation and Disposal, Plum Brook Ordnance Works, Pentolite Road Red Water Ponds, Sandusky, Ohio". McTech Corp., July 2008

Appendix A Scope of Work

Scope of Work for the
Remedial Action Construction (RA-C) – Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works - TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

1.0 Introduction.

This work shall be awarded as Performance Based Services Contract (PBC) and issued as a firm fixed-price contract. The purpose of this Scope of Work (SOW) is for the remediation of soil and sediment within TNT Area C (TNTC) of the Plum Brook Ordnance Works (PBOW) Project. The United States Army Corps of Engineers (USACE) is the responsible authority under the Defense Environmental Restoration Program (DERP) at the former TNTC. Based on the results of the completed Remedial Investigation/Feasibility Study (RI/FS) for soils and sediment, the USACE will conduct a remedial action construction (RA-C) in the TNT Area C. The remediation will be performed to prevent human exposure to site soil and sediment containing any of the 13 constituents of concern (COCs) for soils and 3 COCs for sediment at concentrations that exceed remediation goals. The remediation goals are chemical- and receptor-specific risk based remedial criteria that capture all the exposure assumptions and toxicological data used in the risk assessment. The RA-C will consist of the excavation of approximately 9,205 cubic yards of material, backfilling of the excavation pit with clean material, treatment by alkaline hydrolysis and/or composting (if necessary), ex situ chemical stabilization (if necessary) and on-site / off-site disposal. The remediation is protective of human health and the environment, complies with Federal and State of Ohio Environmental Protection Agency (OEPA) requirements that are either applicable or relevant and appropriate to the remedial action, is cost effective, utilizes permanent solutions and treatment or resource recovery technologies to the maximum extent practicable, and satisfies the requirement for treatment as a principal element of the remedy. No soil or sediment contaminants will be left at levels to which direct exposure would be considered unacceptable by the Ohio Environmental Protection Agency (OEPA). The remediation of soil and sediment represents the removal of a potential source of future groundwater contamination.

1.1 Site History and Location.

The site of the former Plum Brook Ordnance Works (PBOW) is located approximately 4 miles south of Sandusky, Ohio and 59 miles west of Cleveland, Ohio. Although primarily in Perkins and Oxford Townships, the eastern edge of the site extends into Huron and Milan Townships. PBOW is bounded on the north by Bogart Road, on the south by Mason Road, on the west by County Road 43, and on the east by U.S. Highway 250. The surrounding area is mostly agricultural and residential.

The 9,009-acre PBOW site was built in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives at PBOW began in December 1941 and continued until 1945. It is estimated that more than 1 billion pounds of nitroaromatic explosives were manufactured during the 4-year operating period. The three explosive manufacturing areas were designated TNT Area A (TNTA), TNT Area B (TNTB), and TNT Area C (TNTC). Twelve process lines were used in the manufacture of TNT, four lines at TNTA, three lines at TNTB, and five lines at TNTC. This SOW deals primarily with the TNTC area.

The TNT C area occupies approximately 119 acres of land in the western portion of PBOW. Currently, the area is heavily vegetated / overgrown with trees and brush. Several aboveground features that indicate former PBOW facilities were present are still evident at TNTC. These include roads, fire hydrants, water valves, a water valve control well, railroad beds, and former building pad foundations. Below-ground features are also present, including manholes, drains, and underground lines (indicated by aboveground water valves). The National Aeronautics and Space Administration (NASA) does not currently use the area, and no NASA buildings exist on TNTC. One building present on the site was constructed and used by the EPA to perform noise abatement testing in the 1980s. This building is located near a former Wash House (Building 606) along former Process Line 10. Based on this use, there is no reason to expect that EPA contributed in any way to contamination at TNTC.

The TNTC manufacturing site consisted of widely scattered buildings of wood frame construction with asbestos and sheet metal coverings. It also included a series of buried and/or overhead flumes and pipes used to transport various liquids associated with the manufacturing process.

After plant operations ceased, TNTC's manufacturing lines were decontaminated by the War Department in late 1945. During decontamination, all structures, equipment, and manufacturing debris were either removed and salvaged or removed and burned. After the property was certified as decontaminated, 3,230 acres were initially transferred to the Ordnance Department, then to the War Assets Administration in 1946. This transfer did not include the Plum Brook Depot area, which consists of 2,800 acres. The Department of the Army reacquired the 3,230 acres in 1954 and performed cleanup efforts from the mid-1950s until 1963. In 1955, the Army specifically completed further decontamination of TNTC. This effort included removal of contaminated surface and subsurface soil around the buildings and wooden and ceramic waste disposal lines containing TNT. Thousands of pounds of TNT were discovered in catch basins; this TNT was removed and burned at the burning grounds.

Two property use agreements were entered into by the Army and the National Advisory Committee of Aeronautics, the predecessor of NASA, in 1956 and 1958, respectively. On March 15, 1963, accountability and custody of the entire PBOW property was transferred to NASA by the Department of the Army. NASA performed further decontamination efforts during 1964. The NASA decontamination process included removing contaminated surface soil above the drain tiles, flumes, etc., destruction of all buildings by fire, then removal of all soil, debris,

sumps, and above-grade portions of concrete foundations. Portions of the concrete foundations located below grade were left buried, and some that had been previously slightly above grade were likewise buried. All materials, including the soil in those areas, were flashed; the area was then rough-graded. The decontamination process was also to have included the burning of nitroaromatic-filled flumes that were excavated.

NASA has operated and maintained the former PBOW property since 1963, and the facility is currently known as the NASA Glenn Research Center, Plum Brook Station. NASA operates the property as a space research facility in support of their John Glenn Research Center at Lewis Field, Cleveland, Ohio. Most of the aerospace testing facilities built in the 1960s at the site are currently on standby or inactive status. On April 18, 1978, NASA declared approximately 2,152 acres of PBOW as excess. The Perkins Township Board of Education acquired 46 acres of the excess acreage and uses this area as a bus transportation area. The General Services Administration retains ownership of the remaining excess acreage and currently has a use agreement with the Ohio National Guard for 604 acres of this land. NASA presently controls approximately 6,400 acres.

Currently, TNTC consists mostly of early and late old field combined with shrubby thicket vegetation and is less than 10 percent wooded. Some wetland vegetation was found along TNTC drainage ditches and streams. During rain events, drainage from the ditches flows into any of three small streams that eventually flow to Pipe Creek, located northwest of TNTC. Areas east of TNTC are primarily old field and shrub, while to the south, southeast, northeast, north and west, it is primarily forested, and to the southwest, it is old field and early shrub thicket.

1.2 Proposed Action Description

To provide a basis for taking an action at this site, Remedial Investigation (RI) activities were conducted for TNTC soils (415 samples) surface water (10 samples) and sediment 18 26 and therefore not addressed in this RI. During the RI, TNTC soil was investigated by process line or process type, and the associated 29 building areas. As part of the RI, human health and ecological risk assessments was conducted for TNTC. Out of the 29 building areas investigated, 14 building areas and 1 drainage ditch area (total of 15 areas) were identified as having contaminants above the identified Remedial Goals (RGs). Thirteen chemicals of concern (COCs) were identified in surface, subsurface soil and sediment. Five of those COCs are nitroaromatics (2-amino-4,6-dinitrotoluene (2-DNT), 4-amino-2,6-DNT (4-ADNT), 2,4-DNT, 2,6-DNT, and 2,4,6-TNT) and are clearly site related. The remaining eight COCs are polychlorinated biphenyls (PCBs - Aroclor 1254 and 1260), polynuclear aromatic hydrocarbons (PAHs – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenze(a,h)anthracene, and indeno(1,2,3-c,d)pyrene) and lead. Sediment has only 3 COCs: nitroaromatics (2-amino-4,6-dinitrotoluene (DNT), 4-amino-2,6-DNT, and 2,4,6-TNT).

The proposed approach for this RA-C is to excavate all the areas in which the concentration of the COCs in soil exceed the RGs. The estimated volume of contaminated soil from all over TNTC is 9,205 cubic yards (cy). Following excavation of the contaminated soil, representative

soil samples from each AOC area (walls and floor) will be analyzed for "totals" to ensure the AOC has been remediated to meet the "clean-up" requirements set forth in the FS. Additional soil excavation may be required laterally if indicated by a comparison of the confirmation samples to the RGs and OEPA's cancer and noncancer risk goals. However, additional removal of soil to a greater depth is not anticipated as virtually all of the excavations are expected to extend to either bedrock or the water table, whichever is encountered first.

Based on the FS data which defined the AOC limits, contamination and RG levels as well as the Decision Document (DD), which details the selected remedy (Alternative #5) as approved by USACE and Ohio EPA, the estimated volume of excavated soil is 9,205 cy. Of this, an estimated 6,805 cy is targeted for disposal, without treatment, at a regulated non-haz landfill. The landfill used for the disposal of nonhazardous soils must be approved in advance by OEPA as appropriate facilities to receive CERCLA waste. The remaining 2,310 cy are anticipated to be a characteristic hazardous waste based on toxicity as determined by TCLP testing. This hazardous soil will require treatment prior to disposal at a nonhazardous waste landfill or on-site placement. Approximately 2,103 cy of this contaminated soil are estimated to be hazardous prior to treatment based on elevated 2,4-DNT concentrations. Thus nearly half of the lead soil is also expected to contain concentrations of 2,4-DNT sufficiently high to require treatment. The estimated volumes were calculated using the "20 time rule". This is a conservative approach and the actual volumes of hazardous and nonhazardous soil could be less or more depending on the disposal analyses results.

The technologies outlined in the approved DD were not designed to treat PCBs. Generally, areas with elevated concentrations of PCBs in TNTC soil are collocated with elevated nitroaromatic concentrations. Where this is the case, the nitroaromatic-contaminated soil will be treated and disposed of off site at an approved RCRA hazardous waste treatment, storage, disposal facility (TSDF). If areas with elevated PCBs are encountered that do not have elevated nitroaromatics, then this soil will be excavated and disposed of at a nonhazardous waste landfill without treatment. Disposal at a Toxic Substances Control Act-approved landfill is not expected to be required because none of the soil or sediment samples in the RI had PCB concentrations that approached the concentration of 50 mg/kg that would result in a classification as a PCB remediation waste.

Based on the results of the TCLP tests, non-hazardous soil above RG levels may either be treated and used as backfill (pending LDRs are met) or disposed of in an off-site, non-hazardous waste landfill (Erie County Landfill). Any soil identified as hazardous waste would require treatment (i.e., alkaline hydrolysis, windrow composting, metals stabilization) to achieve non-hazardous status prior to onsite or offsite disposal. The Contractor shall use hazardous waste disposal as a last resort.

Based on the results of the human health risk assessment, the following RGs were selected for soil (14 building areas) and sediment (1 ditch area). No RGs were developed for groundwater because groundwater will be evaluated on a sitewide basis at a later date under project 1826.

"Remedial actions will be taken to prevent human exposure via any exposure route (ingestion, inhalation, or dermal contact) to site soil and sediment containing any of the 13 COCs at concentrations that exceed RGs. Remediation goals are chemical- and receptor-specific risk-based remedial criteria that capture all the exposure assumptions and toxicological data used in the risk assessment."

COCs were identified for TNTC soil and sediment as those chemicals that contributed most to an additional incremental lifetime cancer risk (ILCR) of 1E-5 or an additional noncancer hazard index (HI) of 1. In addition to the ILCR and HI requirements, use of the following RG levels has been approved for project clean-up:

Chemicals of Concern (COCs) for Soils	RGs (mg/kg)
Nitroaromatics	
2-amino-4,6-DNT (2-ADNT)	1.7
4-amino-2,6-DNT (4-ADNT)	1.3
2,4-DNT	6.5
2,6-DNT	1.0
2,4,6-TNT	8.0
Polychlorinated Biphenyls	
Aroclor 1254	1.0
Aroclor 1260	1.0
Polynuclear Aromatic Hydrocarbons	
Benzo(a)anthracene	1.0
Benzo(a)pyrene	1.0
Benzo(a)fluoranthene	1.0
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-cd)pyrene	1.0
Metals (Lead)	400

Chemicals of Concern (COCs) for Sediment	RGs (mg/kg)
Nitroaromatics	
2-amino-4,6-DNT (2-ADNT)	5.0
4-amino-2,6-DNT (4-ADNT)	5.0
2,4,6-TNT	41.0

The RGs were developed as not-to-exceed criteria for the purpose of identifying areas at TNTC requiring soil remediation. They will also be used statistically during excavation and confirmation sampling as part of a risk-based approach to aid in determining whether additional soil removal is required. This will involve the averaging of samples from each excavation and comparing the analytical results to the respective RGs. The exceedance of an individual RG will be acceptable for an area of an excavation as long as the overall OEPA risk goals are not exceeded for the area represented by those samples (ILCR <=1E-5 and HI<=1). Also, for the selected and approved Remedial Alternative #5, which is the only alternative that may include on-site placement of treated materials, the RGs would serve as cleanup criteria. Even if an individual RG is exceeded for a batch of treated material, the material may be placed on site as long as the overall OEPA risk goals were not exceeded for that batch and land disposal restriction (LDRs) requirements were met.

The soil RGs and sediment RGs were derived assuming future unrestricted land use. This assumption is appropriate because the area surrounding the former PBOW facility is rural and residential. This is consistent with the remedial objectives of other PBOW sites that have been remediated by the USACE. Also, it is consistent with the cleanup goals used for PBOW sites remediated by NASA.

2.0 Objectives.

The Contractor shall provide all equipment, labor, materials and supervision necessary for the remediation of the TNT Area C site. Remediation activities consist of excavation of the contaminated soil and sediment from the 15 AOCs, TCLP testing, segregation of the hazardous lead-contaminated soil, segregation of the hazardous 2,4-DNT contaminated soil and sediment, alkaline hydrolysis or windrow composting or a combination of both (if necessary), neutralization of the treated soil (if necessary), chemical stabilization of the lead-contaminated soil (if necessary), and the off-site disposal of the nonhazardous untreated soil at a nonhazardous solid waste landfill and/or on-site placement of the treated material. Overall, this work shall consist of the following tasks:

Task 1	Preparation/Submittal of a Site-Specific Safety and Health Plan (SSHP)
Task 2	Preparation/Submittal of a Quality Control Plan (QCP)
Task 3	Preparation/Submission of a Plan of Operations
Task 4	Field Activities/Utilities
Task 5	Site Survey
Task 6	Excavation
Task 7	Treatment (Alkaline Hydrolysis and/or Windrow Composting, if necessary)

Task 8	Stabilization, if necessary
Task 9	Disposal/IDW
Task 10	Confirmation Sampling
Task 11	Preparation/Submission of Draft & Final Construction Completion Report
Task 12	Public Meeting Support
Task 13	Threatened & Endangered (T&E) Species Survey

3.0 Tasks. The tasks outlined in Section 2.0 are described in detail in the following sections of this Scope of Work (SOW). This work shall be conducted by the Contractor in an environmentally acceptable manner conforming to existing federal, state, and local regulations under US Army Corps of Engineers (USACE)/Huntington District (CELRH) supervision.

3.1 (Task 1) Preparation and Submission of the Safety and Health Plan (SSHP)

The Contractor shall prepare a Site-Specific SSHP that covers the field activities planned for the area. The plan shall comply with the requirements of the U.S. Army Corps of Engineers, Safety and Health Requirements Manual, EM 385-1-1, latest version, and the Department of Labor, Occupational Safety and Health Administration (OSHA) as presented in Title 29 of the Code of Federal Regulations, Part 1910.120. As a minimum, the contractor SSHP shall address the following items:

- Cover sheet. Identify company name, contract number, project location, signed and dated by plan developer.
- Responsibilities and lines of authority.
- Employee qualifications. Physical fitness, job competence, special skills, equipment operation.
- Employee training. First aid, CPR, back injury prevention.
- Safety meetings. "Tool box" meetings.
- Job Hazard Analysis. Preparation and revision, discussion with employees.
- Emergency response plan. Emergency number, means of communication, route to nearest medical facility.
- Accident reporting and supervisor responsibility. Report all accidents immediately to the Contracting Officer and submit ENG Form 3394 within two (2) working days.
- First aid kits.
- Personal protection equipment. As a minimum, employees must wear long-legged trousers, sleeved-shirt, and steel-toes shoes. Safety glasses with side shields and hard hats may also be appropriate, depending on activity.

- Hearing Protection
- Vehicles and equipment.
- Public safety.
- Fire safety.
- Environmental hazards.
- Housekeeping.
- Standard operating procedures.

The contractor shall read and conform to the SSHP when conducting this work. Documentation to this effect shall be furnished to the Government Point-of-Contact (POC) prior to initiation of any work. The plan shall also include the names, and qualifications of the Site Safety and Health Officer, including education, training and work experience.

3.2 (Task 2) Preparation and Submission of the Quality Control Plan (QCP)

Prior to initiating any field activities, a project specific Quality Control Plan (QCP) shall be prepared and implemented by the Contractor as part of this work order. The Contractor shall prepare a QCP that covers the office / field activities planned for the area. The QCP shall apply to all tasks/activities and products contained in this SOW. The QCP shall be prepared according to the applicable ISO 9000 processes as identified at www.lrh.usace.army.mil/ct/quality developed for this type of work.

The QCP shall define the responsibilities and roles of each member on the Independent Quality Control Team (IQCT), along with those preparing or performing the tasks/activities in this SOW.

The QC Plan shall also detail the methods and procedures for inspection of work, identifying and correcting deficiencies, maintenance of records, list of authorized Quality Control Inspectors, list of authorized Contractor representatives, and security measures.

The draft and final versions of the various plans shall include a separate QC appendix that includes an activity review checklist (appropriate checks on those activities that were performed/reviewed) for the specific product, along with a signed sheet which designates the name, date and official work title of those persons performing/conducting the QC activities. All comments and responses, from the Contractor's QC review and USACE's QA/QC review, as well as contract compliance review comments of the plans shall be included in the QC appendix of the final plans.

3.3 (Task 3) Preparation and Submission of Plan of Operations

The Contractor shall provide a Plan of Operations (which details specific information for the activities that are to be performed in the field). These plans shall be submitted and approved by USACE prior to start-up of construction field activities.

The Plan of Operations shall include at a minimum the following topics: Introduction (background, history and overview of remedy), Project Organization, Implementation of

Selected Alternative (scheduling, site health and safety controls, access roads and entrance gate, clearing and grubbing, erosion and sediment control, surface water controls, loading and off-site transportation of debris (if necessary)), borrow material, final site activities (seeding, establishing vegetation), Execution of RA-C (SSHP, QCP, contract administration, construction oversite and Project Oversite (scheduling, reporting requirements and SOW adjustments), list of applicable state and local laws and regulations, spill control/prevention (including names and telephone numbers of all personnel and offices to be contacted in the event of a spill that discharges into storm or sanitary sewer, streams or is over the reportable quantity), recycling and waste minimization, contaminant prevention, environmental monitoring, tree protection, soil disposal areas, disposal of solid wastes, clearing debris, disposal of contractor generated hazardous wastes, fuels and lubricants, historical, archeological and cultural resources (known or discovered), protection of water resources, protection of fish and wildlife resources, protection of air resources (particulates and other air pollutants), Inspection and Training of Contractor Personnel. This plan shall also include the Erosion Control Plan, the Spill Containment Plan, the Environmental Protection Plan and the Materials Handling and Storage Plan. These plans shall include, but not be limited to, sections that describe excavation methods, best management practices for managing excavated wastes, spoils, and runon/runoff, as well as showing the proposed limits of excavation. The plans shall be combined into the Plan of Operations so that there is only one document to keep track of at the project site. Many of the topics outlined above fall under the various plans required for the Plan of Operations. To keep the size of the document to a minimum, duplication of information throughout the plans should be avoided (if possible).

The Contractor shall also include in the Plan of Operations a Sampling and Analysis Plan (SAP) and a Quality Assurance Project Plan (QAPP) that will outline the sampling and analysis required for treatment / disposal of the contaminated soil as well as that required for confirmation once excavation has been completed. The Contractor shall use only USEPA NELAP and USACE QSM certified labs for this effort.

For all borrow sites (whether onsite or off-site), the Contractor shall sample the borrow material to ensure that it is not contaminated. Sampling shall be for VOCs (Method 8260A), SVOCs (Methods3540C/8270), TAL Metals (3050B/6010B/7471A) and PCBs (8082/3540B). These were the same sampling parameters used in the Remedial Investigation. The sampling and analysis shall be done in accordance with current USEPA SW-846 protocol at the above certified labs.

The Contractor shall collect the potentially hazardous waste from the field efforts, used PPE, decontamination liquids, and all waste generated from construction activities. This media shall be containerized in sealable drums and placed in a secured area on the site until the results of the soil analyses are known. All drums shall be labeled as to project name, contents, date of collection, and secured to prevent public access. The drums shall be secured with tarps, ropes and pallets. Waste from different sites (i.e., other PBOW projects) shall not be mixed. The TNT C area is considered 1 project site.

The Contractor shall also include in the Plan of Operations an Investigative Derived Waste Plan (IDWP) for this project. The IDW Plan shall contain, at a minimum: analytical methods; management and containerization methods; and proposed disposal facilities. The IDW Plan shall address IDW generated on the sites. Actual disposal of IDW shall not occur until the test results are known and the IDW Plan has been approved by USACE. If analyses of the samples taken from the sites indicate that regulated concentrations of hazardous contaminants are present, then the Contractor shall test the IDW material. If analyses of the IDW material indicate that regulated concentrations of hazardous contaminants are present, then the Contractor shall dispose of the IDW material collected from the sampling activities in accordance with local, state and federal regulations as outlined in the IDW Plan.

The Contractor shall immediately provide the lab analyses along with a letter stating which contaminants were found if the material has been designated as contaminated. The Contractor shall send this letter with results to the USACE Technical POC. The letter shall be included in the final IDW Plan. Once received, the Contractor shall use this information to properly dispose of the drums according to applicable state, federal and local regulations. The Contractor shall be responsible for laboratory analyses and proper disposal of IDW. Actual disposal of the IDW shall not occur until the test results are known. If the material is determined not to be a regulated waste, the Contractor shall dispose of the material in accordance with the IDW Plan, at no additional cost to the Government.

Quality Assurance reviews shall be conducted by the USACE on the IDW Plan. The final IDW Plan shall include, as an appendix, all USACE review comments and Contractor's responses, Independent Quality Control Team (IQCT) comments/responses, activity checklists and signed signature sheets.

3.4 (Task 4) Field Activities/Utilities

3.4.1 Field Activities. The site is currently owned by NASA Plum Brook Station (PBS), however, rights of entry are not required for this RA-C. Coordination with PBS personnel will be conducted by USACE to ensure that the Contractor is allowed access to/from the site to perform all activities during this RA-C. The Contractor shall be required to enter/exit through the PBS security gate, therefore, he shall follow all rules set forth by PBS security. The USACE shall be notified in writing at least two (2) weeks prior to commencement of any field work. The Contractor shall coordinate his field activities with all appropriate authorities and agencies as required. PBS is a secure site, therefore, the Contractor must comply with their access request requirements and provide the proper paperwork, security background check information, daily work schedule. No after hours work (6 pm to 7 am) shall be requested unless approved by USACE POC first and then approved by NASA POC. NASA POC for this action is Robert (Bob) Lallier, 419-621-3234, Robert.F.Lallier@grc.nasa.gov. Persons with a criminal record (felony) or those that do not have their U.S. citizenship WILL NOT be allowed to access to the site OR work on this project. No field work shall be started until the QCP, SSHP and Plan of Operations have been approved by USACE. The Contractor shall prepare and submit to USACE a written response to all comments. The

Contractor shall also be responsible for providing (with the notification) an up-to-date, detailed time schedule for the field work to be performed.

3.4.2 Utilities. There is the potential for active utilities to be encountered in several of the locations within TNTC. Because this land is currently owned and operated by NASA, the Contractor will have to coordinate their activities with NASA prior to commencing field activities and obtain a "digging permit" that will address all active and non-active lines in the project area. NASA POC for this action is Robert (Bob) Lallier, 419-621-3234, Robert.F.Lallier@grc.nasa.gov.

3.5 (Task 5) Site Survey

The RI/FS documents include the survey data for sampling points within each of the contaminated areas within the TNTC site. The survey coordinates will be furnished to the Contractor on CD and/or by email. The Contractor shall use this information to locate and flag the perimeter of each contaminated area and any internal areas. Also, the Contractor shall be responsible for all surveying necessary for identifying limits of excavation once clean-up levels have been reached during excavation efforts. The Contractor shall use the survey data to create the drawings that are required in the draft and final reports. The Contractor shall also use survey methods to calculate volumes (i.e., cy) of excavated soil, as required. Soil taken to the landfill will be measured by weight, therefore, the Contractor shall obtain the weigh tickets to verify quantity of soil disposed (i.e., tons).

3.6 (Task 6) Excavation of Contaminated Material.

The Contractor shall excavate approximately 9,205 cubic yards of contaminated material from the vicinity of the former TNTC site from the 15 AOCs. The following paragraphs detail the different locations within the TNTC areas. Contaminants, levels of cleanup and excavation limits have already been identified during the RI/FS phase of this project. All findings and recommendations have been verified and approved by USACE Headquarters and Ohio EPA and are therefore to be used during this RA-C. This material shall be excavated in a safe manner and activities shall adhere to all environmental and safety laws, regulations and ordinances. Any water generated during the excavation shall be containerized, sampled and disposed of in accordance with local, state and federal regulations. Before excavation shall begin the Contractor shall submit a plan (within the Plan of Operations) showing the proposed limits of excavation as they are given within the FS. Excavation depths are given below, however, if the Contractor encounters groundwater or bedrock before reaching the designated depth, then he shall stop and assume the depth has been reached. The Contractor shall be cautious during excavation operations and watch their depths so that water is not unnecessarily generated, which would then require special handling. The Contractor shall notify the USACE POC as soon as this occurs for each individual excavation area. Coordinates for each AOC will be furnished to the contractor so that the contaminated AOC limits can be surveyed / staked prior to excavation. The excavated soil and sediment can either be placed adjacent to the AOC and sampled or be hauled to a staging area and characterized as hazardous or nonhazardous using the TCLP test. The Contractor shall place all excavated material on plastic to ensure no impacts to

uncontaminated soils occur. Also, the Contractor shall cover the stockpiles with plastic and secure to ensure run-off does not carry contaminants onto adjacent clean areas. Once the stockpile areas are no longer needed, the Contractor shall sample those areas to confirm the soil beneath the stockpile areas have not been impacted.

Materials that pass the TCLP test may be hauled to the Erie County Landfill to be used as daily cover or may be treated (i.e., alkaline hydrolysis and/or windrow composting) to below RG levels and used as backfill (provided the soil meets LDR requirements). Here are the AOCs as identified in the FS:

3.6.1 Building Area 602 Bi-Tri House, Process Line 10 (Figure 1-27 in FS). The Contractor shall excavate approximately 89 cy of material from this area. Dimensions are 20'x 20' x 6'. Primary contaminants are nitroaromatics with a possibility of lead and low levels of PCBs. Groundwater was noted at 6', however, bedrock was not encountered.

3.6.2 Building Area 603 Fortifier House, Process Line 10 (Figure 1-28 in FS). The Contractor shall excavate approximately 119 cy of material from this area. Dimensions are 20'x 20' x 8'. Primary contaminants are nitroaromatics. Groundwater was noted at 8' depth. Bedrock was not encountered.

3.6.3 Building Area 606 Wash House, Process Line 10 (Figure 1-29 in FS). The Contractor shall excavate approximately 104 cy of material from this area. Dimensions are 20'x 20' x 7'. Primary contaminants are nitroaromatics. Groundwater was noted at 6' and bedrock at 8'.

3.6.4 Building Area 616, Wash House, Process Line 11 (Figure 1-30 in FS). The Contractor shall excavate approximately 480 cy of material from this area, with excavation depth at 8'. This area is an irregular shape and as noted above, coordinates will be furnished prior to excavation efforts. Primary contaminants are nitroaromatics and PAHs. Groundwater was noted at 8' and bedrock was at 16.55'.

3.6.5 Building Area 626, Wash House, Process Line 12 (Figure 1-31 in FS). The Contractor shall excavate approximately 119 cy of material from this area, with excavation depth at 8'. Dimensions are 20' x 20' x 8'. Primary contaminants are nitroaromatics, however, lead was noted at a concentration of 134 ppm. Groundwater was noted at 8' and bedrock was at 8.5'.

3.6.6 Building Area 629, Acid & Fume Recovery, Process Line 12 (Figure 1-32 in FS). The Contractor shall excavate approximately 1,333 cy of material from this area. The overall dimension is 60' x 60' x 10'. However, an internal area of approximately 280 cy has been estimated to have lead and low levels of PCBs. Therefore, the Contractor shall segregate, if possible, the lead / PCBs contaminated soil area (280 cy) from the nitroaromatic contaminated soil (estimated at 1,053 cy) and conduct treatment as appropriate. The coordinates for overall

and lead areas will be furnished to the Contractor prior to excavation efforts. Groundwater was not encountered during investigation, however, bedrock was noted at 10'.

3.6.7 Building Area 657, Wastewater Disposal Settling Tank (Figure 1-33 in FS). The Contractor shall excavate approximately 104 cy of material from this area. Dimensions are 20' x 20' x 7'. Primary contaminants are PAHs. Groundwater was not encountered during investigation, however, bedrock was noted at 7'. An adjacent well measured groundwater at 13.3'.

3.6.8 Building Area 682, Bi-Tri House, Process Line 8 (Figure 1-20 in FS). Total remediation volume is estimate at 1,536 cy for this area. Groundwater was noted at 8' and bedrock at 15'. This area has been broken into 2 separate areas due to differences in excavation depths.

Area I totals 540 cy with a depth of 4'. However, an internal area of approximately 57 cy has been estimated to have lead (20'x19'x4'). Therefore, the Contractor shall segregate, if possible, the lead contaminated soil area (57 cy) from the nitroaromatic contaminated soil (estimated at 483 cy) and conduct treatment as appropriate. The coordinates for overall and lead areas will be furnished to the Contractor prior to excavation efforts. Primary contaminants are nitroaromatics and lead.

Area II totals 996 cy and is also broken into two excavation depths due to existing drainage ditch features. The drainage ditch is estimated at 141 cy excavated to a depth of 5' with the area surrounding the ditch estimated at 855 cy excavated to a depth of 8'. Primary contaminants are nitroaromatics.

3.6.9 Building Area 683, Fortifier House, Process Line 8 (Figure 1-21 in FS). The Contractor shall excavate approximately 1,200 cy. Dimensions are 60' x 60' x 9'. Primary contaminants are nitroaromatics. Groundwater was noted at 9' and bedrock encountered at 15'

3.6.10 Building Area 686, Wash House, Process Line 8 (Figure 1-22 in FS). Total remediation volume is estimated at approximately 1,226 cy of material. This area is an irregular shape and as noted above, coordinates will be furnished prior to excavation efforts. Excavation depth for the area is at 4'. An internal area of approximately 134 cy (30'x 30'x 4') has been estimated to have lead and low levels of PCBs. Therefore, the Contractor shall segregate, if possible, the lead / PCBs contaminated soil area (134 cy) from the nitroaromatic contaminated soil (estimated at 1,092 cy) and conduct treatment as appropriate. The coordinates for overall area and lead area will be furnished to the Contractor prior to excavation efforts. Groundwater was note at 3 – 3.5' and bedrock at 12'.

3.6.11 Building Area 689, Acid & Fume Recovery, Process Line 8 (Figure 1-23 in FS). The Contractor shall excavate approximately 119 cy of material from this area, with excavation depth at 8'. Dimensions are 20' x 20' x 8'. Primary contaminants are nitroaromatics, however,

lead was noted at a concentration of 335 ppm. Groundwater was noted at 8' and bedrock was at 15'.

3.6.12 Building Area 692, Bi-Tri House, Process Line 9 (Figure 1-24 in FS). The Contractor shall excavate approximately 845 cy of material from this area. This area has an irregular shape and as noted above, coordinates will be furnished prior to excavation efforts. Excavation depth for this area is at 8'. Primary contaminants are nitroaromatics. Groundwater was noted at 8' and bedrock at 15'.

3.6.13 Building Area 693, Fortifier House, Process Line 9 (Figure 1-25 in FS). The Contractor shall excavate approximately 147 cy of material from this area. The dimensions are approximately 26' x 21' x 7'. Primary contaminants are nitroaromatics. Groundwater was noted at 7' and bedrock was below 10' depth.

3.6.14 Building Area 696, Wash House, Process Line 9 (Figure 1-26 in FS). Total remediation volume is estimated at 1,740 cy. The irregularly-shaped area is broken out into 2 areas for excavation purposes. See Figure 1-26 from the Feasibility Study document for details. As noted above, the Contractor will be furnished the coordinates for each of these areas. Groundwater was not encountered, even at 10' and bedrock was noted at 12'.

I. The areas designated by "I" and outlined in red (noted as red slashed & red/green hatched areas, which overlap onto the green slashed area) are to be excavated to a depth of 12'. The estimated volume of the two areas "I" is 1,467 cy. Primary contaminants are nitroaromatics in red slashed areas (approximately 498 cy) and then nitroaromatics, lead & PAHs in red/green hatched areas (approximately 969 cy).

II. The remaining area designated by "II" with only the green slashed area (between the red slashed & red/green hatched area) is to be excavated to a depth of 5'. The estimated volume of area II is 273 cy. Primary contaminants is lead.

3.6.15 Drainage Ditch - Sediment only Sample location TNTC-SD009 (Figure 1-34 in FS). USACE concern for this area as being a potential wetland led representatives from USACE, Ohio EPA, Shaw Environmental and Davey Resource Group to conduct a site visit to determine if the area was designated as a wetland and if so, any particular requirements required during remediation.

Davey Resource Group representative, Todd Crandall (a biologist with the Natural Resource Consulting Firm), stated that the area in question is a man-made drainage ditch along the edge of an access road. The ditch has a flat bottom and appears to hold standing water at times. The ditch flows west, eventually entering a very small, intermittent stream. The ditch is a wetland based upon vegetation, hydrology, and soils. The vegetation in the ditch bottom consists of *Glyceria striata* (fowl manna grass) and *Fraxinus* pennsylvanica (green ash), both of which are wetland plant species. Blackened leaves and a few water marks are present here, indicating that the ditch holds standing water for significant period of time. The soils are hydric, with a dark, organic surface layer that is underlain by sand and clay. The ditch has a direct surface water

connection with the small, intermittent stream to the west. This is a non-isolated wetland subject to federal regulation. This area was determined to not be a stream based on the lack of a defined bed and bank, no evidence of significant water flow through the ditch, and no ordinary high water mark. Because the wetland is artificial and low quality, there should be minimal amount of mitigation required for any impact. The dark organic topsoil should be removed prior to disturbance and then replaced upon completion of the work. This layer was observed to be approximately 6-8 inches thick. The underlying soil was found to be sand with a clay layer at approximately 16 inches.

Should remediation of this area be required, the Contractor shall replace these layers with similar materials at the similar elevations and match the final grade to the existing ditch bottom's grade, to maintain the current hydrological conditions. The Contractor shall not backfill with only clayey material because that would create a "plug" affect that would affect downstream areas. Because the wetland is small and the vegetation very limited, no additional plantings should be necessary. Mr. Davey stated that the existing seed bank within the topsoil will be sufficient to ensure that the area becomes revegetated. Therefore, the Contractor shall "peel back" the top seed bank layer and set aside to use as vegetative cover backfill. The Contractor shall also keep disturbance to the trees on the uplands surrounding the ditch to a minimum so that the area remains a forested wetland and also to prevent erosion along the steep ditch banks.

USACE wetlands experts were also contacted and stated that this area was well below the minimum acreage ($1/10^{th}$ acre) that would require mitigation, impact would be minimal in the absence of mitigation, the area would "self mitigate" from the natural carry-down action of the upstream seed bank, and therefore would not require monitoring.

In conclusion, the representatives from USACE, Ohio EPA, Shaw Environmental and Davey Resource Group agreed that this area should be resampled to determine if the levels are still above the RGs prior to remediation efforts. Therefore, the Contractor shall resample this area for 2,4,6-TNT, 2-ADNT and 4-ADNT (as was documented in the FS as being above the RGs) and based on comparison of the analytical results to the sediment RG values, either confirm and document that this area requires no remediation or proceed with remediation (in accordance with recommended field efforts as outlined above) in this area as proposed in the FS.

Should the remediation effort be warranted, the Contractor shall excavate approximately 44 cy of material from this area. The dimensions are approximately 60' x 10' x 2'. Primary contaminants are nitroaromatics. The Contractor shall note that the RGs for sediment are different than that for soil. Please reference Section 1.2 for the RGs for sediment. Groundwater and bedrock was not found within the proposed 2' excavation depth. Remediation efforts shall be conducted as outlined by Davey Resources, in the FS and this SOW.

3.7 (Task 7) Treatment (Alkaline Hydrolysis and/or Windrow Composting)

Based on the approved DD, Alkaline hydrolysis (AH) and windrow composting were selected to be used in tandem for a variety of reasons. Although windrow composting is effective at treating

the DNTs and TNT, ADNTs are generated during the composting of nitroaromatic contaminated soils. Past experience at PBOW has shown that it is difficult to cost-effectively reduce ADNTs to RGs using composting alone. AH is very effective at treating TNT and has the added benefit that ADNTs are not generated during treatment. AH is also effective at treating 2,4-DNT. Thus, if the TCLP, LDR and/or RG criteria for the DNTs are not met after AH, then windrow composting would likely be an effective polishing step for the AH treated soil.

A treatment area was previously prepared and used under the Pentolite Road Red Water Pond Removal Action for windrow composting. Based on available funding, this area was maintained until November 2009 and may require minimal maintenance for future use (addition of stone in roadways, placement of new straw bales around perimeter, etc.). This area, previously used for windrow composting operations, should be large enough to use for AH, windrow composting and stabilization efforts under this SOW if activities are staggered effectively. Currently, the windrow composting area is 800 feet long by 260 feet wide and surrounded by an earthen berm to contain storm water runoff. An additional area adjacent to the compost area but still within the bermed area is available for AH and/or stabilization efforts. This area has not previously been used. Treatment operations will be conducted in the open. The area is graded and compacted to a 2% slope to control storm water. The area is not covered with an artificial surface such as asphalt or concrete. Two 60-mil plastic lined sump areas were created to contain the run-off, which could be used as needed to maintain the moisture content of the compost or during AH treatment. The excess water can be pumped to frac tanks for testing and disposal. No on-site treatment of water will be required. The windrows can be constructed within the treatment area, and stockpiles of amendments, untreated soil and treated compost will be staged in the area. Upon completion of treatments in this area, the soil will need to be analyzed for any impacts from the contaminated soil. If impacted, the area will have to be "scraped" until the impacts are no longer found. This impacted soil would most likely be taken to a nonhazardous landfill.

As for the AH process, it may be implemented by adding caustic soda and ferric chloride to the excavated soil and the soil may require neutralization prior to placement back on site or in a landfill. The Decision Document outlines the AH process that has worked at other FUDS sites and in a pilot study for PBOW, however, because this is a performance base service contract, it is the Contractor's ultimate responsibility as to the overall AH process used and it's success at reduction of nitroaromatics below cleanup goals. The Contractor may or may not choose to follow the "process" that's outlined in the Decision Document.

Just like the AH process, the windrow composting operation and it's success at reducing nitroaromatic and/or PAH contaminated soil from hazardous to nonhazardous levels is also the ultimate responsibility of the Contractor. Again, the Decision Document outlines a windrow composting process that has worked at other sites as well as on PBOW soils. The Contractor may or may not choose to follow the "recipe" and process that's outlined in the Decision Document.

The Contractor may choose to use the "processes" in the DD for estimating AH, windrow composting and stabilization efforts. That information can be found on pages 2-46 and 2-47 of the DD.

3.8 (Task 8) Stabilization

Stabilization will be required to treat the excavated soil classified as hazardous waste. Lead-contaminated soil will be chemically stabilized ex-situ using a reagent such as Maectite developed by Sevenson Environmental Services, Inc. Maectite is a cost-effective technology because the chemical can be mixed into the soil using equipment already on site, such as an excavator. This technology has been used successfully in the past at PBOW to stabilize lead-contaminated soil. The contractor must use a reputable company that has a patented or licensed process for their stabilization efforts. In the past, USACE Districts have been FOIA'd for information concerning if the stabilization process they used at various sites was patented or "copied from a patented process".

Representative samples of the stabilized soil would be taken for every 150 tons of processed soil or as directed by the stabilization company and/or non-haz landfill for their disposal requirements. The samples would be tested for hazardous characteristics using the TCLP test. If the soil tests non-hazardous, it will be disposed in a non-hazardous waste landfill. If the soil tests hazardous, further stabilization would be needed or an alternative treatment would be required.

Since stabilization only alters the physical availability of the contaminants, using stabilized material as backfill at the site is prohibited. Therefore, clean fill material will be placed in the excavation pits, compacted with excavator bucket as much as practicable, rough graded as necessary to achieve proper drainage, and reseeded with vegetation as identified by John Blakeman (Prairie Biologist for NASA).

AH and windrow composting should not interfere with the lead stabilization process as long as chemical stabilization is performed AFTER these other treatment operations. AH may actually promote stabilization of lead in the soil because the solubility of lead typically decreases with increasing pH. However, the Contractor shall note that lead-contaminated soil that requires stabilization cannot be used as backfill. Therefore, if soil is treated for lead but still has nitroaromatics, PAHs or PCBs, he may choose not to do the AH or windrow composting on it because it will be going to a landfill anyway. However, if the soil contains levels of 2,4-DNT making it hazardous, then treatment of the nitroaromatics would be required prior to disposal to a nonhazardous landfill.

3.9 (Task 9) Disposal/Investigative Derived Waste (IDW)

The Contractor shall arrange for sampling and analysis, transportation and disposal of material identified as going to a non-haz landfill. All soil excavated during this remediation effort will not be assumed as going to a landfill. Treatment of the soil should allow some volume to be placed on-site, provided all land disposal requirements (LDRs) are achieved. Therefore, the

Contractor shall assume that not all excavated soil is going to a landfill. However, any soil requiring stabilization (i.e., metals) will be disposed of in a regulated landfill, licensed to accept such waste. This alternative requires stabilization of the contaminated material prior to disposal, therefore, for estimating purposes, it is assumed that the material shall be placed in a non-hazardous waste landfill. The Contractor shall perform TCLP for all soil disposed of at a licensed landfill.

The Contractor shall collect the potentially hazardous waste, any used PPE, decontamination liquids, and all waste generated from the construction activities. This media shall be containerized and placed in a secured area on the site until the results of the analyses are known. All containers shall be labeled as to project name, contents, and date of collection, and secured to prevent tampering. If drums are used, they shall be secured with tarps, ropes and pallets. Waste from different sites shall not be mixed.
Actual disposal of IDW shall not occur until the test results are known and the IDW Plan has been approved by USACE. If analyses of the samples taken from the sites indicate that regulated concentrations of hazardous contaminants are present, then the Contractor shall test the IDW material. If analyses of the IDW material indicate that regulated concentrations of hazardous contaminants are present, then the Contractor shall dispose of the IDW material collected from the sampling activities in accordance with local, state and federal regulations as outlined in the IDW Plan.

The Contractor shall immediately provide the lab analyses along with a letter stating which contaminants were found if the material has been designated as contaminated. The Contractor shall send this letter with results to the USACE. The letter shall be included in the final IDW Plan. Once received, the Contractor shall use this information to properly dispose of the drums according to applicable state, federal and local regulations. The Contractor shall be responsible for laboratory analyses and proper disposal of IDW. If the material is determined not to be a regulated waste, the Contractor shall dispose of the material in accordance with the IDW Plan.

3.10 (Task 10) Confirmation Sampling

The Contractor shall excavate to the horizontal and vertical limits outlined for each of the areas in the Feasibility Study. Once these limits have been reached, the Contractor shall use field screening, along with sampling efforts to determine if excavation of the contaminated soil (within the cleanup levels specified) have been reached. Once this determination has been made, the Contractor shall collect at a minimum, five samples from each individual excavation pit for confirmation analysis using SW 846 Methods for nitroaromatics, metals, PCBs and PAHs, (if required). These samples shall be collected, preserved and shipped by the Contractor in accordance with the procedure discussed in the Sampling and Analysis Plans as well as the Plan of Operations. One shall be taken from each of the sidewalls near the midpoint of the excavation and at the floor near the midpoint of the excavation. For those areas where the length exceeds 20 - 25', 2 samples shall be taken along the length (whether this is on a side wall or on the floor). If the walls are longer than 50', then a sample shall be taken within each 25' length in order to get representative samples along the wall length. The contractor may use the individual site

descriptions outlined in Task 3.6 to estimate the number of confirmatory samples needed. Also, depending on the landfill used, requirements for disposal may include additional testing (i.e., ignitability, reactivity, corrosivity). If the remaining soil is determined to still be contaminated, the Contractor shall contact USACE to outline the additional excavation proposed. The soil disposed of at the landfill is designated to be used as daily cover and reduced disposal rates will apply. The Erie County Landfill already has an agreement with Ohio EPA to accept PBOW TNTC area soils for this purpose. Therefore, the Contractor shall contact the landfill in order arrange for the soils to be used in this fashion and also use those reduced rates when preparing their proposal.

3.11 (Task 11) Preparation and Submission of Draft and Final Construction Completion Reports

The Contractor shall prepare a Construction Completion Report, which details everything occurring within the project efforts (i.e., in-house and field efforts in all areas). Because of the huge success with the format for draft and final TNT B and Pentolite Road Red Water Pond Summary Reports, the Contractor shall use their formats as an example. This draft / final reports shall include at a minimum the following: Introduction, Site Location and description, History, Regulatory History, Background Soils information, Construction Activities (site prep, excavation, treatment, stabilization disposal, erosion control, backfilling, grading and seeding, basically detail where the material was removed from; manifest detailing where the material was sent for disposal; where used for backfill (based on LDRs being met) and analytical results from confirmation sampling), Performance Standards and Construction QC (Cleanup standards, SAP, etc), Final Inspection checklists. For estimating and preparation efforts, the Contractor will be provided the above examples either by CD or on the USACE LRH ftp site (with which the Contractor is familiar). The Contractor is only expected to address those items that pertain to this project. Once the draft report has been generated, the Contractor shall submit it to USACE for review. Any comments arising from this review shall be incorporated by the Contractor into the final report. See Section 3.2 for QC review and documentation requirements. See Section 4.3 for reporting requirements.

3.12 (Task 12) Public Meeting Support

The Contractor shall support USACE technical manager and project manager during PBOW team and RAB / public meetings necessary to discuss the work defined by this contract. It is assumed a maximum of 4 meetings will be held to discuss the proposed work. The Contractor shall be responsible for preparing slides, handouts, and coordinating this public meeting. The Contractor shall place a notice in the local newspaper announcing the meeting and inviting the public to attend. The Contractor shall document the meeting minutes and supply these to the USACE Point of Contact (POC). The Contractor shall plan to give a presentation highlighting the requirements and results of this work.

3.13 (Task 13) Threatened / Endangered (T&E) Species Survey

A vegetation survey was conducted by Davey Resources in Sept 2000. No T&E species were identified at that time. However, during the 2000 survey, *Gentiana clause* (closed gentian) was located. At that time, closed gentian was listed as an Ohio potentially threatened species.

USACE felt it necessary to re-survey the TNTC area for T&E species in hopes of eliminating potential problems (i.e, work-stoppages for relocation or complete shut-down) should a species be encountered during construction activities.

Based on the September 2009 re-survey effort by Davey Resource Group, Todd Crandall, the TNTC area currently contains mostly moderate to dense shrub thickets with scattered trees. There are also a few forested areas, and some areas of upland old field, primarily associated with roads, buildings and formerly disturbed areas. The areas of greatest plant species diversity occur in some of the old fields. The dense cover of shrubs over most of the site has prevented a high quality herbaceous layer from becoming established. During the September 2009 survey, the closed gentian could not be relocated. Based on Mr. Crandall's survey efforts, no T&E species were located within the TNTC area and therefore does not pose an issue during the construction efforts.

4.0 Contractor Submittals / Schedule / Reporting / Other

4.1 Contractor Submittals

The Contractor shall furnish originals and copies of the work plans and response to comments in the quantities below. A written response to all comments shall also be prepared by the Contractor and included in the final submittal document. Submittals are as follows:

Draft and Final QCP, SSHP and Plan of Operations – 8 draft and 6 final copies of each plan to USACE

Draft and Final Construction Completion Reports – 8 draft and 6 final copies to USACE

Addresses for submittals:

U.S. Army Corps of Engineers
Huntington District
502 Eighth Street
Huntington, WV 25701-2070
ATTN: CELRH-EC-CE (Lisa A. Humphreys)

4.2 Due Dates, Contractor Submittals and Action Items

Contractor Submittals / Action Items	No. Calendar Days
Contract Award	0

Submission of Draft QCP, SSHP and Plan of Operations	30 Days after Contract Award
Submission of Final QCP, SSHP and Plan of Operations	10 Days after approval of response to comments
Submission of Draft Construction Completion Report	510 days (17 months) after approval of Work Plans
Submission of Final Construction Completion Report	30 days after approval of response to comments

4.3 Work Plans and Reports

All work plans presenting data, analyses, recommendations, and drawings shall be prepared in a standard format for reports, as described herein. The Contractor shall submit copies of the draft and final versions of the work plans using MS Word. A CD ROM containing the text and drawings will be submitted along with the final work plan. A decimal paragraphing system shall be used. All site drawings shall be done in English units and of engineering quality with sufficient detail to show interrelations of major features on the site map (i.e. north arrows, keys, scales, etc.). When drawings are required, data may be combined to reduce the number of drawings, however, the drawings are not to be congested to the point that sight of the detail is lost. All drawings included in the reports shall be done on Microstation 95 or newest version, conform to the current USACE CADD Standards and shall be submitted to USACE along with the final work plan. The report shall consist of 8.5" by 11" pages with drawings folded, if necessary, to this size. If the Contractor must submit large drawings (42" by 29" size) folded to 8.5" by 11", use of top loading sheet protectors for the folded drawings will be required. The Draft and Final Work Plans shall be bound in three-ring binders and clearly labeled as "Draft" and "Final", respectively. Appendices in the work plans will be identified by tabs or other approved manner. A title page shall identify the title, the Contractor, the Corps of Engineer, Huntington District, and the date. Plastic photo holder sheets are to be used when including photos in report. All photos are to be digital color photos and properly labeled and put on a CD for storage. Plastic loose-leaf media files are to be used when submitting CD ROMS. Photo documentation for each of the individual sites shall be taken before and after construction activities. The final report shall be furnished in both working format (i.e., MS Word, Excel, Microstation) and Adobe .pdf format so that it can be included in the electronic Administrative Record and Public Repository.

4.4 Other

The Contractor shall maintain a file documenting all correspondence, phone conversations, and meetings with the USACE and other elements. It shall be bound in an appropriate folder and filed in reverse chronological order. This correspondence file shall be available for inspection at any

time by the USACE upon request and shall be submitted to the USACE upon the conclusion of this work order.

Additional responsibilities of the Contractor under this work order include, but are not limited to, the following items of work:

1) The use of water will be required to control dust during construction activities. The amount of dust resulting from the construction activities shall be controlled to prevent the spread of dust to occupied areas near the construction site and to avoid creation of a nuisance in the surrounding area. Use of water shall not be allowed to result in, or create, hazardous or objectionable conditions such as flooding and pollution.
2) The Contractor is responsible for ensuring traffic safety in all work areas. Flagmen, temporary signage or other approved means shall be provided by the Contractor as needed to comply with the above requirement.
3) The use of burning at the project site for disposal of refuse and debris will not be permitted.
4) The Contractor shall have the following items on-site and available at any time: 1) SSHP, 2) QCP and 3) Plan of Operation.
5) The Contractor shall obtain all permits, licenses, and maintain these documents at the project site where work is to be performed and have such documents readily available. The Contractor shall insure that he meets all Federal, State and Local requirements for the safe removal, containment, hauling and disposal of materials related to the project activities.
6) Compliance with the provisions of this SOW by subcontractors will be the responsibility of the Contractor.
7) The Contractor shall ensure that road repair is included for this work effort. In the past, road repair was necessary due to the weight of the trucks used as well as the bad weather encountered during winter/spring construction efforts. The Contractor shall only replace the road sections that have been damaged by these construction efforts and only repair to the state they were originally in (not a betterment) prior to these construction efforts. The Contractor shall ensure that the trucks used during hauling efforts to/from AOCs as well as for disposal and backfill operations obey speed limits both off and on-site. Trucks must maintain adequate turning speeds on-site so as not to create conditions for road damage.
8) The Contractor shall backfill excavation areas with suitable soil (similar to what was removed from that area except not contaminated) that will allow native vegetative plants to be replanted and grow. The Contractor shall work with John Blakeman, Prairie Biologist knowledgeable in native grasses at PBOW, to verify which plants will be planted in the TNTC area once excavation activities are complete. The Contractor shall make sure the seeding is done in the appropriate time of the year as to have a successful growing season. In past PBOW seeding efforts, Indian Grasses were used.

5.0 Payment

Construction work shall be negotiated as a lump sum to be billable periodically in accordance with the payments clause. This will include provision of documentation prior to payment as well as inspection of site for verification of activities performed. Upon construction completion, if it is determined that certain activities have not been performed or constructed, then costs for those shall not be billed by the Contractor.

6.0 Public Affairs

The Contractor shall not make available to the news media or publicly disclose any data generated or reviewed under this contract. When approached by the news media, the Contractor shall refer them to the USACE Contracting Officer (CO) for response. Reports and data generated under this contract shall become the property of the Government and distribution to any other source by the Contractor, unless authorized by the CO is prohibited.

7.0 Point of Contact

The Contractor shall supply USACE a point-of-contact to facilitate communications. USACE's point-of-contact for the work is:

USACE, Huntington District
502 8th Street
Huntington, WV 25701-2070
Attn: CELRH-EC-CE, Lisa Humphreys
Office: (304) 399-5953
Cell: (304) 617-1461
Email: lisa.a.humphreys@usace.army.mil
Fax: (304) 399-5549

8.0 Reference Documents

Due to the large size of these documents, they have been placed on the USACE Huntington District DERP-FUDS PBOW website.

8.1 TNT Areas A and C Remedial Investigation, Volume 1 – Report of Findings, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, IT Corporations, USACE, November 2001.

8.2 TNT Areas A and C Remedial Investigation, Volume 2 – Human Health Risk Assessment, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, IT Corporations, USACE, November 2001.

8.3 TNT Areas A and C Remedial Investigation, Volume 3 – Ecological Risk Assessment, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, IT Corporations, USACE, November 2001.

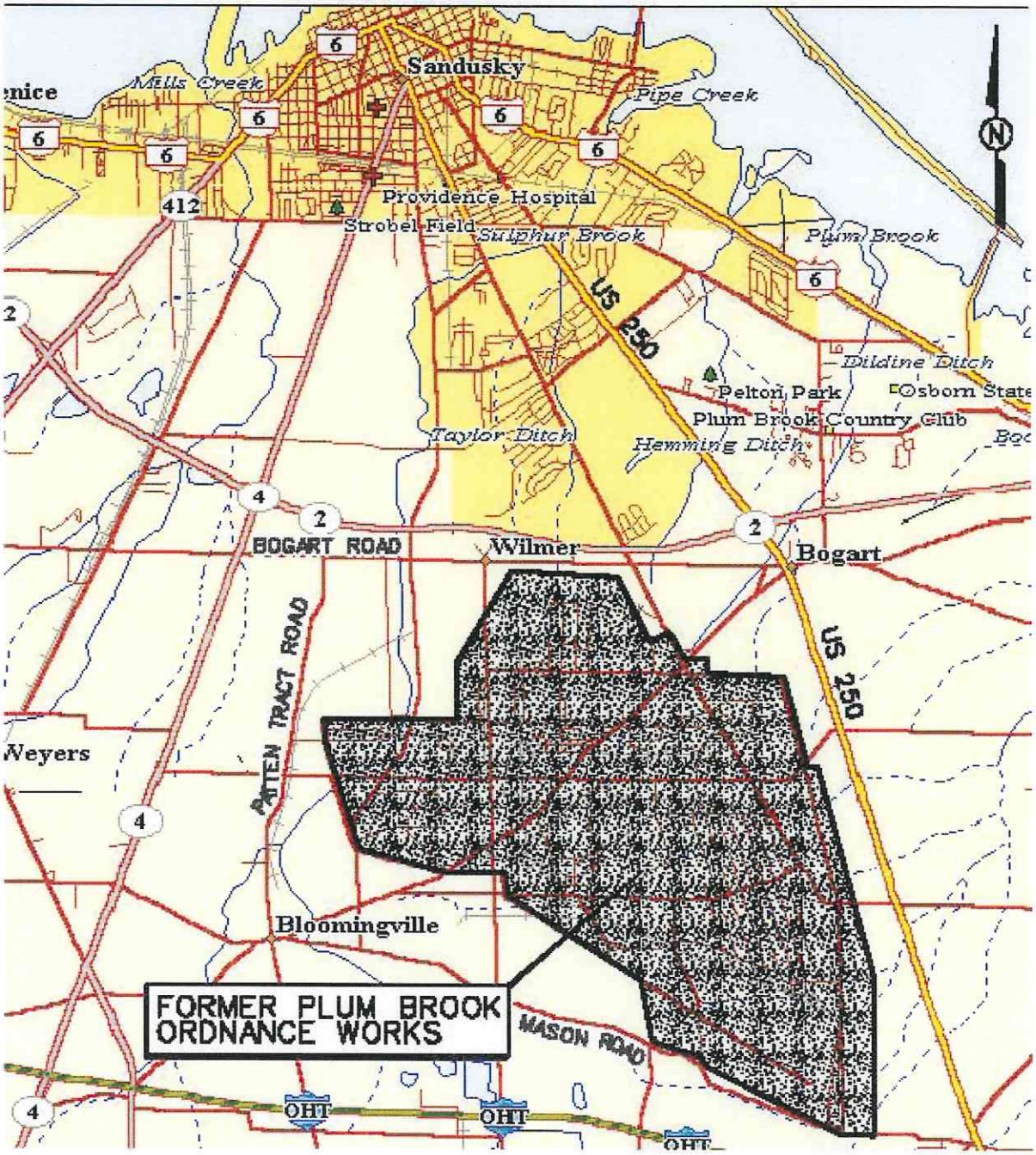
8.4 TNT Areas A and C Remedial Investigation, Volume 4 – Focused Feasibility Study for Soil and Sediment, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, Shaw Environmental Inc., USACE, October 2003.

8.5 Addendum, TNT Area C, Focused Feasibility Study for Soil and Sediment, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, Shaw Environmental Inc., USACE, January 2009.

8.6 Proposed Plan for Soils and Sediments, TNT Area C, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, Shaw Environmental Inc., USACE, January 2009.

8.7 Decision Document for Soils and Sediments, TNT Area C, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, Shaw Environmental Inc., USACE, November 2009.

Appendix B Site Maps



NOT TO SCALE

FIGURE 2-1
VICINITY MAP

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

STARTING DATE: 06/22/05	DATE LAST REV.:	DRAFT. CHCK. BY:	INITIATOR: T. SIARD	807111_011.dgn
DRAWN BY: D. BOMAR	DRAWN BY:	ENGR. CHCK. BY: T. SIARD	PROJ. MGR.: S. DOWNEY	PROJ. NO.: 807111

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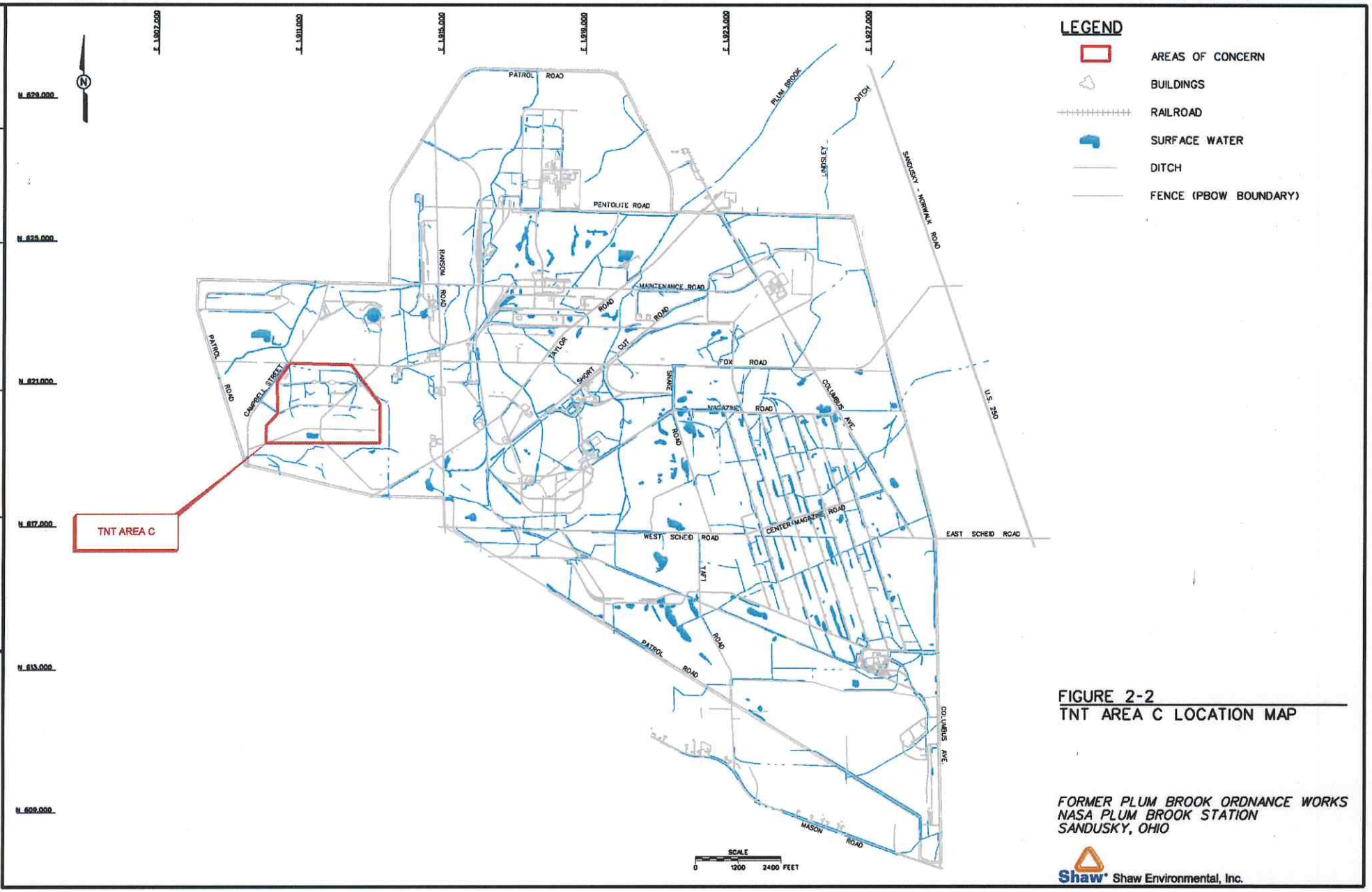

FIGURE 2-2
TNT AREA C LOCATION MAP

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

STARTING DATE: 06/16/05	DATE LAST REV.:	DRAFT. CHCK. BY:	INITIATOR: T. SIARD
DRAWN BY: D. BOMAR	DRAWN BY:	ENGR. CHCK. BY: T. SIARD	PROJ. MGR.: S. DOWNEY
			DWG. NO.: 807111_012.dgn
			PROJ. NO.: 807111

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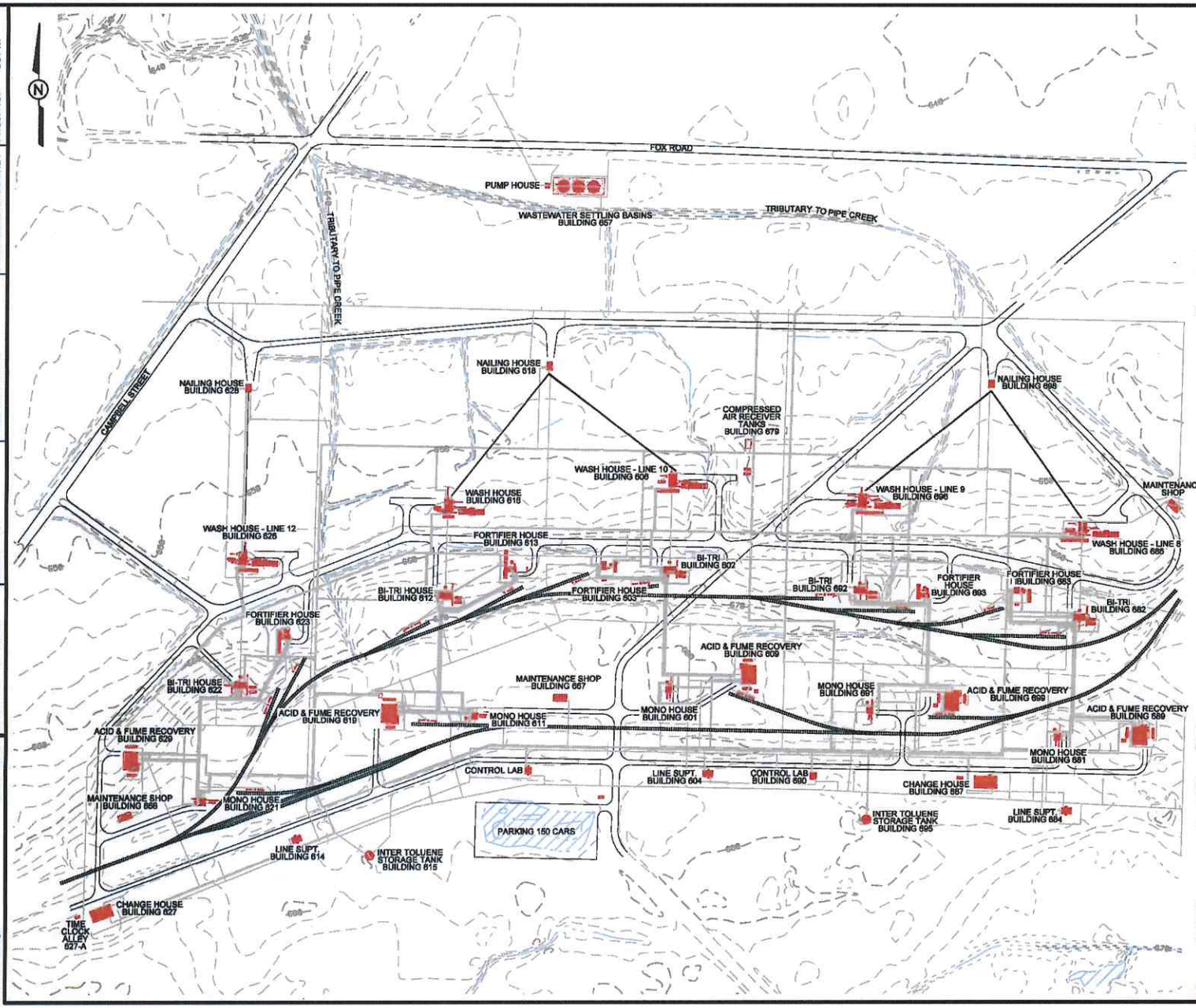

LEGEND

- DRAINAGE
- LOW, WET AREA
- STONE-LINED DRAINAGE DITCH
- ROAD
- HISTORICAL BUILDING OR STRUCTURE
- TANK
- HISTORICAL PROCESS LINE
- TOPOGRAPHIC CONTOUR LINE (FEET-MSL)
- RAILROAD

SCALE

0 300 600 FEET

FIGURE 2-3
TNT AREA C
GENERAL SITE FEATURES MAP

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

STARTING DATE: 6/22/05	DATE LAST REV.:	DRAFT. CHCK. BY:	INITIATOR: T. SIARD
DRAWN BY: D. BOMAR	DRAWN BY:	ENGR. CHCK. BY:	PROJ. MGR.: S. DOWNEY
			DWG. NO.: 807111_013.dgn
			PROJ. NO.: 807111

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DWG. NO.: 807112es.062
PROJ. NO.: 807112
INITIATOR: T. SIARD
PROJ. MGR.: S. DOWNEY
DRAFT. CHCK. BY: C. TUMLIN
ENGR. CHCK. BY: T. SIARD
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 10/22/02
DRAWN BY: B.VANDERGRIFF
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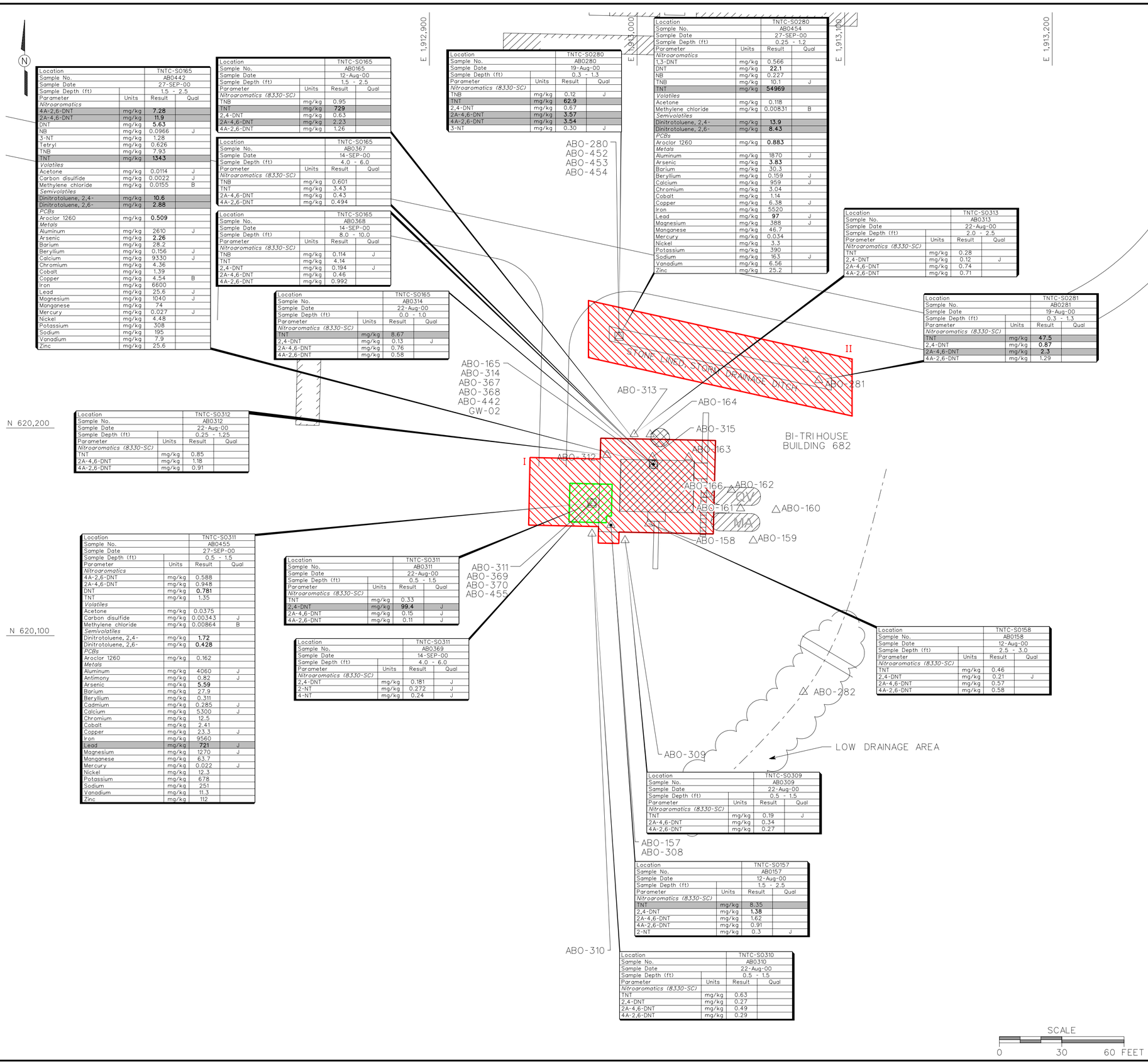


Location		TNTC-S0165	
Sample No.		AB0442	
Sample Date		27-SEP-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**7.28**	
2A-4,6-DNT	mg/kg	**11.9**	
DNT	mg/kg	**5.63**	
NB	mg/kg	0.0966	J
3-NT	mg/kg	1.28	
Tetryl	mg/kg	0.626	
TNB	mg/kg	7.93	
TNT	mg/kg	**1343**	
Volatiles			
Acetone	mg/kg	0.0114	J
Carbon disulfide	mg/kg	0.0022	J
Methylene chloride	mg/kg	0.0155	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**10.6**	
Dinitrotoluene, 2,6-	mg/kg	**2.88**	
PCBs			
Aroclor 1260	mg/kg	**0.509**	
Metals			
Aluminum	mg/kg	2610	J
Arsenic	mg/kg	**2.26**	
Barium	mg/kg	28.2	
Beryllium	mg/kg	0.156	J
Calcium	mg/kg	9330	J
Chromium	mg/kg	4.36	
Cobalt	mg/kg	1.39	
Copper	mg/kg	4.54	B
Iron	mg/kg	6600	
Lead	mg/kg	25.6	J
Magnesium	mg/kg	1040	J
Manganese	mg/kg	74	
Mercury	mg/kg	0.027	J
Nickel	mg/kg	4.48	
Potassium	mg/kg	308	
Sodium	mg/kg	195	
Vanadium	mg/kg	7.9	
Zinc	mg/kg	25.6	

Location		TNTC-S0165	
Sample No.		AB0165	
Sample Date		12-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.95	
TNT	mg/kg	**729**	
2,4-DNT	mg/kg	0.63	
2A-4,6-DNT	mg/kg	2.23	
4A-2,6-DNT	mg/kg	1.26	

Location		TNTC-S0165	
Sample No.		AB0367	
Sample Date		14-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.601	
TNT	mg/kg	3.43	
2A-4,6-DNT	mg/kg	0.43	
4A-2,6-DNT	mg/kg	0.494	

Location		TNTC-S0165	
Sample No.		AB0368	
Sample Date		14-SEP-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.114	J
TNT	mg/kg	4.14	
2,4-DNT	mg/kg	0.194	J
2A-4,6-DNT	mg/kg	0.46	
4A-2,6-DNT	mg/kg	0.992	

Location		TNTC-S0165	
Sample No.		AB0314	
Sample Date		22-Aug-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	8.67	
2,4-DNT	mg/kg	0.13	J
2A-4,6-DNT	mg/kg	0.76	
4A-2,6-DNT	mg/kg	0.58	

Location		TNTC-S0280	
Sample No.		AB0280	
Sample Date		19-Aug-00	
Sample Depth (ft)		0.3 - 1.3	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.12	J
TNT	mg/kg	**62.9**	
2,4-DNT	mg/kg	0.67	
2A-4,6-DNT	mg/kg	**3.57**	
4A-2,6-DNT	mg/kg	**3.54**	
3-NT	mg/kg	0.30	J

Location		TNTC-S0280	
Sample No.		AB0454	
Sample Date		27-SEP-00	
Sample Depth (ft)		0.25 - 1.2	
Parameter	Units	Result	Qual
Nitroaromatics			
1,3-DNT	mg/kg	0.566	
DNT	mg/kg	**22.1**	
NB	mg/kg	0.227	
TNB	mg/kg	10.1	J
TNT	mg/kg	**54969**	
Volatiles			
Acetone	mg/kg	0.118	
Methylene chloride	mg/kg	0.00831	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**13.9**	
Dinitrotoluene, 2,6-	mg/kg	**8.43**	
PCBs			
Aroclor 1260	mg/kg	**0.883**	
Metals			
Aluminum	mg/kg	1870	J
Arsenic	mg/kg	**3.83**	
Barium	mg/kg	30.3	
Beryllium	mg/kg	0.159	J
Calcium	mg/kg	959	J
Chromium	mg/kg	3.04	
Cobalt	mg/kg	1.14	
Copper	mg/kg	6.38	J
Iron	mg/kg	5520	
Lead	mg/kg	**97**	J
Magnesium	mg/kg	388	J
Manganese	mg/kg	46.7	
Mercury	mg/kg	0.034	
Nickel	mg/kg	3.3	
Potassium	mg/kg	390	
Sodium	mg/kg	163	J
Vanadium	mg/kg	6.56	
Zinc	mg/kg	25.2	

Location		TNTC-S0313	
Sample No.		AB0313	
Sample Date		22-Aug-00	
Sample Depth (ft)		2.0 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.28	
2,4-DNT	mg/kg	0.12	J
2A-4,6-DNT	mg/kg	0.74	
4A-2,6-DNT	mg/kg	0.71	

Location		TNTC-S0281	
Sample No.		AB0281	
Sample Date		19-Aug-00	
Sample Depth (ft)		0.3 - 1.3	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	**47.5**	
2,4-DNT	mg/kg	**0.87**	
2A-4,6-DNT	mg/kg	**2.3**	
4A-2,6-DNT	mg/kg	1.29	

Location		TNTC-S0312	
Sample No.		AB0312	
Sample Date		22-Aug-00	
Sample Depth (ft)		0.25 - 1.25	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.85	
2A-4,6-DNT	mg/kg	1.18	
4A-2,6-DNT	mg/kg	0.91	

Location		TNTC-S0311	
Sample No.		AB0455	
Sample Date		27-SEP-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.588	
2A-4,6-DNT	mg/kg	0.948	
DNT	mg/kg	**0.781**	
TNT	mg/kg	1.35	
Volatiles			
Acetone	mg/kg	0.0375	
Carbon disulfide	mg/kg	0.00343	J
Methylene chloride	mg/kg	0.00864	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**1.72**	
Dinitrotoluene, 2,6-	mg/kg	**0.428**	
PCBs			
Aroclor 1260	mg/kg	0.162	
Metals			
Aluminum	mg/kg	4060	J
Antimony	mg/kg	0.82	J
Arsenic	mg/kg	**5.59**	
Barium	mg/kg	27.9	
Beryllium	mg/kg	0.311	
Cadmium	mg/kg	0.285	J
Calcium	mg/kg	5300	J
Chromium	mg/kg	12.5	
Cobalt	mg/kg	2.41	
Copper	mg/kg	23.3	J
Iron	mg/kg	9560	
Lead	mg/kg	**721**	J
Magnesium	mg/kg	1270	J
Manganese	mg/kg	63.7	
Mercury	mg/kg	0.022	J
Nickel	mg/kg	12.3	
Potassium	mg/kg	678	
Sodium	mg/kg	251	
Vanadium	mg/kg	11.3	
Zinc	mg/kg	112	

Location		TNTC-S0311	
Sample No.		AB0311	
Sample Date		22-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.33	
2,4-DNT	mg/kg	**99.4**	J
2A-4,6-DNT	mg/kg	0.15	J
4A-2,6-DNT	mg/kg	0.11	J

Location		TNTC-S0311	
Sample No.		AB0369	
Sample Date		14-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.181	J
2-NT	mg/kg	0.272	J
4-NT	mg/kg	0.24	J

Location		TNTC-S0158	
Sample No.		AB0158	
Sample Date		12-Aug-00	
Sample Depth (ft)		2.5 - 3.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.46	
2,4-DNT	mg/kg	0.21	J
2A-4,6-DNT	mg/kg	0.57	
4A-2,6-DNT	mg/kg	0.58	

Location		TNTC-S0309	
Sample No.		AB0309	
Sample Date		22-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.19	J
2A-4,6-DNT	mg/kg	0.34	
4A-2,6-DNT	mg/kg	0.27	

Location		TNTC-S0157	
Sample No.		AB0157	
Sample Date		12-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	8.35	
2,4-DNT	mg/kg	**1.38**	
2A-4,6-DNT	mg/kg	1.62	
4A-2,6-DNT	mg/kg	0.91	
2-NT	mg/kg	0.3	J

Location		TNTC-S0310	
Sample No.		AB0310	
Sample Date		22-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.63	
2,4-DNT	mg/kg	0.27	
2A-4,6-DNT	mg/kg	0.49	
4A-2,6-DNT	mg/kg	0.29	

LEGEND:

- △ ABO-157 — SCREENING SOIL SAMPLING LOCATION
- • ABO-308 — SURFACE SOIL SAMPLE (0 - 2 FT)
- ○ GW-02 — GROUNDWATER SAMPLING LOCATION
- □ ABO-455 — CONFIRMATION SOIL SAMPLING LOCATION
- FORMER TANK LOCATION
- FORMER BUILDING LOCATION
- FIRE HYDRANT
- POTENTIAL NITROAROMATIC REMEDIATION AREA
- POTENTIAL LEAD REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 PRELIMINARY REMEDIATION GOALS ARE SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0157	1.5 - 2.5
AB0158	2.5 - 3.5
AB0159	1.0 - 2.0
AB0160	0.5 - 1.5
AB0161	1.0 - 2.0
AB0162	1.0 - 2.0
AB0163	1.5 - 2.5
AB0164	1.5 - 2.5
AB0165	1.5 - 2.5
AB0166	1.5 - 1.8
AB0280	0.25 - 1.25
AB0281	0.25 - 1.25
AB0282	0.25 - 1.25
AB0308	0.0 - 1.0
AB0309	0.5 - 1.5
AB0310	0.5 - 1.5
AB0311	0.5 - 1.5
AB0312	0.25 - 1.5
AB0313	2.0 - 2.5
AB0314	0.0 - 1.0
AB0315	0.25 - 1.25
AB0367	4.0 - 6.0
AB0368	8.0 - 10.0
AB0369	4.0 - 6.0
AB0370	8.0 - 10.0
AB0442	1.5 - 2.5
AB0452	0.25 - 1.25
AB0453	0.25 - 1.25
AB0454	0.25 - 1.25
AB0455	0.5 - 1.5

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	3644	4	540
II	763	5*	141
	2885	8*	855
TOTAL	7292		1536

* VERTICAL DEPTH 5 FEET FROM DRAINAGE DITCH SURFACE, 8 FEET FROM GROUND SURFACE.

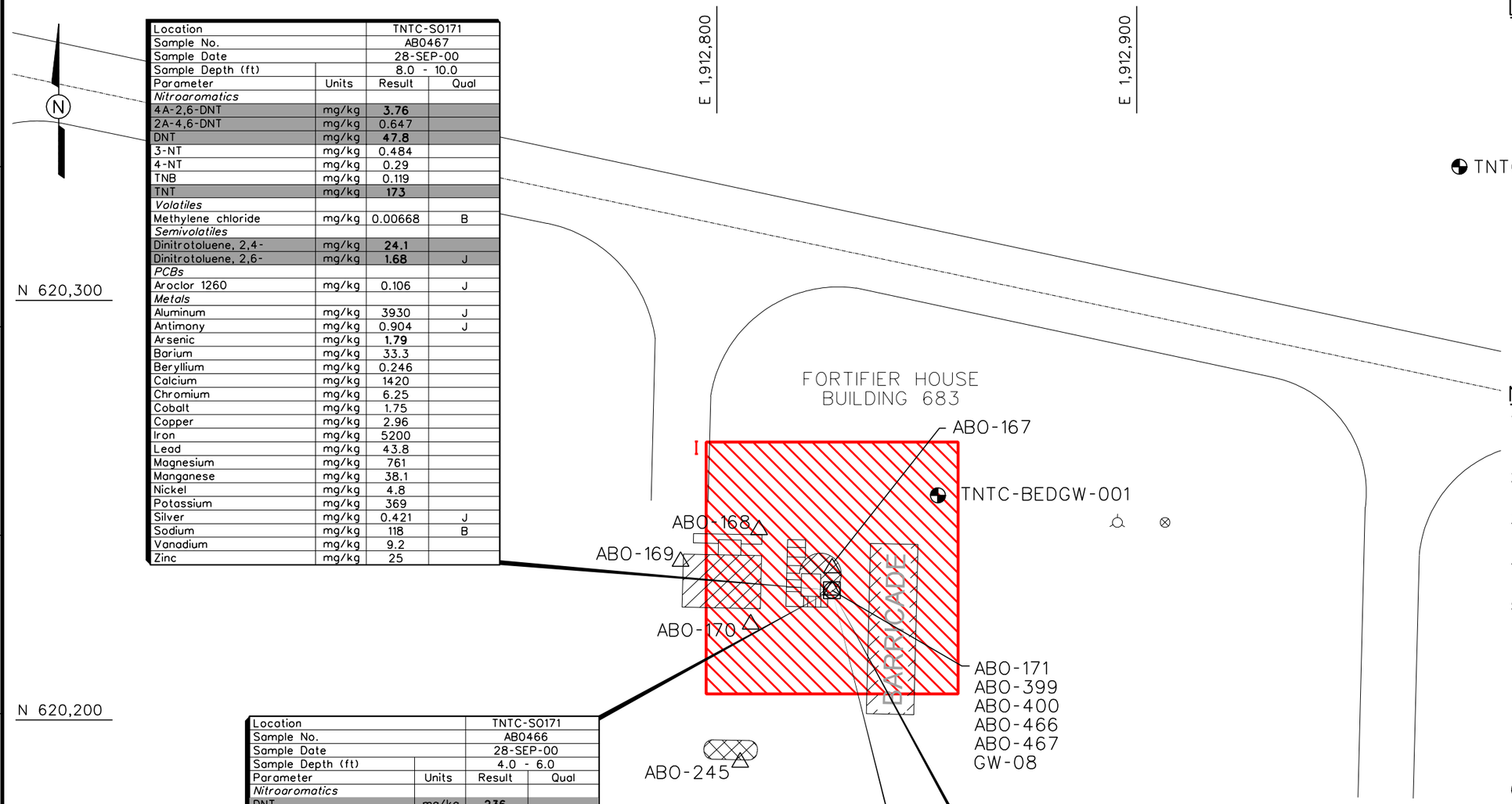
8. GROUNDWATER ENCOUNTERED IN SEPTEMBER 2000 BORING C-369/370 AT 8 FEET.

   GROUNDWATER MEASURED IN GW-02 A DEPTH OF 9.57 FEET OCTOBER 10, 2000. BEDROCK ENCOUNTERED AT 15 FEET IN GW-02 BORING.

FIGURE 1-20
TNT AREA C
BUILDING 682 BI-TRIHOUSE
ANALYTICAL RESULTS AND
ESTIMATED AREA/VOLUME OF
SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.



Location		TNTC-S0171	
Sample No.		AB0467	
Sample Date		28-SEP-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**3.76**	
2A-4,6-DNT	mg/kg	0.647	
DNT	mg/kg	**47.8**	
3-NT	mg/kg	0.484	
4-NT	mg/kg	0.29	
TNB	mg/kg	0.119	
TNT	mg/kg	**173**	
Volatiles			
Methylene chloride	mg/kg	0.00668	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**24.1**	
Dinitrotoluene, 2,6-	mg/kg	**1.68**	J
PCBs			
Aroclor 1260	mg/kg	0.106	J
Metals			
Aluminum	mg/kg	3930	J
Antimony	mg/kg	0.904	J
Arsenic	mg/kg	**1.79**	
Barium	mg/kg	33.3	
Beryllium	mg/kg	0.246	
Calcium	mg/kg	1420	
Chromium	mg/kg	6.25	
Cobalt	mg/kg	1.75	
Copper	mg/kg	2.96	
Iron	mg/kg	5200	
Lead	mg/kg	43.8	
Magnesium	mg/kg	761	
Manganese	mg/kg	38.1	
Nickel	mg/kg	4.8	
Potassium	mg/kg	369	
Silver	mg/kg	0.421	J
Sodium	mg/kg	118	B
Vanadium	mg/kg	9.2	
Zinc	mg/kg	25	

Location		TNTC-S0171	
Sample No.		AB0466	
Sample Date		28-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics			
DNT	mg/kg	**236**	
NB	mg/kg	0.0963	J
TNB	mg/kg	0.146	
TNT	mg/kg	**448**	
Volatiles			
Carbon disulfide	mg/kg	0.00337	J
Methylene chloride	mg/kg	0.00625	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**275**	
Dinitrotoluene, 2,6-	mg/kg	**23.8**	J
PCBs			
Aroclor 1260	mg/kg	0.0768	J
Metals			
Aluminum	mg/kg	3150	J
Arsenic	mg/kg	**1.77**	
Barium	mg/kg	31.9	
Beryllium	mg/kg	0.203	J
Calcium	mg/kg	1430	
Chromium	mg/kg	5.24	
Cobalt	mg/kg	1.37	
Copper	mg/kg	1.36	
Iron	mg/kg	4310	
Lead	mg/kg	8.8	
Magnesium	mg/kg	658	
Manganese	mg/kg	33.7	
Nickel	mg/kg	3.72	
Potassium	mg/kg	242	
Sodium	mg/kg	249	B
Vanadium	mg/kg	8.01	
Zinc	mg/kg	23.9	

Location		TNTC-S0171	
Sample No.		AB0399	
Sample Date		16-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	**18.2**	
2A-4,6-DNT	mg/kg	1.45	
4A-2,6-DNT	mg/kg	1.53	
3-NT	mg/kg	0.597	

Location		TNTC-S0171	
Sample No.		AB0400	
Sample Date		16-SEP-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.249	
TNT	mg/kg	**16.4**	
2A-4,6-DNT	mg/kg	2.05	
4A-2,6-DNT	mg/kg	2.86	

SCALE

0 30 60 FEET

LEGEND:

- △ ABO-167 — SCREENING SOIL SAMPLING LOCATION
- ○ GW-08 — GROUNDWATER SAMPLING LOCATION
- □ ABO-466 — CONFIRMATION SOIL SAMPLING LOCATION
- ◐ TNTC-BEDGW-001 — BEDROCK MONITORING WELL LOCATION
- FORMER TANK LOCATION
- FORMER BUILDING LOCATION
- FIRE HYDRANT
- ⊗ WATER CONTROL VALVE
- POTENTIAL NITROAROMATIC REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 REMEDIATION GOAL OBJECTIVES ARE SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0167	0.5 - 1.0
AB0168	1.0 - 2.0
AB0169	1.5 - 2.5
AB0170	1.0 - 1.5
AB0171	0.5 - 1.0
AB0245	1.0 - 2.0
AB0399	4.0 - 6.0
AB0400	8.0 - 10.0
AB0466	4.0 - 6.0
AB0467	8.0 - 10.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	3600	9	1200

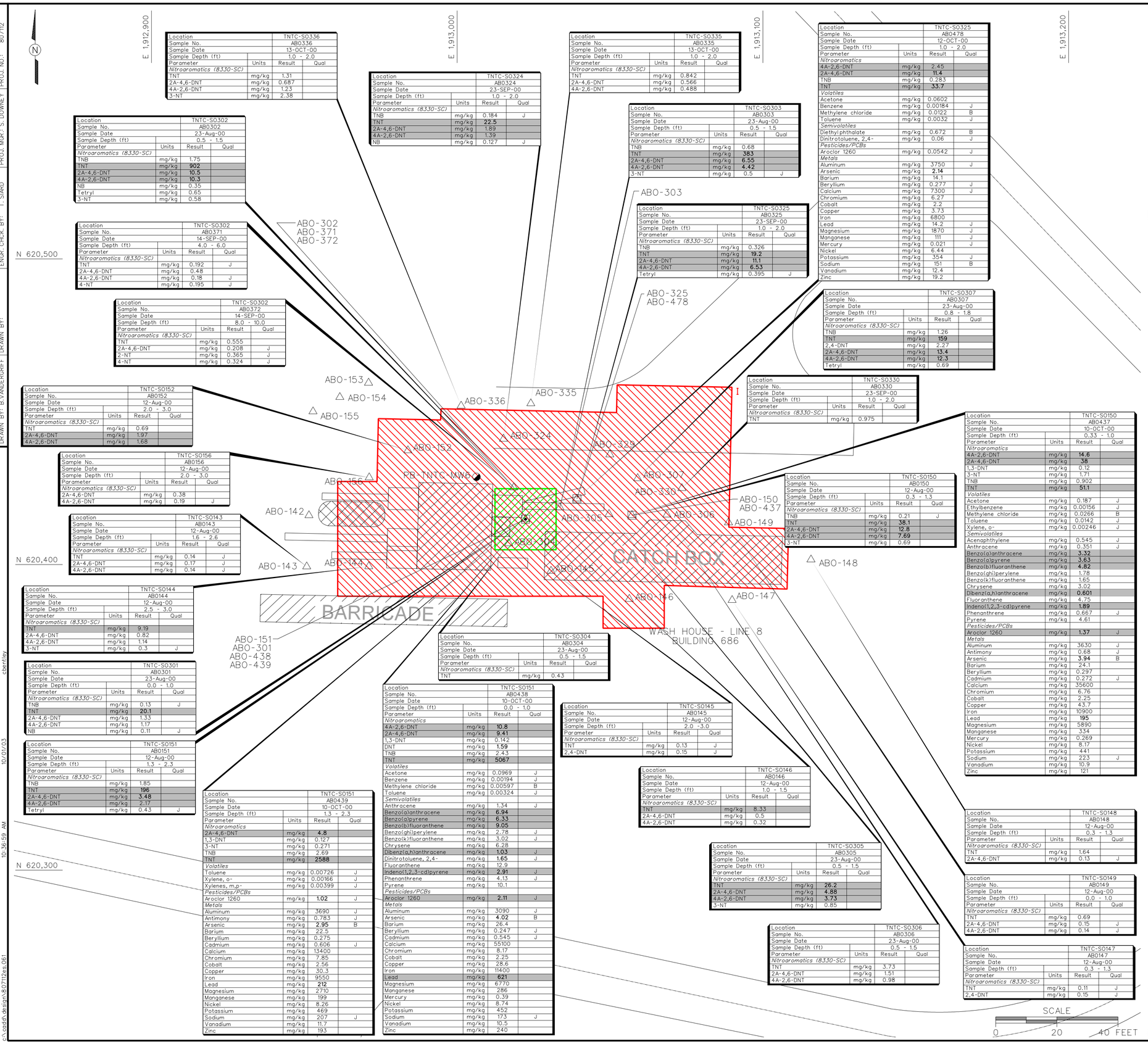
8. GROUNDWATER ENCOUNTERED IN SEPTEMBER 2000 BORING C-399/400 AT 9 FEET.

FIGURE 1-21
TNT AREA C
BUILDING 683 FORTIFIER HOUSE ANALYTICAL RESULTS AND ESTIMATED AREA/VOLUME OF SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

DWG. NO.:...\807112es.063 PROJ. NO.: 807112
INITIATOR: T. SIARD PROJ. MGR.: S. DOWNEY
DRAFT. CHCK. BY: C. TUMLIN ENGR. CHCK. BY: T. SIARD
REV.: DRAWN BY:
DATE LAST
STARTING DATE: 10/18/02 DRAWN BY: B.VANDERGRIFF
12:32:46 PM 09/04/03
cbentley c:\cadd\design\807112es.063



Location		TNTC-S0336	
Sample No.		AB0336	
Sample Date		13-OCT-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.31	
2A-4,6-DNT	mg/kg	0.687	
4A-2,6-DNT	mg/kg	1.23	
3-NT	mg/kg	2.38	

Location		TNTC-S0324	
Sample No.		AB0324	
Sample Date		23-SEP-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.184	J
TNT	mg/kg	**22.5**	
2A-4,6-DNT	mg/kg	1.89	
4A-2,6-DNT	mg/kg	1.39	
NB	mg/kg	0.127	J

Location		TNTC-S0335	
Sample No.		AB0335	
Sample Date		13-OCT-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.842	
2A-4,6-DNT	mg/kg	0.566	
4A-2,6-DNT	mg/kg	0.488	

Location		TNTC-S0325	
Sample No.		AB0478	
Sample Date		12-OCT-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	2.45	
2A-4,6-DNT	mg/kg	**11.4**	
TNB	mg/kg	0.283	
TNT	mg/kg	**33.7**	
Volatiles			
Acetone	mg/kg	0.0602	
Benzene	mg/kg	0.00184	J
Methylene chloride	mg/kg	0.0122	B
Toluene	mg/kg	0.0032	J
Semivolatiles			
Diethylphthalate	mg/kg	0.672	B
Dinitrotoluene, 2,4-	mg/kg	0.06	J
Pesticides/PCBs			
Aroclor 1260	mg/kg	0.0542	J
Metals			
Aluminum	mg/kg	3750	J
Arsenic	mg/kg	**2.14**	
Barium	mg/kg	14.1	
Beryllium	mg/kg	0.277	J
Calcium	mg/kg	7300	J
Chromium	mg/kg	6.27	
Cobalt	mg/kg	2.2	
Copper	mg/kg	3.73	
Iron	mg/kg	6800	
Lead	mg/kg	14.2	J
Magnesium	mg/kg	1870	J
Manganese	mg/kg	111	J
Mercury	mg/kg	0.021	J
Nickel	mg/kg	6.44	
Potassium	mg/kg	354	J
Sodium	mg/kg	151	B
Vanadium	mg/kg	12.4	
Zinc	mg/kg	19.2	

Location		TNTC-S0302	
Sample No.		AB0302	
Sample Date		23-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	1.75	
TNT	mg/kg	**902**	
2A-4,6-DNT	mg/kg	**10.5**	
4A-2,6-DNT	mg/kg	**10.3**	
NB	mg/kg	0.35	
Tetryl	mg/kg	0.65	
3-NT	mg/kg	0.58	

Location		TNTC-S0303	
Sample No.		AB0303	
Sample Date		23-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.68	
TNT	mg/kg	**383**	
2A-4,6-DNT	mg/kg	**6.55**	
4A-2,6-DNT	mg/kg	**4.42**	
3-NT	mg/kg	0.5	J

Location		TNTC-S0302	
Sample No.		AB0371	
Sample Date		14-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.192	J
2A-4,6-DNT	mg/kg	0.48	
4A-2,6-DNT	mg/kg	0.18	J
4-NT	mg/kg	0.195	J

Location		TNTC-S0325	
Sample No.		AB0325	
Sample Date		23-SEP-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.326	
TNT	mg/kg	**19.2**	
2A-4,6-DNT	mg/kg	11.1	
4A-2,6-DNT	mg/kg	**6.53**	
Tetryl	mg/kg	0.395	J

Location		TNTC-S0307	
Sample No.		AB0307	
Sample Date		23-Aug-00	
Sample Depth (ft)		0.8 - 1.8	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	1.26	
TNT	mg/kg	**159**	
2,4-DNT	mg/kg	2.27	
2A-4,6-DNT	mg/kg	**13.4**	
4A-2,6-DNT	mg/kg	**12.3**	
Tetryl	mg/kg	0.69	

Location		TNTC-S0302	
Sample No.		AB0372	
Sample Date		14-SEP-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.555	
2A-4,6-DNT	mg/kg	0.208	J
2-NT	mg/kg	0.365	J
4-NT	mg/kg	0.324	J

Location		TNTC-S0330	
Sample No.		AB0330	
Sample Date		23-SEP-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.975	

Location		TNTC-S0152	
Sample No.		AB0152	
Sample Date		12-Aug-00	
Sample Depth (ft)		2.0 - 3.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.69	
2A-4,6-DNT	mg/kg	1.97	
4A-2,6-DNT	mg/kg	1.68	

Location		TNTC-S0150	
Sample No.		AB0437	
Sample Date		10-OCT-00	
Sample Depth (ft)		0.33 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**14.6**	
2A-4,6-DNT	mg/kg	**38**	
1,3-DNT	mg/kg	0.12	
3-NT	mg/kg	1.71	
TNB	mg/kg	0.902	
TNT	mg/kg	**51.1**	
Volatiles			
Acetone	mg/kg	0.187	J
Ethylbenzene	mg/kg	0.00156	J
Methylene chloride	mg/kg	0.0266	B
Toluene	mg/kg	0.0142	J
Xylene, o-	mg/kg	0.00246	J
Semivolatiles			
Acenaphthylene	mg/kg	0.545	J
Anthracene	mg/kg	0.351	J
Benzo(a)anthracene	mg/kg	**3.32**	
Benzo(a)pyrene	mg/kg	**3.63**	
Benzo(b)fluoranthene	mg/kg	**4.82**	
Benzo(ghi)perylene	mg/kg	1.78	
Benzo(k)fluoranthene	mg/kg	1.65	
Chrysene	mg/kg	3.02	
Dibenz(a,h)anthracene	mg/kg	**0.601**	
Fluoranthene	mg/kg	4.75	
Indeno(1,2,3-cd)pyrene	mg/kg	**1.89**	
Phenanthrene	mg/kg	0.667	J
Pyrene	mg/kg	4.61	
Pesticides/PCBs			
Aroclor 1260	mg/kg	**1.37**	J
Metals			
Aluminum	mg/kg	3630	J
Antimony	mg/kg	0.68	J
Arsenic	mg/kg	**3.94**	B
Barium	mg/kg	24.1	
Beryllium	mg/kg	0.297	
Cadmium	mg/kg	0.272	J
Calcium	mg/kg	35600	
Chromium	mg/kg	6.76	
Cobalt	mg/kg	2.25	
Copper	mg/kg	43.7	
Iron	mg/kg	10900	
Lead	mg/kg	**195**	
Magnesium	mg/kg	5890	
Manganese	mg/kg	334	
Mercury	mg/kg	0.269	
Nickel	mg/kg	8.17	
Potassium	mg/kg	441	
Sodium	mg/kg	223	J
Vanadium	mg/kg	10.9	
Zinc	mg/kg	121	

Location		TNTC-S0156	
Sample No.		AB0156	
Sample Date		12-Aug-00	
Sample Depth (ft)		2.0 - 3.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	0.38	
4A-2,6-DNT	mg/kg	0.19	J

Location		TNTC-S0150	
Sample No.		AB0150	
Sample Date		12-Aug-00	
Sample Depth (ft)		0.3 - 1.3	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.21	J
TNT	mg/kg	**38.1**	
2A-4,6-DNT	mg/kg	**12.8**	
4A-2,6-DNT	mg/kg	**7.69**	
3-NT	mg/kg	0.69	

Location		TNTC-S0143	
Sample No.		AB0143	
Sample Date		12-Aug-00	
Sample Depth (ft)		1.6 - 2.6	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.14	J
2A-4,6-DNT	mg/kg	0.17	J
4A-2,6-DNT	mg/kg	0.14	J

Location		TNTC-S0144	
Sample No.		AB0144	
Sample Date		12-Aug-00	
Sample Depth (ft)		2.5 - 3.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	9.19	
2A-4,6-DNT	mg/kg	0.82	
4A-2,6-DNT	mg/kg	1.14	
3-NT	mg/kg	0.3	J

Location		TNTC-S0304	
Sample No.		AB0304	
Sample Date		23-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.43	

Location		TNTC-S0301	
Sample No.		AB0301	
Sample Date		23-Aug-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.13	J
TNT	mg/kg	**20.1**	
2A-4,6-DNT	mg/kg	1.33	
4A-2,6-DNT	mg/kg	1.17	
NB	mg/kg	0.11	J

Location		TNTC-S0151	
Sample No.		AB0151	
Sample Date		12-Aug-00	
Sample Depth (ft)		1.3 - 2.3	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	1.85	
TNT	mg/kg	**196**	
2A-4,6-DNT	mg/kg	**3.48**	
4A-2,6-DNT	mg/kg	2.17	
Tetryl	mg/kg	0.43	J

Location		TNTC-S0151	
Sample No.		AB0438	
Sample Date		10-OCT-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**10.8**	
2A-4,6-DNT	mg/kg	**9.41**	
1,3-DNT	mg/kg	0.142	
DNT	mg/kg	**1.59**	
TNB	mg/kg	2.43	
TNT	mg/kg	**5067**	
Volatiles			
Acetone	mg/kg	0.0969	J
Benzene	mg/kg	0.00194	J
Methylene chloride	mg/kg	0.00597	B
Toluene	mg/kg	0.00324	J
Semivolatiles			
Anthracene	mg/kg	1.34	J
Benzo(a)anthracene	mg/kg	**6.94**	
Benzo(a)pyrene	mg/kg	**6.33**	
Benzo(b)fluoranthene	mg/kg	**9.05**	
Benzo(ghi)perylene	mg/kg	2.78	J
Benzo(k)fluoranthene	mg/kg	3.02	J
Chrysene	mg/kg	6.28	
Dibenz(a,h)anthracene	mg/kg	**1.03**	J
Dinitrotoluene, 2,4-	mg/kg	**1.65**	J
Fluoranthene	mg/kg	12.9	
Indeno(1,2,3-cd)pyrene	mg/kg	**2.91**	J
Phenanthrene	mg/kg	4.13	J
Pyrene	mg/kg	10.1	
Pesticides/PCBs			
Aroclor 1260	mg/kg	**2.11**	J
Metals			
Aluminum	mg/kg	3090	J
Arsenic	mg/kg	**4.02**	B
Barium	mg/kg	26.4	
Beryllium	mg/kg	0.247	J
Cadmium	mg/kg	0.545	J
Calcium	mg/kg	55100	
Chromium	mg/kg	8.17	
Cobalt	mg/kg	2.25	
Copper	mg/kg	28.6	
Iron	mg/kg	11400	
Lead	mg/kg	**621**	
Magnesium	mg/kg	6770	
Manganese	mg/kg	286	
Mercury	mg/kg	0.39	
Nickel	mg/kg	8.74	
Potassium	mg/kg	452	
Sodium	mg/kg	173	J
Vanadium	mg/kg	10.5	
Zinc	mg/kg	240	

Location		TNTC-S0145	
Sample No.		AB0145	
Sample Date		12-Aug-00	
Sample Depth (ft)		2.0 -3.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.13	J
2,4-DNT	mg/kg	0.15	J

Location		TNTC-S0146	
Sample No.		AB0146	
Sample Date		12-Aug-00	
Sample Depth (ft)		1.0 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	8.33	
2A-4,6-DNT	mg/kg	0.5	
4A-2,6-DNT	mg/kg	0.32	

Location		TNTC-S0148	
Sample No.		AB0148	
Sample Date		12-Aug-00	
Sample Depth (ft)		0.3 - 1.3	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.64	
2A-4,6-DNT	mg/kg	0.13	J

Location		TNTC-S0305	
Sample No.		AB0305	
Sample Date		23-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	**26.2**	
2A-4,6-DNT	mg/kg	**4.88**	
4A-2,6-DNT	mg/kg	**3.73**	
3-NT	mg/kg	0.85	

Location		TNTC-S0149	
Sample No.		AB0149	
Sample Date		12-Aug-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.69	
2A-4,6-DNT	mg/kg	0.15	J
4A-2,6-DNT	mg/kg	0.14	J

Location		TNTC-S0306	
Sample No.		AB0306	
Sample Date		23-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	3.73	
2A-4,6-DNT	mg/kg	1.51	
4A-2,6-DNT	mg/kg	0.98	

Location		TNTC-S0147	
Sample No.		AB0147	
Sample Date		12-Aug-00	
Sample Depth (ft)		0.3 - 1.3	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.11	J
2,4-DNT	mg/kg	0.15	J

LEGEND:

- △ ABO-142 — SCREENING SOIL SAMPLING LOCATION
- • ABO-288 — SURFACE SOIL SAMPLE (0 - 2 FT)
- □ ABO-438 — CONFIRMATION SOIL SAMPLING LOCATION
- FORMER TANK LOCATION
- FORMER BUILDING LOCATION
- POTENTIAL NITROAROMATIC REMEDIATION AREA
- POTENTIAL LEAD/PCB REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 PRELIMINARY REMEDIATION GOALS ARE SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0142	2.0 - 3.0
AB0143	1.6 - 2.6
AB0144	2.5 - 3.0
AB0145	2.0 - 3.0
AB0146	1.0 - 1.5
AB0147	0.33 - 1.0
AB0148	0.33 - 1.0
AB0149	0.0 - 1.0
AB0150	0.33 - 1.0
AB0151	1.3 - 2.3
AB0152	2.0 - 3.0
AB0153	1.0 - 2.0
AB0154	1.0 - 2.0
AB0155	2.5 - 3.5
AB0156	2.0 - 3.0
AB0301	0.0 - 1.0
AB0302	0.5 - 1.5
AB0303	0.5 - 1.5
AB0304	0.5 - 1.5
AB0305	0.5 - 1.5
AB0306	0.5 - 1.5
AB0307	0.75 - 1.25
AB0324	1.0 - 2.0
AB0325	1.0 - 2.0
AB0329	1.0 - 2.0
AB0330	1.0 - 2.0
AB0335	1.0 - 2.0
AB0336	1.0 - 2.0
AB0371	4.0 - 6.0
AB0372	8.0 - 10.0
AB0437	0.3 - 1.0
AB0438	0.0 - 1.0
AB0439	1.3 - 2.3
AB0478	1.0 - 2.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	8277	4	1226

8. GROUNDWATER ENCOUNTERED AT 3 FEET IN SEPTEMBER 2000 C-371/372 BORING. DRILLED TO 10 FEET, BEDROCK NOT ENCOUNTERED.

   GROUNDWATER WAS ENCOUNTERED IN OVERBURDEN MONITORING WELL TNTC-MW06 AT 3.5 FEET DURING OCTOBER 1994 DRILLING. BEDROCK WAS DETECTED AT 12.2 FEET.

SCALE
0 20 40 FEET

FIGURE 1-22
TNT AREA C
BUILDING 686
WASH HOUSE LINE 8
ANALYTICAL RESULTS AND
ESTIMATED AREA/VOLUME OF
SOIL REQUIRING REMEDIATION

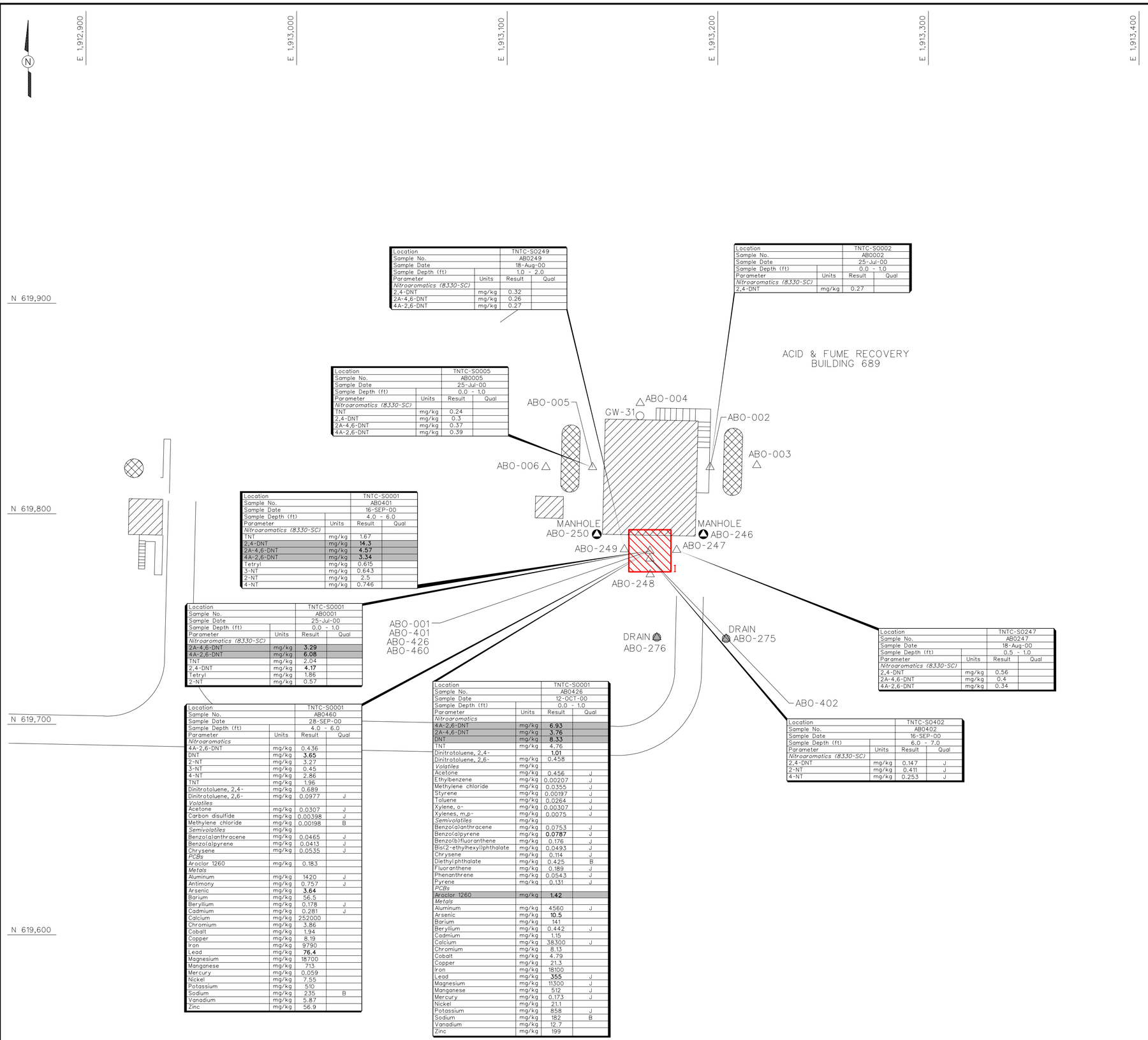
PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

DWG. NO.: 807112ES.061 | PROJ. NO.: 807112
INITIATOR: T. SIARD | PROJ. MGR.: S. DOWNEY
DRAFT. CHCK. BY: C. TUMLIN | T. SIARD
ENGR. CHCK. BY:
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 10/22/02
DRAWN BY: B.VANDERGRIFF

cbentley 10/01/03 10:36:59 AM c:\cadd\design\807112es.061

STARTING DATE: 10/22/02 | DATE LAST REV.: | DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: T. SIARD | DWG. NO.: 807112es.064
DRAWN BY: B.VANDERGRIFF | DRAWN BY: | ENGR. CHCK. BY: T. SIARD | PROJ. MGR.: S. DOWNEY | PROJ. NO.: 807112



Location		TNTC-S0249	
Sample No.		AB0249	
Sample Date		18-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.32	
2A-4,6-DNT	mg/kg	0.26	
4A-2,6-DNT	mg/kg	0.27	

Location		TNTC-S0002	
Sample No.		AB0002	
Sample Date		25-Jul-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.27	

Location		TNTC-S0005	
Sample No.		AB0005	
Sample Date		25-Jul-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.24	
2,4-DNT	mg/kg	0.3	
2A-4,6-DNT	mg/kg	0.37	
4A-2,6-DNT	mg/kg	0.39	

Location		TNTC-S0001	
Sample No.		AB0401	
Sample Date		16-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.67	
2,4-DNT	mg/kg	**14.3**	
2A-4,6-DNT	mg/kg	**4.57**	
4A-2,6-DNT	mg/kg	**3.34**	
Tetryl	mg/kg	0.615	
3-NT	mg/kg	0.643	
2-NT	mg/kg	2.5	
4-NT	mg/kg	0.746	

Location		TNTC-S0001	
Sample No.		AB0001	
Sample Date		25-Jul-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	**3.29**	
4A-2,6-DNT	mg/kg	**6.08**	
TNT	mg/kg	2.04	
2,4-DNT	mg/kg	**4.17**	
Tetryl	mg/kg	1.86	
2-NT	mg/kg	0.57	

Location		TNTC-S0247	
Sample No.		AB0247	
Sample Date		18-Aug-00	
Sample Depth (ft)		0.5 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.56	
2A-4,6-DNT	mg/kg	0.4	
4A-2,6-DNT	mg/kg	0.34	

Location		TNTC-S0402	
Sample No.		AB0402	
Sample Date		16-SEP-00	
Sample Depth (ft)		6.0 - 7.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.147	J
2-NT	mg/kg	0.411	J
4-NT	mg/kg	0.253	J

Location		TNTC-S0001	
Sample No.		AB0460	
Sample Date		28-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.436	
DNT	mg/kg	**3.65**	
2-NT	mg/kg	3.27	
3-NT	mg/kg	0.45	
4-NT	mg/kg	2.86	
TNT	mg/kg	1.96	
Dinitrotoluene, 2,4-	mg/kg	0.689	
Dinitrotoluene, 2,6-	mg/kg	0.0977	J
Volatiles			
Acetone	mg/kg	0.0307	J
Carbon disulfide	mg/kg	0.00398	J
Methylene chloride	mg/kg	0.00198	B
Semivolatiles	mg/kg		
Benzo(a)anthracene	mg/kg	0.0465	J
Benzo(a)pyrene	mg/kg	0.0413	J
Chrysene	mg/kg	0.0535	J
PCBs			
Aroclor 1260	mg/kg	0.183	
Metals			
Aluminum	mg/kg	1420	J
Antimony	mg/kg	0.757	J
Arsenic	mg/kg	**3.64**	
Barium	mg/kg	56.5	
Beryllium	mg/kg	0.178	J
Cadmium	mg/kg	0.281	J
Calcium	mg/kg	252000	
Chromium	mg/kg	3.86	
Cobalt	mg/kg	1.94	
Copper	mg/kg	8.19	
Iron	mg/kg	9790	
Lead	mg/kg	**76.4**	
Magnesium	mg/kg	18700	
Manganese	mg/kg	713	
Mercury	mg/kg	0.059	
Nickel	mg/kg	7.55	
Potassium	mg/kg	510	
Sodium	mg/kg	235	B
Vanadium	mg/kg	5.87	
Zinc	mg/kg	56.9	

Location		TNTC-S0001	
Sample No.		AB0426	
Sample Date		12-OCT-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**6.93**	
2A-4,6-DNT	mg/kg	**3.76**	
DNT	mg/kg	**8.33**	
TNT	mg/kg	4.76	
Dinitrotoluene, 2,4-		1.01	
Dinitrotoluene, 2,6-	mg/kg	0.458	
Volatiles	mg/kg		
Acetone	mg/kg	0.456	J
Ethylbenzene	mg/kg	0.00207	J
Methylene chloride	mg/kg	0.0355	J
Styrene	mg/kg	0.00197	J
Toluene	mg/kg	0.0264	J
Xylene, o-	mg/kg	0.00307	J
Xylenes, m,p-	mg/kg	0.0075	J
Semivolatiles	mg/kg		
Benzo(a)anthracene	mg/kg	0.0753	J
Benzo(a)pyrene	mg/kg	**0.0787**	J
Benzo(b)fluoranthene	mg/kg	0.176	J
Bis(2-ethylhexyl)phthalate	mg/kg	0.0493	J
Chrysene	mg/kg	0.114	J
Diethylphthalate	mg/kg	0.425	B
Fluoranthene	mg/kg	0.189	J
Phenanthrene	mg/kg	0.0543	J
Pyrene	mg/kg	0.131	J
PCBs			
Aroclor 1260	mg/kg	**1.42**	
Metals			
Aluminum	mg/kg	4560	J
Arsenic	mg/kg	**10.5**	
Barium	mg/kg	141	
Beryllium	mg/kg	0.442	J
Cadmium	mg/kg	1.15	
Calcium	mg/kg	38300	J
Chromium	mg/kg	8.13	
Cobalt	mg/kg	4.79	
Copper	mg/kg	21.3	
Iron	mg/kg	18100	
Lead	mg/kg	**35.5**	J
Magnesium	mg/kg	11300	J
Manganese	mg/kg	512	J
Mercury	mg/kg	0.173	J
Nickel	mg/kg	21.1	
Potassium	mg/kg	858	J
Sodium	mg/kg	182	B
Vanadium	mg/kg	12.7	
Zinc	mg/kg	199	

LEGEND:

△ ABO-001	SCREENING SOIL SAMPLING LOCATION
□ ABO-426	CONFIRMATION SOIL SAMPLE LOCATION
○ GW-03	GROUNDWATER SAMPLING LOCATION
	FORMER TANK LOCATION
	FORMER BUILDING LOCATION
	POTENTIAL NITROAROMATIC REMEDIATION AREA

NOTES:

1. ANALTYICAL RESULTS EXCEEDING REGION 9 REMEDIATION GOAL OBJECTIVES SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0001	0.0 - 1.0
AB0002	0.0 - 1.0
AB0003	0.0 - 1.0
AB0004	0.0 - 1.0
AB0005	0.0 - 1.0
AB0006	0.5 - 1.5
AB0246	2.5 - 3.0
AB0247	0.5 - 1.0
AB0248	0.5 - 1.0
AB0249	1.0 - 2.0
AB0250	2.5 - 3.5
AB0275	3.0 - 3.5
AB0276	2.0 - 2.5
AB0401	4.0 - 6.0
AB0402	6.0 - 7.0
AB0426	1.0 - 2.0
AB0460	4.0 - 6.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	400	8	119

8. GROUNDWATER AND BEDROCK ENCOUNTERED IN SEPTEMBER 2000 BORING C-401/402 AT 8 FEET (IT, 2001a).
9. AUGUST 2001 PROBE REFUSAL FOR TEMPORARY PIEZOMETER GW-31 AT 6 FEET. GROUNDWATER NOT ENCOUNTERED.

SCALE
0 30 60 FEET

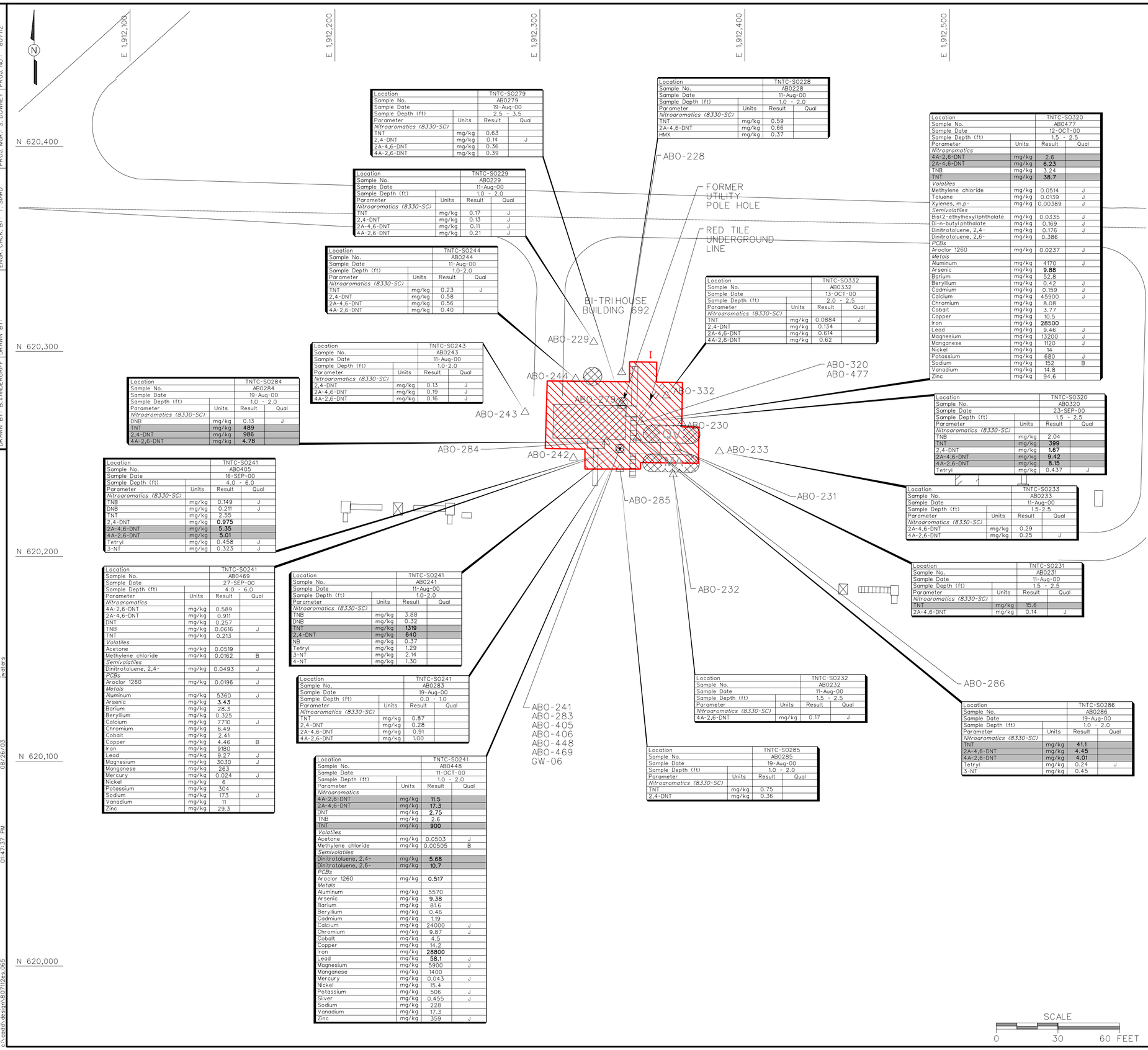
Shaw Environmental, Inc.

FIGURE 1-23
TNT AREA C
BUILDING 689 ACID & FUME RECOVERY
ANALYTICAL RESULTS AND ESTIMATED AREA/VOLUME OF SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

c:\cadd\design\807112es.064 08/26/03 01:42:55 PM jwaters

DWG. NO.: 807112es.065
PROJ. NO.: 807112
INITIATOR: T. SIARD
PROJ. MGR.: S. DOWNEY
DRAFT. CHCK. BY: C. TUMLIN
ENGR. CHCK. BY: T. SIARD
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 10/22/02
DRAWN BY: B.VANDERGRIFF



Location		TNTC-S0279	
Sample No.		AB0279	
Sample Date		19-Aug-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.63	
2,4-DNT	mg/kg	0.14	J
2A-4,6-DNT	mg/kg	0.36	
4A-2,6-DNT	mg/kg	0.39	

Location		TNTC-S0229	
Sample No.		AB0229	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.17	J
2,4-DNT	mg/kg	0.13	J
2A-4,6-DNT	mg/kg	0.11	J
4A-2,6-DNT	mg/kg	0.21	J

Location		TNTC-S0244	
Sample No.		AB0244	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0-2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.23	J
2,4-DNT	mg/kg	0.58	
2A-4,6-DNT	mg/kg	0.56	
4A-2,6-DNT	mg/kg	0.40	

Location		TNTC-S0243	
Sample No.		AB0243	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0-2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.13	J
2A-4,6-DNT	mg/kg	0.19	J
4A-2,6-DNT	mg/kg	0.16	J

Location		TNTC-S0284	
Sample No.		AB0284	
Sample Date		19-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
DNB	mg/kg	0.13	J
TNT	mg/kg	**489**	
2,4-DNT	mg/kg	**986**	
4A-2,6-DNT	mg/kg	**4.78**	

Location		TNTC-S0241	
Sample No.		AB0405	
Sample Date		16-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.149	J
DNB	mg/kg	0.211	J
TNT	mg/kg	2.55	
2,4-DNT	mg/kg	**0.975**	
2A-4,6-DNT	mg/kg	**5.35**	
4A-2,6-DNT	mg/kg	**5.01**	
Tetryl	mg/kg	0.458	J
3-NT	mg/kg	0.323	J

Location		TNTC-S0241	
Sample No.		AB0469	
Sample Date		27-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.589	
2A-4,6-DNT	mg/kg	0.911	
DNT	mg/kg	0.257	
TNB	mg/kg	0.0616	J
TNT	mg/kg	0.213	
Volatiles			
Acetone	mg/kg	0.0519	
Methylene chloride	mg/kg	0.0162	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	0.0493	J
PCBs			
Aroclor 1260	mg/kg	0.0196	J
Metals			
Aluminum	mg/kg	5360	J
Arsenic	mg/kg	**3.43**	
Barium	mg/kg	28.3	
Beryllium	mg/kg	0.325	
Calcium	mg/kg	7710	J
Chromium	mg/kg	6.49	
Cobalt	mg/kg	2.41	
Copper	mg/kg	4.46	B
Iron	mg/kg	9180	
Lead	mg/kg	9.27	J
Magnesium	mg/kg	3030	J
Manganese	mg/kg	263	
Mercury	mg/kg	0.024	J
Nickel	mg/kg	6	
Potassium	mg/kg	304	
Sodium	mg/kg	173	J
Vanadium	mg/kg	11	
Zinc	mg/kg	29.3	

Location		TNTC-S0241	
Sample No.		AB0241	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0-2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	3.88	
DNB	mg/kg	0.32	
TNT	mg/kg	**1319**	
2,4-DNT	mg/kg	**640**	
NB	mg/kg	0.37	
Tetryl	mg/kg	1.29	
3-NT	mg/kg	2.14	
4-NT	mg/kg	1.30	

Location		TNTC-S0241	
Sample No.		AB0283	
Sample Date		19-Aug-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.87	
2,4-DNT	mg/kg	0.28	
2A-4,6-DNT	mg/kg	0.91	
4A-2,6-DNT	mg/kg	1.00	

Location		TNTC-S0241	
Sample No.		AB0448	
Sample Date		11-OCT-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**11.5**	
2A-4,6-DNT	mg/kg	**17.3**	
DNT	mg/kg	**2.75**	
TNB	mg/kg	2.6	
TNT	mg/kg	**900**	
Volatiles			
Acetone	mg/kg	0.0503	J
Methylene chloride	mg/kg	0.00505	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**5.68**	
Dinitrotoluene, 2,6-	mg/kg	**10.7**	
PCBs			
Aroclor 1260	mg/kg	**0.517**	
Metals			
Aluminum	mg/kg	5570	
Arsenic	mg/kg	**9.38**	
Barium	mg/kg	81.6	
Beryllium	mg/kg	0.46	
Cadmium	mg/kg	1.19	
Calcium	mg/kg	24000	J
Chromium	mg/kg	9.87	J
Cobalt	mg/kg	4.5	
Copper	mg/kg	14.2	
Iron	mg/kg	**28800**	
Lead	mg/kg	**58.1**	J
Magnesium	mg/kg	5900	J
Manganese	mg/kg	1490	
Mercury	mg/kg	0.043	J
Nickel	mg/kg	15.4	
Potassium	mg/kg	506	J
Silver	mg/kg	0.455	J
Sodium	mg/kg	228	
Vanadium	mg/kg	17.3	
Zinc	mg/kg	359	J

Location		TNTC-S0228	
Sample No.		AB0228	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.59	
2A-4,6-DNT	mg/kg	0.66	
HMX	mg/kg	0.37	

Location		TNTC-S0332	
Sample No.		AB0332	
Sample Date		13-OCT-00	
Sample Depth (ft)		2.0 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.0884	J
2,4-DNT	mg/kg	0.134	
2A-4,6-DNT	mg/kg	0.614	
4A-2,6-DNT	mg/kg	0.62	

Location		TNTC-S0320	
Sample No.		AB0477	
Sample Date		12-OCT-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	2.6	
2A-4,6-DNT	mg/kg	**6.23**	
TNB	mg/kg	3.24	
TNT	mg/kg	**38.7**	
Volatiles			
Methylene chloride	mg/kg	0.0514	J
Toluene	mg/kg	0.0139	J
Xylenes, m,p-	mg/kg	0.00389	J
Semivolatiles			
Bis(2-ethylhexyl)phthalate	mg/kg	0.0335	J
Di-n-butylphthalate	mg/kg	0.169	J
Dinitrotoluene, 2,4-	mg/kg	0.176	J
Dinitrotoluene, 2,6-	mg/kg	0.386	
PCBs			
Aroclor 1260	mg/kg	0.0237	J
Metals			
Aluminum	mg/kg	4170	J
Arsenic	mg/kg	**9.88**	
Barium	mg/kg	52.8	
Beryllium	mg/kg	0.42	J
Cadmium	mg/kg	0.159	J
Calcium	mg/kg	45900	J
Chromium	mg/kg	8.08	
Cobalt	mg/kg	3.77	
Copper	mg/kg	10.5	
Iron	mg/kg	**28500**	
Lead	mg/kg	9.46	J
Magnesium	mg/kg	13200	J
Manganese	mg/kg	1120	J
Nickel	mg/kg	14	
Potassium	mg/kg	680	J
Sodium	mg/kg	152	B
Vanadium	mg/kg	14.8	
Zinc	mg/kg	94.6	

Location		TNTC-S0320	
Sample No.		AB0320	
Sample Date		23-SEP-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	2.04	
TNT	mg/kg	**399**	
2,4-DNT	mg/kg	**1.67**	
2A-4,6-DNT	mg/kg	**9.42**	
4A-2,6-DNT	mg/kg	**8.15**	
Tetryl	mg/kg	0.437	J

Location		TNTC-S0233	
Sample No.		AB0233	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.5-2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	0.29	
4A-2,6-DNT	mg/kg	0.25	J

Location		TNTC-S0231	
Sample No.		AB0231	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	15.6	
2A-4,6-DNT	mg/kg	0.14	J

Location		TNTC-S0232	
Sample No.		AB0232	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
4A-2,6-DNT	mg/kg	0.17	J

Location		TNTC-S0285	
Sample No.		AB0285	
Sample Date		19-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.75	
2,4-DNT	mg/kg	0.36	

Location		TNTC-S0286	
Sample No.		AB0286	
Sample Date		19-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	**41.1**	
2A-4,6-DNT	mg/kg	**4.45**	
4A-2,6-DNT	mg/kg	**4.01**	
Tetryl	mg/kg	0.24	J
3-NT	mg/kg	0.45	

LEGEND:

- △ ABO-228 — SCREENING SOIL SAMPLING LOCATION
- • ABO-283 — SURFACE SOIL SAMPLE (0-2 FT)
- ○ GW-06 — GROUNDWATER SAMPLING LOCATION
- □ ABO-448 — CONFIRMATION SOIL SAMPLING LOCATION
- FORMER TANK LOCATION
- FORMER BUILDING LOCATION
- POTENTIAL NITROAROMATIC REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 REMEDIATION GOAL OBJECTIVES SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0228	1.0 - 2.0
AB0229	1.0 - 2.0
AB0230	0.5 - 1.5
AB0231	1.5 - 2.5
AB0232	1.5 - 2.5
AB0233	1.5 - 2.5
AB0241	1.0 - 2.0
AB0242	1.0 - 2.0
AB0243	1.0 - 2.0
AB0244	1.0 - 2.0
AB0279	2.5 - 3.5
AB0283	0.0 - 1.0
AB0284	1.0 - 2.0
AB0285	1.0 - 2.0
AB0286	1.0 - 2.0
AB0320	1.5 - 2.5
AB0332	2.0 - 2.5
AB0405	4.0 - 6.0
AB0406	8.0 - 10.0
AB0448	1.0 - 2.0
AB0469	4.0 - 6.0
AB0477	1.5 - 2.5

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	2851	8	845

8. GROUNDWATER ENCOUNTERED IN SEPTEMBER 2000 BORING C-405/406 AT 8 FEET, BEDROCK AT 15 FEET.

   GROUNDWATER MEASURED IN TEMPORARY PIEZOMETER GW-06 AT 9.50 FEET (SEPTEMBER 2000).

SCALE
0 30 60 FEET

FIGURE 1-24
TNT AREA C
BUILDING 692 BI-TRI HOUSE
ANALYTICAL RESULTS AND
ESTIMATED AREA/VOLUME OF
SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

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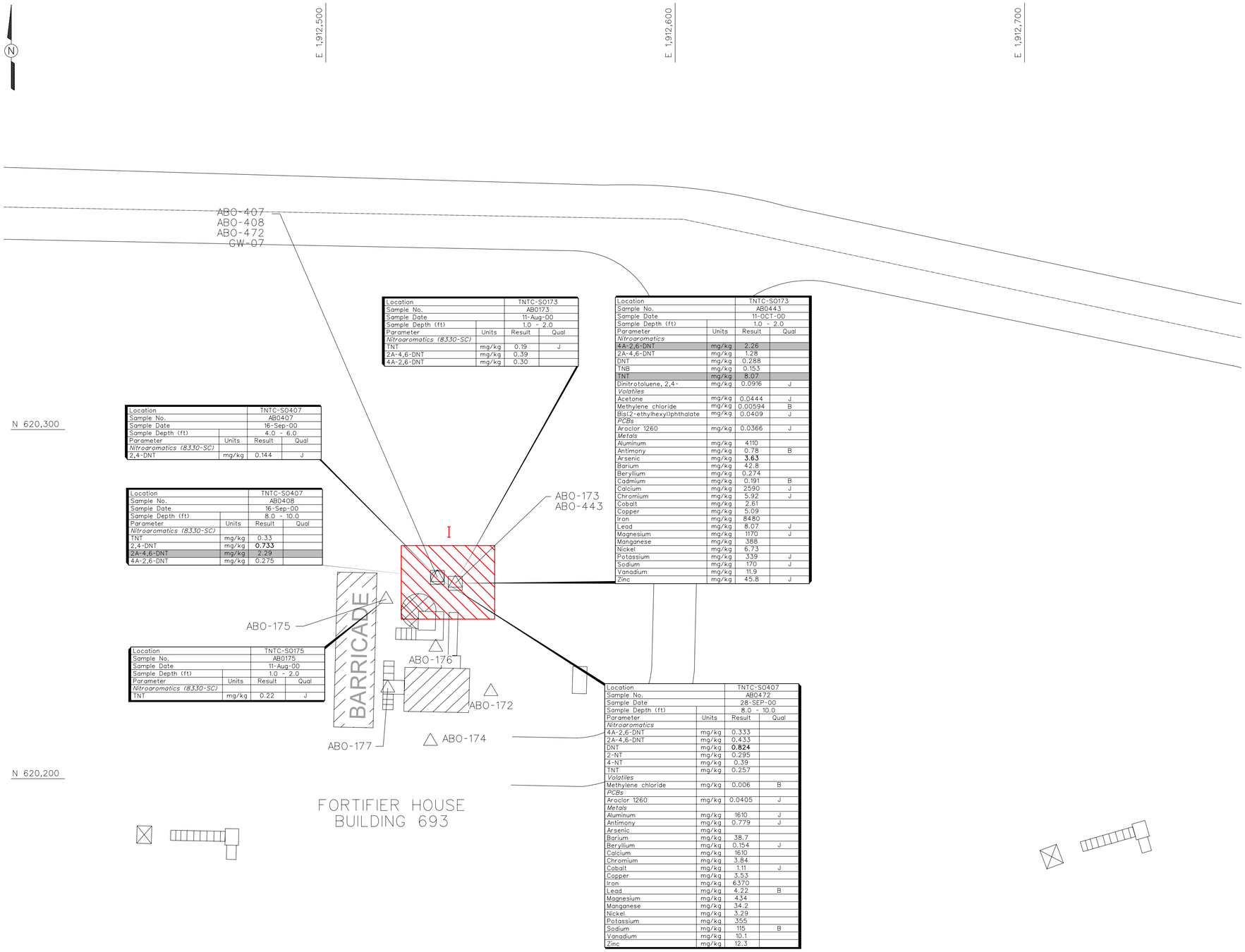

Location		TNTC-S0173	
Sample No.		AB0173	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.19	J
2A-4,6-DNT	mg/kg	0.39	
4A-2,6-DNT	mg/kg	0.30	

Location		TNTC-S0407	
Sample No.		AB0407	
Sample Date		16-Sep-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.144	J

Location		TNTC-S0407	
Sample No.		AB0408	
Sample Date		16-Sep-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.33	
2,4-DNT	mg/kg	**0.733**	
2A-4,6-DNT	mg/kg	2.29	
4A-2,6-DNT	mg/kg	0.275	

Location		TNTC-S0175	
Sample No.		AB0175	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.22	J

Location		TNTC-S0173	
Sample No.		AB0443	
Sample Date		11-OCT-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	2.28	
2A-4,6-DNT	mg/kg	1.25	
DNT	mg/kg	0.288	
TNB	mg/kg	0.153	
TNT	mg/kg	8.07	
Dinitrotoluene, 2,4-	mg/kg	0.0916	J
Volatiles			
Acetone	mg/kg	0.0444	J
Methylene chloride	mg/kg	0.00594	B
Bis(2-ethylhexyl)phthalate	mg/kg	0.0409	J
PCBs			
Aroclor 1260	mg/kg	0.0366	J
Metals			
Aluminum	mg/kg	4110	
Antimony	mg/kg	0.78	B
Arsenic	mg/kg	**3.63**	
Barium	mg/kg	42.8	
Beryllium	mg/kg	0.274	
Cadmium	mg/kg	0.191	B
Calcium	mg/kg	2590	J
Chromium	mg/kg	5.92	J
Cobalt	mg/kg	2.61	
Copper	mg/kg	5.09	
Iron	mg/kg	8480	
Lead	mg/kg	8.07	J
Magnesium	mg/kg	1170	J
Manganese	mg/kg	388	
Nickel	mg/kg	6.73	
Potassium	mg/kg	339	J
Sodium	mg/kg	170	J
Vanadium	mg/kg	11.9	
Zinc	mg/kg	45.8	J

Location		TNTC-S0407	
Sample No.		AB0472	
Sample Date		28-SEP-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.333	
2A-4,6-DNT	mg/kg	0.433	
DNT	mg/kg	**0.824**	
2-NT	mg/kg	0.295	
4-NT	mg/kg	0.39	
TNT	mg/kg	0.257	
Volatiles			
Methylene chloride	mg/kg	0.006	B
PCBs			
Aroclor 1260	mg/kg	0.0405	J
Metals			
Aluminum	mg/kg	1610	J
Antimony	mg/kg	0.779	J
Arsenic	mg/kg		
Barium	mg/kg	38.7	
Beryllium	mg/kg	0.154	J
Calcium	mg/kg	1610	
Chromium	mg/kg	3.84	
Cobalt	mg/kg	1.11	J
Copper	mg/kg	3.53	
Iron	mg/kg	6370	
Lead	mg/kg	4.22	B
Magnesium	mg/kg	434	
Manganese	mg/kg	34.2	
Nickel	mg/kg	3.29	
Potassium	mg/kg	355	
Sodium	mg/kg	115	B
Vanadium	mg/kg	10.1	
Zinc	mg/kg	12.3	

LEGEND:

- △ AB0-172 — SCREENING SOIL SAMPLING LOCATION
- ○ GW-07 — GROUNDWATER SAMPLING LOCATION
- □ AB0-443 — CONFIRMATION SOIL SAMPLING LOCATION
- FORMER TANK LOCATION
- BUILDING FOUNDATION
- POTENTIAL REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 REMEDIATION GOAL OBJECTIVES SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0172	1.5 - 2.5
AB0173	1.0 - 2.0
AB0174	1.0 - 2.0
AB0175	1.0 - 2.0
AB0176	1.0 - 2.0
AB0177	1.0 - 2.0
AB0407	4.0 - 6.0
AB0408	8.0 - 10.0
AB0443	1.0 - 2.0
AB0472	8.0 - 10.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	567	7	147

8. ENCOUNTERED GROUNDWATER AT 7 FEET IN SEPTEMBER 2000 BORING C-407/408. BEDROCK NOT DETECTED IN THE 10 FOOT BORING.
9. DRILLING CONDUCTED IN AUGUST 2001 NOT APPLICABLE. BOREHOLE DRILLED APPROXIMATELY 220 FOOT DOWNGRADIENT OF SITE.

SCALE
0 20 40 FEET

FIGURE 1-25
TNT AREA C
BUILDING 693 FORTIFIER HOUSE
ANALYTICAL RESULTS AND
ESTIMATED AREA/VOLUME OF
SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

STARTING DATE: 01/21/02 | DATE LAST REV.: | DRAFT. CHCK. BY: D. KESSLER | INITIATOR: T. SIARD | DWG. NO.: 807112ES.057
DRAWN BY: B.VANDERGRIFF | DRAWN BY: | ENGR. CHCK. BY: | PROJ. MGR.: S. DOWNEY | PROJ. NO.: 807112

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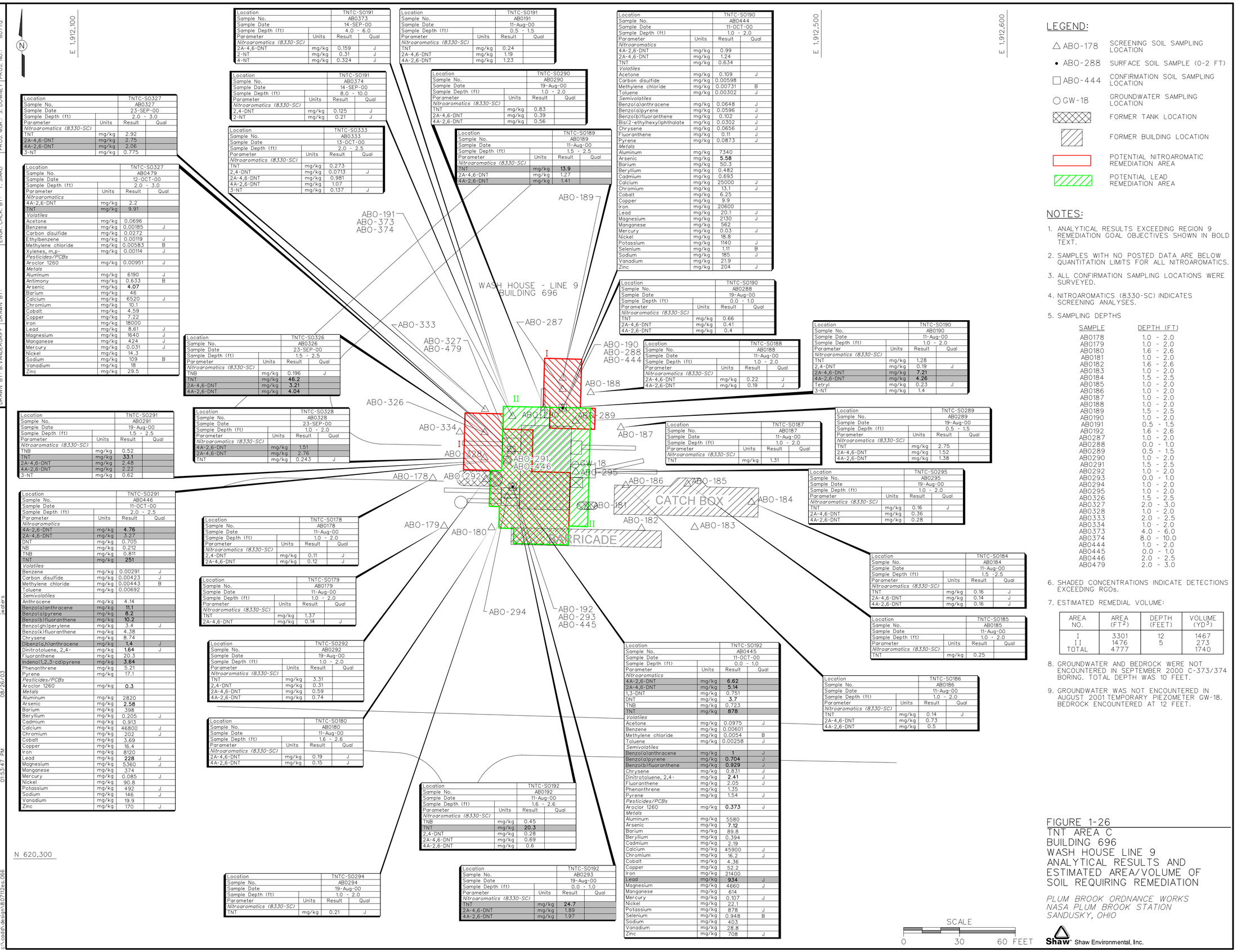
DWG. NO.: 807112ES.066 | PROJ. NO.: 807112
INITIATOR: T. SIARD | PROJ. MGR.: S. DOWNEY
DRAFT. CHCK. BY: C. TUMLIN | ENGR. CHCK. BY: T. SIARD
STARTING DATE: 10/22/02 | DATE LAST REV.:
DRAWN BY: B.VANDERGRIFF | DRAWN BY:



Location		TNTC-S0191	
Sample No.		AB0373	
Sample Date		14-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	0.159	J
2-NT	mg/kg	0.31	J
4-NT	mg/kg	0.324	J

Location		TNTC-S0191	
Sample No.		AB0191	
Sample Date		11-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.24	
2A-4,6-DNT	mg/kg	1.19	
4A-2,6-DNT	mg/kg	1.23	

Location		TNTC-S0190	
Sample No.		AB0444	
Sample Date		11-OCT-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.99	
2A-4,6-DNT	mg/kg	1.24	
TNT	mg/kg	0.634	
Volatiles			
Acetone	mg/kg	0.109	J
Carbon disulfide	mg/kg	0.00598	
Methylene chloride	mg/kg	0.00731	B
Toluene	mg/kg	0.00302	J
Semivolatiles			
Benzo(a)anthracene	mg/kg	0.0648	J
Benzo(a)pyrene	mg/kg	0.0596	J
Benzo(b)fluoranthene	mg/kg	0.102	J
Bis(2-ethylhexyl)phthalate	mg/kg	0.0302	J
Chrysene	mg/kg	0.0656	J
Fluoranthene	mg/kg	0.11	J
Pyrene	mg/kg	0.0873	J
Metals			
Aluminum	mg/kg	7340	
Arsenic	mg/kg	**5.58**	
Barium	mg/kg	50.3	
Beryllium	mg/kg	0.482	
Cadmium	mg/kg	0.693	
Calcium	mg/kg	25000	J
Chromium	mg/kg	13.1	J
Cobalt	mg/kg	6.25	
Copper	mg/kg	9.9	
Iron	mg/kg	20600	
Lead	mg/kg	20.1	J
Magnesium	mg/kg	2130	J
Manganese	mg/kg	562	
Mercury	mg/kg	0.03	J
Nickel	mg/kg	18.8	
Potassium	mg/kg	1140	J
Selenium	mg/kg	1.11	B
Sodium	mg/kg	185	J
Vanadium	mg/kg	21.9	
Zinc	mg/kg	204	J

Location		TNTC-S0191	
Sample No.		AB0374	
Sample Date		14-SEP-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.125	J
2-NT	mg/kg	0.21	J

Location		TNTC-S0290	
Sample No.		AB0290	
Sample Date		19-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.83	
2A-4,6-DNT	mg/kg	0.39	
4A-2,6-DNT	mg/kg	0.56	

Location		TNTC-S0327	
Sample No.		AB0327	
Sample Date		23-SEP-00	
Sample Depth (ft)		2.0 - 3.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	2.92	
2A-4,6-DNT	mg/kg	2.75	
4A-2,6-DNT	mg/kg	2.06	
3-NT	mg/kg	0.775	

Location		TNTC-S0333	
Sample No.		AB0333	
Sample Date		13-OCT-00	
Sample Depth (ft)		2.0 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.273	
2,4-DNT	mg/kg	0.0713	J
2A-4,6-DNT	mg/kg	0.981	
4A-2,6-DNT	mg/kg	1.07	
3-NT	mg/kg	0.137	J

Location		TNTC-S0189	
Sample No.		AB0189	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	**13.9**	
2A-4,6-DNT	mg/kg	1.27	
4A-2,6-DNT	mg/kg	1.41	

Location		TNTC-S0327	
Sample No.		AB0479	
Sample Date		12-OCT-00	
Sample Depth (ft)		2.0 - 3.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	2.2	
TNT	mg/kg	9.91	
Volatiles			
Acetone	mg/kg	0.0696	
Benzene	mg/kg	0.00185	J
Carbon disulfide	mg/kg	0.0272	
Ethylbenzene	mg/kg	0.00119	J
Methylene chloride	mg/kg	0.00583	B
Xylenes, m,p-	mg/kg	0.00114	J
Pesticides/PCBs			
Aroclor 1260	mg/kg	0.00951	J
Metals			
Aluminum	mg/kg	6190	J
Antimony	mg/kg	0.633	B
Arsenic	mg/kg	**4.07**	
Barium	mg/kg	46	
Calcium	mg/kg	6520	J
Chromium	mg/kg	10.1	
Cobalt	mg/kg	4.59	
Copper	mg/kg	7.22	
Iron	mg/kg	18000	
Lead	mg/kg	8.61	J
Magnesium	mg/kg	1640	J
Manganese	mg/kg	424	J
Mercury	mg/kg	0.031	J
Nickel	mg/kg	14.3	
Sodium	mg/kg	109	B
Vanadium	mg/kg	18	
Zinc	mg/kg	29.5	

Location		TNTC-S0190	
Sample No.		AB0288	
Sample Date		19-Aug-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.66	
2A-4,6-DNT	mg/kg	0.41	
4A-2,6-DNT	mg/kg	0.4	

Location		TNTC-S0188	
Sample No.		AB0188	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	0.22	J
4A-2,6-DNT	mg/kg	0.19	J

Location		TNTC-S0190	
Sample No.		AB0190	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.28	
2,4-DNT	mg/kg	0.19	J
2A-4,6-DNT	mg/kg	**7.21**	
4A-2,6-DNT	mg/kg	**4.26**	
Tetryl	mg/kg	0.23	J
3-NT	mg/kg	1.4	

Location		TNTC-S0326	
Sample No.		AB0326	
Sample Date		23-SEP-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.196	J
TNT	mg/kg	**46.2**	
2A-4,6-DNT	mg/kg	**3.21**	
4A-2,6-DNT	mg/kg	**4.04**	

Location		TNTC-S0291	
Sample No.		AB0291	
Sample Date		19-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.52	
TNT	mg/kg	**33.1**	
2A-4,6-DNT	mg/kg	2.48	
4A-2,6-DNT	mg/kg	2.22	
3-NT	mg/kg	0.62	

Location		TNTC-S0328	
Sample No.		AB0328	
Sample Date		23-SEP-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
4A-2,6-DNT	mg/kg	1.51	
2A-4,6-DNT	mg/kg	2.76	
TNT	mg/kg	0.243	J

Location		TNTC-S0187	
Sample No.		AB0187	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.31	

Location		TNTC-S0289	
Sample No.		AB0289	
Sample Date		19-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	2.75	
2A-4,6-DNT	mg/kg	1.52	
4A-2,6-DNT	mg/kg	1.38	

Location		TNTC-S0295	
Sample No.		AB0295	
Sample Date		19-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.16	J
2A-4,6-DNT	mg/kg	0.36	
4A-2,6-DNT	mg/kg	0.28	

Location		TNTC-S0291	
Sample No.		AB0446	
Sample Date		11-OCT-00	
Sample Depth (ft)		2.0 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**4.76**	
2A-4,6-DNT	mg/kg	3.27	
DNT	mg/kg	0.705	
NB	mg/kg	0.212	
TNB	mg/kg	0.811	
TNT	mg/kg	**251**	
Volatiles			
Benzene	mg/kg	0.00291	J
Carbon disulfide	mg/kg	0.00423	J
Methylene chloride	mg/kg	0.00443	B
Toluene	mg/kg	0.00692	
Semivolatiles			
Anthracene	mg/kg	4.14	
Benzo(a)anthracene	mg/kg	**11.1**	
Benzo(a)pyrene	mg/kg	**8.2**	
Benzo(b)fluoranthene	mg/kg	**10.2**	
Benzo(ghi)perylene	mg/kg	3.4	J
Benzo(k)fluoranthene	mg/kg	4.38	
Chrysene	mg/kg	8.74	
Dibenz(a,h)anthracene	mg/kg	**1.4**	J
Dinitrotoluene, 2,4-	mg/kg	**1.64**	J
Fluoranthene	mg/kg	20.3	
Indeno(1,2,3-cd)pyrene	mg/kg	**3.64**	
Phenanthrene	mg/kg	5.21	
Pyrene	mg/kg	17.1	
Pesticides/PCBs			
Aroclor 1260	mg/kg	**0.3**	
Metals			
Aluminum	mg/kg	2820	
Arsenic	mg/kg	**2.58**	
Barium	mg/kg	398	
Beryllium	mg/kg	0.205	J
Cadmium	mg/kg	0.913	
Calcium	mg/kg	46800	J
Chromium	mg/kg	202	J
Cobalt	mg/kg	3.69	
Copper	mg/kg	16.4	
Iron	mg/kg	8120	
Lead	mg/kg	**228**	J
Magnesium	mg/kg	5360	J
Manganese	mg/kg	374	
Mercury	mg/kg	0.085	J
Nickel	mg/kg	90.8	
Potassium	mg/kg	492	J
Sodium	mg/kg	146	J
Vanadium	mg/kg	19.9	
Zinc	mg/kg	170	J

Location		TNTC-S0178	
Sample No.		AB0178	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.11	J
2A-4,6-DNT	mg/kg	0.12	J

Location		TNTC-S0179	
Sample No.		AB0179	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.37	
2A-4,6-DNT	mg/kg	0.14	J

Location		TNTC-S0184	
Sample No.		AB0184	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.5 -2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.16	J
2A-4,6-DNT	mg/kg	0.14	J
4A-2,6-DNT	mg/kg	0.16	J

Location		TNTC-S0185	
Sample No.		AB0185	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.25	

Location		TNTC-S0292	
Sample No.		AB0292	
Sample Date		19-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	3.31	
2,4-DNT	mg/kg	0.31	
2A-4,6-DNT	mg/kg	0.59	
4A-2,6-DNT	mg/kg	0.74	

Location		TNTC-S0192	
Sample No.		AB0445	
Sample Date		11-OCT-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**6.62**	
2A-4,6-DNT	mg/kg	**5.14**	
1,3-DNT	mg/kg	0.751	
DNT	mg/kg	**3.7**	
TNB	mg/kg	0.723	
TNT	mg/kg	**878**	
Volatiles			
Acetone	mg/kg	0.0975	J
Benzene	mg/kg	0.00601	
Methylene chloride	mg/kg	0.0054	B
Toluene	mg/kg	0.00258	J
Semivolatiles			
Benzo(a)anthracene	mg/kg	**1**	J
Benzo(a)pyrene	mg/kg	**0.704**	J
Benzo(b)fluoranthene	mg/kg	**0.929**	J
Chrysene	mg/kg	0.831	J
Dinitrotoluene, 2,4-	mg/kg	**2.41**	J
Fluoranthene	mg/kg	2.05	J
Phenanthrene	mg/kg	1.35	
Pyrene	mg/kg	1.54	J
Pesticides/PCBs			
Aroclor 1260	mg/kg	**0.373**	J
Metals			
Aluminum	mg/kg	5580	
Arsenic	mg/kg	**7.12**	
Barium	mg/kg	89.8	
Beryllium	mg/kg	0.394	
Cadmium	mg/kg	2.19	
Calcium	mg/kg	45900	J
Chromium	mg/kg	16.2	J
Cobalt	mg/kg	4.36	
Copper	mg/kg	52.2	
Iron	mg/kg	21400	
Lead	mg/kg	**934**	J
Magnesium	mg/kg	4660	J
Manganese	mg/kg	614	
Mercury	mg/kg	0.107	J
Nickel	mg/kg	22.1	
Potassium	mg/kg	878	J
Selenium	mg/kg	0.948	B
Sodium	mg/kg	403	
Vanadium	mg/kg	28.8	
Zinc	mg/kg	708	J

Location		TNTC-S0186	
Sample No.		AB0186	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.14	J
2A-4,6-DNT	mg/kg	0.73	
4A-2,6-DNT	mg/kg	0.5	

Location		TNTC-S0180	
Sample No.		AB0180	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.6 - 2.6	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	0.19	J
4A-2,6-DNT	mg/kg	0.15	J

Location		TNTC-S0192	
Sample No.		AB0192	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.6 - 2.6	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.45	
TNT	mg/kg	**20.3**	
2,4-DNT	mg/kg	0.28	
2A-4,6-DNT	mg/kg	0.69	
4A-2,6-DNT	mg/kg	0.6	

Location		TNTC-S0294	
Sample No.		AB0294	
Sample Date		19-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.21	J

Location		TNTC-S0192	
Sample No.		AB0293	
Sample Date		19-Aug-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	**24.7**	
2A-4,6-DNT	mg/kg	1.89	
4A-2,6-DNT	mg/kg	1.97	

LEGEND:

- △ ABO-178 — SCREENING SOIL SAMPLING LOCATION
- • ABO-288 — SURFACE SOIL SAMPLE (0-2 FT)
- □ ABO-444 — CONFIRMATION SOIL SAMPLING LOCATION
- ○ GW-18 — GROUNDWATER SAMPLING LOCATION
- FORMER TANK LOCATION
- FORMER BUILDING LOCATION
- POTENTIAL NITROAROMATIC REMEDIATION AREA
- POTENTIAL LEAD REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 REMEDIATION GOAL OBJECTIVES SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0178	1.0 - 2.0
AB0179	1.0 - 2.0
AB0180	1.6 - 2.6
AB0181	1.0 - 2.0
AB0182	1.6 - 2.6
AB0183	1.0 - 2.0
AB0184	1.5 - 2.5
AB0185	1.0 - 2.0
AB0186	1.0 - 2.0
AB0187	1.0 - 2.0
AB0188	1.0 - 2.0
AB0189	1.5 - 2.5
AB0190	1.0 - 2.0
AB0191	0.5 - 1.5
AB0192	1.6 - 2.6
AB0287	1.0 - 2.0
AB0288	0.0 - 1.0
AB0289	0.5 - 1.5
AB0290	1.0 - 2.0
AB0291	1.5 - 2.5
AB0292	1.0 - 2.0
AB0293	0.0 - 1.0
AB0294	1.0 - 2.0
AB0295	1.0 - 2.0
AB0326	1.5 - 2.5
AB0327	2.0 - 3.0
AB0328	1.0 - 2.0
AB0333	2.0 - 2.5
AB0334	1.0 - 2.0
AB0373	4.0 - 6.0
AB0374	8.0 - 10.0
AB0444	1.0 - 2.0
AB0445	0.0 - 1.0
AB0446	2.0 - 3.5
AB0479	2.0 - 3.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	3301	12	1467
II	1476	5	273
TOTAL	4777		1740

8. GROUNDWATER AND BEDROCK WERE NOT ENCOUNTERED IN SEPTEMBER 2000 C-373/374 BORING. TOTAL DEPTH WAS 10 FEET.
9. GROUNDWATER WAS NOT ENCOUNTERED IN AUGUST 2001 TEMPORARY PIEZOMETER GW-18. BEDROCK ENCOUNTERED AT 12 FEET.

SCALE
0 30 60 FEET

FIGURE 1-26
TNT AREA C
BUILDING 696
WASH HOUSE LINE 9
ANALYTICAL RESULTS AND ESTIMATED AREA/VOLUME OF SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

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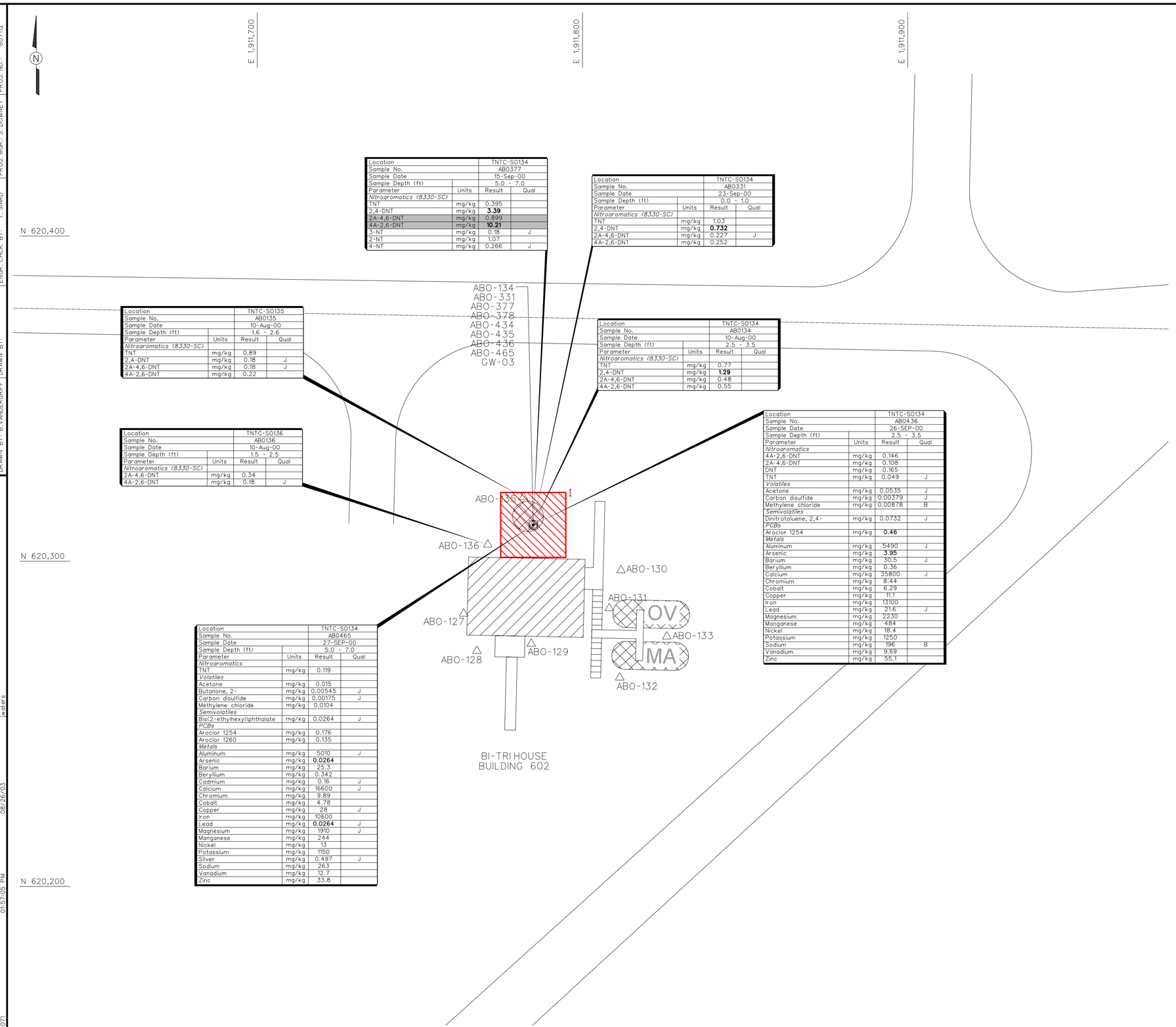

Location		TNTC-S0134	
Sample No.		AB0377	
Sample Date		15-Sep-00	
Sample Depth (ft)		5.0 - 7.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.395	
2,4-DNT	mg/kg	**3.39**	
2A-4,6-DNT	mg/kg	0.899	
4A-2,6-DNT	mg/kg	**10.21**	
3-NT	mg/kg	0.18	J
2-NT	mg/kg	1.07	
4-NT	mg/kg	0.266	J

Location		TNTC-S0134	
Sample No.		AB0331	
Sample Date		23-Sep-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.03	
2,4-DNT	mg/kg	**0.732**	
2A-4,6-DNT	mg/kg	0.227	J
4A-2,6-DNT	mg/kg	0.252	

Location		TNTC-S0135	
Sample No.		AB0135	
Sample Date		10-Aug-00	
Sample Depth (ft)		1.6 - 2.6	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.89	
2,4-DNT	mg/kg	0.18	J
2A-4,6-DNT	mg/kg	0.18	J
4A-2,6-DNT	mg/kg	0.22	

Location		TNTC-S0134	
Sample No.		AB0134	
Sample Date		10-Aug-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.77	
2,4-DNT	mg/kg	**1.29**	
2A-4,6-DNT	mg/kg	0.48	
4A-2,6-DNT	mg/kg	0.55	

Location		TNTC-S0136	
Sample No.		AB0136	
Sample Date		10-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	0.34	
4A-2,6-DNT	mg/kg	0.18	J

Location		TNTC-S0134	
Sample No.		AB0436	
Sample Date		26-SEP-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.146	
2A-4,6-DNT	mg/kg	0.108	
DNT	mg/kg	0.165	
TNT	mg/kg	0.049	J
Volatiles			
Acetone	mg/kg	0.0535	J
Carbon disulfide	mg/kg	0.00379	J
Methylene chloride	mg/kg	0.00878	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	0.0732	J
PCBs			
Aroclor 1254	mg/kg	**0.46**	
Metals			
Aluminum	mg/kg	5490	J
Arsenic	mg/kg	**3.95**	
Barium	mg/kg	30.5	J
Beryllium	mg/kg	0.36	
Calcium	mg/kg	35800	J
Chromium	mg/kg	8.44	
Cobalt	mg/kg	6.29	
Copper	mg/kg	11.1	
Iron	mg/kg	13100	
Lead	mg/kg	21.6	J
Magnesium	mg/kg	2230	
Manganese	mg/kg	484	
Nickel	mg/kg	18.4	
Potassium	mg/kg	1250	
Sodium	mg/kg	196	B
Vanadium	mg/kg	9.69	
Zinc	mg/kg	55.1	

Location		TNTC-S0134	
Sample No.		AB0465	
Sample Date		27-SEP-00	
Sample Depth (ft)		5.0 - 7.0	
Parameter	Units	Result	Qual
Nitroaromatics			
TNT	mg/kg	0.119	
Volatiles			
Acetone	mg/kg	0.015	
Butanone, 2-	mg/kg	0.00545	J
Carbon disulfide	mg/kg	0.00175	J
Methylene chloride	mg/kg	0.0104	
Semivolatiles			
Bis(2-ethylhexyl)phthalate	mg/kg	0.0264	J
PCBs			
Aroclor 1254	mg/kg	0.176	
Aroclor 1260	mg/kg	0.135	
Metals			
Aluminum	mg/kg	5010	J
Arsenic	mg/kg	**0.0264**	
Barium	mg/kg	25.3	
Beryllium	mg/kg	0.342	
Cadmium	mg/kg	0.16	J
Calcium	mg/kg	16600	J
Chromium	mg/kg	9.89	
Cobalt	mg/kg	4.78	
Copper	mg/kg	28	J
Iron	mg/kg	10600	
Lead	mg/kg	**0.0264**	J
Magnesium	mg/kg	1910	J
Manganese	mg/kg	244	
Nickel	mg/kg	13	
Potassium	mg/kg	1150	
Silver	mg/kg	0.497	J
Sodium	mg/kg	263	
Vanadium	mg/kg	12.7	
Zinc	mg/kg	33.8	

LEGEND:

- △ ABO-127 — SCREENING SOIL SAMPLING LOCATION
- • ABO-331 — SURFACE SOIL SAMPLE (0 - 1FT)
- ○ GW-03 — GROUNDWATER SAMPLING LOCATION
- □ ABO-465 — CONFIRMATION SOIL SAMPLING LOCATION
- FORMER TANK LOCATION
- FORMER BUILDING LOCATION
- POTENTIAL NITROAROMATIC REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 PRELIMINARY REMEDIATION GOALS ARE SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0127	2.6 - 3.6
AB0128	2.0 - 3.0
AB0129	2.0 - 3.0
AB0130	2.5 - 3.5
AB0131	1.8 - 2.8
AB0132	1.5 - 2.0
AB0133	2.0 - 3.0
AB0134	2.5 - 3.5
AB0135	1.6 - 2.6
AB0136	1.5 - 2.5
AB0331	0.0 - 1.0
AB0377	5.0 - 7.0
AB0378	8.0 - 10.0
AB0434	2.5 - 3.5
AB0435	2.5 - 3.5
AB0436	2.5 - 3.5
AB0465	5.0 - 7.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	400	6	89

8. GROUNDWATER ENCOUNTERED AT 6 FEET IN SEPTEMBER 2000 BORING C-377/378.

SCALE
0 20 40 FEET

Shaw Shaw Environmental, Inc.

FIGURE 1-27
TNT AREA C
BUILDING 602 BI-TRI HOUSE
ANALYTICAL RESULTS AND
ESTIMATED AREA/VOLUME OF
SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

STARTING DATE: 10/22/02 | DATE LAST REV.: | DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: T. SIARD | DWG. NO.: 807112ES.071
DRAWN BY: B.VANDERGRIFF | DRAWN BY: | ENGR. CHCK. BY: T. SIARD | PROJ. MGR.: S. DOWNEY | PROJ. NO.: 807112

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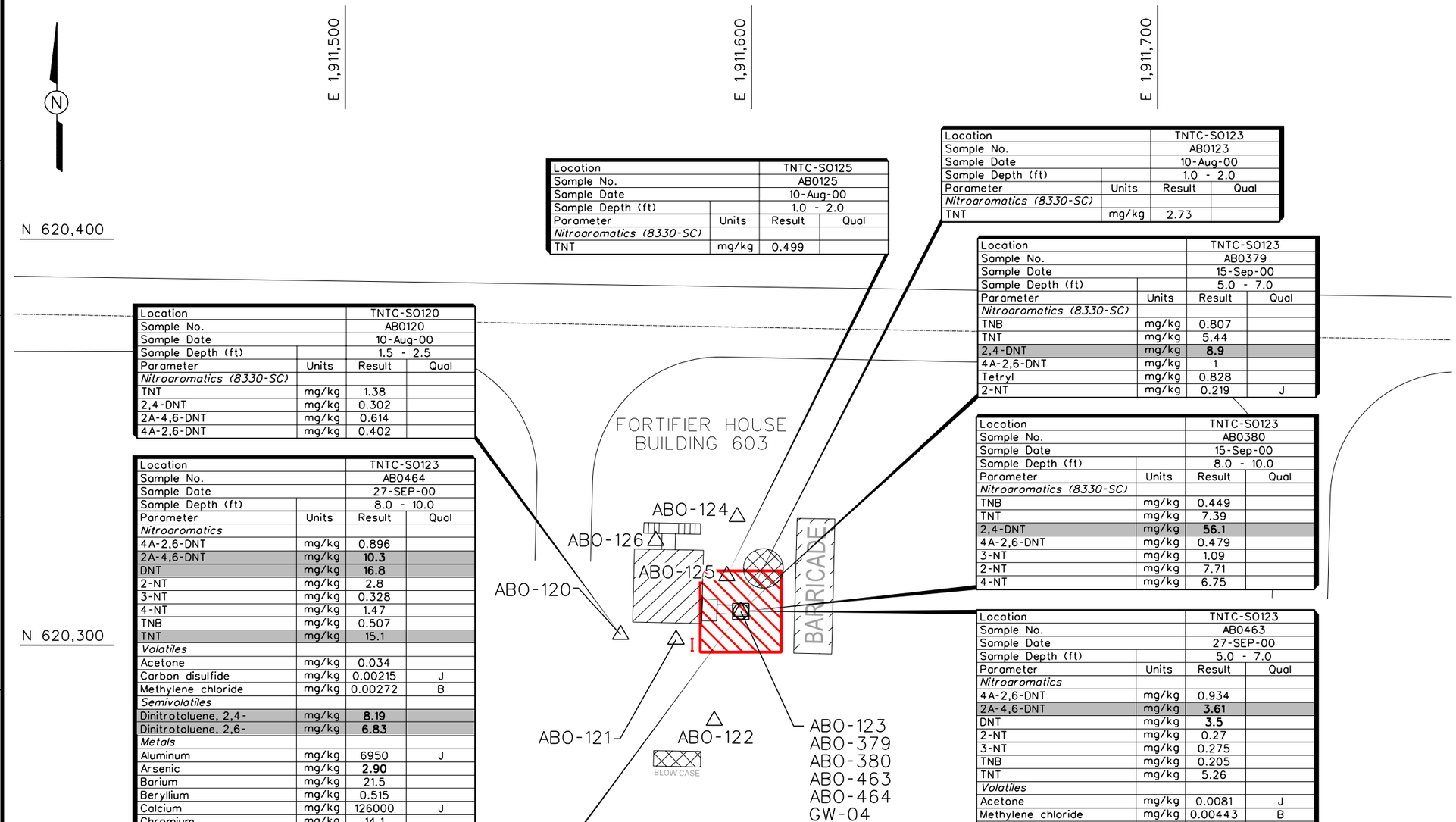

Location		TNTC-S0125	
Sample No.		AB0125	
Sample Date		10-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.499	

Location		TNTC-S0120	
Sample No.		AB0120	
Sample Date		10-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.38	
2,4-DNT	mg/kg	0.302	
2A-4,6-DNT	mg/kg	0.614	
4A-2,6-DNT	mg/kg	0.402	

Location		TNTC-S0123	
Sample No.		AB0464	
Sample Date		27-SEP-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.896	
2A-4,6-DNT	mg/kg	**10.3**	
DNT	mg/kg	**16.8**	
2-NT	mg/kg	2.8	
3-NT	mg/kg	0.328	
4-NT	mg/kg	1.47	
TNB	mg/kg	0.507	
TNT	mg/kg	15.1	
Volatiles			
Acetone	mg/kg	0.034	
Carbon disulfide	mg/kg	0.00215	J
Methylene chloride	mg/kg	0.00272	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**8.19**	
Dinitrotoluene, 2,6-	mg/kg	**6.83**	
Metals			
Aluminum	mg/kg	6950	J
Arsenic	mg/kg	**2.90**	
Barium	mg/kg	21.5	
Beryllium	mg/kg	0.515	
Calcium	mg/kg	126000	J
Chromium	mg/kg	14.1	
Cobalt	mg/kg	8.38	
Copper	mg/kg	11.5	J
Iron	mg/kg	14000	
Lead	mg/kg	4.05	J
Magnesium	mg/kg	3960	J
Manganese	mg/kg	764	
Nickel	mg/kg	23.1	
Potassium	mg/kg	2640	
Sodium	mg/kg	355	
Vanadium	mg/kg	9.79	
Zinc	mg/kg	17.3	

Location		TNTC-S0123	
Sample No.		AB0123	
Sample Date		10-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	2.73	

Location		TNTC-S0123	
Sample No.		AB0379	
Sample Date		15-Sep-00	
Sample Depth (ft)		5.0 - 7.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.807	
TNT	mg/kg	5.44	
2,4-DNT	mg/kg	**8.9**	
4A-2,6-DNT	mg/kg	1	
Tetryl	mg/kg	0.828	
2-NT	mg/kg	0.219	J

Location		TNTC-S0123	
Sample No.		AB0380	
Sample Date		15-Sep-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.449	
TNT	mg/kg	7.39	
2,4-DNT	mg/kg	**56.1**	
4A-2,6-DNT	mg/kg	0.479	
3-NT	mg/kg	1.09	
2-NT	mg/kg	7.71	
4-NT	mg/kg	6.75	

Location		TNTC-S0123	
Sample No.		AB0463	
Sample Date		27-SEP-00	
Sample Depth (ft)		5.0 - 7.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.934	
2A-4,6-DNT	mg/kg	**3.61**	
DNT	mg/kg	**3.5**	
2-NT	mg/kg	0.27	
3-NT	mg/kg	0.275	
TNB	mg/kg	0.205	
TNT	mg/kg	5.26	
Volatiles			
Acetone	mg/kg	0.0081	J
Methylene chloride	mg/kg	0.00443	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	0.617	J
Dinitrotoluene, 2,6-	mg/kg	**7.21**	
Metals			
Aluminum	mg/kg	4310	J
Arsenic	mg/kg	**2.99**	
Barium	mg/kg	24.4	
Beryllium	mg/kg	0.321	
Cadmium	mg/kg	0.136	J
Calcium	mg/kg	65300	J
Chromium	mg/kg	7.13	
Cobalt	mg/kg	3.62	
Copper	mg/kg	11.2	J
Iron	mg/kg	10100	
Lead	mg/kg	27.9	J
Magnesium	mg/kg	1160	J
Manganese	mg/kg	361	
Nickel	mg/kg	10.4	
Potassium	mg/kg	897	
Sodium	mg/kg	288	
Vanadium	mg/kg	8.95	
Zinc	mg/kg	41.2	

LEGEND:

- △ ABO-120 — SCREENING SOIL SAMPLING LOCATION
- ○ GW-04 — GROUNDWATER SAMPLING LOCATION
- □ ABO-464 — CONFIRMATION SOIL SAMPLING LOCATION
- FORMER TANK LOCATION
- FORMER BUILDING LOCATION
- POTENTIAL NITROAROMATIC REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 REMEDIATION GOAL OBJECTIVES SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0120	1.5 - 2.5
AB0121	1.0 - 2.0
AB0122	2.5 - 3.5
AB0123	1.0 - 2.0
AB0124	1.0 - 2.0
AB0125	1.0 - 2.0
AB0126	0.0 - 1.0
AB0379	5.0 - 7.0
AB0380	8.0 - 10.0
AB0463	5.0 - 7.0
AB0464	8.0 - 10.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	400	8	119

8. GROUNDWATER ENCOUNTERED AT 8 FEET IN SEPTEMBER 2000, C-379/380 BORING (IT, 2001a)

   GROUNDWATER MEASURED IN GW-04 AT 6.9 FEET.

SCALE

0 30 60 FEET

FIGURE 1-28
TNT AREA C
BUILDING 603 FORTIFIER HOUSE ANALYTICAL RESULTS AND ESTIMATED AREA/VOLUME OF SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

DWG. NO.:...\807112es.068 PROJ. NO.: 807112
INITIATOR: T. SIARD PROJ. MGR.: S. DOWNEY
DRAFT. CHCK. BY: C. TUMLIN ENGR. CHCK. BY: T. SIARD
DATE LAST REV.: DRAWN BY:
STARTING DATE: 10/22/02 DRAWN BY: B.VANDERGRIFF
12:01:12 PM 09/04/03
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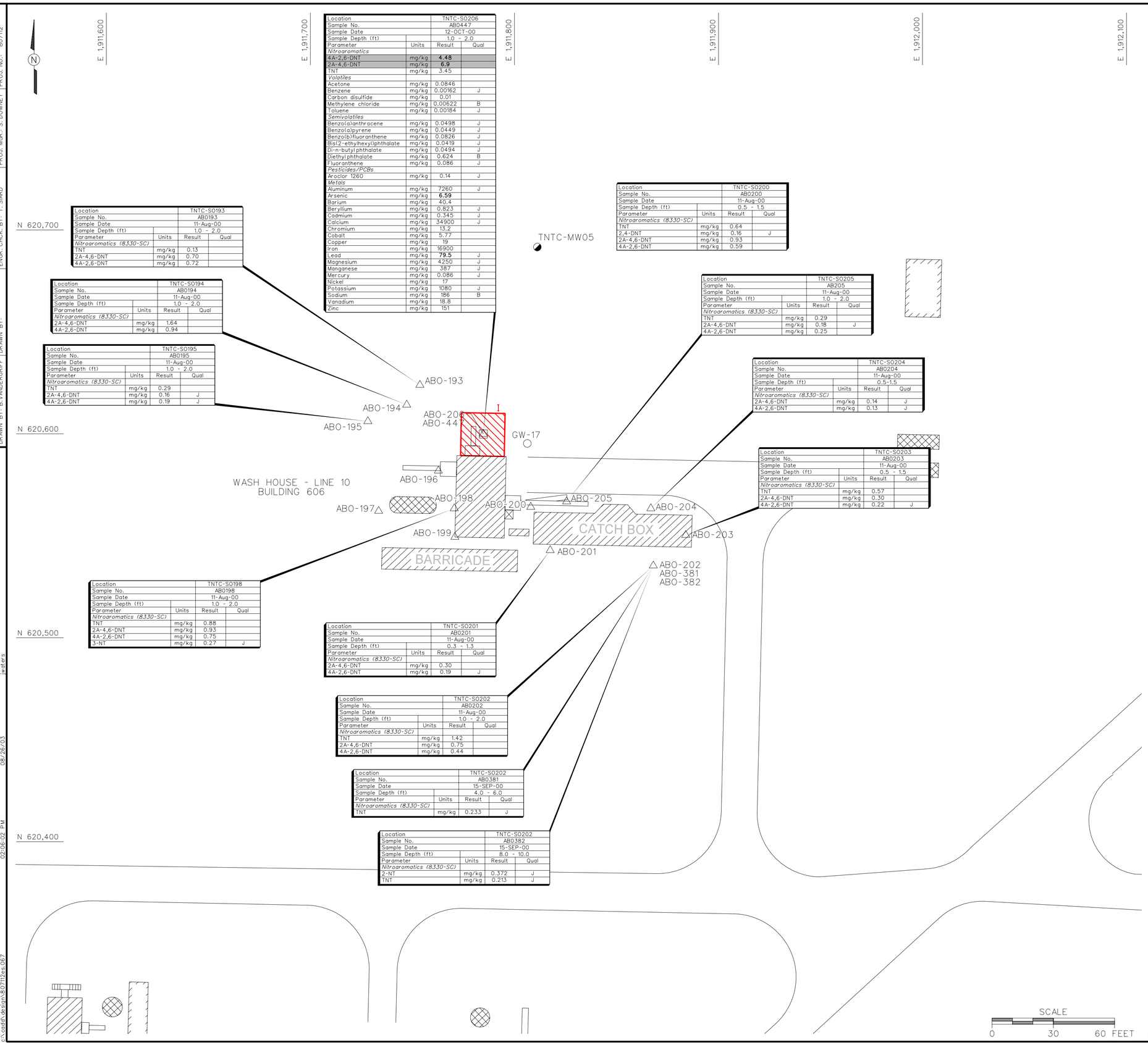


Location		TNTC-S0206	
Sample No.		AB0447	
Sample Date		12-OCT-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**4.48**	
2A-4,6-DNT	mg/kg	**6.9**	
TNT	mg/kg	3.45	
Volatiles			
Acetone	mg/kg	0.0846	
Benzene	mg/kg	0.00162	J
Carbon disulfide	mg/kg	0.01	
Methylene chloride	mg/kg	0.00622	B
Toluene	mg/kg	0.00184	J
Semivolatiles			
Benzo(a)anthracene	mg/kg	0.0498	J
Benzo(a)pyrene	mg/kg	0.0449	J
Benzo(b)fluoranthene	mg/kg	0.0826	J
Bis(2-ethylhexyl)phthalate	mg/kg	0.0419	J
Di-n-butyl phthalate	mg/kg	0.0494	J
Diethyl phthalate	mg/kg	0.624	B
Fluoranthene	mg/kg	0.086	J
Pesticides/PCBs			
Aroclor 1260	mg/kg	0.14	J
Metals			
Aluminum	mg/kg	7260	J
Arsenic	mg/kg	**6.59**	
Barium	mg/kg	40.4	
Beryllium	mg/kg	0.823	J
Cadmium	mg/kg	0.345	J
Calcium	mg/kg	34900	J
Chromium	mg/kg	13.2	
Cobalt	mg/kg	5.77	
Copper	mg/kg	19	
Iron	mg/kg	16900	
Lead	mg/kg	**79.5**	J
Magnesium	mg/kg	4250	J
Manganese	mg/kg	387	J
Mercury	mg/kg	0.086	J
Nickel	mg/kg	17	
Potassium	mg/kg	1080	J
Sodium	mg/kg	186	B
Vanadium	mg/kg	18.8	
Zinc	mg/kg	151	

Location		TNTC-S0193	
Sample No.		AB0193	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.13	
2A-4,6-DNT	mg/kg	0.70	
4A-2,6-DNT	mg/kg	0.72	

Location		TNTC-S0194	
Sample No.		AB0194	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	1.64	
4A-2,6-DNT	mg/kg	0.94	

Location		TNTC-S0195	
Sample No.		AB0195	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.29	
2A-4,6-DNT	mg/kg	0.16	J
4A-2,6-DNT	mg/kg	0.19	J

Location		TNTC-S0198	
Sample No.		AB0198	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.88	
2A-4,6-DNT	mg/kg	0.93	
4A-2,6-DNT	mg/kg	0.75	
3-NT	mg/kg	0.27	J

Location		TNTC-S0200	
Sample No.		AB0200	
Sample Date		11-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.64	
2,4-DNT	mg/kg	0.16	J
2A-4,6-DNT	mg/kg	0.93	
4A-2,6-DNT	mg/kg	0.59	

Location		TNTC-S0205	
Sample No.		AB205	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.29	
2A-4,6-DNT	mg/kg	0.18	J
4A-2,6-DNT	mg/kg	0.25	

Location		TNTC-S0204	
Sample No.		AB0204	
Sample Date		11-Aug-00	
Sample Depth (ft)		0.5-1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	0.14	J
4A-2,6-DNT	mg/kg	0.13	J

Location		TNTC-S0203	
Sample No.		AB0203	
Sample Date		11-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.57	
2A-4,6-DNT	mg/kg	0.30	
4A-2,6-DNT	mg/kg	0.22	J

Location		TNTC-S0201	
Sample No.		AB0201	
Sample Date		11-Aug-00	
Sample Depth (ft)		0.3 - 1.3	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2A-4,6-DNT	mg/kg	0.30	
4A-2,6-DNT	mg/kg	0.19	J

Location		TNTC-S0202	
Sample No.		AB0202	
Sample Date		11-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.42	
2A-4,6-DNT	mg/kg	0.75	
4A-2,6-DNT	mg/kg	0.44	

Location		TNTC-S0202	
Sample No.		AB0381	
Sample Date		15-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.233	J

Location		TNTC-S0202	
Sample No.		AB0382	
Sample Date		15-SEP-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2-NT	mg/kg	0.372	J
TNT	mg/kg	0.213	J

LEGEND:

△ ABO-193	SCREENING SOIL SAMPLING LOCATION
□ ABO-447	CONFIRMATION SOIL SAMPLING LOCATION
○ GW-17	GROUNDWATER SAMPLING LOCATION
◐ TNTC-MW05	OVERBURDEN MONITORING WELL LOCATION
	FORMER TANK LOCATION
	FORMER BUILDING LOCATION
	POTENTIAL NITROAROMATIC REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 PRELIMINARY REMEDIATION GOALS ARE SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0193	1.0 - 2.0
AB0194	1.0 - 2.0
AB0195	1.0 - 2.0
AB0196	1.0 - 2.0
AB0197	1.0 - 2.0
AB0198	1.0 - 2.0
AB0199	1.0 - 2.0
AB0200	0.5 - 1.5
AB0201	0.3 - 1.3
AB0202	1.0 - 2.0
AB0203	0.5 - 1.5
AB0204	0.5 - 1.5
AB0205	1.0 - 2.0
AB0206	1.0 - 2.0
AB0381	4.0 - 6.0
AB0382	8.0 - 10.0
AB0447	1.0 - 2.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING PRGs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	400	7	104

8. GROUNDWATER WAS ENCOUNTERED IN SEPTEMBER 2000 BORING C-381/382 AT 6 FEET. BEDROCK WAS NOT ENCOUNTERED.
9. GROUNDWATER WAS NOT ENCOUNTERED IN AUGUST 2001 TEMPORARY PIEZOMETER GW-17. BEDROCK WAS ENCOUNTERED AT 8 FEET.

SCALE
0 30 60 FEET

FIGURE 1-29
TNT AREA C
BUILDING 606
WASH HOUSE - LINE 10
ANALYTICAL RESULTS AND ESTIMATED AREA/VOLUME OF SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

STARTING DATE: 10/22/02	DATE LAST REV.:	DRAFT.: C. TUMLIN	INITIATOR: T. SIARD	DWG. NO.: 807112es.067
DRAWN BY: B.VANDERGRIFF	DRAWN BY:	ENGR. CHCK. BY: T. SIARD	PROJ. MGR.: S. DOWNEY	PROJ. NO.: 807112

c:\cadd\design\807112es.067 08/26/03 02:06:02 PM jwaters

DWG. NO.: 807112ES.069 | PROJ. NO.: 807112 | INITIATOR: T. SIARD | PROJ. MGR.: S. DOWNEY | DRAFT. CHCK. BY: C. TUMLIN | ENGR. CHCK. BY: T. SIARD | DATE LAST REV.: | DRAWN BY: | STARTING DATE: 10/22/02 | DRAWN BY: B.VANDERGRIFF

E 1,911,000

E 1,911,100

E 1,911,200

N 620,600

N 620,500

Location		TNTC-S0098	
Sample No.		AB0098	
Sample Date		27-Jul-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.07	
2A-4,6-DNT	mg/kg	0.28	
4A-2,6-DNT	mg/kg	0.17	J

Location		TNTC-S0264	
Sample No.		AB0264	
Sample Date		18-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.12	J
2A-4,6-DNT	mg/kg	0.6	
4A-2,6-DNT	mg/kg	0.57	

Location		TNTC-S0110	
Sample No.		AB0110	
Sample Date		27-Jul-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.32	
TNT	mg/kg	1.34	
2A-4,6-DNT	mg/kg	**3.25**	
4A-2,6-DNT	mg/kg	1.94	

Location		TNTC-S0110	
Sample No.		AB0263	
Sample Date		18-Aug-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.15	J
TNT	mg/kg	0.16	J
2A-4,6-DNT	mg/kg	0.63	
4A-2,6-DNT	mg/kg	0.48	

Location		TNTC-S0251	
Sample No.		AB0251	
Sample Date		18-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.23	J
TNT	mg/kg	**68.6**	
2A-4,6-DNT	mg/kg	1.93	
4A-2,6-DNT	mg/kg	2.38	

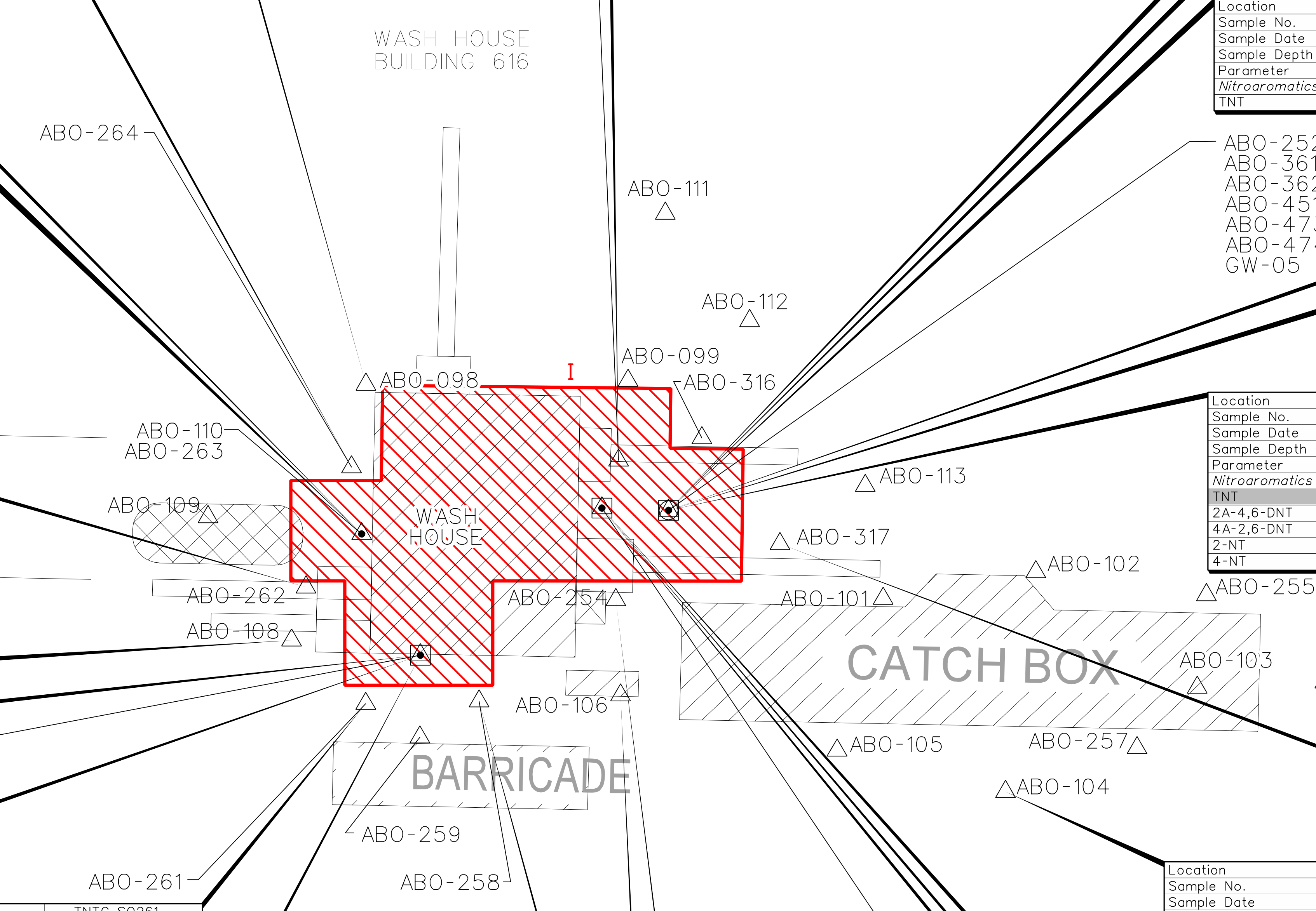
Location		TNTC-S0252	
Sample No.		AB0474	
Sample Date		29-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Volatiles			
Methylene chloride	mg/kg	0.00138	B
Metals			
Aluminum	mg/kg	10800	
Antimony	mg/kg	1.15	J
Arsenic	mg/kg	**13.2**	
Barium	mg/kg	43	
Beryllium	mg/kg	0.633	
Calcium	mg/kg	50800	
Chromium	mg/kg	17.3	
Cobalt	mg/kg	12.1	
Copper	mg/kg	27.2	
Iron	mg/kg	**25600**	
Lead	mg/kg	13.4	
Magnesium	mg/kg	14000	
Manganese	mg/kg	426	
Mercury	mg/kg	0.019	J
Nickel	mg/kg	33	
Potassium	mg/kg	2830	
Sodium	mg/kg	253	
Vanadium	mg/kg	19.8	
Zinc	mg/kg	83.9	

Location		TNTC-S0252	
Sample No.		AB0252	
Sample Date		18-Aug-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	1.5	
1,3-DNB	mg/kg	0.24	J
TNT	mg/kg	**797**	
2,4-DNT	mg/kg	1.86	
2A-4,6-DNT	mg/kg	**5.45**	
HMX	mg/kg	0.4	J
RDX	mg/kg	1.51	

Location		TNTC-S0252	
Sample No.		AB0361	
Sample Date		14-Sep-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	4.81	J

Location		TNTC-S0252	
Sample No.		AB0451	
Sample Date		27-SEP-00	
Sample Depth (ft)		0.5 - 1.5	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	**4.78**	
2A-4,6-DNT	mg/kg	**3.77**	
1,3-DNT	mg/kg	0.0829	J
DNT	mg/kg	0.57	
NB	mg/kg	0.283	
3-NT	mg/kg	0.462	
TNB	mg/kg	0.966	
TNT	mg/kg	**681**	
Volatiles			
Acetone	mg/kg	0.0438	
Butanone, 2-	mg/kg	0.015	
Carbon disulfide	mg/kg	0.00347	J
Methylene chloride	mg/kg	0.00772	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**0.899**	J
Pesticides/PCBs			
Aroclor 1260	mg/kg	**0.41**	
Metals			
Aluminum	mg/kg	3880	J
Antimony	mg/kg	1.03	J
Arsenic	mg/kg	**3.75**	
Barium	mg/kg	19.6	
Beryllium	mg/kg	0.294	
Cadmium	mg/kg	0.163	J
Calcium	mg/kg	5710	J
Chromium	mg/kg	38	
Cobalt	mg/kg	3.45	
Copper	mg/kg	13.1	J
Iron	mg/kg	11500	
Lead	mg/kg	**117**	J
Magnesium	mg/kg	1600	J
Manganese	mg/kg	119	
Mercury	mg/kg	0.247	
Nickel	mg/kg	24.9	
Potassium	mg/kg	507	
Sodium	mg/kg	252	
Vanadium	mg/kg	18	
Zinc	mg/kg	55.4	

Location		TNTC-S0262	
Sample No.		AB0262	
Sample Date		18-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.36	
2,4-DNT	mg/kg	0.12	J
2A-4,6-DNT	mg/kg	0.16	J
4A-2,6-DNT	mg/kg	0.16	J



Location		TNTC-S0252	
Sample No.		AB0473	
Sample Date		29-SEP-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics			
2A-4,6-DNT	mg/kg	0.275	
DNT	mg/kg	0.121	
TNT	mg/kg	1.32	
Semivolatiles			
Bis(2-ethylhexyl)phthalate	mg/kg	0.0207	J
Metals			
Aluminum	mg/kg	11000	
Arsenic	mg/kg	**18.5**	
Barium	mg/kg	62.3	
Beryllium	mg/kg	0.683	
Calcium	mg/kg	34700	
Chromium	mg/kg	17.2	
Cobalt	mg/kg	10.8	
Copper	mg/kg	29.7	
Iron	mg/kg	**27600**	
Lead	mg/kg	14.6	
Magnesium	mg/kg	10300	
Manganese	mg/kg	295	
Mercury	mg/kg	0.019	J
Nickel	mg/kg	31.9	
Potassium	mg/kg	2690	
Sodium	mg/kg	264	
Vanadium	mg/kg	20.9	
Zinc	mg/kg	91.4	

Location		TNTC-S0252	
Sample No.		AB0362	
Sample Date		14-Sep-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	8.66	
2A-4,6-DNT	mg/kg	1.67	
4A-2,6-DNT	mg/kg	0.455	
2-NT	mg/kg	0.494	J
4-NT	mg/kg	0.346	J

Location		TNTC-S0108	
Sample No.		AB0108	
Sample Date		27-Jul-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.63	
2,4-DNT	mg/kg	0.14	J
2A-4,6-DNT	mg/kg	0.18	J

Location		TNTC-S0107	
Sample No.		AB0107	
Sample Date		27-Jul-00	
Sample Depth (ft)		3.0 - 4.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	**39.9**	
2A-4,6-DNT	mg/kg	0.13	J

Location		TNTC-S0104	
Sample No.		AB0104	
Sample Date		27-Jul-00	
Sample Depth (ft)		2.0 - 3.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.19	J

Location		TNTC-S0317	
Sample No.		AB0317	
Sample Date		23-SEP-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
4A-2,6-DNT	mg/kg	0.226	J
2A-4,6-DNT	mg/kg	0.444	
TNT	mg/kg	0.608	

Location		TNTC-S0107	
Sample No.		AB0432	
Sample Date		10-OCT-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics			
TNT	mg/kg	0.566	
Volatiles			
Acetone	mg/kg	0.0861	J
Methylene chloride	mg/kg	0.0188	B
Semivolatiles			
Benzo(a)anthracene	mg/kg	0.269	J
Benzo(a)pyrene	mg/kg	**0.305**	J
Benzo(b)fluoranthene	mg/kg	0.443	
Benzo(ghi)perylene	mg/kg	0.222	J
Benzo(k)fluoranthene	mg/kg	0.178	J
Bis(2-ethylhexyl)phthalate	mg/kg	0.0328	J
Chrysene	mg/kg	0.31	J
Dibenz(a,h)anthracene	mg/kg	**0.0817**	J
Fluoranthene	mg/kg	0.409	J
Indeno(1,2,3-cd)pyrene	mg/kg	0.21	J
Phenanthrene	mg/kg	0.107	J
Pyrene	mg/kg	0.33	J
Pesticides/PCBs			
Aroclor 1260	mg/kg	0.088	
Metals			
Aluminum	mg/kg	5290	J
Antimony	mg/kg	1.59	
Arsenic	mg/kg	**3.86**	B
Barium	mg/kg	57.7	
Beryllium	mg/kg	0.403	
Cadmium	mg/kg	0.316	J
Calcium	mg/kg	10700	
Chromium	mg/kg	13.7	
Cobalt	mg/kg	5.03	
Copper	mg/kg	99.8	
Iron	mg/kg	12900	
Lead	mg/kg	**361**	
Magnesium	mg/kg	1660	
Manganese	mg/kg	505	
Mercury	mg/kg	0.04	B
Nickel	mg/kg	11.9	
Potassium	mg/kg	1070	
Sodium	mg/kg	227	J
Vanadium	mg/kg	16.9	
Zinc	mg/kg	171	

Location		TNTC-S0261	
Sample No.		AB0261	
Sample Date		18-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.1	

Location		TNTC-S0107	
Sample No.		AB0433	
Sample Date		10-OCT-00	
Sample Depth (ft)		3.0 - 4.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.293	
2A-4,6-DNT	mg/kg	0.226	
TNB	mg/kg	0.238	
TNT	mg/kg	**47.3**	
Volatiles			
Acetone	mg/kg	0.0204	J
Methylene chloride	mg/kg	0.00523	B
Semivolatiles			
Bis(2-ethylhexyl)phthalate	mg/kg	0.0883	J
Pesticides/PCBs			
Aroclor 1260	mg/kg	0.03	J
Metals			
Aluminum	mg/kg	3750	J
Arsenic	mg/kg	**3.68**	B
Barium	mg/kg	14.6	
Beryllium	mg/kg	0.28	
Calcium	mg/kg	2790	
Chromium	mg/kg	7.44	
Cobalt	mg/kg	3.16	
Copper	mg/kg	5.36	
Iron	mg/kg	8140	
Lead	mg/kg	15.3	
Magnesium	mg/kg	1660	
Manganese	mg/kg	122	
Mercury	mg/kg	0.114	B
Nickel	mg/kg	9.44	
Potassium	mg/kg	639	
Sodium	mg/kg	110	J
Vanadium	mg/kg	12.2	
Zinc	mg/kg	31.3	

Location		TNTC-S0258	
Sample No.		AB0258	
Sample Date		18-Aug-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.13	
2A-4,6-DNT	mg/kg	0.37	
4A-2,6-DNT	mg/kg	0.32	

Location		TNTC-S0106	
Sample No.		AB0106	
Sample Date		27-Jul-00	
Sample Depth (ft)		3.0 - 4.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.24	
2A-4,6-DNT	mg/kg	0.14	J
4A-2,6-DNT	mg/kg	0.11	J

Location		TNTC-S0254	
Sample No.		AB0254	
Sample Date		18-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
1,3-TNB	mg/kg	0.24	J
TNT	mg/kg	0.3	
2A-4,6-DNT	mg/kg	0.14	J

Location		TNTC-S0100	
Sample No.		AB0476	
Sample Date		12-OCT-00	
Sample Depth (ft)		2.0 - 3.0	
Parameter	Units	Result	Qual
Nitroaromatics			
2A-4,6-DNT	mg/kg	**6.44**	
NB	mg/kg	0.195	
TNB	mg/kg	0.499	
TNT	mg/kg	**2226**	
Volatiles			
Acetone	mg/kg	0.0196	J
Carbon disulfide	mg/kg	0.00175	J
Methylene chloride	mg/kg	0.00798	B
Semivolatiles			
Bis(2-ethylhexyl)phthalate	mg/kg	0.0324	J
Diethyl phthalate	mg/kg	0.622	B
Dinitrotoluene, 2,4-	mg/kg	0.496	
Pesticides/PCBs			
Aroclor 1260	mg/kg	**0.26**	
Metals			
Aluminum	mg/kg	4540	J
Antimony	mg/kg	0.654	B
Arsenic	mg/kg	3.32	
Barium	mg/kg	28.3	
Beryllium	mg/kg	0.36	J
Cadmium	mg/kg	0.498	J
Calcium	mg/kg	10700	J
Chromium	mg/kg	9.85	
Cobalt	mg/kg	3.23	
Copper	mg/kg	35.9	
Iron	mg/kg	11500	
Lead	mg/kg	111	J
Magnesium	mg/kg	1910	J
Manganese	mg/kg	211	J
Mercury	mg/kg	0.072	J
Nickel	mg/kg	8.95	
Potassium	mg/kg	706	J
Sodium	mg/kg	134	B
Vanadium	mg/kg	17.1	
Zinc	mg/kg	86.1	

Location		TNTC-S0100	
Sample No.		AB0253	
Sample Date		18-Aug-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.97	
2A-4,6-DNT	mg/kg	0.16	J
4A-2,6-DNT	mg/kg	0.16	J

Location		TNTC-S0100	
Sample No.		AB0100	
Sample Date		27-Jul-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.54	
TNT	mg/kg	**47.2**	
2A-4,6-DNT	mg/kg	0.64	
4A-2,6-DNT	mg/kg	0.44	

LEGEND:

- △ ABO-101 — SCREENING SOIL SAMPLING LOCATION
- • ABO-253 — SURFACE SOIL SAMPLE (0 - 2 FT)
- ○ GW-05 — GROUNDWATER SAMPLING LOCATION
- □ ABO-476 — CONFIRMATION SOIL SAMPLING LOCATION
- TNTC-S21 — HISTORICAL SOIL BORING LOCATION
- TNTB-S6 — HISTORICAL SOIL BORING LOCATION WITH EXPLOSIVES DETECTION
- FORMER TANK LOCATION
- FORMER BUILDING LOCATION
- POTENTIAL NITROAROMATIC REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 PRELIMINARY REMEDIATION GOALS ARE SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0098	1.0 - 2.0
AB0099	0.5 - 1.5
AB0100	2.0 - 3.0
AB0101	0.5 - 1.5
AB0102	1.0 - 2.0
AB0103	1.0 - 2.0
AB0104	2.0 - 3.0
AB0105	0.5 - 1.5
AB0106	3.0 - 4.0
AB0107	3.0 - 4.0
AB0108	1.0 - 2.0
AB0109	1.0 - 2.0
AB0110	1.0 - 2.0
AB0111	0.5 - 1.5
AB0112	0.5 - 1.5
AB0113	0.5 - 1.5
AB0251	0.5 - 1.5
AB0252	0.5 - 1.5
AB0253	0.0 - 1.0
AB0254	1.5 - 2.5
AB0255	1.0 - 2.0
AB0256	0.5 - 1.5
AB0257	1.0 - 2.0
AB0258	1.0 - 2.0
AB0259	0.5 - 1.5
AB0260	0.0 - 1.0
AB0261	1.0 - 2.0
AB0262	1.0 - 2.0
AB0263	0.0 - 1.0
AB0264	1.0 - 2.0
AB0300	5.0 - 6.0
AB0316	1.0 - 2.0
AB0317	1.0 - 2.0
AB0361	4.0 - 6.0
AB0362	8.0 - 10.0
AB0432	0.0 - 1.0
AB0433	3.0 - 4.0
AB0449	0.5 - 1.5
AB0450	0.5 - 1.5
AB0451	0.5 - 1.5
AB0473	4.0 - 6.0
AB0474	8.0 - 10.0
AB0476	2.0 - 3.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	1619	8	480

8. GROUNDWATER ENCOUNTERED AT 8 FEET IN SEPTEMBER 2000, C-361/362 BORING. GROUNDWATER MEASURED IN TEMPORARY PIEZOMETER GW-05 AT 0.90 FEET. BEDROCK WAS ENCOUNTERED AT 16.55 FEET.
9. COMBINED PAH CHEMICALS OF CONCERN EXCEEDING 1 mg/kg RGO IN SAMPLE ABO432.

SCALE: 0 — 20 — 40 FEET

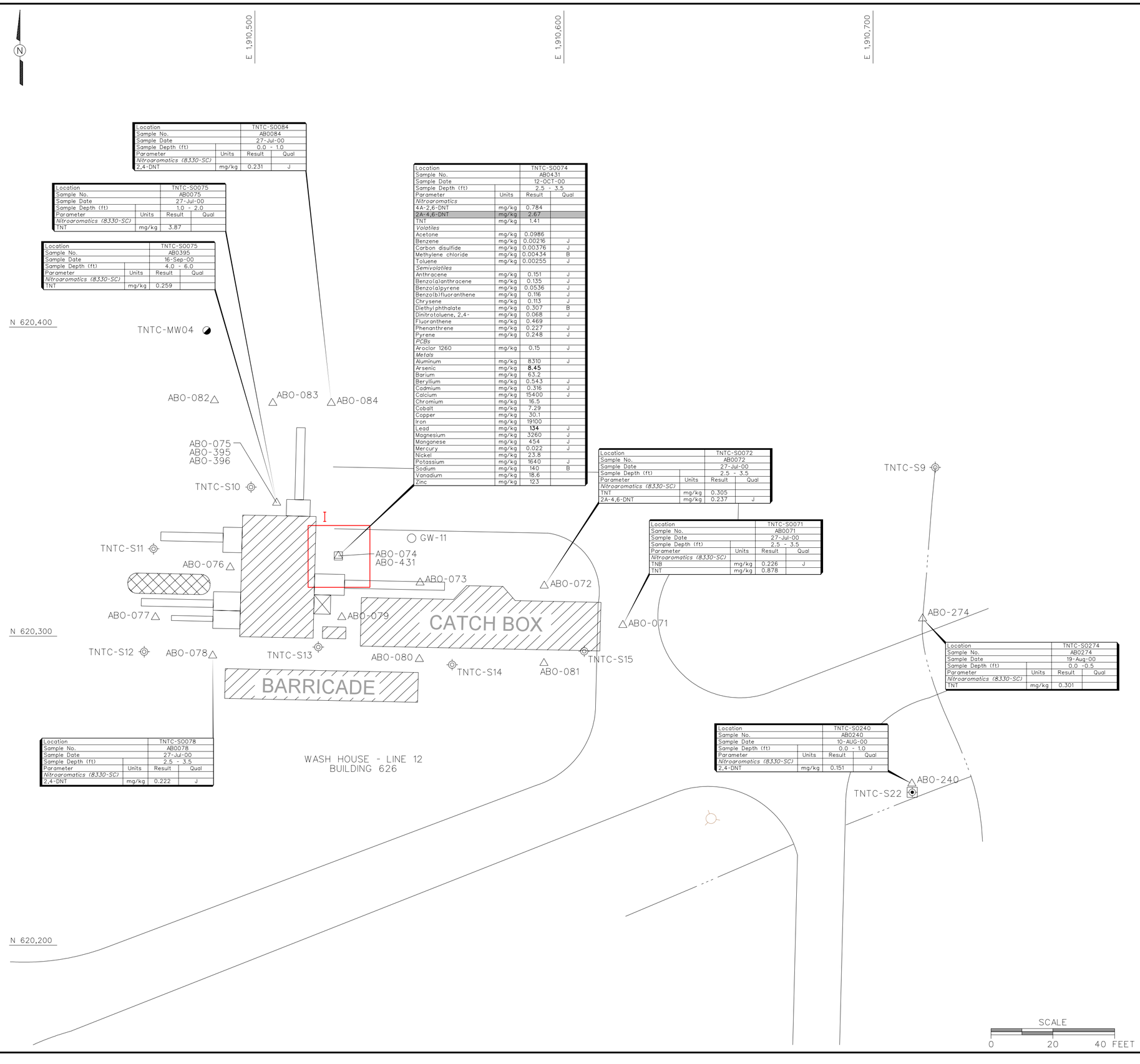
FIGURE 1-30
TNT AREA C BUILDING 616 WASH HOUSE LINE 11, ANALYTICAL RESULTS AND ESTIMATED AREA/VOLUME OF SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

jwaters 08/26/03 02:10:33 PM 807112es.069

STARTING DATE: 10/30/00 | DATE LAST REV.: | DRAFT. CHCK. BY: | INITIATOR: T. SIARD | DWG. NO.: 807112ES.028
DRAWN BY: B.VANDERGRIFF | DRAWN BY: | ENGR. CHCK. BY: D. KESSLER | PROJ. MGR.: S. DOWNEY | PROJ. NO.: 807112
c:\caddh\design\807112es.028 | 08/26/03 | 02:16:08 PM | jwaters



Location		TNTC-S0084	
Sample No.		AB0084	
Sample Date		27-Jul-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.231	J

Location		TNTC-S0075	
Sample No.		AB0075	
Sample Date		27-Jul-00	
Sample Depth (ft)		1.0 - 2.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	3.87	

Location		TNTC-S0075	
Sample No.		AB0395	
Sample Date		16-Sep-00	
Sample Depth (ft)		4.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.259	

Location		TNTC-S0074	
Sample No.		AB0431	
Sample Date		12-OCT-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.784	
2A-4,6-DNT	mg/kg	2.67	
TNT	mg/kg	1.41	
Volatiles			
Acetone	mg/kg	0.0986	
Benzene	mg/kg	0.00216	J
Carbon disulfide	mg/kg	0.00376	J
Methylene chloride	mg/kg	0.00434	B
Toluene	mg/kg	0.00255	J
Semivolatiles			
Anthracene	mg/kg	0.151	J
Benzo(a)anthracene	mg/kg	0.135	J
Benzo(a)pyrene	mg/kg	0.0536	J
Benzo(b)fluoranthene	mg/kg	0.116	J
Chrysene	mg/kg	0.113	J
Diethyl phthalate	mg/kg	0.307	B
Dinitrotoluene, 2,4-	mg/kg	0.068	J
Fluoranthene	mg/kg	0.469	
Phenanthrene	mg/kg	0.227	J
Pyrene	mg/kg	0.248	J
PCBs			
Aroclor 1260	mg/kg	0.15	J
Metals			
Aluminum	mg/kg	8310	J
Arsenic	mg/kg	**8.45**	
Barium	mg/kg	63.2	
Beryllium	mg/kg	0.543	J
Cadmium	mg/kg	0.316	J
Calcium	mg/kg	15400	J
Chromium	mg/kg	16.5	
Cobalt	mg/kg	7.29	
Copper	mg/kg	30.1	
Iron	mg/kg	19100	
Lead	mg/kg	**134**	J
Magnesium	mg/kg	3260	J
Manganese	mg/kg	454	J
Mercury	mg/kg	0.022	J
Nickel	mg/kg	23.8	
Potassium	mg/kg	1640	J
Sodium	mg/kg	140	B
Vanadium	mg/kg	18.6	
Zinc	mg/kg	123	

Location		TNTC-S0072	
Sample No.		AB0072	
Sample Date		27-Jul-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.305	
2A-4,6-DNT	mg/kg	0.237	J

Location		TNTC-S0071	
Sample No.		AB0071	
Sample Date		27-Jul-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.226	J
TNT	mg/kg	0.878	

Location		TNTC-S0274	
Sample No.		AB0274	
Sample Date		19-Aug-00	
Sample Depth (ft)		0.0 -0.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.301	

Location		TNTC-S0240	
Sample No.		AB0240	
Sample Date		10-AUG-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.151	J

Location		TNTC-S0078	
Sample No.		AB0078	
Sample Date		27-Jul-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.222	J

LEGEND:

△ AB0-178	SCREENING SOIL SAMPLING LOCATION
□ AB0-465	CONFIRMATION SOIL SAMPLING LOCATION
TNTC-S10	HISTORICAL SOIL BORING LOCATION
TNTC-S22	HISTORICAL SOIL BORING LOCATION WITH EXPLOSIVES DETECTION
TNTC-MW04	OVERBURDEN MONITORING WELL LOCATION
○ GW-11	JULY 2001 TEMPORARY PIEZOMETER LOCATION (DRY)
	FORMER TANK LOCATION
	FORMER BUILDING FOUNDATION
	POTENTIAL REMEDIATION AREA
	FIRE HYDRANT

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 PRELIMINARY REMEDIATION GOALS ARE SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0071	2.5 - 3.5
AB0072	2.5 - 3.5
AB0073	2.5 - 3.5
AB0074	2.5 - 3.5
AB0075	1.0 - 2.0
AB0076	2.5 - 3.5
AB0077	2.5 - 3.5
AB0078	2.5 - 3.5
AB0079	2.5 - 3.5
AB0080	2.5 - 3.5
AB0081	2.5 - 3.5
AB0082	0.0 - 1.0
AB0083	0.0 - 1.0
AB0084	0.0 - 1.0
AB0240	0.0 - 1.0
AB0395	4.0 - 6.0
AB0396	8.0 - 10.0
AB0431	2.5 - 3.5

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	400	8	119

8. ENCOUNTERED GROUNDWATER AT 8 FEET IN SEPTEMBER 2000 BORING C-395/396. BEDROCK NOT DETECTED IN 10 FOOT BORING.
9. GROUNDWATER NOT PRESENT IN JULY 2001 TEMPORARY PIEZOMETER GW-11, BEDROCK ENCOUNTERED AT 8.5 FEET.
10. ENCOUNTERED BEDROCK AT 18 FEET, GROUNDWATER AT 16 FEET IN OCTOBER 1994 BORING TNTC-MW04.

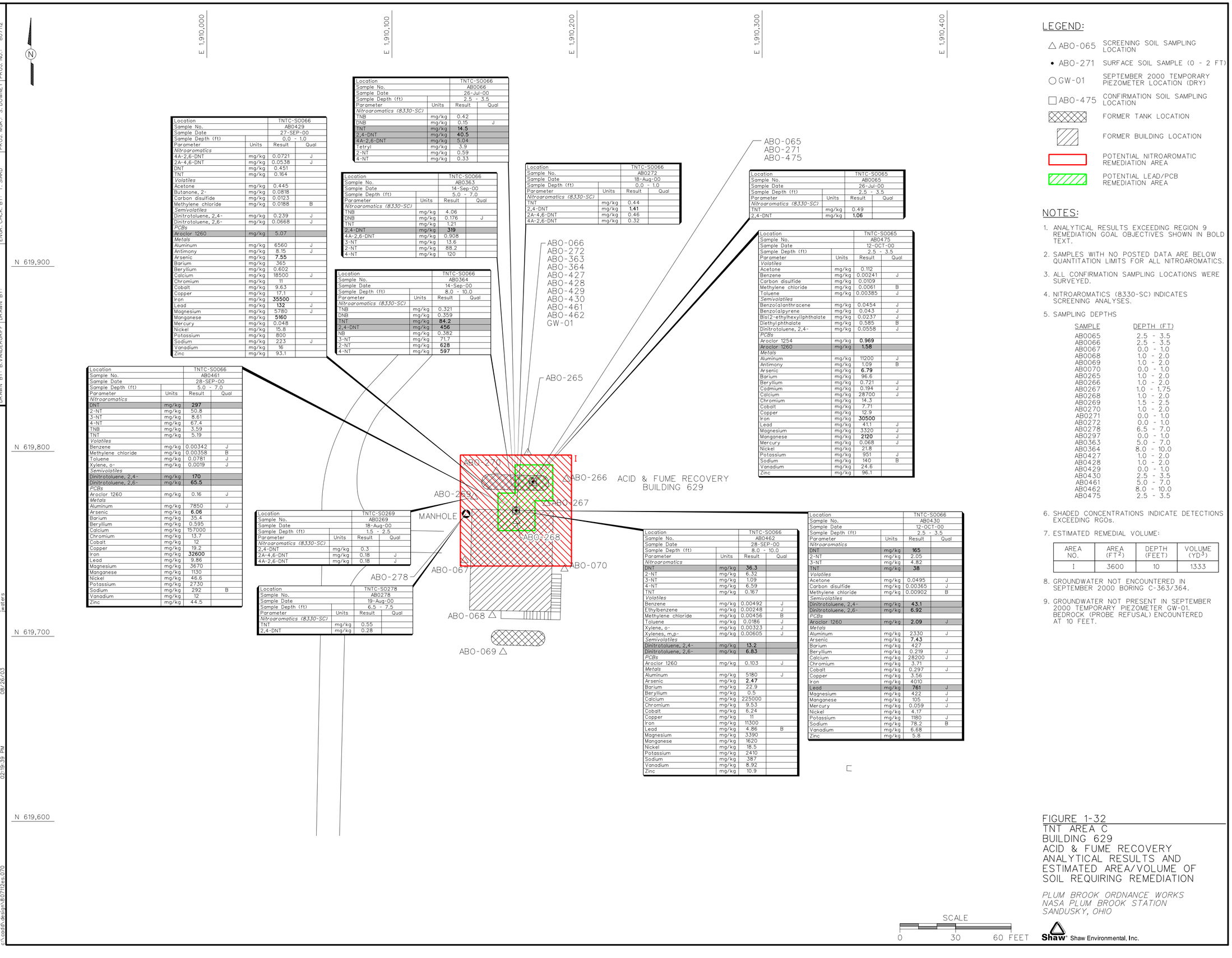
SCALE
0 20 40 FEET

Shaw Shaw Environmental, Inc.

FIGURE 1-31
TNT AREA C
BUILDING 626
WASH HOUSE - LINE 12
ANALYTICAL RESULTS AND
ESTIMATED AREA/VOLUME
OF SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

STARTING DATE: 10/22/02 | DATE LAST REV.: | DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: T. SIARD | DWG. NO.: 807112es.070
DRAWN BY: B.VANDERGRIFF | DRAWN BY: | ENGR. CHCK. BY: T. SIARD | PROJ. MGR.: S. DOWNEY | PROJ. NO.: 807112



Location		TNTC-S0066	
Sample No.		AB0429	
Sample Date		27-SEP-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.0721	J
2A-4,6-DNT	mg/kg	0.0538	J
DNT	mg/kg	0.451	
TNT	mg/kg	0.164	
Volatiles			
Acetone	mg/kg	0.445	
Butanone, 2-	mg/kg	0.0818	
Carbon disulfide	mg/kg	0.0123	
Methylene chloride	mg/kg	0.0188	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	0.239	J
Dinitrotoluene, 2,6-	mg/kg	0.0668	J
PCBs			
Aroclor 1260	mg/kg	5.07	
Metals			
Aluminum	mg/kg	6560	J
Antimony	mg/kg	8.15	J
Arsenic	mg/kg	**7.55**	
Barium	mg/kg	365	
Beryllium	mg/kg	0.602	
Calcium	mg/kg	18500	J
Chromium	mg/kg	11	
Cobalt	mg/kg	9.63	
Copper	mg/kg	17.1	J
Iron	mg/kg	**35500**	
Lead	mg/kg	**132**	J
Magnesium	mg/kg	5780	J
Manganese	mg/kg	**5160**	
Mercury	mg/kg	0.048	
Nickel	mg/kg	15.8	
Potassium	mg/kg	800	
Sodium	mg/kg	223	J
Vanadium	mg/kg	16	
Zinc	mg/kg	93.1	

Location		TNTC-S0066	
Sample No.		AB0066	
Sample Date		26-Jul-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.42	
DNB	mg/kg	0.15	J
TNT	mg/kg	**14.5**	
2,4-DNT	mg/kg	**40.5**	
4A-2,6-DNT	mg/kg	5.04	
Tetryl	mg/kg	3.9	
2-NT	mg/kg	0.59	
4-NT	mg/kg	0.33	

Location		TNTC-S0066	
Sample No.		AB0363	
Sample Date		14-Sep-00	
Sample Depth (ft)		5.0 - 7.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	4.06	
DNB	mg/kg	0.176	J
TNT	mg/kg	1.21	
2,4-DNT	mg/kg	**319**	
4A-2,6-DNT	mg/kg	0.908	
3-NT	mg/kg	13.6	
2-NT	mg/kg	88.2	
4-NT	mg/kg	120	

Location		TNTC-S0066	
Sample No.		AB0364	
Sample Date		14-Sep-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNB	mg/kg	0.321	
DNB	mg/kg	0.359	
TNT	mg/kg	**84.2**	
2,4-DNT	mg/kg	**456**	
NB	mg/kg	0.382	
3-NT	mg/kg	71.7	
2-NT	mg/kg	**628**	
4-NT	mg/kg	**597**	

Location		TNTC-S0066	
Sample No.		AB0272	
Sample Date		18-Aug-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.44	
2,4-DNT	mg/kg	**1.41**	
2A-4,6-DNT	mg/kg	0.46	
4A-2,6-DNT	mg/kg	0.32	

Location		TNTC-S0065	
Sample No.		AB0065	
Sample Date		26-Jul-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.49	
2,4-DNT	mg/kg	**1.06**	

Location		TNTC-S0065	
Sample No.		AB0475	
Sample Date		12-OCT-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Volatiles			
Acetone	mg/kg	0.112	
Benzene	mg/kg	0.00241	J
Carbon disulfide	mg/kg	0.0109	
Methylene chloride	mg/kg	0.0061	B
Toluene	mg/kg	0.00385	J
Semivolatiles			
Benzo(a)anthracene	mg/kg	0.0454	J
Benzo(a)pyrene	mg/kg	0.043	J
Bis(2-ethylhexyl)phthalate	mg/kg	0.0237	J
Diethylphthalate	mg/kg	0.585	B
Dinitrotoluene, 2,4-	mg/kg	0.0558	J
PCBs			
Aroclor 1254	mg/kg	**0.969**	
Aroclor 1260	mg/kg	**1.58**	
Metals			
Aluminum	mg/kg	11200	J
Antimony	mg/kg	1.09	B
Arsenic	mg/kg	**6.79**	
Barium	mg/kg	96.6	
Beryllium	mg/kg	0.721	J
Cadmium	mg/kg	0.194	J
Calcium	mg/kg	28700	J
Chromium	mg/kg	14.3	
Cobalt	mg/kg	7.71	
Copper	mg/kg	12.9	
Iron	mg/kg	**30500**	
Lead	mg/kg	41.1	J
Magnesium	mg/kg	3320	J
Manganese	mg/kg	**2120**	J
Mercury	mg/kg	0.068	J
Nickel	mg/kg	21.8	
Potassium	mg/kg	951	J
Sodium	mg/kg	140	B
Vanadium	mg/kg	24.6	
Zinc	mg/kg	96.1	

Location		TNTC-S0066	
Sample No.		AB0461	
Sample Date		28-SEP-00	
Sample Depth (ft)		5.0 - 7.0	
Parameter	Units	Result	Qual
Nitroaromatics			
DNT	mg/kg	**297**	
2-NT	mg/kg	50.8	
3-NT	mg/kg	8.61	
4-NT	mg/kg	67.4	
TNB	mg/kg	3.59	
TNT	mg/kg	5.19	
Volatiles			
Benzene	mg/kg	0.00342	J
Methylene chloride	mg/kg	0.00358	B
Toluene	mg/kg	0.0781	J
Xylene, o-	mg/kg	0.0019	J
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**170**	
Dinitrotoluene, 2,6-	mg/kg	**65.5**	
PCBs			
Aroclor 1260	mg/kg	0.16	J
Metals			
Aluminum	mg/kg	7850	J
Arsenic	mg/kg	**6.06**	
Barium	mg/kg	35.4	
Beryllium	mg/kg	0.595	
Calcium	mg/kg	157000	
Chromium	mg/kg	13.7	
Cobalt	mg/kg	12	
Copper	mg/kg	19.2	
Iron	mg/kg	**32600**	
Lead	mg/kg	9.86	
Magnesium	mg/kg	3670	
Manganese	mg/kg	1130	
Nickel	mg/kg	46.6	
Potassium	mg/kg	2730	
Sodium	mg/kg	292	B
Vanadium	mg/kg	12	
Zinc	mg/kg	44.5	

Location		TNTC-S0269	
Sample No.		AB0269	
Sample Date		18-Aug-00	
Sample Depth (ft)		1.5 - 2.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
2,4-DNT	mg/kg	0.3	
2A-4,6-DNT	mg/kg	0.18	J
4A-2,6-DNT	mg/kg	0.18	J

Location		TNTC-S0278	
Sample No.		AB0278	
Sample Date		19-Aug-00	
Sample Depth (ft)		6.5 - 7.5	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.55	
2,4-DNT	mg/kg	0.28	

Location		TNTC-S0066	
Sample No.		AB0462	
Sample Date		28-SEP-00	
Sample Depth (ft)		8.0 - 10.0	
Parameter	Units	Result	Qual
Nitroaromatics			
DNT	mg/kg	**36.3**	
2-NT	mg/kg	6.32	
3-NT	mg/kg	1.09	
4-NT	mg/kg	6.59	
TNT	mg/kg	0.167	
Volatiles			
Benzene	mg/kg	0.00492	J
Ethylbenzene	mg/kg	0.00248	J
Methylene chloride	mg/kg	0.00456	B
Toluene	mg/kg	0.0186	J
Xylene, o-	mg/kg	0.00323	J
Xylenes, m,p-	mg/kg	0.00605	J
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**13.2**	
Dinitrotoluene, 2,6-	mg/kg	**6.83**	
PCBs			
Aroclor 1260	mg/kg	0.103	J
Metals			
Aluminum	mg/kg	5180	J
Arsenic	mg/kg	**2.47**	
Barium	mg/kg	22.9	
Beryllium	mg/kg	0.5	
Calcium	mg/kg	225000	
Chromium	mg/kg	9.53	
Cobalt	mg/kg	6.24	
Copper	mg/kg	11	
Iron	mg/kg	11300	
Lead	mg/kg	4.86	B
Magnesium	mg/kg	3390	
Manganese	mg/kg	1620	
Nickel	mg/kg	18.5	
Potassium	mg/kg	2410	
Sodium	mg/kg	387	
Vanadium	mg/kg	8.92	
Zinc	mg/kg	10.9	

Location		TNTC-S0066	
Sample No.		AB0430	
Sample Date		12-OCT-00	
Sample Depth (ft)		2.5 - 3.5	
Parameter	Units	Result	Qual
Nitroaromatics			
DNT	mg/kg	**165**	
2-NT	mg/kg	2.05	
3-NT	mg/kg	4.82	
TNT	mg/kg	**38**	
Volatiles			
Acetone	mg/kg	0.0495	J
Carbon disulfide	mg/kg	0.00365	J
Methylene chloride	mg/kg	0.00902	B
Semivolatiles			
Dinitrotoluene, 2,4-	mg/kg	**43.1**	
Dinitrotoluene, 2,6-	mg/kg	**6.92**	
PCBs			
Aroclor 1260	mg/kg	**2.09**	J
Metals			
Aluminum	mg/kg	2330	J
Arsenic	mg/kg	**7.43**	
Barium	mg/kg	427	
Beryllium	mg/kg	0.219	J
Calcium	mg/kg	28200	J
Chromium	mg/kg	3.71	
Cobalt	mg/kg	0.297	J
Copper	mg/kg	3.56	
Iron	mg/kg	4010	
Lead	mg/kg	**761**	J
Magnesium	mg/kg	422	J
Manganese	mg/kg	105	J
Mercury	mg/kg	0.059	J
Nickel	mg/kg	4.17	
Potassium	mg/kg	1180	J
Sodium	mg/kg	78.2	B
Vanadium	mg/kg	6.68	
Zinc	mg/kg	5.8	

LEGEND:

- △ ABO-065 — SCREENING SOIL SAMPLING LOCATION
- • ABO-271 — SURFACE SOIL SAMPLE (0 - 2 FT)
- ○ GW-01 — SEPTEMBER 2000 TEMPORARY PIEZOMETER LOCATION (DRY)
- □ ABO-475 — CONFIRMATION SOIL SAMPLING LOCATION
- FORMER TANK LOCATION
- FORMER BUILDING LOCATION
- POTENTIAL NITROAROMATIC REMEDIATION AREA
- POTENTIAL LEAD/PCB REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 REMEDIATION GOAL OBJECTIVES SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0065	2.5 - 3.5
AB0066	2.5 - 3.5
AB0067	0.0 - 1.0
AB0068	1.0 - 2.0
AB0069	1.0 - 2.0
AB0070	0.0 - 1.0
AB0265	1.0 - 2.0
AB0266	1.0 - 2.0
AB0267	1.0 - 1.75
AB0268	1.0 - 2.0
AB0269	1.5 - 2.5
AB0270	1.0 - 2.0
AB0271	0.0 - 1.0
AB0272	0.0 - 1.0
AB0278	6.5 - 7.0
AB0297	0.0 - 1.0
AB0363	5.0 - 7.0
AB0364	8.0 - 10.0
AB0427	1.0 - 2.0
AB0428	1.0 - 2.0
AB0429	0.0 - 1.0
AB0430	2.5 - 3.5
AB0461	5.0 - 7.0
AB0462	8.0 - 10.0
AB0475	2.5 - 3.5

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	3600	10	1333

8. GROUNDWATER NOT ENCOUNTERED IN SEPTEMBER 2000 BORING C-363/364.
9. GROUNDWATER NOT PRESENT IN SEPTEMBER 2000 TEMPORARY PIEZOMETER GW-01. BEDROCK (PROBE REFUSAL) ENCOUNTERED AT 10 FEET.

SCALE
0 30 60 FEET

FIGURE 1-32
TNT AREA C
BUILDING 629
ACID & FUME RECOVERY
ANALYTICAL RESULTS AND
ESTIMATED AREA/VOLUME OF
SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

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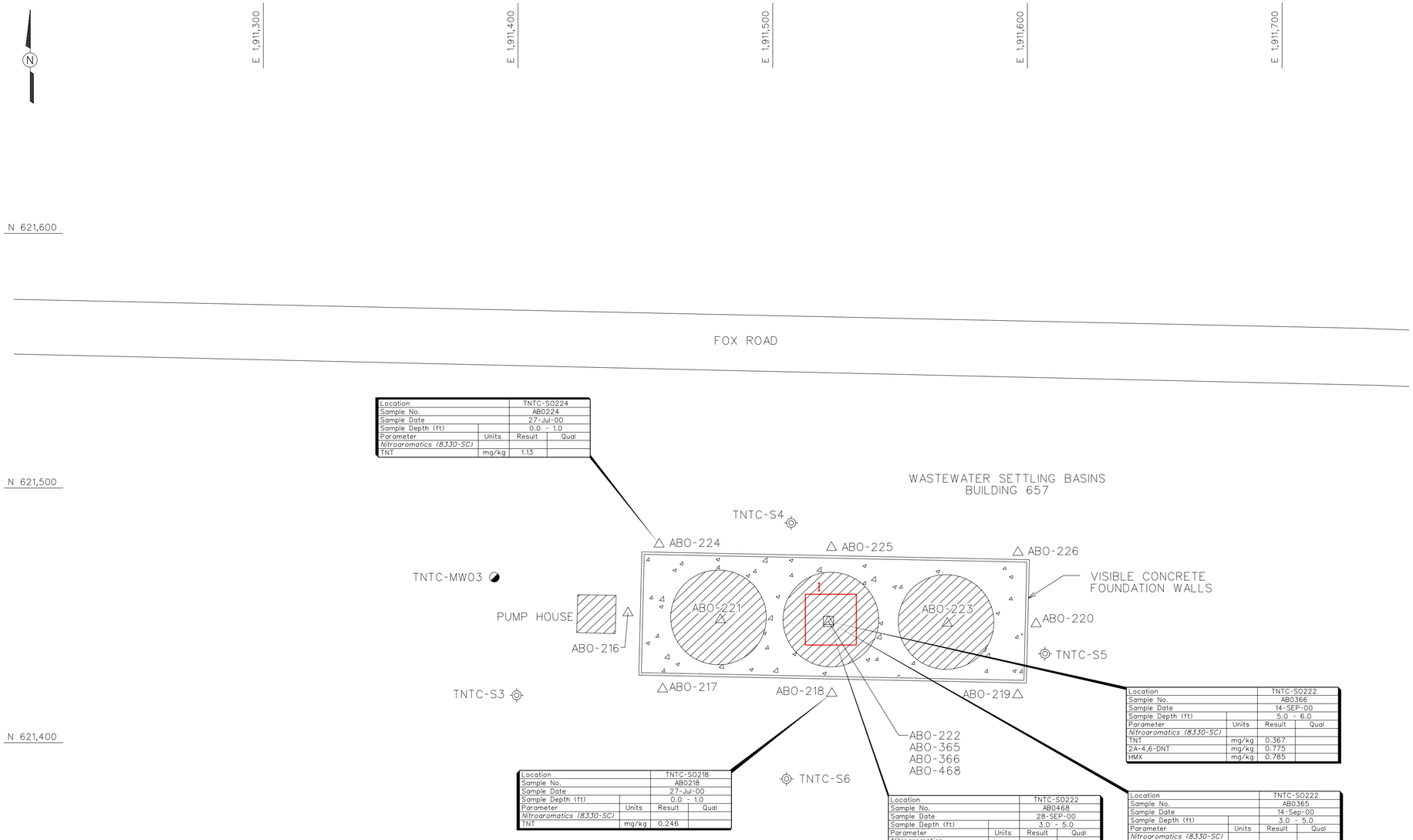
STARTING DATE: 11/01/00 | DATE LAST REV.: | DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: GUNDERSON | DWG. NO.: 807112es.073
DRAWN BY: B.VANDERGRIFF | DRAWN BY: | ENGR. CHCK. BY: S. MUFFLER | PROJ. MGR.: SPANGBERG | PROJ. NO.: 807112



Location		TNTC-S0224	
Sample No.		AB0224	
Sample Date		27-Jul-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	1.13	

Location		TNTC-S0222	
Sample No.		AB0366	
Sample Date		14-SEP-00	
Sample Depth (ft)		5.0 - 6.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.367	
2A-4,6-DNT	mg/kg	0.775	
HMX	mg/kg	0.785	

Location		TNTC-S0222	
Sample No.		AB0365	
Sample Date		14-Sep-00	
Sample Depth (ft)		3.0 - 5.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.489	
2,4-DNT	mg/kg	**0.948**	
2A-4,6-DNT	mg/kg	0.208	J
4A-2,6-DNT	mg/kg	0.276	
2-NT	mg/kg	0.864	
4-NT	mg/kg	0.695	

Location		TNTC-S0218	
Sample No.		AB0218	
Sample Date		27-Jul-00	
Sample Depth (ft)		0.0 - 1.0	
Parameter	Units	Result	Qual
Nitroaromatics (8330-SC)			
TNT	mg/kg	0.246	

Location		TNTC-S0222	
Sample No.		AB0468	
Sample Date		28-SEP-00	
Sample Depth (ft)		3.0 - 5.0	
Parameter	Units	Result	Qual
Nitroaromatics			
4A-2,6-DNT	mg/kg	0.151	
DNT	mg/kg	0.483	
2-NT	mg/kg	1.94	
3-NT	mg/kg	0.263	
4-NT	mg/kg	1.99	
TNT	mg/kg	0.166	
Volatiles			
Acetone	mg/kg	0.0644	J
Carbon disulfide	mg/kg	0.0075	
Methylene chloride	mg/kg	0.00308	B
Toluene	mg/kg	0.00194	J
Semivolatiles			
Anthracene	mg/kg	0.113	J
Benzo(a)anthracene	mg/kg	0.289	J
Benzo(a)pyrene	mg/kg	**0.356**	J
Benzo(b)fluoranthene	mg/kg	0.492	
Benzo(ghi)perylene	mg/kg	0.352	J
Benzo(k)fluoranthene	mg/kg	0.155	J
Bis(2-ethylhexyl)phthalate	mg/kg	0.202	J
Carbazole	mg/kg	0.109	J
Chrysene	mg/kg	0.357	J
Dibenz(a,h)anthracene	mg/kg	**0.123**	J
Fluoranthene	mg/kg	0.666	
Indeno(1,2,3-cd)pyrene	mg/kg	0.27	J
Methylnaphthalene, 2-	mg/kg	0.0381	J
Phenanthrene	mg/kg	0.568	
Pyrene	mg/kg	0.605	
PCBs			
Aroclor 1260	mg/kg	0.0613	J
Metals			
Aluminum	mg/kg	6810	J
Arsenic	mg/kg	**9.27**	
Barium	mg/kg	57.5	
Beryllium	mg/kg	0.487	
Cadmium	mg/kg	0.385	J
Calcium	mg/kg	67600	
Chromium	mg/kg	11	
Cobalt	mg/kg	3.89	
Copper	mg/kg	15.2	
Iron	mg/kg	15400	
Lead	mg/kg	**68.9**	
Magnesium	mg/kg	6710	
Manganese	mg/kg	396	
Mercury	mg/kg	0.113	
Nickel	mg/kg	12	
Potassium	mg/kg	968	
Sodium	mg/kg	214	B
Vanadium	mg/kg	16.5	
Zinc	mg/kg	158	

LEGEND:

△ ABO-216	SCREENING SOIL SAMPLING LOCATION
□ ABO-468	CONFIRMATION SOIL SAMPLING LOCATION
◕ TNTC-MW03	OVERBURDEN MONITORING WELL LOCATION
⊚ TNTC-S3	HISTORICAL SOIL BORING LOCATION
	FORMER BUILDING LOCATION
	FORMER SETTLING BASIN LOCATION
	POTENTIAL REMEDIATION AREA

NOTES:

1. ANALYTICAL RESULTS EXCEEDING REGION 9 REMEDIATION GOAL OBJECTIVES ARE SHOWN IN BOLD TEXT.
2. SAMPLES WITH NO POSTED DATA ARE BELOW QUANTITATION LIMITS FOR ALL NITROAROMATICS.
3. ALL CONFIRMATION SAMPLING LOCATIONS WERE SURVEYED.
4. NITROAROMATICS (8330-SC) INDICATES SCREENING ANALYSES.
5. SAMPLING DEPTHS

SAMPLE	DEPTH (FT)
AB0216	0.0 - 1.0
AB0217	0.0 - 1.0
AB0218	0.0 - 1.0
AB0219	0.0 - 1.0
AB0220	0.0 - 1.0
AB0221	0.0 - 1.0
AB0222	0.0 - 1.0
AB0223	0.0 - 1.0
AB0224	0.0 - 1.0
AB0225	0.0 - 1.0
AB0226	0.0 - 1.0
AB0365	3.0 - 5.0
AB0366	5.0 - 6.0
AB0468	3.0 - 5.0

6. SHADED CONCENTRATIONS INDICATE DETECTIONS EXCEEDING RGOs.
7. ESTIMATED REMEDIAL VOLUME:

AREA NO.	AREA (FT^2)	DEPTH (FEET)	VOLUME (YD^3)
I	400	7	104

8. PROBE REFUSAL AT 7 FEET (POSSIBLE PAD BOTTOM) IN SEPTEMBER 2000 BORING C-365/366.

   AUGER REFUSAL AT 14.5 FEET IN OCTOBER 1994 BORING TNTC-MW03. GROUNDWATER NO ENCOUNTERED.

   GROUNDWATER WAS MEASURED IN WELL TNTC-MW03 NOVEMBER 21, 2002 AT A DEPTH OF 13.3 FEET BELOW GROUND SURFACE.

SCALE
0 30 60 FEET

FIGURE 1-33
TNT AREA C
BUILDING 657 WASTEWATER SETTLING BASINS AND PUMP HOUSE
ANALYTICAL RESULTS AND ESTIMATED AREA/VOLUME OF SOIL REQUIRING REMEDIATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Environmental, Inc.

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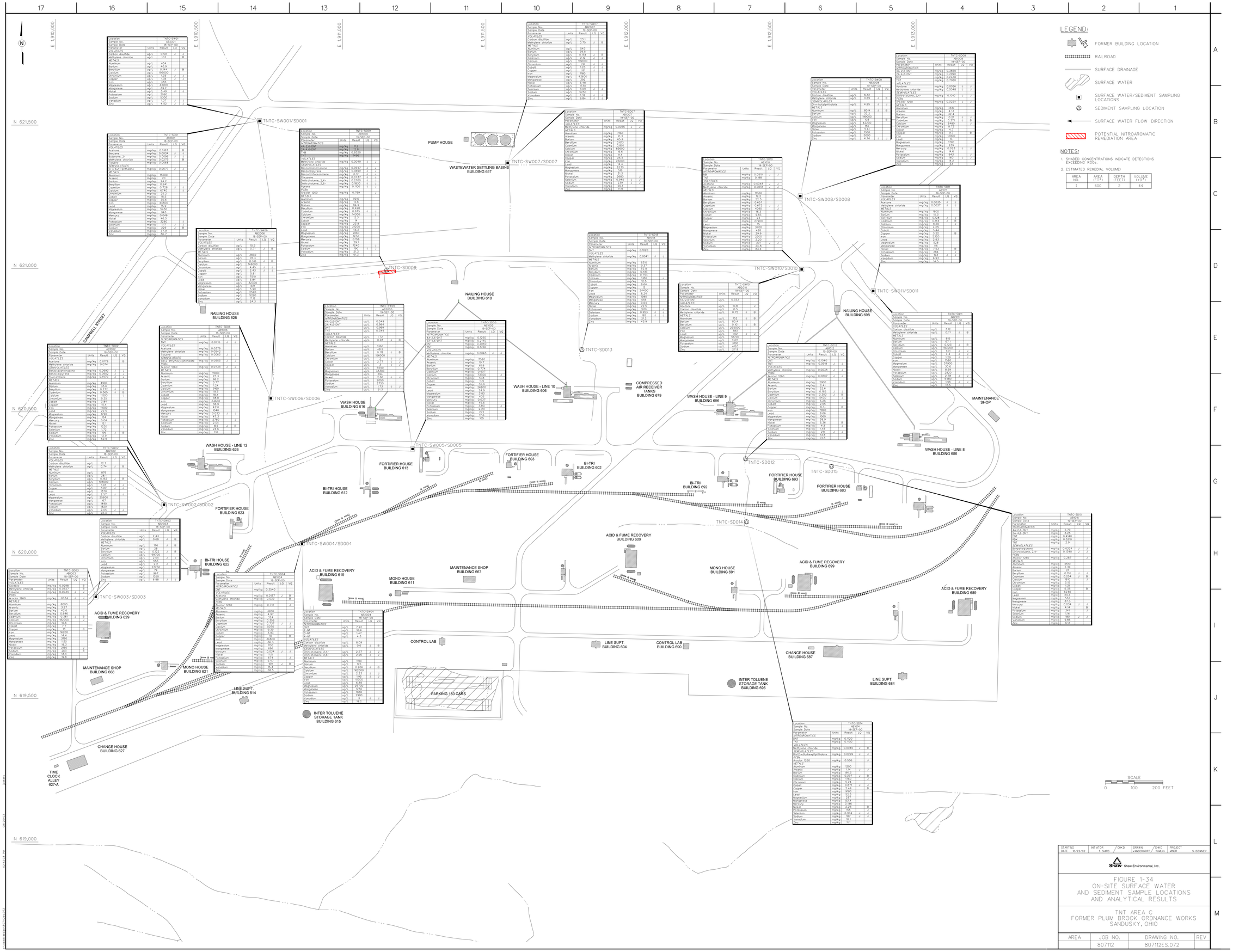

Location		TNTC-SW01		
Sample No.		AB000		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Carbon disulfide	ug/L	0.59	J	J
Methylene chloride	ug/L	1.5		B
METALS				
Aluminum	ug/L	454		
Barium	ug/L	4.03	J	
Beryllium	ug/L	0.144	J	B
Calcium	ug/L	190000		
Chromium	ug/L	1.35	J	J
Cobalt	ug/L	1.55	J	J
Copper	ug/L	4.55	J	J
Magnesium	ug/L	43900		
Manganese	ug/L	69.2		
Nickel	ug/L	3.49	J	J
Potassium	ug/L	2000		
Sodium	ug/L	5.00		
Vanadium	ug/L	1.55	J	J
Zinc	ug/L	4.52	J	J

Location		TNTC-SD07		
Sample No.		AB007		
Sample Date		19-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Carbon disulfide	ug/L	23.1		
Methylene chloride	ug/L	0.75	J	B
METALS				
Aluminum	ug/L	54.1		
Barium	ug/L	39.5		
Beryllium	ug/L	0.154	J	B
Cadmium	ug/L	2.12	J	J
Calcium	ug/L	190000		
Chromium	ug/L	1.16	J	J
Cobalt	ug/L	1.23	J	J
Copper	ug/L	2.27	J	J
Iron	ug/L	180		
Magnesium	ug/L	43600		
Manganese	ug/L	592		
Nickel	ug/L	5.48		
Potassium	ug/L	2100		
Selenium	ug/L	3.09	J	J
Sodium	ug/L	5250		
Vanadium	ug/L	1.32	J	J
Zinc	ug/L	9.84	J	J

Location		TNTC-SD08		
Sample No.		AB008		
Sample Date		19-SEP-00		
Parameter	Units	Result	LQ	VQ
NITROAROMATICS				
2,4,6-DNT	mg/kg	0.1850		
2,4-DNT	mg/kg	0.2390		
DNT	mg/kg	0.2460		
TNT	mg/kg	0.7080		
VOLATILES				
Acetone	mg/kg	0.0058	J	J
Methylene chloride	mg/kg	0.0048	J	J
SEMIVOLATILES				
Dinitrotoluene, 2,4-	mg/kg	0.1010	J	J
PCBs				
Aroclor 1260	mg/kg	0.0224	J	J
METALS				
Aluminum	mg/kg	4610		
Arsenic	mg/kg	4.13		
Barium	mg/kg	32.4		
Beryllium	mg/kg	0.31	J	J
Cadmium	mg/kg	0.83	J	B
Calcium	mg/kg	6470		
Chromium	mg/kg	8.73		
Cobalt	mg/kg	4.7		
Copper	mg/kg	9.7		B
Iron	mg/kg	12900		
Lead	mg/kg	14.4		
Magnesium	mg/kg	1790		
Manganese	mg/kg	239		
Mercury	mg/kg	0.023	J	J
Nickel	mg/kg	14.6		
Potassium	mg/kg	284	J	J
Sodium	mg/kg	160	J	J
Vanadium	mg/kg	14.2		
Zinc	mg/kg	53		

Location		TNTC-SW08		
Sample No.		AB008		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Carbon disulfide	ug/L	8.32		
Methylene chloride	ug/L	0.69	J	B
SEMIVOLATILES				
Bis(2-ethylhexyl)phthalate	ug/L	4.95	J	J
METALS				
Aluminum	ug/L	80.9	J	B
Barium	ug/L	39.2		
Calcium	ug/L	190000		
Iron	ug/L	3090		B
Magnesium	ug/L	42200		
Manganese	ug/L	66		
Nickel	ug/L	5.61		
Potassium	ug/L	2100		
Sodium	ug/L	5090		
Zinc	ug/L	4.76	J	J

Location		TNTC-SD09		
Sample No.		AB009		
Sample Date		19-SEP-00		
Parameter	Units	Result	LQ	VQ
NITROAROMATICS				
2,4,6-DNT	mg/kg	0.3		
2,4-DNT	mg/kg	0.8		
DNT	mg/kg	0.8320		
TNT	mg/kg	0.940		
VOLATILES				
Methylene chloride	mg/kg	0.0049	J	J
SEMIVOLATILES				
Benzo(a)anthracene	mg/kg	0.0947	J	J
Benzo(b)fluoranthene	mg/kg	0.089	J	J
Benzo(k)fluoranthene	mg/kg	0.05	J	J
Chrysene	mg/kg	0.0963	J	J
Dinitrotoluene, 2,4-	mg/kg	0.2760	J	J
Dinitrotoluene, 2,6-	mg/kg	0.1830	J	J
Pyrene	mg/kg	0.1100	J	J
PCBs				
Aroclor 1260	mg/kg	0.769		J
METALS				
Aluminum	mg/kg	9230		
Arsenic	mg/kg	12.6		
Barium	mg/kg	84.9		
Beryllium	mg/kg	0.479	J	J
Cadmium	mg/kg	2.679	J	J
Calcium	mg/kg	14300	J	J
Chromium	mg/kg	12.3		
Cobalt	mg/kg	14		
Copper	mg/kg	223.5		
Iron	mg/kg	29000		
Lead	mg/kg	46.2		
Magnesium	mg/kg	2660		
Manganese	mg/kg	1230		
Mercury	mg/kg	0.106		
Nickel	mg/kg	29.1		
Potassium	mg/kg	1270	J	J
Sodium	mg/kg	190	J	J
Vanadium	mg/kg	41.3		
Zinc	mg/kg	1.3		

Location		TNTC-SD10		
Sample No.		AB010		
Sample Date		19-SEP-00		
Parameter	Units	Result	LQ	VQ
NITROAROMATICS				
NB	mg/kg	0.0510	J	J
TNT	mg/kg	0.598		
VOLATILES				
Acetone	mg/kg	0.0048	J	J
Methylene chloride	mg/kg	0.0041	J	J
METALS				
Aluminum	mg/kg	7300		
Arsenic	mg/kg	12.2		
Barium	mg/kg	52.3		
Beryllium	mg/kg	0.657		
Cadmium	mg/kg	0.673	J	J
Calcium	mg/kg	400		
Chromium	mg/kg	16.6		
Cobalt	mg/kg	4.83		
Copper	mg/kg	24		
Iron	mg/kg	27900		
Lead	mg/kg	16		
Magnesium	mg/kg	3700		
Manganese	mg/kg	159		
Nickel	mg/kg	29.9		
Potassium	mg/kg	2300	J	J
Selenium	mg/kg	2.20		
Sodium	mg/kg	201	J	J
Vanadium	mg/kg	37.1		
Zinc	mg/kg	63.4		

Location		TNTC-SD11		
Sample No.		AB011		
Sample Date		19-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Acetone	mg/kg	0.0035	J	J
Methylene chloride	mg/kg	0.0037	J	J
METALS				
Aluminum	mg/kg	9800		
Barium	mg/kg	95.3		
Beryllium	mg/kg	0.338	J	J
Cadmium	mg/kg	0.144	J	B
Calcium	mg/kg	1320		
Chromium	mg/kg	14.4		
Cobalt	mg/kg	4.25		
Copper	mg/kg	22.2		B
Iron	mg/kg	5320		
Lead	mg/kg	21.5		
Magnesium	mg/kg	528		
Manganese	mg/kg	73		
Nickel	mg/kg	7.53		B
Potassium	mg/kg	284	J	J
Sodium	mg/kg	93	J	J
Vanadium	mg/kg	6.93		
Zinc	mg/kg	14.5		

Location		TNTC-SW10		
Sample No.		AB010		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
NITROAROMATICS				
Tetryl	ug/L	0.332		
VOLATILES				
Acetone	ug/L	10.8		
Carbon disulfide	ug/L	0.5		
Methylene chloride	ug/L	0.75	J	B
METALS				
Aluminum	ug/L	83	J	B
Barium	ug/L	87.1		
Beryllium	ug/L	0.101	J	B
Calcium	ug/L	235000		
Iron	ug/L	341		
Lead	ug/L	1.62	J	J
Magnesium	ug/L	43100		
Manganese	ug/L	1010		
Potassium	ug/L	3100		
Sodium	ug/L	4120		
Zinc	ug/L	27.9		

Location		TNTC-SW11		
Sample No.		AB011		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Methylene chloride	ug/L	0.71	J	B
METALS				
Aluminum	ug/L	816		
Barium	ug/L	61.1		
Beryllium	ug/L	0.223	J	B
Calcium	ug/L	39000		
Iron	ug/L	131	J	J
Cobalt	ug/L	4.4		
Copper	ug/L	1.29	J	J
Iron	ug/L	5320		
Magnesium	ug/L	37900		
Manganese	ug/L	3010		
Nickel	ug/L	8.59		
Potassium	ug/L	2820		
Sodium	ug/L	5480	J	J
Vanadium	ug/L	1.98	J	J
Zinc	ug/L	19.5		

Location		TNTC-SD05		
Sample No.		AB005		
Sample Date		19-SEP-00		
Parameter	Units	Result	LQ	VQ
2,4-DNT	mg/kg	0.549		
2,6-DNT	mg/kg	0.984		
DNT	mg/kg	0.969		
TNT	mg/kg	0.344		
VOLATILES				
Acetone	ug/L	1.72		
Methylene chloride	ug/L	0.93	J	B
METALS				
Aluminum	ug/L	1360		
Barium	ug/L	46.9		
Beryllium	ug/L	0.153	J	B
Calcium	ug/L	156000		
Chromium	ug/L	3	J	J
Cobalt	ug/L	2.27	J	J
Copper	ug/L	5	J	J
Iron	ug/L	10600		
Magnesium	ug/L	33500		
Manganese	ug/L	684		
Nickel	ug/L	2.66	J	J
Potassium	ug/L	2000		
Sodium	ug/L	7190	J	J
Vanadium	ug/L	2.13	J	J
Zinc	ug/L	7.1	J	J

Location		TNTC-SD06		
Sample No.		AB006		
Sample Date		19-SEP-00		
Parameter	Units	Result	LQ	VQ
NITROAROMATICS				
2,4-DNT	mg/kg	0.0280		
2,6-DNT	mg/kg	0.0340		
DNT	mg/kg	0.0940		
TNT	mg/kg	0.1760		
VOLATILES				
Methylene chloride	mg/kg	0.0045	J	J
METALS				
Aluminum	mg/kg	7520		
Arsenic	mg/kg	10.7		
Barium	mg/kg	61.9		
Beryllium	mg/kg	0.214		
Cadmium	mg/kg	0.8	J	B
Calcium	mg/kg	23800	J	
Chromium	mg/kg	13.8		
Cobalt	mg/kg	11.9		
Copper	mg/kg	30.8		
Iron	mg/kg	26800		
Lead	mg/kg	12.1		
Magnesium	mg/kg	3180		
Manganese	mg/kg	405		
Mercury	mg/kg	0.031		
Nickel	mg/kg	45.5		
Potassium	mg/kg	1270	J	J
Selenium	mg/kg	3.01		
Sodium	mg/kg	272		
Vanadium	mg/kg	77.6		
Zinc	mg/kg	105		

Location		TNTC-SW05		
Sample No.		AB005		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Methylene chloride	ug/L	1.12		
METALS				
Aluminum	ug/L	1360		
Barium	ug/L	46.9		
Beryllium	ug/L	0.153	J	B
Calcium	ug/L	156000		
Chromium	ug/L	3	J	J
Cobalt	ug/L	2.27	J	J
Copper	ug/L	5	J	J
Iron	ug/L	10600		
Magnesium	ug/L	33500		
Manganese	ug/L	684		
Nickel	ug/L	2.66	J	J
Potassium	ug/L	2000		
Sodium	ug/L	7190	J	J
Vanadium	ug/L	2.13	J	J
Zinc	ug/L	7.1	J	J

Location		TNTC-SD12		
Sample No.		AB012		
Sample Date		19-SEP-00		
Parameter	Units	Result	LQ	VQ
NITROAROMATICS				
2,4-DNT	mg/kg	0.1040		
TNT	mg/kg	0.0916	J	J
VOLATILES				
Methylene chloride	mg/kg	0.0038	J	J
PCBs				
Aroclor 1260	mg/kg	0.0807	J	J
METALS				
Aluminum	mg/kg	2900		
Arsenic	mg/kg	5.23		
Barium	mg/kg	22.6		
Beryllium	mg/kg	0.165	J	J
Cadmium	mg/kg	0.42	J	B
Calcium	mg/kg	5230		
Chromium	mg/kg	5.23		
Cobalt	mg/kg	2.55		
Copper	mg/kg	8.11		B
Iron	mg/kg	7890		
Lead	mg/kg	9.06		
Magnesium	mg/kg	1060		
Manganese	mg/kg	58.9		
Nickel	mg/kg	6.36		B
Potassium	mg/kg	413	J	J
Sodium	mg/kg	146	J	J
Sodium	mg/kg	211	J	J
Vanadium	mg/kg	13.8		
Zinc	mg/kg	21.8		

Location		TNTC-SD15		
Sample No.		AB015		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
NITROAROMATICS				
2,4-DNT	mg/kg	2.79		
2,4,6-DNT	mg/kg	3.27		
DNT	mg/kg	0.410		
TNT	mg/kg	0.550		
TNB	mg/kg	2.3		
SEMIVOLATILES				
Benzo(a)pyrene	mg/kg	0.0324	J	J
Dinitrotoluene, 2,4-	mg/kg	0.1840	J	J
PCBs				
Aroclor 1260	mg/kg	0.287		J
METALS				
Aluminum	mg/kg	2510		
Arsenic	mg/kg	2.79		
Barium	mg/kg	41		
Beryllium	mg/kg	0.157	J	J
Cadmium	mg/kg	0.254	J	B
Calcium	mg/kg	1610		
Chromium	mg/kg	5.15		
Cobalt	mg/kg	1.31		
Copper	mg/kg	5.39		B
Iron	mg/kg	6240		
Lead	mg/kg	24.4		
Magnesium	mg/kg	534		
Manganese	mg/kg	37.1		
Mercury	mg/kg	0.098	J	J
Nickel	mg/kg	4.14		B
Potassium	mg/kg	141	J	J
Selenium	mg/kg	1.16		
Sodium	mg/kg	190	J	J
Vanadium	mg/kg	5.89		
Zinc	mg/kg	17.8		

Location		TNTC-SD03		
Sample No.		AB003		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Acetone	mg/kg	0.0298		B
Methylene chloride	mg/kg	0.0038	J	J
Toluene	mg/kg	0.0024	J	J
PCBs				
Aroclor 1260	mg/kg	0.074	J	J
METALS				
Aluminum	mg/kg	8000		
Barium	mg/kg	3.27		
Beryllium	mg/kg	0.646		
Cadmium	mg/kg	0.581	J	B
Calcium	mg/kg	16000		
Chromium	mg/kg	5.2		
Cobalt	mg/kg	1.3		
Copper	mg/kg	13		B
Iron	mg/kg	16200		
Lead	mg/kg	14.4		
Magnesium	mg/kg	3180		
Manganese	mg/kg	170		
Nickel	mg/kg	10.3		
Potassium	mg/kg	2360	J	
Sodium	mg/kg	1140	J	
Vanadium	mg/kg	15.4		
Zinc	mg/kg	19.2		

Location		TNTC-SW02		
Sample No.		AB002		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Carbon disulfide	ug/L	3.7		
Methylene chloride	ug/L	0.74	J	B
METALS				
Aluminum	ug/L	876		
Barium	ug/L	28.1		
Beryllium	ug/L	0.302	J	B
Cadmium	ug/L	0.193		
Chromium	ug/L	1.93	J	J
Copper	ug/L	3.82	J	J
Iron	ug/L	1370		
Lead	ug/L	2.37	J	J
Magnesium	ug/L	43900		
Manganese	ug/L	367		
Potassium	ug/L	1490		
Sodium	ug/L	1810		
Vanadium	ug/L	2.05	J	J
Zinc	ug/L	22.3		

Location		TNTC-SW03		
Sample No.		AB003		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Carbon disulfide	ug/L	2.43		
Methylene chloride	ug/L	0.68	J	B
METALS				
Aluminum	ug/L	176	J	B
Barium	ug/L	18		
Beryllium	ug/L	0.102	J	B
Calcium	ug/L	99700		
Chromium	ug/L	1.05	J	J
Iron	ug/L	555		
Lead	ug/L	2.3	J	J
Magnesium	ug/L	37200		
Manganese	ug/L	64		
Potassium	ug/L	1170		
Sodium	ug/L	1650		
Zinc	ug/L	6.88	J	J

Location		TNTC-SD04		
Sample No.		AB004		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
NITROAROMATICS				
2,4-DNT	mg/kg	0.5540		
VOLATILES				
Acetone	mg/kg	0.0137	J	B
Methylene chloride	mg/kg	0.039		B
PCBs				
Aroclor 1260	mg/kg	0.712		J
METALS				
Aluminum	mg/kg	3950		
Arsenic	mg/kg	4.37		
Barium	mg/kg	324		
Beryllium	mg/kg	0.326		
Cadmium	mg/kg	0.737	J	J
Calcium	mg/kg	1300		
Chromium	mg/kg	8.29		
Cobalt	mg/kg	3.93		
Copper	mg/kg	10		B
Iron	mg/kg	34800		
Lead	mg/kg	15.1		
Magnesium	mg/kg	930		
Manganese	mg/kg	696		
Mercury	mg/kg	0.034	J	J
Nickel	mg/kg	6.5		
Potassium	mg/kg	1170		
Sodium	mg/kg	243		
Vanadium	mg/kg	909	J	B
Zinc	mg/kg	18.5		

Location		TNTC-SW04		
Sample No.		AB004		
Sample Date		18-SEP-00		
Parameter	Units	Result	LQ	VQ
VOLATILES				
Carbon disulfide	ug/L	7.92		
1-NT	ug/L	10.4		
1,3-NT	ug/L	1.47		
1,5-NT	ug/L	4.7		
SEMIVOLATILES				
Carbon disulfide	ug/L	8.09		
Methylene chloride	ug/L	0.6	J	B
SEMIVOLATILES				
Dinitrotoluene, 2,4-	ug/L	2.57	J	J
Dinitrotoluene, 2,6-	ug/L	2.95	J	J
METALS				
Aluminum	ug/L	1190		
Barium	ug/L	125		
Beryllium	ug/L	0.206	J	B
Calcium	ug/L	162000		
Chromium	ug/L	2.23	J	J
Copper	ug/L	3.09	J	J
Iron	ug/L	10300		
Lead	ug/L	6.89		
Magnesium	ug/L	27700		
Manganese	ug/L	1240		
Nickel	ug/L	1980		
Potassium	ug/L	2490		
Sodium	ug/L	7.1	J	J
Zinc	ug/L	18.7		

STARTING DATE	INITIATOR	CHKD	DRAWN	CHKD	PROJECT
10/22/02	T. SIARD	/	S.WADDERUFF /	T.MLIN	MNGR S. DONNEY

Shaw Environmental, Inc.

FIGURE 1-34
ON-SITE SURFACE WATER
AND SEDIMENT SAMPLE LOCATIONS
AND ANALYTICAL RESULTS

TNT AREA C
FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

AREA	JOB NO.	DRAWING NO.	REV.
	807112	807112ES.072	

Appendix C Treatment Processes

Work Plan for Alkaline Hydrolysis

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

Prepared for:

Department of the Army
Huntington District, Corps of Engineers
502 Eighth Street
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TMG Project No. – TMG09-22

July 2010

Work Plan for Alkaline Hydrolysis

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

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Work Plan for Alkaline Hydrolysis

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

1.0 PROJECT DESCRIPTION

The project description is provided in Section 1.0 of the Plan of Operations document.

2.0 PROJECT ORGANIZATION

The project organization is provided in Section 2.0 of the Plan of Operations document.

3.0 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS

A discussion of the Applicable, Relevant and Appropriate Requirements (ARARs) are provided in Section 3.0 of the Plan of Operations document.

4.0 FIELD ACTIVITIES

4.1 Ex-Situ Alkaline Hydrolysis of Contaminated Soil and Sediment

Based on the approved selected remedy detailed in the Decision Document, remediation efforts for the TNT Area C will consists of 5 steps: excavation, ex-situ treatment through alkaline hydrolysis and/or composting, stabilization (if necessary) and disposal (off-site or on-site, depending on final levels achieved). TMG will initially perform remediation in the form of ex-situ alkaline hydrolysis of approximately 3000 cubic yards of 2,4-DNT and other nitroaromatic contaminated soil above the RGOs excavated from TNT Area C. This section addresses the field activities for the alkaline hydrolysis activities.

4.2 On-Site Equipment

TMG may use the following equipment on-site to perform the activities associated with this project:

- Tracked excavators (PC-220 or comparable)
- Vacuum truck (3000-gallon CUSCO or comparable)
- Bulldozer (D5C or comparable)
- Endloader (rubber tired)
- Windrow turner
- Clay
- Dump trucks (articulated)
- Roller
- Tractor
- Tractor and trailer used for mobilization of equipment
- Hand tools (rakes, shovels, etc.)
- Minimum of four 10,000 gallon frac tanks
- Water pump (4”) and hoses

4.3 Transportation

TMG shall transport the stockpiled material to the designated treatment area adjacent to the Pentolite Road Red Water Pond (PRRWP) area to undergo alkaline hydrolysis. It is anticipated that dump trucks will be used to transport the material to the treatment area.

4.4 Treatment Area

Minimal preparation of the treatment area will include mowing and vegetation removal; grading; rolling for compaction and possible installation of a liner or other barrier material below the active treatment areas to prevent or minimize infiltration of contaminants into the underlying soils as may be necessary. The specific requirements for a liner will be determined during the treatability study.

Depending on the degradation of the berms (around site and sump perimeters), straw bales may be replaced. Also, depending on road conditions, additional gravel may be placed and/or road may be further compacted with roller.

4.5 Air Monitoring

Air monitoring shall be performed to ensure the safety of personnel and/or determine if the level of personal protective equipment (PPE) should be upgraded. All field personnel are fit tested and their certifications are in Appendix C of this addendum. Additional personnel may be fit-tested to perform work on-site during the alkaline hydrolysis process. Fit-test documentation for those individuals will be provided in a separate addendum to this work plan. At this time, it is anticipated that air monitoring will be performed during alkaline hydrolysis activities for ammonia, methane, hydrogen sulfide, carbon monoxide, and carbon dioxide. There are no monitoring requirements for the caustic soda (NaOH) or the ferric chloride. The on-site SSHO or other designee under SSHO qualified to conduct this sampling will be responsible for performing air monitoring. Ammonia and carbon dioxide samples will be collected using a Drager® pump and the appropriate Drager® tubes. Methane, hydrogen sulfide, and carbon monoxide samples will be collected using a GasTech 402 or similar device. The instrument will be calibrated daily prior to using the monitor and it will be operated in conformance with the manufacturer's requirements. The air monitoring will be conducted at the perimeter of the treatment area and in the work zones during the initial treatment operations to verify these conditions will not create any harmful conditions to the personnel. If harmful conditions exist, monitoring will continue until the results are below the PEL. Subsequently, monitoring will be performed if there are any significant changes to the composting procedures or if requested by the SSHO or USACE.

Personnel will be required to use level C PPE until the air monitoring is completed and the required level of PPE is determined. Depending on the monitoring results, the level of PPE may be downgraded from level C to level D. In order to downgrade to level D, the air monitoring results must be below the PEL for the monitored parameters. The requirements for PPE levels C and D are presented in Section 13.0. The PELs are provided in Table 1 in Appendix A of this document. The office trailer will maintain supplies to facilitate upgrade to level C from level D PPE if necessary.

4.6 Water Management System

Two collection sumps are installed to collect run-off water at the end of the treatment area. Earthen berms are constructed around the perimeter of the treatment area and lined with straw bales as part of the water management system. The sump areas were constructed with at least a 2:1 slope and have a capacity of approximately 60,000 gallons. The sump is lined with geotextile liner (60-mil thickness). The sump perimeters are lined with straw bales to eliminate sediment from entering the sumps. The treatment area is sloped such that any water will run toward the sumps. The water management system is designed such that water collected in the sumps can be re-used as contact water during the stabilization process. Additional water can be obtained from the reservoir adjacent to the PRRWP area, if needed. Frac tanks (with at least a 40,000 gallon capacity) will be

on-site for storage of the sump water. The water in the frac tanks will be analyzed prior to its disposal for the COCs as well as the pH and other materials used during the alkaline hydrolysis process. Excess water in the frac tanks may be disposed at the West Area Red Water Pond (WARWP) depending upon sampling results of the water to be discharged. USACE, NASA and Ohio EPA will review analytical data from water sampling of the frac tanks prior to allowing discharge to the WARWP. Discharge to the pond must be done slowly to ensure that no erosion occurs and pond sediment is not disturbed. All water not approved for placement in the WARWP will be taken off-site for recycling.

4.7 Fencing

The NASA site is a secure site with its own security fence and full-time guards. TMG will install plastic construction fencing around the treatment area and storage area. Warning signs will be placed on the fencing and perimeter indicating that the area is a hazardous area.

4.8 Ex-Situ Treatment of Contaminated Soil

Approximately 3,000 cubic yards of contaminated stockpiled soil may require ex-situ treatment to reduce not only the 2,4-DNT to below hazardous levels but also other nitroaromatics currently above the RGOs prior to off-site disposal at a non-hazardous landfill or on-site placement. Windrow alkaline hydrolysis will be accomplished by mixing contaminated soil and amendments to destroy the nitroaromatic compounds. The amendments will consist of caustic soda, metal ion catalysts, and water. Prior to treatment, treatability studies will be conducted to determine the design quantities required for treatment.

Windrows will be used for the alkaline hydrolysis treatment. Each windrow shall be approximately 12 feet wide and 6 feet high. The windrows shall not end any closer than 15 feet from the ends of the treatment pad to allow for the maneuvering of the windrow turner. The spacing (minimum of 15 feet width) between the parallel windrows shall be sufficient to prevent impeding windrow turning and materials handling equipment. It is expected that each windrow will be turned at least once daily. Refer to Section 5.0 of this plan for analytical requirements for the alkaline hydrolysis process.

4.8.1 Storage and Addition of Chemicals

The two chemicals being used for treatment, i.e., caustic soda and ferric chloride solution (or selected alternative) will be purchased from a chemical supplier local to the project location in Sandusky, Ohio. Most likely the supplier will be located in Toledo or Cleveland, Ohio. Caustic soda will be in the form of beads and will be supplied in 2,000 lb super sacs. These super sacs will be purchased and stored onsite at the treatment area and will be used as needed for treatment. Iron catalysts are available in solution form (ferric chloride solution) and will be supplied in 300 gallon tote tanks. They will be

purchased and stored at the same location to be used as needed for treatment. The on-site storage capacity will be kept to a minimum..

Treatment Chemical Storage

Sodium hydroxide - The dry chemical, sodium hydroxide pellets (NaOH) – supplied in 2000 pound super sacks - stored on-site in a Conax box adjacent to the treatment area. The conax box will provide dry, ventilated storage for the sodium hydroxide which is consistent with the requirements in the MSDS (Appendix D of this work plan).

Ferric chloride solution - The wet chemical, ferric chloride solution, if used, will be supplied in 300-gallon, double walled totes and stored in a lined and diked area adjacent to the treatment area. The FeCl solution will be maintained in the tote and stored as described above within a diked area. The tote will be covered with a tarp or other covering to keep precipitation from directly contacting the container. It is anticipated the entire contents of the tote (~300 gallons) will be applied during treatment.

Treatment Chemical Handling

Sodium hydroxide – It is anticipated that use of NaOH in pellet form will eliminate or greatly reduce chemical dusts generated from the application process. Application of the chemical will be performed in low wind conditions. However, personnel handling, applying the NaOH, or handling the waste chemical container will be required to wear the following:

- Tyvek coveralls
- Nitrile gloves
- Face shield
- Chemical (Tyvek) booties

Ferric chloride solution – The use of FeCl solution will be determined in the bench-scale studies. Since the FeCl is in solution, inhalation exposure is not anticipated. Personnel working in the area of the FeCl, applying the chemical, or handling the empty totes will be required to wear the following:

- Tyvek coveralls
- Nitrile gloves
- Safety goggles or full face shield
- Portable eye wash equipment will be available in the work area.

Likewise, incompatible chemicals, if used on-site will be segregated and stored as dry or wet chemicals, whichever is appropriate.

The first step in chemical addition will involve the even spreading of caustic soda on each of the soil windrows awaiting treatment. Based upon the conclusions of the treatability studies, a design quantity of caustic soda will be added in a defined ratio to soil. The spreader will ensure that the caustic soda is spread as evenly as possible across

the treatment soil pile. Following spreading of caustic soda, the windrow turner will be used to work the chemical into the soil uniformly in all locations to obtain as homogenized a dry mix as possible. A minimum of three equipment passes will be made to ensure homogenized blending and mixing.

Following application and mixing of the caustic soda, the treatment piles will be wetted with water at a rate defined in the treatability tests. Once the treatment pile is moist, the catalytic solution will be added to the soils as determined by the treatability study. Because the catalyst will be in the solution form, it will be applied uniformly using gravity flow and evenly mixed into the soil. Water used in the treatment process will be drawn from a reservoir located near the treatment pad. In the event that sufficient rainfall occurs to complete the treatment, this water will be used in lieu of water from the reservoir. Runoff water from the treatment area will be captured in lined sumps and recycled to maintain soil moisture during treatment.

The final mixing step will involve additional application of water onto the soil. Because water is an essential ingredient in the reaction process and contaminant destruction occurs predominantly in the aqueous phase, sufficient quantities of water are required to be added until defined conditions are attained based on visual observation. The compost turner will be used to mix the wet soil in place once during the addition of water. However, a majority of the water will be allowed to permeate into the soil over the windrow once it is wet enough by visual observations.

4.8.2 Periodic Mixing Procedures

The mixing procedures outlined herein assume a 14-day overall treatment period from the start of chemical addition. The soil to which chemicals and water have been added to desired saturation is expected to take one to two weeks for treatment to reach target concentrations for nitroaromatic compounds. During this period, the soil will be mixed at least every other day. The first mixing operation will be performed one day after the initial mixing (Day 3 of operation). Thereafter, the windrow will be mixed on Days 5, 7, 9 and 11 before sampling. This schedule will ensure homogeneity of chemicals in the soil and uniform destruction of the COCs.

Water will be added using water trucks or hose evenly over the piles following mixing on an as-needed basis to maintain the moisture of the windrows.

4.8.3 Prolonged Treatment

If one or more of the organic constituents of interest are still above the target concentrations in isolated soil piles following treatment, further treatment will be performed in three steps. First, the pH of the soil will be tested via the procedures outlined below in Section 5.0. If the pH criteria do not meet those established, caustic soda will be added in 2,000 lb increments until these levels are met. Moisture addition and mixing will be performed as outlined above. Soil field testing and laboratory testing will be the third step to ensure target concentrations are met. These three steps will be repeated as needed for stubborn soil batches or piles. In the event that target concentrations are not achieved for a selected batch following extended treatment and further treatment (i.e., composting) is deemed inefficient, those soils will be designated for off-site disposal as appropriate.

4.8.4 pH Adjustment and Denitrification

The final treatment step in post-explosive decontamination will be soil pH adjustment and denitrification, if required. The same organic acid, such as citric acid, may be employed for both purposes; however, the pH-reducing agent will be defined during the treatability testing. Citric acid is a pH reducer as well as a rich source of carbon donor that natural microorganisms and denitrifiers can consume. For soil piles which have completed explosives treatment it is anticipated that only pH adjustment will be performed.

A final target pH of 8 to 9 units has been established prior to backfilling the treated soil. pH adjustment is a routine process and a treatability test will be conducted to determine the quantity and type of acidic amendment to be added and mixed into the soil. The acid amendment will be mixed in a similar fashion to the prior chemical addition and mixing. However, moisture addition is not required in this step. Soil pH will be analyzed after the addition of the pH-reducing agent as outlined above.

Following pH reduction and denitrification if necessary, soils will be sampled as outlined in Section 5.2.

4.9 Ultimate Disposal of the Treated Soil

Upon completion of the AH soil treatment, the soil shall be disposed of in a non-hazardous landfill licensed to accept these wastes or if the levels are below the RGOs, non-hazardous and meet the Land Disposal Restrictions, then the soil may be used as backfill in the excavated areas in TNT Area C. If off-site disposal is used, the non-hazardous soil will be transported and disposed of at Erie County Landfill.

4.10 Guard Services and Stabilization Schedule

Treatment is a 7-day a week operation and NASA employees usually do not work on the weekends or holidays. TMG shall coordinate with NASA's security services as well as the NASA POC, Bob Lallier, to ensure site access to accomplish the stabilization efforts. All work will be conducted between 7:00 am and 6:00 pm. No work will be conducted after-hours (after 6:00 pm).

5.0 ANALYTICAL REQUIREMENTS

5.1 Alkaline Hydrolysis

Laboratory analytical results will be used to determine when the treatment operation is completed. One 10-point composite sample from each windrow will be collected weekly and submitted to the laboratory for analysis by EPA Method 8330. A baseline round of sampling will be conducted prior to alkaline hydrolysis efforts.

After the initial chemical application and turning of the windrow, the pH will be measured in each windrow at 10 equidistant points, or approximately every ten feet, depending on the length of the windrow. pH data will be collected using an in-situ pH soil probe for the purpose of ensuring that optimum conditions have been achieved.

Every five to ten calendar days, personnel will collect treated material (after turning). Confirmation sample aliquots will be collected from 5 random locations from every 300 cubic yards of soils and composited into one sample for laboratory analysis (5 aliquots per sample). Samples will be collected from the treated material after turning (which mixes the material), consequently the grab samples will be collected from about 0 to 6" inches deep while walking along the windrow. These samples will be shipped as per standard procedures and protocol to the laboratory, where they will be analyzed for the following constituents as per the analytical methods outlined:

- SW8330 – Nitroaromatic Compounds
- SW9056/E300 - Nitrate
- SW9056/E300 - Nitrite
- SW9045 – pH

Every five to ten calendar days, personnel will collect treated material (after turning) at roughly 10 equal distanced points along each windrow, or every 10 feet, depending on length of windrow. Since personnel are collecting the treated material after turning (which mixes the material), the grab samples can be collected from about 0 to 6" inches deep while walking along the windrow. The grab samples will be composited in a zip-lock bag and thoroughly mixed.

Personnel will be required to use level C PPE while collecting samples, until the air monitoring is completed and the required level of PPE is determined. Depending on the monitoring results, the level of PPE may be downgraded from level C to level D. In order to downgrade to level D, the air monitoring results must be below the PEL for the monitored parameters. The requirements for PPE levels C and D are presented in Section 13.0. The PELs are provided in Table 1 in Appendix A of this document. The office trailer will maintain supplies to facilitate upgrade to level C from level D PPE if necessary.

The composited soil samples will be thoroughly mixed in the bag and a portion removed and placed in a sample container provided by the laboratory. The sample container will be labeled, packaged in a clean zip-lock bag and wrapped with bubble wrap for shipment. The samples will be packaged for shipment in an iced cooler. The samples will be placed inside a large plastic bag (trash bag), along with ice packs. The trash bag will be tightly closed and tied-off to prevent leakage of melted ice. The cooler will be secured with strapping tape, shipping labels applied and sent to Test America, Inc. located in North Canton, Ohio. The cooler will be shipped using an expediting service such as FedEx or UPS.

The treatment process will conclude when nitroaromatic levels in all soils have been reduced to levels suitable for off-site disposal at a non-hazardous landfill or on-site placement. Completion of treatment shall be determined by laboratory analysis for COCs below the RGOs, non-hazardous for 2,4-DNT and meet the Land Disposal Restrictions for the underlying constituents.

5.1.1 Field Analyses

pH will be used as the major indicator of uniform physical and chemical mixing of the soil chemicals. Because it is critical that initial pHs above 12.5 units are attained following initial mixing and the addition of water, this parameter will be measured on Day 2 of operations. pH will me measured in situ following mixing of the windrow at intervals of approximately 10 feet to ensure that the targeted pH has been obtained. Should it be necessary, the windrow will be amended with additional caustic soda to further elevate the pH.

5.2 Sampling and Analytical Requirements for Disposal of Treated Soil

It is anticipated that initial treatment of the soil by alkaline hydrolysis will reduce levels below the RGOs. Once these levels are obtained, the levels should be checked against the LDRs to ensure the soil can be used for on-site placements (as anticipated). If the soil does not meet the above requirements then the treated soil may undergo an extended treatment until the levels are below the RGs, or composted as outlined in the compost work plan.

Since personnel are collecting the treated material after turning (which mixes the material), the 10-point composite sample will be collected from 0 to 6" inches deep while walking along the windrow. While collecting samples, personnel will be required to use level C PPE until the air monitoring is completed and the required level of PPE is determined. Depending on the monitoring results, the level of PPE may be downgraded from level C to level D. In order to downgrade to level D, the air monitoring results must be below the PEL for the monitored parameters. The requirements for PPE levels C and D are presented in Section 13.0. The PELs are provided in Table 1 in Appendix A of this document. The office trailer will maintain supplies to facilitate upgrade to level C from level D PPE if necessary.

Once the AH-treated soil has been removed for on-site placement, the surface soil in the footprint of the windrow will be sampled and analyzed to verify the underlying soil has not been impacted by the contaminants in the windrows. A 5-point composite sample will be collected from equi-distant locations within each windrow and composited in a zip-lock bag. The soil sample will be placed in a sample container and processed and shipped to the laboratory as described above. The samples will be analyzed for VOCs, SVOCs, PCBs, TAL Metals, and full TCLP. If the results of the underlying soil analyses indicate the soil has not been impacted by the contaminants in the windrows, the treatment pad will be considered clean.

In the event the sample results indicate the underlying soil was impacted by the contaminants in the windrows, a minimum of 6 inches of soil will be scraped and stockpiled on plastic within the treatment pad area. The underlying soil will be sampled again following the same procedures as detailed above. The process of scraping, stockpiling and resampling will be repeated until the sample results indicate the underlying soil is clean. The stockpiled soil from the scraping will be sampled by collecting a 5-point composite sample from random locations within the pile. The samples will be submitted to the laboratory and analyzed for off-site disposal.

Table 5-1 summarizes the sampling and analytical requirements for the alkaline hydrolysis treatment of TNT Area C soils.

TABLE 5-1. SUMMARY OF SAMPLING AND ANALYTICAL REQUIREMENTS

SOURCE	REASON	MATRIX	TYPE	FREQUENCY	TIMING	ANALYTES	PROCEDURE
AH Soils	Baseline level of contaminant concentrations	Soil	Composite	Once	Before starting AH Treatment	SVOC, PCBs, TAL Metals, Full TCLP	One 10-part composite from 10 equi-distant locations
Air	PPE selection	Air	Grab	While turning windrows	Daily until levels are consistently below PEL	O2, CO2, CO, H2S, Ammonia, Methane	Work zones, pad perimeter
Frac Tank	Disposal determination	Water	Composite	As needed	10K gallon accumulation	SVOC, PCBs, TAL Metals, Full TCLP, pH	1 grab from each tank
AH Windrow	Condition	Soil	Grab	Daily	Prior to turning	pH	10 equi-distant locations along windrow
AH Windrow	Treatment	Soil	Composite	Weekly	After turning	Total nitroaromatics	One 10-part composite from 10 equi-distant locations
AH Windrow	Disposal or on-site placement	Soil	Composite	Once	After AH treatment	SVOC, PCBs, TAL Metals, Full TCLP	One 10-part composite from 10 equi-distant locations
Soil beneath windrow	To determine if windrow contaminants impacted underlying soil	Surface soil	Composite	Once	After removal of windrow	SVOC, PCBs, TAL Metals, Full TCLP	One 5-part composite
Stockpile of soil scrapings from windrow footprint	For disposal	Soil	Composite	Once	After scraping the footprint of windrow	Full TCLP	One 5-part composite

6.0 EQUIPMENT DECONTAMINATION

Equipment decontamination is provided in Section 8.0 of the Plan of Operations document.

7.0 FIELD DOCUMENTATION PROCEDURES

The Field Documentation Procedures are discussed in Section 9.0 of the Plan of Operations document.

8.0 SAMPLE PACKING AND TRANSPORTATION

The sample packing and transportation are discussed in Section 10.0 of the Plan of Operations document and outlined in Section 5 of this work plan.

9.0 TMG CHEMICAL QUALITY CONTROL

The discussion of TMG's Chemical Quality Control is provided in Section 7.2 of the Plan of Operations.

10.0 SPILL PREVENTION, CONTROL AND COUNTERMEASURE (SPCC)

The discussion of the SPCC is provided in Section 12.0 of the Plan of Operations document. In cases of spills it is very important to make sure that the area is secured and that the situation is assessed quickly. This section discusses the SPCC as it pertains to alkaline hydrolysis treatment operations.

10.1 Potential Spills

Potential spills may occur from handling the amendments (caustic soda, catalysts), overflowing of the sump, and spills/leaks from the frac tanks that may be on-site to store the accumulated sump water for subsequent disposal. Amendments will be stockpiled in the treatment area so that a spill or runoff from these materials will drain to the sump and be captured. Site personnel will monitor the sump to ensure that it does not overflow. A vacuum truck or pump will be used to transfer water from the sump into the frac tank.

The sump water and /or the contents of each 10,000 gallon frac tank will be analyzed to determine proper disposal. If analytical data does not meet discharge criteria the water will be utilized for contact water on the windrows or transported off-site for disposal at an approved facility. If the water is approved for on-site discharge to the West Area Red Water Ponds (WARWP), personnel must ensure that discharge of any water into the pond is done slowly so as not to cause bank erosion or disturb pond sediments.

10.2 Spill Prevention

The following are additional spill prevention procedures that will be implemented at the site:

- The four frac tanks shall be visually inspected weekly for leaks. The QC person will be responsible for the inspections and document on the daily QCR.
- The sumps shall be inspected daily to ensure that no damage has occurred to the liner that would allow contaminated water to leak into the underlying soil or banks of the sump.
- The berm around the treatment area shall be inspected weekly to ensure that there are no breaks or low spots that will allow run-off water to leak into the surrounding soil.
- The wet chemical will be stored inside a lined and diked area. The containment will be inspected daily to ensure no leaks or spills have occurred.
- The dry chemical will be stored in a conax box and this box will be inspected daily to make sure the box is maintaining dry conditions
- During chemical application to the windrows, the chemical container will be secured to the lift to prevent spillage

10.3 Spill Containment

Damage to the liners in each sump can result in potentially large spills/leakage of contaminated water from the sump. Therefore, care shall be taken not to damage the liners and any damage to the liners shall be repaired immediately even if the damage is above the water line. As much as is feasible, personnel shall not use equipment on or near the liners which may result in tears or cuts to the liners. Personnel shall not throw objects into the sump that might damage the liners. The liner shall be inspected at least once weekly to ensure its integrity. The QCO will be responsible for the inspections and document the findings on the QCR.

Treatment chemicals will be stored in containment areas until use. During use the chemicals will be maintained within the treatment area. In the event of a spill of dry chemical, it will be cleaned up with brooms and shovel or backhoe, depending on the quantity. In the event of a spill of the wet chemical, it will be contained with shovels and other equipment to avoid flowing across the surface of the treatment area. If necessary, the spilled material (wet or dry) will be scraped with dozer and placed with the treated soil. At no time will any of the treatment chemicals be transported off of the treatment pad area.

The “just-in-time” delivery will be used to eliminate the need to store quantities of treatment chemicals in the treatment area. Treatment materials will only be transported to the site and to the treatment area by carriers authorized to carry such materials. The carriers will be authorized by the transporter or supplier.

11.0 PROTECTION OF RIVERS STREAMS AND IMPOUNDMENTS

This information is provided in Section 13.0 of the Plan of Operations document. This section provides additional discussion regarding the discharge of sump water into the WARWP. USACE will review the analytical data from frac tank sampling prior to submitting to NASA and Ohio EPA for approval. Any discharge to the pond must be performed slowly to ensure that no erosion occurs and no pond sediment is disturbed.

12.0 AIR EMISSION CONTROLS

If necessary, water will be used for dust control on the treatment area and access roads to the treatment area. The Project Manager/On-site Superintendent and the Quality Control Officer (QCO) will make visual observations of dust levels to determine if water suppression is necessary and/or working. No odors are anticipated from the alkaline hydrolysis treatment. TMG proposes the following management practices to reduce air emissions from the treatment activities:

- Amendments will be covered when not in use
- Every attempt will be made not to overstock amendments
- Amendments will be thoroughly mixed with the contaminated soil.
- The windrows will be kept moist (between 40 and 60% moisture) to reduce the potential for dust emissions as well as prevent possible spontaneous combustion of the windrows.
- The windrows will be turned as needed to ensure proper treatment.

13.0 SITE-SPECIFIC HEALTH AND SAFETY PLAN

The purpose of this supplement is to address additional safety issues relating to the remediation of 2,4-DNT-contaminated soil to below hazardous levels. The remediation will be accomplished using ex-situ alkaline hydrolysis in windrows. The original SSHP shall be followed in its entirety, in addition to the issues outlined in this section. The supplement to the SSHP is provided in Appendix A of this document.

Personnel will wear protective equipment meeting appropriate American National Standards Institute (ANSI) requirements when their activities involve known or suspected contaminated materials. Level D personal protective equipment (PPE) will be used for all site activities.

Based on the site conditions observed and the results of the air monitoring performed during the initial excavations and during the statrt up of treatment operations at the site, it is not anticipated that Level C PPE will be required. However, as with any contamination clean up, site conditions may change. Therefore, information is provided in this section if an upgrade to Level C PPE is necessary.

Level D PPE will consist of:

- Steel-toed safety shoes/boots
- Safety glasses with side shields
- Leather gloves (general site work)
- Chemical resistant inner/outer gloves (used when performing sampling, decontamination activities, and handling treatment chemicals)
- Hard hat
- Hearing protection (when working around heavy equipment)
- Long trousers and sleeved shirt

Level C PPE will consist of:

- Tyvek overalls
- Full Face or Half-face Respirator (NIOSH approved which meets OSHA and USACE requirements)
- Appropriate chemical cartridges and/or filters
- Chemical resistant inner and outer work gloves
- Steel-toed safety boots/shoes
- Face shield or safety glasses with side shields to be used with half-faced respirator
- Hard hat

14.0 QUALITY CONTROL PLAN

There are no changes to the requirements outlined in the Quality Control Plan, TMG Services, Inc., July 2010.

15.0 PROJECT SCHEDULE

The project schedule is presented in Section 21.0 of the Plan of Operations.

16.0 REFERENCES

The following reference was added to Section 22.0 in the Plan of Operations:

"*Addendum to Plan of Operations, Interim Soil Removal Action Continuation, Soil Excavation and Disposal, Plum Brook Ordnance Works, Pentolite Road Red Water Ponds, Sandusky, Ohio*" . McTech Corp., July 2008

APPENDIX A Alkaline Hydrolysis Treatment Supplement to the Site-Specific Health Plan

Alkaline Hydrolysis Work Plan Supplement to

SITE-SPECIFIC SAFETY AND HEALTH PLAN

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

1.0 HAZARD/RISK ANALYSIS

The hazards associated with the performance of contract W91237-10-C-0002 are discussed in the Final SSHP (TMG Services, July 2010) and will not be reiterated in this supplement. The following summarizes field activities related to remediation in the form of ex-situ alkaline hydrolysis treatment of 2,4-DNT contaminated soil and the actions that can be taken to eliminate or minimize each of those hazards.

1.1 Activity Hazard Analysis

The following tables summarize activity hazards related to ex-situ alkaline hydrolysis treatment of 2,4-DNT contaminated soil and the actions that can be taken to eliminate or minimize those hazards. The Activity Hazard Analysis specific to the alkaline hydrolysis treatment is included in Appendix B of this supplement.

Hazard Analysis

Activity	Stabilization Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be mixing amendments and contaminated soil	Personnel may be injured by heavy equipment used in the loading and relocation of the contaminated soil.	• Heavy machinery will be operated only by designated qualified personnel • Getting on or off of any equipment while it is in motion is prohibited • Machinery shall be operated in accordance with the manufacturer's recommendations • The use of headphones for entertainment purposes (such as radio or cassette) while operating equipment is prohibited. • All machinery shall be inspected daily (when in use) by a competent and knowledgeable person to ensure safe operating conditions • Personnel shall not operate heavy equipment in area where the utilities have not been properly marked. • All heavy equipment shall be equipped with working audible reverse signal alarms • Personnel shall wear hearing protection when working nearing operating equipment.
	Heat stress can occur.	• The work schedule will be adjusted, if possible, to schedule heavy work during the cooler part of the day. • The work will be paced to include adequate rest periods. Five to fifteen minute rest periods will be scheduled hourly or every 2 hours depending upon the workload, temperature, and relative humidity. • Drinking water and ice will be provided in the clean zone. Personnel will be encouraged to drink plenty of water. • The weather conditions shall be monitored and work halted if the temperature (including humidity) rises to levels that present a danger to worker safety
	Personnel may be injured by lifting or moving heavy objects	• If a load is heavy or bulky, get help • Remember to lift with your legs and keep your back straight. • Keep the load as close to your body as you can. • Do not jerk the load. Lift slowly and carefully. • Make sure the area you will be carrying the load through is clear of obstacles. • Do not twist or turn your spine when lifting or carrying the load. • Be sure to have a good grip on your load at all times. • Be careful when lowering your load (get help, if necessary).

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

Hazard Analysis

Activity	Stabilization Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be mixing amendments and contaminated soil	Personnel may be injured by the composting equipment that is used to mix the materials and to turn the windrows.	• Only qualified personnel will operate the composting equipment. • Getting on or off of any equipment while it is in motion is prohibited. • Machinery shall be operated in accordance with the manufacturer's recommendations. • The use of headphones for entertainment purposes (such as radio or cassette) while operating equipment is prohibited. • All machinery shall be inspected daily (when in use) by a competent and knowledgeable person to ensure safe operating conditions. • Personnel shall not operate equipment in area where a potential to hit utilities is present. • All composting equipment shall be equipped with working audible reverse signal alarms. • Personnel shall wear hearing protection when working near composting equipment. • All moving or rotating equipment must be guarded to prevent accidental contact. • Personnel shall only operate the composting equipment with the machine guard in place. • Whenever a moving machinery part presents a hazard during servicing or maintenance, the engine shall be stopped, the power source disconnected, and all machine movement stopped before servicing or maintenance is performed. • The mesh or nip points of all power driven gears, belts, chains, sheaves, pulleys, sprockets, and so forth shall be guarded. • Functional components such as choppers, rotary beaters, mixing augers, feed rolls, conveying augers, and so forth which must be exposed for proper function shall be guarded to the fullest extent which will not substantially interfere with the normal functioning of the component. • All guards must be free from burrs, sharp edges, and sharp corners. Guards must be securely fastened to the equipment. • Stones or other foreign objects may forcibly eject from the composting equipment during turning activities.

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

Hazard Analysis

Activity	Stabilization Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be acquiring water and placing water on the windrows and stockpiles	Personnel may fall into a pond (if it is used as a source of water or if the sump contents are discharged to the pond).	• Work shall not be performed alone. • Personnel working near water where a drowning hazard is present will be equipped with a minimum of one throwable PFD that is attached to a polypropylene, or equivalent rope. • Wherever there is a potential for a drowning hazard, personnel shall wear US Coast Guard approved International Orange personal flotation devices (PFDs). • Before and after each use, the PFD shall be inspected for defects that would alter its strength or buoyancy. • Defective devices or devices with less than 13 pounds of buoyancy shall be removed from service. • All PFDs shall be equipped with retro-reflective tape.
Personnel will be performing alkaline hydrolysis activities	Personnel may come into contact with or inhale potentially high concentration of soil contaminants or decomposition products during stabilization activities.	• Potential chemical contaminants at a site shall be reviewed prior to performing work. • Personnel are required to wear the assigned level of PPE. • Personnel shall be careful when containerizing the decontamination waste so as not to further expose themselves. • Air monitoring will be performed. The PELs are listed below in Table 1.
	Wet or muddy surfaces may cause a tripping hazard	• Be alert and observe terrain while walking. • Wear appropriate footwear. • Personnel will avoid walking through or working in water or mud. • Personnel will avoid climbing over site debris or equipment. • Personnel shall ensure that equipment not in use will be put in a place where it will not create a tripping hazard.
	Materials with sharp edges may present a cutting hazard	• Personnel shall wear leather gloves to protect them from potential cuts whenever possible. • A 16-unit first aid kit will be available on-site in the event personnel are cut. • Cut areas will be decontaminated and first aid rendered. • Personnel will be taken to the hospital for a tetanus shot if they are cut.

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

Hazard Analysis

Activity	Stabilization Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be performing stabilization activities	Personnel may be exposed to noise levels that will potentially harm their hearing.	• Personnel shall wear hearing protection with at least a noise reduction rating (NRR) of 29 when working near heavy equipment, or the composting equipment.
	Personnel will be potentially exposed to harmful animals, insects, and poisonous plants.	• Insect repellants may be used except when sampling for nitroaromatics because they can interfere and cause false hits in subsequent analysis. • A 16-unit first aid kit shall be available at the site and shall contain a variety of ointments for skin afflictions. • Water and soap shall be provided on-site for personnel to wash affected skin areas. • Personnel shall report all known allergies to plants, insects, and medication to the Project Manager/SSHO prior to work.
	A possible fire hazard exists because of the stockpiled amendments (hay/straw, wood chips, and so forth) may spontaneously ignite or would burn quickly if ignited from another source.	• Amendment stockpiles and the windrows containing the mixed soil and amendments will be watered daily to keep a high level of moisture present. • The windrows and stockpiles will be kept at a height of 10 feet or less to inhibit the buildup of excess internal heat. • In order to keep aerobic conditions within the windrow, the windrows are required to be turned daily. This daily turning will inhibit the buildup of internal heat; therefore, contributing to fire protection. • The amendment stockpiles until used will be turned two to three times a week to inhibit the buildup of internal heat, which may cause spontaneous combustion. • A vacuum truck filled with water will be present on-site at the treatment pad area. This truck will be used for fire suppression. • All combustible materials shall be stored at least 35 feet (10.7 m) from windrow stockpiles.
	Personnel will potentially be exposed to mold spores, bacteria, and parasite.	• The amendment materials shall be wetted prior to mixing to reduce potential dust generation. • The windrows will be wetted prior to turning to limit generation of dust. • Personnel will be equipped with air purifying respirators with HEPA filters. • Personnel will be required to wash prior to eating, drinking, or smoking.

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

1.2 Chemical Hazards

The primary chemical hazards associated with these remediation activities are exposure to nitroaromatic compounds. Also, personnel will be potentially exposed to gases such as carbon dioxide, hydrogen sulfide, ammonia, and methane, which may be formed. Additionally, carbon monoxide levels may become elevated between the windrows during turning operations due to exhaust from equipment used to turn the windrows.

TMG proposes the following management practices to reduce air emissions from stabilization activities:

- Every attempt will be made not to overstock amendments.
- Amendments will be thoroughly mixed with the contaminated soil. This is necessary for proper remediation but it will also decrease emissions.
- The windrows will be kept moist (between 40 and 60% moisture) to reduce the potential for dust emissions as well as prevent possible spontaneous combustion of the windrows.

Personnel will be potentially exposed to products brought on the site by TMG Services, Inc. These products include Tornado-50 cleaner, gasoline and diesel fuel. The hazards from nitroaromatic compounds, diesel fuel, Tornado-50 cleaner, and gasoline were addressed in the previously approved Final SSHP (TMG Services, Inc. July 2010) and will not be reiterated in this plan.

Refer to Table 1 for permissible exposure limits (PELs) and immediately dangerous to life and health (IDLH) limits for all chemical hazards anticipated for the site. Chemical hazards from exposure to carbon dioxide, hydrogen sulfide, ammonia, methane, and carbon monoxide are discussed below in this section. Material Data Safety Sheets (MSDS) for all chemicals brought on-site shall be available for review by personnel prior to field mobilization and on-site.

TABLE 1 – EXPOSURE LIMITS

Compound	**PEL[1]**	**IDLH[1]**
o-Dinitrobenzene	1 mg/m3	200 mg/m3
m-Dinitrobenzene	1 mg/m3	200 mg/m3
p-Dinitrobenzene	1 mg/m3	200 mg/m3
Nitrobenzene	1 ppm	200 ppm
Nitrotoluene	5 ppm	200 ppm
Dinitrotoluene	1.5 mg/m3	200 mg/m3
o-Dinitrotoluene	2 ppm	200 ppm
p-Dinitrotoluene	2 ppm	200 ppm
2,4,6-Trinitrotoluene	1.5 mg/m3 (skin)	500 mg/m3
Hydrogen sulfide	20 ppm[2]	100 ppm
Ammonia	50 ppm	300 ppm
Carbon monoxide	50 ppm	1200 ppm
Carbon dioxide	5000 ppm	40,000 ppm
Methane	N/A3	N/A3
Diesel fuel	N/A3	N/A3
Tornado-50 cleaner	N/A3	N/A3

1 - PEL and IDLH values were taken from the NIOSH Pocket Guide to Chemical Hazards, June 1997.
2 - Ceiling level
N/A=not applicable, there is not OSHA PEL or IDLH value for this compound

1.2.1 Methane

Methane is the simplest of all hydrocarbons and is emitted into the atmosphere in quantities larger than any other hydrocarbon. On an annual worldwide basis, the amount of methane emitted into the atmosphere from natural sources has been estimated to be around 310 million tons. Bacterial decomposition reactions represent the primary source (greater than 50%) of all worldwide methane emissions. Although aerobic conditions should be maintained in the compost, if anaerobic conditions are allowed to develop, methane and hydrogen sulfide may be generated. Some of the chemical and physical properties of methane are as follows:

- Methane has a molecular weight of 16.05 g/mol.
- Naturally occurring Methane is a colorless, odorless, and tasteless gas.
- Methane has a boiling point of -322.7 °F and a flash point of -361.76 °F.
- Methane has a lower explosive limit (LEL) of 5.3% and an upper explosive limit (UEL) of 15%.
- Methane is a simple asphyxiant.
- Methane is a very dangerous fire hazard when exposed to an ignition source and presents an explosion hazard.

Specific routes of exposure are:

- Inhalation

Symptoms a worker may exhibit when exposed to methane include, but are not limited to the following:

- Rapid respiration
- Diminished mental alertness
- Impaired muscular coordination
- Depression of senses
- Emotional instability
- Fatigue
- Nausea and vomiting
- Loss of consciousness
- Convulsions
- Deep coma and death

The target organs affected are:

- Respiratory system
- Central nervous system

Emergency First Aid procedures are:
Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Get medical attention immediately.
- Contact lenses should not be worn when working with this chemical.

1.2.2 Hydrogen Sulfide

Hydrogen sulfide is a highly toxic gas. It is produced naturally by decaying organic matter. Although aerobic conditions should be maintained in the compost, if anaerobic conditions are allowed to develop, methane and hydrogen sulfide may be generated. Some of the chemical and physical properties of hydrogen sulfide are as follows:

- Hydrogen sulfide has a molecular weight of 34.08.
- Hydrogen sulfide is a colorless, flammable gas with an offensive odor. The odor is frequently characterized as smelling like rotten eggs. *(NOTE: The sense of smell becomes rapidly deadened and can not be relied upon to warn of the continuous presence of hydrogen sulfide)*
- Hydrogen sulfide has a boiling point of -77°F.
- Hydrogen sulfide has a immediately dangerous to life or health value of 100 ppm. Exceeding this value requires the use of supplied air respiratory protection.
- Hydrogen sulfide has an upper explosive limit (UEL) or 44% and a lower explosive limit (LEL) of 4.0%.
- Hydrogen sulfide is heavier than air and may accumulate in low areas and may travel a considerable distance to an ignition source.
- Hydrogen sulfide is a poison. Exposures of 800-1000 ppm may be fatal in 30 minutes, and higher concentrations can be instantly fatal.
- Hydrogen sulfide is an irritant. Low concentrations of 20-150 ppm causes irritation to the eyes and slightly higher concentrations may cause irritation to the upper respiratory tract.
- Hydrogen sulfide is an asphyxiant. Hydrogen sulfide in very high amounts can paralyze the respiratory system.
- Hydrogen sulfide is a very dangerous fire hazard when exposed to heat, flame, or oxidizers. Also, it is a moderate explosion hazard when exposed to heat or flame.

Specific routes of exposure to hydrogen sulfide are:

- Inhalation
- Absorption through eyes and mucous membrane

Symptoms a worker may exhibit when exposed to hydrogen sulfide include, but are not limited to the following:

- Eye irritation
- Conjunctivitis
- Photophobia
- Corneal bullae
- Mucous membrane irritation
- Upper respiratory irritation
- Rhinitis

- Bronchitis
- Pulmonary edema
- Headache
- Dizziness
- Confusion
- Depression (when exposed to small concentrations)
- Excitement (when exposed to large concentrations)
- Irritability
- Gastrointestinal disturbances
- Staggering gait
- Diarrhea
- Paralysis of the respiratory system
- Coma
- Death

The target organs affected by hydrogen sulfide are:

- Eyes
- Respiratory system
- Central nervous system

Emergency First Aid procedures are:

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Get medical attention immediately.
- Contact lenses should not be worn when working with this chemical.

1.2.3 Ammonia

It is typical for ammonia gas to be generated during the composting process. Exposure to ammonia vapors is especially likely during the windrow turning operations. Some of the chemical and physical properties of ammonia are:

- Ammonia is a colorless gas with a pungent, suffocating odor.
- Ammonia has a molecular weight of 17.0 g/mol.
- Ammonia has a immediately dangerous to life or health value of 300 ppm. Exceeding this value requires the use of supplied air respiratory protection.
- Ammonia has an upper explosive limit (UEL) of 28% and a lower explosive limit (LEL) of 15%.

- Ammonia is incompatible and/or reactive with strong oxidizers, acids, halogens, and salts of silver and zinc.

Specific routes of exposure to ammonia are:

- Inhalation
- Absorption through eyes and mucous membrane
- Skin absorption

Symptoms a worker may exhibit when exposed to ammonia include, but are not limited to the following:

- Eye, nose, and throat irritation
- Respiratory irritation
- Bronchial spasms
- Chest pain
- Pulmonary edema
- Skin burns
- Dyspnea

The target organs affected by hydrogen sulfide are:

- Eyes
- Respiratory system
- Skin

Emergency First Aid procedures are:

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

Skin Absorption

- Promptly wash contaminated skin using soap or a mild detergent and water.
- If contaminant has penetrated through clothing, remove the clothing immediately and wash the skin with soap and water.
- Get medical attention immediately.

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Get medical attention immediately.
- Contact lenses should not be worn when working with this chemical.

1.2.4 Carbon Dioxide

Carbon dioxide is generated in copious amounts during the composting process. Carbon dioxide is a simple asphyxiant; therefore, it replaces oxygen in the air. Some of the chemical and physical properties of carbon dioxide are:

- Carbon dioxide is a colorless, odorless gas.
- Carbon dioxide has a molecular weight of 44.0 g/mol.
- Carbon dioxide is a normal constituent of air; however, at elevated concentrations it tends to displace oxygen causing asphyxiation.

Specific routes of exposure to carbon dioxide related to this project are:

- Inhalation

Symptoms a worker may exhibit when exposed to carbon dioxide for this project include, but are not limited to the following:

- Dizziness
- Headache
- Inability to sleep well

The target organs affected by carbon dioxide are:

- Central Nervous System
- Respiratory system

Emergency First Aid procedures are:

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

1.2.5 Carbon Monoxide

Carbon monoxide is a by-product of combustion and will be exhausted by the heavy equipment used on-site. Of particular concern with this chemical is the use of heavy equipment between the windrows where diffusion of carbon monoxide will be limited due to restricted air flow caused by the windrows and by carbon monoxide's inherent chemical/physical properties. Some of the chemical and physical properties of carbon monoxide are as follows:

- Carbon monoxide has a molecular weight of 28.01 g/mol.
- Carbon monoxide is a colorless, odorless gas. It has almost the same density as air; therefore, it won't diffuse by rising.
- Carbon monoxide has a boiling point of -312.7°F.
- Carbon monoxide has a immediately dangerous to life or health value of 1200 ppm. Exceeding this value requires the use of supplied air respiratory protection.

- The upper explosive limit (UEL) for carbon monoxide is 74.2% and the lower explosive limit (LEL) is 12.5%.
- Carbon monoxide is a poison by inhalation and is an experimental teratogen.
- Carbon monoxide is an asphyxiant, it prevents hemoglobin from binding with oxygen
- Carbon monoxide is a dangerous fire and explosion hazard when exposed to flame.

Specific routes of exposure are:
- Inhalation

Symptoms a worker may exhibit when exposed to carbon monoxide includes, but is not limited to the following:
- Dizziness
- Fatigue
- Headache
- Nausea
- Flu like symptoms
- Confusion
- Auditory disturbances
- Contraction of the visual field
- Heart irregularities
- Edema

The target organs affected are:
- Respiratory system
- Central nervous system

Emergency First Aid procedures are:

Inhalation
- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

1.2.6 Sodium Hydroxide (Caustic Soda)

Sodium hydroxide pellets will be used for during Alkaline Hydrolysis. The MSDS for sodium hydroxide is included in Appendix D of this document. Some of the properties of sodium hydroxide are:
- Sodium hydroxide is a white solid (pellet form will be used)
- Sodium hydroxide has a molecular weight of 40 g/mole.
- Sodium hydroxide is a non-flammable.

The specific routes of exposure for sodium hydroxide are:

- Inhalation
- Skin absorption
- Ingestion
- Skin and/or eye contact

Symptoms a worker may exhibit when exposed to sodium hydroxide include, but are not limited to the following:

- Skin irritation and burns
- Ulcers of the skin
- Severe eye irritation and burns
- Irritation of respiratory tract and mucous memberanes.
- Perforation of the digestive tract.

The target organs affected by sodium hydroxide are:

- Eyes
- Skin
- Respiratory System
- Digestive System

Emergency First Aid procedures are:

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Seek medical attention immediately.
- Contact lenses shall not be worn when working with this chemical.

Skin Absorption

- Promptly wash contaminated skin using soap or a mild detergent and water.
- Wash the skin with soap and water.
- Seek medical attention immediately.

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Seek medical attention immediately.

Ingestion

- DO NOT INDUCE VOMITING unless directed by medical personnel.
- Seek medical attention immediately.

1.2.7 Ferric Chloride

The use of ferric chloride (FeCl) will be evaluated during bench scale studies. The studies will determine if FeCl will benefit the stabilization process and further determine if it will be used at all. The MSDS for ferric chloride solution is included in Appendix D.

Ferric Chloride will be used as a catalyst during Alkaline Hydrolysis, if necessary. Some of the chemical and physical properties of ferric chloride are as follows:

- Ferric chloride is a dark reddish-brown color with an oily texture.
- Ferric chloride has a molecular weight of 162.21 g/mole, pH of <1, and has a boiling point of 225$_o$F.
- Ferric chloride is not considered a fire hazard.
- Ferric chloride may generate hydrogen gas on contact with metals. Corrosive to stainless steel, mild steel, bronze, iron, aluminum, copper, and concrete.

The specific routes of exposure for ferric chloride are:

- Inhalation
- Skin absorption
- Ingestion
- Skin and/or eye contact

Symptoms a worker may exhibit when exposed to ferric chloride include, but are not limited to the following:

- Irritation of mucous membranes, respiratory tract, and lung tissures.
- Altered respiratory rates may occur.
- Stomach irritation
- Blistering and staining.
- Burns and severe irritation of mucous membrane lining of inner surfaces of the eyelids.

The target organs affected by ferric chloride are:

- Eyes
- Skin
- Respiratory System
- Digestive System

Emergency First Aid procedures are:

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Seek medical attention immediately.
- Contact lenses shall not be worn when working with this chemical.

Skin Absorption

- Promptly wash contaminated skin using soap or a mild detergent and water.
- If methanol have penetrated through clothing, remove the clothing immediately and wash the skin with soap and water.
- Seek medical attention immediately.

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Seek medical attention immediately.

Ingestion

- If victim is conscious, have drink large quantities of water or milk to reduce concentration and neutralize acid.
- DO NOT INDUCE VOMITING.
- Seek medical attention immediately.

1.3 Physical Hazards

The General Safety and Health Plan addressed numerous physical hazards that might be encountered during various projects; however, site-specific conditions could not be addressed in the General Plan and must be addressed in this addendum. TMG anticipates that the following physical hazards will be encountered on this project.

- Heavy Equipment Hazards
- Utility Lines
- Slips, Trips, and Falls
- Lifting Techniques (manual)
- Inclement Weather (heat stress)
- Noise
- Harmful Plants, Animals, and Insects
- Cuts
- Composting Equipment Hazards
- Fire Hazards
- Biological Hazards
- Water Hazards

All of these hazards (except for composting equipment hazards, cuts, fire hazards, and biological hazards) were addressed in the Final SSHP (TMG Services, Inc. July 2010) issued under Contract No. W91237-10-C-0002 and will not be reiterated in this supplement. This supplement will address site-specific conditions for composting equipment hazards, cuts, fire hazards, and biological hazards.

1.3.1 Equipment Hazards

The windrow equipment typically contains powerful mixing flails, knives, or hammers that rotate at a high rate of speed which poses a significant physical hazard for personnel working with and around this equipment. The following safety precautions shall be adhered to for this project:

- Only qualified personnel will operate the composting equipment.
- Getting on or off of any equipment while it is in motion is prohibited.
- Machinery shall be operated in accordance with the manufacturer's recommendations.
- The use of headphones for entertainment purposes (such as radio or cassette) while operating equipment is prohibited.
- All machinery shall be inspected daily (when in use) by a competent and knowledgeable person to ensure safe operating conditions.
- Personnel shall not operate equipment in area where a potential to hit utilities is present.
- All composting equipment shall be equipped with working audible reverse signal alarms.
- Personnel shall wear Level C PPE (downgrade possible to Level D PPE if air monitoring results are below PEL, Table 1) and hearing protection as described in Section 5.1 of the final SSHP (TMG Services, Inc. July 2010) when working near composting equipment.
- All moving or rotating equipment must be guarded to prevent accidental contact.
- Personnel shall only operate the composting equipment with the machine guard in place.
- Whenever a moving machinery part presents a hazard during servicing or maintenance, the engine shall be stopped, the power source disconnected, and all machine movement stopped before servicing or maintenance is performed.
- The mesh or nip points of all power driven gears, belts, chains, sheaves, pulleys, sprockets, and so forth shall be guarded.
- Functional components such as choppers, rotary beaters, mixing augers, feed rolls, conveying augers, and so forth which must be exposed for proper function shall be guarded to the fullest extent which will not substantially interfere with the normal functioning of the component.
- All guards must be free from burrs, sharp edges, and sharp corners. Guards must be securely fastened to the equipment.
- Stones or other foreign objects may forcibly eject from the composting equipment during turning activities.
- Hearing protection is required while operating the compost turner.
- Personnel shall wear hearing protection with at least a noise reduction rating (NRR) of 29 when working near heavy equipment, or the composting equipment.

1.3.2 Fire Hazards

A possible fire hazard exists because of the stockpiled amendments (straw and so forth) may spontaneously ignite or would burn quickly if ignited from another source. Also, the mixed materials within the windrows may ignite if they overheat. Fires are rarely a

problem in outdoor stabilization operations but they do sometimes occur. Organic material can ignite spontaneously at moisture contents between 25 and 35 percent. The following safety precautions shall be taken:

- Amendment stockpiles and the windrows containing the mixed soil and amendments will be watered daily, during dry conditions, to keep a high level of moisture present.
- The windrows and stockpiles will be kept at a height of 10 feet or less to inhibit the buildup of excess internal heat.
- In order to keep aerobic conditions within the windrow, the windrows are required to be turned daily. This daily turning will inhibit the buildup of internal heat; therefore, contributing to fire protection. The amendment stockpiles until used will be turned two to three times a week to inhibit the buildup of internal heat, which may cause spontaneous combustion.
- At a minimum, there will be four 10,000 gallon Frac tanks located near the treatment pad, in the event of a fire in the windrows, water from these tanks or from the sumps can be used. The water in the tanks may contain some nitroaromatics, but not in sufficient concentration to be a concern for fire application uses.
- All combustible materials shall be stored at least 35 feet (10.7 m) from windrow stockpiles

1.3.3 Biological Hazards

There are no biological hazards anticipated during the alkaline hydrolysis remediation.

1.3.4 Water Hazard

Water hazards are not expected to be a major hazard; however, a potential exists that personnel removing water from the excavation pits prior to backfilling the pits may fall into water that has filled or partially filled the pits. Additionally, personnel may fall into the West Area Red Water Pond when they are disposing of pit water or possible obtaining water to put on the windrows. The following safety precautions shall be taken, wherever there is a potential for a drowning hazard.

- Personnel will be required to wear a personal flotation device when working over or near bodies of water three or more feet in depth or swiftly moving water.
- Work shall not be performed alone.
- Personnel working near water where a drowning hazard is present will be equipped with a minimum of one throwable personal floatation device (PFD) that is attached to a polypropylene, or equivalent rope.
- Wherever there is a potential for a drowning hazard, personnel shall wear Type III, Type V, or better US Coast Guard approved International Orange PFD.
- Before and after each use, the PFD shall be inspected for defects that would alter its strength or buoyancy.
- Defective devices or devices with less than 13 pounds of buoyancy shall be removed from service.

- All PFDs shall be equipped with retro-reflective tape.

APPENDIX B Activity Hazard Analysis – Alkaline Hydrolysis Treatment

ACTIVITY HAZARD ANALYSIS

Work Location: Plum Brook Ordnance Works, Ohio	**Developed by**: Roberto Rolon, CIH, REM, CIPS
Task Title: Remedial Treatment of Contaminated Soils	**Date**: July 2010
Work Phase: Surface Soil Treatment	
A. General Site Safety- all work phases.	**Risk Assessment Code (RAC) Table**
B. Establish treatment area, CRZ, and support zone.	
C. Transport contaminated soil into treatment area.	
D. Add caustic material (e.g. sodium hydroxide pellets).	
E. Thoroughly mix soils and caustic.	
F. Add water to soil.	
G. Add amended chemicals (e.g. ferric chloride or citric acid)	
H. Collect confirmation samples IAW QAAP.	
I. Soil Disposition.	
J. Decon equipment and personnel.	

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

E = Extremely High Risk; H = High Risk; M = Moderate Risk; L = Low Risk

ACTIVITY HAZARD ANALYSIS –SURFACE SOIL TREATMENT

Work Phase:	List Work Groups Needed for Each Phase
A. General Site Safety- all work phases.	A. All workers.
B. Establish treatment area, CRZ, and support zone.	B. All workers.
C. Transport contaminated soil into treatment area.	C. Heavy equipment operator, UXO tech, laborer, and supervisor (SEL).
D. Add caustic material (e.g. sodium hydroxide pellets).	D. Heavy equipment operator, laborer, and supervisor (SEL).
E. Thoroughly mix soils and caustic.	E. Heavy equipment operator, UXO tech, laborer, and supervisor (SEL).
F. Add water to soil.	F. Laborer (SEL).
G. Add amended chemicals (e.g. ferric chloride or citric acid)	G. Laborer (SEL).
H. Collect confirmation samples IAW QAAP.	H. Samplers (SEL).
I. Soil Disposition.	I. All workers.
J. Decon equipment and personnel.	J. All workers.

ACTIVITY HAZARD ANALYSIS

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
A. General Site Safety – All phases.	All	Heat/Cold Stress (RAC: M)	Heat stress and cold related injuries will be monitored and controls will be implemented as necessary. (EM 385-1-1 06.I) Workers and supervisors shall receive training on the signs and symptoms of heat and cold related injuries. An adequate supply of drinking water shall be provided in all places of employment. Frequent rest breaks shall be taken as needed to insure proper hydration during weather extremes. (EM-385-1-1 02.C.01) During ambient air temperatures of below 40°F and greater than 5 mph winds, exposed skin is at risk to frostbite. Personnel shall implement measures to reduce exposed skin exposure to these conditions.
		Slips/Trips/Falls (RAC: M)	Tripping hazards will be identified and avoided or removed, if possible. If hazard removal is not feasible, hazard will be posted and communicated to personnel by use of barriers such as tape, flags, cones, etc. (EM 385-1-1 14.C) Both Trench 6 and 7 pose significant slip/trip/fall hazards due to the uneven terrain. Extreme caution is required especially when wearing protective clothing.

ACTIVITY HAZARD ANALYSIS

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
A. General Site Safety – All phases. (cont.)		Faulty/Damaged Equipment (RAC: L)	Appropriate foot wear will be in serviceable condition (e.g. adequate tread on sole). Equipment will be inspected upon arrival and at the start of each shift. Damaged equipment will be removed from service. (EM 385-1-1 16.A) Equipment found to be in need of repair, defective, or unsafe in any way, shall be tagged and taken out of service. Equipment shall not be operated with damaged windshield or glass. Equipment shall not be placed back into service until repaired and inspected and authorized to do so by SSHO.
		Uneven Terrain (RAC: L)	Inspection or determination of road conditions and structures shall be made in advance to assure that clearances and load capacities are safe for passage. Whenever the equipment is parked on an incline, the wheels will be chocked. (EM 385-1-1 18.B)
		Lifting (RAC: L)	Use proper lifting techniques, size up load, use teamwork, never twist or turn when lifting, keep load close to the trunk of the body, and ensure clear path of travel. (EM 385-1-1 14.A) Whenever practical, use hydraulic lifting devices to avoid manual lifting. Inspect grasp points on objects for damage.

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
A. General Site Safety – All phases. (cont.)		Eye Injury (RAC: L) Head Injury (RAC: L) Hand Injury (RAC: L) Foot Injury (RAC: L) Insects, Spiders, and Ticks (RAC: L) Snakes and Animals (RAC: L)	Eye protection will be required at all times while on-site. Eye protection must comply with ANSI standard Z87.1, meaning impact resistant with side shields. Personnel who wear vision correcting glasses may wear either safety glasses or goggles with vision correction, side shields or goggle to fit over the corrective glasses. Hard hats will be worn when there is a potential for head injury. (EM 385-1-1 05.D) Leather work gloves will be worn when handling rough material where pinch point hazards exist and for handling sharp material. (EM 385-1-1 05.A) Steel-toed safety shoes will be worn by all personnel performing work in the area. Ensure adequate tread on sole of shoes. (EM 385-1-1 05.E) Insect/tick repellant will be provided for use by employees. Personnel will be instructed to be cautious of insects, spiders, and ticks. Wear clothing that covers potentially affected body parts. Seal pants legs against contact with plants and to prevent access by organisms (examples – ticks & chiggers). Check body thoroughly after work to detect ticks and chiggers. Take hot shower after field work and wash thoroughly. (EM 385-1-1 06.D)

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
A. General Site Safety – All phases. (cont.)		Sunburn (RAC: L) Noise Exposure (RAC: L) Hypersensitivity or Allergic Reactions (RAC: L) Lack of Communication (RAC: L) Severe Weather (RAC: L) Vehicle Accidents (RAC: L)	All animals are to be avoided and care should be taken to observe the work area for snakes and other animals. Noise should be made when entering the area to compel snakes to leave. (EM 385-1-1 06.D) Sunscreen will be available for use. Shade should be utilized when available and /or shade provided when feasible. (EM 385-1-1 06.I) Hearing protection will be worn in areas where the noise level exceeds 85 dBA (8-hr TWA). (EM 385-1-1 05.C) Personnel who are knowingly hypersensitive or allergic to insects or plants will be identified and precautions taken. (EM 385-1-1 06.D) Personnel will remain in visual site. A two-way radio system will be used in remote locations in order to contact emergency services. (EM 385-1-1 01.E) Check the weather forecast for the day prior to work. Take cover in a building/vehicle if lightning is spotted. (EM 385-1-1 06.I) All site personnel operating motor vehicles shall comply with all federal, state, and local traffic regulations. Personnel shall only use vehicles that are in good condition and are safe to operate. Personnel

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
		First Aid and Emergencies (RAC: L)	shall routinely inspect vehicles using the Vehicle Inspection Form. All personnel will drive defensively, wear seatbelts while vehicles are in motion, and comply with site speed limits. Backing of vehicles shall be avoided when possible. Extra care shall be taken to back vehicles when unavoidable. Personnel shall wear ANSI/ISEA 07-2004 performance class 2 high visibility vest in the vicinity of vehicle traffic. (EM 385-1-1 05.F;18.C) Follow emergency procedures outlined in the SSHP. Two on site personnel will be trained in first aid and CPR. (EM 385-1-1 03.A)
B. Establish treatment area, CRZ, and support zone. - Demarcate areas using appropriate warning signage and tape. - Decon area required for rinsing off tools, equipment, and PPE disposal. B. Establish treatment area, CRZ, and support zone. - Demarcate areas using appropriate warning signage and tape. - Decon area required for rinsing off tools, equipment, and PPE disposal. (cont.)	All	Heavy Lifting, Strains, Sprains (RAC: L) Untrained Personnel (RAC: L) Site Control (RAC: L)	No individual employee is permitted to lift any object that weighs over 50 pounds without assistance. Proper lifting techniques shall be used. Multiple employees or the use of mechanical lifting devices are required for lifting objects over the 50 pound limit. (EM 385-1-1 14.A) Only personnel meeting the outlined training requirements are allowed to working in the treatment area (exclusion zone). Personnel will be trained to safely use the equipment they will be required to operate and wear appropriate PPE. (EM 385-1-1 01.B; 05.A.02) Keep non-essential personnel out of the work zone. Barricade as necessary. (EM 385-1-1 06.A; 28.D)
C. Transport contaminated soil into	SEL	Heavy Equipment	Personnel will avoid areas where heavy equipment is

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
treatment area. - Position soil in windrows for treatment.		(RAC: M) (Note: This potential hazard exist during phases C, D, E, and I).	operating. If workers require moving into the heavy equipment work zone, the pedestrian worker shall make eye contact with operator prior to moving near heavy equipment. The operator will stop activities (e.g. place excavator bucket on the ground). This action notifies the pedestrian worker that it is clear to proceed. **Pedestrian worker activities and heavy equipment operations will not occur simultaneously within 20 feet**. **If excavators come equipped with quick coupler device, the operator will ensure that a manual locking pin is inserted on the lever of the couplers to prevent unintended release of the bucket.** Personnel shall wear ANSI/ISEA 07-2004 performance class 2 high visibility vest in the vicinity of heavy equipment activities. (EM 385-1-1 05.F;18.C) Follow manufacturer's safety precautions when using equipment. Avoid pinch points. (EM 385-1-1 05.A)
C. Transport contaminated soil into treatment area. - Position soil in windrows for treatment.		Chemical Health Hazards – Contact and Ingestion (RAC: L) (Note: This potential hazard exist during phases C, D, E, F, G, H, I, and J).	Personnel are not allowed to eat, drink, smoke, or apply cosmetics while working in the treatment area. (EM385-1-1 02.J.04) Personnel shall don the following PPE in addition to the PPE listed in the General Safety activity: - Tyvek coveralls,

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
(cont.)			- Nitrile rubber gloves, - Chemical booties. These items reduce the potential for cross-contamination of clean areas. Prevent contact with chemical, exit work zone and wash hands & face prior to taking anything by mouth (eating, drinking, smoking, chewing, etc.) (EM 385-1-1 06.B)
D. Add caustic material (e.g. sodium hydroxide pellets). - Position 2,200 lb super sack using excavator bucket and rigging equipment.	SEL	Chemical Health Hazards – Contact and Ingestion. (RAC: H) (Note: This potential hazard exist during phases D, E, F, G, H, I, and J).	All personnel shall be briefed on the physical and health hazards associated with sodium hydroxide prior to utilizing product (See material safety data sheet). A chemical inventory of all hazardous chemicals used on-site shall be available. Corresponding MSDSs for each hazardous chemical listed will be available in the work area. Workers handling caustic material shall don the following PPE in addition to the PPE listed in the General Safety activity: - Tyvek QC coveralls, - Nitrile rubber gloves (15 mm thickness), - Face shield, - Chemical booties. These items reduce the potential for skin contact to caustic material. If winds exceed 15 mph, personnel shall remain upwind at

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
D. Add caustic material (e.g. sodium hydroxide pellets). (cont.)			all times during adding of caustic material. No personnel shall be allowed downwind without proper protective clothing.
		Improper use of hand tool (RAC: L)	Inspect hand tools prior to use. Use the proper tools for specific task.
		Sharp edge tools (RAC:L)	Use caution when cutting plastic covering over super sac. Ensure cutting tool does not pierce the canvas super sack causing the release of caustic material out of the bag. Do not use dull, jaded, or rusted cutting tools. Always move the cutting tool away from the body while cutting materials.
		Hoisting and Rigging Hazards (RAC: M)	Hydraulic excavating equipment shall not be used to hoist personnel. The riding of personnel on loads, hooks, hammers, buckets or any other hydraulic excavating equipment attachment is prohibited. (EM 385-1-1 16.S.01) The following requirements are required when using hooks, slings, chains, and other rigging equipment: - Rigging equipment rating to load ratio shall be 4 to 1 as a minimum. Ensures stability of load during transport. - Equipment shall be used for its intended purpose only; - Manufacturer's load rating capacity or chart shall be on-site; - Open hooks are prohibited in rigging used to hoist

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
D. Add caustic material (e.g. sodium hydroxide pellets). (cont.)		Crushing injuries from unstable loads (RAC: M)	loads and hooks should be equipped with an operational self-closing safety latch; - Personnel shall follow operating procedures in accordance with the equipment manufacturer's operating manual; - Personnel shall inspect equipment devices prior to use for damage; - Damage equipment devices shall be removed and tagged with the words "OUT OF ORDER-DO NOT USE"; - Personnel will utilize a tag line to control swaying of hoisted item; - Ensure stability of surfaces beneath the hydraulic excavating equipment; - Establish safe swing radius and briefing personnel on this radius; - Loads shall be lifted the minimum height necessary to clear the ground or other obstacles and carried as low as possible when the equipment is traveling; and - Under no circumstance shall loads be lifted over personnel. (EM 385-1-1 16.S.03) No load shall be transported above any individual. Maintain load as close to the ground when transporting from one location to the other. Personnel shall not stand underneath loads handled by lifting or digging equipment.
E. Thoroughly mix soils and caustic.	SEL	Heavy Equipment	Note Controls listed in phase C for same hazard

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
- Utilize compost turner or hydraulic excavator to mix soils		(RAC: M) (Note: This potential hazard exist during phases C, D, E, and H).	category.
		Chemical Health Hazard - Inhalation (RAC: M) (Note: This potential hazard exists during phases E, F, G, and H).	Perform air monitoring during mixing activities due to exothermic breakdown of chemical contaminates. Use enclosed cab excavators to reduce potential of inhalation to chemical by products. Monitor for VOCs using PID hand-held instruments. If total VOCs is greater than 10 ppm, assess exposure using contaminant specific NIOSH methodologies to determine specific contaminant concentrations. Monitor for DNT and TNT during excavation of contaminated soils, soil mixing and loadout activities. Section 8.4.2 of the SSHP list the action levels and methodology for air monitoring.
E. Thoroughly mix soils and caustic. - Utilize compost turner or hydraulic excavator to mix soils (cont.)			Prior to the initiation of work, personnel will be informed of potential hazards and required precautions.
		Crushing injuries from unstable loads (RAC: M)	Equipment shall be properly leveled/stabilized and checked to insure that it will not move once in place. No load shall be transported above any individual. Maintain load as close to the ground when transporting from one location to the other. Personnel shall not stand underneath loads handled by lifting or digging equipment.

ACTIVITY HAZARD ANALYSIS

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
F. Add water to soil. - Utilize water truck to apply water.	SEL	Heavy Lifting, Strains, Sprains (RAC: L) Chemical Health Hazards – Contact and Inhalation (RAC: M)	Note Controls listed in phase B for same hazard category. Note Controls listed in phase C for same hazard category. Note Controls listed in phase E for same hazard category. Reduce water pressure output to minimize splash effect.
G. Add amended chemicals (e.g. ferric chloride or citric acid)	SEL	Chemical Health Hazards – Contact and Ingestion (RAC: M) Chemical Health Hazard - Inhalation (RAC: M)	Note Controls listed in phase D for same hazard category. Note Controls listed in phase E for same hazard category.
H. Collect confirmation samples IAW Work Plan. - Excavator bucket used to remove soils from various depths for composite samples. - Sample aliquots collected from bucket using sampling trowel, then aliquots mixed in stainless bowl to make up composite samples.	SEL	Heavy Equipment (RAC: M) Chemical Health Hazards – Inhalation and Contact (RAC: M) Hand Tool Hazards	Note Controls listed in phase C for same hazard category. Note Controls listed in phase C for same hazard category. Note Controls listed in phase D for same hazard category.

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
		(RAC: L)	Note Controls listed in phase E for same hazard category. Hand tools shall be used, inspected, and maintained in accordance with the manufacturer's instructions and recommendations and shall be used only for the purpose for which designed. A copy of the manufacturer's instructions and recommendations shall be maintained with the tools. (EM 385-1-1 13.A.02) Hand tools shall be inspected, tested, and determined to be in safe operating condition before use. Continued periodic inspections shall be made to assure safe operating condition and proper maintenance. (EM 385-1-1 13.A.02) Hand tools shall be in good repair and with all required safety devices installed and properly adjusted. Tools having defects that will impair their strength or render them unsafe shall be removed from service. (EM 385-1-1 13.A.02)
I. Soil Disposition. - Determine if additional treatment time required to reduce contaminates down to clean-up goals. - If soil contaminates are below clean-up goals, transport soils to predetermined location.	SEL	Heavy Equipment (RAC: M)	Note Controls listed in phase C for same hazard category.

ACTIVITY HAZARD ANALYSIS

Activity Steps	Work Groups	Hazards	Hazard Controls [Engineered, Operational, Documents, Personal Protective Equipment (PPE), Qualifications]
J. Decon equipment and personnel.	All	Chemical Health Hazard - Contact (RAC: L)	Note Controls listed in phase C for same hazard category. Note Controls listed in phase F for same hazard category.

APPENDIX C Respirator Fit-Test Certifications

TRAINING ACKNOWLEDGMENT

TYPE OF TRAINING: *New Hire* ☐ *Hazwhoper* ☒ *Refresher* ☒

Other Sub-Contractor Training and for Beaver Contractor

Total Hours Trained 8

I JAMES B. RUSSELL acknowledge that I have received instruction and understand the following subjects (initial all that apply):

C&K Safety Training Programs:

JBR Hazard Communication
JBR Lockout/Tagout
JBR Confined Space
JBR Fire Extinguisher/Emergency Action
JBR Respiratory Protection
N/A Forklift
JBR Confined Space Communication
N/A Asbestos Awareness

JBR Personal Protective Equipment
N/A Drug Free Workplace
JBR General Company Safety Policies*
N/A Vac Truck Safety & Operations
N/A Waterblast Safety & Operations
N/A Manlift
N/A Lead Abatement
N/A Inorganic Arsenic Awareness

Site Specific Trainings:

N/A Alcoa- Contractor/Stand-down
N/A Charter Steel
JBR X Other Fall Protection
X Other Monitoring Equipment

N/A Reliant Energy
____ Other _____
JBR X Other Fit-Testing
____ Other _____

* I have received a copy of C&K Abridged Safety Policy Manual.

James B. Russell 4-7-10
Employee Signature Date

John P. Gabriel 4-7-2010
Instructor Signature Date

TRAINING ACKNOWLEDGMENT

TYPE OF TRAINING: *New Hire* ☐ *Hazwhoper* ☒ *Refresher* ☒

Other Sub-Contractor Training and for Base Contractor

Total Hours Trained 8

I [illegible] acknowledge that I have received instruction and understand the following subjects (initial all that apply):

C&K Safety Training Programs:

- DH Hazard Communication
- DH Lockout/Tagout
- DH Confined Space
- DH Fire Extinguisher/Emergency Action
- DH Respiratory Protection
- N/A Forklift
- DH Confined Space Communication
- N/A Asbestos Awareness
- DH Personal Protective Equipment
- N/A Drug Free Workplace
- DH General Company Safety Policies*
- N/A Vac Truck Safety & Operations
- N/A Waterblast Safety & Operations
- N/A Manlift
- N/A Lead Abatement
- N/A Inorganic Arsenic Awareness

Site Specific Trainings:

- N/A Alcoa- Contractor/Stand-down
- N/A Charter Steel
- DH X Other Fall Protection
- X Other Monitoring Equipment
- N/A Reliant Energy
- ____ Other ____
- DH X Other Fit-Testing
- ____ Other ____

* I have received a copy of C&K Abridged Safety Policy Manual.

Employee Signature 4-7-10 Date

Instructor Signature 4-7-2010 Date

TRAINING ACKNOWLEDGMENT

TYPE OF TRAINING: *New Hire* ☐ *Hazwhoper* ☒ *Refresher* ☒

Other Sub-Contractor Training as for Base Contractor

Total Hours Trained 8

I [illegible] acknowledge that I have received instruction and understand the following subjects (initial all that apply):

C&K Safety Training Programs:

UPC Hazard Communication
UPC Lockout/Tagout
UPC Confined Space
UPC Fire Extinguisher/Emergency Action
UPC Respiratory Protection
N/A Forklift
UPC Confined Space Communication
N/A Asbestos Awareness

UPC Personal Protective Equipment
N/A Drug Free Workplace
UPC General Company Safety Policies*
N/A Vac Truck Safety & Operations
N/A Waterblast Safety & Operations
N/A Manlift
N/A Lead Abatement
N/A Inorganic Arsenic Awareness

Site Specific Trainings:

N/A Alcoa- Contractor/Stand-down
N/A Chester Steel
UPC X Other Fall Protection
X Other Monitoring Equipment

N/A Reliant Energy
____ Other _____
UPC X Other Eb-Testing
____ Other _____

* I have received a copy of C&K Abridged Safety Policy Manual.

[signature] 4-7-2010
Employee Signature Date

[signature] 4-7-2010
Instructor Signature Date

Concentra Medical Centers (Ohio)
4900 Hinckley Industrial Pkwy CLEVELAND, OH 44109
Phone: (216) 749-0730 Fax: (216) 749-0733

PLHCP[1] WRITTEN STATEMENT for RESPIRATORS (EMPLOYEE)

Service Date: 04/06/2010

Employee Name: Cashbaugh, Daniel P.

Employee SSN: XXX-XX-1919

Address: 1651 Price Rd.

YOUNGSTOWN OH 44509

Employer: TMG Services Inc

You were evaluated in this office of your medical status related to your physical capability to wear a respirator. (Check ✓ one that applies)

- ☐ There were no abnormal findings that would hamper your ability to perform your job duties while wearing a respirator.
- ☐ The abnormal findings listed below were not related to wearing a respirator but should be reported to your personal physician for further evaluation.

Based upon the results of this evaluation it is my opinion that you: (Check ✓ ALL that apply)

- ☑ ARE qualified to wear a respirator.
- ☑ Have the following restrictions concerning respirator usage: No SCBA
- ☐ ARE NOT qualified to wear a respirator.
- ☐ Require further testing by your private physician who must submit a written report of his/her findings to **Concentra Medical Centers (Ohio)** so that a final decision on your ability to wear a respirator can be made.
- ☐ Must wear Special prescription eye-wear needed to accommodate respirator.
- ☐ Must use an Eye glass conversion kit.
- ☐ May need to shave Facial hair to assure tight seal on certain face masks.
- ☐ Need to stop smoking.

(Check ✓ ALL that apply)

- ☑ The above individual HAS been examined for respirator fitness in accordance with 29 CFR 1910.134. This limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status in their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☐ The above individual HAS NOT been examined by me for respirator fitness. The employer's medical evaluation consisted of a review of OSHA's Medical Evaluation Questionnaire in Appendix C Part A Section 2. In accordance with 29 CFR 1910.134, this limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status in their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☑ In accordance with specific OSHA requirements, I have informed the above named individual of the results of this evaluation and of any medical conditions resulting from exposures that may require further explanation or treatment. Where applicable, the above named individual has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos, lead and/or other chemical exposure(s).

Respirators must be properly selected based on the contaminant and concentration levels to which the worker will be exposed. Failure to follow the use and fitting instructions and warnings for proper use contained on the respirator packaging and/or failure to wear the respirator during all times of exposure can reduce the respirator's effectiveness and result in sickness or death. Wearer must be trained in the proper use of any respirator. Refer to product literature and packaging for specific information regarding its use and/or limitations.

PLHCP Signature

PLHCP Name (printed)

[1] Physician or other Licensed Healthcare Professional

Employee's Signature

4/6/2011
Expiration Date

To be maintained in the employee's file with a copy to the employee.

Concentra Medical Centers (Ohio)

4850 Hinckley Industrial Pkwy CLEVELAND, OH 44109
Phone: (216) 749-2100 Fax: (216) 749-2136

PLHCP[1] WRITTEN STATEMENT for RESPIRATORS (EMPLOYEE)

Service Date: 04/05/2010

Employee Name: Russell, James B.

Employee SSN: XXX-XX-8578

Address: 2901 Hampton

SHAKER HEIGHTS OH 44120

Employer: TMG Services Inc

You were evaluated in this office of your medical status related to your physical capability to wear a respirator. (Check ✓ one that applies)

- ☐ There were no abnormal findings that would hamper your ability to perform your job duties while wearing a respirator.
- ☐ The abnormal findings listed below were not related to wearing a respirator but should be reported to your personal physician for further evaluation.

Based upon the results of this evaluation it is my opinion that you: (Check ✓ ALL that apply)

- ☑ ARE qualified to wear a respirator.
- ☐ Have the following restrictions concerning respirator usage: _____
- ☐ ARE NOT qualified to wear a respirator.
- ☐ Require further testing by your private physician who must submit a written report of his/her findings to Concentra Medical Centers (Ohio) so that a final decision on your ability to wear a respirator can be made.
- ☐ Must wear Special prescription eye-wear needed to accommodate respirator.
- ☐ Must use an Eye glass conversion kit.
- ☐ May need to shave Facial hair to secure tight seal on certain face masks.
- ☐ Need to stop smoking.

(Check ✓ ALL that apply)

- ☑ The above individual HAS been examined for respirator fitness in accordance with 29 CFR 1910.134. This limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☐ The above individual HAS NOT been examined by me for respirator fitness. The employer's medical evaluation consisted of a review of OSHA's Medical Evaluation Questionnaire in Appendix C Part A, Section 2. In accordance with 29 CFR 1910.134, this limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☑ In accordance with specific OSHA requirements, I have informed the above named individual of the results of the evaluation and of any medical conditions resulting from exposures that may require further explanation or treatment. Where applicable, the above named individual has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos, lead and/or other chemical exposures.

Respirators must be properly selected based on the contaminant and concentration levels to which the worker will be exposed. Failure to follow the care and fitting instruction and warnings for proper use contained on the respirator packaging and/or failure to wear the respirator during all times of exposure can reduce the respirator's effectiveness and result in sickness or death. Users must be trained in the proper care of any respirator. Refer to product literature and packaging for specific information regarding its use and/or limitations.

PLHCP Signature

PLHCP Name (printed)

Employee's Signature

4/6/2011
Expiration Date

[1] Physician or other Licensed Healthcare Professional

To be maintained in the employee's file with a copy to the employee

Concentra Medical Centers (Ohio)

6605 Hinckley Industrial Pkwy CLEVELAND, OH 44125
Phone: (216) 749-2750 Fax: (216) 749-2755

PLHCP[1] WRITTEN STATEMENT for RESPIRATORS (EMPLOYEE)

Service Date: 03/23/2010

Employee Name:
Hartness, Delmar S.

Employee SSN: XXX-XX-6563

Address:
23581 Sprague rd
apt. 5
COLUMBIA STATION OH 44028

Employer: TMG Services Inc

You were evaluated in this office of your medical status related to your physical capability to wear a respirator. (Check ✓ one that applies)

- ☐ There were no abnormal findings that would hamper your ability to perform your job duties while wearing a respirator.
- ☐ The abnormal findings listed below were not related to wearing a respirator but should be reported to your personal physician for further evaluation.

Based upon the results of this evaluation it is my opinion that you: (Check ✓ ALL that apply)

- ☑ ARE qualified to wear a respirator.
- ☐ Have the following restrictions concerning respirator usage: _____
- ☐ ARE NOT qualified to wear a respirator.
- ☐ Require further testing by your private physician who must submit a written report of his/her findings to **Concentra Medical Centers (Ohio)** so that a final decision on your ability to wear a respirator can be made.
- ☐ Must wear Special prescription eye-wear needed to accommodate respirator.
- ☐ Must use an Eye glass conversion kit.
- ☐ May need to shave Facial hair to assure tight seal on certain face masks.
- ☑ Need to stop smoking.

(Check ✓ ALL that apply)

- ☑ The above individual WAS been examined for respirator fitness in accordance with 29 CFR 1910.134. This limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☐ The above individual WAS NOT been examined by me for respirator fitness. The employee's medical evaluation consisted of a review of OSHA's Medical Evaluation Questionnaire in Appendix C Part A Section 2. In accordance with 29 CFR 1910.134, this limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☑ In accordance with specific OSHA requirements, I have informed the above named individual of the results of this evaluation and of any medical conditions resulting from exposures that may require further explanation or treatment. Where applicable, the above named individual has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos, lead and/or other chemical exposures.

Respirators must be properly selected based on the contaminant and concentration levels to which the worker will be exposed. Failure to follow the use and fitting instruction and warnings for proper use contained on the respirator packaging and/or failure to wear the respirator during all times of exposure can reduce the respirator's effectiveness and result in sickness or death. Where doubt as to/next in the proper use of any respirator, refer to product literature and packaging for specific information regarding its use and/or limitations.

PLHCP Signature

PLHCP Name (printed)

Employee's Signature

3/23/2011
Expiration Date

[1] Physician or other Licensed Healthcare Professional

To be maintained in the employee's file with a copy to the employee

APPENDIX D

Material Safety Data Sheets

Sodium Hydroxide Pellets
Ferric Chloride Solution

Health	3
Fire	0
Reactivity	2
Personal Protection	J

Material Safety Data Sheet
Sodium hydroxide, Pellets, Reagent ACS MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium hydroxide, Pellets, Reagent ACS

Catalog Codes: SLS4090

CAS#: 1310-73-2

RTECS: WB4900000

TSCA: TSCA 8(b) inventory: Sodium hydroxide

CI#: Not available.

Synonym: Caustic Soda

Chemical Name: Sodium Hydroxide

Chemical Formula: NaOH

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium hydroxide	1310-73-2	100

Toxicological Data on Ingredients: Sodium hydroxide LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, of inhalation. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of heat.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
sodium hydroxide + zinc metal dust causes ignition of the latter. Under proper conditions of temperature, pressure and state of division, it can ignite or react violently with acetaldehyde, ally alcohol, allyl chloride, benzene-1,4-diol, chlorine trifluoride, 1,2 dichlorethylene, nitroethane, nitromethane, nitroparaffins, nitropropane, cinnamaldehyde, 2,2-dichloro-3,3-dimethylbutane. Sodium hydroxide in contact with water may generate enough heat to ignite adjacent combustible materials. Phosphorous boiled with NaOH yields mixed phosphines which may ignite spontanously in air. sodium hydroxide and cinnamaldehyde + heat may cause ignition. Reaction with certain metals releases flammable and explosive hydrogen gas.

Special Remarks on Explosion Hazards:
Sodium hydroxide reacts to form explosive products with ammonia + silver nitrate. Benzene extract of allyl benzenesulfonate prepared from allyl alcohol, and benzene sulfonyl chloride in presence of aquesous sodium hydroxide, under vacuum distillation, residue darkened and exploded. Sodium Hydroxde + impure tetrahydrofuran, which can contain peroxides, can

cause serious explosions. Dry mixtures of sodium hydroxide and sodium tetrahydroborate liberate hydrogen explosively at 230-270 deg. C. Sodium Hydroxide reacts with sodium salt of trichlorophenol + methyl alcohol + trichlorobenzene + heat to cause an explosion.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid.

Large Spill:
Corrosive solid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of acetic acid. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep container dry. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, metals, acids, alkalis, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
CEIL: 2 from ACGIH (TLV) [United States] [1995] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Odorless.

Taste: Not available.

Molecular Weight: 40 g/mole

Color: White.

pH (1% soln/water): 13.5 [Basic.]

Boiling Point: 1388°C (2530.4°F)

Melting Point: 323°C (613.4°F)

Critical Temperature: Not available.

Specific Gravity: 2.13 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Highly reactive with metals. Reactive with oxidizing agents, reducing agents, acids, alkalis, moisture.

Corrosivity: Not available.

Special Remarks on Reactivity:
Hygroscopic. Much heat is evolved when solid material is dissolved in water. Therefore cold water and caution must be used for this process. Sodium hydroxide solution and octanol + diborane during a work-up of a reaction mixture of oxime and diborane in tetrahyrofuran is very exothermic, a mild explosion being noted on one occassion. Reactive with water, acids, acid chlorides, strong bases, strong oxidizing agents, strong reducing agents, flammable liquids, organic halogens, metals (i.e aluminum, tin, zinc), nitromethane, glacial acetic acid, acetic anhydride, acrolein, chlorohydrin, chlorosulfonic acid, ethylene cyanohydrin, glyoxal, hydrochloric acid, sulfuric acid, hydrosulfuric acid, nitric acid, oleum, propiolactone, acylonitrile, phorosous pentoxide, chloroethanol, chloroform-methanol, tetrahydroborate, cyanogen azide, 1,2,4,5 tetrachlorobenzene, cinnamaldehyde. Reacts with formaldehyde hydroxide to yield formic acid, and hydrogen.

Special Remarks on Corrosivity: Very caustic to aluminum and other metals in presence of moisture.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: Causes damage to the following organs: lungs.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals:

Lowest Published Lethal Dose: LDL [Rabbit] - Route: Oral; Dose: 500 mg/kg

Special Remarks on Chronic Effects on Humans: May affect genetic material (mutagenic). Investigation as a mutagen (cytogenetic analysis), but no data available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May be harmful if absorbed through skin. Causes severe skin irritation and burns. May cause deep penetrating ulcers of the skin. Eyes: Causes severe eye irritation and burns. May cause chemical conjunctivitis and corneal damage. Inhalation: Harmful if inhaled. Causes severe irritation of the respiratory tract and mucous membranes with coughing, burns, breathing difficulty, and possible coma. Irritation may lead the chemical pneumonitis and pulmonary edema. Causes chemical burns to the respiratory tract and mucous membranes. Ingestion: May be fatal if swallowed. May cause severe and permanent damage to the digestive tract. Causes severe gastrointestinal tract irritation and burns. May cause perforation of the digestive tract. Causes severe pain, nausea, vomiting, diarrhea, and shock. May cause corrosion and permanent destruction of the esophagus and digestive tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Sodium hydroxide, solid UNNA: 1823 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Illinois toxic substances disclosure to employee act: Sodium hydroxide Illinois chemical safety act: Sodium hydroxide New York release reporting list: Sodium hydroxide Rhode Island RTK hazardous substances: Sodium hydroxide Pennsylvania RTK: Sodium hydroxide Minnesota: Sodium hydroxide Massachusetts RTK: Sodium hydroxide New Jersey: Sodium hydroxide Louisiana spill reporting: Sodium hydroxide California Director's List of Hazardous Substances: Sodium hydroxide TSCA 8(b) inventory: Sodium hydroxide CERCLA: Hazardous substances.: Sodium hydroxide: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive solid.

DSCL (EEC):

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 2

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 06:32 PM

Last Updated: 11/06/2008 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

MSDS Number: **F1080** * * * * * *Effective Date:* ***11/21/08*** * * * * * *Supercedes:* ***02/16/06***

MSDS **Material Safety Data Sheet**

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker®

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

Ferric Chloride Solution

1. Product Identification

Synonyms: Iron (III) Chloride Solution
CAS No.: 7705-08-0
Molecular Weight: Not applicable to mixtures.
Chemical Formula: FeCl3 in H2O
Product Codes: 5251

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Ferric Chloride	7705-08-0	35 - 45%	Yes
Water	7732-18-5	55 - 65%	No

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. CAUSES BURNS TO ANY AREA OF CONTACT. HARMFUL IF SWALLOWED OR INHALED. AFFECTS THE LIVER.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Extremely destructive to tissues of the mucous membranes and upper respiratory tract. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea and vomiting.
Ingestion:
Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach. Can cause sore throat, vomiting, diarrhea. Low systemic toxicity in small quantities but larger doses may cause systemic effects. Pink urine discoloration is a strong indicator of iron poisoning. Liver damage, coma and death may follow, sometimes delayed as long as three days.
Skin Contact:
Corrosive. Symptoms of redness, pain, and severe burn can occur.
Eye Contact:
Corrosive. Contact can cause blurred vision, redness, pain and severe tissue burns.
Chronic Exposure:
Repeated ingestion may cause liver damage. Prolonged exposure of the eyes may cause discoloration.
Aggravation of Pre-existing Conditions:
No information found.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Irritating hydrogen chloride fumes may form in fire.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Water, dry chemical, foam or carbon dioxide. Do not allow water runoff to enter sewers or waterways.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

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6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

---

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material are hazardous when empty since they retain product residues; observe all warnings for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-ACGIH Threshold Limit Value (TLV):
1 mg/m3 (TWA) soluble iron salt as Fe
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece particulate respirator (NIOSH type N100 filters) may be worn for up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids. glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Orange to brown liquid.
Odor:
Acid odor.
Solubility:
Complete (100%)

Specific Gravity:
1.40
pH:
No information found.
% Volatiles by volume @ 21C (70F):
55-65
Boiling Point:
230C (446F)
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May produce hydrogen chloride.
Hazardous Polymerization:
This substance does not polymerize.
Incompatibilities:
Metals, allyl chloride, sodium, potassium.
Conditions to Avoid:
Incompatibles.

---

11. Toxicological Information

Oral rat LD50: 316 mg/kg (anhydrous); investigated as a mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Ferric Chloride (7705-08-0)	No	No	None
Water (7732-18-5)	No	No	None

---

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

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13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

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14. Transport Information

Not regulated.

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Ferric Chloride (7705-08-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Ferric Chloride (7705-08-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Ferric Chloride (7705-08-0)	No	No	No	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Ferric Chloride (7705-08-0)	1000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
DANGER! CORROSIVE. CAUSES BURNS TO ANY AREA OF CONTACT. HARMFUL IF SWALLOWED OR INHALED. AFFECTS THE LIVER.
Label Precautions:
Do not get in eyes, on skin, or on clothing.

Do not breathe mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.

Label First Aid:

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3.

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

APPENDIX E Response to Comments

TMG Response to USACE Comments
Alkaline Hydrolysis Work Plan
W91237-10-C-0002

The above referenced plan has been reviewed for Safety considerations and compliance issues and the following comments are provided for your information and use:

Comment 1 - Page 4, paragraph 4.5 - Addresses calibration of portable gas monitors indicating "calibrated at least weekly". A bump test or full calibration should be made before each day's use per International Safety Equipment Association guidance reference in OSHA's Safety and Health Information Bulletin 05-04-2004. I would also recommend air monitoring be either continuous or as a minimum periodically throughout the workday when personnel are present.

Response: Concur. The text has been revised to state the monitor will be calibrated daily. Also, the plan was revised based on the recommendation to monitor more frequently and in the work zones when personnel are present.

Comment 2 - Page 5, paragraph 4.7 - Recommend including appropriate signage warning that this is a hazardous area.

Response: Concur. The paragraph was revised to state that warning signs will be posted on the fence and the perimeter area.

Comment 3 - Page 5, paragraph 4.8.1 - Specific storage requirements for caustic soda and ferric chloride should be addressed. What type of storage will be used to safely store these materials? What precautions will be utilized in the safe handling of these materials?

Response: Concur. Section 4.8.1 has been revised to outline the treatment chemical storage and handling procedures.

Comment 4 - There are several references throughout that state "Level C PPE may be required." A clear determination needs to be made on the level of PPE required and the criteria for changing levels.

Response: Concur. In Sections 4.5, 5.1 and 5.2, the plan was revised to state the level of PPE required, the criteria for downgrading PPE levels, and referenced the PEL Table in Appendix A of the work plan.

Comment 5 - The AHA provided references sodium hydroxide powder but the work plan calls for caustic soda beads. The AHA needs clarification and specific guidance to workers on the measures required for their protection rather than references to other documents not present.

Response: Concur. The AHA was corrected to refer to sodium hydroxide pellets. With regard to the second part of this comment, the Material Safety Data Sheets for sodium hydroxide pellets as well as ferric chloride solution are included as Appendix D of the supplement. The call-out for the MSDSs is included in Section 1.2.6 and 1.2.7.

Work Plan for Lead Stabilization

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

Prepared for:

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TMG Project No. – TMG09-22

July 2010

Work Plan for Lead Stabilization

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

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Work Plan for Lead Stabilization

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

1.0 PROJECT DESCRIPTION

The project description is provided in Section 1.0 of the Plan of Operations document.

2.0 PROJECT ORGANIZATION

The project organization is provided in Section 2.0 of the Plan of Operations document.

3.0 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS

A discussion of the Applicable, Relevant and Appropriate Requirements (ARARs) are provided in Section 3.0 of the Plan of Operations document.

4.0 FIELD ACTIVITIES

4.1 Ex-Situ Stabilization of Contaminated Soil

Based on the approved selected remedy detailed in the Decision Document, remediation efforts for the TNT Area C will consists of 5 steps: excavation, ex-situ treatment through alkaline hydrolysis and/or composting, stabilization (if necessary) and disposal (off-site or on-site, depending on final levels achieved). This supplement details the lead stabilization activities.

TMG will perform remediation in the form of ex-situ stabilization of approximately 400 cubic yards of lead-contaminated soil excavated from TNT Area C, half of which is expected to have 2,4-DNT concentrations exceeding the RG. Prior to the lead stabilization, the 2,4-DNT contaminated soil will undergo alkaline hydrolysis treatment. The stabilized soil will be disposed off-site at the Erie County Landfill. This section addresses the field activities for the stabilization activities.

4.2 On-Site Equipment

TMG may use the following equipment on-site to perform the activities associated with this project:

- Tracked excavators (PC-220 or comparable)
- Vacuum truck (3000-gallon CUSCO or comparable)
- Bulldozer (D5C or comparable)
- Endloader (rubber tired)
- Windrow turner
- Clay
- Dump trucks (articulated)
- Roller
- Tractor
- Tractor and trailer used for mobilization of equipment
- Hand tools (rakes, shovels, etc.)
- Minimum of four 10,000 gallon frac tanks
- Water pump (4”) and hoses

4.3 Transportation

Soils contaminated with lead will be segregated and stockpiled at the individual hot spots. Soils co-contaminated with lead and 2,4-DNT will also be stockpiled at the individual hot spots, but segregated from the other soil. The co-contaminated soil will be transported from the individual hot spots to the treatment area and configured into a windrow. This soil will remain separated from the other soil in the alkaline hydrolysis treatment area. The lead-only soil will be transported from the individual hot spot to the treatment area and configured into windrows in an area separated from the alkaline hydrolysis treatment area by the treatment area access road. Dump trucks will be used to transport the material from the hot spots to the treatment area.

4.4 Treatment Area

The treatment area preparation will include construction of windrows to maintain separation of the lead stabilization area from the alkaline hydrolysis treatment area. This will involve grading to ensure the runoff is directed into the sump, laying down gravel for

the compost turner to travel on, and rolling to pack down the surface. Straw bales will be placed around the stabilization area.

4.5 Personal Protective Equipment

During the excavation activities and stabilization activities personnel will be required to use level C PPE until the air monitoring is completed and the required level of PPE is determined. Depending on the monitoring results, the level of PPE may be downgraded from level C to level D. In order to downgrade to level D, the air monitoring results must be below the PEL for the monitored parameters. The requirements for PPE levels C and D are presented in Section 13.0. The PELs are provided in Table 1 in Appendix A of this document. The office trailer will maintain supplies to facilitate upgrade to level C from level D PPE if necessary.

All field personnel are fit tested and their certifications are in Appendix B of this addendum. Additional personnel may be fit-tested to perform work on-site during the stabilization process. Fit-test documentation for those individuals will be provided in a separate addendum to this work plan.

4.6 Water Management System

The lead stabilization process will be performed in an area separated from the alkaline hydrolysis treatment area. Keeping the two processes separated will allow for any run-off from the stabilization process to be directed into one of the sumps, therefore allowing the run-off water from each process to remain segregated. Frac tank capacity will also be dedicated to the sump containing the run-off from the stabilization process. The frac tank water will be analyzed and disposed as described below.

Two collection sumps are installed to collect run-off water at the end of the treatment area. Earthen berms are constructed around the perimeter of the treatment area and lined with straw bales as part of the water management system. The sump areas were constructed with at least a 2:1 slope and have a capacity of approximately 60,000 gallons. The sump is lined with geotextile liner (60-mil thickness). The sump perimeters are lined with straw bales to eliminate sediment from entering the sumps. The treatment area is sloped such that any water will run toward the sumps. The water management system is designed such that water collected in the sumps can be re-used as contact water during the stabilization process. Additional water can be obtained from the reservoir adjacent to the PRRWP area, if needed. Frac tanks (with at least a 40,000 gallon capacity) will be on-site for storage of the sump water. The water in the frac tanks will be analyzed prior to its disposal. Excess water in the frac tanks may be disposed at the West Area Red Water Pond (WARWP) depending upon sampling results of the water to be discharged. USACE, NASA and Ohio EPA will review analytical data from water sampling of the frac tanks prior to allowing discharge to the WARWP. Discharge to the pond must be

done slowly to ensure that no erosion occurs and pond sediment is not disturbed. All water not approved for placement in the WARWP will be taken off-site for recycling.

4.7 Fencing

The NASA site is a secure site with its own security fence and full-time guards. TMG will install plastic construction fencing around the treatment area and storage area.

4.8 Ex-Situ Treatment of Contaminated Soil

Approximately 400 cubic yards of contaminated stockpiled soil may require ex-situ treatment to reduce the lead to below hazardous levels prior to off-site disposal at a non-hazardous landfill. A windrow soil stabilization approach will be utilized for the lead treatment by mixing contaminated soil and amendments to immobilize the lead. The amendments will consist of a slow-release organic compost and sulfur salts. Prior to treatment, treatability studies will be conducted to determine the design quantities required for treatment.

Windrows will be used for the lead stabilization. Each windrow shall be approximately 12 feet wide and 6 feet high. The windrows shall not end any closer than 15 feet from the ends of the treatment pad to allow for the maneuvering of the windrow turner. The spacing (minimum of 15 feet width) between the parallel windrows shall be sufficient to prevent impeding windrow turning and materials handling equipment. For lead treatment, each windrow will be turned a minimum of four times after application of the amendments. Refer to Section 5.2 of this plan for analytical requirements for the stabilization process.

4.8.1 Storage and Addition of Chemicals

For metals stabilization, a slow release organic compost that is selected (based on the bench-scale study) will be procured and stored onsite in the desired amounts based on unit dosages and covered with a liner to prevent loss and rainfall runoff. Compost from the local area will be preferred because of ease of transportation, delivery and availability. The organic compost material will be available from a local supplier. Sulfur salts (if deemed to be required based on bench-scale studies) will also be used for treatment to ensure lead stabilization. Sulfur salts will be procured in drums and stored adjacent to the treatment area.

Within the treatment area, compost and sulfur salts will be added together and spread on the treatment windrow after the soils have been staged. The spreader will ensure that the additives are spread evenly as possible across the treatment soil pile. The windrow turner will be used to work the additives into the soil uniformly in all locations to obtain as homogenized a dry mix as possible. A minimum of four equipment passes will be made to ensure homogenized blending and mixing.

Following application and mixing of additives, the treatment piles will be wetted with water at a rate defined in the treatability tests. The compost turner will be used to mix the wet soil in place once during the addition of water. However, a majority of the water will be allowed to permeate into the soil over the windrow once it is wet enough by visual observations.

4.8.2 Periodic Mixing Procedures

Mixing is not anticipated as a requirement for lead treatment soil. However, if successful treatment is not attained within a 14-day period, a second mixing operation may be recommended.

4.9 Ultimate Disposal of the Treated Soil

Upon completion of the soil treatment, the stabilized soil shall be disposed of in a non-hazardous landfill licensed to accept these wastes. If off-site disposal is used, the non-hazardous soil will be transported and disposed of at Erie County Landfill.

4.10 Guard Services and Stabilization Schedule

Lead stabilization is a 7-day a week operation and NASA employees usually do not work on the weekends or holidays. TMG shall coordinate with NASA's security services as well as the NASA POC, Bob Lallier, to ensure site access to accomplish the stabilization efforts. All work will be conducted between 7:00 am and 6:00 pm. No work will be conducted after-hours (after 6:00 pm,).

5.0 ANALYTICAL REQUIREMENTS

5.1 Lead Stabilization

Laboratory analytical results will be used to determine when the stabilization operation is completed. One composite sample from each windrow will be collected weekly and submitted to the laboratory for TCLP lead analysis. There will be no field screening tests used during this effort.

Every five to ten calendar days, personnel will collect treated material (after turning). A 10-point composite will be collected from 10 equidistant locations from each windrow. Samples will be collected from the treated material after turning (which mixes the material), consequently the grab samples will be collected from about 0 to 6" inches deep while walking along the windrow. These samples will be shipped as per standard procedures and protocol to the laboratory, where they will be analyzed for the following constituents as per the analytical methods outlined:

- SW1311/6010B/7470 – TCLP Lead
- SW9045 – pH

- EPA 300/SW846 9056 – Sulfate
- SW6010/7471 - Iron
- EPA 415.1 /SW846 9060M – TOC

The composited soil samples will be thoroughly mixed in the bag and a portion removed and placed in a sample container provided by the laboratory. The sample container will be labeled, packaged in a clean zip-lock bag and wrapped with bubble wrap for shipment. The samples will be packaged for shipment in an iced cooler. The samples will be placed inside a large plastic bag (trash bag), along with ice packs. The trash bag will be tightly closed and tied-off to prevent leakage of melted ice. The cooler will be secured with strapping tape, shipping labels applied and sent to Test America, Inc. located in North Canton, Ohio. The cooler will be shipped using an expediting service such as FedEx or UPS.

The stabilization process will conclude when lead levels in all soils have been reduced to levels suitable for off-site disposal at a non-hazardous landfill. Completion of treatment shall be determined by laboratory analysis with lead levels below 5 mg/L (TCLP).

5.2 Sampling and Analytical Requirements for Disposal of Treated Soil

Upon completion of the lead stabilization treatment, the treated soil shall be disposed of in a non-hazardous landfill licensed to accept special waste. The anticipated disposal facility for the treated soil is Erie County Landfill. Erie County Landfill indicated that they would receive the treated soil from PBOW but indicated there would be a 200-ton per day restriction during peak operational periods. TMG will coordinate disposal with the landfill to ensure the daily restrictions are not exceeded.

Since personnel are collecting the treated material after turning (which mixes the material), the 10-point composite sample will be collected from 0 to 6” inches deep while walking along the windrow. While collecting samples, personnel will be required to use level C PPE until the air monitoring is completed and the required level of PPE is determined. Depending on the monitoring results, the level of PPE may be downgraded from level C to level D. In order to downgrade to level D, the air monitoring results must be below the PEL for the monitored parameters. The requirements for PPE levels C and D are presented in Section 13.0. The PELs are provided in Table 1 in Appendix A of this document. The office trailer will maintain supplies to facilitate upgrade to level C from level D PPE if necessary.

For disposal purposes to the landfill, one 10-point composite sample will be collected from each windrow, as described above in Section 5.1. The samples will be analyzed for Full TCLP. The landfill may also require additional tests for paint filter and TPH (GRO / DRO). TMG will coordinate all disposal sampling requirements prior to submission of any analytical to landfill. Per landfill requirements, the soil will be considered non-hazardous when 3 consecutive readings of non-hazardous analytical data have been submitted. At that point, TMG shall consider the soil non-hazardous and begin transportation to landfill.

Once the stabilized soil has been removed for disposal, the surface soil in the footprint of the windrow will be sampled and analyzed to verify the underlying soil has not been impacted by the contaminants in the windrows. A 5-point composite sample will be collected from equi-distant locations within each windrow and composited in a zip-lock bag. The soil sample will be placed in a sample container and processed and shipped to the laboratory as described above. The samples will be analyzed for SVOCs, PCBs, TAL Metals, and full TCLP. If the results of the underlying soil analysis indicate the soil has not been impacted by the stabilization process, the treatment area will be considered clean.

In the event the sample results indicate the underlying soil was impacted by the contaminants in the stabilized soil, a minimum of 6 inches of soil will be scraped and stockpiled on plastic within the treatment pad area. The underlying soil will be sampled again following the same procedures as detailed above. The process of scraping, stockpiling and resampling will be repeated until the sample results indicate the underlying soil is clean. The stockpiled soil from the scraping will be sampled by collecting a 5-point composite sample from random locations within the pile. The samples will be submitted to the laboratory and analyzed for off-site disposal.

Table 5-1 summarizes the sampling and analytical requirements for the lead stabilization of TNT Area C soils.

TABLE 5-1. SUMMARY OF SAMPLING AND ANALYTICAL REQUIREMENTS

SOURCE	REASON	MATRIX	TYPE	FREQUENCY	TIMING	ANALYTES	PROCEDURE
Pb Soils	Verification	Soil	Composite	Once	Baseline	Pb TCLP	One 10-part composite per windrow
Air	PPE selection	Air	Grab	While adding amendments	Daily until levels are consistently below PEL	O2, CO2, CO, H2S, Methane	Work zones, pad perimeter
Frac Tank	Disposal determination	Water	Composite	As needed	10K gallon accumulation	pH, total lead	1 grab from each tank
Windrow	Condition	Soil	Visual Observation	Daily	Prior to turning	Moisture	observe length of windrow
Windrow	Stabilization	Soil	Composite	5-10 days	After turning	Pb TCLP pH Sulfate Iron TOC	One 10-part composite or 1 part every 10 feet
Windrow	Disposal verification	Soil	Composite	Once	After stabilization	SVOC, PCBs, TAL Metals, Full TCLP	One 10-part composite per windrow
Soil beneath windrow	Verification	Surface soil	Composite	Once	After removal of windrow	SVOC, PCBs, TAL Metals, Full TCLP	One 5-part composite
Stockpile of soil scrapings from windrow footprint	For disposal	Soil	Composite	Once	After scraping the footprint of windrow	Full TCLP	One 5-point composite

6.0 EQUIPMENT DECONTAMINATION

Equipment decontamination is provided in Section 8.0 of the Plan of Operations document.

7.0 FIELD DOCUMENTATION PROCEDURES

The Field Documentation Procedures are discussed in Section 9.0 of the Plan of Operations document.

8.0 SAMPLE PACKING AND TRANSPORTATION

The sample packing and transportation are discussed in Section 10.0 of the Plan of Operations document and outlined in Section 5 of this work plan.

9.0 TMG CHEMICAL QUALITY CONTROL

The discussion of TMG's Chemical Quality Control is provided in Section 7.2 of the Plan of Operations.

10.0 SPILL PREVENTION, CONTROL AND COUNTERMEASURE (SPCC)

The discussion of the SPCC is provided in Section 12.0 of the Plan of Operations document. In cases of spills it is very important to make sure that the area is secured and that the situation is assessed quickly. This section discusses the SPCC as it pertains to stabilization operations.

10.1 Potential Spills

Potential spills may occur from handling the amendments (stabilization), overflowing of the sump, and spills/leaks from the frac tanks that may be on-site to store the accumulated sump water for subsequent disposal. Amendments will be stockpiled in the treatment area so that a spill or runoff from these materials will drain to the sump and be captured. Site personnel will monitor the sump to ensure that it does not overflow. A vacuum truck or pump will be used to transfer water from the sump into the frac tank. The sump water

and /or the contents of each 10,000 gallon frac tank will be analyzed to determine proper disposal. If analytical data does not meet discharge criteria the water will be utilized for contact water on the windrows or transported off-site for disposal at an approved facility. If the water is approved for on-site discharge to the West Area Red Water Ponds (WARWP), personnel must ensure that discharge of any water into the pond is done slowly so as not to cause bank erosion or disturb pond sediments.

10.2 Spill Prevention

The following are additional spill prevention procedures that will be implemented at the site:

- The four frac tanks shall be visually inspected weekly for leaks. The QC person will be responsible for the inspections and document on the daily QCR.
- The sumps shall be inspected daily to ensure that no damage has occurred to the liner that would allow contaminated water to leak into the underlying soil or banks of the sump.
- The berm around the treatment area shall be inspected weekly to ensure that there are no breaks or low spots that will allow run-off water to leak into the surrounding soil.

10.3 Spill Containment

Damage to the liners in each sump can result in potentially large spills/leakage of contaminated water from the sump. Therefore, care shall be taken not to damage the liners and any damage to the liners shall be repaired immediately even if the damage is above the water line. Personnel shall not use equipment on or near the liners which may result in tears or cuts to the liners. Personnel shall not throw objects into the sump that might damage the liners. The liner shall be inspected daily to ensure its integrity. The QCO will be responsible for the inspections and document the findings on the QCR.

11.0 PROTECTION OF RIVERS STREAMS AND IMPOUNDMENTS

This information is provided in Section 13.0 of the Plan of Operations document. This section provides additional discussion regarding the discharge of sump and pit water into the West Area Red Water Pond area. USACE will review the analytical data from water sampling of the frac tanks prior to submitting to NASA and Ohio EPA for approval. Any discharge to the pond must be performed slowly to ensure that no erosion occurs and no pond sediment is disturbed.

12.0 AIR EMISSION CONTROLS

Water will be used for dust control in the treatment area and access roads to the treatment area. The Project Manager/On-site Superintendent and the Quality Control Officer (QCO) will make visual observations of dust levels to determine if water suppression is necessary and/or working. If not, then additional water will be added to control dust.

TMG proposes the following management practices to reduce air emissions from the stabilization activities:

- Stockpiled amendments (organic compost material) will be covered when not in use
- Every attempt will be made not to overstock amendments
- Amendments will be thoroughly mixed with the contaminated soil.
- The windrows will be kept moist (between 40 and 60% moisture) to reduce the potential for dust emissions as well as prevent possible spontaneous combustion of the windrows.

13.0 SITE-SPECIFIC HEALTH AND SAFETY PLAN

The purpose of this supplement is to address additional safety issues relating to the stabilization of lead-contaminated soil, if necessary to reduce the lead to below hazardous levels. The stabilization will be accomplished using ex-situ windrow stabilization. The original SSHP shall be followed in its entirety, in addition to the issues outlined in this section. The supplement to the SSHP is provided in Appendix A of this document. Personnel will wear protective equipment meeting appropriate American National Standards Institute (ANSI) requirements when their activities involve known or suspected contaminated materials. Level D personal protective equipment (PPE) will be used for all site activities.

Based on the site conditions observed and the results of the air monitoring performed during the initial excavations and during the statrt up of treatment operations at the site, it is not anticipated that Level C PPE will be required. However, as with any contamination clean up, site conditions may change. Therefore, information is provided in this section if an upgrade to Level C PPE is necessary.

Level D PPE will consist of:

- Steel-toed safety shoes/boots
- Safety glasses with side shields
- Leather gloves (general site work)
- Chemical resistant inner/outer gloves (used when performing sampling, decontamination activities, and handling stabilization amendments)
- Hard hat and hearing protection (when working around heavy equipment)
- Long trousers and sleeved shirt

Level C PPE will consist of:

- Tyvek overalls
- Full Face or Half-face Respirator (NIOSH approved which meets OSHA and USACE requirements)
- Appropriate chemical cartridges and/or filters
- Chemical resistant inner and outer work gloves
- Steel-toed safety boots/shoes
- Face shield or safety glasses with side shields to be used with half-faced respirator
- Hard hat

14.0 QUALITY CONTROL PLAN

There are no changes to the requirements outlined in the Quality Control Plan, TMG Services, Inc., July 2010.

15.0 PROJECT SCHEDULE

The project schedule is presented in Section 21.0 of the Plan of Operations.

16.0 REFERENCES

The following reference was added to Section 22.0 in the Plan of Operations:

"*Addendum to Plan of Operations, Interim Soil Removal Action Continuation, Soil Excavation and Disposal, Plum Brook Ordnance Works, Pentolite Road Red Water Ponds, Sandusky, Ohio*" . McTech Corp., July 2008

APPENDIX A Lead Stabilization Supplement to the Site-Specific Health Plan

Lead Stabilization Work Plan Supplement to

SITE-SPECIFIC SAFETY AND HEALTH PLAN

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

1.0 HAZARD/RISK ANALYSIS

The following summarizes field activities related to the stabilization of lead - contaminated soil and the actions that can be taken to eliminate or minimize each of those hazards. The additional hazards associated with the performance of contract W91237-10-C-0002 are discussed in the Final SSHP (TMG Services, July 2010) and will not be reiterated in this supplement.

1.1 Activity Hazard Analysis

The following tables summarize activity hazards related the stabilization of lead in soil and the actions that can be taken to eliminate or minimize those hazards. The additional activity hazards associated with the performance of contract W91237-10-C-0002 are discussed in Appendix A of the Final SSHP (TMG Services, Inc., July 2010).

Hazard Analysis

Activity	Stabilization Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be mixing amendments and contaminated soil	Personnel may be injured by heavy equipment used in the loading and relocation of the contaminated soil.	• Heavy machinery will be operated only by designated qualified personnel • Getting on or off of any equipment while it is in motion is prohibited • Machinery shall be operated in accordance with the manufacturer's recommendations • The use of headphones for entertainment purposes (such as radio or cassette) while operating equipment is prohibited. • All machinery shall be inspected daily (when in use) by a competent and knowledgeable person to ensure safe operating conditions • Personnel shall not operate heavy equipment in area where the utilities have not been properly marked. • All heavy equipment shall be equipped with working audible reverse signal alarms • Personnel shall wear hearing protection when working nearing operating equipment.
	Heat stress can occur.	• The work schedule will be adjusted, if possible, to schedule heavy work during the cooler part of the day. • The work will be paced to include adequate rest periods. Five to fifteen minute rest periods will be scheduled hourly or every 2 hours depending upon the workload, temperature, and relative humidity. • Drinking water and ice will be provided in the clean zone. Personnel will be encouraged to drink plenty of water. • The weather conditions shall be monitored and work halted if the temperature (including humidity) rises to levels that present a danger to worker safety
	Personnel may be injured by lifting or moving heavy objects	• If a load is heavy or bulky, get help • Remember to lift with your legs and keep your back straight. • Keep the load as close to your body as you can. • Do not jerk the load. Lift slowly and carefully. • Make sure the area you will be carrying the load through is clear of obstacles. • Do not twist or turn your spine when lifting or carrying the load. • Be sure to have a good grip on your load at all times. • Be careful when lowering your load (get help, if necessary).

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

Hazard Analysis

Activity		Stabilization Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**		**Recommended Controls**
Personnel will be mixing amendments and contaminated soil	Personnel may be injured by the composting equipment that is used to mix the materials and to turn the windrows.		• Only qualified personnel will operate the composting equipment. • Getting on or off of any equipment while it is in motion is prohibited. • Machinery shall be operated in accordance with the manufacturer's recommendations. • The use of headphones for entertainment purposes (such as radio or cassette) while operating equipment is prohibited. • All machinery shall be inspected daily (when in use) by a competent and knowledgeable person to ensure safe operating conditions. • Personnel shall not operate equipment in area where a potential to hit utilities is present. • All composting equipment shall be equipped with working audible reverse signal alarms. • Personnel shall wear hearing protection when working near composting equipment. • All moving or rotating equipment must be guarded to prevent accidental contact. • Personnel shall only operate the composting equipment with the machine guard in place. • Whenever a moving machinery part presents a hazard during servicing or maintenance, the engine shall be stopped, the power source disconnected, and all machine movement stopped before servicing or maintenance is performed. • The mesh or nip points of all power driven gears, belts, chains, sheaves, pulleys, sprockets, and so forth shall be guarded. • Functional components such as choppers, rotary beaters, mixing augers, feed rolls, conveying augers, and so forth which must be exposed for proper function shall be guarded to the fullest extent which will not substantially interfere with the normal functioning of the component. • All guards must be free from burrs, sharp edges, and sharp corners. Guards must be securely fastened to the equipment. • Stones or other foreign objects may forcibly eject from the composting equipment during turning activities.

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

Hazard Analysis

Activity	Stabilization Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be acquiring water and placing water on the windrows and stockpiles	Personnel may fall into a pond (if it is used as a source of water or if the sump contents are discharged to the pond).	• Work shall not be performed alone. • Personnel working near water where a drowning hazard is present will be equipped with a minimum of one throwable PFD that is attached to a polypropylene, or equivalent rope. • Wherever there is a potential for a drowning hazard, personnel shall wear US Coast Guard approved International Orange personal flotation devices (PFDs). • Before and after each use, the PFD shall be inspected for defects that would alter its strength or buoyancy. • Defective devices or devices with less than 13 pounds of buoyancy shall be removed from service. • All PFDs shall be equipped with retro-reflective tape.
Personnel will be performing stabilization activities	Personnel may be exposed to soil contaminants or decomposition products during stabilization activities.	• Potential chemical contaminants at a site shall be reviewed prior to performing work. • Personnel are required to wear the assigned level of PPE. • Personnel shall be careful when containerizing the decontamination waste so as not to further expose themselves. • Air monitoring will be performed
	Wet or muddy surfaces may cause a tripping hazard	• Be alert and observe terrain while walking. • Wear appropriate footwear. • Personnel will avoid walking through or working in water or mud. • Personnel will avoid climbing over site debris or equipment. • Personnel shall ensure that equipment not in use will be put in a place where it will not create a tripping hazard.
	Materials with sharp edges may present a cutting hazard	• Personnel shall wear leather gloves to protect them from potential cuts whenever possible. • A 16-unit first aid kit will be available on-site in the event personnel are cut. • Cut areas will be decontaminated and first aid rendered. • Personnel will be taken to the hospital for a tetanus shot if they are cut.

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

Hazard Analysis

Activity	Stabilization Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be performing stabilization activities	Personnel may be exposed to noise levels that will potentially harm their hearing.	Personnel shall wear hearing protection when working near heavy equipment, the drilling rig, and the composting equipment.
	Personnel will be potentially exposed to harmful animals, insects, and poisonous plants.	• Insect repellants may be used except when sampling for nitroaromatics because they can interfere and cause false hits in subsequent analysis. • A 16-unit first aid kit shall be available at the site and shall contain a variety of ointments for skin afflictions. • Water and soap shall be provided on-site for personnel to wash affected skin areas. • Personnel shall report all known allergies to plants, insects, and medication to the Project Manager/SSHO prior to work.
	A possible fire hazard exists because of the stockpiled amendments (hay/straw, wood chips, and so forth) may spontaneously ignite or would burn quickly if ignited from another source.	• Amendment stockpiles and the windrows containing the mixed soil and amendments will be watered daily to keep a high level of moisture present. • The windrows and stockpiles will be kept at a height of 10 feet or less to inhibit the buildup of excess internal heat. • In order to keep aerobic conditions within the windrow, the windrows are required to be turned daily. This daily turning will inhibit the buildup of internal heat; therefore, contributing to fire protection. • The amendment stockpiles until used will be turned two to three times a week to inhibit the buildup of internal heat, which may cause spontaneous combustion. • A vacuum truck filled with water will be present on-site at the treatment pad area. This truck will be used for fire suppression. • All combustible materials shall be stored at least 35 feet (10.7 m) from windrow stockpiles.
	Personnel will potentially be exposed to mold spores, bacteria, and parasite.	• The amendment materials shall be wetted prior to mixing to reduce potential dust generation. • The windrows will be wetted prior to turning to limit generation of dust. • Personnel will be equipped with air purifying respirators with HEPA filters. • Personnel will be required to wash prior to eating, drinking, or smoking.

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

1.2 Chemical Hazards

The primary chemical hazards associated with these remediation activities are exposure to lead-contaminated soil. Also, personnel will be potentially exposed to gases such as carbon dioxide, hydrogen sulfide, ammonia, and methane, which may be formed as part of the stabilization process. Additionally, carbon monoxide levels may become elevated between the windrows during turning operations due to exhaust from equipment used to turn the windrows. TMG proposes the following management practices to reduce air emissions from activities associated with stabilization:

- Stockpiled amendments (organic compost) will be covered when not in use.
- Every attempt will be made not to overstock amendments.
- Amendments will be thoroughly mixed with the contaminated soil. This is necessary for proper remediation but it will also decrease emissions.
- The windrows will be kept moist (between 40 and 60% moisture) to reduce the potential for dust emissions as well as prevent possible spontaneous combustion of the windrows.

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Personnel will be potentially exposed to products brought on the site by TMG Services, Inc. These products include Tornado-50 cleaner, gasoline and diesel fuel. The hazards from nitroaromatic compounds, diesel fuel, Tornado-50 cleaner, and gasoline were addressed in the previously approved Final SSHP (TMG Services, Inc. July 2010) and will not be reiterated in this plan. The organic compost should not present a risk to personnel. Similarly, due to the small amount of sulfur present in the sulfur salts, and the limited quantity that may be used, these do not present a health risk.

Refer to Table 1 for permissible exposure limits (PELs) and immediately dangerous to life and health (IDLH) limits for all chemical hazards anticipated for the site. Chemical hazards from exposure to carbon dioxide, hydrogen sulfide, methane, and carbon monoxide are discussed in this supplement. Material Data Safety Sheets (MSDS) for all chemicals brought on-site shall be available for review by personnel prior to field mobilization and on-site.

TABLE 1 – EXPOSURE LIMITS

Compound	**PEL[1]**	**IDLH[1]**
Lead	0.050 mg/m^3	100 mg/m^3
o-Dinitrobenzene	1 mg/m^3	200 mg/m3
m-Dinitrobenzene	1 mg/m^3	200 mg/m3
p-Dinitrobenzene	1 mg/m^3	200 mg/m^3
Nitrobenzene	1 ppm	200 ppm
Nitrotoluene	5 ppm	200 ppm
Dinitrotoluene	1.5 mg/m^3	200 mg/m^3
o-Dinitrotoluene	2 ppm	200 ppm
p-Dinitrotoluene	2 ppm	200 ppm
2,4,6-Trinitrotoluene	1.5 mg/m^3 (skin)	500 mg/m^3
Hydrogen sulfide	20 ppm[2]	100 ppm
Ammonia	50 ppm	300 ppm
Carbon monoxide	50 ppm	1200 ppm
Carbon dioxide	5000 ppm	40,000 ppm
Methane	N/A3	N/A3
Diesel fuel	N/A3	N/A3
Tornado-50 cleaner	N/A3	N/A3

1 – PEL and IDLH values were taken from the NIOSH Pocket Guide to Chemical Hazards, June 1997.
2 - Ceiling level
N/A=not applicable, there is not OSHA PEL or IDLH value for this compound

1.2.1 Lead

Lead is a heavy metal at room temperature and pressure. It can combine with various other substances to form numerous lead compounds.

- Lead has a molecular weight of 207.2 g/mol.
- Pure lead is a heavy, ductile, soft, gray solid.
- Lead has a melting point of 621 °F.
- Lead is a confirmed animal carcinogen with unknown relevance to humans.

Specific routes of exposure are:

- Inhalation
- Ingestion
- Contact with skin and eyes

Symptoms a worker may exhibit when exposed to lead include, but are not limited to the following:

- Irritation to eyes
- Lassitude (weakness, exhaustion)
- Insomnia
- Anorexia (symptom of poor appetite)
- Malnutrition
- Constipation
- Abdominal pain
- Colic
- Tremor
- Paralysis of the wrist and ankles
- Kidney disease
- Hypotension (abnormally low blood pressure)

The target organs affected are:

- Eyes
- GI tract
- Kidneys
- Blood
- Respiratory system
- Central nervous system

Emergency First Aid procedures are:
Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Get medical attention immediately.
- Contact lenses should not be worn when working with this chemical.

Skin Absorption

- Promptly wash contaminated skin using soap or a mild detergent and water.
- If contaminant has penetrated through clothing, remove the clothing immediately and wash the skin with soap and water.
- Get medical attention immediately

1.2.2 Methane

Methane is the simplest of all hydrocarbons and is emitted into the atmosphere in quantities larger than any other hydrocarbon. On an annual worldwide basis, the amount of methane emitted into the atmosphere from natural sources has been estimated to be around 310 million tons. Bacterial decomposition reactions represent the primary source (greater than 50%) of all worldwide methane emissions. Although aerobic conditions should be maintained in the stabilization, if anaerobic conditions are allowed to develop, methane and hydrogen sulfide may be generated. Some of the chemical and physical properties of methane are as follows:

- Methane has a molecular weight of 16.05 g/mol.
- Naturally occurring Methane is a colorless, odorless, and tasteless gas.
- Methane has a boiling point of -322.7 °F and a flash point of -361.76 °F.
- Methane has a lower explosive limit (LEL) of 5.3% and an upper explosive limit (UEL) of 15%.
- Methane is a simple asphyxiant.
- Methane is a very dangerous fire hazard when exposed to an ignition source and presents an explosion hazard.

Specific routes of exposure are:

- Inhalation

Symptoms a worker may exhibit when exposed to methane include, but are not limited to the following:

- Rapid respiration
- Diminished mental alertness
- Impaired muscular coordination
- Depression of senses
- Emotional instability
- Fatigue
- Nausea and vomiting
- Loss of consciousness
- Convulsions
- Deep coma and death

The target organs affected are:

- Respiratory system
- Central nervous system

Emergency First Aid procedures are:
Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Get medical attention immediately.
- Contact lenses should not be worn when working with this chemical.

1.2.3 Hydrogen Sulfide

Hydrogen sulfide is a highly toxic gas. It is produced naturally by decaying organic matter. Although aerobic conditions should be maintained in the stabilization, if anaerobic conditions are allowed to develop, methane and hydrogen sulfide may be generated. Some of the chemical and physical properties of hydrogen sulfide are as follows:

- Hydrogen sulfide has a molecular weight of 34.08.
- Hydrogen sulfide is a colorless, flammable gas with an offensive odor. The odor is frequently characterized as smelling like rotten eggs. *(NOTE: The sense of smell becomes rapidly deadened and can not be relied upon to warn of the continuous presence of hydrogen sulfide)*
- Hydrogen sulfide has a boiling point of -77°F.
- Hydrogen sulfide has an immediately dangerous to life or health value of 100 ppm. Exceeding this value requires the use of supplied air respiratory protection.
- Hydrogen sulfide has an upper explosive limit (UEL) or 44% and a lower explosive limit (LEL) of 4.0%.
- Hydrogen sulfide is heavier than air and may accumulate in low areas and may travel a considerable distance to an ignition source.
- Hydrogen sulfide is a poison. Exposures of 800-1000 ppm may be fatal in 30 minutes, and higher concentrations can be instantly fatal.
- Hydrogen sulfide is an irritant. Low concentrations of 20-150 ppm causes irritation to the eyes and slightly higher concentrations may cause irritation to the upper respiratory tract.
- Hydrogen sulfide is an asphyxiant. Hydrogen sulfide in very high amounts can paralyze the respiratory system.
- Hydrogen sulfide is a very dangerous fire hazard when exposed to heat, flame, or oxidizers. Also, it is a moderate explosion hazard when exposed to heat or flame.

Specific routes of exposure to hydrogen sulfide are:

- Inhalation
- Absorption through eyes and mucous membrane

Symptoms a worker may exhibit when exposed to hydrogen sulfide include, but are not limited to the following:

- Eye irritation
- Conjunctivitis
- Photophobia
- Corneal bullae
- Mucous membrane irritation
- Upper respiratory irritation
- Rhinitis
- Bronchitis
- Pulmonary edema
- Headache
- Dizziness
- Confusion
- Depression (when exposed to small concentrations)
- Excitement (when exposed to large concentrations)
- Irritability
- Gastrointestinal disturbances
- Staggering gait
- Diarrhea
- Paralysis of the respiratory system
- Coma
- Death

The target organs affected by hydrogen sulfide are:

- Eyes
- Respiratory system
- Central nervous system

Emergency First Aid procedures are:

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Get medical attention immediately.
- Contact lenses should not be worn when working with this chemical.

1.2.5 Carbon Dioxide

Carbon dioxide is generated in copious amounts during the stabilization process. Carbon dioxide is a simple asphyxiant; therefore, it replaces oxygen in the air. Some of the chemical and physical properties of carbon dioxide are:

- Carbon dioxide is a colorless, odorless gas.
- Carbon dioxide has a molecular weight of 44.0 g/mol.
- Carbon dioxide is a normal constituent of air; however, at elevated concentrations it tends to displace oxygen causing asphyxiation.

Specific routes of exposure to carbon dioxide related to this project are:

- Inhalation

Symptoms a worker may exhibit when exposed to carbon dioxide for this project include, but are not limited to the following:

- Dizziness
- Headache
- Inability to sleep well

The target organs affected by carbon dioxide are:

- Central Nervous System
- Respiratory system

Emergency First Aid procedures are:

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

1.2.6 Carbon Monoxide

Carbon monoxide is a by-product of combustion and will be exhausted by the heavy equipment used on-site. Of particular concern with this chemical is the use of heavy equipment between the windrows where diffusion of carbon monoxide will be limited due to restricted air flow caused by the windrows and by carbon monoxide's inherent chemical/physical properties. Some of the chemical and physical properties of carbon monoxide are as follows:

- Carbon monoxide has a molecular weight of 28.01 g/mol.
- Carbon monoxide is a colorless, odorless gas. It has almost the same density as air; therefore, it won't diffuse by rising.
- Carbon monoxide has a boiling point of -312.7°F.
- Carbon monoxide has an immediately dangerous to life or health value of 1200 ppm. Exceeding this value requires the use of supplied air respiratory protection.
- The upper explosive limit (UEL) for carbon monoxide is 74.2% and the lower explosive limit (LEL) is 12.5%.
- Carbon monoxide is a poison by inhalation and is an experimental teratogen.
- Carbon monoxide is an asphyxiant, it prevents hemoglobin from binding with oxygen
- Carbon monoxide is a dangerous fire and explosion hazard when exposed to flame.

Specific routes of exposure are:

- Inhalation

Symptoms a worker may exhibit when exposed to carbon monoxide includes, but is not limited to the following:

- Dizziness
- Fatigue
- Headache
- Nausea
- Flu like symptoms
- Confusion
- Auditory disturbances
- Contraction of the visual field
- Heart irregularities
- Edema

The target organs affected are:

- Respiratory system
- Central nervous system

Emergency First Aid procedures are:

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

1.2.7 Sulfur Salts

Sulfur salts may be used as part of the lead stabilization process. Bench-scale studies will be conducted to determine if the sulfur salts will be needed to stabilize the lead. If sulfur salts are utilized for the project, chemical hazard information will be provided in an addendum to this work plan. An MSDS will also be included in that addendum.

1.3 Physical Hazards

The General Safety and Health Plan addressed numerous physical hazards that might be encountered during various projects; however, site-specific conditions could not be addressed in the General Plan and must be addressed in this addendum. TMG anticipates that the following physical hazards will be encountered on this project.

- Heavy Equipment Hazards
- Utility Lines
- Slips, Trips, and Falls
- Lifting Techniques (manual)
- Inclement Weather (heat / cold stress)
- Noise
- Harmful Plants, Animals, and Insects
- Cuts
- Stabilization Equipment Hazards
- Fire Hazards
- Biological Hazards
- Water Hazards

All of these hazards (except for composting equipment hazards, cuts, fire hazards, and biological hazards) were addressed in the Final SSHP (TMG Services, Inc. July 2010) issued under Contract No. W91237-10-C-0002 and will not be reiterated in this supplement. This supplement will address site-specific conditions for composting equipment hazards, cuts, fire hazards, and biological hazards.

1.3.1 Composting Equipment Hazards

Composting equipment typically contains powerful mixing flails, knives, or hammers that rotate at a high rate of speed which poses a significant physical hazard for personnel working

with and around this equipment. The following safety precautions shall be adhered to for this project:

- Only qualified personnel will operate the composting equipment.
- Getting on or off of any equipment while it is in motion is prohibited.
- Machinery shall be operated in accordance with the manufacturer's recommendations.
- The use of headphones for entertainment purposes (such as radio or cassette) while operating equipment is prohibited.
- All machinery shall be inspected daily (when in use) by a competent and knowledgeable person to ensure safe operating conditions.
- Personnel shall not operate equipment in area where a potential to hit utilities is present.
- All composting equipment shall be equipped with working audible reverse signal alarms.
- Personnel shall wear Level C PPE (downgrade possible to Level D PPE) and hearing protection as described in Section 5.1 of the final SSHP (TMG Services, Inc. July 2010) when working near composting equipment.
- All moving or rotating equipment must be guarded to prevent accidental contact.
- Personnel shall only operate the composting equipment with the machine guard in place.
- Whenever a moving machinery part presents a hazard during servicing or maintenance, the engine shall be stopped, the power source disconnected, and all machine movement stopped before servicing or maintenance is performed.
- The mesh or nip points of all power driven gears, belts, chains, sheaves, pulleys, sprockets, and so forth shall be guarded.
- Functional components such as choppers, rotary beaters, mixing augers, feed rolls, conveying augers, and so forth which must be exposed for proper function shall be guarded to the fullest extent which will not substantially interfere with the normal functioning of the component.
- All guards must be free from burrs, sharp edges, and sharp corners. Guards must be securely fastened to the equipment.
- Stones or other foreign objects may forcibly eject from the composting equipment during turning activities.
- Hearing protection is required while operating the compost turner.

1.3.2 Fire Hazards

It is anticipated that all amendments will be applied and stockpiled material will be kept to a minimum. However, a possible fire hazard exists because of the potential for stockpiled amendments (organic materials) to spontaneously ignite or burn quickly if ignited from another source. Also, the mixed materials within the windrows may ignite if they overheat. Fires are rarely a problem in outdoor stabilization operations but they do sometimes occur. Organic material can ignite spontaneously at moisture contents between 25 and 35 percent.

The following safety precautions shall be taken:

- Amendment stockpiles and the windrows containing the mixed soil and amendments will be watered daily, during dry conditions, to keep a high level of moisture present.

- The windrows and stockpiles will be kept at a height of 10 feet or less to inhibit the buildup of excess internal heat.
- At a minimum, there will be four 10,000 gallon Frac tanks located near the sumps, in the event of a fire in the windrows, water from these tanks or from the sumps can be used. The water in the tanks may contain some nitroaromatics, but not in sufficient concentration to be a concern for fire application uses.
- All combustible materials shall be stored at least 35 feet (10.7 m) from windrow

1.3.3 Biological Hazards

A potential exists for personnel to be exposed to biological hazards associated with the amendment materials (organic compost). There is potential exposure to bacteria, molds, and parasites. Mold spores are produced by microorganisms, which grow when the moisture content is at least 30 percent and the temperature reaches 70 degrees Fahrenheit. Many forms of bacteria thrive at warm, moist conditions that will be found in the stabilization material. Therefore, potential exposure to various molds and bacteria is likely. When the amendment material is moved, billions of microscopic sized particles become airborne and attach themselves to dust particles. These dust particles with the attached microorganisms pass through the body's natural filtering mechanisms and accumulate in the lungs where they can cause an allergic type of pneumonia. Repeated attacks can lead to scarring of lung tissue which impairs it function. Exposure to mold spores and bacteria may produce the following symptoms:

- Shortness of breath
- Tightness in the chest
- Fatigue
- A dry cough
- Muscle aches
- Headaches
- Chills

Dust will be controlled by maintaining moisture in the windrows to prevent the generation of dusts. Personnel will be equipped with air purifying respirators equipped with HEPA filters, which can be worn if dust generation becomes a problem. Good hygiene practices are necessary to prevent exposure by ingestion. All food and drink shall be consumed away from the work area after proper decontamination procedures have been followed. Also, personnel shall not smoke in the work area and shall not smoke until they have performed proper decontamination.

1.3.4 Water Hazard

Water hazards are not expected to be a major hazard; however, a potential exists that personnel removing water from the excavation pits prior to backfilling the pits may fall into water that has filled or partially filled the pits. Additionally, personnel may fall into the West Area Red Water Pond when they are disposing of pit water or possible obtaining water to put on the windrows. The following safety precautions shall be taken, wherever there is a potential for a drowning hazard.

- Work shall not be performed alone.
- Personnel working near water where a drowning hazard is present will be equipped with a minimum of one throwable personal floatation device (PFD) that is attached to a polypropylene, or equivalent rope.
- Wherever there is a potential for a drowning hazard, personnel shall wear Type III, Type V, or better US Coast Guard approved International Orange PFD.
- Before and after each use, the PFD shall be inspected for defects that would alter its strength or buoyancy.
- Defective devices or devices with less than 13 pounds of buoyancy shall be removed from service.
- All PFDs shall be equipped with retro-reflective tape.

APPENDIX B Respirator Fit-Test Certifications

TRAINING ACKNOWLEDGMENT

TYPE OF TRAINING: *New Hire* ☐ *Hazwhoper* ☒ *Refresher* ☒

Other Sub-Contractor Training and for Beaver Contractor

Total Hours Trained 8

I JAMES B. RUSSELL acknowledge that I have received instruction and understand the following subjects (initial all that apply):

C&K Safety Training Programs:

JBR Hazard Communication
JBR Lockout/Tagout
JBR Confined Space
JBR Fire Extinguisher/Emergency Action
JBR Respiratory Protection
N/A Forklift
JBR Confined Space Communication
N/A Asbestos Awareness

JBR Personal Protective Equipment
N/A Drug Free Workplace
JBR General Company Safety Policies*
N/A Vac Truck Safety & Operations
N/A Waterblast Safety & Operations
N/A Manlift
N/A Lead Abatement
N/A Inorganic Arsenic Awareness

Site Specific Trainings:

N/A Alcoa- Contractor/Stand-down
N/A Charter Steel
JBR X Other Fall Protection
X Other Monitoring Equipment

N/A Reliant Energy
____ Other _____
JBR X Other Fit-Testing
____ Other _____

* I have received a copy of C&K Abridged Safety Policy Manual.

James B. Russell 4-7-10
Employee Signature Date

John P. Gabriel 4-7-2010
Instructor Signature Date

TRAINING ACKNOWLEDGMENT

TYPE OF TRAINING: *New Hire* ☐ *Hazwhoper* ☒ *Refresher* ☒

Other Sub-Contractor Training and for Base Contractor

Total Hours Trained 8

I [illegible] acknowledge that I have received instruction and understand the following subjects (initial all that apply):

C&K Safety Training Programs:

- DH Hazard Communication
- DH Lockout/Tagout
- DH Confined Space
- DH Fire Extinguisher/Emergency Action
- DH Respiratory Protection
- N/A Forklift
- DH Confined Space Communication
- N/A Asbestos Awareness
- DH Personal Protective Equipment
- N/A Drug Free Workplace
- DH General Company Safety Policies*
- N/A Vac Truck Safety & Operations
- N/A Waterblast Safety & Operations
- N/A Manlift
- N/A Lead Abatement
- N/A Inorganic Arsenic Awareness

Site Specific Trainings:

- N/A Alcoa- Contractor/Stand-down
- N/A Chester Steel
- X Other Fall Protection
- X Other Monitoring Equipment
- N/A Reliant Energy
- ____ Other ____
- X Other Fit-Testing
- ____ Other ____

* I have received a copy of C&K Abridged Safety Policy Manual.

Employee Signature 4-7-10 Date

Instructor Signature 4-7-2010 Date

TRAINING ACKNOWLEDGMENT

TYPE OF TRAINING: *New Hire* ☐ *Hazwhoper* ☒ *Refresher* ☒

Other Sub-Contractor Training and for Base Contractor

Total Hours Trained 8

I Joe Cassiano acknowledge that I have received instruction and understand the following subjects (initial all that apply):

C&K Safety Training Programs:

JPC Hazard Communication
JPC Lockout/Tagout
JPC Confined Space
JPC Fire Extinguisher/Emergency Action
JPC Respiratory Protection
N/A Forklift
JPC Confined Space Communication
N/A Asbestos Awareness

JPC Personal Protective Equipment
N/A Drug Free Workplace
JPC General Company Safety Policies*
N/A Vac Truck Safety & Operations
N/A Waterblast Safety & Operations
N/A Manlift
N/A Lead Abatement
N/A Inorganic Arsenic Awareness

Site Specific Trainings:

N/A Alcoa- Contractor/Stand-down
N/A Charter Steel
JPC X Other Fall Protection
X Other Monitoring Equipment

N/A Reliant Energy
____ Other _____
JPC X Other Eye Testing
____ Other _____

* I have received a copy of C&K Abridged Safety Policy Manual.

Employee Signature — Date 4-7-2010

Instructor Signature — Date 4-7-2010

Concentra Medical Centers (Ohio)
4940 Hinckley Industrial Pkwy CLEVELAND, OH 44109
Phone: (216) 749-2700 Fax: (216) 749-2732

PLHCP[1] WRITTEN STATEMENT for RESPIRATORS (EMPLOYEE)

Service Date: 04/06/2010

Employee Name:
Cashbaugh, Daniel P.

Employee SSN: XXX-XX-1919

Address:
1651 Price Rd.

YOUNGSTOWN OH 44509

Employer: TMG Services Inc

You were evaluated in this office of your medical status related to your physical capability to wear a respirator. (Check ✓ one that applies)

- ☐ There were no abnormal findings that would hamper your ability to perform your job duties while wearing a respirator.
- ☐ The abnormal findings listed below were not related to wearing a respirator but should be reported to your personal physician for further evaluation.

Based upon the results of this evaluation it is my opinion that you: (Check ✓ ALL that apply)

- ☑ ARE qualified to wear a respirator.
- ☑ Have the following restrictions concerning respirator usage: No SCBA
- ☐ ARE NOT qualified to wear a respirator.
- ☐ Require further testing by your private physician who must submit a written report of his/her findings to **Concentra Medical Centers (Ohio)** so that a final decision on your ability to wear a respirator can be made.
- ☐ Must wear Special prescription eye-wear needed to accommodate respirator.
- ☐ Must use an Eye glass conversion kit.
- ☐ May need to shave Facial hair to assure tight seal on certain face masks.
- ☐ Need to stop smoking.

(Check ✓ ALL that apply)

- ☑ The above individual HAS been examined for respirator fitness in accordance with 29 CFR 1910.134. This initial evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status in their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☐ The above individual HAS NOT been examined by me for respirator fitness. The employee's medical evaluation consisted of a review of OSHA's Medical Evaluation Questionnaire in Appendix C Part A Section 2. In accordance with 29 CFR 1910.134, this limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status in their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☑ In accordance with specific OSHA requirements, I have informed the above named individual of the results of this evaluation and of any medical conditions resulting from exposures that may require further examination or treatment. Where applicable, the above named individual has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos, lead and/or other chemical exposure(s).

Respirators must be properly selected based on the contaminant and concentration levels to which the worker will be exposed. Failure to follow the use and fitting instructions and warnings for proper use contained on the respirator packaging and/or failure to wear the respirator during all times of exposure can reduce the respirator's effectiveness and result in sickness or death. Warner must be trained in the proper care of any respirator. Refer to product literature and packaging for specific information regarding its use and/or limitations.

PLHCP Signature

PLHCP Name (printed)

[1] Physician or other Licensed Healthcare Professional

Employee's Signature

4/6/2011
Expiration Date

To be maintained in the employee's file with a copy to the employee

Concentra Medical Centers (Ohio)
4850 Hinckley Industrial Pkwy CLEVELAND, OH 44109
Phone: (216) 749-2700 Fax: (216) 749-2730

PLHCP[1] WRITTEN STATEMENT for RESPIRATORS (EMPLOYEE)

Service Date: 04/05/2010

Employee Name: Russell, James B.

Employee SSN: XXX-XX-8578

Address:
2901 Hampton

SHAKER HEIGHTS OH 44120

Employer: TMG Services Inc

You were evaluated in this office of your medical status related to your physical capability to wear a respirator. (Check ✓ one that applies)

- ☐ There were no abnormal findings that would hamper your ability to perform your job duties while wearing a respirator.
- ☐ The abnormal findings listed below were not related to wearing a respirator but should be reported to your personal physician for further evaluation.

Based upon the results of this evaluation it is my opinion that you: (Check ✓ ALL that apply)

- ☑ ARE qualified to wear a respirator.
- ☐ Have the following restrictions concerning respirator usage: _____
- ☐ ARE NOT qualified to wear a respirator.
- ☐ Require further testing by your private physician who must submit a written report of he/her findings to Concentra Medical Centers (Ohio) so that a final decision on your ability to wear a respirator can be made.
- ☐ Must wear Special prescription eye-wear needed to accommodate respirator.
- ☐ Must use an Eye glass conversion kit.
- ☐ May need to shave Facial hair to assure tight seal on certain face masks.
- ☐ Need to stop smoking.

[Check ✓ ALL that apply]

- ☑ The above individual HAS been examined for respirator fitness in accordance with 29 CFR 1910.134. This limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☐ The above individual HAS NOT been examined by me for respirator fitness. This employee's medical evaluation consisted of a review of OSHA's Medical Evaluation Questionnaire in Appendix C Part A Section 2. In accordance with 29 CFR 1910.134, this limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☑ In accordance with specific OSHA requirements, I have informed the above named individual of the results of the evaluation and of any medical conditions resulting from exposures that may require further explanation or treatment. Where applicable, the above named individual has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos, lead and/or other chemical exposures.

Respirators must be properly selected based on the contaminant and concentration levels to which the worker will be exposed. Failure to follow the use and fitting instructions and warnings for proper use contained on the respirator packaging and/or failure to wear the respirator during all times of exposure can reduce the respirator's effectiveness and result in sickness or death. Wearer must be trained in the proper care of any respirator. Refer to product literature and packaging for specific information regarding its use and/or limitations.

PLHCP Signature

PLHCP Name (printed)

[1] Physician or other Licensed Healthcare Professional

Employee's Signature

4/6/2011
Expiration Date

To be maintained in the employee's file with a copy to the employee

Concentra Medical Centers (Ohio)
[illegible] Hinckley Industrial Pkwy CLEVELAND, OH 44135
Phone: (216) 749-2750 Fax: (216) 749-2755

PLHCP[1] WRITTEN STATEMENT for RESPIRATORS (EMPLOYEE)

Service Date: 03/03/2010

Employee Name: Hartness, Delmar S.

Employee SSN: XXX-XX-6563

Address:
23581 Sprague rd
apt. 5
COLUMBIA STATION OH 44028

Employer: TMG Services Inc

You were evaluated in this office of your medical status related to your physical capability to wear a respirator. (Check ✓ one that applies)

- ☐ There were no abnormal findings that would hamper your ability to perform your job duties while wearing a respirator.
- ☐ The abnormal findings listed below were not related to wearing a respirator but should be reported to your personal physician for further evaluation.

Based upon the results of this evaluation it is my opinion that you: (Check ✓ ALL that apply)

- ☑ ARE qualified to wear a respirator.
- ☐ Have the following restrictions concerning respirator usage: _____
- ☐ ARE NOT qualified to wear a respirator.
- ☐ Require further testing by your private physician who must submit a written report of his/her findings to **Concentra Medical Centers (Ohio)** so that a final decision on your ability to wear a respirator can be made.
- ☐ Must wear Special prescription eye-wear needed to accommodate respirator.
- ☐ Must use an Eye glass conversion kit.
- ☐ May need to shave Facial hair to assure tight seal on certain face masks.
- ☑ Need to stop smoking.

(Check ✓ ALL that apply)

- ☑ The above individual HAS been examined for respirator fitness in accordance with 29 CFR 1910.134. This limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☐ The above individual HAS NOT been examined by me for respirator fitness. The employer's medical evaluator consisted of a review of OSHA's Medical Evaluation Questionnaire in Appendix C Part A Section 2. In accordance with 29 CFR 1910.134, this limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☑ In accordance with specific OSHA requirements, I have informed the above named individual of the results of this evaluation and of any medical conditions resulting from exposures that may require further explanation or treatment. Where applicable, the above named individual has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos, lead and/or other chemical exposure(s).

Respirators must be properly selected based on the contaminant and concentration levels to which the worker will be exposed. Failure to follow the use and fitting instruction and warnings for proper use contained on the respirator packaging and/or failure to wear the respirator during all times of exposure can reduce the respirator's effectiveness and result in sickness or death. Where must be trained in the proper care of any respirator. Refer to product literature and packaging for specific information regarding the use and/or limitations.

PLHCP Signature

PLHCP Name (printed)

Employee's Signature

3/23/2011
Expiration Date

[1]Physician or other Licensed Healthcare Professional

To be maintained in the employee's file with a copy to the employee

APPENDIX C Response to USACE Review Comments

TMG Response to Comments

Work Plan for Lead Stabilization
Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

Comments provided by Jean Read, USACE LRH, July 22, 2010

Comment 1 - Page 4, Section 4.5. Certifications for respirator fit testing are said to be in Appendix A of this addendum, but Appendix A is the supplement SSHP.

Response: Concur – The respirator fit-test certifications are provided in Appendix A.

Comment 2 - Page 5, Section 4.8. The last sentence in the second paragraph refers to Section 5.4 of this plan. There is no Section 5.4.

Response: Concur – The reference was corrected to refer to Section 5.2.

Comment 3 - Page 5, Section 4.8.1. The sulfur salts that may be used for lead treatment are not addressed in Appendix A, Section 1.2 on Chemical Hazards.

Response: Concur – Based on the guidance provided by the subcontractor performing the stabilization, the text was revised to read "Similarly, due to the small amount of sulfur present in the sulfur salts, and the limited quantity that may be used, these do not present a health risk".

Comment 4 - Page 11, Section 4.2. This section number does not follow the 10.1-10.2 sequence.

Response: The formatting error was corrected.

Comment 5 - Appendix A, Section 1.2.1 on lead. The first sentence refers to lead; the remainder of the paragraph switches to methane.

Response: Concur – The text was corrected by deleting the discussion of methane in this paragraph.

Work Plan for Composting

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

Prepared for:

Department of the Army
Huntington District, Corps of Engineers
502 Eighth Street
Huntington, West Virginia 25701

Prepared by:

TMG Services, Inc.
240 Oliver Street, Suite 1
St. Albans, West Virginia 25177
Phone: (304) 722-6015
Fax: (304) 722-6017

TMG Project No. – TMG09-22

July 2010

Work Plan for Composting

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

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Work Plan for Composting

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

1.0 PROJECT DESCRIPTION

The project description is provided in Section 1.0 of the Plan of Operations document.

2.0 PROJECT ORGANIZATION

The project organization is provided in Section 2.0 of the Plan of Operations document.

3.0 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS

A discussion of the Applicable, Relevant and Appropriate Requirements (ARARs) are provided in Section 3.0 of the Plan of Operations document.

4.0 FIELD ACTIVITIES

4.1 Ex-Situ Composting of Contaminated Soil and Sediment

Based on the approved selected remedy detailed in the Decision Document, remediation efforts for the TNT Area C will consists of 5 steps: excavation, ex-situ treatment through alkaline hydrolysis and/or composting, stabilization (if necessary) and disposal (off-site or on-site, depending on final levels achieved). TMG will initially perform treatment in the form of ex-situ alkaline hydrolysis on approximately 3000 cubic yards contaminated with 2,4-DNT and other nitroaromatics above the RGOs excavated from TNT Area C.

In the event the alkaline hydrolysis treatment does not reduce the 2,4-DNT to below hazardous levels, TMG will perform further treatment in the form of ex-situ windrow composting. This section addresses the field activities for the composting activities.

4.2 On-Site Equipment

TMG may use the following equipment on-site to perform the activities associated with this project:

- Tracked excavators (PC-220 or comparable)
- Vacuum truck (3000-gallon CUSCO or comparable)
- Bulldozer (D5C or comparable)
- Endloader (rubber tired)
- Windrow turner
- Clay
- Dump trucks (articulated)
- Roller
- Tractor
- Straw Blower
- Tractor and trailer used for mobilization of equipment
- Hand tools (rakes, shovels, etc.)
- Minimum of four 10,000 gallon frac tanks
- Water pump (4”) and hoses

4.3 Transportation

TMG shall transport the stockpiled material from the individual hot spots to the designated treatment area (adjacent to the Pentolite Road Red Water Pond (PRRWP) area) to undergo the initial alkaline hydrolysis treatment. As mentioned above, if the alkaline hydrolysis treatment isn’t successful, then windrow composting will be necessary and the soil will already be in place in the treatment area. Therefore, no further transport of the material will be necessary to facilitate composting. It is anticipated that dump trucks will be used to transport the material to the treatment area from the hot spots.

4.4 Treatment Area

Since the treatment area will have been prepared for the alkaline hydrolysis process, minimal preparation of the area will is anticipated. Water in the sumps may be sampled (if necessary) and disposed of prior to beginning compost treatment. Depending on the degradation of the berms (around site and sump perimeters), straw bales may be replaced. Also, depending on road conditions, additional gravel may be placed and/or road may be further compacted with roller.

4.5 Air Monitoring

Air monitoring shall be performed to ensure the safety of personnel and/or determine if the level of personal protective equipment (PPE) should be upgraded. All field personnel are fit tested and their certifications are in Appendix B of this addendum. Additional

personnel may be fit-tested to perform work on-site during the composting process. Fit-test documentation for those individuals will be provided in a separate addendum to this work plan. At this time, it is anticipated that air monitoring will be performed during composting activities for ammonia, methane, hydrogen sulfide, carbon monoxide, and carbon dioxide. The on-site SSHO or other designee under SSHO qualified to conduct this sampling will be responsible for performing air monitoring. Ammonia and carbon dioxide samples will be collected using a Drager® pump and the appropriate Drager® tubes. Methane, hydrogen sulfide, and carbon monoxide samples will be collected using a GasTech 402 or similar device. The instrument will be calibrated daily prior to using the monitor and it will be operated in conformance with the manufacturer's requirements. The air monitoring will be conducted at the perimeter of the treatment area and in the work zones during the initial composting operations to verify these conditions will not create any harmful conditions to the operators. If harmful conditions exist, monitoring will continue until the results are below the PEL. Subsequently, monitoring will be performed if there are any significant changes to the composting procedures or if requested by the SSHO or USACE.

Personnel will be required to use level C PPE until the air monitoring is completed and the required level of PPE is determined. Depending on the monitoring results, the level of PPE may be downgraded from level C to level D. In order to downgrade to level D, the air monitoring results must be below the PEL for the monitored parameters. The requirements for PPE levels C and D are presented in Section 13.0. The PELs are provided in Table 1 in Appendix A of this document. The office trailer will maintain supplies to facilitate upgrade to level C from level D PPE if necessary.

4.6 Water Management System

Two collection sumps are installed to collect run-off water at the end of the treatment area. Earthen berms are constructed around the perimeter of the treatment area and lined with straw bales as part of the water management system. The sump areas were constructed with at least a 2:1 slope and have a capacity of approximately 60,000 gallons. The sump is lined with geotextile liner (60-mil thickness). The sump perimeters are lined with straw bales to eliminate sediment from entering the sumps. The treatment area is sloped such that any water will run toward the sumps. The water management system is designed such that water collected in the sumps can be re-used as contact water during the composting process. Additional water can be obtained from the reservoir adjacent to the PRRWP area, if needed. Frac tanks (with at least a 40,000 gallon capacity) will be on-site for storage of the sump water. The water in the frac tanks will be analyzed prior to its disposal. Excess water in the frac tanks may be disposed at the West Area Red Water Pond (WARWP) depending upon sampling results of the water to be discharged. USACE, NASA and Ohio EPA will review analytical data from water sampling of the frac tanks prior to allowing discharge to the WARWP. Discharge to the pond must be done slowly to ensure that no erosion occurs and pond sediment is not disturbed. All water not approved for placement in the WARWP will be taken off-site for recycling.

4.7 Fencing

The NASA site is a secure site with its own security fence and full-time guards. TMG will install plastic construction fencing around the treatment area and storage area. Warning signs will be placed on the fencing and perimeter indicating that the area is a hazardous area.

4.8 Ex-Situ Treatment of Contaminated Soil

Following alkaline hydrolysis, bioremediation treatment in the form of ex-situ windrow composting may be necessary to reduce the 2,4-DNT concentrations to non-hazardous levels. Approximately 3,000 cubic yards of contaminated stockpiled soil may require ex-situ treatment to reduce the 2,4-DNT to below hazardous levels prior to off-site disposal at a non-hazardous landfill or on-site placement. Windrow composting will be accomplished by mixing contaminated soil and amendments to biodegrade the 2,4-DNT. The amendments will consist of chicken manure and straw to promote the bacterial growth necessary for the bioremediation. Approximately 1,000 cubic yards of manure and 5,000 bales of straw will be used in the composting process.

The windrows will be in place from the alkaline hydrolysis treatment, so no further construction of windrows is anticipated. Each windrow shall be approximately 12 feet wide and 6 feet high. The windrows shall not end any closer than 15 feet from the ends of the treatment pad to allow for the maneuvering of the windrow turner. The spacing (minimum of 15 feet width) between the parallel windrows shall be sufficient to prevent impeding windrow turning and materials handling equipment. It is expected that each windrow will be turned at least once daily; however, when temperatures drop near the end of the composting processing the windrow turning may be performed every other day. Refer to Section 5.0 of this plan for analytical requirements for the composting process.

4.9 Ultimate Disposal of the Treated Soil

Upon completion of the soil treatment, the composted soil shall be disposed of in a non-hazardous landfill licensed to accept these wastes or if the levels are below the RGOs, , non-hazardous and meet the Land Disposal Restrictions, then the soil may be used as backfill in the excavated areas in TNT Area C. If off-site disposal is used, the non-hazardous soil will be transported and disposed of at Erie County Landfill.

4.10 Guard Services and Composting Schedule

Composting is a 7-day a week operation and NASA employees usually do not work on the weekends or holidays. TMG shall coordinate with NASA's security services as well as the NASA POC, Bob Lallier, to ensure site access to accomplish the composting efforts. All work will be conducted between 7:00 am and 6:00 pm. No work will be conducted after-hours (after 6:00 pm).

5.0 ANALYTICAL REQUIREMENTS

5.1 Windrow Composting

Laboratory analytical results will be used to determine when the composting operation is completed. One 10-point composite sample from each windrow will be collected weekly and submitted to the laboratory for analysis by EPA Method 8330. A baseline round of sampling will be conducted prior to composting efforts. There will be no field screening tests used during this effort.

Prior to the windrow being turned (i.e. aerated), temperature and moisture data will be collected daily from each windrow at 10 equi-distance points, or approximately every ten feet, depending on the length of the windrow. Moisture data will be collected using a soil moisture meter equipped with a two-foot solid probe that can be pushed into the windrows. Temperature data shall be collected using a stainless steel probe equipped with a thermocouple attached to a digital thermometer. The probe is approximately 8 feet long.

For sampling purposes, personnel shall collect composted material (after turning) at roughly 10 equi-distanced points along each windrow. Since personnel are collecting the composted material after turning (which mixes the material), the grab samples can be collected from about 0 to 6” inches deep while walking along the windrow. Each windrow’s grab samples will be composited in a zip-lock bag and thoroughly mixed to produce one composite sample for each windrow. Air monitoring will be conducted during sampling events to determine if there is a risk of exposure contaminants in the air. Personnel will be required to use level C PPE while collecting samples, until the air monitoring is completed and the required level of PPE is determined. Depending on the monitoring results, the level of PPE may be downgraded from level C to level D. In order to downgrade to level D, the air monitoring results must be below the PEL for the monitored parameters. The requirements for PPE levels C and D are presented in Section 13.0. The PELs are provided in Table 1 in Appendix A of this document. The office trailer will maintain supplies to facilitate upgrade to level C from level D PPE if necessary.

The composited soil samples will be thoroughly mixed in the bag and a portion removed and placed in a sample container provided by the laboratory. The sample container will be labeled, packaged in a clean zip-lock bag and wrapped with bubble wrap for shipment. The samples will be packaged for shipment in an iced cooler. The samples will be placed inside a large plastic bag (trash bag), along with ice packs. The trash bag will be tightly closed and tied-off to prevent leakage of melted ice. The cooler will be secured with strapping tape, shipping labels applied and sent to Test America, Inc. located in North Canton, Ohio. The cooler will be shipped using an expediting service such as FedEx or UPS.

The composting process will conclude when nitroaromatic levels in all soils have been reduced to levels suitable for off-site disposal at a non-hazardous landfill or on-site placement. Completion of composting shall be determined by laboratory analysis with 2,4-DNT levels below 0.13 mg/L (TCLP).

5.2 Sampling and Analytical Requirements for Disposal of Treated Soil

It is anticipated that initial treatment of the soil by alkaline hydrolysis will reduce levels below the RGOs. Composting would only be required should 2,4-DNT need treatment to below hazardous levels. Once these levels are obtained, the levels should be checked against the LDRs to ensure the soil can be used for on-site placements (as anticipated). If the soil does not meet the above requirements then the composted soil shall be disposed of in a non-hazardous landfill licensed to accept special waste (pending it isn't still hazardous). The anticipated disposal facility for the treated soil is Erie County Landfill. Eric County Landfill indicated that they would receive the treated soil from PBOW but indicated there would be a 200-ton per day restriction during peak operational periods. TMG will coordinate disposal with the landfill to ensure the daily restrictions are not exceeded.

Since personnel are collecting the treated material after turning (which mixes the material), the 10-point composite sample will be collected from 0 to 6" inches deep while walking along the windrow. While collecting samples, personnel will be required to use level C PPE until the air monitoring is completed and the required level of PPE is determined. Depending on the monitoring results, the level of PPE may be downgraded from level C to level D. In order to downgrade to level D, the air monitoring results must be below the PEL for the monitored parameters. The requirements for PPE levels C and D are presented in Section 13.0. The PELs are provided in Table 1 in Appendix A of this document. The office trailer will maintain supplies to facilitate upgrade to level C from level D PPE if necessary.

For disposal purposes to the landfill, one 10-point composite sample will be collected from each windrow, as described above in Section 5.1. The samples will be analyzed for Full TCLP. The landfill may also require additional tests for paint filter and TPH (GRO / DRO). TMG will coordinate all disposal sampling requirements prior to submission of any analytical to landfill. Per landfill requirements, the soil will be considered non-hazardous when 3 consecutive readings of non-hazardous analytical data have been submitted. At that point, TMG shall consider the soil non-hazardous and begin transportation to landfill.

Once the composted soil has been removed for disposal or on-site placement, the surface soil in the footprint of the windrow will be sampled and analyzed to verify the underlying soil has not been impacted by the contaminants in the windrows. A 5-point composite sample will be collected from equi-distant locations within each windrow and composited in a zip-lock bag. The soil sample will be placed in a sample container and processed and shipped to the laboratory as described above. The samples will be analyzed for SVOCs, PCBs, TAL Metals, and full TCLP. If the results of the underlying soil analysis indicate

the soil has not been impacted by the composting process, the composting pad will be considered clean.

In the event the sample results indicate the underlying soil was impacted by the contaminants in the compost soil, a minimum of 6 inches of soil will be scraped and stockpiled on plastic within the treatment pad area. The underlying soil will be sampled again following the same procedures as detailed above. The process of scraping, stockpiling and resampling will be repeated until the sample results indicate the underlying soil is clean. The stockpiled soil from the scraping will be sampled by collecting a 5-point composite sample from random locations within the pile. The samples will be submitted to the laboratory and analyzed for off-site disposal.

Table 5-1 summarizes the sampling and analytical requirements for the composting of TNT Area C soils.

TABLE 5-1. SUMMARY OF SAMPLING AND ANALYTICAL REQUIREMENTS

SOURCE	REASON	MATRIX	TYPE	FREQUENCY	TIMING	ANALYTES	PROCEDURE
AH Soils	Baseline level of contaminant concentrations	Soil	Composite	Once	After AH Treatment	SVOC, PCBs, TAL Metals, Full TCLP	One 10-point composite at 10 equi-distant locations
Air	PPE selection	Air	Grab	While turning compost	Daily until levels are consistently below PEL	O2, CO2, CO, H2S, Ammonia, Methane	Work zones, pad perimeter
Frac Tank	Disposal determination	Water	Composite	As needed	10K gallon accumulation	SVOC, PCBs, TAL Metals, Full TCLP	1 grab from each tank
Windrow	Condition	Soil	Grab	Daily	Prior to turning	Temperature, moisture	10 equi-distant locations
Windrow	Composting	Soil	Composite	Weekly	After turning	Total nitroaromatics	One 10-point composite at 10 equi-distant locations
Windrow	On-site placement	Soil	Composite	Once	After composting	SVOC, PCBs, TAL Metals, Full TCLP	One 10-point composite at 10 equi-distant locations
Soil beneath windrow	To determine if windrow contaminants impacted underlying soil	Surface soil	Composite	Once	After removal of windrow	SVOC, PCBs, TAL Metals, Full TCLP	One 5-point composite
Stockpile of soil scrapings from windrow footprint	For disposal	Soil	Composite	Once	After scraping the footprint of windrow	Full TCLP	One 5-point composite

6.0 EQUIPMENT DECONTAMINATION

Equipment decontamination is provided in Section 8.0 of the Plan of Operations document.

7.0 FIELD DOCUMENTATION PROCEDURES

The Field Documentation Procedures are discussed in Section 9.0 of the Plan of Operations document.

8.0 SAMPLE PACKING AND TRANSPORTATION

The sample packing and transportation are discussed in Section 10.0 of the Plan of Operations document and outlined in Section 5 of this work plan.

9.0 TMG CHEMICAL QUALITY CONTROL

The discussion of TMG's Chemical Quality Control is provided in Section 7.2 of the Plan of Operations.

10.0 SPILL PREVENTION, CONTROL AND COUNTERMEASURE (SPCC)

The discussion of the SPCC is provided in Section 12.0 of the Plan of Operations document. In cases of spills it is very important to make sure that the area is secured and that the situation is assessed quickly. This section discusses the SPCC as it pertains to composting operations.

10.1 Potential Spills

Potential spills may occur from handling the amendments (manure and straw), overflowing of the sump, and spills/leaks from the frac tanks that may be on-site to store the accumulated sump water for subsequent disposal. Amendments will be stockpiled in the treatment area so that a spill or runoff from these materials will drain to the sump and be captured. Site personnel will monitor the sump to ensure that it does not overflow. A vacuum truck or pump will be used to transfer water from the sump into the frac tank.

The sump water and /or the contents of each 10,000 gallon frac tank will be analyzed to determine proper disposal. If analytical data does not meet discharge criteria, the water will be utilized for contact water on the windrows or transported off-site for disposal at an approved facility. If the water is approved for on-site discharge to the West Area Red Water Ponds (WARWP), personnel must ensure that discharge of any water into the pond is done slowly so as not to cause bank erosion or disturb pond sediments.

10.2 Spill Prevention

The following are additional spill prevention procedures that will be implemented at the site:

- The four frac tanks shall be visually inspected weekly for leaks. The QC person will be responsible for the inspections and document on the daily QCR.
- The sumps shall be inspected daily to ensure that no damage has occurred to the liner that would allow contaminated water to leak into the underlying soil or banks of the sump.
- The berm around the treatment area shall be inspected weekly to ensure that there are no breaks or low spots that will allow run-off water to leak into the surrounding soil.

10.3 Spill Containment

Damage to the liners in each sump can result in potentially large spills/leakage of contaminated water from the sump. Therefore, care shall be taken not to damage the liners and any damage to the liners shall be repaired immediately even if the damage is above the water line. Personnel shall not use equipment on or near the liners which may result in tears or cuts to the liners. Personnel shall not throw objects into the sump that might damage the liners. The liner shall be inspected at daily to ensure its integrity. The QCO will be responsible for the inspections and document the findings on the QCR.

11.0 PROTECTION OF RIVERS STREAMS AND IMPOUNDMENTS

This information is provided in Section 13.0 of the Plan of Operations document. This section provides additional discussion regarding the discharge of sump water into the WARWP. USACE will review the analytical data from frac tank sampling prior to submitting to NASA and Ohio EPA for approval. Any discharge to the pond must be performed slowly to ensure that no erosion occurs and no pond sediment is disturbed.

12.0 AIR EMISSION CONTROLS

Water will be used for dust control in the treatment area and access roads to the treatment area. The Project Manager/On-site Superintendent and the Quality Control Officer (QCO) will make visual observations of dust levels to determine if water suppression is necessary and/or working. If not, then additional water will be added to control dust.

Odor emissions are not uncommon during the composting process. Odors are generated by the natural decomposition of the organic material inherent to any compost site. The use of manure adds to the odor emissions from composting activities. Additionally, if the compost process is allowed to become anaerobic, significant odors may be emitted. TMG proposes the following management practices to reduce air emissions from composting activities:

- Stockpiled amendments (straw and chicken manure) will be covered when not in use
- Every attempt will be made not to overstock amendments
- Amendments will be thoroughly mixed with the contaminated soil. This is necessary for proper bioremediation but it will also decrease odor emissions.
- The windrows will be turned as needed to facilitate the introduction of oxygen within the windrow and to maintain the temperature of the windrow between 90-160 degrees Fahrenheit. This will support the aerobic conditions in the windrow and to reduce odor emissions.

13.0 SITE-SPECIFIC HEALTH AND SAFETY PLAN

The purpose of this supplement is to address additional safety issues relating to the bioremediation of 2,4-DNT-contaminated soil, if necessary to reduce the 2,4-DNT to below hazardous levels. The bioremediation will be accomplished using ex-situ windrow composting. The original SSHP shall be followed in its entirety, in addition to the issues outlined in this section. The supplement to the SSHP is provided in Appendix A of this document.

14.0 QUALITY CONTROL PLAN

There are no changes to the requirements outlined in the Quality Control Plan, TMG Services, Inc., July 2010.

15.0 PROJECT SCHEDULE

The project schedule is presented in Section 21.0 of the Plan of Operations.

16.0 REFERENCES

The following reference was added to Section 22.0 in the Plan of Operations:

"*Addendum to Plan of Operations, Interim Soil Removal Action Continuation, Soil Excavation and Disposal, Plum Brook Ordnance Works, Pentolite Road Red Water Ponds, Sandusky, Ohio*" . McTech Corp., July 2008

APPENDIX A Composting Supplement to the Site-Specific Health Plan

Composting Work Plan Supplement to

SITE-SPECIFIC SAFETY AND HEALTH PLAN

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio
Contract No. W91237-10-C-0002

1.0 HAZARD/RISK ANALYSIS

The following summarizes field activities related to bioremediation in the form of ex-situ windrow composting of 2,4-DNT contaminated soil and the actions that can be taken to eliminate or minimize each of those hazards. The additional hazards associated with the performance of contract W91237-10-C-0002 are discussed in the Final SSHP (TMG Services, July 2010) and will not be reiterated in this supplement.

1.1 Activity Hazard Analysis

The following tables summarize activity hazards related to bioremediation in the form of ex-situ windrow composting of 2,4-DNT contaminated soil and the actions that can be taken to eliminate or minimize those hazards. The additional activity hazards associated with the performance of contract W91237-10-C-0002 are discussed in Appendix A of the Final SSHP (TMG Services, Inc., July 2010).

Hazard Analysis

Activity	Composting Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be mixing amendments and contaminated soil	Personnel may be injured by heavy equipment used in the loading and relocation of the contaminated soil.	• Heavy machinery will be operated only by designated qualified personnel • Getting on or off of any equipment while it is in motion is prohibited • Machinery shall be operated in accordance with the manufacturer's recommendations • The use of headphones for entertainment purposes (such as radio or cassette) while operating equipment is prohibited. • All machinery shall be inspected daily (when in use) by a competent and knowledgeable person to ensure safe operating conditions • Personnel shall not operate heavy equipment in area where the utilities have not been properly marked. • All heavy equipment shall be equipped with working audible reverse signal alarms • Personnel shall wear hearing protection when working nearing operating equipment • Personnel working on the pad are required to wear safety-colored shirts or reflective vests (ANSI Class II)
	Heat stress can occur.	• The work schedule will be adjusted, if possible, to schedule heavy work during the cooler part of the day. • The work will be paced to include adequate rest periods. Five to fifteen minute rest periods will be scheduled hourly or every 2 hours depending upon the workload, temperature, and relative humidity. • Drinking water and ice will be provided in the clean zone. Personnel will be encouraged to drink plenty of water. • The weather conditions shall be monitored and work halted if the temperature (including humidity) rises to levels that present a danger to worker safety
	Personnel may be injured by lifting or moving heavy objects	• If a load is heavy or bulky, get help • Lift with your legs and keep your back straight. • Keep the load as close to your body as you can. • Do not jerk the load. Lift slowly and carefully. • Make sure the area you will be carrying the load through is clear of obstacles. • Do not twist or turn your spine when lifting or carrying the load. • Be sure to have a good grip on your load at all times. • Be careful when lowering your load (get help, if necessary).

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

Hazard Analysis

Activity	Composting Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be mixing amendments and contaminated soil	Personnel may be injured by the composting equipment that is used to mix the materials and to turn the windrows.	• Only qualified personnel will operate the composting equipment. • Getting on or off of any equipment while it is in motion is prohibited. • Machinery shall be operated in accordance with the manufacturer's recommendations. • The use of headphones for entertainment purposes (such as radio or cassette) while operating equipment is prohibited. • All machinery shall be inspected daily (when in use) by a competent and knowledgeable person to ensure safe operating conditions. • Personnel shall not operate equipment in area where a potential to hit utilities is present. • All composting equipment shall be equipped with working audible reverse signal alarms. • Personnel shall wear hearing protection when working near composting equipment. • All moving or rotating equipment must be guarded to prevent accidental contact. • Personnel shall only operate the composting equipment with the machine guard in place. • Whenever a moving machinery part presents a hazard during servicing or maintenance, the engine shall be stopped, the power source disconnected, and all machine movement stopped before servicing or maintenance is performed. • The mesh or nip points of all power driven gears, belts, chains, sheaves, pulleys, sprockets, and so forth shall be guarded. • Functional components such as choppers, rotary beaters, mixing augers, feed rolls, conveying augers, and so forth which must be exposed for proper function shall be guarded to the fullest extent which will not substantially interfere with the normal functioning of the component. • All guards must be free from burrs, sharp edges, and sharp corners. Guards must be securely fastened to the equipment. • Stones or other foreign objects may forcibly eject from the composting equipment during turning activities.

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

Hazard Analysis

Activity	Composting Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be acquiring water and placing water on the windrows and stockpiles	Personnel may fall into a pond (if it is used as a source of water or if the sump contents are discharged to the pond).	• TMG will assign personnel (subcontractors and TMG personnel) who know how to swim to perform work along the edges of any pits or reservoirs where there is a potential for personnel to fall into the water. • Work shall not be performed alone. • Personnel working near water where a drowning hazard is present will be equipped with a minimum of one throwable PFD that is attached to a polypropylene, or equivalent rope. • Wherever there is a potential for a drowning hazard, personnel shall wear US Coast Guard approved International Orange personal flotation devices (PFDs). • Before and after each use, the PFD shall be inspected for defects that would alter its strength or buoyancy. • Defective devices or devices with less than 13 pounds of buoyancy shall be removed from service. • All PFDs shall be equipped with retro-reflective tape.
Personnel will be performing composting activities	Personnel may come into contact with or inhale potentially high concentration of soil contaminants or decomposition products during composting activities.	• Potential chemical contaminants at a site shall be reviewed prior to performing work. • Personnel are required to wear the assigned level of PPE. • Personnel shall be careful when containerizing the decontamination waste so as not to further expose themselves. • Air monitoring will be performed
	Wet or muddy surfaces may cause a tripping hazard	• Be alert and observe terrain while walking. • Wear appropriate footwear. • Personnel will avoid walking through or working in water or mud. • Personnel will avoid climbing over site debris or equipment. • Personnel shall ensure that equipment not in use will be put in a place where it will not create a tripping hazard.
	Materials with sharp edges may present a cutting hazard	• Personnel shall wear leather gloves to protect them from potential cuts whenever possible. • A 16-unit first aid kit will be available on-site in the event personnel are cut. • Cut areas will be decontaminated and first aid rendered. • Personnel will be taken to the hospital for a tetanus shot if they are cut.

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

Hazard Analysis

Activity	Composting Activities	Reviewed By/Date – RB/072010
Principal Steps	**Potential Hazards**	**Recommended Controls**
Personnel will be performing composting activities	Personnel may be exposed to noise levels that will potentially harm their hearing.	Personnel shall wear hearing protection when working near heavy equipment, the drilling rig, and the composting equipment.
	Personnel will be potentially exposed to harmful animals, insects, and poisonous plants.	• Field personnel are required on this project to wear personal protective equipment (PPE) at all times while in the work zone. This should be helpful in limiting skin exposure to harmful plants and insects. • Insect repellants may be used except when sampling for nitroaromatics because they can interfere and cause false hits in subsequent analysis. • A 16-unit first aid kit shall be available at the site and shall contain a variety of ointments for skin afflictions. • Water and soap shall be provided on-site for personnel to wash affected skin areas. • Personnel shall report all known allergies to plants, insects, and medication to the Project Manager/SSHO prior to work.
	A possible fire hazard exists because of the stockpiled amendments (hay/straw, wood chips, and so forth) may spontaneously ignite or would burn quickly if ignited from another source.	• Amendment stockpiles and the windrows containing the mixed soil and amendments will be watered daily to keep a high level of moisture present. • The windrows and stockpiles will be kept at a height of 10 feet or less to inhibit the buildup of excess internal heat. • In order to keep aerobic conditions within the windrow, the windrows are required to be turned daily. This daily turning will inhibit the buildup of internal heat; therefore, contributing to fire protection. • The amendment stockpiles until used will be turned two to three times a week to inhibit the buildup of internal heat, which may cause spontaneous combustion. • A vacuum truck filled with water will be present on-site at the treatment pad area. This truck will be used for fire suppression.
	Personnel will potentially be exposed to mold spores, bacteria, and parasite.	• The amendment materials shall be wetted prior to mixing to reduce potential dust generation. • The windrows will be wetted prior to turning to limit generation of dust. • Personnel will be equipped with air purifying respirators with HEPA filters. • Personnel will be required to wash prior to eating, drinking, or smoking.

Equipment to be used	**Inspection Requirements**	**Training Requirements**
Level C PPE will be used initially with a possible downgrade to Level D PPE. Hearing protection is required around heavy equipment	Refer to PPE Checklist in Appendix C of the Final Plan of Operations (TMG Services, Inc., July 2010)	40 hour HAZWOPER training, CPR, and First Aid

1.2 Chemical Hazards

The primary chemical hazards associated with these bioremediation activities are exposure to nitroaromatic compounds. Also, personnel will be potentially exposed to gases such as carbon dioxide, hydrogen sulfide, ammonia, and methane, which may be formed as part of the composting process. Additionally, carbon monoxide levels may become elevated between the windrows during turning operations due to exhaust from equipment used to turn the windrows.

Odor emissions are not uncommon during the composting process. Odors are generated by the natural decomposition of the organic material inherent to any compost pile. The use of manure adds to the odor emissions from composting activities. Additionally, if the compost process is allowed to become anaerobic, significant odors and hazardous chemicals (methane and hydrogen sulfide) may be emitted. TMG proposes the following management practices to reduce air emissions from composting activities:

- Stockpiled amendments (straw and chicken manure) will be covered when not in use.
- Every attempt will be made not to overstock amendments.
- Amendments will be thoroughly mixed with the contaminated soil. This is necessary for proper bioremediation but it will also decrease emissions.
- The windrows will be kept moist (between 40 and 60% moisture) to reduce the potential for dust emissions as well as prevent possible spontaneous combustion of the windrows.
- The windrows will be turned at least once daily to ensure an appropriate supply of oxygen is provided within the windrows. This will serve to keep the decomposition process aerobic; thus, limiting the odor emissions as well as preventing the formation of methane and hydrogen sulfide. As the composting process progresses, the windrow turning may be decreased to once every two days.

Personnel will be potentially exposed to products brought on the site by TMG Services, Inc. These products include Tornado-50 cleaner, gasoline and diesel fuel. The hazards from nitroaromatic compounds, diesel fuel, Tornado-50 cleaner, and gasoline were addressed in the previously approved Final SSHP (TMG Services, Inc. July 2010) and will not be reiterated in this plan.

Refer to Table 1 for permissible exposure limits (PELs) and immediately dangerous to life and health (IDLH) limits for all chemical hazards anticipated for the site. Chemical hazards from exposure to carbon dioxide, hydrogen sulfide, ammonia, methane, and carbon monoxide are discussed in Section 3.2.1 through 3.2.5. Material Data Safety Sheets (MSDS) for all chemicals brought on-site shall be available for review by personnel prior to field mobilization and on-site.

TABLE 1 – EXPOSURE LIMITS

Compound	**PEL[1]**	**IDLH[1]**
o-Dinitrobenzene	1 mg/m3	200 mg/m3
m-Dinitrobenzene	1 mg/m3	200 mg/m3
p-Dinitrobenzene	1 mg/m3	200 mg/m3
Nitrobenzene	1 ppm	200 ppm
Nitrotoluene	5 ppm	200 ppm
Dinitrotoluene	1.5 mg/m3	200 mg/m3
o-Dinitrotoluene	2 ppm	200 ppm
p-Dinitrotoluene	2 ppm	200 ppm
2,4,6-Trinitrotoluene	1.5 mg/m3 (skin)	500 mg/m3
Hydrogen sulfide	20 ppm[2]	100 ppm
Ammonia	50 ppm	300 ppm
Carbon monoxide	50 ppm	1200 ppm
Carbon dioxide	5000 ppm	40,000 ppm
Methane	N/A3	N/A3
Diesel fuel	N/A3	N/A3
Tornado-50 cleaner	N/A3	N/A3

1 - PEL and IDLH values were taken from the NIOSH Pocket Guide to Chemical Hazards, June 1997.
2 - Ceiling level
N/A=not applicable, there is not OSHA PEL or IDLH value for this compound

1.2.1 Methane

Methane is the simplest of all hydrocarbons and is emitted into the atmosphere in quantities larger than any other hydrocarbon. On an annual worldwide basis, the amount of methane emitted into the atmosphere from natural sources has been estimated to be around 310 million tons. Bacterial decomposition reactions represent the primary source (greater than 50%) of all worldwide methane emissions. Although aerobic conditions should be maintained in the compost, if anaerobic conditions are allowed to develop, methane and hydrogen sulfide may be generated. Some of the chemical and physical properties of methane are as follows:

- Methane has a molecular weight of 16.05 g/mol.
- Naturally occurring Methane is a colorless, odorless, and tasteless gas.
- Methane has a boiling point of -322.7 °F and a flash point of -361.76 °F.
- Methane has a lower explosive limit (LEL) of 5.3% and an upper explosive limit (UEL) of 15%.
- Methane is a simple asphyxiant.
- Methane is a very dangerous fire hazard when exposed to an ignition source and presents an explosion hazard.

Specific routes of exposure are:

- Inhalation

Symptoms a worker may exhibit when exposed to methane include, but are not limited to the following:

- Rapid respiration
- Diminished mental alertness
- Impaired muscular coordination
- Depression of senses
- Emotional instability
- Fatigue
- Nausea and vomiting
- Loss of consciousness
- Convulsions
- Deep coma and death

The target organs affected are:

- Respiratory system
- Central nervous system

Emergency First Aid procedures are:
Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Get medical attention immediately.
- Contact lenses should not be worn when working with this chemical.

1.2.2 Hydrogen Sulfide

Hydrogen sulfide is a highly toxic gas. It is produced naturally by decaying organic matter. Although aerobic conditions should be maintained in the compost, if anaerobic conditions are allowed to develop, methane and hydrogen sulfide may be generated. Some of the chemical and physical properties of hydrogen sulfide are as follows:

- Hydrogen sulfide has a molecular weight of 34.08.
- Hydrogen sulfide is a colorless, flammable gas with an offensive odor. The odor is frequently characterized as smelling like rotten eggs. *(NOTE: The sense of smell becomes rapidly deadened and can not be relied upon to warn of the continuous presence of hydrogen sulfide)*
- Hydrogen sulfide has a boiling point of -77°F.
- Hydrogen sulfide has an upper explosive limit (UEL) or 44% and a lower explosive limit (LEL) of 4.0%.
- Hydrogen sulfide is heavier than air and may accumulate in low areas and may travel a considerable distance to an ignition source.
- Hydrogen sulfide is a poison. Exposures of 800-1000 ppm may be fatal in 30 minutes, and higher concentrations can be instantly fatal.
- Hydrogen sulfide is an irritant. Low concentrations of 20-150 ppm causes irritation to the eyes and slightly higher concentrations may cause irritation to the upper respiratory tract.
- Hydrogen sulfide is an asphyxiant. Hydrogen sulfide in very high amounts can paralyze the respiratory system.
- Hydrogen sulfide is a very dangerous fire hazard when exposed to heat, flame, or oxidizers. Also, it is a moderate explosion hazard when exposed to heat or flame.

Specific routes of exposure to hydrogen sulfide are:

- Inhalation
- Absorption through eyes and mucous membrane

Symptoms a worker may exhibit when exposed to hydrogen sulfide include, but are not limited to the following:

- Eye irritation
- Conjunctivitis
- Photophobia
- Corneal bullae
- Mucous membrane irritation
- Upper respiratory irritation
- Rhinitis
- Bronchitis
- Pulmonary edema

- Headache
- Dizziness
- Confusion
- Depression (when exposed to small concentrations)
- Excitement (when exposed to large concentrations)
- Irritability
- Gastrointestinal disturbances
- Staggering gait
- Diarrhea
- Paralysis of the respiratory system
- Coma
- Death

The target organs affected by hydrogen sulfide are:

- Eyes
- Respiratory system
- Central nervous system

Emergency First Aid procedures are:

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Get medical attention immediately.
- Contact lenses should not be worn when working with this chemical.

1.2.3 Ammonia

It is typical for ammonia gas to be generated during the composting process. Exposure to ammonia vapors is especially likely during the windrow turning operations. Some of the chemical and physical properties of ammonia are:

- Ammonia is a colorless gas with a pungent, suffocating odor.
- Ammonia has a molecular weight of 17.0 g/mol.
- Ammonia has an upper explosive limit (UEL) of 28% and a lower explosive limit (LEL) of 15%.
- Ammonia is incompatible and/or reactive with strong oxidizers, acids, halogens, and salts of silver and zinc.

Specific routes of exposure to ammonia are:

- Inhalation
- Absorption through eyes and mucous membrane
- Skin absorption

Symptoms a worker may exhibit when exposed to ammonia include, but are not limited to the following:

- Eye, nose, and throat irritation
- Respiratory irritation
- Bronchial spasms
- Chest pain
- Pulmonary edema
- Skin burns
- Dyspnea

The target organs affected by hydrogen sulfide are:

- Eyes
- Respiratory system
- Skin

Emergency First Aid procedures are:

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

Skin Absorption

- Promptly wash contaminated skin using soap or a mild detergent and water.
- If contaminant has penetrated through clothing, remove the clothing immediately and wash the skin with soap and water.
- Get medical attention immediately.

Eye Contact

- Wash eyes immediately with large amounts of water, lifting the lower and upper eye lids occasionally.
- Get medical attention immediately.
- Contact lenses should not be worn when working with this chemical.

1.2.4 Carbon Dioxide

Carbon dioxide is generated in copious amounts during the composting process. Carbon dioxide is a simple asphyxiant; therefore, it replaces oxygen in the air. Some of the chemical and physical properties of carbon dioxide are:

- Carbon dioxide is a colorless, odorless gas.
- Carbon dioxide has a molecular weight of 44.0 g/mol.
- Carbon dioxide is a normal constituent of air; however, at elevated concentrations it tends to displace oxygen causing asphyxiation.

Specific routes of exposure to carbon dioxide related to this project are:

- Inhalation

Symptoms a worker may exhibit when exposed to carbon dioxide for this project include, but are not limited to the following:

- Dizziness
- Headache
- Inability to sleep well

The target organs affected by carbon dioxide are:

- Central Nervous System
- Respiratory system

Emergency First Aid procedures are:

Inhalation

- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

1.2.5 Carbon Monoxide

Carbon monoxide is a by-product of combustion and will be exhausted by the heavy equipment used on-site. Of particular concern with this chemical is the use of heavy equipment between the windrows where diffusion of carbon monoxide will be limited due to restricted air flow caused by the windrows and by carbon monoxide's inherent chemical/physical properties. Some of the chemical and physical properties of carbon monoxide are as follows:

- Carbon monoxide has a molecular weight of 28.01 g/mol.
- Carbon monoxide is a colorless, odorless gas. It has almost the same density as air; therefore, it won't diffuse by rising.
- Carbon monoxide has a boiling point of -312.7°F.
- The upper explosive limit (UEL) for carbon monoxide is 74.2% and the lower explosive limit (LEL) is 12.5%.
- Carbon monoxide is a poison by inhalation and is an experimental teratogen.

- Carbon monoxide is an asphyxiant, it prevents hemoglobin from binding with oxygen
- Carbon monoxide is a dangerous fire and explosion hazard when exposed to flame.

Specific routes of exposure are:
- Inhalation

Symptoms a worker may exhibit when exposed to carbon monoxide includes, but is not limited to the following:
- Dizziness
- Fatigue
- Headache
- Nausea
- Flu like symptoms
- Confusion
- Auditory disturbances
- Contraction of the visual field
- Heart irregularities
- Edema

The target organs affected are:
- Respiratory system
- Central nervous system

Emergency First Aid procedures are:

Inhalation
- Immediately move exposed person to fresh air.
- If breathing has stopped, perform artificial respiration.
- Keep the affected person warm and at rest.
- Get medical attention immediately.

1.3 Physical Hazards

The General Safety and Health Plan addressed numerous physical hazards that might be encountered during various projects; however, site-specific conditions could not be addressed in the General Plan and must be addressed in this addendum. TMG anticipates that the following physical hazards will be encountered on this project.
- Heavy Equipment Hazards
- Utility Lines
- Slips, Trips, and Falls
- Lifting Techniques (manual)
- Inclement Weather (heat stress)
- Noise

- Harmful Plants, Animals, and Insects
- Cuts
- Composting Equipment Hazards
- Fire Hazards
- Biological Hazards
- Water Hazards

All of these hazards (except for composting equipment hazards, cuts, fire hazards, and biological hazards) were addressed in the Final SSHP (TMG Services, Inc. July 2010) issued under Contract No. W91237-10-C-0002 and will not be reiterated in this supplement. This supplement will address site-specific conditions for composting equipment hazards, cuts, fire hazards, and biological hazards.

1.3.1 Composting Equipment Hazards

Composting equipment typically contains powerful mixing flails, knives, or hammers that rotate at a high rate of speed which poses a significant physical hazard for personnel working with and around this equipment. The following safety precautions shall be adhered to for this project:

- Only qualified personnel will operate the composting equipment.
- Getting on or off of any equipment while it is in motion is prohibited.
- Machinery shall be operated in accordance with the manufacturer's recommendations.
- The use of headphones for entertainment purposes (such as radio or cassette) while operating equipment is prohibited.
- All machinery shall be inspected daily (when in use) by a competent and knowledgeable person to ensure safe operating conditions.
- Personnel shall not operate equipment in area where a potential to hit utilities is present.
- All composting equipment shall be equipped with working audible reverse signal alarms.
- Personnel shall wear Level C PPE (downgrade possible to Level D PPE) and hearing protection as described in Section 5.1 of the final SSHP (TMG Services, Inc. July 2010) when working near composting equipment.
- All moving or rotating equipment must be guarded to prevent accidental contact.
- Personnel shall only operate the composting equipment with the machine guard in place.
- Whenever a moving machinery part presents a hazard during servicing or maintenance, the engine shall be stopped, the power source disconnected, and all machine movement stopped before servicing or maintenance is performed.
- The mesh or nip points of all power driven gears, belts, chains, sheaves, pulleys, sprockets, and so forth shall be guarded.
- Functional components such as choppers, rotary beaters, mixing augers, feed rolls, conveying augers, and so forth which must be exposed for proper function shall be guarded to the fullest extent which will not substantially interfere with the normal functioning of the component.

- All guards must be free from burrs, sharp edges, and sharp corners. Guards must be securely fastened to the equipment.
- Stones or other foreign objects may forcibly eject from the composting equipment during turning activities.
- Hearing protection is required while operating the compost turner.

1.3.2 Fire Hazards

A possible fire hazard exists because of the stockpiled amendments (straw and so forth) may spontaneously ignite or would burn quickly if ignited from another source. Also, the mixed materials within the windrows may ignite if they overheat. Fires are rarely a problem in outdoor composting operations but they do sometimes occur. Organic material can ignite spontaneously at moisture contents between 25 and 35 percent. The following safety precautions shall be taken:

- Amendment stockpiles and the windrows containing the mixed soil and amendments will be watered daily, during dry conditions, to keep a high level of moisture present.
- The windrows and stockpiles will be kept at a height of 10 feet or less to inhibit the buildup of excess internal heat.
- In order to keep aerobic conditions within the windrow, the windrows are required to be turned daily. This daily turning will inhibit the buildup of internal heat; therefore, contributing to fire protection. The amendment stockpiles until used will be turned two to three times a week to inhibit the buildup of internal heat, which may cause spontaneous combustion.
- At a minimum, there will be two 10,000 gallon Frac tanks located near the treatment pad, in the event of a fire in the windrows, water from these tanks or from the sumps can be used. The water in the tanks may contain some nitroaromatics, but not in sufficient concentration to be a concern for fire application uses.

1.3.3 Biological Hazards

A potential exists for personnel to be exposed to biological hazards associated with the amendment materials (manure and straw). There is potential exposure to bacteria, molds, and parasites. Mold spores are produced by microorganisms, which grow when the moisture content is at least 30 percent and the temperature reaches 70 degrees Fahrenheit. Many forms of bacteria thrive at warm, moist conditions that will be found in the composting material. Therefore, potential exposure to various molds and bacteria is likely. When the amendment material is moved, billions of microscopic sized particles become airborne and attach themselves to dust particles. These dust particles with the attached microorganisms pass through the body’s natural filtering mechanisms and accumulate in the lungs where they can cause an allergic type of pneumonia. Repeated attacks can lead to scarring of lung tissue which impairs it function. Exposure to mold spores and bacteria may produce the following symptoms:

- Shortness of breath
- Tightness in the chest
- Fatigue

- A dry cough
- Muscle aches
- Headaches
- Chills

Perhaps the best management practice to help limit or prevent exposure to mold and bacteria is to prevent the moisture content of the material from rising to 30 % or more. However, due to the nature of the project, this is not feasible. It may be possible to initially cover the stockpiled amendments prior to mixing with the soil; however, they may eventually be mixed and exposed not only to rainwater but also to the addition of water necessary for the composting process. Since it is not feasible to keep the material below 30% in moisture content, McTech proposes to wet the amendments prior to mixing with the soil and to wet the windrows prior to mixing them on a daily basis. By wetting the materials, the dust levels should be kept to a minimum; therefore, limiting exposure. Exposure to parasites is expected to be low. Pig manure will not be used due to the number of parasites in that species that can be easily transmitted to humans. Chicken manure will be used. Even though parasites are likely to be present in chicken manure their transmission to humans is generally considered to be less than the transmission of parasites from other animals such as cats, dogs, and pigs.

Personnel will be equipped with air purifying respirators equipped with HEPA filters, which can be worn if dust generation becomes a problem. Good hygiene practices are necessary to prevent exposure by ingestion. All food and drink shall be consumed away from the work area after proper decontamination procedures have been followed. Also, personnel shall not smoke in the work area and shall not smoke until they have performed proper decontamination.

1.3.4 Water Hazard

Water hazards are not expected to be a major hazard; however, a potential exists that personnel removing water from the excavation pits prior to backfilling the pits may fall into water that has filled or partially filled the pits. Additionally, personnel may fall into the West Area Red Water Pond when they are disposing of pit water or possible obtaining water to put on the windrows. The following safety precautions shall be taken, wherever there is a potential for a drowning hazard.

- TMG will assign personnel (subcontractors and TMG personnel) who know how to swim to perform work along the edges of any pits or reservoirs where there is a potential for personnel to fall into the water.
- Personnel will be required to wear a personal flotation device when working over or near bodies of water greater than 3 feet deep or swiftly moving water.
- Work shall not be performed alone.
- Personnel working near water where a drowning hazard is present will be equipped with a minimum of one throwable personal floatation device (PFD) that is attached to a polypropylene, or equivalent rope.
- Wherever there is a potential for a drowning hazard, personnel shall wear Type III, Type V, or better US Coast Guard approved International Orange PFD.
- Before and after each use, the PFD shall be inspected for defects that would alter its strength or buoyancy.

- Defective devices or devices with less than 13 pounds of buoyancy shall be removed from service.
- All PFDs shall be equipped with retro-reflective tape.

APPENDIX B Respirator Fit-Test Certifications

TRAINING ACKNOWLEDGMENT

TYPE OF TRAINING: *New Hire* ☐ *Hazwhoper* ☒ *Refresher* ☒

Other Sub-Contractor Training and for Bacon Contractor

Total Hours Trained 8

I JAMES B. RUSSELL acknowledge that I have received instruction and understand the following subjects (initial all that apply):

C&K Safety Training Programs:

JBR Hazard Communication
JBR Lockout/Tagout
JBR Confined Space
JBR Fire Extinguisher/Emergency Action
JBR Respiratory Protection
N/A Forklift
JBR Confined Space Communication
N/A Asbestos Awareness

JBR Personal Protective Equipment
N/A Drug Free Workplace
JBR General Company Safety Policies*
N/A Vac Truck Safety & Operations
N/A Waterblast Safety & Operations
N/A Manlift
N/A Lead Abatement
N/A Inorganic Arsenic Awareness

Site Specific Trainings:

N/A Alcoa- Contractor/Stand-down
N/A Charter Steel
JBR X Other Fall Protection
X Other Monitoring Equipment

N/A Reliant Energy
____ Other _____
JBR X Other Fit-Testing
____ Other _____

* I have received a copy of C&K Abridged Safety Policy Manual.

James B. Russell 4-7-10
Employee Signature Date

John P. Gabriel 4-7-2010
Instructor Signature Date

TRAINING ACKNOWLEDGMENT

TYPE OF TRAINING: *New Hire* ☐ *Baseshopar* ☒ *Refresher* ☒

Other Sub-Contractor Training and for Basic Contractor

Total Hours Trained 8

I Delmar Hudson acknowledge that I have received instruction and understand the following subjects (initial all that apply):

C&K Safety Training Programs:

DH Hazard Communication
DH Lockout/Tagout
DH Confined Space
DH Fire Extinguisher/Emergency Action
DH Respiratory Protection
N/A Forklift
DH Confined Space Communication
N/A Asbestos Awareness

DH Personal Protective Equipment
N/A Drug Free Workplace
DH General Company Safety Policies*
N/A Vac Truck Safety & Operations
N/A Waterblast Safety & Operations
N/A Manlift
N/A Lead Abatement
N/A Inorganic Arsenic Awareness

Site Specific Trainings:

N/A Alcoa- Contractor/Stand-down
N/A Chester Steel
DH X Other Fall Protection
X Other Monitoring Equipment

N/A Reliant Energy
___ Other ___
DH X Other Fit-Testing
___ Other ___

* I have received a copy of C&K Abridged Safety Policy Manual.

Employee Signature 4-7-10 Date

Instructor Signature 4-7-2010 Date

TRAINING ACKNOWLEDGMENT

TYPE OF TRAINING: *New Hire* ☐ *Hazwhoper* ☒ *Refresher* ☒

Other Sub-Contractor Training and for Base Contractor

Total Hours Trained 8

I Joe Cassiano acknowledge that I have received instruction and understand the following subjects (initial all that apply):

C&K Safety Training Programs:

JPC Hazard Communication
JPC Lockout/Tagout
JPC Confined Space
JPC Fire Extinguisher/Emergency Action
JPC Respiratory Protection
N/A Forklift
JPC Confined Space Communication
N/A Asbestos Awareness

JPC Personal Protective Equipment
N/A Drug Free Workplace
JPC General Company Safety Policies*
N/A Vac Truck Safety & Operations
N/A Waterblast Safety & Operations
N/A Manlift
N/A Lead Abatement
N/A Inorganic Arsenic Awareness

Site Specific Trainings:

N/A Alcoa- Contractor/Stand-down
N/A Charter Steel
JPC X Other Fall Protection
X Other Monitoring Equipment

N/A Reliant Energy
____ Other _____
JPC X Other Eye Testing
____ Other _____

* I have received a copy of C&K Abridged Safety Policy Manual.

Employee Signature — Date 4-7-2010

Instructor Signature — Date 4-7-2010

Concentra Medical Centers (Ohio)
4660 Holiday Industrial Pkwy CLEVELAND, OH 44126
Phone: (216) 749-2720 Fax: (216) 749-2728

PLHCP[1] WRITTEN STATEMENT for RESPIRATORS (EMPLOYEE)

Service Date: 04/06/2010

Employee Name: Cashbaugh, Daniel P.

Employee SSN: XXX-XX-1919

Address: 1551 Price Rd.

YOUNGSTOWN OH 44509

Employer: TMG Services Inc

You were evaluated in this office of your medical status related to your physical capability to wear a respirator. (Check ✓ one that applies)

- ☐ There were no abnormal findings that would hamper your ability to perform your job duties while wearing a respirator.
- ☐ The abnormal findings listed below were not related to wearing a respirator but should be reported to your personal physician for further evaluation.

Based upon the results of this evaluation it is my opinion that you: (Check ✓ ALL that apply)

- ☑ ARE qualified to wear a respirator.
- ☑ Have the following restrictions concerning respirator usage: No SCBA
- ☐ ARE NOT qualified to wear a respirator.
- ☐ Require further testing by your private physician who must submit a written report of his/her findings to Concentra Medical Centers (Ohio) so that a final decision on your ability to wear a respirator can be made.
- ☐ Must wear Special prescription eye-wear needed to accommodate respirator.
- ☐ Must use an Eye glass conversion kit.
- ☐ May need to shave Facial hair to assure tight seal on certain face masks.
- ☐ Need to stop smoking.

(Check ✓ ALL that apply)

- ☑ The above individual HAS been examined for respirator fitness in accordance with 29 CFR 1910.134. This limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☐ The above individual HAS NOT been examined by me for respirator fitness. The employee's medical evaluation consisted of a review of OSHA's Medical Evaluation Questionnaire in Appendix C Part A Section 2. In accordance with 29 CFR 1910.134, this limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☑ In accordance with specific OSHA requirements, I have informed the above named individual of the results of this evaluation and of any medical conditions resulting from exposures that may require further explanation or treatment. Where applicable, the above named individual has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos, lead and/or other chemical exposure(s).

Respirators must be properly selected based on the contaminant and concentration levels to which the worker will be exposed. Failure to follow the site and fitting instructions and warnings for proper use contained on the respirator packaging and/or failure to wear the respirator during all times of exposure can reduce the respirator's effectiveness and result in sickness or death. Worker must be trained in the proper use of any respirator. Refer to product literature and packaging for specific information regarding fit, use and/or limitations.

PLHCP Signature

Employee's Signature

PLHCP Name (printed)

4/6/2011
Expiration Date

[1] Physician or other Licensed Healthcare Professional

To be maintained in the employee's file with a copy to the employee

Concentra Medical Centers (Ohio)
4850 Hinckley Industrial Pkwy CLEVELAND, OH 44109
Phone: (216) 749-2130 Fax: (216) 749-2730

PLHCP[1] WRITTEN STATEMENT for RESPIRATORS (EMPLOYEE)

Service Date: 04/06/2010

Employee Name: Russell, James B.

Employee SSN: XXX-XX-8578

Address:
2901 Hampton

SHAKER HEIGHTS OH 44120

Employer: TMG Services Inc

You were evaluated in this office of your medical status related to your physical capability to wear a respirator. (Check ✓ one that applies)

- ☐ There were no abnormal findings that would hamper your ability to perform your job duties while wearing a respirator.
- ☐ The abnormal findings listed below were not related to wearing a respirator but should be reported to your personal physician for further evaluation.

Based upon the results of this evaluation it is my opinion that you: (Check ✓ ALL that apply)

- ☑ ARE qualified to wear a respirator.
- ☐ Have the following restrictions concerning respirator usage:
- ☐ ARE NOT qualified to wear a respirator.
- ☐ Require further testing by your private physician who must submit a written report of his/her findings to Concentra Medical Centers (Ohio) so that a final decision on your ability to wear a respirator can be made.
- ☐ Must wear Special prescription eye-wear needed to accommodate respirator.
- ☐ Must use an Eye glass conversion kit.
- ☐ May need to shave Facial hair to assure tight seal on certain face masks.
- ☐ Need to stop smoking.

(Check ✓ ALL that apply)

- ☑ The above individual HAS been examined for respirator fitness in accordance with 29 CFR 1910.134. This limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☐ The above individual HAS NOT been examined by me for respirator fitness. The employer's medical evaluation consisted of a review of OSHA's Medical Evaluation Questionnaire in Appendix C Part A Section 2. In accordance with 29 CFR 1910.134, this limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☑ In accordance with specific OSHA requirements, I have informed the above named individual of the results of the evaluation and of any medical conditions resulting from exposures that may require further explanation or treatment. Where applicable, the above named individual has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos, lead and/or other chemical exposure(s).

Respirators must be properly selected based on the contaminant and concentration levels to which the worker will be exposed. Failure to follow the site and fitting instruction and warnings for proper use contained on the respirator packaging and/or failure to wear the respirator during all times of exposure can reduce the respirator's effectiveness and result in sickness or death. Wearer must be trained in the proper care of any respirator/refer to product literature and packaging for specific information regarding its use and/or limitations.

PLHCP Signature

Employee's Signature

PLHCP Name (printed)

4/6/2011
Expiration Date

[1]Physician or other Licensed Healthcare Professional

To be maintained in the employee's file with a copy to the employee

Concentra Medical Centers (Ohio)
[illegible] Hinckley Industrial Pkwy CLEVELAND, OH 44135
Phone: (216) 749-2750 Fax: (216) 749-2755

PLHCP[1] WRITTEN STATEMENT for RESPIRATORS (EMPLOYEE)

Service Date: 03/03/2010

Employee Name: Hartness, Delmar S.

Employee SSN: XXX-XX-6563

Address:
23581 Sprague rd
apt. 5
COLUMBIA STATION OH 44028

Employer: TMG Services Inc

You were evaluated in this office of your medical status related to your physical capability to wear a respirator. (Check ✓ one that applies)

- ☐ There were no abnormal findings that would hamper your ability to perform your job duties while wearing a respirator.
- ☐ The abnormal findings listed below were not related to wearing a respirator but should be reported to your personal physician for further evaluation.

Based upon the results of this evaluation it is my opinion that you: (Check ✓ ALL that apply)

- ☑ ARE qualified to wear a respirator.
- ☐ Have the following restrictions concerning respirator usage: _____
- ☐ ARE NOT qualified to wear a respirator.
- ☐ Require further testing by your private physician who must submit a written report of his/her findings to **Concentra Medical Centers (Ohio)** so that a final decision on your ability to wear a respirator can be made.
- ☐ Must wear Special prescription eye-wear needed to accommodate respirator.
- ☐ Must use an Eye glass conversion kit.
- ☐ May need to shave Facial hair to assure tight seal on certain face masks.
- ☑ Need to stop smoking.

(Check ✓ ALL that apply)

- ☑ The above individual HAS been examined for respirator fitness in accordance with 29 CFR 1910.134. This limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☐ The above individual HAS NOT been examined by me for respirator fitness. The employer's medical evaluator consisted of a review of OSHA's Medical Evaluation Questionnaire in Appendix C Part A Section 2. In accordance with 29 CFR 1910.134, this limited evaluation is specific to respirator use only. Employees should be instructed to report any difficulties in using respirators or change of any physical status to their supervisor or physician. This evaluation included the Respiratory Questionnaire outlined in 29 CFR 1910.134.
- ☑ In accordance with specific OSHA requirements, I have informed the above named individual of the results of this evaluation and of any medical conditions resulting from exposures that may require further explanation or treatment. Where applicable, the above named individual has been informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos, lead and/or other chemical exposure(s).

Respirators must be properly selected based on the contaminant and concentration levels to which the worker will be exposed. Failure to follow the use and fitting instruction and warnings for proper use contained on the respirator packaging and/or failure to wear the respirator during all times of exposure can reduce the respirator's effectiveness and result in sickness or death. Where must be trained in the proper care of any respirator. Refer to product literature and packaging for specific information regarding the use and/or limitations.

PLHCP Signature

PLHCP Name (printed)

Employee's Signature

3/23/2011
Expiration Date

[1]Physician or other Licensed Healthcare Professional

To be maintained in the employee's file with a copy to the employee

APPENDIX C Response to USACE Comments

TMG Response to USACE Comments
Composting Work Plan
W91237-10-C-0002

Comments provided by Shreda Gorum, USACE LRH

The above referenced plan has been reviewed for Safety considerations and compliance issues and the following comments are provided for your information and use:

Comment 1 - Page 4, paragraph 4.5 - The fifth sentence down addresses calibration of portable gas monitors indicating "calibrated at least weekly". A bump test or full calibration should be made before each day's use per International Safety Equipment Association guidance reference in OSHA's Safety and Health Information Bulletin 05-04-2004. I would also recommend air monitoring be either continuous or as a minimum periodically throughout the workday when personnel are present.

Response: Concur. The text has been revised to state the monitor will be calibrated daily. Also, the plan was revised based on the recommendation to monitor more frequently and in the work zones when personnel are present.

Comment 2 - Page 4, paragraph 4.7 Recommend including appropriate signage warning that this is a hazardous area.

Response: Concur. The paragraph was revised to state that warning signs will be posted on the fence and the perimeter area.

Comment 3 - Page 6, paragraph 5.1 The second paragraph down on page 6 discusses sampling, the last sentence says "Level C PPE may be required while collecting and handling samples." Recommend requiring air monitoring be conducted while collecting grab samples.

Response: Concur. The plan was revised to require air monitoring during each of the sampling events.

TMG Response to USACE Comments
Composting Work Plan
W91237-10-C-0002

Comments provided by Shreda Gorum, USACE LRH

Comment 4 - Page 1, Activity Hazard Analysis: Personnel may be injured by heavy equipment... Recommend adding ANSI Class II reflective vests as an additional "Recommended Control".

Response: Concur. The AHA was revised to require personnel to wear safety-colored shirts or reflective vests (ANSI Class II).

Appendix D Field Activity Forms

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

2417 Bond Street, University Park, IL 60466
Phone: 708.534.5200 Fax: 708.534.5211

(optional)
Report To
Contact: _____
Company: _____
Address: _____
Address: _____
Phone: _____
Fax: _____
E-Mail: _____

(optional)
Bill To
Contact: _____
Company: _____
Address: _____
Address: _____
Phone: _____
Fax: _____
PO#/Reference# _____

Chain of Custody Record

Lab Job #: _____

Chain of Custody Number: _____

Page _____ of _____

Temperature °C of Cooler: _____

Client	Client Project #	Preservative
Project Name		Parameter
Project Location/State	Lab Project #	
Sampler	Lab PM	

Preservative Key
1. HCL, Cool to 4°
2. H2SO4, Cool to 4°
3. HNO3, Cool to 4°
4. NaOH, Cool to 4°
5. NaOH/Zn, Cool to 4°
6. Cool to 4°
7. None
8. Other

Lab ID	MS/MSD	Sample ID	Sampling Date	Sampling Time	# of Containers	Matrix											Comments

Turnaround Time Required (Business Days)

___ 1 Day ___ 2 Days ___ 5 Days ___ 10 days ___ 15 Days _____ Other

Sample Disposal

☐ Return to Client ☐ Disposal by Lab ☐ Archive for _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Relinquished By	Company	Date	Time	Received By	Company	Date	Time

Lab Courier ☐
Shipped ☐
Hand Delivered ☐

Matrix Key

WW – Wastewater	SE – Sediment
W – Water	SO – Soil
S – Soil	L – Leachate
SL – Sludge	WI – Wipe
MS – Miscellaneous	DW – Drinking Water
OL – Oil	O – Other
A – Air	

Client Comments

Lab Comments:

CONTRACTOR'S QUALITY CONTROL REPORT (QCR) (ER 1180-1-6)

DATE:_____ REPORT NO._____

CONTRACT NUMBER AND NAME OF CONTRACTOR_____

_____

DESCRIPTION AND LOCATION OF THE WORK:_____

WEATHER CLASSIFICATION:_____
CLASS A No interruptions of any kind from weather conditions occurring on this or previous shifts.
CLASS B Weather occurred during this shift that caused a complete stoppage of all work.
CLASS C Weather occurred during this shift that caused a partial stoppage of work.
CLASS D Weather overhead excellent or suitable during shift. Work completely stopped due to results of previous adverse weather.
CLASS E Weather overhead excellent or suitable during shift but work partially stopped due to previous adverse manner.
OTHER Explain. CLASSIFICATION:

CLASS _____
TEMPERATURE:

MAX ___ MIN ___
PRECIPITATION:

INCHES _____

CONTRACTOR/SUBCONTRACTORS AND AREA OF RESPONSIBILITY FOR WORK PERFORMED TODAY: (Attach list of items of equipment either idle or working as appropriate.)
a._____
_____
b._____
_____
c._____
_____
d._____
_____
e._____
_____
f._____
_____
g._____
_____

1. WORK PERFORMED TODAY: (Indicate location and description of work performed. Refer to work performed by prime and /or subcontractors by letter in Table above.)

2. TYPE AND RESULTS OF INSPECTION: (Indicate whether: P-Preparatory, I-Initial, or F-Follow-up and include satisfactory work completed or deficiencies with action to be taken.)

3. TESTS REQUIRED BY PLANS AND/OR SPECIFICATIONS PERFORMED AND RESULTS OF TESTS:

4. VERBAL INSTRUCTIONS RECEIVED: (List any instructions given by Government personnel on construction deficiencies, retesting required, etc., with action to be taken.)

5. REMARKS: (Cover any conflicts in plans, specifications or instructions: acceptability of incoming materials; offsite surveillance activities; progress of work, delays, causes and extent thereof; days of no work with reasons for same.)

6. SAFETY: (Include any infractions of approved safety plan, safety manual or instructions from Government personnel. Specify corrective actions taken.)

_____

INSPECTOR

CONTRACTOR'S CERTIFICATION: I certify that the above report is complete and correct and that all material and equipment used, work performed and tests conducted during this reporting period were in strict compliance with the contract plans and specifications except as noted above.

_____

CONTRACTOR'S APPROVED AUTHORIZED REPRESENTATIVE

Appendix E Laboratory QA Plan

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board/ACLASS
500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

Test America-North Canton
4101 Shuffle Street NW
North Canton, OH 44720

has been assessed by ACLASS
and meets the requirements of

DoD-ELAP

while demonstrating technical competence in the field(s) of

TESTING

Refer to the accompanying Scope(s) of Accreditation for information regarding the types of tests to which this accreditation applies.

ADE-1437
Certificate Number

ACLASS Approval
Certificate Valid: 03/03/2010-03/03/2012
Version No. 001

Cover Page:

Quality Assurance Manual

TestAmerica North Canton
4101 Shuffle Street NW
North Canton, OH 44720
Phone: 330-497-9396
Fax: 330-497-0772

www.testamericainc.com

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Title Page:

Quality Assurance Manual
Approval Signatures

Laboratory Director – Opal Davis-Johnson	12/10/07 Date
Quality Manager – Dorothy Leeson	12/10/07 Date
Technical Director – Dr. Mark Bruce	12/10/07 Date

SECTION 2

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SOPs AND POLICIES REFERRED TO IN THE QA MANUAL

SOP/Policy Reference	Title
CA-C-S-001	Work Sharing Process
CA-L-S-001	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-P-001	Ethics Policy
CA-L-P-002	Contract Compliance Policy
CA-L-S-002	Subcontracting Procedures
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-003	Management of Change Procedure
CA-Q-S-004	Method Compliance & Data Authenticity Audits
CA-Q-S-005	Calibration Curves (General)
CA-T-P-001	Qualified Products List
CORP-MS-0001NC	GC/MS Analysis Based on Method 8270C,
CORP-MS-0002NC	Determination of Volatile Organics by GC/MS based on Method 8260B & 8260A).
CORP-QA-0010	Nonconformance and Corrective Action System
CORP-QA-0013	Employee Orientation and Training
CW-F-P-002	Authorization Matrix
CW-F-S-004	Controlled Purchases Policy
CW-L-P-001	Record Retention
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
NC-QA-0012	Shipping Department
NC-QA-015	Equipment Monitoring and Thermometer Calibration
NC-QA-0017	Standards and Reagents
NC-QA-0018	Statistical Evaluation of Data and Development of Control Charts
NC-QA-0019	Records Information Management
NC-QA-0020	Laboratory Holding Blanks
NC-QA-0021	Evaluation of Method Detection Limits for Chemical Tests

NC-QA-0027	Preparation and Management of Standard Operating Procedures
NC-SC-0005	Sample Receiving and Sample Control
NC-SC-0006	Sample Procurement Protocol
QA-003	TestAmerica North Canton Quality Control Program
S-C-002	Complaint Handling and Service Recovery
S-Q-001	Document Control
S-Q-004	Acceptable Manual Integration Practices

SECTION 3

INTRODUCTION
(NELAC 5.1 - 5.3)

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

The TestAmerica North Canton Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica data quality goals. Each TestAmerica laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with the 2003 National Environmental Laboratory Accreditation Conference (NELAC) standards and ISO/IEC Guide 17025 (1999). In addition, the policies and procedures outlined in this manual are compliant with the various accreditation and certification programs listed in Appendix 7. The relevant NELAC section is included in the heading of each QAM section.

The QAM has been prepared to be consistent with the requirements of the following documents:

- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- EPA SW-846, *Test Methods for the Evaluation of Solid Waste, 3rd Edition,* September 1986; Update I, July 1992; Update II, September 1994; and Update III, December 1996.
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- U.S. Department of Defense, *Quality Systems Manual for Environmental Laboratories*, Final Version 3, January 2006.
- Toxic Substances Control Act (TSCA).

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by TestAmerica North Canton conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 6 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

TestAmerica analyzes thousands of environmental and industrial samples every month. Sample matrices vary among effluent water, groundwater, hazardous waste, sludge, wipes, and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical process, reviewing results, servicing clients and

tracking samples through the laboratory. The technical and service requirements of all requests to provide analyses are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested water, industrial waste, and soil methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in Appendix 4. The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet requirements. All methods performed by TestAmerica North Canton shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director, the Quality Assurance (QA) Manager, and the Technical Director. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

- Specific requirements delineated in project plans may supersede general quality requirements described in this manual. Ohio VAP requirements are listed throughout the document.

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

The manual is reviewed annually by the QA Manager and laboratory personnel to assure that it reflects current practices and meets the requirements of TestAmerica North Canton clients and regulators. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. The updates will be reviewed by the QA Manager, Laboratory Director/Manager, Technical Director(s), relevant operational staff and Corporate Quality Assurance (if a change is made to the Corporate template) and then formally incorporated into the document in periodic updates. The QAM is based on a Corporate QAM Template that is prepared and approved by the Chief Operating Officers (COOs) and Corporate Quality Assurance. This template is reviewed annually by the COOs, Corporate Quality, and each laboratory. Necessary changes are coordinated by the Vice President of Quality and Environmental Health & Safety (EHS) and distributed to each laboratory for inclusion in the laboratory specific QA Manuals.

Policies in the QAM that require immediate attention may be addressed through the use of Corporate QA/QC Policy Memoranda. QA/QC Policy Memoranda are published from time to time to facilitate immediate changes to QA/QC Policy. QA/QC Policy Memoranda supersede the QAM and all other SOPs (refer to Section 5.3). All policy memoranda are dated, archived and distributed by their placement into the front of the QAM between the signature page and Section 2. At a minimum, each policy memorandum is approved by the same authorized signatories as shown on the cover page of the QA Manual. In addition, Corporate QA/QC Policy

Memoranda are signed by the COOs and VP of Quality and EHS. The QA/QC Policy Memoranda are incorporated into the QAM during the periodic updates. Policy memorandum may also include an expiration date if appropriate. An example format can be found in Figure 3-1. A similar procedure is followed for local laboratory changes.

3.4.2 Control

This manual is considered confidential within TestAmerica and may not be altered in any manner by other than a duly appointed representative from TestAmerica. If the document has been provided to external users or regulators, it is for the exclusive purpose of reviewing TestAmerica North Canton quality systems and shall not be used in any other way without the written permission of an appointed representative of TestAmerica. The procedure for control of distribution is incorporated by reference to SOP S-Q-001, Document Control.

The order of precedence in the event of a conflict between policies is outlined in Section 5.3 of this Quality Assurance Manual.

Figure 3-1.

Example - Format for a QA/QC Policy Memorandum

TestAmerica North Canton **SOP/LQM CHANGE FORM**	
SOP/LQM NUMBER:	
TITLE:	
SECTION(S) AFFECTED BY CHANGE:	
REASON FOR ADDITION OR CHANGE:	
CHANGE EFFECTIVE FROM: (DATE):	
CHANGE OR ADDITION:	
SUBMITTED BY/DATE:	
*APPROVED BY:	
Technical Reviewer Signature	Date
Environmental Health & Safety Signature	Date
QA Signature	Date
Technical Director (if applicable)	Date
Laboratory Director Signature	Date

SECTION 4

ORGANIZATION AND MANAGEMENT
(NELAC 5.4.1)

4.1 OVERVIEW

TestAmerica North Canton is part of a national network of laboratories known as TestAmerica. This Quality Assurance Manual (QAM) is applicable to the TestAmerica North Canton laboratory only.

TestAmerica North Canton Laboratory
4101 Shuffle Drive NW
North Canton, OH 44720
EPA I.D. Code No. 9503

The Corporate organization chart can be found in Figure 4-1 and the laboratory organization chart can be found in Appendix 2. The locations of other TestAmerica labs are as follows:

Aerotech Environmental Laboratories (AEL)
TestAmerica Anchorage
TestAmerica Austin
TestAmerica Buffalo
TestAmerica Buffalo Grove
TestAmerica Burlington
TestAmerica Cedar Falls
TestAmerica Chicago
TestAmerica Colorado Springs
TestAmerica Connecticut
TestAmerica Corpus Christi
TestAmerica Dayton
TestAmerica Denver
TestAmerica Edison
TestAmerica Honolulu
TestAmerica Houston
TestAmerica Irvine
TestAmerica King of Prussia
TestAmerica Knoxville
TestAmerica Los Angeles
TestAmerica Mobile
TestAmerica Morgan Hill
TestAmerica Nashville
TestAmerica New Orleans
TestAmerica Ontario
TestAmerica Orlando
TestAmerica Pensacola
TestAmerica Phoenix
TestAmerica Pittsburgh

TestAmerica Portland
TestAmerica Richland
TestAmerica San Francisco
TestAmerica Savannah
TestAmerica Seattle
TestAmerica Spokane
TestAmerica St. Louis
TestAmerica Tacoma
TestAmerica Tallahassee
TestAmerica Tampa
TestAmerica Valparaiso
TestAmerica Watertown
TestAmerica West Sacramento
TestAmerica Westfield

4.2 ROLES AND RESPONSIBILITIES

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions define each role in its relationship to the Quality Assurance Program. More extensive job descriptions are maintained by laboratory management.

4.2.1 Quality Assurance Program

The responsibility for quality lies with every employee of TestAmerica North Canton. All employees have access to the QAM and are responsible for knowing the content of this manual and upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs.

4.2.2 Chairman/Chief Executive Officer (CEO)

The Chairman/CEO is the Chairman of the Board of Directors and is ultimately responsible for the quality and performance of all TestAmerica facilities. Together with the President/CEO of the Analytical Division, the Chairman/CEO establishes the overall quality standard and data integrity program for the company, providing the necessary leadership and resources to assure that the standard and integrity program are met.

4.2.3 President/Chief Executive Officer (CEO)

The President/CEO is a member of the Board of Directors and is ultimately responsible for the quality and performance of all TestAmerica facilities. Together with the Chairman/CEO, the President/CEO establishes the overall quality standard and data integrity program for the Analytical Division, providing the necessary leadership and resources to assure that the standard and integrity program are met.

4.2.4 Chief Operating Officer (COO) – East and West

The COOs serve as the ranking executives for all respective analytical laboratory operational functions and report to the President/CEO of the Analytical Division. They are responsible for the daily management of all analytical laboratories, long-term planning and development of technical policies and management plans. They ensure the attainment of corporate objectives through the selection, development, motivation, and evaluation of top management personnel. The COOs approve all operating budgets and capital expenditures. The COOs sign-off on the final QAM template that contains company policies for implementing the Quality Program.

4.2.5 General Manager (GM)

Each GM reports directly to a COO. Each GM has full responsibility for the overall administrative and operational management of their respective laboratories. The GM's responsibilities include allocation of personnel and resources, long-term planning, setting goals, and achieving the financial, business, and quality objectives of TestAmerica. The GM ensures timely compliance with corporate management directives, policies, and management systems reviews. The GM is also responsible for restricting any laboratory from performing analyses that cannot be consistently and successfully performed to meet the standards set forth in this manual.

4.2.6 Vice President of Quality and Environmental Health and Safety (VP-QA/EHS)

The Vice President of QA/EHS reports directly to the Chairman/CEO. With the aid of the Analytical Division and Non-Analytical Division Senior Management Teams, Laboratory Director/ Managers, Quality Directors, EHS Directors, QA Managers and EHS Coordinators, the VP-QA/EHS has the responsibility for the establishment, general overview and Corporate maintenance of the Quality Assurance and Environmental, Health and Safety Program within TestAmerica. Additional responsibilities include:

- Review of QA/QC aspects of Corporate SOPs, national projects and expansions or changes in services.
- Coordination/preparation of the Corporate QAM Template that is used by each laboratory to prepare its own laboratory-specific QAM.
- Maintenance of Corporate Policies, Quality Memorandums and SOPs. Maintenance of data investigation records that are reported to Corporate Management.
- Work with various organizations outside of TestAmerica to further the development of quality standards and represent TestAmerica at various trade meetings.
- Preparation of a monthly report that includes quality metrics across the Analytical Division and a summary of any quality related initiatives and issues.
- With the assistance of the Corporate Senior Management Teams and the EHS Directors, development and implementation of the TestAmerica Environmental, Health and Safety Program.

4.2.7 Quality Directors (Corporate)

The Quality Directors report to the VP-QA/EHS. Together with the VP-QA/EHS, the Quality Directors have the responsibility for the establishment, general overview and maintenance of

the Analytical Division's Quality Assurance Program within TestAmerica. The Quality Directors are responsible for:

- Oversight of the QA/QC programs within each laboratory. This includes a final review of each laboratory-specific QAM and receipt of each laboratory's QA monthly report.
- Review of QA/QC aspects of national projects.
- Assistance with certification activities.

4.2.8 Ethics and Compliance Officers (ECOs)

TestAmerica has designated two senior members of the Corporate staff to fulfill the role of Ethics and Compliance Officer (ECO) – VP-QA/EHS and VP-Client and Technical Services. Each ECO acts as a back-up to the other ECO and both are involved when data investigations occur. Each ECO has a direct line of communication to the entire senior Corporate and lab management staff.

The ECOs ensure that the organization distributes the data integrity and ethical practices policies to all employees and ensures annual trainings and orientation of new hires to the ethics program and its policies. The ECO is responsible for establishing a mechanism to foster employee reporting of incidents of illegal, unethical, or improper practices in a safe and confidential environment.

The ECOs monitor and audit procedures to determine compliance with policies and to make recommendations for policy enhancements to the CEOs, COOs, Laboratory Director/Manager or other appropriate individuals within the laboratory. The ECO will assist the laboratory QA Manager in the coordination of internal auditing of ethical policy related activities and processes within the laboratory, in conjunction with the laboratories regular internal auditing function.

The ECOs will also participate in investigations of alleged violations of policies and work with the appropriate internal departments to investigate misconduct, remedy the situation, and prevent recurrence of any such activity.

4.2.9 Vice President of Client and Technical Services

The Vice President (VP) of Client and Technical Services is responsible for offerings to clients including risk management, technical assistance, legal compliance and contract administration. The VP of Client and Technical Services provides support and direction to the Managers of these areas, and supports the COOs in decisions regarding long term planning, resource allocation and capital expenditures.

4.2.10 Director of Technical Services

The Director of Technical Services is responsible for establishing, implementing and communicating TestAmerica's Analytical Division's Technical Policies, SOPs, and Manuals. Other responsibilities include conducting technical assessments as required, acting as a technical resource in national contracts review, coordinating new technologies, establishing best practices, advising staff on technology advances, innovations, and applications.

4.2.11 Chief Information Officer (CIO)

The CIO is responsible for establishing, implementing and communicating TestAmerica Information Technology (IT) Policies, SOPs, and Manuals. Other responsibilities include coordinating new technologies; development of electronic communication tools such as TestAmerica intranet and internet sites; ensuring data security and documentation of software; ensuring compliance with the NELAC standard; and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various TestAmerica facilities.

4.2.12 Environmental Health and Safety Directors (EHSDs) (Corporate)

The EHSDs report directly to the VP-QA/EHS. The EHSDs are responsible for the development and implementation of the TestAmerica Environmental, Health and Safety program. Responsibilities include:

- Consolidation and tracking all safety and health-related information and reports for the company, and managing compliance activities for TestAmerica locations.
- Coordination/preparation of the corporate Environmental, Health and Safety Manual Template that is used by each laboratory to prepare its own laboratory-specific Safety Manual/ CHP.
- Preparation of information and training materials for laboratory EHS Coordinators.
- Assistance in the internal and external coordination of employee exposure and medical monitoring programs to insure compliance with applicable safety and health regulations.
- Serving as Department of Transportation (D.O.T.) focal point and providing technical assistance to location management.
- Serving as Hazardous Waste Management main contact and providing technical assistance to location management.

4.2.13 Laboratory Director

- Reports directly to the Regional General Manager
- Responsible for implementation and adherence by lab staff to the TestAmerica North Canton QAM and all policies and procedures within the laboratory
- Has signature authority for QAM, policies, SOPs, and contracts (as detailed in TestAmerica policy)
- Assesses the effectiveness of the QAM within the operation
- Maintains adequate trained staff documented on organization charts
- Responsible for implementing internal/external audit findings corrective actions

4.2.14 Quality Assurance Manager

- Reports directly to the Laboratory Director and, for all QA matters, to the Corporate QA Director to maintain independence of QA oversight
- Responsible for the implementing and communicating the QAM
- Maintains, approves, and implements the QAM

- Has joint signature authority, with the Laboratory Director and Technical Director for approval of quality documents, e.g., QAM, policies, and SOPs
- Directs controlled distribution of laboratory quality documents
- Provides Quality System training to all new personnel
- Reviews and approves documentation of analyst training records
- Serves as a focal point for QA and QC issues, reviews corrective actions and recommends resolution for recurring nonconformances within the laboratory
- Assists in maintaining regulatory analytical compliance, including maintaining certifications, and in this regard has signature authority for laboratory quality documents
- Monitors data quality measures via statistical methods to verify that the laboratory routinely meets stated quality goals
- Performs systems, data, contract compliance, and surveillance audits.
- Hosts external audits conducted by outside agencies
- Responsible for approving quality control reference data changes in the LIMS
- Oversees the selection, review, and approval of analytical subcontractors
- Prepares monthly QA Reports to management describing significant quality events
- Has the final authority to accept or reject data and to stop work in progress in the event that procedures or practices compromise the validity and integrity of analytical data
- Responsible for implementing internal/external audit findings corrective actions

4.2.15 Operations Manager/Laboratory Supervisor

- Reports directly to the Laboratory Director
- Supervises daily activities of the Operational Groups
- Schedules analytical operations
- Supervises QC activities performed as a part of routine analytical operations
- Implements data review procedures
- Supervises the preparation and maintenance of laboratory records
- Supervises maintenance of instruments and scheduling of repairs
- Works with the Project Managers and Group Leaders to assure the requirements of projects are met in a timely manner
- Supervises daily activities of the Sample Control Group.

4.2.16 Laboratory Technical Director

- Reports directly to Laboratory Director
- Responsible for the technical operation of the laboratory
- Has joint signature authority for QAM, policies, SOPs, and training records
- Performs technical training in area(s) of expertise
- Interfaces with management on technical needs and solving day-to-day technical issues
- Investigates technical issues related to projects as directed by QA
- Evaluates new methods, technical proposals, and statements of work
- Certifies technical laboratory personnel based on education and background to ensure that staff have demonstrated capability in the activities for which they are responsible by reviewing and signing analyst demonstrations.
- Performs other tasks as required by NELAC.

The Technical Director meets the requirements specified in Section 4.1.1.1 of NELAC standards.

4.2.17 Project Management Group Leader

- Reports directly to the Manager of Client Services
- Supervises daily activities of the Project Management and Administrative Groups
- Works with the Operations Manager and/or Group/Team Leaders to ensure the requirements of projects are met in a timely manner

4.2.18 Manager of Client Services

- Reports directly to Laboratory Director
- Supervises Field Analytical Services Group
- Supervises Service Centers
- Supervises daily activities of the customer
- Supervises Service Managers

4.2.19 Customer Service Managers (CSMs)

- Reports directly to the Manager of Client Services
- Defines customer requirements through project definition
- Assesses and assures customer satisfaction
- Provides feedback to management on changing customer needs
- Brings together resources necessary to ensure customer satisfaction.

4.2.20 Project Manager

- Reports directly to the Project Manager Group Leader
- Monitors analytical and QA project requirements for a specified project
- Acts as a liaison between the client and the laboratory staff
- Communicates project-specific requirements to all parties involved
- Assists the laboratory staff with interpretation of work plans, contracts, and QAPP requirements
- Oversees project data packages for completeness and compliance to client needs
- Has signature authority for final reports
- Keeps the laboratory and client informed of project status
- Together with the QA Manager, approves customer requested variances to methods and to standard laboratory protocols
- Monitors, reviews, and evaluates the progress and performance of projects
- Reports client inquiries involving data quality issues or data acceptability to the facility QA Manager and to the operations staff
- Conducts project reviews to assess the laboratory's performance in meeting customer requirements
- Prepares reissue requests for project data
- Responsible for meeting quality requirements.

4.2.21 Group Leader

- Reports directly to the Operations Manager
- Supervises daily activities of analyses within the group
- Supervises QC activities performed as a part of routine analytical operations
- Implements data review procedures
- Supervises the preparation and maintenance of laboratory records
- Evaluates instrument performance and supervises the calibration, preventive maintenance, and scheduling of repairs
- Oversees or performs review and approval of all analytical data
- Reports nonconformances to the appropriate managers
- Responsible for generation of SOPs for their section
- Responsible for meeting quality requirements.

4.2.22 Analyst

- Performs analytical methods and data recording in accordance with documented procedures
- Performs and documents calibration and preventive maintenance
- Performs data processing and data review procedures
- Reports nonconformances to the Supervisor/Manager and QA Manager
- Ensures sample and data integrity by adhering to internal chain-of-custody procedures
- Responsible for meeting quality requirements defined in this LQM and other supporting QA procedures.

4.2.23 Sample Custodian

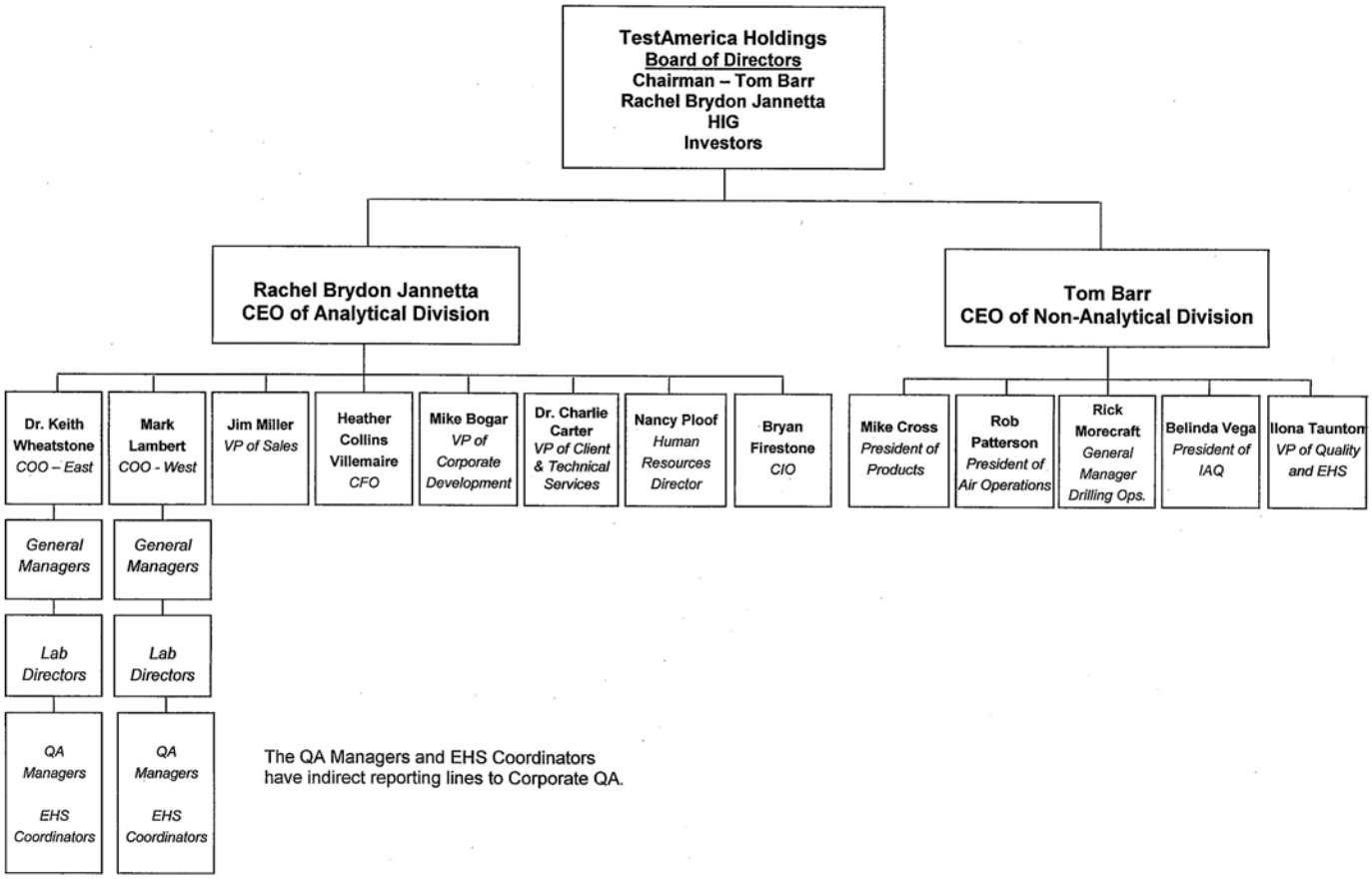
- Ensures implementation of proper sample receipt procedures, including maintenance of chain-of-custody
- Reports nonconformances associated with condition-upon-receipt of samples
- Logs samples into the LIMS
- Ensures that all samples are stored in the proper environment
- Assists Environmental Health and Safety staff with sample disposal
- Responsible for meeting quality requirements.

4.2.24 Report Production Staff

- Accurately generates and compiles analytical reports and associated deliverables for delivery to the client
- Responsible for meeting quality requirements
- Produce as needed reports that meet the NELAC requirements.

Figure 4-1.

Corporate Organization Chart



SECTION 5

QUALITY SYSTEM
(NELAC 5.4.2)

5.1 QUALITY POLICY STATEMENT

The management of TestAmerica and TestAmerica North Canton are committed to providing data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols described in this manual.

In all aspects of the laboratory and business operations, management is dedicated in maintaining the highest ethical standards. An Ethics Policy sign-off can be viewed in Appendix 1. Training on ethical and legal responsibilities is provided annually and each employee signs off annually on the policy as a condition of employment.

It is TestAmerica's Policy to continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. The company recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.

TestAmerica North Canton strives to provide clients with the highest level of professionalism and the best service practices in the industry.

Every staff member at TestAmerica North Canton plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 ETHICS AND DATA INTEGRITY

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The seven elements of the TestAmerica Ethics and Data Integrity Program include:

- An Ethics Policy (Policy CA-L-P-001) and Employee Ethics Statements (Appendix 1)
- An Ethics and Compliance Officer (ECO)
- A training program
- Self-governance through disciplinary action for violations
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct (SOP CA-L-S-001)
- Procedures and guidance for recalling data if necessary (SOP CA-L-S-001)
- An effective external and internal monitoring system that includes procedures for internal audits (Section 16)

As an American Council of Independent Laboratories (ACIL) member, all TestAmerica laboratories adhere to the following ACIL Code of Ethics:

- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the ethical and quality standards of our industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 QUALITY SYSTEM SUPPORTING DOCUMENTATION

The Laboratory Quality System is communicated through a variety of documents prepared by the laboratory and company management:

- Quality Assurance Manual (QAM) Template
- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system, e.g., checklists, preformatted bench sheets, forms.
- Laboratory SOPs – General and Technical
- Corporate TestAmerica QA/QC Policy Memorandums (refer to Section 3.4).
- Laboratory QA/QC Policy Memorandums (refer to Section 3.4).

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- TestAmerica QA/QC Policy Memorandum - Corporate
- Laboratory QA/QC Policy Memorandum
- Quality Assurance Manual
- Corporate SOPs and Policies

- Laboratory SOPs and Policies
- Other: Work Instructions (WI), memos, flow charts, etc.

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples. The calculation of precision is described in Section 25.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery. The calculation of accuracy is described in Section 25.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories, and by the degree to which approval from the US EPA or other pertinent regulatory agencies is obtained for any procedure for which significant modifications have been made.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project) expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), inter-element corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc.

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory prepares a Control Limit Report that summarizes the precision and accuracy acceptability limits for analyses performed at TestAmerica North Canton. This summary includes an effective date, is updated each time new limits are generated, and is located in QC Browser. The charts are stored as hard copies. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, TestAmerica North Canton has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in Section 25.

5.6 STATISTICAL QUALITY CONTROL

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs [such as the Ohio Voluntary Action Plan (VAP)]. TestAmerica North Canton routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts are instructed to use the current limits in the laboratory (dated and approved by the Group Leader and QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance Department maintains an archive of all limits used within the laboratory. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 25. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Surrogate recoveries are determined for a specific time period as defined above. The resulting ranges are entered in LIMS.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

In-house limits for all QC data must be evaluated and compared to the limits published in the methods for applicable matrices. Method limits will be employed until sufficient QC data are acquired. A minimum of 20 to 30 data points are recommended to establish the in-house QC limits. Calculated results of the QC (LCS) samples are evaluated by comparing against control limits (3-sigma).

Control charts are used to develop control limits, trouble-shoot analytical problems, and, in conjunction with the non-conformance system, to monitor for trends. Program-specific data analysis requirements for control charts are followed as required for data generated under those programs. These additional requirements shall be documented in a QAPP or QAS.

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 17). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6

DOCUMENT CONTROL
(NELAC 5.4.3)

6.1 OVERVIEW

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled at each laboratory Facility:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

The Corporate staff posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These are collectively termed "Official Documents" and encompass the Policies and Procedures that all facilities are required to employ. These official documents are only considered controlled when they are read on the company intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving official documents is found in Corporate SOP CW-Q-S-001, Corporate Document Control and Archiving.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports. Discussion on records control is described in Section 15.

The maintenance of purchasing data is discussed in Section 9.

The maintenance of sales and marketing contracts is discussed in Section 7.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a control system for each document include a unique name and number, the number of pages of the item, the effective date, revision number, and the laboratory

name. The QA Department is responsible for the maintenance of the system, and maintains the items electronically on the Laboratory public drive or the QA Department files.

Controlled documents are authorized by the QA Department and other management. In order to develop a new document, a staff member submits an electronic draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document, and retains the official document on file. The official document is provided as needed to those using it. Controlled documents shall be available at all locations where the operational activity described in the document is performed (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every 24 months, and revised as appropriate. For procedures associated with DoD project work, SOPs and Policies are reviewed every 12 months. Changes to documents occur when a procedural change warrants a revision of the document.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

For changes to the QA Manual, refer to SOPs NC-QA-002 and CW-Q-S-001. Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA/QC Department. Electronic copies are stored on the Public server in the QA folder for the applicable revision.

For changes to SOPs, refer to SOP CW-Q-S-002, Writing a Standard Operating Procedure (SOP), and SOP NC-QA-027, Preparation and Management of Standard Operating Procedures.

Forms, worksheets, work instructions, and information are organized by department in the QA office. Electronic versions are kept on a hard drive in the QA department; hard copies are kept in QA files. The procedure for the care of these documents is in SOP NC-QA-027.

6.4 OBSOLETE DOCUMENTS

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived as described in Section 15.

SECTION 7

REVIEW OF WORK REQUEST

7.1 OVERVIEW

TestAmerica North Canton has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is TestAmerica's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and TestAmerica's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (Percent Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these regulatory and client requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the lab's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval (refer to Section 8 for Subcontracting Procedures).

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and TestAmerica's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the

contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The review process is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the opportunity is forwarded to a Customer Service Manager (CSM) for review. The CSM contacts the appropriate Sales Executive (National Account Manager, Key Account Executive, Regional Account Executive, and/or Program Manager) to determine which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, reporting specifications, and available capacity to perform the work. The contract review process is outlined in SOP CA-L-P-002**,** Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Legal & Contracts Director
- Laboratory Customer Service Manager
- Laboratory Operations Manager
- Laboratory and/or Corporate Technical Director
- Laboratory and/or Corporate Information Technology Managers/Directors
- Regional and/or National Account representatives
- Laboratory and/or Corporate Quality Managers
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote, and makes final acceptance for their facility.
- Based on the level of discount extended for the project, approval of the General Manager or Sales Director may also be required.

The Customer Service Manager or local Account Executive then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her backup will fulfill the review requirements.

The Legal & Contracts Director (or their designee) maintains copies of all signed contracts. The Laboratory Director also maintains an electronic copy of any contract signed at the local level.

7.3 DOCUMENTATION

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes.

The contract will be distributed to and maintained by the Corporate Contracts Department and the applicable Account Executive. A copy of the contract will be filed electronically by the Laboratory Director. Quotes will be archived electronically in the laboratory quote module (TALs) or in the public shared drive if an off-TALs quote is submitted.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps email records or a phone log of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, TestAmerica assigns a PM to each client. The PM is the first point of contact for the client. It is the PM's responsibility to ensure that project specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the direct client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes, e.g., use of a non-standard method or modification of a method, and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory. Project-specific changes made after samples are in-house are communicated through Change Order forms.

Programmatic and/or method changes are communicated via email transmittal and/or in meetings with the applicable Operations Managers. If the modification includes use of a non-standard method, or significant modification of a method, documentation of the modification is made in the case narrative of the applicable data report(s).

TestAmerica strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

SECTION 8

SUBCONTRACTING OF TESTS
(NELAC 5.4.5)

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the corporate network. The phrase "work sharing" refers to internal transfers of samples between company laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When we must outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to the SOP on Subcontracting Procedures (CA-L-S-002) and the Work Sharing Process SOP (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in NELAC/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-NELAC accredited work where required.

For DOD projects, the subcontractor laboratories used must have an established and documented laboratory quality system that complies with DoD QSM requirements. The subcontractor laboratories are evaluated following the procedures outlined below and as seen in Figure 8-2. The subcontractor laboratory must receive project-specific approval from the DoD client before any samples are analyzed.

The QSM has five specific requirements for subcontracting:

1. Subcontractor laboratories must have an established laboratory quality system that complies with the QSM.

2. Subcontractor laboratories must be approved by the specific DoD Component laboratory approval process.

3. Subcontractor laboratories must demonstrate the ability to generate acceptable results from the analysis of PT samples, subject to availability, using each applicable method, in the specified matrix, and provide appropriate documentation to the DoD client.

4. Subcontractor laboratories must receive project-specific approval from the DoD client before any samples are analyzed.

5. Subcontractor laboratories are subject to project-specific, on-site assessments by the DoD client or their designated representatives.

Project Managers (PMs) or Customer Service Managers (CSM) for the Export Lab are responsible for obtaining client approval prior to outsourcing any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder.

Note: In addition to the client, some regulating agencies, such as the US Army Corps of Engineers and the USDA, require notification prior to placing such work.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM or Customer Service Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified network laboratory
- Firms specified by the client for the task (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be as simple as placing a copy of an e-mail from the client in the project folder)
- Firms listed as pre-qualified and currently under a subcontract with the company (in J.D.Edwards). A listing of all approved subcontracting laboratories and supporting documentation is available on the TestAmerica intranet site. Verify necessary accreditation for the requested tests prior to sending samples.
- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses
- NELAC or A2LA-accredited laboratories
- In addition, the firm must hold the appropriate certification to perform the work required

All intra-company laboratories are pre-qualified for work sharing, provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. Refer to SOP CA-C-S-001, Work Sharing Process.

When the potential subcontract laboratory has not been previously approved, CSMs or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director/Manager. The Laboratory Director/Manager requests that the QA Manager begin the process of approving the subcontract

laboratory. The client must provide acknowledgement that the samples can be sent to that facility. (An e-mail is sufficient documentation; or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented.)

8.2.1 The QA Manager must ensure that the Subcontracting Approval Form (Figure 8-2) has been completed and have supporting documentation on file prior to initiation of any work. A letter or e-mail is sent to the lab requesting the following information:

8.2.1.1 If a lab is NELAC or A2LA-accredited:

8.2.1.1.1 Copy of necessary certifications verifying the required approvals are current. Ensure all needed analytes are included; some may not be accreditable (if so, document). Certificate and scope of international Standard accreditation are required, when applicable.

8.2.1.1.2 Insurance Certificate. This is required by the TestAmerica Chief Financial Officer

8.2.1.1.3 USDA soil permit, if available

8.2.1.2 For laboratories accredited by other agencies with an auditing program

8.2.1.2.1 Copy of necessary certifications verifying that the required approvals are current. Ensure all needed analytes are included; some may not be accreditable (if so, document). Certificate and scope of International Standard accreditation are required, when applicable.

8.2.1.2.2 Insurance Certificate. This is required by the TestAmerica Chief Financial Officer

8.2.1.2.3 USDA soil permit, if available**

8.2.1.2.4 Description of Ethics and Data Integrity Plan

8.2.1.2.5 The most recent two sets of full proficiency testing (PT) results relevant to the analyses of interest and any associated corrective action

8.2.1.2.6 State Audit with Corrective Action Response

8.2.1.2.7 Example final report to confirm format is compliant and provides the necessary information. (Minimally, it must be determined the Batch QC results are included in the laboratory reports, and data is appropriately qualified.)

8.2.1.2.8 A copy of raw data associated with the first project is requested for internal review. The raw data is reviewed by the QA Manager and the PM to ensure that the results meet the client's needs. If the QA Manager is unfamiliar with the analysis being performed, notify Corporate QA for guidance on the review. (It may need to be sent elsewhere for evaluation.) This requirement can be skipped if an on-site visit of the laboratory is planned. (This requirement is effective as of the effective date of this section. Laboratories worked with previously—minimum of six months—are

grandfathered.)

8.2.1.2.9 DoD work includes additional requirements as described in Section 8.1 above.

8.2.1.3 For laboratories performing tests that are unaccredited or accredited by an agency without an audit program:

8.2.1.3.1 A copy of their Quality Assurance Manual (controlled, if possible). Ensure data quality limits for relevant methods are acceptable and that training procedures are adequate.

8.2.1.3.2 A copy of necessary certifications (if available) verifying the required approvals are current. Ensure all needed analytes are included. Some may not be accreditable (if so, document). Certificate and scope of international Standard accreditation are required, when applicable.

8.2.1.3.3 Insurance Certificate. This is required by the Test America Chief Financial Officer.

8.2.1.3.4 USDA soil permit, if available**.

8.2.1.3.5 Evidence of a current SOP per method. A copy of the first page and signature page of the SOP is acceptable. A Table of Contents including effective dates may also be acceptable. The SOP can be examined if an on-site audit is performed.

8.2.1.3.6 Description of Ethics and Data Integrity Plan

8.2.1.3.7 The most recent two sets of full proficieincy teting (PT) results relevant to the analyses of interest and any associated corrective action.

8.2.1.3.8 Example final report to confirm format is compliant and provides the necessary information. (Minimally, it msut be determined the Batch QC results are included in the laboratory reports, and data is appropriately qualified.)

8.2.1.3.9 Statement of Qualification (SOQ) or summary list of Technical Staff and Qualifications – position, education, and years of experience.

8.2.1.3.10 DoD work includes additional requirements as described in Section 8.1 above.

**USDA permit is required if soils less than three feet deep from New York, North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, Texas, Oklahoma, New Mexico, Arizona, California, Hawaii, or outside the continental U.S. are to be analyzed. These samples require special shipping measures (check with the EHS Department). It may be necessary to heat-treat the samples before shipping if the subcontract laboratory does not have a USDA permit; however, some analytes/tests may be irrelevant after heat treatment.

8.2.1.3.11 A copy of raw data associated with the first project is requested for internal review. The raw data is reviewed by the QA Manager and the PM to ensure that the results meet the client's needs. If the QA Manager is unfamiliar with the analysis being performed, notify Corporate QA for guidance on the review. (It may need to be sent elsewhere for evaluation.) This requirement can be skipped if an on-site visit of the laboratory is planned. (This requirement is effective as of the effective date of this section. Laboratories worked with previously—minimum of six months—are grandfathered.)

8.2.2 Once the information is received by the QA Manager, it is evaluated for acceptability and forwarded to Corporate Contracts for formal contracting with the laboratory. They will add the lab to the approved list on the intranet site, along with the associated documentation and notify the Finance Group for J.D.Edwards.

8.2.3 The client will assume responsibility for the quality of the data generated from the use of a subcontarctor they have requested the lab to use. The qualified subcontractors on the intranet site are to meet minimal standards. The company does not certify laboratories. The subcontractor is on our approved list, and can only be recommended to the extent that we would use them.

8.2.4 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contract Department. Any problems identified will be brought to Corporate QA attention.

- Complaints shall be investigated. Documentation of the complaint, investigation, and corrective action will be maintained in the subcontractor file on the intranet site. Complaints must be posted using the Vendor Performance Report (Form CW-F-WI-009)**.**
- Information must be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all network laboratories and Corporate QA and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all Lab Directors/Managers, QA Managers, and Sales Directors.

8.3 OVERSIGHT AND REPORTING

The CSM or PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and the Legal & Contracts Director can tailor the document or assist with negotiations, if needed. The PM or CSM responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented on a Subcontracted Sample Form (Figure 8-3) and the form is retained in the project folder. For network laboratories, certifications can be viewed on the company website.

The Sample Control Department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a Chain of Custody (COC). A copy of the original COC sent by the client must be included with all samples subbed within the network.

The PM will communicate with the subcontracted laboratory to monitor the status of the analyses, facilitate successful execution of the work and ensure the timeliness and completeness of the analytical report.

Non-NELAC accredited work must be identified in the subcontractor's report as appropriate. If NELAC accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratory EDD, i.e., imported, the report must explicitly indicate the specific lab that produced the data and identify the specific methods and samples.

Note: The results submitted by a network work sharing laboratory may be transferred electronically and the results reported by the network work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 CONTINGENCY PLANNING

The Laboratory Director/Manager may waive the full qualification of a subcontractor process temporarily to meet emergency needs. In the event this provision is utilized, Corporate QA must be informed, and the QA Manager will be required to verify adequacy of proficiency scores and certifications. The laboratory must also request a copy of the raw data to support the analytical results for the first project submitted to the subcontract laboratory unless the laboratory has NELAC accreditation. The raw data is reviewed by the QA Manager and the PM to ensure that the results meet the client's needs. The QA Manager will request full documentation and qualify the subcontractor under the provisions above. The approval process should be completed within 30 calendar days of subcontracting.

Figure 8-1.
Example - Client-Approved Subcontractor Form

Client Information:

Client Name & Account Number:_____

Client Contact: _____

Client Address: _____
_____

Project Information: **(Please choose all applicable.)**

- **Certification required:** ◻ **State** ◻ **NELAC** ◻ **A2LA** ◻ **Method**___
  ◻ **Target compound**_____ ◻ **Other**_____ ◻ **N/A**
- **Required Turn around time (method provisional)**_____

Subcontractor's Information:

Subcontractor's Name: _____

Subcontractor's Contact: _____

Subcontractor's Email: _____

Subcontractor's Address: _____
_____

Subcontractor's Phone Number: _____

Analytical Test/Compound/Method to be subcontracted: _____

Certification Statement:

I hereby give ***[Insert Lab Name]*** permission to use the above noted subcontractor for the above noted testing procedures/methods. I realize that the above subcontractor will be held liable for the validity of the above mentioned testing procedures/methods. All subcontractors shall meet the requirements as spelled out in project information and will follow all analytical holding times and turn around times for analytical reports. The subcontract laboratory, and not TestAmerica, will be held liable for liquidated damages for delays in subcontracted analytical reports and/or electronic data deliverables.

_____
Client Signature **Date**

Figure 8-2.
Example - Subcontracting Laboratory Approval Form (Initial / Renewal)

SUBCONTRACTING LABORATORY APPROVAL

Reference: Section 8 – Quality Assurance Manual

Date: _____
Laboratory: _____

Address: _____
_____

Contact and e-mail address: _____
Phone: Direct _____ Fax _____

Requested Item[3]	Date Received	Reviewed/ Accepted	Date
1. QA Manual[3]			
2. Copy of State Certification[1]			
3. State Audit with Corrective Action Response (or NELAC or A2LA Audit)[3]			
4. Most Recent (and relevant) 2 Sets of WP/WS Reports with Corrective Action Response[1,3]			
5. SOQ or Summary list of Technical Staff and Qualifications [3]			
6. SOPs for Methods to Be Loadshifted[2,3]			
7. USDA Soil Permit			
8. Insurance Certificate			
9. Sample Report[3]			
10. For DoD Work: Statement that Lab quality system complies with QSM			
11. For DoD Work: Approved by specific DoD Component laboratory approval process			
11. Description of Ethics Program[3]			

1 - Required when emergency procedures are implemented.
2 - Some labs may not submit copies due to internal policies. In these cases, a copy of the first page and signature page of the SOP is acceptable. This requirement may also be fulfilled by supplying a table of SOPs with effective dates.
3 – If the laboratory has NELAC accreditation, Item numbers 4 through 10 are not required.

On Site Audit Planned: YES NO If yes, Date Completed: _____ By Whom: _____

Comments:

Lab Acceptable for Subcontracting Work: YES NO Limitations: _____

QA Manager: _____ Date: _____
(Printed Name)

☐ Forwarded to Contract Coordinator by: _____ Date: _____

SECTION 9

PURCHASING SERVICES AND SUPPLIES
(NELAC 5.4.6)

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the supervisory or management staff.

Capital expenditures are made in accordance with the Controlled Purchases Procedure, CW-F-S-004. Only one quote is required where the item being purchased is a sole source product, Examples of sole source capital expenditures are laboratory test equipment, client specified purchases and building leases. A minimum of two quotes is required where the opportunity exists to source from more than one vendor. All documentation related to the purchase of capital items will be maintained in the individual CapEx files located in Corporate Purchasing. Data will be held in accordance with the record retention policy.

TestAmerica will enter into formal contracts with vendors when it is advantageous to do so. Contracts will be signed in accordance with the Authorization Matrix Policy, CW-F-P-002. Examples of items that are purchased through vendor contracts are laboratory instruments, consumables, copiers and office supplies. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

Non-capital expenditure items are purchased through the requisition and approval process in JD Edwards or through other TestAmerica authorized methods (approved web-sites, purchasing cards). Labs have the ability to select from the approved vendors in JD Edwards.

9.2 GLASSWARE

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 REAGENTS, STANDARDS & SUPPLIES

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Purchasing guidelines for equipment and reagents must

meet with the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP CA-Q-S-001.

9.3.1 Purchasing

The nature of the analytical laboratory demands that all material used in any of the procedures is of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP.

9.3.2 Receiving

It is the responsibility of the Warehouse Manager to receive the shipment. It is the responsibility of the analyst who ordered the materials to date the material when received. Once the ordered reagents or materials are received, the analyst compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. Material Safety Data Sheets (MSDSs) are kept on a backup disc located in the Wet Chemistry bullpen and online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

There are many different grades of analytical reagents available to the analyst. All methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, it may be assumed that it is not significant in that procedure and, therefore, any grade reagent may be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals unless noted otherwise by the manufacturer or by the reference source method.

- An expiration date cannot be extended if the dry chemical is discolored or appears otherwise physically degraded, the dry chemical must be discarded.

- Expiration dates can be extended if the dry chemical is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).

- If the dry chemical is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical is compared to an unexpired independent source in performing the method and the performance of the dry chemical is found to be satisfactory. The comparison must show that the dry chemical meets CCV limits. The comparison studies are maintained in the Standard Logbook in each laboratory group.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. The minimum total pressure must be 500 psig or the tank must be replaced. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a conductivity of less than 1 mmho/cm at 25°C. The conductivity is checked and recorded daily. If the water's conductivity is less than the specified limit, the Operations Manager must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased VOA vials must be certified clean and the certificates must be maintained. If uncertified VOA vials are purchased, all lots must be verified clean prior to use. This verification must be maintained.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Table 9-1 details specific storage instructions for reagents and chemicals. Section 22 discusses conditions for standard storage.

9.4 PURCHASE OF EQUIPMENT/INSTRUMENTS/SOFTWARE

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Operations Manager and/or the Laboratory Director/Manager. If they agree with the request the procedures outlined in Policy CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed, and Purchasing places the order.

Upon receipt of a new or used piece of equipment, it is given a short name, such as HP-20, added to the equipment list described in Section 21 that is maintained by the QA Department, and I.T. must be notified so it can be linked for backups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (see Section 20). For software, its operation must be deemed reliable and evidence of

instrument verification must be retained by the IT Department or QA Department as specified in the laboratory's procedure for software verification. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained at the bench.

9.5 SERVICES

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 21. The need for service is determined by analysts and/or Department Managers. The service providers that perform the services are approved by the Department Managers or Operations Manager.

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). The level of control used in the selection process is dependent on the anticipated spend and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers /vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report (CW-F-WI-009).

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form (CW-F-WI-007 – refer to Figure 9-2).

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Laboratory Director are consulted with vendor and product selection that have an impact on quality.

Table 9-1.

Storage of Reagents and Chemicals

Chemical	Storage Requirements
Concentrated Acids and Bases	Stored in the original containers at room temperature. All organic acids must be stored separately from inorganic acids. Acids should not be stored with bases.
Bulk Dry Chemicals	Stored in the original containers at room temperature. All organic acids must be stored separately from inorganic acids. Acids should not be stored with bases.
Working Solutions containing Organic Compounds	Stored as per method recommendation/ requirement. They are generally stored refrigerated at 4°C± 2°C.
Working Solutions containing only Inorganics	Stored at room temperature; refrigeration is optional.
Flammable Solvents	Stored in solvent cabinets at room temperature.
Non-Flammable Solvents	Stored separately from the flammable solvents in cabinets at room temperature.

Figure 9-2.
Example – JD Edwards Vendor Add Request Form

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

JD Edwards Vendor Add Request Form

Vendor name:	Lab location and individual making request:
Vendor address (remit to):	Vendor phone:
Vendor address (remit to):	Vendor fax:
Contact name:	Product / service provided:

Reason for Vendor Addition: Check all reasons that apply

☐ Cost Reduction	Estimated Annual Savings $
☐ Replace Current Vendor	Reason?
	Vendor being Replaced?
☐ New Product / Service	Describe:
☐ ISO Approved (Required for Aerotech / P&K only)	

Small Business:

Does this vendor help us to meet our small business objectives: _____

If yes, which category: _____

Personal and Ethical Considerations:

Is there any personal conflict of interest with a TestAmerica employee and the vendor listed above? _____
_____

Have ethical considerations been taken into account in your evaluation of this vendor?_____
_____

Can this product be sourced from another TestAmerica facility?_____

Please complete form and email to NCPurchasing@testamericainc.com or fax to (330) 966-9275.

I approve the addition of this vendor:

_____ _____

Purchasing Manager - Patrick Eckman Corporate Controller - Leslie Bowers

Form No. CW-F-WI-007

SECTION 10

SERVICE TO THE CLIENT
(NELAC 5.4.7)

10.1 OVERVIEW

TestAmerica North Canton cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements discussed in Section 5. The laboratory has procedures to ensure confidentiality to clients (Sections 16 and 26).

Note: ISO 17025/NELAC 2003 states that a laboratory "shall afford clients or their representatives cooperation to clarify the client's request". This topic is discussed in Section 7.

10.2 SPECIAL SERVICES

The laboratory's standard procedures for reporting data are described in Section 26. When requested the following special services are provided:

- The laboratory will provide the client or the client's representative reasonable access to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- The laboratory will work with client-specified third party data validators as specified in the client's contract.
- The laboratory will provide the client with all requested information pertaining to the analysis of their samples. An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

10.3 CLIENT COMMUNICATION

Customer Service Managers (CSMs) and Project Managers (PMs) are an important communication link to the clients. The lab shall inform its clients of any delays in project completion as well as any non-conformances in either sample receipt (refer to Section 24) or sample analysis. Project Management will maintain ongoing client communication throughout the entire client project.

A Technical Director, Operation Manager, or Lab Supervisors are available to discuss any technical questions or concerns that the client may have.

10.4 REPORTING

The laboratory will work with the client to produce any special communication reports required by the contract.

10.5 CLIENT SURVEYS

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service.

TestAmerica Sales and Marketing teams periodically develop lab and client-specific surveys to assess client satisfaction.

SECTION 11

COMPLAINTS
(NELAC 5.4.8)

11.1 OVERVIEW

TestAmerica North Canton believes that effective client complaint handling processes have important business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that helps to continually improve processes and improving client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services, communications, responsiveness, data, reports, invoicing and other functions expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for dealing with both external and internal complaints.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 13 (Corrective Actions) and is documented following SOPs CORP-QA-0010, Nonconformance and Corrective Action System, and S-C-002, Complaint Handling and Service Recovery. It is the laboratory's goal to provide a satisfactory resolution to complaints in a timely and professional manner.

11.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process and the documentation of the complaint.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving Complaints
- Complaint Investigation and Service Recovery

- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

11.3 INTERNAL COMPLAINTS

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 13. In addition, Corporate Management, Sales and Marketing, and Information Technology (IT) may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 13.

11.4 MANAGEMENT REVIEW

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 17)

SECTION 12

CONTROL OF NON-CONFORMING WORK
(NELAC 5.4.9)

12.1 OVERVIEW

When data discrepancies are discovered or deviations and departures from laboratory standard procedures, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 13).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. Refer to SOP CORP-QA-0010, Nonconformance and Corrective Action System, for details of the nonconformance process.

12.2 RESPONSIBILITIES AND AUTHORITIES

SOP CA-L-S-001, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall, outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of the company's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances the Laboratory Director/Manager, Operations Manager, Project Manager, or a member of the QA team may exceptionally authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures described in Section 13. This information may also need to be documented in logbooks and/or data review as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility senior laboratory management within 24 hours. The Senior Management staff is compromised of the Laboratory Director, QA Manager, Customer Service Manager, Operations Manager, I.T. Manager, H.R. Manager, and Technical Director. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO) and Quality Director within 24 hours.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director/Manager, QA Manager, ECOs, COOs (East and West), General Managers and the Quality Directors (East and West) have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

12.3 EVALUATION OF SIGNIFICANCE AND ACTIONS TAKEN

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

SOP CA-L-S-001 distinguishes between situations when it would be appropriate for the laboratory QA Manager and Laboratory Director/Manager (or his/her designee) to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECOs and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting (Section 13) in lieu of the data recall determination form contained in SOP CA-L-S-001.

12.4 PREVENTION OF NONCONFORMING WORK

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system (Section 13).

On a monthly basis, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

12.5 METHOD SUSPENSION/RESTRICTION (STOP WORK PROCEDURES)

In some cases it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 12.2, Paragraph 5 above.

Prior to suspension/restriction, confidentiality will be respected, and the problem and the required corrective and preventive action will be stated in writing and presented to the Laboratory Director/Manager.

The Laboratory Director/Manager shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases that may not

be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.

The QA Manager will also initiate a corrective action report as described in Section 13 if one has not already been started. A copy of any meeting notes and agreed upon steps must be faxed or e-mailed by the laboratory to the appropriate General Manager and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the Internet. It is the responsibility of the Laboratory Director/Manager to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction, i.e., Project Management, Log-in, etc. Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Director, QA Manager, Supervisor) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management, Director of Client Services, and Director of Sales and Marketing should be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report as described in Section 13.

Company Confidential & Proprietary

SECTION 13

CORRECTIVE ACTION
(NELAC 5.4.10)

13.1 OVERVIEW

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Nonconformance Memos (NCM).

13.2 DEFINITIONS

- **Correction***:* Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions are contained in the method-specific SOPs. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis**.** No significant action is taken to change behavior, process or procedure.

- **Corrective Action***:* The action taken is not only a correction made to the immediate event, but a change in process, procedure or behavior that is required to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence.

13.3 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility for investigation.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify Systematic Problems before they become serious.
- Identify and track Client complaints and provide resolution (see more on client complaints in Section 11).

13.3.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP

- QC outside of limits (non matrix related)
- Isolated Reporting / Calculation Errors
- Client Complaints

13.4 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

13.4.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An NCM must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 13-1 in SOP CORP-QA-0010, Nonconformance and Corrective Action System, provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Supervisor, Lab Director, QA Manager, or designee is consulted.

13.4.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCM is used for this documentation.

13.4.3 Monitoring of the Corrective Actions

- The Department Manager/Supervisor and QA Manager is responsible to ensure that the corrective action taken was effective.
- Ineffective actions will be documented and re-evaluated until acceptable resolution is achieved. Department Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCM is entered into a database for tracking purposes and a monthly summary of all corrective actions is printed out for review to aid in ensuring that the corrective actions have taken effect.
- The QA Manager reviews monthly NCMs for trends. Highlights are included in the QA monthly report (refer to Section 17). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.

- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

13.4.4 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements. (Section 16 includes additional information regarding internal audit procedures.)
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

13.5 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 12 for information regarding the control of non-conforming work). The documentation of these procedures is through the use of an NCM.

Table 13-1 includes examples of general technical corrective actions. For specific criteria and corrective actions refer to the analytical methods or specific method SOPs.

Table 13-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, QAM Sections 20 and 21, and SOP CA-L-S-001, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall. All corrective actions are reviewed at a minimum monthly by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by a written NCM and appropriate corrective action (e.g., reanalysis) is taken and documented.

13.6 BASIC CORRECTIONS

When mistakes occur in records, each mistake shall be crossed-out, and not erased, deleted, made illegible, or otherwise obliterated (e.g. no white-out), and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Table 13-1.
Example – General Corrective Action Procedures

*** For Ohio VAP, method blank contamination must not exceed the RL if that analyte is a Contaminant of Concern for the project site.**

INORGANIC LABORATORY QUALITY CONTROL SAMPLES

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Alkalinity	* Method Blank	310.1 2320B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A
	Laboratory Control Sample	310.1 2320B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	N/A
	Matrix Spike	310.1 2320B	Total alkalinity: 1 per batch of 20 samples	—	N/A
	Matrix Spike Duplicate	310.1 2320B	Total alkalinity: 1 per batch of 20 samples	—	N/A
	Duplicate	310.1 2320B	For carbonate, bicarbonate, hydroxide, alkalinity only. Frequency: 1 per batch of 10 samples Criteria 310.1: ≤ 20 % RPD(3) Criteria 2320B: ≤ 25 % RPD(3) Corrective Action: Flag data outside of limit.	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Ammonia	* Method Blank	350.1 350.2 SM4500 NH-E,F	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A
	Laboratory Control Sample	350.1 350.2 SM4500 NH-E,F	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within control limits, rerun all associated samples	—	N/A
	Matrix Spike	350.1 350.2 SM4500 NH-E,F	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Ammonia (Cont'd)	Matrix Spike Duplicate	350.1 350.2 SM4500 NH-E,F	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	—	N/A
	Duplicate	350.1 350.2 SM4500 NH-E,F	N/A	—	N/A
Ammonia (TKN)	* Method Blank	351.2 351.3 SM4500 NO_3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Ammonia (TKN) (Cont'd)	Laboratory Control Sample	351.2 351.3 SM4500 NO_3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	N/A
	Matrix Spike	351.2 351.3 SM4500 NO_3	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	—	N/A
	Matrix Spike Duplicate	351.2 351.3 SM4500 NO_3	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	—	N/A
	Duplicate	351.2 351.3 SM4500 NO_3	N/A	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
BOD	* Method Blank	405.1 SM5210B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A
	Laboratory Control Sample and Laboratory Control Sample Duplicate	405.1 SM5210B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	N/A
	Matrix Spike	405.1 SM5210B	N/A	—	N/A
	Matrix Spike Duplicate	405.1 SM5210B	N/A	—	N/A
	Duplicate	405.1 SM5210B	N/A	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Bromide	* Method Blank	300.0A(5)	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample and Laboratory Control Sample Duplicate	300.0A(5)	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within control limits, rerun all associated samples	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within control limits, rerun all associated samples
	Matrix Spike	300.0A(5)	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data associated with MS outside of limit
	Matrix Spike Duplicate	300.0A(5)	N/A	9056A	N/A
	Duplicate	300.0A(5)	N/A	9056A	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Chemical Oxygen Demand (COD)	* Method Blank	410.4 SM5220D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A
	Laboratory Control Sample and Laboratory Control Sample Duplicate	410.4 SM5220D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	N/A
	Matrix Spike	410.4 SM5220D	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	—	N/A
	Matrix Spike Duplicate	410.4 SM5220D	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	—	N/A
	Duplicate	410.4 SM5220D	N/A	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Chloride	* Method Blank	300.0A [5] 325.2 325.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	300.0A [5] 325.2 325.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within control limits, rerun all associated samples	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples
	Matrix Spike	300.0A(5)	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Methods 9251Corrective Action: If not within laboratory control limits, rerun all associated samples Method 9056/9253 Corrective Action: Flag data associated with MS outside of limits

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Chloride (cont'd)	Matrix Spike Duplicate	325.2 325.3	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits/< 20 % RPD(3) Corrective Action: Flag data outside of limit Method 9056: MSD is not applicable
	Duplicate	300.0A(5) 325.2 325.3	N/A	9056A	N/A
Chlorine, Residual	* Method Blank	330.5	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A
	Laboratory Control Sample	330.5	N/A	—	N/A
	Matrix Spike	330.5	N/A	—	N/A
	Matrix Spike Duplicate	330.5	N/A	—	N/A
	Duplicate	330.5	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: ≤ 20 % RPD(3) Corrective Action: Flag data outside of limit.	—	Water

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Chromium (Cr^{+6})	* Method Blank	3500 Cr-D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	7196A 3060A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	3500 Cr-D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	7196A 3060A	Frequency: 1 with each batch of samples processed not to exceed 20 samples prepped Criteria: percent recovery for water must be within ± 15 % and for solids must be within ± 20% Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	3500 Cr-D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit	3060A 7196A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Advisory limits are 75% - 125% recovery Corrective Action: Flag data associated with unacceptable Matrix Spike

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Chromium (Cr^{+6}) (Cont'd)	Matrix Spike Duplicate	3500 Cr-D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit	7196A 3060A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Advisory limits are 75% - 125% recovery Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	3500 Cr-D	N/A	7196A 3060A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: ≤ 20 % RPD(3) limit Corrective Action: Flag data outside of limit.

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Conductivity, Specific	* Method Blank	120.1 SM2510B	N/A	9050A	Not Applicable
	Laboratory Control Sample	120.1 SM2510B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9050A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples
	Matrix Spike	120.1 SM2510B	N/A	9050A	N/A
	Matrix Spike Duplicate	120.1 SM2510B	N/A	9050A	N/A
	Duplicate	120.1 SM2510B	Frequency: 1 with each batch of samples processed not to exceed 10 samples Criteria: $\leq$ 20 % RPD(3) Corrective Action: Flag data outside of limit.	9050A	Frequency: 1 with each batch of samples processed not to exceed 10 samples

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Cyanide (Amenable)	* Method Blank	335.1 SM4500C N-G	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9012A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	335.1 SM4500C N-G	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9012A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	335.1 SM4500C N-G	N/A	9012A	N/A
	Matrix Spike Duplicate	335.1 SM4500C N-G	N/A	9012A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within lab control limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	335.1 SM4500C N-G	N/A	9012A	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Cyanide (Total)	* Method Blank	335.2 335.3 335.4 4500-CN E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9012A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	335.2 335.3 335.4 4500-CN E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9012A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	335.2 335.3 335.4 4500-CN E	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9012A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data associated with unacceptable Matrix Spike

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Cyanide (Total) (cont'd)	Matrix Spike Duplicate	335.2 335.3 335.4 4500-CN E	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9012A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	335.2 335.3 335.4	N/A	9012A	N/A
Flashpoint	* Method Blank	—	N/A	1010 ASTM D93-9	N/A
	Laboratory Control Sample	—	N/A	1010 ASTM D93-9	N/A
	Matrix Spike	—	N/A	1010 ASTM D93-9	N/A
	Matrix Spike Duplicate	—	N/A	1010 ASTM D93-9	N/A
	Duplicate	—	Frequency: 1 per batch of ≤20 samples per matrix Criteria: RPD(3) must be ≤ 20% Corrective Action: Flag data associated with unacceptable Duplicate	1010 ASTM D93-9	Frequency: 1 per batch of ≤20 samples per matrix Criteria: RPD(3) must be ≤ 20% Corrective Action: Flag data associated with unacceptable Duplicate

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Fluoride	* Method Blank	300.0A(5) 340.2 SM4500F-C,ISE	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable
	Laboratory Control Sample	300.0A(5) 340.2 SM4500F-C,ISE	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within control limits, rerun all associated samples
	Laboratory Control Sample Duplicate	300.0A(5) SM4500F-C,ISE	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9056	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within control limits, rerun all associated samples

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Flouride (Cont'd)	Matrix Spike	300.0A(5) 340.2 SM4500F-C,ISE	Frequency: 1 per 10 samples by IC Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data associated with outside of limit
	Matrix Spike Duplicate	340.2 SM4500F-C,ISE	Frequency: 1 per 20 samples by IC Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit	340.2	N/A
	Duplicate	300.0A(5) 340.2 SM4500F-C,ISE	N/A	9056A	Frequency: 1 with each batch of samples processed Criteria: RPD(3) must be within laboratory control limits Corrective Action: Flag data associated with duplicates outside of laboratory RPD(3) limits

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Hardness	* Method Blank	130.2 2340B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A
	Laboratory Control Sample	130.2 2340B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	N/A
	Matrix Spike	130.2 2340B	Method 130.2: 1 per 20 samples Method 2340B: Frequency , Criteria, and Corrective Action: See ICP Metals Method 200.7 Requirements	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Hardness (cont'd)	Matrix Spike Duplicate	130.2 2340B	Method 130.2: 1 per 20 samples Method 2340B: Frequency, Criteria, and Corrective Action: See ICP Metals Method 200.7 Requirements	—	N/A
	Duplicate	130.2 2340B	N/A	—	N/A
Iron, Ferrous & Ferric	* Method Blank	3500-Fe D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A
	Laboratory Control Sample	3500-Fe D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Iron, Ferrous & Ferric (Cont'd)	Matrix Spike	3500-Fe D	Frequency: 1 every 10 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag associated data outside of limit	—	N/A
	Matrix Spike Duplicate	3500-Fe D	Frequency: 1 every 10 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag associated data outside of limit	—	N/A
	Duplicate	3500-Fe D	N/A	—	N/A
Nitrate	* Method Blank	300.0A(5) 353.2 SM4500-NO_3-E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Nitrate (Cont'd)	Laboratory Control Sample	300.0A(5) 353.2 SM4500-NO_3-E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples
	Matrix Spike	300.0A(5) 353.2 SM4500-NO_3-E	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, flag all associated samples
	Matrix Spike Duplicate	300.0A(5) 353.2 SM4500-NO_3-E	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	9056A	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Nitrate (cont'd)	Duplicate	300.0A(5) 353.2 SM4500-NO_3-E	N/A	9056A	Frequency: 1 per 10 samples Criteria: RPD(3) must be within laboratory control limits Corrective Action: If not within laboratory control limits, flag all associated samples
Nitrite	* Method Blank	300.0A(5) 353.2	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	300.0A(5) 354.1 353.2	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Nitrite (Cont'd)	Matrix Spike	300.0A[(5)] 354.1 353.2	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, flag all associated samples
	Matrix Spike Duplicate	300.0A[(5)] 354.1 353.2	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	9056A	N/A
	Duplicate	300.0A[(5)] 354.1 353.2	N/A	9056A	Frequency: 1 per 10 samples Criteria: RPD[(3)] must be within laboratory control limits Corrective Action: If not within laboratory control limits, flag all associated samples

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Nitrate-Nitrite	* Method Blank	353.2	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A
	Laboratory Control Sample	353.2	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	N/A
	Matrix Spike	353.2	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	—	N/A
	Matrix Spike Duplicate	353.2	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	—	N/A
	Duplicate	353.2	N/A	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
pH	* Method Blank	150.1 SM4500H-B	N/A	9040B 9045C	N/A
	Laboratory Control Sample	150.1 SM4500H-B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9040B 9045C	N/A
	Matrix Spike	150.1 SM4500H-B	N/A	9040B 9045C	N/A
	Matrix Spike Duplicate	150.1 SM4500H-B	N/A	9040B 9045C	N/A
	Duplicate	150.1 SM4500H-B	Frequency: 1 with each batch of samples processed not to exceed 10 samples per matrix Criteria: ≤ 20 % RPD(3) limit Corrective Action: Flag data outside of limit.	9040B 9045C	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Advisory limits are ≤ 20% RPD(3) Corrective Action: Flag data associated with unacceptable Duplicate
Phenolics	* Method Blank	420.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9065	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Phenolics (Cont'd)	Laboratory Control Sample	420.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9065	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples
	Matrix Spike	420.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data associated with unacceptable matrix spike	9065	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data
	Matrix Spike Duplicate	420.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data	9065	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Phosphorus (Total and Ortho-phosphate)	* Method Blank	300.0 (4,5) 365.3 365.1 SM4500P-E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	300.0(4,5) 365.3 365.1 SM4500P-E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples
	Matrix Spike	300.0(4,5) 365.3 365.1 SM4500P-E	Frequency: 1 per 10 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit	9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data associated with MS outside of limits
	Matrix Spike Duplicate	365.3 365.1 SM4500P-E	Frequency: 1 per 20 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit	9056A	**N/A**

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Phosphorus (Total and Ortho-phosphate) (Cont'd)	Duplicate	300.0(4,5) 365.3 365.1 SM4500P-E	N/A	9056A	Frequency: 1 with each batch of samples processed Criteria: RPD(3) must be within laboratory control limits Corrective Action: Flag data associated with duplicates outside of laboratory RPD(3) limits
Solids	* Method Blank	160.1 160.2 160.3 160.4 160.5 SM2540E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: If analyte level in method blank is ≥ RL for the analyte of interest in the sample, all associated samples with reportable levels of analyte are reprepared and reanalyzed.	—	N/A
	Laboratory Control Sample	160.1 160.2 160.3 160.4 160.5 SM2540E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, reprepare and rerun all associated samples	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Solids (Cont'd)	Matrix Spike	160.1 160.2 160.3 160.4 160.5 SM4500P-E	N/A	—	N/A
	Matrix Spike Duplicate	160.1 160.2 160.3 160.4 160.5 SM4500P-E	N/A	—	N/A
	Duplicate	160.1 160.2 160.3 160.4 160.5 SM4500P-E	Frequency: 1 with each batch of samples processed not to exceed 10 samples Criteria: Sample results should agree within 20% if both the sample and sample duplicate results are > 5 X RL Corrective Action: Flag data outside of limit	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Sulfate	* Method Blank	300.0A[(5)] 375.4	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9038 9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	300.0A[(5)] 375.4	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9038 9056A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Method 9038 Criteria: Percent recovery must be within ± 15 % Method 9056 Criteria: Percent recovery must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS (ICV)

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Sulfate (cont'd)	Matrix Spike	300.0A(5) 375.4	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9038 9056A	Frequency: 1 with each batch of samples processed not to exceed 10 samples (9038) or 20 samples (9056) Method 9038 Criteria: Limits are 75% - 125% recovery Method 9056 Criteria: Percent recovery must be within laboratory 0control limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Matrix Spike Duplicate	300.0A(5) 375.4	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9038 9056A	N/A
	Duplicate	300.0A(5) 375.4	N/A	9038 9056A	N/A
Sulfide	* Method Blank	376.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9030A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Sulfide (Cont'd)	Laboratory Control Sample	376.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9030A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data
	Matrix Spike	376.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9030A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data
	Matrix Spike Duplicate	376.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9030A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data Method 9034: Not Applicable
	Duplicate	376.1	N/A	9030A	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Total Organic Carbon (TOC)	* Method Blank	415.1 SM5310D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9060 Walkley-Black	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	415.1 SM5310D	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9060 Walkley-Black	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	415.1 SM5310D	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9060 Walkley-Black	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Reanalyze if sample remaining. If not, flag data associated with unacceptable Matrix Spike

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Total Organic Carbon (TOC) (cont'd)	Matrix Spike Duplicate	415.1 SM5310D	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9060 Walkley-Black	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Reanalyze if sample remaining. If not, flag data associated with unacceptable Matrix Spike Duplicate
	Duplicate	415.1 SM5310D	N/A	9060 Walkley-Black	Not Applicable
Total Organic Halides (TOX)	* Method Blank	450.1 (5)	Frequency: 1 with each set of 8 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9020B	Frequency: Run in duplicate between each group of 8 analytical determinations Criteria: Concentration less than reporting limit or less than 2 X MDL or RL whichever is lower Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	450.1 (5)	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery of analyte must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS (ICV)	9020B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery of analyte must be within 90-110% Corrective Action: Rerun all samples associated with unacceptable LCS (ICV)

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Total Organic Halides (TOX) (cont'd)	Matrix Spike	450.1 (5)	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Reanalyze if sample remaining. If not, flag data with unacceptable Matrix Spike	9020B	Frequency: 1 per batch of 10 samples Criteria: Must be within laboratory control limits Corrective Action: Flag data associated with unacceptable Matrix Spike SOP NO. CORP-WC-0001
	Matrix Spike Duplicate	450.1(5)	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Reanalyze if sample remaining. If not, flag data with unacceptable Matrix Spike	9020B	N/A
	Duplicate	450.1(5)	**N/A**	9020B	N/A
Turbidity	* Method Blank	180.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	N/A

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Turbidity (cont'd)	Laboratory Control Sample	180.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	N/A
	Matrix Spike	180.1	N/A	—	N/A
	Matrix Spike Duplicate	180.1	N/A	—	N/A
	Duplicate	180.1	Frequency: 1 per 10 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit Not Applicable.	—	N/A
Mercury by CVAA & CVAFS	* Method Blank	200 series 1631E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank SOP CORP-MT-0003. Exception: If blank is above RL, and samples are ND.	7000A series	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank SOP CORP-MT-0003. Exception: If blank is above RL and samples are ND.

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Mercury by CVAA & CVAFS (Cont'd)	Laboratory Control Sample	200 series 1631E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery of analyte must be within ± 20 %. 1631E is +/- 23% Corrective Action: Rerun all samples associated with unacceptable LCS SOP CORP-MT-0003. Exception: If samples are ND, results are reported.	7000A series	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery of analyte must be within ± 20 % Corrective Action: Rerun all samples associated with unacceptable LCS SOP CORP-MT-0003. Exception: If samples are ND, results are reported.
	Matrix Spike	200 series 1631E	Frequency: with each batch of samples processed not to exceed 20 samples. 1631E frequency is 1 in 10 samples, 71-125% Criteria: Recovery should be within 75-125 % Corrective Action: Flag data associated with unacceptable MS. (See SOP CORP-MT-0003 for detailed corrective action procedure and for other QC procedures.)	7000A series	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Recovery should be within 75-125 % Corrective Action: Flag data associated with unacceptable MS. (See SOP CORP-MT-0003 for detailed corrective action procedure and for other QC procedures.)
	Matrix Spike Duplicate	200 series 1631E	Frequency: 1 with each batch of samples processed not to exceed 20 samples. 1631E frequency is 1 in 10 samples, 71-125% RPD 24% Criteria: Recovery should be within 75-125 % , RPD(3) should be within 20% Corrective Action: Flag data associated with unacceptable MSD SOP CORP-MT-0003	7000A series	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Recovery should be within 75-125 % , RPD(3) should be within 20% Corrective Action: Flag data associated with unacceptable MSD SOP CORP-MT-0003

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Mercury by CVAA & CVAFS (Cont'd)	Duplicate	200 series 1631E	N/A	7000A series	N/A
ICP Metals	* Method Blank	200.7 200.8	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit. Concentration less than reporting with the exception of lab common contaminants. Sample results <RL are also valid. Corrective Action: Rerun all samples associated with unacceptable blank SOP CORP-MT-0001	6010B 6020	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit. Concentration less than reporting with the exception of lab common contaminants. Sample results <RL are also valid. Corrective Action: Rerun all samples associated with unacceptable blank SOP CORP-MT-0001
	Laboratory Control Sample	200.7 200.8	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery of analyte must be ± 85-115%. If LCS is biased high and samples are <RL, the results are valid. Corrective Action: Rerun all samples associated with unacceptable LCS SOP CORP-MT-0001	6010B 6020	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery of analyte must be ± 20 %. If LCS is biased high and samples are <RL, the results are valid. Corrective Action: Rerun all samples associated with unacceptable LCS SOP CORP-MT-0001. If samples are ND, results are reported.

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
ICP Metals (Cont'd)	Matrix Spike	200.7 200.8	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Limits for percent recovery are 75-125% Corrective Action: Flag data associated with unacceptable Matrix Spike SOP CORP-MT-0001	6010B 6020	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Limits for percent recovery are 75-125% Corrective Action: Flag data associated with unacceptable Matrix Spike SOP CORP-MT-0001
	Matrix Spike Duplicate	200.7 200.8	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Limits for percent recovery are 75-125%, RPD(3) must be within 20% Corrective Action: Flag data associated with unacceptable Matrix Spike SOP CORP-MT-0001	6010B 6020	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Limits for percent recovery are 75-125%, RPD(3) must be within 20% Corrective Action: Flag data associated with unacceptable Matrix Spike SOP CORP-MT-0001
	Duplicate	200.7 200.8	Not Applicable	6010B 6020	Not Applicable
	Serial Dilution	200.7 200.8	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: 10% difference. 10% difference only applied if sample results are >50 times IDL. Corrective Action: Flag data associated with unacceptable Serial Dilution SOP CORP-MT-0001	6010B 6020	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: 10% difference. 10% difference only applied if sample results are >50 times IDL. Corrective Action: Flag data associated with unacceptable Serial Dilution SOP CORP-MT-0001

INORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Footnotes

[1] National Pollutant Discharge Elimination System

[2] Resource Conservation and Recovery Act, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA (August 1993), Final Update II (September 1994), Final Update IIB (January 1995), and Final Update III (December 1996).

[3] RPD-Relative Percent Difference

[4] Orthophosphate only

[5] Method not listed in 40 CFR Part 136. Method 300.0 is a proposed 40CFR method. Specific state and/or region approval is required for NPDES.

[6] Current promulgated method is a Guidance Method Only, SW-846, Final Update III, Rev.3, 12/96.

ORGANIC LABORATORY QUALITY CONTROL SAMPLES

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Aromatic Volatiles by GC	* Method Blank	602	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	8021B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	602	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery must be within acceptance limits given in method for each analyte Corrective Action: Rerun all samples associated with unacceptable LCS	8021B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte must be within laboratory acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	602	Frequency: 1 per 10 samples from each site or 1 per month, whichever is more frequent Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8021B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Aromatic Volatiles by GC (Cont'd)	Matrix Spike Duplicate	602	N/A	8021B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	602	N/A	8021B	N/A
	Surrogates	602	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: All surrogates must be within laboratory established control limits before sample analysis may proceed. Sample Criteria: Re-extract samples or flag sample data not meeting surrogate criteria	8021B	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: All surrogates must be within laboratory established control limits before sample analysis may proceed. Sample Criteria: Reprepare and reanalyze samples or flag sample data not meeting surrogate criteria
	Internal Standards	602	Optional: Internal standards are added to the method blank and all samples (QC included).	8021B	Optional: Internal standards are added to the method blank and all samples (QC included). If used, same compounds as used for surrogates may be appropriate.

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Halogenated Volatiles by GC	* Method Blank	--	N/A	8021B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	--	N/A	8021B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte must be within laboratory acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	--	N/A	8021B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Matrix Spike Duplicate	--	N/A	8021B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Halogenated Volatiles by GC (Cont'd)	Duplicate	--	N/A	8021B	N/A
	Surrogates	--	N/A	8021B	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: All surrogates must be within laboratory established control limits before sample analysis may proceed. Sample Criteria: Reprepare and reanalyze samples or flag sample data not meeting surrogate criteria.
	Internal Standards	--	N/A	8021B	Optional: Internal standards are added to the method blank and all samples (QC included). If used, same compounds as used for surrogates may be appropriate.

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Herbicides	Laboratory Control Sample	615 [3]	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Percent recovery must be within acceptance limits given in method for each analyte Corrective Action: Re-extract all samples associated with unacceptable LCS	8151A	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Percent recovery for each analyte must be within laboratory acceptance limits Corrective Action: Re-extract and reanalyze all samples associated with unacceptable LCS
	Matrix Spike	615 [3]	Frequency: 1 per 10 samples from each site or 1 per month, whichever is more frequent Criteria: Percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8151A	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Matrix Spike Duplicate	615 [3]	N/A	8151A	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory control limits Corrective Action: Flag data associated with unacceptable matrix spike sample

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Herbicides (cont'd)	Duplicate	615 [3]	N/A	8151A	N/A
	Surrogates	615 [3]	N/A	8151A	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: All surrogates must fall within laboratory established control limits before sample analysis may proceed. Sample Criteria: Re-extract and reanalyze samples or flag sample data not meeting surrogate criteria
	Internal Standards	615 [3]	N/A	8151A	Optional
Pesticides/ PCBs	* Method Blank	608	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	8081A 8082	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Reprepare and reanalyze all samples associated with unacceptable blank

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Pesticides/ PCBs (Cont'd)	Laboratory Control Sample	608	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery must be within acceptance limits given in method for each analyte Corrective Action: Rerun all samples associated with unacceptable LCS	8081A 8082	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte must be within laboratory acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	608	Frequency: 1 per 10 samples from each site or 1 per month, whichever is more frequent Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8081A 8082	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Pesticides/ PCBs (cont'd)	Matrix Spike Duplicate	608	N/A	8081A 80882	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	608	N/A	8081A 8082	N/A
	Surrogates	608	Not specified in method	8081A 8082	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: Results must fall within laboratory established control limits Sample Criteria: Re-extract and reanalyze samples or flag sample data not meeting surrogate criteria
Petroleum Hydro-carbons	* Method Blank	1664A	Frequency: 1 with each preparation batch Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9071B	Frequency: 1 with each preparation batch Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Petroleum Hydro-carbons (Cont'd)	Laboratory Control Sample	1664A	Frequency: 1 with each analytical batch Criteria: Waters - See limits in SOP, NC-WC-0084 Soils - Percent recovery must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS	9071B	Frequency: 1 with each analytical batch Criteria: Waters - See limits in SOP, NC-WC-0084 Soils - Percent recovery must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	1664A	Frequency: 1 with every 10 samples per site Criteria: See percent recovery limits in SOP, NC-WC-0084 Corrective Action: See SOP, NC-WC-0084	9071B	Frequency: 1 with every 10 samples per site Criteria: See percent recovery limits in SOP, NC-WC-0084 Corrective Action: See SOP, NC-WC-0084
	Matrix Spike Duplicate	1664A	Frequency: 1 with every 20 samples per site Criteria: See percent recovery and RPD limits in SOP, NC-WC-0084 Corrective Action: See NC-WC-0084	9071B	Frequency: 1 with every 10 samples per site Criteria: See percent recovery and RPD limits in SOP, NC-WC-0084 Corrective Action: See NC-WC-0084
	Duplicate	1664A	N/A	9071B	N/A

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Purgeable Halocarbons by GC	* Method Blank	601	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	8021B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	601	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery must be within acceptance limits given in method for each analyte Corrective Action: Rerun all samples associated with unacceptable LCS	8021B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte must be within laboratory acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	601	Frequency: 1 per 10 samples from each site or 1 per month, whichever is more frequent Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8021B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Purgeable Halocarbons by GC (Cont'd)	Matrix Spike Duplicate	601	N/A	8021B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	601	N/A	8021B	N/A
	Surrogates	601	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: All surrogates must be within laboratory established control limits before sample analysis may proceed. Sample Criteria: Re-extract samples or flag sample data not meeting surrogate criteria	8021B	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: All surrogates must be within laboratory established control limits before sample analysis may proceed. Sample Criteria: Re-extract and reanalyze samples or flag sample data not meeting surrogate criteria
	Internal Standards	601	Optional: Internal standards are added to the method blank and all samples (QC included). If used, same compounds as used for surrogates may be appropriate.	8021B	Optional: Internal standards are added to the method blank and all samples (QC included). If used, same compounds as used for surrogates may be appropriate.

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Semivolatiles	Matrix Spike	625	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8270C	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Matrix Spike Duplicate	625	N/A	8270C	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Semivolatiles (Cont'd)	Duplicate	625	N/A	8270C	N/A
	Surrogates	625	Surrogates spiked into method blank and all samples (QC included) Method Blank and LCS Criteria: All surrogates must be in control before sample analysis may proceed. One surrogate per fraction may exceed control limits if greater than 10% recovery. Sample Criteria: Re-extract samples or flag sample data not meeting surrogate criteria	8270C	Surrogates spiked into method blank and all samples (QC included) Method Blank and LCS Criteria: All surrogates must be in control before sample analysis may proceed. One surrogate per fraction may exceed control limits if greater than 10% recovery. Sample Criteria: Re-extract and reanalyze samples or flag sample data not meeting surrogate criteria
	Internal Standards	625	Frequency: Internal standards spiked into method blank and all samples (QC included) Criteria: All internal standard recoveries must be within laboratory control limits Corrective Action: Flag sample data not meeting internal standard recovery requirements	8270C	Internal Standards are added to all samples (QC samples included). Internal standard area of daily standard must be within 50% to 200% of the response in the mid level of the initial calibration standard. The retention time (RT) for any internal standard (IS) in the continuing calibration must not exceed ± 0.5 minutes from mid level initial calibration standard IS RT.

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Volatiles by GC/MS	* Method Blank	624	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	8260B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	624	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8260B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte must be within laboratory acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Volatiles by GC/MS (Cont'd)	Matrix Spike	624	Frequency: 1 per ≤ 20 samples from each site or 1 per month, whichever is more frequent Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8260B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Matrix Spike Duplicate	624	N/A	8260B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within laboratory acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	624	N/A	8260B	N/A

ORGANIC LABORATORY QUALITY CONTROL SAMPLES (Cont'd)

Analysis	QC Sample	Method	NPDES [1]	Method	RCRA (SW846) [2]
Volatiles by GC/MS (cont'd)	Surrogates	624	Surrogates spiked into Method Blank and all samples (QC included) Method Blank Criteria: All surrogates must be in control before sample analysis may proceed. Sample Criteria: Re-extract samples or flag sample data not meeting surrogate criteria	8260B	Surrogates spiked into Method Blank and all samples (QC included) Method Blank Criteria and LCS: All surrogates must be in control before sample analysis may proceed. Sample Criteria: Re-extract and reanalyze samples or flag sample data not meeting surrogate criteria
	Internal Standards	624	Frequency: Internal standards spiked into method blank and all samples (QC included) Criteria: All internal standard recoveries must be within laboratory control limits Corrective Action: Flag sample data not meeting internal standard recovery requirements	8260B	Internal Standards are added to all samples (QC samples included). Internal standard area of daily standard must be within 50% to 200% of the response in the mid level of the initial calibration standard. The retention time (RT) for any internal standard (IS) in the continuing calibration must not exceed ± 0.5 minutes from mid level initial calibration standard IS RT.

Footnotes

[1] National Pollutant Discharge Elimination System

[2] Resource Conservation and Recovery Act, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA (August 1993), Final Update II (September 1994), Final Update IIB (January 1995), and Final Update III (December 1996)

[3] Method not listed in 40 CFR Part 136

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SECTION 14.0

PREVENTIVE ACTION
(*NELAC 5.4.11)*

14.1 OVERVIEW

The laboratory's preventive action programs improve, or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive continuous process improvement activity that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes our TestAmerica North Canton commitment to the Quality Assurance (QA) program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the QA Metrics Report, internal or external audits, proficiency testing performance, client complaints, staff observation, etc.

The monthly Quality Assurance Metrics Report shows performance indicators in all areas of the quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, Ethics training, etc. These metrics are used to help evaluate quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's Corrective Action process (Section 13) is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action provides a valuable mechanism for identifying preventive action opportunities.

14.1.1 The following elements are part of a preventive action system:

- Identification of an opportunity for preventive action.
- Process for the preventive action.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action. Documentation of Preventive Action is incorporated into the monthly QA reports, corrective action process, management review, and the Management of Change process (see below).

Note: There may be varying levels of formality and documentation during the preventive action process due to the simplicity/complexity of the action taken.

14.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the Annual Management Review (Section 17). A highly detailed recap is not required; a simple recount of success and failure within the preventive action program will provide management a measure for evaluation.

14.2 MANAGEMENT OF CHANGE

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of changes covered under this system include: Facility Changes, Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation, Key Personnel Changes, Laboratory Information Management System (LIMS) changes. This process is discussed in further detail in SOP CA-Q-S-003, Management of Change.

SECTION 15.0

CONTROL OF RECORDS
(NELAC 5.4.12)

TestAmerica North Canton maintains a record system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued as described in SOP NC-QA-0019, Records Information Management.

15.1 OVERVIEW

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 15-1. Quality records are maintained by the Quality Assurance (QA) Manager in a database which is backed up as part of the regular network backup. Records are of two types--either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by the Records Manager.

Table 15-1. Record and Retention Schedule

Type of Record	Retention	Disposition
General Laboratory Documents		
Instrument output	5 yrs from project completion	Shred or burn
Quality control data	5 yrs from project completion	Shred or burn
Field sample data	5 yrs from project completion	Shred or burn
Final analytical reports	5 yrs from project completion	Shred or burn
Instrument logbooks	5 yrs from last entry	Shred or burn
Equipment monitoring & maintenance records	5 yrs from last entry	Shred or burn
Instrument calibration records	5 yrs from last entry	Shred or burn
Standard preparation logs	5 yrs from last entry	Shred or burn
Standards certificates	5 yrs from last entry	Shred or burn
Measurement & test equipment logs (e.g., refrig., balances, etc.)	5 yrs from last entry	Shred or burn
Method & instrument validation records	5 yrs from last entry	Shred or burn
Instrument manuals	Retain until superseded	Trash
Project management files	5 yrs from date of archival	Shred or burn
Quotes & proposals	2 yrs from date of expiration	Shred or burn

Type of Record	Retention	Disposition
LQM, policies, & SOPs	5 yrs from date of archiving	Shred or burn
Analyst demonstrations of proficiency	5 yrs from date of archival	Shred or burn
Quality assurance audits	5 yrs from last entry	Shred or burn
Certifications & approvals	5 yrs from last entry	Shred or burn
Employee signature list	5 yrs from date of archival	Shred or burn
MDL Studies	5 yrs from last entry	Shred or burn
Performance testing studies	5 yrs from last entry	Shred or burn
QA reports to management	5 yrs from last entry	Shred or burn
Quality control charts	5 yrs from last entry	Shred or burn
Environment, Health and Safety Records		
Medical records	Retain while active & 30 yrs from last entry	Shred or burn
Employee exposure & monitoring records	Retain while active & 30 yrs from last entry	Shred or burn
Workers compensation files & first report of injury	Retain while active & 30 yrs from last entry	Shred or burn
Accident logs (OSHA Form 200)	5 yrs from last entry	Shred or burn
Accident reports	5 yrs from last entry	Shred or burn
Environmental permits	5 yrs from last entry	Shred or burn
Environmental management, e.g., discharge reports	5 yrs from last entry	Shred or burn
Health & safety audits	5 yrs from last entry	Shred or burn
Chemical Hygiene Plan	5yrs from archival	
Safety Inspections	5 yrs from last entry	Shred or burn
TLD exposure records	5 yrs from last entry	Shred or burn
EH&S training	5 yrs from last entry	Shred or burn
Accounting	See Accounting and Controls Procedures Manual	
Administrative		
Personnel records (not including medical or disability records)	7 years from last entry	Shred or burn

All records are legible and stored and retained in such a way that they are secure and readily retrievable at the laboratory facility that provides a suitable environment to prevent damage or deterioration and to prevent loss. Records are maintained for a minimum of five years unless other wise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 15-2 have lengthier retention requirements and are subject to the requirements in Section 15.1.3. Policy CW-L-P-001, Record Retention, provides additional information on record retention requirements.

15.1.1 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 15-3 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 15-2. Special Record Retention Requirements

Program	Retention Requirement
Ohio – Drinking Water	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
OSHA - 40 CFR Part 1910	30 years
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement and others as negotiated.
Ohio Voluntary Action Program	10 years

15.1.2 All records are held secure and in confidence. Records maintained at the laboratory are located in the Records Storage area of the Warehouse. Records archived off-site are stored in a secure location where a record is maintained of any entry into the storage facility. Logs are maintained in each storage box to note removal and return of records.

15.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is

maintained as hardcopy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, see Section 20.12.1, Computer and Electronic Data Related Requirements, for more information.

15.1.4 The record-keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. (Records stored off site should be accessible within two days of a request for such records). The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory copy of the Chain-of-Custody is stored with the invoice and the Work Order sheet generated by LIMS. The Chain-of-Custody would indicate the name of the sampler. If any sampling notes are provided with a Work Order, they are kept with this package.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record-keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes, e.g., set format for naming electronic files, set format for what is included with a given analytical data set. SOP NC-QA-0019, Records Information Management, outlines this procedure. Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method; a copy of each day's run long or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in logbooks or entered into the LIMS for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "Sampled by," "Prepared by," "Reviewed by", or "Analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost, and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy which was scanned.

- Also refer to Section 20.13.1, "Computer and Electronic Data Related Requirements".

15.2 TECHNICAL AND ANALYTICAL RECORDS

15.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement (refer to Section 15.1). The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for sample preparation, performance of each analysis and checking of results.

15.2.2 Observations, data and calculations are recorded at the time they are made and are identifiable to the specific task.

15.2.3 Changes to hardcopy records shall follow the procedures outlined in Sections 13 and 20. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include (previous discussions relate where most of this information is maintained – specifics may be added below):

- Laboratory sample ID code
- Date of analysis and time of analysis is required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs where available. Instrument logs may be in electronic format.
- analysis type
- all manual calculations and manual integrations
- analyst or operator initials/signature
- sample preparation
- test results
- standard and reagent origin, receipt, preparation, and use
- calibration criteria, frequency and acceptance criteria
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions
- quality control protocols and assessment
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

15.3 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

15.3.1 Sample Handling Records

Sample handling and tracking is discussed in Section 24. Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

15.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hardcopy form (see Table 15-1).

15.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

15.5.1 All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure, and in confidence to the client. Certification-related records are available to the accrediting body upon request.

15.5.2 All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

15.5.3 Records that are stored or generated by computers or personal computers have hardcopy, write-protected backup copies, or an electronic audit trail controlling access**.**

15.5.4 TestAmerica North Canton has a record management system for control of instrument logbooks, standards logbooks, and records for data reduction, validation, storage, and reporting. Benchsheets are filed sequentially per method.

15.5.5 Records are considered archived when moved to Records Storage. Access to archived hard-copy information is documented with an access log and in/out records is used in archived boxes to note data that is removed and returned. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to the data is limited to laboratory and company employees**.**

15.5.6 In the event that the laboratory transfers ownership or goes out of business, TestAmerica North Canton shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous five years of such action.

15.5.7 **<u>Records Disposal</u>**

15.5.7.1 Records are removed from the archive and disposed after five years, unless otherwise specified by a client or regulatory requirement. On a project-specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration.

15.5.7.2 Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

15.5.7.3 If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required. Refer to Policy CW-L-P-001, Records Retention.

SECTION 16

AUDITS
(NELAC 5.4.13)

16.1 OVERVIEW

Audits measure laboratory performance and insure compliance with accreditation/certification and project requirements. Audits specifically provide management with an on-going assessment of the quality of results produced by the laboratory, including how well the policies and procedures of the QA system and the Ethics and Data Integrity Program are being executed. They are also instrumental in identifying areas where improvement in the QA system will increase the reliability of data. There are two principle types of audits: Internal and External. Internal audits are performed by laboratory or corporate personnel. External audits are conducted by regulators, clients or third-party auditing firms. In either case, the assessment to program requirements is the focus.

Table 16-1. Audit Types and Frequency

Internal Audits	Description	Performed by	Frequency
	Analyst & Method Compliance	QA Department or Designee	- 100% of all methods over a two year period. - 100% of all analysts annually.
	Instrument	QA Department or Designee	100% of all organic instruments and any inorganic chromatography instruments. Annually.
	Work Order/ Final Report	QA Department or Designee	- 1 complete report each month.
	Support Systems	QA Department or Designee	- Annual for entire labs support departments & equipment (e.g., thermometers, balances), can be divided into sub-sections over the course of the year.
	Performance Audits (Double-Blind PTs)	Corporate QA, Laboratory QA Department or Designee	- As needed.
	Special	QA Department or Designee	- As Needed
External Audits	**Description**	**Performed by**	**Frequency**
	Program / Method Compliance	Regulatory Agencies, Clients, accreditation organizations	- As required by program and/or clients needs
	Performance Audits	Provided by a third party.	- As required by a client or regulatory agency. Generally provided semi-annually through the analysis of PT samples.

16.2 INTERNAL AUDITS

Annually, the laboratory prepares a schedule of internal audits to be performed throughout the year. As previously stated, these audits verify and monitor that operations continue to comply with the requirements of the laboratory's QA Manual and the Corporate Ethics Program. A

schedule of internal audits is maintained by the QA Manager in the *Internal Audit Workbook*. An example can be found in Figure 16-1.

It is the responsibility of the QA Manager to plan and organize audits in consideration of the laboratory workload and the department personnel schedules so that all pertinent personnel and operations are thoroughly reviewed. When designees (other than QA Department personnel and approved by the QA Manager) perform audits, the QA Manager shall ensure that these persons do not audit their own activities, except when it can be demonstrated that an effective audit will be carried out. In general, the auditor:

- Is neither the person responsible for the process being audited nor the immediate supervisor of the person responsible for the project/process.
- Is free of any conflicts of interest.
- Is free from bias and influences that could affect objectivity.

Laboratory personnel (e.g., supervisors and analysts) may assist with both method and support system audits as long as the items listed in the above paragraph are observed. These audits are conducted according to defined criteria listed in the checklists of the *Internal Audit Workbook.* These personnel must be approved by the QA Manager; and must complete the audit checklists in their entirety. This process introduces analyst experience and insight into the laboratory's auditing program.

The auditor must review the previous audit report and identify all items for verification of corrective actions. A primary focus will be dedicated to the ability of the laboratory to correct root-cause deficiencies and that the corrective action has been implemented and sustained as documented.

16.2.1 Systems

An annual Systems audit is required to ensure compliance to analytical methods and SOPs, laboratory Data Integrity and Ethics Policies, NELAC quality systems, client, and State requirements. This audit is performed in portions throughout the year through method, analyst, instrument, Work Order/Final Report, and support system audits. Audits are documented and reported to management within one week of their performance. Systems audits cover all departments of the facility--both operational and support. The multiple audits are compiled into one systems audit package at the end of the year (*Internal Audit Workbook*).

16.2.1.1 Method, Analyst, Instrument and Work Order/Final Report Audits

Procedures for the method compliance, analyst, instrument and work order/final report audits are incorporated by reference to SOP CA-Q-S-004, Method Compliance and Data Authenticity Audits. These audits are not mutually exclusive. For example, the performance of a method audit will also cover multiple analysts and instruments. The laboratory's goal is to annually review all analysts and instruments as described in SOP CA-Q-S-004. The laboratory will also audit all methods within a two-year time period, and audit a minimum of one Work Order/Final Report from receiving through reporting on a monthly basis.

16.2.1.2 Support Systems

Support system audits are performed to ensure that all departments & ancillary equipment are operating according to prescribed criteria. Support system audits include the review of both non-analytical and operational departments. Support equipment audits, e.g., metrology items, include the review of balance calibrations, weight calibrations; water quality testing, etc.. Non-analytical may include sample receiving and bottle preparation. These types of support audits ensure that the operations are being performed to support ethical data as well as ensuring the accuracy & precision of the utilized equipment.

These audits can be performed in portions throughout the year or in one scheduled session. However, the audit schedule must document that these aspects are reviewed annually. Many of the metrology systems are considered to be surveillance activities that can be monitored by QA personnel or delegated to specified department personnel. These surveillance activities are performed on a semi-annual basis unless issues warrant a greater frequency or previous audits continually showing no deficiencies allow the frequency to be reduced to once a year.

An example audit checklist can be found in Figure 16-2. Instructions for reporting findings are included in the *Internal Audit Workbook*. In general, findings are reported to management within 1 week of the audit and a response is due from management within 30 days.

16.2.2 Performance Audits

Corporate QA may arrange for double blind PT studies to be performed in the laboratories. Results are given to Management and Corrective actions of any findings are coordinated at each facility by the QA Managers and Laboratory Directors/Managers. These studies are performed on an as needed basis. They may be performed when concerns are raised regarding the performance of a particular method in specific laboratories, periodically to evaluate methods that may not normally be covered in the external PT program or may be used in the process of developing best practices. The local QA Manager may also arrange for PT studies on an as needed basis (refer to Section 16.3.2 for additional information on Performance Audits).

16.2.3 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

16.3 EXTERNAL AUDITS

TestAmerica facilities are routinely audited by clients and external regulatory authorities. External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is the TestAmerica policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. The Laboratory Supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. This time frame is generally 30 days.

Be aware that NELAC requires that the audit response report be acceptable to the primary accrediting authority after the second submittal. The lab shall have accreditation revoked for all or any portion of its scope of an accreditation for any or all fields of testing, a method, or analyte within a field of testing if it is not corrected.

TestAmerica North Canton cooperates with clients and their representatives to monitor laboratory performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

16.3.1 Confidential Business Information (CBI) Considerations

During on-site audits, on-site auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2003 NELAC standards.

16.3.2 Performance Audits

The laboratory is involved in performance audits conducted as directed by state agencies through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies—water pollution and soil studies.

- It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Further, where PT samples present special or unique problems in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

- PTs generally do not have holding times associated with them. In the absence of any holding time requirement, it is recommended that the holding time begin when the PT sample is prepared according to the manufacturer's instructions. Holding times should apply to full volume PT samples only if the provider gives a meaningful "sampling date". If this is not provided, it is recommended that the date/time of opening of the full volume sample be considered the beginning of holding time.

- Login will obtain the COC information from the documentation provided with the PTs with review by QA or other designated staff.

- Vials will be prepared as required in the instruction set provided with the samples. After preparation to full volume the sample may be spiked, digested, concentrated, etc., as would be done for any normal sample requiring similar analysis.

- PT samples will not undergo multiple preps, multiple runs, multiple methods (unless being used to evaluate multiple methods), multiple dilutions, UNLESS this is what would be done to a normal client sample. An example of this is if a client requests, as PT clients do, that we split VOA coeluters, then dual analysis IS normal practice.

- The type, composition, concentration and frequency of quality control samples analyzed with the PT samples shall be the same as with routine environmental samples.

- Instructions may be included in the laboratory SOPs on how low-level samples are analyzed, including concentration of the sample or adjustment of the normality of titrant. When a PT sample falls below the range of the routine analytical method, the low-level procedure may be used. Results below the routine reporting limit are reviewed against PT instructions and analyte PT reporting limit values.

- No special reviews shall be performed by operation and QA, UNLESS this is what would be done to a normal client sample. To the degree that special report forms or login procedures are required by the PT supplier, it is reasonable that the laboratory WOULD apply special review procedures, as would be done for any client requesting unusual reporting or login processes.

- Written responses to unacceptable PT results are required. In some cases, it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

16.4 AUDIT FINDINGS

Internal or External Audit findings should be documented using the corrective action process. The laboratory is expected to prepare a response to audit findings within 30 days of receipt of an audit report unless the report specifies a different time frame. The response may include action plans that could not be completed within the 30-day timeframe. In these instances, a completion date must be set and agreed to by Operations Management and the QA Manager.

Responsibility for developing and implementing corrective actions to findings is the responsibility of the Group Leader where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory must take timely corrective action, and must notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

The procedures must be in accordance to SOP CA-L-S-001, Internal Investigations of Data Discrepancies and Determination of Data Recall.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24 hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

Figure 16-1.

Example - Internal Audit Workbook

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica <Name>
Last Updated: 9/10/2007
Workbook Instruction No. CA-Q-WI-011

Internal Audit Workbook
Summary Page

Note: Click on the (Summary Page) to located on each audit sheet to return to this page.

*** The lab may choose to audit these areas with each method/analyst/instrument audit. The auditor must document on the checklist that this item is audited as part of the <defined> audit.**

	Area Audited	Audit Type	Audit Cycle	Scheduled	Date Audited	Date Closed	Comments
	(Click on the Area to get to that Sprea	heet)					
1	Balances	System	6 mo				
2	Temperature Logs/Thermometers	System	6 mo				
3	Sample Storage and Disposal	System	1 yr				
4	Maintenance Logs *	System	6 mo				
5	Volatile Storage Blanks	System	6 mo				
6	Lab Water Quality Testing	System	6 mo				
7	Sample Log In	System	1 yr				
8	Shipping Procedures	System	1 yr				
9	Computer Operations (LIMS)	System	1 yr	Pending Corp. IT Policies			
10	SOP & Document Distribution System	System	1 yr				
11	Archiving Electronic & Paper Records	System	1 yr	Pending Corp. IT Policies			
12	Statistical Process Control	System	1 yr				
13	Data Review System	System	1 yr				
14	Final Report Generation	System	1 yr				
15	Standards/Reagents *	System	6 mo				
16	Manual Integration *	System	1 yr				
17	Corrective Action System	System	1 yr				
18	Training Records	System	6 mo				
19	MDLs	System	1 yr				
20	SOPs - Prep/Review/Update Process	System	1 yr				
21	Purchasing/Procurement	System	1 yr				
22	Eppendorf/Diluter/Dispenser Calibration Check	System	6 mo				
23	Subcontract Lab Approval	System	1 yr				
24	Customer Complaint System	System	1 yr				
25	Methods	Method	2 yr				
	....	....	....				
	.....	....	....				
	.....	....	....				

Figure 16-2.

Example – Internal Audit System Checklist: Corrective Actions

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica <Location>

INTERNAL AUDIT - Corrective Actions

(Summary Page)

[Printed Name(s) or Date(s)]

Area Audited:
Auditor:
Date:
Persons Contacted During Audit:

Date Reported to Department Manager:
Reported To:

Date Reported to Lab Director/Manager:
Reported To:

Date Response Due:

Response Received and Accepted by QA Manager:

Associated Corrective Action Report Number(s):

Scheduled Follow-up:

Item	Requirement	Ref.	Y	N	NA	Evidence/Comments	Follow Up
1	Does the laboratory have a corrective action program in place?	5.4.10.1					
2	Does the laboratory have a current corrective action SOP or is this information in the QA Manual?	5.4.10.1					
3	Do all laboratory personnel have documented training and access to initiate corrective actions?	5.4.10.1					
4	Are causes clearly identified by department, staff name, scope of issue (how many reports affected)?	5.4.10.6					
5	Is a root cause for the issue identified?	5.4.10.2					
6	Is a corrective action (plan) clearly described?						
7	Was the corrective action fully implemented?						
8	Is documentation (if applicable) completed as specifed by the corrective action (training, revised SOP, etc)						
9	Has a follow-up assessment been conducted to verify the corrective action was successful?						
10	Are corrective actions reviewed on a regular basis by management?	5.4.10.6a 5					
11	Is there a defined distribution flow for corrective action notification, review, closure, and follow-up?	5.4.10.6a					
12	Are non-conformances reviewed on a regular basis and used, if necessary, to initiate root cause corrective actions?						
13	Does the lab have a documented procedure for QC corrective action (i.e., documented within each method / parameter SOP or in the QA Manual)?	4.10.1					
14	***Verify Corrective Actions from previous systems audits. List Items:***						
15							
16							
17							

Auditor Signature:_____

Primary Reference(s): Corporate SOP CA-Q-S-002, Acceptable Manual Integration Practices
NELAC Standard, June 2003
DoD Quality Systems Manual, Version 3, January 2006
EPA Manual for the Certification of Laboratories Analyzing Drinking Water

SECTION 17

MANAGEMENT REVIEWS
(NELAC 5.4.14)

17.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director/Manager for review and comments. The final report shall be submitted to the Laboratory Director as well as the appropriate Quality Director and General Manager. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. At a minimum, the report content will contain the items listed below. During the course of the year, the Laboratory Director/Manager, General Manager or Corporate QA may request that additional information be added to the report.

The TestAmerica QA Report template is comprised of a discussion of three key QA issues facing the laboratory and ten specific sections (Figure 17-1):

- **Metrics:** Describe actions or improvement activities underway to address any outlying quality metrics that have been reported in the monthly Quality System Metrics Table.
- **Quality System Metrics Table:** The report also includes statistical results that are used to assess the effectiveness of the quality system. Effective quality systems are the responsibility of the entire laboratory staff. Each laboratory provides their results in a template provided by Corporate QA (Figure 17-2).
- **SOPs:** Report SOPs that have been finalized and report status of any outstanding SOP reviews.
- **Corrective Actions:** Describe highlights and the most frequent cause for report revisions and corrective/preventive action measures underway. Include a discussion of any recalls handled at the lab level as per Section 6.2.2 in the Investigation/Recall SOP, CA-L-S-001. Include a section for client feedback and complaints. Include both positive and negative feedback. Describe the most serious client complaints and resolutions in progress.
- **MDLs and Control Limits:** Report which MDLs/ MDL verifications are due. Report the same for Control Limits.
- **Audits:** Report Internal and External Audits that were conducted. Include all relevant information such as which methods, by whom, corrective actions needed by when and discuss unresolved audit findings.
- **Performance Testing (PT) Samples:** Report the PT tests that are currently being tested with their due dates, report recent PT results by study, acceptable, total reported and the month and year.
- **Certifications:** Report on any certification programs being worked on by due date, packages completed. Describe any issues, lapses, or potential revocations.
- **Regulatory Updates:** Include information on new state or federal regulations that may impact the laboratory. Report new methods that require new instrumentation, deletion of methods, changes in sampling requirements and frequencies etc…

- **Miscellaneous:** Include any issues that may impact quality within the laboratory.
- **Next Month:** Report on plans for the upcoming month.
- **Lab Director Comments Section:** This section gives the Laboratory Director/Manager the opportunity to comment on issues discussed in the report and to document plans to resolve these issues. Unresolved issues that reappear in subsequent monthly reports must be commented on by the Laboratory Director/Manager.
- **Quality System Metrics Table:** The report also includes statistical results that are used to assess the effectiveness of the quality system. Effective quality systems are the responsibility of the entire laboratory staff. Each laboratory provides their results in a template provided by Corporate QA (Figure 17-2).

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The VP-QA/EHS prepares a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Analytical Division Senior Management Team and General Managers.

17.2 ANNUAL MANAGEMENT REVIEW

The Senior Lab Management Team (Laboratory Director, Technical Director, Operations Manager, QA Manager, HR Supervisor, I.T. Supervisor) conducts an annual review of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. Corporate Operations and Corporate QA personnel may be included in this meeting at the discretion of the Laboratory Director/Manager. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that cannot be solved by the lab and report them to Corporate IT.

This review uses information generated during the preceding year to assess the “big picture” by ensuring that routine quality actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review (refer to Section 17.1) should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review
- Prior Monthly QA Reports issues
- Laboratory QA Metrics
- Review of report reissue requests
- Review of client feedback and complaints
- Issues arising from any prior management or staff meetings
- Minutes from prior Senior Management team meetings. Issues that may be raised from these meetings include:

- Adequacy of staff, equipment and facility resources
- Adequacy of policies and procedures
- Future plans for resources and testing capability and capacity

- The annual internal double blind PT program sample performance (if performed)
- Compliance to the Ethics Policy and Data Integrity Plan, including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

The annual review includes the previous 12 months. Based on the annual review, a report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants
- A reference to the existing data quality related documents and topics that were reviewed
- Quality system or operational changes or improvements that will be made as a result of the review, e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)

The QA Manual is also reviewed at this time, and revised to reflect any significant changes made to the quality systems.

17.3 POTENTIAL INTEGRITY RELATED MANAGERIAL REVIEWS

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. The Corporate Data Investigation/ Recall SOP shall be followed (SOP CA-L-S-001). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

The Chairman/CEO, President/CEO, COOs, and Quality Directors receive a monthly report from the VP of Quality and EHS summarizing any current data integrity or data recall investigations as described in SOP CA-L-S-001. The General Managers are also made aware of progress on these issues for their specific labs.

Figure 17-1.

Example - QA Monthly Report to Management

LABORATORY: x
PERIOD COVERED: Month/Year
PREPARED BY: x DATE: Month Day, Year
DISTRIBUTED TO: xx (Include LD, GM, QA Director, etc…)

THREE KEY ISSUES FOR MONTH:
Include a discussion of three key issues that were focused in on this month.
1. x
2. x
3. x

---

1. METRICS
Describe actions or improvement activities underway to address any outlying quality metrics.

2. SOPs

See Tab for SOP specifics.

The following SOPs were finalized (or reviewed for accuracy): (See Tab)

The following SOPs are due to QA: xx

In QA to complete: xx

3. CORRECTIVE ACTION

Highlights: xx

Revised Reports:
Describe the most frequent cause for report revisions and corrective/preventive action measures underway.

Data Investigations/Recalls (Corporate Data Investigation/Recall SOP) :
Include a discussion of any recalls handled at the lab level as Corp SOP.

Client Feedback and Complaints:
Include both positive and negative feedback.

Describe the most serious client complaints) and resolutions in progress.

4. MDLs AND CONTROL LIMITS

MDLs Due:

Control Limits Due:

5. AUDITS

INTERNAL AUDITS

Discuss Any Outstanding Issues (or Attach Summary):

EXTERNAL AUDITS
Discuss Any Outstanding Issues (or Attach Summary):

6. PT SAMPLES

The following PT samples are now in house (Due Dates):
xx

7. CERTIFICATIONS

Certification Packages Being Worked On (Include Due Date):
x

Describe any issues, lapses, or potential revocations.

8. REGULATORY UPDATE
Include information on new state or federal regulations that may impact the laboratory – new methods that require new instrumentation, deletion of methods, changes in sampling requirements or frequencies, …

9. MISCELLANEOUS
Include any issues that may impact quality within the laboratory.

10. NEXT MONTH
Items planned for next month.

LAB DIRECTOR COMMENTS AND PLANNED CORRECTIVE ACTIONS:	
LAB DIRECTOR REVIEW:	DATE:

Figure 17-2.

Example - Laboratory Metrics Categories

No. of reports for month
No. of reports revised due to lab error
Percent revised reports
No. of Data Recall Investigations
No. of reports actually recalled
No. of Corrective Action Reports
No. of Corrective Action Reports still open
Total number of unresolved open Corrective Action Reports
Percent of unresolved open Corrective Action Reports
No. of reports independent QA reviewed
Percent QA Data Review: Reports
No. of technical staff (analysts/technicians, including temps)
No. of analyst work product reviewed year-to-date
No. of analytical instruments with electronic data file storage capability
No. of Analytical instruments reviewed for data authenticity year-to-date
Percent Analyst/Instrument Data Authenticity Audits
No. of client complaints
No. of client compliments
No. of planned internal audits
No. of planned internal method audits performed year-to-date
Percent annual Internal Audits complete
No. of open Internal Audit findings past due
Total Number of External Audit findings
No. of open External Audit findings past due
Percent External Audit findings past due
No. of PT analytes participated and received scores
No. of PT analytes not acceptable
Percent PT cumulative score
No. of PT repeat analyte failures cumulative (analyte failed more than once in 4 consecutive studies by PT type--only applies to failed analytes)
No. of SOPs

No. of SOPs reviewed/revised within 24 months
No. of methods or administrative procedures without approved SOPs
SOP status
Method certification losses due to performance/audit issues
Hold Time violations due to lab error
Date of last Comprehensive Ethics Training session
No. of staff that haven't received Comprehensive Ethics Training (>90 days from employment date)
MDL status (good, fair, or poor) >90%, >70%, <70%
Training Documentation Records (good, fair, or poor)
LQM Revision/review date
QAM updated to new integrated template
Last annual Internal Audit date (opened, closed)
Last Management QS Review date
No. of SOPs required for 12-month review cycle (DOD *or drinking water)*
No. of SOPs for 12-month cycle/revised within 12 months *(Includes QS and Methods Listed in QSM)*
12-month percent SOP status *(Includes QS and Methods Listed in QSM)*

SECTION 18

PERSONNEL
(NELAC 5.5.2)

18.1 OVERVIEW

TestAmerica's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Appendix 2.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

18.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

TestAmerica makes every effort to hire analytical staff that posses a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. There are competent analysts and technicians in the industry who have not earned a college degree. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are

located on the TestAmerica intranet "Human Resources" web-page (also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc. are also considered

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Directors/Department Managers – **General**	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee
Technical Director – **Wet Chem** only (no advanced instrumentation)	Associate degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience

Specialty	Education	Experience
Technical Director - Microbiology	Bachelors degree in applied science with at least 16 semester hours in general microbiology and biology An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years of relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Department Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

18.3 TRAINING

TestAmerica is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame*	Employee Type
New Hire Orientation	Immediately	All
Environmental Health & Safety Orientation	Day of hire	All
Environmental Health & Safety Orientation Follow-up Test	30-60 days after hire	All
Environmental Health & Safety Training	Refer to EH&S Manual	All
Ethics – New Hires	1 week of hire	All
Ethics - Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 20.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in the employee's training file.
- Documentation of proficiency (refer to Section 20).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct, e.g., ethics. This information is maintained in the employee's secured personnel file.

Further details of the laboratory's training program are described in the Laboratory Training SOP CORP-QA-0013, Employee Orientation and Training.

18.4 DATA INTEGRITY AND ETHICS TRAINING PROGRAM

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times, TestAmerica has established an Ethics Policy CA-L-P-001 and an Ethics Statement/Agreement (Appendix 1). All initial and annual training is documented by signature on the signed Ethics Statement/Agreement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts; and for that reason, TestAmerica has a zero tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting
- Ethics Policy (Appendix 1)
- How and when to report ethical/data integrity issues. Confidential reporting.

- Record keeping
- Discussion regarding data integrity procedures
- Specific examples of breaches of ethical behavior--peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion
- Internal monitoring. Investigations and data recalls
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient

Additionally, a Data Integrity Hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 19

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS
(NELAC 5.5.3)

19.1 OVERVIEW

TestAmerica North Canton is an 11,466 sq ft secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity-controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, and administrative functions.

19.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory. A 225KVA UPS is installed in the main electrical bus to provide at least 15 minutes of backup power in the event of a power failure. This unit also provides voltage and frequency control of lab and office power. A spike/surge arrestor is installed to protect against power surge/sag and lightning strikes. A 30 KW natural gas-fueled backup generator is installed to provide power to the I.T. area in the event of a power failure. Additionally, this generator provides power to two walk-in sample

storage coolers and several other smaller sample storage coolers. Smaller portable generators are available to provide "spot power" where needed in the event of a power failure.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels (refer to Section 12).

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

19.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory.

Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

19.4 FLOOR PLAN

A floor plan can be found in Appendix 3.

19.5 BUILDING SECURITY

Building keys are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of TestAmerica North Canton. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed.

Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

Signs are posted in the laboratory designating employee only areas - "Authorized employees beyond this point".

SECTION 20.0

TEST METHODS AND METHOD VALIDATION
(NELAC 5.5.4)

20.1 OVERVIEW

TestAmerica North Canton uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples; and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

20.2 STANDARD OPERATING PROCEDURES (SOPs)

TestAmerica North Canton maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory (refer to Section 6 on Document Control):

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for preparation, review, revision, and control are incorporated by reference to SOP CW-Q-S-002, Writing a Standard Operating Procedure (SOP), and SOP NC-QA-0027, Preparation and Management of Standard Operating Procedures.
- SOPs are reviewed at a minimum of every two years (annually for Drinking Water and DoD SOPs); and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

20.3 LABORATORY METHODS MANUAL

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP. Refer to the corporate SOP CW-Q-S-002, Writing a Standard Operating Procedure, and SOP NC-QA-0027, Preparation and Management of Standard Operating Procedures, for content and requirements of technical and non-technical SOPs.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from

the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

20.4 SELECTION OF METHODS

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services, e.g., special matrices, non-routine compound lists, etc., the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

20.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

In general, TestAmerica North Canton follows procedures from the referenced methods shown below in Section 20.3.1.4.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

20.4.1.1 The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM); Non-polar Material) by Extraction and Gravimetry, EPA-821-R-98-002, February 1999*
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*

- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

TABLE 20-1. Wet Chemistry Methods [1]

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Acidity	Water		305. [2] SM 2310 B	--	--
Alkalinity, Bicarbonate, Carbonate	Water		305. [2] SM 2320 B		
	Solid		EPA 310.1[2] (M)	--	--
Arsenic (ASV) Anodic Stripping Voltammetry	Water		--	EPA 7063	--
Ash Content	Solid		--	--	ASTM D29-74
Biochemical Oxygen Demand, Carbonaceous	Water		EPA 405.1 SM 5210 B	--	--
Bromide	Water		EPA 300.0A	EPA 9056A	--
	Waste		EPA 300.0A	EPA 9056A	--
	Solid		EPA 300.0A (M)	EPA 9056A	--
Cation-Exchange Capacity	Solid		--	EPA 9081	--
Chemical Oxygen Demand	Water		EPA 410.4 SM 5220D	--	--
	Waste		EPA 410.4	--	--
Chloride	Water		EPA 300.0A EPA 325.2[2]	EPA 9056A EPA 9251	EPA 325.2[2]
	Waste		EPA 300.0A	EPA 9056A	--
	Solid		EPA 300.0A (M)	EPA 9056A EPA 9251(M)	--

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Chromium, Hexavalent	Water		EPA 3500-Cr-D	EPA 7196A	--
	Waste		EPA 3500-Cr-D	EPA 7196A	--
	Solid		--	EPA 3060A EPA 7196A	--
Specific Conductance	Water		EPA 120.1 SM 2510B	EPA 9050A	--
	Waste		EPA 120.1	EPA 9050A	--
	Solid		--	EPA 9050A	--
Chlorine, Residual	Water		EPA 330.5[2] SM 3500 CL-G	--	--
Cyanide (Amenable)	Water		EPA 335.1[2] SM 4500 CN-G	EPA 9012A	--
	Solid		--	EPA 9012A	--
Cyanide (Total)	Water		SM 4500-CN E EPA 335.4	EPA 9012A	---
	Waste		--	EPA 9012A	--
	Solid		--	EPA 9012A	--
Cyanide (Weak and Dissociable) (Free)	Water		SM 4500-CN I	--	--
Dissolved Oxygen	Water		360.1[2] SM 4500 O-G	--	--
Flash Point	Waste		--	EPA 1010	ASTM D93-9
	Solid		--	EPA 1010	ASTM D93-9
Fluoride	Water		EPA 300.0A EPA 340.2[2]	EPA 9056A	SM 4500 F-C, ISE
	Waste		EPA 340.2 (M)[2] EPA 300.0A (M)	EPA 9056A	--
	Solid		EPA 340.2 (M)[2] EPA 300.0A (M)	EPA 9056A	--
Iron, Ferrous & Ferric	Water		SM 3500 FE D	--	--
Hardness	Water		EPA 130.2[2]	--	SM 2340B
Moisture	Solid		---	EPA 160.3 (M) ASTM D2216-90	---
Nitrogen, Ammonia	Water		EPA 350.1	--	EPA 350.2[2]
	Waste		EPA 350.1	--	EPA 350.2[2]
	Solid		EPA 350.1	--	EPA 350.2[2]
	Water		SM 4500 NH_3-E (Titration)	--	--

Analytical Parameters Matrix	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Nitrogen, Ammonia (cont'd)	Water		SM 4500 NH_3-F (ISE)	--	--
Nitrite (NO_2)	Water		EPA 300.0A	EPA 9056A	--
	Waste		EPA 300.0A (M)	EPA 9056A	--
	Solid		EPA 300.0A (M)	EPA 9056A	--
Nitrate (NO_3)	Water		EPA 300.0A	EPA 9056A	SM 4500 NO_3-E
	Waste		EPA 300.0A (M)	EPA 9056A	--
	Solid		EPA 300.0A (M)	--	--
Nitrate plus Nitrite NO_2/NO_3	Water		EPA 353.2	--	--
	Waste		EPA 353.2	--	--
Total Kjeldahl Nitrogen (TKN)	Water		EPA 351.3	--	SM 4500 NO_3
	Waste		EPA 351.3	--	--
	Solid		EPA 351.3	--	--
Oil and Grease (Hexane Extractable Material)	Water		EPA 1664A	EPA 9071B	--
	Waste		EPA 1664A	EPA 9071B	--
	Solid		--	EPA 9071B	--
Ortho-phosphate o-PO_4	Water		EPA 300.0A EPA 365.1	EPA 9056A	SM 4500 P-E
	Waste		EPA 300.0A (M)	EPA 9056A	--
	Solid		EPA 300.0A (M) EPA 365.1	EPA 9056A	--
pH	Water		EPA 150.1[2]	EPA 9040B	EPA 9041
	Waste		SM 4500 H-B	EPA 9045C	--
	Solid		---	EPA 9045C	--
Paint Filter	Water		--	EPA 9095A	--
Phenolics	Water		EPA 420.1	--	--
	Waste		--	EPA 9065	--
	Solid		--	EPA 9065	--
Phosphorus (Total)	Water		EPA 365.1	--	SM 4500 P-E
	Waste		EPA 365.1	--	--
	Solid		EPA 365.1	--	--
Sulfate (SO_4)	Water		EPA 300.0A EPA 375.4[2]	EPA 9056A EPA 9038	--
	Waste		EPA 300.0A (M) EPA 375.4[2]	EPA 9056A EPA 9038	--
	Solid		EPA 300.0A (M)	EPA 9056A EPA 9038 (M)	--

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA	Other
Sulfide	Water		EPA 376.1[2]	EPA 9030A SM 4500	9030B/9034
Total Organic Carbon (TOC)	Water		EPA 415.1[2]	EPA 9060	SM 5310 D
	Waste		--	EPA 9060	--
	Solid		EPA 415.1 (M)	EPA 9060 (M)	Walkley-Black
Total Organic Halides (TOX)	Water		--	EPA 9020B EPA 9023(EOX)	EPA 450.1
	Waste		--	--	--
	Solid		--	EPA 9020B	--
Total Petroleum Hydrocarbons	Water		EPA 1664A (SGT-HEM)	EPA 9071B	--
	Waste		EPA 1664A (SGT-HEM)	EPA 9071B	--
	Solid		--	EPA 9071B	--
Total Solids	Water		EPA 160.3	--	--
	Waste		EPA 160.3	--	--
	Solid		EPA 160.3 (M)	--	--
Total Dissolved Solids	Water		EPA 160.1	--	2540E
Total Suspended Solids	Water		EPA 160.2	---	2540E
Volatile and Volatile Suspended Solids	Water		EPA 160.4	--	--
Settleable Solids	Water		EPA 160.5	--	--
Turbidity	Water		EPA 180.1	--	--

[1] Any matrix not listed is not applicable for the associated method
[2] Removed from 40CFR

TABLE 20-2. Methods for Mercury by Cold Vapor Atomic Absorption

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Mercury (CVAA)	Water		EPA 245.1	EPA 7470A	--
	TCLP Leachate		--	EPA 7470A	--
	Waste		--	EPA 7471A	--
	Solid		EPA 254.5	EPA 7471A	--

TABLE 20-3. Methods for Mercury by Cold Vapor Atomic Fluororescence

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Mercury, Low Level (CVAFS)	Water		EPA 245.7	--	EPA 1631E

TABLE 20-4. Methods for Metals by ICP and ICPMS

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Aluminum	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Antimony	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Arsenic	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Barium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Beryllium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Boron	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		EPA 200.7	EPA 6010B	---
Calcium	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		EPA 200.7	EPA 6010B	---
Cadmium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Cobalt	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Chromium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Copper	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Iron	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Lead	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Magnesium	Water		EPA 200.7	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7	EPA 6010B EPA 6020	---
Manganese	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Molybdenum	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Nickel	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Potassium	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		---	EPA 6010B	---
Selenium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Silver	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Sodium	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		---	EPA 6010B	---
Tin	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Thallium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Titanium	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		---	EPA 6010B	---
Vanadium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		---	EPA 6010B EPA 6020	---
Zinc	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---

TABLE 20-5. Metals Sample Preparation Methods

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Toxicity Characteristic Leaching Procedure (TCLP)	Water		---	EPA 1311	---
	Waste		---	EPA 1311	---
	Solid		---	EPA 1311	---
ICP Metals	Water		EPA 200.7	EPA 3005A EPA 3010A	---
	TCLP Leachate		---	EPA 3010A	---
	Waste		---	EPA 3050B	---
	Solid		---	EPA 3050B	---
ICPMS Metals	Water		EPA 200.8	EPA 3010A	---
	TCLP		---	EPA 3010A	---
	Waste		---	EPA 3050B	---
	Solid		---	EPA 3050B	---
CVAA Mercury	Water		EPA 245.1	EPA 7470A	---
	TCLP Leachate		---	EPA 7470A	---
	Waste		---	EPA 7471A	---
	Solid		---	EPA 7471A	
CVAFS Mercury Low Level	Water		EPA 245.7	---	EPA 1631E

TABLE 20-6. Organic Sample Preparation Methods

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Volatiles by GC/MS	Water		EPA 624	EPA 5030B	---
	Waste		---	EPA 5030B EPA 5035	---
	Solid		---	EPA 5035 EPA 5035A	---
Halogenated Volatiles by GC	Water		EPA 601	EPA 5030B	---
	Waste		---	EPA 5030B EPA 5035	---
	Solid		---	EPA 5035 EPA 5035A	---
Aromatic Volatiles by GC	Water		EPA 602	EPA 5030B	---
	Waste		---	EPA 5030B EPA 5035	---
	Solid		---	EPA 5035 EPA 5035A	---
Semivolatiles by GC/MS	Water		EPA 625	EPA 3510C EPA 3520C	---
	TCLP Leachate		---	EPA 3510C EPA 3520C	---
	Waste		---	EPA 3550B EPA 3540C EPA 3580A EPA 3541	---
	Solid		---	EPA 3550B EPA 3540C EPA 3541	---
Pesticides/PCBs by GC	Water		EPA 608	EPA 3510C EPA 3520C	---
	TCLP Leachate		---	EPA 3510C EPA 3520C	---
	Waste		---	EPA 3550B EPA 3540C EPA 3580A EPA 3541	---
	Solid		---	EPA 3550B EPA 3540C EPA 3541	---

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Herbicides by GC	Water		EPA 615	EPA 8151A	---
	Waste		---	EPA 8151A	---
	Solid		---	EPA 8151A	---
Total Petroleum Hydrocarbons (Gasoline Range) by GC	Water		---	EPA 5030B	WI GRO
	Waste		---	EPA 5030B EPA 5035	WI GRO
	Solid		---	EPA 5035 EPA 5035	WI GRO
Total Petroleum Hydrocarbons (Diesel Range) by GC	Water		---	EPA 3510C EPA 3520C	WI DRO
	TCLP Leachate		---	EPA 3510C EPA 3520C	---
	Waste		---	EPA 3550B EPA 3580A	WI DRO
	Solid		---	EPA 3550B	WI DRO

TABLE 20-7. Organic Methods of Analysis

Analytical Parameters	Matrix	Fields of Testing		
		CWA	RCRA (SW846)	Other
Volatiles by GC/MS	Water	EPA 624	EPA 8260B	---
	Waste	---	EPA 8260B	---
	Solid	---	EPA 8260B	---
Halogenated Volatiles by GC	Water	EPA 601	EPA 8021B	---
	Waste	---	EPA 8021B	---
	Solid	---	EPA 8021B	---
Aromatic Volatiles by GC	Water	EPA 602	EPA 8021B	---
	Waste	---	EPA 8021B	---
	Solid	---	EPA 8021B	---
Semivolatiles by GC/MS	Water	EPA 625	EPA 8270C	
	Waste	---	EPA 8270C	---
	Solid	---	EPA 8270C	---
Pesticides/PCBs by GC	Water	EPA 608	Pesticides 8081A PCBs 8082	---
	TCLP Leachate	---	Pesticides 8081A PCBs 8082	---
	Waste	---	Pesticides 8081A PCBs 8082	---
	Solid	---	Pesticides 8081A PCBs 8082	---
Phenoxyacid Herbicides by GC	Water	---	EPA 8151A	---
	TCLP Leachate	---	EPA 8151A	---
	Waste	---	EPA 8151A	---
	Solid	---	EPA 8151A	---
Gasoline Range Organics by GC	Water	---	EPA 8015B (M)	WI GRO
	Waste	---	EPA 8015B (M)	---
	Solid	---	EPA 8015B (M)	WI GRO
Total Petroleum Hydrocarbons (Diesel Range) by GC/FID	Water	---	EPA 8015B (M)	WI DRO
	Waste	---	EPA 8015B (M)	---
Dissolved Gases RSK-175	Water	---	---	SOP
Formaldehyde Carbonyl Compounds	Water	---	EPA 8315	---

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

20.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

20.4.2.1 A demonstration of capability is performed whenever there is a change in instrument type, method or personnel.

20.4.2.2 The initial demonstration of capability must be thoroughly documented and approved by the Technical Director and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures. Refer to Section 15, Control of Records.

20.4.2.3 The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct a method detection limit study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method).
- The reporting limit is set at or above the first standard of the curve for the analyte.
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. This must be addressed in the Case Narrative.

- Refer to Section 12, Control of Non-Conforming Work.

20.4.3 Initial Demonstration of Capability (IDOC) Procedures

20.4.3.1 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

20.4.3.2 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest. Refer to SOP CORP-QA-0013, Employee Orientation and Training, for details on this procedure.

A certification statement (see Figure 20-1 as an example) shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

20.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP/Methods Manual (Section 20.2) and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method. The information included in the checklist below (Figure 20-2) is needed before samples are accepted for analysis by a new method.

20.6 VALIDATION OF METHODS

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled (from 2003 NELAC Standard).

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

20.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

20.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some

cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

20.6.1.2 **Determination of Method Sensitivity**

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed. The laboratory determinations of MDLs are described in Section 20.6.

20.6.1.3 **Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)**

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum level at which both the presence of an analyte and its concentration can be reliably determined. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

20.6.1.4 **Determination of Interferences**

A determination that the method is free from interferences in a blank matrix is performed.

20.6.1.5 **Determination of Range**

Where appropriate, a determination of the applicable range of the method may be performed. In most cases, range is determined and demonstrated by comparison of the response of an analyte in a curve to established or targeted criteria. The curve is used to establish the range of quantitation and the lower and upper values of the curve represent upper and lower quantitation limits. Curves are not limited to linear relationships.

20.6.1.6 **Determination of Accuracy and Precision**

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

20.6.1.7 **Documentation of Method**

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

20.6.1.8 **Continued Demonstration of Method Performance**

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

20.7 METHOD DETECTION LIMITS (MDL)/ LIMITS OF DETECTION (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B, or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements (refer to Section 20.7.10). The analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL. To allow for some flexibility, this low level standard may be analyzed every batch or every week or some other frequency rather than doing the study all at once. In addition, a larger number of data points may be used if the appropriate t-value multiplier is used.

20.7.1 MDLs are initially performed for each individual instrument and non-microbiological method analysis. Unless there are requirements to the contrary, the laboratory will use the highest calculated MDL for all instruments used for a given method as the MDL for reporting purposes. This MDL is not required for methods that are not readily spiked, e.g., pH, turbidity, etc. Titration and gravimetric methods where there is no additional preparation involved, the MDL is based on the lowest discernable unit of measure that can be observed.

20.7.2 MDLs must be run against acceptable instrument QC, including ICVs and Tunes. This is to ensure that the instrument is in proper working condition and falsely high or low MDLs are not calculated.

20.7.3 Use only clean matrix which is free of target analytes (e.g.: Laboratory reagent water, Ottawa Sand) unless a project specific MDL is required in a field sample matrix.

20.7.4 The Reporting Limit should generally be between two and five times the MDL. If the MDL is being performed during method development, use this guideline to determine the Reporting Limit for the analysis. For DoD labs, the RL is $\geq$ 3x MDL. If a sample is diluted, the reported MDL is adjusted according to the dilution factor.

20.7.5 If the MDL is < 1/10 of the spike concentration for more than 10% of the analytes in the method (< 1/5 of spike recovered for DoD for water samples), the MDL must be repeated (including extraction or digestion) using a lower spike level unless the percent recovery is <50% or >150% of the "true value". Note: The concentration of the spike will be at a level below the calibration range. Note: The spiking concentration must be less than the reporting limit.

20.7.6 The calculated MDL cannot be not greater than the spike amount.

20.7.7 If the most recent calculated MDL does not permit qualitative identification of the analyte then the laboratory may use technical judgment for establishing the MDL (e.g., calculate what level would give a qualitative ID, compare with IDL (20.7), spike at a level where qualitative ID is determined and assign that value as MDL, minimum sensitivity requirements, Standard deviation of method blanks over time, etc.).

20.7.8 Each of the seven spikes must be qualitatively identifiable, e.g., appear in both columns for dual column methods, characteristic ions for GCMS mass spectra, etc. Manual integrations to force the baseline for detection are not allowed.

20.7.9 The initial MDL is calculated as follows:

$$MDL = t_{(n-1,\ 1-a\ =\ 0.99)} \times (\text{Standard Deviation of replicates})$$

where $t_{(n-1,\ 1-a\ =\ 0.99)} = 3.143$ for seven replicates.

20.7.10 Subsequent to the initial MDL determination, periodic MDL verification, confirmation or determinations may be performed by the procedure in 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices (e.g., method blanks over time, single standard spikes that have been subjected to applicable sample prep processes, etc.). The procedures utilized must be documented in the MDL SOP NC-QA-0021, Evaluation of Method Detection Limits for Chemical Tests.

20.7.11 Because of the inherent variability in results outside of the calibration range, TestAmerica does not recommend the reporting of results below the lowest calibration point in a curve; however, it is recognized that some projects and agencies require the reporting of results below the RL. Any result that falls between the MDL and the Reporting limit, when reported, will be qualified as an estimated value.

20.7.12 Detections reported down to the MDL must be qualitatively identified.

20.7.13 MDLs and Reporting limits are adjusted in LIMs based on moisture content and sample aliquot size.

20.8 INSTRUMENT DETECTION LIMITS (IDL)

20.8.1 The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

20.8.2 IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either by using seven replicate spike analyses, like MDL but without sample preparation, or by the analysis of ten instrument blanks and calculating three times the absolute value of the standard deviation.

20.8.3 If IDL is > than the MDL, it may be used as the reported MDL.

20.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

20.9.1 Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at approximately two times the calculated MDL. The analytes must be qualitatively identified or see Section 20.6.7 for other options. This verification does not apply to methods that are not readily spiked, e.g., pH, turbidity, etc. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established (see Section 20.6.7). MDLs must be verified at least quarterly.

20.9.2 When a Reporting limit is established, it must be initially verified by the analysis of a low-level standard or QC sample (LCS at 1-2 the reporting limit) and annually thereafter. Unless there are requirements to the contrary, the acceptance criteria is ±50%. The annual requirement is waved for methods that have an annually verified MDL.

20.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept in each department.

For GC, HPLC and IC methods, there must be sufficient separation between analyte peaks so as to not misidentify analytes. In the mid-level standard, the distance between the valley and peak height cannot be any less than 25% of the sum of the peak heights of the analytes. This also applies to GCMS in the case where the two compounds share the same quantitation ion.

Note: Some analytes do not separate sufficiently to be able to identify or quantitate them as separate analytes, e.g., m-xylene and p-xylene, and are quantitated and reported as a single analyte, e.g., m,p-xylenes.

Once the analyst has determined that the instrument is in optimum working condition through calibration and calibration verification procedures, he or she uses a mid-range calibration or calibration verification standard to establish the retention times for each of the individual analytes in a method. The analyst makes three injections of the same standard over a 72-hour (24-hr period for 300.0) period, tabulating the retention times for each analyte for each of the three injections. The width of retention time window is normally the average absolute retention time ± 3

Standard Deviations. A peak outside the retention time window will not be identified by the computer as a positive match of the analyte of interest.

It is possible for the statistically calculated RT window to be too tight and need to be adjusted based on analyst experience. In these instances method default retention time windows may be used, e.g., for 8000 series methods a default of 0.03 minutes may be used, and EPA CLP 0.05 minutes is used. The same concept is applied when any peak outside of that window will not be identified by the computer as a positive match.

The calibration verification standard at the beginning of a run may be used to adjust the RT for an analyte. This is essentially re-centering the window, but the size of the window remains the same. The RTs are verified when all analytes are within their RT windows and are properly identified.

20.11 EVALUATION OF SELECTIVITY

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, atomic absorption, or fluorescence profiles.

20.12 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

20.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

20.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

20.12.3 The uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

20.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent a 99%-certain range for the reported result. As an example, suppose that the result reported is 1.0 mg/l, and the LCS percent recovery range is 50 to 150%. The uncertainty range would be 0.5 to 1.5 mg/l, which could also be written as 1.0 +/- 0.5 mg/l.

20.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement, e.g., 524.2, 525, etc., and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

20.13 CONTROL OF DATA

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

20.13.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. The laboratory is currently running the QuantIMS LIMS which is a custom in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes AS400 which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

20.13.1.1 **Maintain the Database Integrity:** Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.

- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use.

  Note: "Commercial off-the-shelf software in use within the designed application range is considered to be sufficiently validated" f*rom NELAC 2003 Standard.* However, laboratory specific configurations or modifications are validated prior to use.

- In order to assure accuracy, all data entered or transferred into the LIMS data system goes through a minimum of two levels of review.

- The QA department performs random data audits to ensure the correct information has been reported.

- Changes to reports are documented via Change Order Forms and by noting "Revised" on the cover page.

- Analytical data file security is provided through three policies.
  - The first policy forbids unauthorized personnel from using laboratory data acquisition computers.
  - The second policy is the implementation of network passwords and login names that restrict directory access.
  - The third layer is maintained through the LIMS and includes the use of username/password combinations to gain access to the LIMS system, the fact that all data in the LIMS is associated with the user to added/reviewed the data, and the restriction of review authority of data.

- All software installations will be in accordance with any relevant copyright licensing regulations.

- All software installed on any computer within the laboratory must be approved by the Information Technology Department regional support technician assigned to the laboratory**.** Shrink-wrapped or otherwise sealed OEM software that is directly related to instrument usage does not need approval, but the Information Technology Department must be notified of the installation.

- Anti-virus software shall be installed on all servers and workstations. The anti-virus software shall be configured to check for virus signature file and program updates on a daily basis and these updates will be pushed to all servers and workstations. The anti-virus software will be configured to clean any virus-infected file if possible, otherwise the file will be deleted. Disks and CDs brought from any outside source that are not OEM software must be scanned for viruses before being accessed.

- **Interlab LIMS Permissions Policy**
  - <u>PURPOSE</u> - The purpose of this policy is to provide a mechanism for maintaining the integrity of information contained in each laboratory's LIMS while providing the necessary access for information sharing to staff at other laboratory facilities.

  - <u>DEFINITIONS</u> - Host Laboratory: The laboratory facility that 'owns' the LIMS system or 'hosts' a project/job.

  - <u>POLICIES</u>
    (a) All permissions for the laboratory's LIMS system must only be granted by a representative of that laboratory.
    - If someone outside of the host lab needs permissions for Project Management or other uses, they must go through the Lab Director or his/her designated representative.
    - Permissions must never be granted without the knowledge of the host laboratory.

    (b) Only laboratory analytical or QA staff from the home laboratory may have edit permissions for laboratory analysis data.

(c) Any changes made in laboratory's LIMS system:
- Must be documented and traceable.
- If made by staff of an affiliate lab, written permission from the home lab to make the changes (email approval is sufficient) is required.
- No corrections may be made in another laboratories system without their knowledge.

(d) Data qualifiers in laboratory reports must only be corrected, edited, etc. by the staff at the host laboratory.

(e) Full analytical data "View" only permissions may be granted to outside Project Management and Sales staff. Search permissions may also be granted so status may be checked.

(f) All qualifiers must be approved by QA staff before adding to standard reference tables.

(g) Please contact Corporate QA or IT staff if you have any questions regarding implementation or interpretation of this policy.

20.13.1.2 **Ensure Information Availability:** Protection against loss of information or service through scheduled back-ups, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

- Insured by timely backup procedures on reliable backup media, stable file server network architecture, and UPS protection

- UPS Protection:
  - Each fileserver is protected by an appropriate power protection/backup unit. In the event of a power outage, there is approximately 15-30 minutes of up-time for the servers prior to shutdown. This allows for proper shutdown procedures to be followed with the fileservers.

- File Server Architecture
  - All files are maintained on multiple Windows 2000 or newer servers which are secured physically in the Information Technology office. Access to these servers is limited to members of the Information Technology staff.
  - All supporting software is maintained for at least five years from the last raw data generated using that software. Length of time is dependent on local regulations or client requirements, e.g., OVAP requires ten years.

- System Back-up Overview and Procedures
  - Data from both servers and instrument attached PC's are backed up and purged in compliance with the corporate back-up policy.
  - A Maintenance Plan has been defined to create a daily archive of all data within the LIMS database to a backup location. This backup is initiated automatically by either the database or back-up system.

- Backup tapes will be stored in compliance with the corporate Data Backup Policy. Backup verifications are carried out in accordance with the corporate Data Backup Policy.
- Instrument data back-ups are verified on a periodic basis by the QA department when performing electronic data audits. The audit takes place on data that has been moved to a back-up location ensuring that it has been moved.

20.13.1.3 Maintain Confidentiality: Ensure data confidentiality through physical access controls, and encryption of when electronically transmitting data.

- All servers are located in a secure area of the IT department offices. Access to the servers is limited to IT staff members.
- The company website contains SSL (Secure Socket Layer) encryption for secure website sessions and data transfers.
- Electronic documents such as PDF files and electronic data deliverables may be made available to clients via the secure web site. The logon page for this web site contains an agreement that the customer must accept before they will be logged on which states that the customer agrees not to alter any electronic data made available to them.

20.13.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved, e.g., extractions, dilutions, instrument readings and concentrations. The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by peer review once updated in LIMS. The review checklists are signed by both the analyst and reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP CA-Q-S-002, *Acceptable Manual Integration Practices*.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it must not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

20.13.2.1 All raw data must be retained. All criteria pertinent to the method must be recorded. The documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

20.13.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. The units "mg/l" and "mg/kg" are the same as "parts per million (ppm)". The units "µg/l" and "µg/kg" are the same as "parts per billion (ppb)." For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%.

- Several environmental methods, such as color, turbidity, conductivity, use very specific, non-concentration units to report results (e.g., NTU, umhos/cm etc).

- Occasionally, the client requests that results be reported in units which take into account the measured flow of water or air during the collection of the sample. When they provide this information, the calculations can be performed and reported.

20.13.2.3 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

20.13.2.4 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file.

20.13.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 13.
- Logbooks are controlled by the QA Department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

20.13.4 Review / Verification Procedures

20.13.4.1 Data Recording Procedures: To ensure data integrity, all documentation of data and records generated or used during the process of data generation must be performed in compliance with Section 3 of this document and Policy T-Q-005, Recording Laboratory Observations and Raw Data.

20.13.4.2 Data Reduction and Verification Procedures: Data review procedures comprise a set of computerized and manual checks applied at appropriate levels of the measurement process. Data review begins with the reduction or processing of data and continues through verification of the data and the reporting of analytical results. Calculations are checked from the raw data to the final value prior to reporting results for each group of samples. Data reduction can be performed by the analyst who obtained the data or by another analyst. Data verification starts with the analyst who performs a 100% review of the data to ensure the work was done correctly the first time. Data verification continues with review by a second reviewer who verifies that data reduction has been correctly performed and that the analytical results correspond to the data acquired and processed.

20.13.4.2.1 Data Reduction and Initial Verification: Data reduction and initial verification may be performed by more than one analyst depending upon the analytical method employed. The preparation and analytical data may be reviewed independently by different analysts. In these instances, each item may not be applicable to the subset of the data verified or an item may be applicable in both instances. It is the responsibility of the analyst to ensure that the verification of data in his or her area is complete. The data reduction and initial verification process must ensure that:

- Sample preparation information is correct and complete including documentation of standard identification, solvent lot numbers, sample amounts, etc.
- Analysis information is correct and complete including proper identification of analysis output (charts, chromatograms, mass spectra, etc.)
- Analytical results are correct and complete including calculation or verification of instrument calibration, QC results, and qualitative and quantitative sample results with appropriate qualifiers
- The appropriate SOPs have been followed and are identified in the project and/or laboratory records
- Proper documentation procedures have been followed
- All non-conformances have been documented
- Special sample preparation and analytical requirements have been met.
- The data generated have been reported with the appropriate number of significant figures as defined by the analytical method in the LIMS or otherwise specified by the client.

In general, data will be processed by an analyst in one of the following ways:

- Manual computation of results directly on the data sheet or on calculation pages attached to the data sheets
- Input of raw data for computer processing

- Direct acquisition and processing of raw data by a computer.

If data are manually processed by an analyst, all steps in the computation shall be provided including equations used and the source of input parameters such as response factors (RFs), dilution factors, and calibration constants. If calculations are not performed directly on the data sheet, they may be attached to the data sheets.

Manual integrations are sometimes necessary to correct misintegrations by an automatic data system software program, but must only be performed when necessary. Further discussion of manual integrations and the required documentation is given in Policy S-Q-004, Acceptable Manual Integration Practices.

For data that are input by an analyst and processed using a computer, a copy of the input shall be kept and uniquely identified with the project number and other information as needed. The samples analyzed must be clearly identified.

If data are directly acquired from instrumentation or a test procedure and processed, or immediately entered into LIMS, the analyst must verify that the following are correct:

- Project and sample numbers
- Calibration constants and RFs
- Units
- Numerical values used for reporting limits.

Analysis-specific calculations for methods are provided in SOPs. In cases where computers perform the calculations, software must be validated or verified, as described in Section 6.0 of this document, before it is used to process data.

The data reduction is documented, signed and dated by the analyst completing the process. Initial verification of the data reduction by the same analyst is documented on a data review checklist, signed and dated by the analyst.

20.13.4.2.2. Data Verification: Following the completion of the initial verification by the analyst performing the data reduction, a systematic check of the data that has been fully reduced and checked through Level 1 review is performed by an experienced peer, supervisor, or designee. This Level 2 check is performed to ensure that Level 1 review has been completed correctly and thoroughly. The second level reviewer examines the data signed by the analyst. Any exceptions noted by the analyst must be reviewed. Included in this review is an assessment of the acceptability of the data with respect to:

- Adherence of the procedure used to the requested analytical method SOP
- Correct interpretation of chromatograms, mass spectra, etc.
- Correctness of numerical input when computer programs are used (checked randomly)
- Correct identification and quantitation of constituents with appropriate qualifiers

- Numerical correctness of calculations and formulas (checked randomly)
- Acceptability of QC data (100% review)
- Documentation that instruments were operating according to method specifications (calibrations, performance checks, etc.)
- Documentation of dilution factors, standard concentrations, etc.
- Sample holding time assessment.

This review also serves as verification that the process the analyst has followed is correct in regard to the following:

- The analytical procedure follows the methods and client-specific instructions.
- Nonconforming events have been addressed by corrective action as defined on a nonconformance memo
- Valid interpretations have been made during the examination of the data and the review comments of the initial reviewer are correct
- The package contains all of the necessary documentation for data review and report production and results are reported in a manner consistent with the method used for preparation of data reports.

The specific items covered in the second stage of data verification may vary according to the analytical method, but this review of the data must be documented by signing the same checklist.

20.13.4.2.3. Completeness Verification: A third-level review is performed by the reporting and project management staff. This review is required before results are submitted to clients. This review serves to verify the completeness of the data report and to ensure that project requirements are met for the analyses performed. The items to be reviewed are:

- Analysis results are present for every sample in the analytical batch, reporting group, or sample delivery group (SDG)
- Every parameter or target compound requested is reported with either a value or reporting limit
- All nonconformances, including holding time violations, and data evaluation statements that impact the data quality are accompanied by clearly expressed comments from the laboratory
- The final report contains all the supporting documentation required by the project, and is in either the standard TestAmerica format or in the client-required format.
- Implement checks to monitor the quality of laboratory results using correlation of results for different parameters of a sample (for example, does the TOC results justify the concentration of organic compounds found by GC/MS.)
- A narrative to accompany the final report will be finalized by the PM. This narrative will include relevant comments collected during the earlier reviews.

20.13.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an

invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using SOP CA-Q-S-002 as the guidelines.

20.13.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

20.13.5.2 Analysts shall not increase or decrease peak areas to for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principals and policy and is grounds for immediate termination.

20.13.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

20.13.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale “after” chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale “before” chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate-approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 20-1.
Example - Demonstration of Capability Documentation

Analyst Demonstration of Capability
Certification Statement

Analyst Name
Date:

Test Method:
SOP:
Matrix:

TestAmerica North Canton laboratory
4101 Shuffel Drive NW
North Canton, OH 44720
(330) 497-9396

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method with the specifications in the cited SOP, which is in use at this facility for the analysis of samples under the TestAmerica Quality Assurance Plan, has met the Initial or Ongoing Demonstration of Capability.

2. The test method was performed by the analyst identified on this certification following the TestAmerica SOP.

3. A copy of the laboratory-specific SOP is available for all personnel on-site.

4. The data associated with the initial/ongoing demonstration of capability are true, accurate, complete and self-explanatory (*). These data are attached to this certification statement.

5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized inspectors.

Comments/Observations:

Analyst's Name	Signature	Date
Technical Director's Name	Signature	Date
QA Manager's Name	Signature	Date

* *True: Consistent with supporting data.*
Accurate: Based on good laboratory practices consistent with sound scientific principles/practices.
Complete: Includes the results of all supporting performance testing.
Self-explanatory: Data properly labeled and stored so that the results are traceable and require no additional explanation.

Figure 20-2.

Example - New Method / Additional Analyte Checklist

New Method / Additional Analyte Checklist

The following items are **required** to be completed prior to the acceptance of client samples.
Fill in any blanks that do not apply with "NA".
Forward to Analytical Group, Operations Manager, Technical Director, and QA.

New Method – include method number and reference _____

New Analytes – list analyte and reporting limit

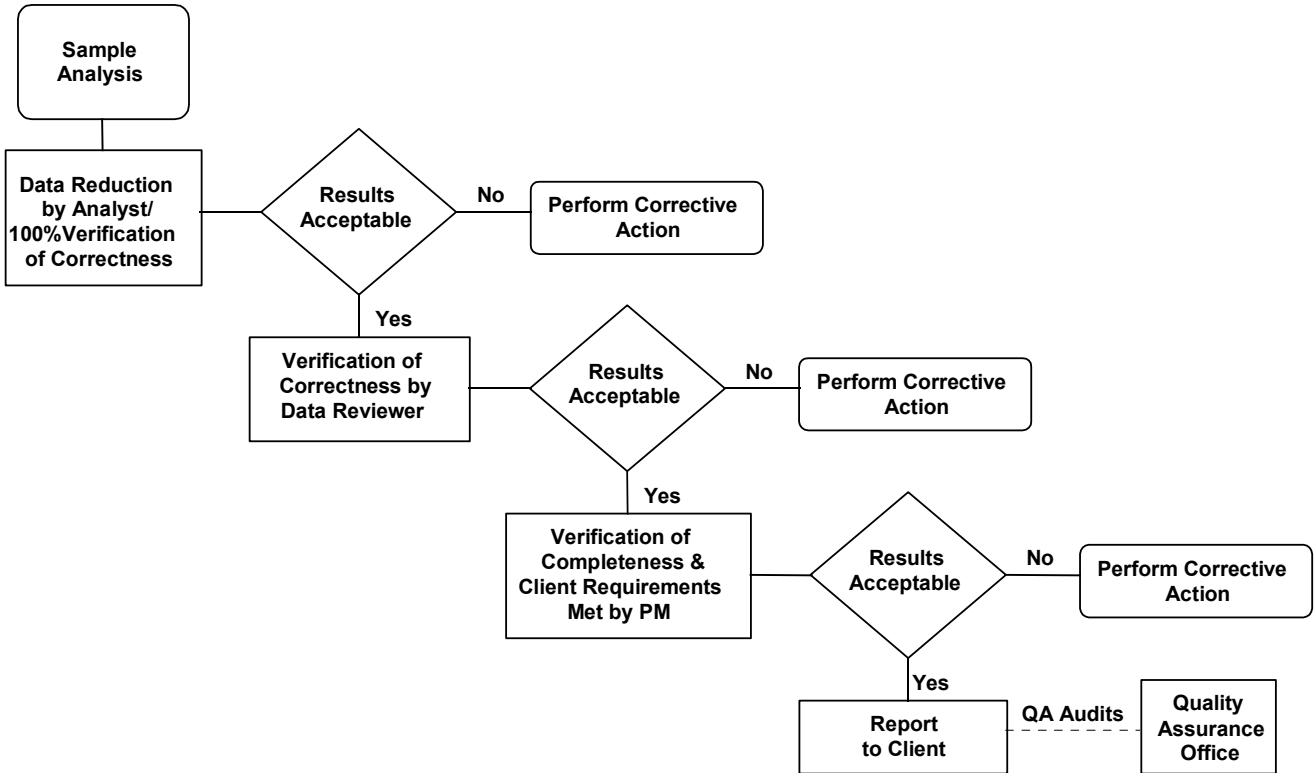
_____
_____
_____

Matrix: water – solid – waste	
Analytical Groups Contacted	
Standard available for new analyte(s), including second source. If not, include time frame for order.	
Cost	
MDL study required	
MDL study completed	
LCS/MS/MSD spike required	
Project tied to QAPP? Lab has a copy?	
Project Program: DoD QSM, LCG, Client specific, State Specific	
Special QC Requirements: control limits, special criteria	
Certification required	
Standard Operating Procedure available for method	
One time project or on-going	
Special reporting parameters	
SAC created in LIMS	
Spike lists created in LIMS	
RL/MDL data entered into LIMS	

QA Review / Acceptance _____ **Date** _____

Figure 20-3.

Work Flow



SECTION 21

EQUIPMENT (AND CALIBRATIONS)
(NELAC 5.5.5)

21.1 OVERVIEW

TestAmerica purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory equipment and instrumentation is presented in Table 21-1.

Equipment is only operated by authorized and trained personnel. Manufacturers instructions for equipment use are readily accessible to all appropriate laboratory personnel.

21.2 PREVENTIVE MAINTENANCE

21.2.1 TestAmerica North Canton follows a well-defined program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

21.2.2 Routine preventive maintenance procedures and frequency, such as lubrication, cleaning, and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

21.2.2.1 Calibrations, routine maintenance, and adjustments are part of the Analyst and Group Leader responsibilities. However, service contracts may be in place for some instruments to cover any major repairs.

21.2.2.2 High purity gases, reagents, and spare parts are kept on hand to minimize repair time and optimize instrument performance.

21.2.3 Table 21-2 summarizes the schedule for routine maintenance. It is the responsibility of each Group Leader to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may also be outlined in analytical SOPs or instrument manuals. (Note: For some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

21.2.4 Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument Maintenance Logbooks may also be used to specify instrument parameters.

21.2.4.1 Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.

21.2.4.2 Each entry in the instrument log includes the Analyst's initials, date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control, e.g., CCV run on 'date' was acceptable, or instrument recalibrated on 'date' with acceptable verification, etc.)

21.2.4.3 When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled-in page must be signed across the page entered and the logbook, so it is clear that a page is missing if only half a signature is found in the logbook.

21.2.5 In addition, the maintenance records contain:

- The identification of the instrument/equipment (instrument Serial and Model Number)
- The date the instrument/equipment was put into use.
- If available, the condition when the instrument was received, e.g. new, used, reconditioned

21.2.6 If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out of service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses (refer to Sections 12 and 13).

21.2.7 In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted using the procedures outlined in Section 8.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and verified (including new initial MDL study) prior to return to lab operations.

21.3 SUPPORT EQUIPMENT

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, dispensing devices, if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

21.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to use with at least two certified ASTM Type 1 weights spanning its range of use (weights that have been calibrated to ASTM Type 1 weights may also be used for daily verification). ASTM Type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every five years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains “calibration only” ASTM Type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file. Reference SOP NC-QA-015, Equipment Monitoring and Thermometer Calibration. A list of balances is in Table 21.2.

21.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

21.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly.

The NIST thermometer is recalibrated every three years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer has increments of 0.2 ºC, and has a range applicable to all method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logsheets. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logsheets. More information on this subject can be found in SOP NC-QA-015, Equipment Monitoring and Thermometer Calibration.

21.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day (seven days a week for DOD labs).

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between or $4 \pm 2^{o}C$.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logsheets posted on each unit and method-specific logbooks.

21.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware) are checked for accuracy at least quarterly. Glass micro-syringes are considered the same as Class A glassware.

The laboratory maintains a sufficient inventory of autopipettors, and dilutors of differing capacities that fulfill all method requirements.

These devices are given unique identification numbers, and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.

Any device not regularly verified cannot be used for any quantitative measurements.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

21.3.6 Field Sampling Devices (ISCO Autosamplers)

Each autosampler (ISCO) is assigned a unique identification number in order to keep track of the calibration. This number is recorded on the sampling documentation in a logbook.

The autosampler is calibrated semi-annually by setting the sample volume to 100ml and recording the volume received. The results are filed in a logbook/binder. The autosampler is programmed to run three cycles, and each of the three cycles is measured into a beaker to verify 100 ml are received.

If the RSD (Relative Standard Deviation) between the three cycles is greater than 20%, the procedure is repeated. If the result is still greater than 20%, the following options may be employed:

1) The unit is taken out of service.
2) The unit is used to pull composite samples only over a 24-hour period.

The results of this check are kept in a logbook/binder.

21.4 INSTRUMENT CALIBRATIONS

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 13).

Note: Instruments are calibrated initially and as needed after that and at least annually.

CALIBRATION STANDARDS

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. However, the general procedures are described below.

21.4.1.1 For each analyte and surrogate (if applicable) of interest, prepare calibration standards at the minimum number of concentrations as stated in the analytical methods. If a reference or mandated method does not specify the number of calibration standards, the minimum number is three, not including blanks or a zero standard. All of the standard solutions are prepared using Class A volumetric glassware, calibrated pipettes, and/or microsyringes and appropriate laboratory quality solvents and stock standards.

21.4.1.2 Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to NIST whenever possible. Dilution standards are prepared from stock standards purchased from commercial suppliers. A standard log is maintained for each department, containing concentration, date of receipt, date of standard preparation, any dilutions made, lot number, supplier, type of solvent and a unique code number to identify the standard.

21.4.1.3 The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

21.4.1.4 The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to 3 significant figures) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The lowest calibration standard must be at or below the reporting limit. The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards.

21.4.1.5 Given the number of target compounds addressed by some of the organic methods, it may be necessary to prepare several sets of calibration standards, each set consisting of the appropriate number of solutions at different concentrations. The initial calibration will then involve the analysis of each of these sets of the appropriate number of standards.

21.4.1.6 All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

21.4.2 CALIBRATION FOR ORGANIC METHODS (GC, HPLC, GC/MS)

21.4.2.1 Many of the organic analytical methods utilize an internal standard calibration (GCMS and some GC). Because of the complex nature of the multipeak chromatograms produced by the method, some instruments necessitate the use of external standard calibration (most GC and HPLC). Surrogate compounds are included in the calibration processes for all appropriate organic analyses. For more details on the calibration types listed below, refer to SOP CA-Q-S-005, Calibration Curves.

21.4.2.2 Once the operating parameters have been established according to the method, each instrument is calibrated for the appropriate method. The analyst prepares five or more standard solutions at various concentrations containing all of the analytes of interest, internal standards, and surrogates that are appropriate for the method. Note: There are a several EPA methods that have different requirements and are exceptions (e.g. EPA 547) where a minimum of three calibration standards are prepared and analyzed.

21.4.2.3 The standard solutions are introduced into the instrument in the same manner as samples are; whether it be by direct injection, by headspace analysis, or by purge and trap. The calibration factor (CF) for methods that use external standards, and the response factor (RF) for methods that use internal standards are calculated for the five standards.

- External standard calibration involves comparison of instrument responses from the sample to the responses from the target compounds in the calibration standards. Sample peak areas (or peak heights) are compared to peak areas (or heights) of the standards. The ratio of the response to the amount of analyte in the calibration standard is defined as the Calibration factor (CF).

- Internal standard calibration involves the comparison of instrument responses from the target compounds in the sample to the responses of specific standards added to the sample or sample extract prior to injection. The ratio of the peak area (or height) of the target compound in the sample or sample extract to the peak area (or height) of the internal standard in the sample or sample extract is compared to a similar ratio derived for each calibration standard. The ratio is termed the response factor (RF), and may also be known as a relative response factor in other methods.

In many cases, internal standards are recommended. These recommended internal standards are often brominated, fluorinated, or stable isotopically labeled analogs of specific target compounds, or are closely related compounds whose presence in environmental samples is highly unlikely. The use of specific internal standards is available in the method SOP.

Whichever internal standards are employed, the analyst needs to demonstrate that the measurement of the internal standard is not affected by method analytes and surrogates or by matrix interferences. In general, internal standard calibration is not as useful for GC and HPLC methods with non-MS detectors because of the inability to chromatographically resolve many internal standards from the target compounds. The use of MS detectors makes internal standard calibration practical because the masses of the internal standards can be resolved from those of the target compounds even when chromatographic resolution cannot be achieved.

When preparing calibration standards for use with internal standard calibration, add the same amount of the internal standard solution to each calibration standard, such that the concentration of each internal standard is constant across all of the calibration standards, whereas the concentrations of the target analytes will vary. The internal standard solution will contain one or more internal standards and the concentration of the individual internal standards may differ within the spiking solution. Not all internal standards need to be at the same concentration in this solution. The mass of each internal standard added to each sample extract immediately prior to injection into the instrument or to each sample prior to purging must be the same as the mass of the internal standard in each calibration standard. The volume of the solution spiked into sample extracts should be such that minimal dilution of the extract occurs, e.g., 10 uL of solution added to a 1 mL final extract results in only a negligible 1% change in the final extract volume which can be ignored in the calculations.

An ideal internal standard concentration would yield a response factor of one for each analyte. However, this is not practical when dealing with more than a few target analytes. Therefore, as a general rule, the amount of internal standard should produce an instrument response, e.g., area counts, that is no more than 100 times that produced by the lowest concentration of the least responsive target analyte associated with the internal standard. This should result in a minimum response factor of approximately 0.01 for the least responsive target compound. Refer to SOP CA-Q-S-005, Calibration Curves, for specific calculations.

21.4.2.4 Policies regarding the use of calibration standard results for creating the calibration curve are as follows:

- A low calibration standard may be excluded from the calibration if the signal-to-noise ratio or spectral criteria are not suitable. The reporting level must be elevated to be the lowest calibration standard used for calibration.

- The upper calibration standard may be excluded if it saturates the detector or is obviously becoming non-linear. Any sample exceeding the upper standard used in the calibration must be diluted and re-analyzed.

- Mid-calibration standards may not be excluded unless an obvious reason is found, i.e., cracked vial, incorrectly made, etc. The failed standard should be re-run immediately and inserted into the initial calibration. If not useful, recalibration is required.

21.4.2.5 **Percent RSD Corrective Action**

Given the potentially large numbers of analytes that may be analyzed in some methods, it is likely that some analytes may exceed the acceptance limit for the RSD for a given calibration. In those instances, the following steps are recommended, but not required.

21.4.2.5.1 The first step is generally to check the instrument operating conditions. This option will apply in those instances where a linear instrument response is expected. It may involve some trade-offs to optimize performance across all target analytes. For instance, changes to the operating conditions necessary to achieve linearity for problem compounds may cause the RSD for other

compounds to increase, but as long as all analytes meet the RSD limits for linearity, the calibration is acceptable.

21.4.2.5.2 If the RSD for any analyte is greater than the applicable acceptance criteria in the applicable analytical method, the analyst may wish to review the results (area counts, calibration or response factors, and RSD) for those analytes to ensure that the problem is not associated with just one of the initial calibration standards. If the problem appears to be associated with a single standard, that one standard may be reanalyzed and the RSD recalculated. Replacing the standard may be necessary in some cases.

21.4.2.5.3 A third alternative is to narrow the calibration range by replacing one or more of the calibration standards with standards that cover a narrower range. If linearity can be achieved using a narrower calibration range, document the calibration linearity, and proceed with analyses. The changes to the upper end of the calibration range will affect the need to dilute samples above the range, while changes to the lower end will affect the overall sensitivity of the method. Consider the regulatory limits or action levels associated with the target analytes when adjusting the lower end of the range.

Note: When the purpose of the analysis is to demonstrate compliance with a specific regulatory limit or action level, the laboratory must ensure that the method quantitation limit is at least as low as the regulatory limit or action level.

21.4.2.6 Alternatively, the least squares regression may be used to determine linearity. A five-point line must result in a correlation coefficient (r) of 0.990 or better using the least squares method to be considered acceptable.

21.4.2.7 Instead of a linear curve model (either Average RF or least squares regression), a second order curve (Quadratic) may be used (and preferred) as long as it contains at least six data points. As a rule of thumb, if there is a consistent trend in RFs (or CFs) in the calibration curve, either up or down, then quadratic curve fit may be indicated as the preferred calibration routine for that analyte. The coefficient of determination (COD or r^2) for the quadratic curve must be at least 0.99 for it to be considered acceptable. For more details on the calculations see Calibration Curve SOP CA-Q-S-005. Some limitations on the use of quadratic curve fits:

21.4.2.7.1 Care MUST be exercised to assure that the results from this equation are real, positive, and fit the range of the initial calibration.

21.4.2.7.2 They **may not** be used to mask instrument problems that can be corrected by maintenance. (Not to be used where the analyte is normally found to be linear in a properly maintained instrument).

21.4.2.7.3 They **may not** be used to compensate for detector saturation. If it is suspected that the detector is being saturated at the high end of the curve, remove the higher concentration standards from the curve and try a 1st order fit or average RF.

21.4.3 Calibration for Inorganic Analyses

EPA Method 7000 from EPA SW-846 is a general introduction to the quality control requirements for metals analysis. For inorganic methods, quality control measures set out in the individual methods and in the *Standard Methods for the Examination of Water and Wastewater* (20th Edition) may also be included. Standard Operating Procedures for the analysis and the quality control documentation measures are available electronically on the public drive.

In general, inorganic instrumentation is calibrated with external standards. Some exceptions would be Inductively Coupled Plasma (ICP), Inductively Coupled Plasma Mass Spec (ICPMS), and Ion Chromatography Mass Spec (ICMS). These analyses may use an internal standard to compensate for viscosity or other matrix effects. While the calibration procedures are much the same for inorganics as they are for organics, CF's or RF's are not used. The calibration model in Section 21.4.2.6 is generally used for most methods, however in some instances the model from Section 21.4.2.7 may be used. A correlation coefficient (r) of 0.995 or greater must be used to accept a calibration curve generated for an inorganic procedure. Correlation coefficients are determined by hand-held scientific calculators or by computer programs [state what your lab uses] and documented as part of the calibration raw data. Coefficients of calibration curves used for quantitation must be documented as part of the raw data. Curves are not allowed to be stored in calculator memories and must be written on the raw data for the purposes of data validation.

21.4.3.1 "Calibrations" for titrimetric analyses are performed by standardizing the titrants against a primary standard solution. See specific methods in *Standard Methods for the Examination of Water and Wastewater* (20th Edition) for more information.

21.4.3.2 Spreadsheets that are used for general chemistry calculations must have all cells containing calculations locked to prevent accidental changes to the calculations.

21.4.3.3 Instrument technologies, e.g., ICP, with validated techniques from the instrument manufacturer or other methods using a zero point and single point calibration require the following:

21.4.3.3.1 The instrument is calibrated using a zero point and a single point calibration standard.

21.4.3.3.2 Sample results within the established linear range do not need to be qualified.

21.4.3.3.3 The linearity is verified at a frequency established by the manufacturer or method.

21.4.4 Calibration Verification

The calibration relationship established during the initial calibration must be verified at periodic intervals as specified in the laboratory method SOPs in accordance with the referenced analytical methods and NELAC (2003) standard, Section 5.5.5.10. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models.

Note: The process of calibration verification referred to is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration

factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration, and is not appropriate nor permitted in SW-846 chromatographic procedures for trace environmental analyses.

21.4.4.1 Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample or standard that can be injected within 12 hours of the beginning of the shift.

21.4.4.2 A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples.

21.4.4.3 The acceptance limits for calibration verifications can be found in each method SOP. As a rule of thumb: GCMS ± 20%, GC and HPLC ± 15%, Inorganics: ± 10 or 15%. Actual methods may have wider or tighter limits (see the Method SOP for specifics).

21.4.4.4 If the response (or calculated concentration) for an analyte is within the acceptance limits of the response obtained during the initial calibration, then the initial calibration is considered still valid, and the analyst may continue to use the CF, RF or % drift values from the initial calibration to quantitate sample results.

21.4.4.5 If the response (or calculated concentration) for any analyte varies from the mean response obtained during the initial calibration by more than the acceptance criteria, then the initial calibration relationship may no longer be valid. If routine corrective action procedures fail to produce a second consecutive (immediate) calibration verification within acceptance criteria, then either the laboratory has to demonstrate performance after corrective action with two consecutive successful calibration verifications, or a new initial instrument calibration must be performed. However, sample data associated with an unacceptable calibration verification may be reported as qualified data under the following special conditions:

21.4.4.5.1 When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

21.4.4.5.2 When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

21.4.4.6 **Verification of Linear Calibrations**

Calibration verification for linear calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. Use the equations below to calculate % Drift or % Difference, depending on the procedure specified in the method SOP. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

The Percent Difference is calculated as follows:

$$\% \text{ Difference} = \frac{(\text{CF(v) or RF(v)}) - (\text{Avg. CF or RF})}{(\text{Avg. CF or RF})} \times 100$$

Where: CF(v) or RF(v) = CF or RF from verification standard
Avg. CF or RF = Average CF or RF from Initial Calibration.

The Percent Drift is calculated as follows:

$$\% \text{ Drift} = \frac{\text{Result} - \text{True Value}}{\text{True Value}} \times 100$$

The Percent Recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{Result}}{\text{True Value}} \times 100$$

21.4.4.7 **Verification of a Non-Linear Calibration**

Calibration verification of a non-linear calibration is performed using the percent drift or percent recovery calculations described in Section 21.4.4.6 above.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

21.5 POLICY ON TENTATIVELY IDENTIFIED COMPOUNDS (TICS) – GC/MS ANALYSIS

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it will not be reported as a TIC. If the compound is reported on the same form as true TICs, it must be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. See the following SOPs for guidelines for making tentative identifications (CORP-MS-0001NC, GC/MS Analysis Based on Method 8270C, and CORP-MS-0002NC, Determination of Volatile Organics by GC/MS based on Method 8260B & 8260A).

21.6 POLICY ON GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

21.6.1 The concentration of the BFB or DFTPP must be at or below the concentrations that are referenced in the analytical methods. Part of the purpose of the tune is to demonstrate sensitivity and analyzing solutions at higher concentrations does not support this purpose. Tune failures may be due to saturation and a lower BFB/DFTPP concentration may be warranted.

21.6.2 Tune evaluations usually utilize the "Autofind" function and are set up to look at the apex +/- 1 scan and average the three scans. Background correction is required prior to the

start of the peak but no more than 20 scans before. Background correction cannot include any part of the target peak.

21.6.3 Other Options or if Auto Tune Fails:

21.6.3.1 Sometimes the instrument does not always correctly identify the apex on some peaks when the peak is not perfectly shaped. In this case, manually identify and average the apex peak +/- 1 scan and background correct as in 21.6.4 above. This is consistent with EPA 8260 and 8270.

21.6.3.2 Or the scan across the peak at one half peak height may be averaged and background corrected. This is consistent with Standard Methods 6200, EPA 624 and EPA 625.

21.6.3.3 Adjustments such as adjustments to the repeller and ion focus lenses, adjusting the EM Voltage, etc. may be made prior to tune verification as long as all of the subsequent injections in the 12-hour tune cycle are analyzed under the same MS tune settings and it is documented in the run sequence log and/or maintenance log that an adjustment was made. Excessive adjusting (more than two tries) without clear documentation is not allowed. Necessary maintenance is performed and documented in the Instrument Log.

21.6.3.4 A single scan at the Apex (only) may also be used for the evaluation of the tune. For SW 846 and EPA 600 series methods, background correction is still required.

21.6.3.5 Cleaning the source or other maintenance may be performed and then follow steps for tune evaluation above. Note: If significant maintenance was performed, see methods 8000B or 8000C then the instrument may require recalibration prior to proceeding.

21.6.4 Tune evaluation printouts must include the chromatogram and spectra as well as the Tune evaluation information. In addition, the verifications must be sent directly to the printer or pdf file (no screen prints for DFTPP or BFB tunes). This ability should be built into the instrument software.

21.6.5 All MS tune settings must remain constant between running the tune check and all other samples. It is recommended that a separate tune method not be used, however a separate method may be used as long as the MS conditions between the methods are the same as the sample analysis method and tracked so any changes that are made to the analysis method are also made to the tune method.

Table 21-1.

Example - Laboratory Equipment and Instrumentation

Instrument Type	Manufacturer	Model	Auto-sampler
Metals ICP	Thermo Jarrell Ash	Trace Analyzer 61E	Yes
	Thermo Jarrell Ash	Trace Analyzer 61E	Yes
Metals ICP/MS	Perkin Elmer (I-7)	ELAN 6100	Yes
	Thermo (I-8)	Series 2	Yes
Metals Mercury Analyzer	Leeman (CVAA)	PS200 II	Yes
	Leeman (CVAF) Low Level	Hydra AF Gold+, Model #112-00067-1	Yes
	Leeman (CVAA)	Hydra AA	Yes
GC/MS Semivolatiles	Agilent A4AG2	5975-C	NA
	Hewlett-Packard HP7	5973-6890	NA
	Hewlett-Packard HP8	5973-6890	NA
	Hewlett-Packard HP9	5973-6890	NA
	Hewlett-Packard HP10	5973-6890	NA
GC/MS Volatiles	Hewlett-Packard (UX2)	5971A-5890	Yes
	Hewlett-Packard (HP6)	5973-6890	Yes
	Hewlett-Packard (UX7)	5973-6890	Yes
	Hewlett-Packard (UX8)	5973-6890	Yes
	Hewlett-Packard (UX9)	5973-6890	Yes
	Hewlett-Packard (UX10)	5973-6890	Yes
	Agilent (UX11) (former HP)	5973-6890	Yes
	Agilent (UX12)	5973-6890	Yes
	Agilent (UX14)	5973-6890	Yes
	Agilent (UX15)	5973-6890	Yes
	Agilent (UX16)	5975-6890	Yes
GC/MS Volatiles Autosampler	OI Analytical (UX2)	4552	
	OI Analytical (HP6)	4552	
	OI Analytical (UX7)	4552	
	OI Analytical (UX8)	4552	
	OI Analytical (UX9)	4552	
	OI Analytical (UX10)	4552	
	OI Analytical (UX11)	4552	
	OI Analytical (UX12)	4552	
	OI Analytical (UX14)	4552	
	OI Analytical (UX15)	4552	
	OI Analytical (UX16)	4552	

Instrument Type	Manufacturer	Model	Auto-sampler
GC/MS Volatiles Purge and Trap	OI Analytical (UX2)	4560	
	OI Analytical (HP6)	4560	
	OI Analytical (UX7)	4660	
	OI Analytical (UX8)	4560	
	OI Analytical (UX9)	4560	
	OI Analytical (UX10)	4560	
	OI Analytical (UX11)	4560	
	OI Analytical (UX12)	4560	
	OI Analytical (UX14)	4560	
	OI Analytical (UX15)	4660	
	OI Analytical (UX16)	4660	
	EST (spare)	Encon	
WC Ion Chromatograph	Dionex	DX-320	NA
	Dionex	DX-120	NA
WC TOC	OI Analytical	1010 TOC Analyzer	
WC TOX	Thermo Electron	1200-S/N 973515	
	Thermo Electron	1200-S/N 2001.0174	
	Thermo Electron	1200-S/N 2005.0234	
WC UV/VIS	Milton Roy	Spectronic 401	No
	Genesys	Spectronic 20	No
WC Autotitrator	Man-Tech	PC – Titrate	
WC pH Meter	Orion pH Meter	250A	
	Orion (Ammonia ISE)	520A	
WC Dissolved Oxygen Meter	YSI	52C E	No
WC Turbidimeter	HF Scientific	Micro 100	No
WC BOD	Labtronics, Inc.	BOD	
WC Block Digester	Andrews	2210 Phenol	
	Andrews	2205 Ammonia	
	Lachat	BD46 TKN	

Instrument Type	Manufacturer	Model	Auto-sampler
WC Cyanide	Midi Serial #1000-99-01	PRG-2520-BL	
WC Conductivity	Man-Tech	4310	
WC Flashpoint	Petrolab (199443)	Petrotest	
	Herzog	HFP 339	
WC Discrete Analyzer	Kone	Konelab 200	
	Kone	Konelab 250	
WCResidual Chlorine Meter	Hanna	HI 93701	
	Hanna	HI 93701	
WC TRAACS	Bran & Luebbe	800	
Ext. 6-Position Accelerated Soxhlet Extractor	Gerhardt Soxtherm	6 units	
Extractions Sonicators	Misonix	3000	NA
	Fisher	550	NA
GC Semivolatiles	Hewlett-Packard (P1)	6890 EPC & Dual ECD Y-Splitter	Yes
	Hewlett-Packard (P2)	6890 EPC & Dual ECD Y-Splitter	Yes
	Hewlett-Packard (P3)	6890 EPC & Dual ECD Y-Splitter	Yes
	Hewlett-Packard (P4)	6890 EPC & Dual ECD Y-Splitter	Yes
	Hewlett-Packard (P5)	6890 EPC & Dual ECD Y-Splitter	Yes
	Hewlett-Packard (P6)	6890 EPC & Dual FID	Yes
	Hewlett-Packard (P7)	6890 EPC & Dual FID	Yes
	Hewlett-Packard (P9)	6890 EPC & Dual ECD Y-Splitter	Yes
	Hewlett-Packard (P10)	6890 EPC & Dual ECD Y-Splitter	Yes

Instrument Type	Manufacturer	Model	Auto-sampler
GC Semivolatiles (Cont'd)	Hewlett-Packard (P11)	6890 EPC & Dual ECD Y-Splitter	Yes
GC Semivolatiles HPLC	Hewlett-Packard (L2)	HPLC 1100	Yes
	Hewlett-Packard (L3)	HPLC 1100	Yes
GC Volatiles	Agilent (A)	6890 PID/FID	Yes
	Hewlett-Packard (O)	6890 Dual PID/Hall	Yes
	Hewlett-Packard (P)	6890 PID/HALL	Yes
	Hewlett-Packard (Y)	6890N PID/FID	Yes
	Hewlett-Packard (P8)	6890 EPC & Dual FID	Yes
GC Volatiles Auto Sampler	OI Analytical (O)	Archon	
	OI Analytical (Y)	4552	
	Varian (A)	Archon	
	Varian (P)	4552	
GC Volatiles Purge & Trap	Tekmar (O)	4560	
	Tekmar (P)	3000	
	OI Analytical (A)	4560	
	OI Analytical (Y)	3000	
GM Bedford	Agilent	6890N	Yes
	Agilent	6890N	Yes
	Agilent	6890N	Yes
	Misonix Sonicator	3000	NA

Table 21-2.

Example – Laboratory Balance Inventory

Instrument	Location	Manufacturer	Model Number	Type	Serial Number
B001	MS Volatiles	OHAUS	E400D	Top Loader	3317
B002	MS Volatiles	Mettler	AC 100	Analytical	B01177
B005	Metals	Sartarius	R300S	Analytical	38020045
B006	Wet Chemistry	American Scientific	SP180	Analytical	2904794
B007	High Hazard Room	American Scientific	ER-180A	Analytical	2904257
B008	Waste Building (no log book)	Howe Richardson	XL 5401		A029390
B009	Leachates (Extractions)	OHAUS	GT 4800	Top Loader	1687
B010	Wet Chemistry	Mettler	PJ 3600	Top Loader	G29475
B011	Extractions	American Scientific	SP 180	Analytical	2902127
B013	Extractions	OHAUS	TS 4KD	Top Loader	1936
B018	GC Volatiles	American Scientific	DTL 350	Analytical	10594
B019	GC Volatiles	Sartarius	L2200S	Top Loader	36020158
B022	Wet Chemistry	Mettler	PM300	Top Loader	F03040
B023	Wet Chemistry	OHAUS	TS 400S	Top Loader	3608
B024	Wet Chem Prep Room	Mettler	AE 100	Analytical	C25750
B025	Extractions	Mettler	PM 4600	Top Loader	G64548
B027	Wet Chemistry	American Scientific	SP 180	Analytical	2904154
B028	Wet Chemistry	Denver Instrument	M Series	Analytical	P119656
B030	Metals (new 9/5/6)	AND	EK410i	Top Loader	P1841870
B031	Metals (new 9/5/6)	AND	EK410i	Top Loader	P1841872
B032	Metals	OHAUS	ARC120	Top Loader	H28312
B033	Leachates (Extractions)	OHAUS	ARC120	Top Loader	H27612

Table 21-3.

Example – Laboratory Refrigerators, Freezers, Ovens, Thermometers, Steambaths, Hotblocks, and Hotplates

Instrument Type	Manufacturer / Model	Location	Tracking No.
Refrigerators	American Scientific CLP	BNA	R015
	VWR Scientific	BNA	R027
	Frigidaire	BNA	R031
	GE GPC	Extractions	R007
	Hotpoint “D”	Extractions	R008
	GE	Extractions	R010
	Hotpoint CLP Pest.	GC Semi	R016
	VWR	GC Semi	R021
	Frigidaire	GC Semi	R030
	Kelvinator	GC Semi	R032
	BB	GC VOA	R017
	True	MS Voa	R028
	Cryo Frig A CLP	MS Voa	R001
	Mr. Winter	MS Voa	R002
	#203 Enseco	MS Voa	R003
	Hotpoint “OO”	Org Haz	R012
	Kelvinator	Org Prep	R011
	Frigidaire	R&D	R013
	Sample Walk-In 2nd	Sample Receiving	R018
	LaCross	Sample Receiving	R019
	Walk-In CLP	Sample Receiving	R020
	True	Sample Receiving	R025
	Baxter Cryo	Sample Receiving	R033
	True	Wet Chem	R024
	Frigidaire BOD	Wet Chem	R023
	Baxter Cryo Fridge BOD	Wet Chem	R029
	Frigidaire BOD	Wet Chem	R034
	Fisher Scientific 307 BOD	Wet Chem	R004
Ovens	TDS	Wet Chem	O-001
	WWR	Wet Chem	O-002
	TSS	Wet Chem	O-003
	TDS Evap	Wet Chem	O-004
	Lindberg/Blue	Wet Chem	O-006

Instrument Type	Manufacturer / Model	Location	Tracking No.
Freezers	Kenmore	BNA	F005
	Frigidaire	BNA	F012
	Hotpoint "D"	Extractions	F007
	Magic Chef	GC Semi	F004
	Marvel HPLC	GC Semi	F013
	GE	GC VO	F002
	Kenmore Side/Side	MS Voa	F001
	Frigidaire	MS Voa	F011
	Frigidaire	MS Voa	F016
	Kelvinator	Org Prep	F003
	Crosley	Receiving - Warehouse	F008
	GE	Receiving – Warehouse	F009
	Frigidaire	Receiving - Warehouse	F014
NIST Thermometers	Ertco S/N 69887 Product 15041D		92564
	Ertco S/N NB179010 Product N/A		167513
	Ertco S/N 3053 Product ASTM 068C-BF		15169121
	Ertco S/N 3243 Product ASTM 62C		163757
Steambaths		Extractions	A
		Extractions	B
		Extractions	C
Hotblocks		Metals	0
		Metals	1
		Metals	2
		Metals	3
		Metals	4
		Metals	A1
		Metals	A2
		Metals	B1
		Metals	C1
		Metals	C2
		Metals	C3
		Metals	C4
Hotplate		Metals	1-A
		Metals TCLP	9 K

Table 21-4.

Example: Schedule of Routine Maintenance
(Refer to manufacturer's instructions for each instrument to identify and perform maintenance operations)

INSTRUMENT MAINTENANCE SCHEDULE
ION CHROMATOGRAPH

As Needed	Daily	Weekly	Monthly
Clean micro-membrane suppressor when decreases in sensitivity are observed.	Check plumbing/leaks.	Check pump heads for leaks.	Check all air and liquid lines for discoloration and crimping, if indicated.
Check fuses when power problems occur.	Check gases.	Check filter (inlet)	Check/change bed supports guard and analytical columns, if indicated.
Reactivate or change column when peak shape and resolution deteriorate or when retention time shortening indicates that exchange sites have become deactivated.	Check pump pressure.		
De-gas pump head when flow is erratic.	Check conductivity meter.		

INSTRUMENT MAINTENANCE SCHEDULE
TOTAL ORGANIC HALIDE ANALYZER

Daily	As Needed
Check electrodes for damage; polish the electrodes.	Examine and clean or replace pyrolysis tube.
Replace dehydrating fluid and electrolyte fluid.	Clean titration cell.
Clean quartz boat.	Observe gas flow.
Observe check valves during use for backfeed.	Replace reference electrode fluid.
At end of each day of use, wash out absorption module, empty electrolyte and fill cell with DI water. Empty dehydrator tube	Change quartz wool.
Perform cell performance check.	Replace O-rings and seals.

INSTRUMENT MAINTENANCE SCHEDULE
HIGH PRESSURE LIQUID CHROMATOGRAPH

Daily	As Needed
Check level of solution in reservoirs. If adding, verify that solvent is from the same source. If changing, rinse gas and delivery lines to prevent contamination of the new solvent.	Replace columns when peak shape and resolution indicate that chromatographic performance of column is below method requirements.
Check gas supply.	Oil autosampler slides when sample does not advance.
Flush with an appropriate solvent to remove all bubbles.	Rinse flow cell with 1N nitric acid if sensitivity low.
Pre-filter all samples.	Change pump seals when flow becomes inconsistent.
	Repack front end of column Backflush column.

INSTRUMENT MAINTENANCE SCHEDULE
ICP AND ICP/MS

Daily	Monthly or As Needed	Semi-Annually	Annually
Check vacuum pump gage. (<10 millitorr)	Clean plasma torch assembly to remove accumulated deposits	Change vacuum pump oil	Notify manufacturer service engineer for scheduled preventive maintenance service
Check cooling water supply system is full and drain bottle is not full. Also drain tubing is clear, tight fitting, and has few bends.	Clean nebulizer and drain chamber; keep free flowing to maintain optimum performance	Replace coolant water filter (may require more or less frequently depending on quality of water)	
Check nebulizer is not clogged	Clean filters on back of power unit to remove dust		
Check capillary tubing is clean and in good condition	Replace when needed: - peristaltic pump tubing - sample capillary tubing - autosampler sipper probe		
Check peristaltic pump windings are secure	- Check yttrium position - Check O-rings - Clean/lubricate pump rollers		
Check high voltage switch is on			
Check torch, glassware, aerosol injector tube, and bonnet are clean			

INSTRUMENT MAINTENANCE SCHEDULE
CVAS AND CVAFS

Daily	As Needed	Annually
Change drying tube	Change pump tubing	Change Hg lamp
Check pump tubing/drain tubing	Check/change Hg lamp	
Check gas pressure	Clean optical cell	
Check aperture reading Check tubing	Lubricate pump	

INSTRUMENT MAINTENANCE SCHEDULE
GAS CHROMATOGRAPH

Daily *	As Needed
Check for sufficient supply of carrier and detector gases. Check for correct column flow and/or inlet pressures.	Replace front portion of column packing or break off front portion of capillary columns. Replace column if this fails to restore column performance, or when column performance (e.g., peak tailing, poor resolution, high backgrounds, etc.) indicates it is required. Quarterly FID: clean detector, only as needed—not quarterly/or semi-annually.
Check temperatures of injectors and detectors. Verify temperature programs by RT shift.	Change glass wool plug in injection port and/or replace injection port liner when front portion of column packing is changed or front portion of capillary column is removed.
Clean injector port weekly for TPH for 8015B, when breakdown fails; otherwise, when RT shift or bad samples run.	Annually FID: replace flame tip, only as needed. Only as needed: ECD--detector cleaning and re-foiling, whenever loss of sensitivity, erratic response, or failing resolution is observed
Check baseline level during analysis of run—not maintenance.	Perform gas purity check (if high baseline indicates that impure carrier gas may be in use).

Watched weekly: check reactor temperature of electrolytic conductivity detector. Inspect chromatogram to verify symmetrical peak shape and adequate resolution between closely eluting peaks, when analyzing pesticides; part of analysis—not maintenance. Clip column leader when chromatography looks bad—not daily.	Replace or repair flow controller if constant gas flow cannot be maintained. Replace fuse. Reactivate external carrier gas dryers. Detectors: clean when baseline indicates contamination or when response is low. FID: clean/replace jet, replace ignitor. ECD: follow manufacturer's suggested maintenance schedule. Reactivate flow controller filter dryers when presence of moisture is suspected. HP 7673 Autosampler: replace syringe, fill wash bottle, dispose of waste bottle contents.

*No daily maintenance done on any instrument/method. Weekly change IPL on TPH instrument. Everything else is on an "as needed" basis.

INSTRUMENT MAINTENANCE SCHEDULE
MASS SPECTROMETER

Daily	Weekly	As Needed	Quarterly	Annually
Check for sufficient gas supply. Check for correct column flow and/or inlet pressure.	Check mass calibration (PFTBA or FC-43)	Check level of oil in mechanical pumps and diffusion pump if vacuum is insufficient. Add oil if needed between maintenance.	Check ion source and analyzer (clean, replace parts as needed)	Replace the exhaust filters on the mechanical rough pump every 1-2 years.
Check temperatures of injector, detector. Verify temperature programs.		Replace electron multiplier when the tuning voltage approaches the maximum and/or when sensitivity falls below required levels.	Check vacuum, relays, gas pressures and flows	
Check inlets, septa		Clean Source, including all ceramics and lenses - the source cleaning is indicated by a variety of symptoms including inability of the analyst to tune the instrument to specifications, poor response, and high background contamination.	Change oil in the mechanical rough pump.	
Check baseline level		Repair/replace jet separator.		
Check values of lens voltages, electron multiplier, and relative abundance and mass assignments of the calibration compounds.		Replace filaments when both filaments burn out or performance indicates need for replacement.		

INSTRUMENT MAINTENANCE SCHEDULE
TRAACS AUTO ANALYZER

As Needed	Daily
Replaces air filter when progressive loss of air pressure is observed.	Check air pressure gauge (22 ± 2 psi)
Replace air valve tubing when occlusion in tubing is observed	Use recommended washout procedure (at end of analysis operations)
Change all pump tubes (or after 200 hours of pumping time, or after 1000 hours of pumping time)	
Clean sample probe shaft	
Replace pump platens	
Lightly lubricate the linear sample rails (use semi-fluid lubricant)	
Replace colorimeter lamp (or after 2500 hours of use)	

INSTRUMENT MAINTENANCE SCHEDULE
ANALYTICAL/TOP LOADING BALANCES

Daily	Annually
Check using Class 1-verified weights once daily or before use Clean pan and weighing compartment	Manufacturer cleaning and calibration

INSTRUMENT MAINTENANCE SCHEDULE
REFRIGERATORS/WALK-IN COOLERS

Daily	As Needed
Temperatures checked and logged	Refrigerant system and electronics serviced

INSTRUMENT MAINTENANCE SCHEDULE
OVENS

Daily	As Needed
Temperatures checked and logged	Electronics serviced

INSTRUMENT MAINTENANCE SCHEDULE
SPECIFIC DIGITAL ION ANALYZER

Daily	As Needed
Daily when used: • Calibrate with check standards • Inspect electrode daily, clean as needed • Inspect electrode proper levels of filling solutions daily; fill as needed • Clean probe after each use	Electronics serviced

INSTRUMENT MAINTENANCE SCHEDULE
TURBIDIMETER

Daily	Monthly	As Needed
Daily when used: • Adjust linearity on varying levels of NTU standards. Standardize with NTU standards • Inspect cells	Clean instrument housing	Electronics serviced

INSTRUMENT MAINTENANCE SCHEDULE
DISSOLVED OXYGEN METER

Daily	As Needed
Daily when used: • Calibrate with saturated air • Check probe membrane for deterioration • Clean and replace membrane with HCl solution	• Electronics serviced • Clean and replace membrane with HCl solution

INSTRUMENT MAINTENANCE SCHEDULE
CONDUCTANCE METER

Daily	As Needed
Daily when used: • Check probe and cables • Inspect conductivity cell	Electronics serviced

INSTRUMENT MAINTENANCE SCHEDULE
CHEMICAL OXYGEN DEMAND (COD) REACTOR [1]

Daily	As Needed
Daily when used: • Calibrate with check standards	Electronics serviced

INSTRUMENT MAINTENANCE SCHEDULE
SPECTROPHOTOMETER

As Needed	Daily	Monthly	Annually
Dust the lamp and front of the front lens	Check the zero % adjustment	Clean windows	Check instrument manual
	Clean sample compartment		Perform wavelength calibration
	Clean cuvettes		Replace lamp annually or when erratic response is observed
			Clean and align optics

INSTRUMENT MAINTENANCE SCHEDULE
pH METER

As Needed	Daily
Clean electrode	Inspect electrode. Verify electrodes are properly connected and filled
Refill reference electrode	Inspect electrode proper levels of filling solutions. Make sure electrode is stored in buffer

INSTRUMENT MAINTENANCE SCHEDULE
TOTAL ORGANIC CARBON ANALYZER

Daily	As Needed	Weekly	Monthly
Check: • Oxygen supply • Persulfate supply • Acid supply • Carrier gas flow rate (~ 150 cc/min) • IR millivolts for stability (after 30 min. warm-up) • Reagent reservoirs	Check injection port septum after 50-200 runs Tube end-fitting connections after 100 hours or use Indicating drying tube NDIR zero, after 100 hours of use Sample pump, after 2000 hours for use Digestion vessel/condensation chamber, after 2000 hours of use Permeation tube, after 2000 hours of use NDIR cell, after 2000 hours of use Change pump tubing	Check liquid-flow-rate-pump-tubing conditions on autosampler Check injection port septum	Clean digestion vessel Clean condenser column Do the leak test

Instrument Maintenance Schedule
Digestion Block

Annually
Check temperature with NIST thermometer

Instrument Maintenance Schedule
Flash Point Tester

Daily
Check tubing Clean sample cup each use
Check gas
Clean flash assembly
Check stirrer

Table 21-5.

Example: Periodic Equipment Calibrations

Type of Equipment	Calibration Requirements
Balances	• Must be serviced and calibrated annually by an approved vendor. • Calibration must be checked daily or before use by analyst with weight(s) classified as Class 1 (formerly termed Class S) by NIST or Class 1 traceable. Acceptance criteria vary according to weight used and accuracy of balance. Acceptance criteria must be documented in the log. • All Class 1 weights must be certified by an outside vendor every three years. • All non-Class 1 weights must be checked annually against NIST Class 1 weights annually.
Thermometers	• Working glass thermometers must be calibrated against a certified. • NIST thermometer at least annually as described in operation-specific SOPs. • Working non-glass thermometers must be calibrated against a certified NIST thermometer annually as described in operation-specific SOPs. • The NIST thermometer must be recertified every three years.
Refrigerators/ Freezers	• Thermometers must be immersed in a liquid such as mineral oil or glycol. • Temperature of units used for sample or standard storage must be checked daily as described in operation-specific SOPs. Refrigerator acceptance limits: 4°C ± 2°C. Freezer acceptance limits: < - 10°C
Ovens	• Temperature of units must be checked daily or before use. • Acceptance limits vary according to use as described in operation-specific SOPs, andmust be documented in the temperature log.
Micropipettes	• Calibrations are checked gravimetrically as required by the operation-specific SOP. • Must be calibrated at the frequency (normally quarterly) required by the manufacturer at a minimum.
Syringes, Volumetric Glassware and Graduated Glassware	• All syringes and volumetric glassware are purchased as Class A items. • Class A items are certified by the manufacturer to be within ± 1% of the measured volume; therefore, calibration of these items by TestAmerica laboratories is not required. • All analysts are trained in the proper use and maintenance of measuring devices to ensure the measurement of standards, reagents, and sample volumes are within method tolerances.

Table 21-6.

Example: Preventive Maintenance Procedures

SUMMARY OF INORGANIC METHOD CALIBRATIONS

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Acidity	Initial	350.1	Two-level calibration that bracket the expected pH of the sample ± 0.05 pH units of true value	9040B 9045C	2 point calibration ± 0.05 pH units of true value
	Continuing	350.1	One buffer check every 10 samples ± 5% of true value	9040B 9045C	N/A
	Other	350.1	Third point check	9040B 9045C	Third point check
	Ending	350.1	One buffer check ± 5% of true value	9040B 9045C	N/A
Alkalinity, Bicarbonate, Carbonate	Initial	310.1 2320B	2 point calibration of pH meter ± 0.05 pH units of true value	--	N/A
	Continuing	310.1 2320B	N/A	--	N/A
	Ending	310.1 2320B	N/A	--	N/A
Ammonia	Initial	350.1	6 levels including blank, "r" [3] ≥ 0.995	--	N/A
	Continuing	350.1	One level or LCS every 10 samples ± 10% of true value	--	N/A
	Ending	350.1	One level or LCS every 10 samples ± 10% of true value	--	N/A
Arsenic Speciation		N/A	N/A	7063	* Refer to Section 10 of SOP NC-WC-0090

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Biochemical Oxygen Demand (BOD)	Initial	405.1 SM5210B	a. Winkler titration: Iodometric with standard thiosulfate b. Membrane electrode: Read in air and in water with zero dissolved oxygen	--	N/A
	Continuing	405.1 SM5210B	N/A	--	N/A
	Ending	405.1 SM5210B	N/A	--	N/A
Bromide	Initial	300.0A	5 levels plus a blank, "r"[3] ≥ 0.995	9056A	5 levels plus a blank, "r" [3] ≥ 0.995
	Continuing	300.0A	Level every 10 samples ± 10% of true value	9056A	N/A
	Ending	300.0A	N/A	9056A	N/A
Cation Exchange	Initial	N/A	N/A	9081	N/A
	Continuing	N/A	N/A	9081	N/A
	Ending	N/A	N/A	9081	N/A
Chemical Oxygen Demand (COD)	Initial	410.4 SM5220D	5 levels plus a blank"r" [3] ≥ 0.995	--	N/A
	Continuing	410.4 SM5220D	One level every 10 samples ± 10% of true value	--	N/A
	Ending	410.4 SM5220D	One level ± 10% of true value	--	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Chloride	Initial	300.0A 325.2	5 levels plus blank "r" [3] ≥ 0.995	9056A 9251	Method 9056: 3 levels plus a blank Method 9252: 5 levels plus blank "r" [3] ≥ 0.995
	Continuing	300.0A 325.2	One level every 10 samples ± 10% of true value	9056A 9251	Method 9056: One per batch of 20 samples, ± 10% of true value Method 9252: One level every 10 samples, ± 10% of true value
	Ending	300.0A 325.2	One level every 10 samples ± 10% of true value	9056A 9251	Method 9056 : N/A Method 9252: One level ± 10% of true value
Chromium Cr^{+6}	Initial	3500 Cr-D	3 levels plus blank	7196A	5 levels plus blank "r" [3] ≥ 0.995
	Continuing	3500 Cr-D	One level every 10 samples ± 10% of true value	7196A	One level every 10 samples ± 15%
	Ending	3500 Cr-D	One level ± 10% of true value	7196A	One level ± 15%
Chlorine, Residual	Initial	330.5 SM3500CL-G	N/A	--	N/A
	Continuing	330.5 SM3500CL-G	N/A	--	N/A
	Ending	330.5 SM3500CL-G	N/A	--	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Conductivity	Initial	120.1 SM2510B	Standard KCl solution	9050A	One level to determine cell constant
	Continuing	120.1 SM2510B	N/A	9050A	N/A
	Ending	120.1 SM2510B	N/A	9050A	N/A
Cyanide (Amenable)	Initial	335.1 SM4500CN-G	6 levels plus blank "r" [3] ≥ 0.995	9012A	6 levels plus blank "r" [3] ≥ 0.995
	Continuing	335.1 SM4500CN-G	One level every 10 samples ± 10% of true	9012A	One mid-level every 10 samples ± 15% of true value
	Ending	335.1 SM4500CN-G	One level ± 10 % of true value	9012A	± 15% of true value
Cyanide (Total)	Initial	335.1/335.2 335.3/335.4 SM4500CU-E	6 levels plus blank "r" [3] ≥ 0.995	9012A	6 levels plus blank "r" [3] ≥ 0.995
	Continuing	335.1/335.2 335.3/335.4 SM4500CU-E	One mid-level every 10 samples ± 10 % of true value	9012A	One mid-level every 10 samples ± 15% of true value
	Ending	335.1/335.2 335.3/335.4 SM4500CU-E	One mid-level ± 10 % of true value	9012A	± 15% of true value
Flashpoint	Initial	--	N/A	1010 ASTM D93-9	p-Xylene reference standard must have flashpoint of 81°F ±2°F
	Continuing	--	N/A	1010 ASTM D93-9	N/A
	Ending	--	N/A	1010 ASTM D93-9	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Fluoride	Initial	300.0A 340.2	Method 300.0A: 5 levels plus a blank, "r" [3] ≥ 0.995 Method 340.2: 5 levels "r" [3] ≥ 0.995	9056A	3 levels plus a blank
	Continuing	300.0A 340.2	One mid-level every 10 samples ± 10% of true value	9056A	One per batch of 20 samples ± 10% of true value
	Ending	300.0A 340.2	One mid-level ± 10% of true value	9056A	N/A
Hardness	Initial	130.2 2340B	Method 130.2: Standardize titrant Method 2340B: See ICP Metals 200.7	--	N/A
	Continuing	130.2 2340B	Method 130.2: N/A Method 2340B: See ICP Metals 200.7	--	N/A
	Ending	130.2 2340B	Method 130.2: N/A Method 2340B: See ICP Metals 200.7	--	N/A
Iron (Ferrous)	Initial	3500-Fe D	3 levels plus a blank, "r" [3] ≥ 0.995	-	N/A
	Continuing	3500-Fe D	One mid-level every 10 samples ± 10% of true value	-	N/A
	Ending	3500-Fe D	One mid-level ± 10% of true value	-	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Nitrate	Initial	300.0A 353.2 SM4500NO_3-E	5 levels plus a blank "r" [3] ≥ 0.995	9056A	3 levels plus a blank
	Continuing	300.0A 353.2 SM4500NO_3-E	One mid-level every 10 samples ± 10% of true value	9056A	One per batch of 20 samples ± 10% of true value
	Ending	300.0A 353.2 SM4500NO_3-E	One mid-level ± 10% of true value	9056A	N/A
Nitrite	Initial	300.0A 354.1	5 levels plus a blank "r" [3] ≥ 0.995	9056A	3 levels plus a blank
	Continuing	300.0A 354.1	One mid-level every 10 samples ± 10% of true value	9056A	One per batch of 20 samples ± 10% of true value
	Ending	300.0A 354.1	One mid-level ± 10% of true value	9056A	N/A
Nitrate-Nitrite	Initial	300.0A 353.2	5 levels plus blank "r" [3] ≥ 0.995	--	N/A
	Continuing	300.0A 353.2	One level every 10 samples ± 10% of true value	--	N/A
	Ending	300.0A 353.2	One mid-level ± 10% of true value	--	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Phosphorus (Total and Ortho-phosphate)	Initial	300.0A 365.1 SM4500P-E	Method 300.0A/365.3: 3 levels plus a blank Method 365.2: 5 levels plus a blank	--	N/A
	Continuing	300.0A 365.1 SM4500P-E	Method 300.0A/365.3: One level every 10 samples ± 10% of true value Method 365.2: Blank and 2 standards with each series of samples, ± 2% of true value or recalibrate	--	N/A
	Ending	300.0A 365.1 SM4500P-E	Method 300.0A/365.3: ± 10% of true value Method 365.2: N/A	--	N/A
pH	Initial	150.1 SM4500H-B	2 level calibration that bracket the expected pH of the sample ± 0.05 pH units of true value	9040B 9045C	2 point calibration ± 0.05 pH units of true value
	Continuing	150.1 SM4500H-B	One buffer check every 10 samples ± 5% of true value	9040B 9045C	N/A
	Other	150.1 SM4500H-B	Third point check	9040B 9045C	Third point check
	Ending	150.1 SM4500H-B	One buffer check ± 5% of true value	9040B 9045C	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Phenolics	Initial	420.1	5 levels plus a blank "r" [3] ≥ 0.995	9065 9066	5 levels plus a blank "r" [3] 0.995
	Continuing	420.1	One mid-level every 10 samples ± 10% true value	9065 9066	One mid-level ± 15% true value
	Ending	420.1	One mid-level ± 10% true value	9065 9066	One mid-level ± 15% true value
Phosphate	Initial	SM4500P-E	N/A	9056	3 levels plus a blank
	Continuing	SM4500P-E	N/A	9056	One per batch of 20 samples ± 15% of true value
	Ending	SM4500P-E	N/A	9056	N/A
Settleable Solids	Initial	160.5	N/A	--	N/A
	Continuing	160.5	N/A	--	N/A
	Ending	160.5	N/A	--	N/A
Specific Conductance	Initial	120.1 SM2510B	Standardize meter with 0.01 M KCl	9050A	N/A
	Continuing	120.1 SM2510B	One level every 10 samples ± 10% of true value	9050A	N/A
	Ending	120.1 SM2510B	One level ± 10% of true value	9050A	N/A
Sulfate	Initial	300.0A 375.4	Method 300.0A: 5 levels plus blank "r" [3] ≥ 0.995 Method 375.4: 3 levels plus blank "r" [3] ≥ 0.995	9038 9056A	Method 9038: 3 levels plus a blank for every hour of continuous sample analysis. Method 9056: 3 levels plus a blank

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Sulfate (Cont'd)	Continuing	300.0A 375.4	Method 300.0A: One mid-level after every 10 samples ± 10% of true value Method 375.4: One level every 3 or 4 samples ± 10% of true value	9038 9056A	Method 9038: Independent-prepared check standard every 15 samples Method 9056: 1 per batch of 20 samples ± 10% of true value
	Ending	300.0A 375.4	± 10% of true value	9038 9056A	N/A
Sulfide	Initial	376.1	Method 376.1: This is a titration method. Therefore, calibrations are not applicable.	9030B/ 9034 9030A	This is a colorimetric titration. Therefore, calibration is not applicable.
	Continuing	376.1	Method 376.1: N/A	9030B/ 9034 9030A	This is a colorimetric titration. Therefore, calibration is not applicable.
	Ending	376.1	Method 376.1: N/A	9030B/ 9034 9030A	This is a colorimetric titration. Therefore, calibration is not applicable.
Total Dissolved Solids	Initial	160.1 SM2540E	This is a gravimetric determination. Calibrate balance prior to analysis	--	N/A
	Continuing	160.1 SM2540E		--	N/A
	Ending	160.1 SM2540E		--	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Total Kjeldahl Nitrogen (TKN)	Initial	351.3 SM4500NO_3	Method 351.3: Titrimetric: Standardize titrant Colorimetric: 7 levels plus blank	--	N/A
	Continuing	351.3 SM4500NO_3	Method 351.3: N/A	--	N/A
	Ending	351.3 SM4500NO_3	Method 351.3: N/A	--	N/A
Total Organic Carbon (TOC)	Initial	415.1 SM5310D	3 levels plus blank	9060 Walkley Black	3 levels plus blank "r" [3] ≥ 0.995
	Continuing	415.1 SM5310D	1 mid-level every 10 samples ± 15% of true value	9060 Walkley Black	1 mid-level every 10 samples ± 15% of true value
	Ending	415.1 SM5310D	± 15% of true value	9060 Walkley Black	± 15% of true value
Total Organic Halides (TOX)	Initial	450.1	Method 450.1: Daily instrument calibration standard and blank in duplicate ± 10% of true value (calibration standard) Verify with independently-prepared check standard	9020B 9023 (EOX)	Daily instrument calibration standard and blank in duplicate ± 10% of true value (calibration standard) Verify with independently-prepared check standard –ICV ± 10% SOP CORP-WC-0001

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Total Organic Halides (TOX) (cont'd)	Continuing	450.1	± 10% of true value	9020B 9023 (EOX)	CCV ± 10% of true value SOP CORP-WC-0001
	Ending	450.1	± 10% of true value	9020B 9023 (EOX)	CCV ± 10% of true value SOP CORP-WC-0001
Total Solids	Initial	160.3	This is a gravimetric determination. Calibrate balance before use.	--	N/A
	Continuing	160.3		--	N/A
	Ending	160.3		--	N/A
Total Suspended Solids (Nonfilterable)	Initial	160.2 SM2540E	This is a gravimetric determination. Calibrate balance before use.	--	N/A
	Continuing	160.2 SM2540E		--	N/A
	Ending	160.2 SM2540E		--	N/A
Turbidity	Initial	180.1	Minimum of 1 level in each instrument range. Follow manufacturer's instructions	--	N/A
	Continuing	180.1	N/A	--	N/A
	Ending	180.1	N/A	--	N/A
Volatile Solids	Initial	160.4	This is a gravimetric determination. Calibrate balance before use.	--	N/A
	Continuing	160.4		--	N/A
	Ending	160.4		--	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
ICP & ICP/MS Metals (excludes Hg)	Initial	200.7	One level and blank. ICV RSD <3% from replicate	6010B	One level and blank. ICV RSD <5% from replicate
	Initial	200.8	One level and blank	6020	One level and blank
	Continuing	200.7	Every 10 samples ±10% of true value CCV RSD < 5% from replicate	6010B	Mid-level calibration standard Every 10 samples ± 10% of true value CCV RSD < 5% from replicate
	Continuing	200.8	N/A	6020	N/A
	Ending	200.7	±10% of true value CCV RSD < 5% from replicate	6010B	Mid-level calibration standard ± 10% of true value CCV RSD < 5% from replicate
	Ending	200.8	N/A	6020	N/A
	Other	200.7	ICSA, ICSAB: Analyze at beginning of run. For ICSA, AB criteria see SOP Semi-Annually: ICP interelement correction factors Instrument detection limits	6010B	ICSA, ICSAB: Analyze at beginning of run. For ICSA, AB criteria see SOP Semi-Annually: ICP interelement correction factors Instrument detection limits
	Other	200.8	N/A	6020	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Mercury by CVAA & CVAFS	Initial	245.1 1631E	5 levels plus blank ICV ±10% of true value "r" [3] ≥ 0.995	7470A 7471A	5 levels plus blank ICV ± 10% of true value "r" [3] ≥ 0.995
	Continuing	245.1* 1631E	Daily or every 10 samples, whichever is more frequent ±20% of true value	7470A 7471A	Every 10 samples ±20% of true value
	Ending	245.1 1631E	±20% of true value	7470A 7471A	±20% of original prepared standard
	Other	245.1 1631E	Annually: MDL	7470A 7471A	Annually: MDL

* 245.1 continuing – Initial CCV ±5% of true value

Footnotes

[1] National Pollutant Discharge Elimination System.

[2] Resource Conservation and Recovery Act, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA (August 1993), Final Update II (September 1994), Final Update IIB (January 1995), and Final Update III (December, 1996).

[3] "r" = correlation coefficient.

SUMMARY OF ORGANIC METHOD CALIBRATIONS

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Aromatic Volatiles by GC	Initial	602	Minimum of 3 levels If % RSD < 10%, use avg RF. Otherwise, calibration curve employed. Six levels for quadratic equation.	8021B	Minimum of 5 levels If % RSD < 20%, use avg RF. Otherwise, calibration curve employed. Six levels for quadratic equation.
	Continuing	602	Analyze QC check sample and evaluate per method requirements	8021B	Mid-level calibration standard analyzed every 10 injections or 12 hrs whichever is greater, % D ≤ 15%, gases 20% D. Evaluate per SOP
	Ending	602	Run closer per NELAC requirement, but no criteria	8021B	Mid-level calibration standard, % D ≤ 15%. Evaluate per SOP, except as noted above.
	Other	602	N/A	8021B	N/A
Herbicides by GC	Initial	615 [9]	Minimum of 3 levels If % RSD < 10%, use avg RF. Otherwise, calibration curve employed	8151A	Minimum of 5 levels If % RSD < 20%, use avg RF. Otherwise, calibration curve employed.
	Continuing	615 [9]	One or more calibration standards analyzed daily % D ± 15% of predicted response	8151A	Mid-level calibration standard analyzed every 10 samples. % D < 15% of predicted response for any analyte quantitated and reported.
	Ending	615 [9]	N/A	8151A	Mid-level calibration standard. % D < 15% of predicted response for any analyte quantitated and reported.
	Other	615 [9]	N/A	8151A	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Pesticides/ PCBs by GC	Initial	608	Minimum of 3 levels If % RSD < 10%, use avg RF. Otherwise, calibration curve employed	8081A 8082	Minimum of 5 levels. If % RSD < 20%, use avg RF. Otherwise, calibration curve employed. (See SOP CORP-GC-0001)
	Continuing	608	One or more calibration standards analyzed daily. % D ± 15% of predicted response	8081A 8082	Mid-level calibration standard analyzed every 10 samples. % D < 15% of predicted response for any analyte quantitated and reported.
	Ending	608	N/A	8081A 8082	Mid-level calibration standard. % D < 15% of predicted response for any analyte quantitated and reported.
	Other	608	N/A	8081A 8082	N/A
Petroleum Hydrocarbons/ Oil and Grease	Initial	1664A	Calibrate analytical balance at 2 mg and 1000 mg Calibration must be ± 10% at 2 mg and ± 0.5% at 1000 mg or recalibrate balance	9071B	Calibrate analytical balance at 2 mg and 1000 mg Calibration must be ± 10% at 2 mg and ± 0.5% at 1000 mg or recalibrate balance
	Continuing	1664A	N/A	9071B	N/A
	Ending	1664A	N/A	9071B	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Purgeable Halocarbons by GC	Initial	601	Minimum of 3 levels If % RSD < 10%, use avg RF. Otherwise, calibration curve employed. Six levels for quadratic equation.	8021B	Minimum of 5 levels If % RSD < 20%, use avg RF. Otherwise, calibration curve employed. Six levels for quadratic equation.
	Continuing	601	Analyze QC check sample and evaluate per method requirements	8021B	Mid-level calibration standard analyzed every 10 injections, or 12 hrs, whichever is greater. % D < 15%, gases 20% D Evaluate per SOP
	Ending	601	Run per NELAC, but no requirement to meet	8021B	Mid-level calibration standard, % D <15%. Evaluate per SOP
	Other	601	N/A	8021B	N/A
Halogenated Volatiles by GC	Initial	--	N/A	8021B	Minimum of 5 levels If % RSD < 20%, use avg RF. Otherwise, calibration curve employed.
	Continuing	--	N/A	8021B	Mid-level calibration standard analyzed every 10 samples. % D < 15% of predicted response for any analyte quantitated and reported.
	Ending	--	N/A	8021B	Mid-level calibration standard % D < 15% of predicted response for any analyte quantitated and reported.
	Other	--	N/A	8021B	N/A

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Semivolatiles	Initial	625	Minimum of 3 levels, lowest near but above MDL. If % RSD ≤ 35%, use avg RF. Otherwise calibration curve employed.	8270C	Minimum of 5 levels, % RSD for RF for CCCs(4) < 30% SPCCs(5): RF > 0.050
	Continuing	625	One level every 24 ours. Acceptance criteria are found in the method and SOP.	8270C	Mid-level standard every 12 hours (after tuning) %D for CCCs(4) < 20 % between RF from standard and avg RF from initial SPCCs(5): RF > 0.050.
	Ending	625	N/A	8270C	N/A
	Other	625	DFTPP(7) tuning every 24 hours before standard or sample runs.	8270C	DFTPP(7) tuning at the beginning of every 12 hour shift.

Analysis	Calibration	NPDES [1]		RCRA (SW846) [2]	
		Method	Requirement	Method	Requirement
Volatiles	Initial	624	Minimum of 3 levels, lowest near but above MDL. If % RSD ≤ 35%, use avg RF. Otherwise, calibration curve employed.	8260B	Minimum of 5 levels, %RSD for RF for CCCs[4] < 30.0% SPCCs[5]:RF ≥ 0.300 for Chlorobenzene and 1,1,2,2-tetrachloroethane, Chloromethane and 1,1-dichloroethane, and RF > 0.100 for Bromoform
	Continuing	624	1 level every 24 hours Acceptance criteria are found in the method and SOP	8260B	Mid-level standard every 12 hours (after tuning) %Drift for CCCs(4) < 20.0% between RF from standard and avg RF from initial SPCCs(5): RF ≥ 0.300 for Chlorobenzene and 1,1,2,2-tetrachloroethane, Chloromethane and 1,1-dichloroethane, and RF > 0.100 for Bromoform
	Ending	624	N/A	8260B	N/A
	Other	624	BFB(6)tuning at the beginning of every 24 hour shift.	8260B	BFB(6)tuning at the beginning of every 12 hour shift.

Footnotes:

1 National Pollutant Discharge Elimination System.
2 Resource Conservation and Recovery Act, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA (August 1993), Final Update II (September 1994), Final Update IIB (January 1995), and Final Update III (December 1996).
3 TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin.
4 CCC - Continuing Calibration Compounds.
5 SPCC - System Performance Check Compound.
6 BFB – Bromofluorobenzene.
7 DFTPP – Decafluorotriphenylphosphine.
8 Footnote deleted.
9 Method not listed in 40 CFR Part 136.

SECTION 22

MEASUREMENT TRACEABILITY
(NELAC 5.5.6)

22.1 OVERVIEW

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. With the exception of Class A Glassware (including glass microliter syringes that have a certificate of accuracy), quarterly accuracy checks are performed for all mechanical volumetric devices. Microsyringes are verified at least semi-annually or disposed of after six months of use. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. The following definitions are provided by the American Association for Laboratory Accreditation (A2LA):

"Traceability is the property of a measurement result whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons, each step in the chain having stated uncertainties." There are six essential elements:

- An unbroken chain of comparison
- A calculated measurement uncertainty for each step in the chain to allow for an overall uncertainty calculation
- Documentation of each step in each calibration report
- All steps in the chain are performed by individuals with evidence of technical competence and accredited by a recognized accreditation body
- Reference to International Standard (SI) units
- Recalibration at appropriate intervals to preserve traceability

Calibration is defined as "determining and documenting the deviation of the indication of a measuring instrument (or the stated value of a material measure) from the conventional 'true' value of the measurand."

Uncertainty is defined as "a parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measurand." Measurement of Uncertainty is discussed is Section 20 of this QA Manual.

22.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), APLAC (Asia-Pacific Laboratory Accreditation Cooperation), or EA (European Cooperation for Accreditation). A certificate and scope of accreditation is kept on file at the laboratory. Refer to Section 21 for calibration of weights and thermometers.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

22.3 REFERENCE STANDARDS / MATERIALS

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors accredited by A2LA, NVLAP, with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. (Refer to Section 9 for additional information on purchasing). The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to Table 9-1 in Section 9 for general storage requirements and Table 22-1 for additional storage information. Please refer to SOP NC-QA-0017, Standards and Reagents, for additional details. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

22.4 DOCUMENTATION AND LABELING OF STANDARDS, REAGENTS, AND REFERENCE MATERIALS

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. Refer to SOP CA-Q-S-001, Solvent and Acid Lot Testing and Approval.

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained in each group. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material.

22.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into standard or reagent logbooks, and are assigned a unique identification number. The following information is typically recorded in the Standards Logbook.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation date
- Expiration date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent standard analyte concentration (if applicable)
- Parent standard amount used (if applicable)
- Component analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained in each group for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

22.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration date
- Standard ID (from the Standards Logbook)
- Special health/safety warnings if applicable

22.4.3 In addition, the following information may be helpful:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include a preparation date, expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and raw data.

All reagents and standards must be stored in accordance to the following priority:

1) With the manufacturer's recommendations
2) With requirements in the specific analytical methods
3) According to Table 22-1

SECTION 23.0

SAMPLING
(NELAC 5.5.7)

23.1 OVERVIEW

TestAmerica North Canton provides sampling services. Sampling procedures are described in SOP NC-SC-0006, Sample Procurement Protocol.

23.2 SAMPLING CONTAINERS

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Any certificates of cleanliness that are provided by the supplier are available from the vendor electronically, or stored at the laboratory.

23.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

23.2.2 Preparing Container Orders

Container orders are prepared using the laboratory Shipping Department, SOP NC-QA-0012. The laboratory also provides EnCore, TerraCore or other soil sampling devices when requested.

If containers are provided directly to the client from the manufacturer or from other sources, the laboratory will not be responsible for any of the above records.

23.3 FIELD QUALITY CONTROL (QC)

Common field quality control samples are defined in the following paragraphs. The frequency of field quality control samples should be specified in the site specific Quality Assurance Project Plan (QAPP) or by the client. TestAmerica provides trip blanks for VOC analysis with the sample

containers for all volatile organic analyses. Blanks generated in the field will be analyzed along with the field samples (exception soil samples where the blank is aqueous).

23.3.1 Equipment Blank / Rinsate Blank - The equipment blank, sometimes referred to as a rinsate blank, is a sample of the water used to decontaminate sampling equipment. The source water should be as free of target analytes as possible. An aliquot of this water is poured over or through the sample collection device after decontamination, collected in a sample container, preserved with appropriate reagents, and returned to the laboratory. This serves as a check on sampling device cleanliness, and will also be affected by the site and sample handling conditions evaluated by the other types of blanks. The sampling time for the equipment blank should begin when the equipment is rinsed and the water is collected. Equipment blank collection for low level mercury is generally done at a clean facility rather than at the sample collection site.

23.3.2 Field Blank - The field blank is water that is as free of target analytes as possible and from the same source as the equipment blank. The water is poured into a sampling container at the sampling site, preserved with the appropriate reagents, and returned to the laboratory. This serves as a check on reagent and environmental contamination. The sampling time for the field blank should be when the blank is prepared in the field.

23.3.3 Trip Blank - The trip blank pertains to volatile analysis only. This serves as a check on sample contamination originating from sample transport, sample container contamination, shipping and storage, or from certain site conditions. Trip blanks are often referred to as travel blanks. They are prepared using pre-cleaned sample containers. They are filled with organic-free water (the source of the organic free water is the same source of water used to prepare volatile standards, method blanks, LCS and sample dilutions), sealed and taken into the field with the empty containers which will be used for sampling. The recommended frequency is one trip blank per cooler (in duplicate or triplicate), per volatiles method. Unless otherwise specified, the sampling time for the trip blank is the time of receipt at the laboratory (When the “Trip” ends).

23.3.4 Field Duplicates - Field duplicates are replicate samples collected from the same sampling point or location during a field collection event. This control sample is used to demonstrate the ability of both the sampling and analytical process to generate data of acceptable precision.

23.4 DEFINITION OF HOLDING TIME

The date and time of sampling documented on the chain-of-custody (COC) form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in “days” (e.g. 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in “hours” (e.g. 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling. Holding times for analysis include any necessary reanalysis. However there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is.

23.4.1 Semi-Volatile - Holding times for sample preparation for semi-volatile organics are measured from the sampling date (and time where applicable) until the day (and time where applicable) solvent contacts the sample. If a sample is to be extracted on the day of expiration, the actual time of extraction must be recorded on the sample preparation worksheet. Holding

times for analysis are measured from the date (and time where applicable) of initiation of extraction to the time of injection into the gas chromatograph.

23.4.2 Volatiles - Holding times for volatile organics are measured from the date (and time where applicable) of sampling to the date and time of injection into the gas chromatograph.

23.4.3 Inorganics - For inorganic and metals analysis, the preparation/digestion/distillation must be started within the maximum holding time as measured from the sampling date (and time where applicable).

23.5 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

The preservation and holding time criteria specified in the following tables are derived from the source documents for the methods. If method required holding times (refer to Tables 23-1 to 23-7) or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

23.6 SAMPLE ALIQUOTS / SUBSAMPLING

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis. In that regard the following guidelines apply to analysts:

Analysts must handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

23.6.1 For water samples, before taking each aliquot for analysis, invert the sample container end-over-end three times and immediately pour off the aliquot. Especially when suspended solids are present, adequate mixing of the sample is extremely important.

23.6.2 For solid samples, when volatile organics are not requested, if the solid can be mixed, stir before removing the aliquot. When possible stir the entire sample in the sample container. Remove small increments of sample from different parts of the container to make up the complete subsample.

- For soil samples, avoid debris in the subsample aliquot as much as possible (e.g. gravel, sticks, roots and grass); note this information in the sample preparation record.

23.6.3 For solid samples, when volatile organics analysis is requested, the sample should be manipulated as little as possible. In most cases, the sample will arrive already preserved or in an EnCore™ sampler of the correct mass (requiring quick preservation of the entire amount). If the client requests volatiles on a solid sample which has been collected in a jar and is in a common container from which aliquots for other test methods must be taken, login should deliver the container to the volatiles department for preparing a proper aliquot prior to any other aliquots being taken out.

23.6.4 For multiphasic samples, the client should instruct the laboratory as to the intent of the testing and how to handle the sample. If the entire sample is to be accounted for, and the phases do not mix easily with inversion/stirring, such that a representative aliquot can be taken, the analyst must record the percent by volume of each phase. The analysis must be conducted on each phase separately; the final results are combined mathematically, weighting the individual phase results by volume. One exception to this procedure is the situation addressed in the TCLP and SPLP methods for wastes containing free liquids. However, if the leachate and final filtrate are not miscible, it is necessary to combine mathematically the concentrations of the two (or more) solutions by volume. A laboratory coliwasa can be used to subsample a multilayer liquid sample when appropriate.

Tables 23-1 to 23-7 detail holding times, preservation and container requirements, and sample volumes for SDWA and NPDES methods. The sample volumes are intended to be a minimal amount to perform the method. The containers used may be of larger size. **Please note**: The holding times are program specific and different programs may have different holding times for equivalent methods, e.g., there are differences in holding times for many organic analytes between SDWA and NPDES. RCRA methods may also be different.

Table 23-1.

Inorganic Sample Containers, Preservatives, and Holding Times

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3, 7]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method	Requirements
Acidity	Water	100 mL	305.1 SM2310B	250 mL plastic or glass. Cool to 4°C, 14 days	---	N/A
Alkalinity, Bicarbonate, Carbonate	Water	100 mL	310.1 2320B	250 mL plastic or glass. Cool to 4°C, 14 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Ammonia	Water	100 mL	350.1 350.2 SM4500NH_3-E SM4500NH_3-F	500 mL plastic or glass. Cool to 4°CH_2SO_4 to pH < 2, 28 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Arsenic (ASV) Anodic Stripping Voltammetry	Water	100 mL	---	N/A	7063	250 mL plastic. Cool to 4°C. HCl to pH <2, 28 days
Biochemical Oxygen Demand (BOD), Carbonaceous	Water	1000 mL	405.1 5210B	1000 mL plastic or glass. Cool to 4°C, 48 hours	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Bromide	Water	50 mL	300.0A[7]	250 mL plastic or glass. No preservative required, 28 days	9056A	Cool to 4°C. Analyze ASAP after collection
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Cation Exchange	Solid	8 oz	---	N/A	9081	8 or 16 oz glass. Cool to 4°C, 6 months
Chemical Oxygen Demand (COD)	Water	100 mL	410.4 5220D	250 mL glass or plastic. Cool to 4°C, H_2SO_4 to pH < 2, 28 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3, 7]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method	Requirements
Chloride	Water	50 mL	300.0A [7] 325.2	250 mL plastic or glass. No preservative required, 28 days	9056A 9251	Method 9056: Cool to 4°C. Analyze ASAP after collection. Method 9251: 250ml plastic or glass, no preservative required, 28 days
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Chlorine, Residual	Water	100 mL	330.5	250 mL glass or plastic. Cool to 4°C, analyze immediately	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Chromium (Cr^{+6})	Water	100 mL	3500 Cr-D	Method 218.4: 200 mL plastic or glass. Cool to 4°C, 24 hours. Method 3500 Cr-D: 200 mL quartz, TFE, or polypropylene HNO_3 to pH <2. Cool to 4°C. Analyze ASAP after collection	7196A	200 mL plastic or glass. Cool to 4°C, 24 hours
	Solid	20 g	---	N/A	7196A 3060A	250 mL plastic or glass, 30 days to digestion, 96 hours after digestion
	Waste	N/A	---	N/A	---	N/A
Conductivity	Water	100 mL	120.1 2510B	200 mL glass or plastic. Cool to 4°C, 28 days	9050A	200 mL glass or plastic. Cool to 4°C, 24 hours
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3, 7]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method	Requirements
Cyanide (Amenable)	Water	250 mL	335.1 SM4500CN-G	1 liter plastic or glass, NaOH to pH >12 0.6g ascorbic acid[6]. Cool to 4°C, 14 days unless sulfide is present. Then maximum holding time is 24 hours.	9012A	1 liter plastic or glass, NaOH to pH >12 0.6g ascorbic acid[6]. Cool to 4°C, 14 days
	Solid	50g	---	N/A	9012A	Not Specified
	Waste	50g	---	N/A	9012A	Not Specified
Cyanide (Total)	Water	1L	335.2 335.3 335.4 [(7)] SM4500CN-E	1 liter plastic or glass, NaOH to pH >12 0.6g ascorbic acid[6]. Cool to 4°C, 14 days unless sulfide is present. Then maximum holding time is 24 hours.	9012A	1 liter plastic or glass, NaOH to pH >12 0.6g ascorbic acid[6]. Cool to 4°C, 14 days.
	Solid	50g	--	N/A	9012A	8 or 16 oz glass Teflon-lined lids, Cool to 4°C, 14 days
	Waste	50g	--	N/A	9012A	8 or 16 oz glass Teflon-lined lids, Cool to 4°C
Flashpoint (Ignitability)	Liquid	100 mL	---	N/A	1010 ASTM D93-9	No requirements, 250 mL amber glass. Cool to 4°C recommended
	Solid	100 g	--	N/A	---	N/A
	Waste	100 mL	--	N/A	---	N/A
Fluoride	Water	300 mL	300.0 [7] 340.2	500 mL plastic. No preservation required, 28 days.	9056A	Cool to 4°C. Analyze ASAP after collection.
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3, 7]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method	Requirements
Hardness (Total)	Water	50 mL	130.2 2340B	250 mL glass or plastic, HNO_3 to pH < 2, 6 months	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Iron (Ferrous)	Water	100 mL	3500-Fe D	1 liter glass or polyethylene container, 6 months. **This test should be performed in the field.**	-	N/A
	Solid	N/A	-	N/A	-	N/A
	Waste	N/A	-	N/A	-	N/A
Nitrate	Water	50 mL	300.0A [7] SM4500NO_3-E	Method 300.0: 250 mL plastic or glass. Cool to 4°C, 48 hours.	9056A	Method 9056: Cool to 4°C. Analyze ASAP after collection
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	Not Specified
Nitrite	Water	50 mL	300.0A [7] 354.1	250 mL plastic or glass. Cool, 4°C, 48 hours	9056A	Cool, 4°C. Analyze ASAP after collection
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Nitrate-Nitrite	Water	50 mL	353.2	250 mL plastic or glass, H_2SO_4 to pH < 2, 28 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Ortho-phosphate	Water	50 mL	300.0A [7] 365.1 SM4500P-E	100 mL plastic or glass. Filter on site. Cool to 4°C, 48 hours	9056A	Cool to 4°C. Analyze ASAP collection
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3, 7]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method	Requirements
pH	Water	50 mL	150.1 SM4500H-B	100 mL plastic or glass. Analyze immediately. **This test should be performed in the field.**	9040B	100 mL plastic or glass. Analyze immediately. **This test should be performed in the field.**[(8)]
	Solid	N/A	---	N/A	9045C	4 oz glass or plastic. Cool to 4°C. Analyze as soon as possible.[8]
	Waste	N/A	---	N/A	9045C	4 oz glass or plastic, Cool to 4°C. Analyze as soon as possible.[8]
Phenolics	Water	100 mL	420.1	500 mL glass, Cool to 4°C, H_2SO_4 to pH < 2, 28 days	9065	1 liter glass recommended, Cool to 4°C, H_2SO_4 to pH < 4, 28 days
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	9065	Not Specified
Phosphate	Water	50 mL	---	N/A	9056A	Cool to 4°C, analyze ASAP collection
	Solid	N/A	---	N/A	9056A	N/A
	Waste	N/A	---	N/A	9056A	N/A

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3, 7]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method	Requirements
Phosphorus (Total)	Water	100 mL	365.2 365.1 SM4500P-E	100 mL plastic or glass, H_2SO_4 to pH < 2, 28 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Settleable Solids	Water	1000 mL	160.5	1000 mL plastic or glass. Cool to 4°C, 48 hours	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Specific Conductance	Water	50 mL	120.1 2510B	250 mL plastic or glass. Cool to 4°C, 24 hours	9050A	250 mL plastic or glass. Cool to 4°C, 28 days
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Sulfate (SO_4)	Water	50 mL	300.0A [7] 375.4	100 mL plastic or glass. Cool to 4°C, 28 days	9056A 9038	Method 9056: Cool to 4°C. Analyze ASAP collection. Method 9038: 200 mL plastic or glass, Cool to 4°C, 28 days
	Solid	N/A	---	N/A	---	N/A
	Waste	100 mL	---	N/A	9038	200 mL plastic or glass. Cool to 4°C, 28 days

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3, 7] Method	NPDES [2, 3, 7] Requirements	RCRA (SW846) [3, 4] Method	RCRA (SW846) [3, 4] Requirements
Sulfide	Water	250 mL	376.1	500 mL plastic or glass. Cool to 4°C, Add 2 mL zinc acetate plus NaOH to pH > 9, 7 days	9030A 9030B/ 9034	500 mL plastic, No headspace. Cool to 4°C. Add 4 drops of 2N zinc acetate per 100 mL of sample, adjust the pH to > 9 with 6 N NaOH solution, 7 days
	Solid	50 g	---	N/A	9030A 9030B/ 9034	Cool to 4°C. Fill surface of solid with 2N Zinc acetate until moistened. Store headspace-free
	Waste	50 g	---	N/A	9030A 9030B/ 9034	Cool to 4°C. Fill surface of solid with 2N Zinc acetate until moistened. Store headspace-free
Total Dissolved Solids (Filterable)	Water	100 mL	160.1 2540C	250 mL plastic or glass. Cool to 4°C, 7 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3, 7]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method	Requirements
Total Kjeldahl Nitrogen (TKN)	Water	100 mL	351.3	500 mL plastic or glass. Cool to 4°C, H_2SO_4 to pH < 2, 28 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Total Organic Carbon (TOC)	Water	100 mL	415.1 SM5310D	100 mL plastic or glass. Cool to 4°C, H_2SO_4 to pH < 2, 28 days	9060 Walkley-Black	100 mL glass or 40 mL VOA vials,Cool to 4°C, H_2SO_4 or HCl to pH < 2, 28 days
	Solid	N/A	---	N/A	9060 Walkley-Black	Not Specified
	Waste	N/A	---	N/A	9060 Walkley-Black	Not Specified
Total Organic Halides (TOX) (EOX)	Water	100 mL	450.1 [7]	500 mL amber glass, Teflon®-lined lid. Cool to 4°C, HNO_3 to pH <2, no headspace, 28 days	9020B 9023 (EOX)	500 mL amber glass, Teflon®-lined lid. Cool to 4°C, H_2SO_4 to pH < 2, no headspace, 28 days
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Total Solids	Water	100 mL	160.3	250 mL plastic or glass. Cool to 4°C, 7 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Total Suspended Solids (Nonfilterable)	Water	100 mL	160.2	250 mL plastic or glass. Cool, 4°C, 7 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3, 7]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method	Requirements
Turbidity	Water	50 mL	180.1	250 mL plastic or glass. Cool, 4°C, 48 hours	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Volatile Solids	Water	100 mL	160.4	250 mL plastic or glass. Cool, 4°C, 7 days	---	N/A
	Solid	N/A	---	N/A	---	N/A
	Waste	N/A	---	N/A	---	N/A
Metals (excludes Hg)	Water	100 mL	200 series	1 liter glass or polyethylene container, HNO_3 to pH $\leq$ 2, 6 months	6010B 6020	1 liter glass or polyethylene container, HNO_3 to pH $\leq$ 2, 6 months
	Solid	200 g	200 series	2, 8, or 16 oz glass or polyethylene container storage at 4 °C	6010B 6020	8 or 16 oz glass or polyethylene container, storage at 4°C, 6 months
	Waste	200 g	200 series	N/A	6010B 6020	8 or 16 oz glass or polyethylene container, storage at 4°C, 6 months
Mercury (CVAA) (CVAFS)	Water	100 mL	245.1 245.7 1631E	250 mL glass or polyethylene container, HNO_3 to pH $\leq$ 2, 28 days	7470A	1 liter glass or polyethylene container, HNO_3 to pH $\leq$ 2, 28 days
	Solid	200 g	--	2, 8, or 16 oz glass or polyethylene container. Cool to 4°C, 28 days. Not applicable for Method 1631E.	7471A	8 or 16 oz glass or polyethylene container. Cool to 4°C, 28 days (CORP-MT-0007)
	Waste	200 g	--	N/A	7471A	8 or 16 oz glass or polyethylene container. Cool, 4°C, 28 days (CORP-MT-0007)

Footnotes

[1] Minimum sample size indicates sample amount needed for a single analysis. Matrix spikes or duplicates will require an additional sample amount of at least this amount for each additional QC sample aliquot required.

[2] National Pollutant Discharge Elimination System - MCAWW, March 1983.

[3] Holding times are calculated from date of collection.

[4] Resource Conservation and Recovery Act, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA, (August 1993), Final Update II (September 1994), Final Update IIB (January 1995), and Final Update III (December 1996).

[5] Solid matrix type includes soil, sediment, sludge and other solid materials not classified as waste.

[6] Samples to be analyzed for cyanide should be field-tested for residual chlorine. If residual chlorine is detected, ascorbic acid should be added.

[7] Method not listed in 40 CFR Part 136.

[8] If not done in the field (ASAP) per the method and requested by client, analyze in lab within 48 hours.

[9] EPA issued memo recommending not to use reactive cyanide and sulfide methods.

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Table 23-2.

Organic Sample Containers, Preservatives, and Holding Times

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method [6]	Requirements
Aromatic Volatiles	Water	40 mL	602	40 mL glass, VOA vial (in triplicate) with Teflon®-lined septa without headspace. Cool to 4°C, 7 days with pH > 2,14 days with pH ≤ 2	8021B	40 mL glass, VOA vial (in triplicate) with Teflon®-lined septa without headspace. Cool to 4°C, 1:1 HCl to pH ≤2, 14 days with pH ≤ 2
	Solid [5]	5 g or 25 g	--	N/A	8021B	4 or 8 oz glass with Teflon®-lined lid. Cool to 4 °C, 14 days. Field preserved with methanol for medium level analysis. Soil sample can also be taken by using the EnCore™ sampler and preserved in the lab within 48 hours of sampling. Maximum holding time for Encore Sampler is 48 hours (before the sample is added to methanol). Cool, 4°C [12]
	Waste	5 g or 25 g	--	N/A	8021B	4 or 8 oz glass with Teflon®-lined lid. Cool to 4 °C, 14 days. Field preserved with methanol for medium level analysis. Soil sample can also be taken by using the EnCore™ sampler and preserved in the lab within 48 hrs of sampling. Max holding time for EnCore™ sampler is 48 hrs (before the sample is added to methanol). Cool to 4°C [12]

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method [6]	Requirements
Halogenated Volatiles by GC	Water	40 mL	--	N/A	8021B	40 mL glass, VOA vial (in triplicate) with Teflon®-lined septa without headspace. Cool to 4°C, 1:1 HCl to pH ≤ 2, 14 days
	Solid [5]	5 g or 25 g	--		8021B	4 or 8 oz glass with Teflon®-lined lid. Cool to 4 °C, 14 days. Field preserved with methanol for medium level analysis. Soil sample can also be taken by using the EnCore™ sampler and preserved in the lab within 48 hours of sampling. Maximum holding time for Encore Sampler is 48 hours (before the sample is added to methanol). Cool to 4°C [12]
	Waste	5 g or 25 g	--	N/A	8021B	4 or 8 oz glass with Teflon®-lined lid. Cool to 4 °C, 14 days. Field preserved with methanol for medium level analysis. Soil sample can also be taken by using the EnCore™ sampler and preserved in the lab within 48 hours of sampling. Maximum holding time for Encore Sampler is 48 hours (before the sample is added to methanol). Cool, 4°C [12].

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method [6]	Requirements
Herbicides	Water	1L	615 [(10)]	1 liter amber glass with Teflon®-lined lid, Sodium thiosulfate or ascorbic acid if residual chlorine present. Cool to 4°C, Extraction, 7 days. Analysis, 40 days after extraction	8151A	1 liter amber glass with Teflon®-lined lid. If residual chlorine present, add 3 mL sodium thiosulfate per gallon. Cool to 4°C. Extraction, 7 days. Analysis, 40 days of the start of extraction.
	Solid	50 g	--	N/A	8151A	4 or 8 oz glass widemouth with Teflon®-lined lid. Cool to 4 °C. Extraction, 14 days. Analysis, 40 days of the start of the extraction.
	Waste	50 g	--	N/A	8151A	4 or 8 oz glass widemouth with Teflon®-lined lid. Cool to 4 °C. Extraction, 14 days. Analysis, 40 days of the start of the extraction.

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method [6]	Requirements
Pesticides/ PCBs	Water	1L	608	1 liter amber glass with Teflon®-lined lid, Adjust pH to 5-9 if extraction not to be done within 72 hours of sampling. Add sodium thiosulfate if residual chlorine present and aldrin is being determined. Cool, 4°C. Extraction, 7 days. Analysis, 40 days after extraction.	8081A 8082	1 liter amber glass with Teflon®-lined lid, If residual chlorine present, add 3 mL 10% sodium thiosulfate per gallon. Cool, 4°C. Extraction, 7 days. Analysis, 40 days of the start of the extraction.
	Solid	50 g	---	N/A	8081A 8082	4 or 8 oz glass wide mouth with Teflon®-lined lid. Cool, 4°C. Extraction, 14 days. Analysis, 40 days of the start of the extraction.
	Waste	50 g	---	N/A	8081A 8082	4 or 8 oz glass wide mouth with Teflon®-lined lid. Cool, 4°C. Extraction, 14 days. Analysis, 40 days of the start of the extraction.

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method [6]	Requirements
Petroleum Hydrocarbons /Oil and Grease	Water	1 L	1664A[(7)]	1 liter glass, Cool, 4°C HCl or H_2SO_4 to pH <2 28 days	9071B	1 liter glass, Cool, 0-4°C HCl or H_2SO_4 to pH <2 28 days
	Solid	30 g	1664A[(7)]	8 or 16 oz. Wide mouth glass jar, Cool, 4°C, 28 days	9071B	8 or 16 oz. wide mouth glass jar, Cool, 0-4°C, 28 days
	Waste	---	---	N/A	9071B	N/A
Purgeable Halocarbons by GC	Water	40 mL	601	40 mL glass VOA vial (in triplicate) with Teflon®-lined septa with no headspace, Cool, 4°C, 14 days.	8021B	40 mL glass VOA vial (in triplicate) with Teflon®-lined septa with no headspace, Cool, 4°C, 1:1 HCl to pH ≤ 2, 14 days.
	Solid	5 g or 25 g	---	N/A	8021B	4 or 8 oz glass with Teflon®-lined lid, Cool 4 °C, 14 days. Field preserved with methanol for medium level analysis. Soil sample can also be taken by using the EnCore™ sampler and preserved in the lab within 48 hours of sampling. Maximum holding time for EnCore™ sampler is 48 hrs (before the sample is added to methanol). Cool, 4°C[12].

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method [6]	Requirements
Purgeable Halocarbons by GC (cont'd)	Waste	5 g or 25 g	---	N/A	8021B	4 or 8 oz glass with Teflon®-lined lid, Cool 4 °C, 14 days. Field preserved with methanol for medium level analysis. Soil sample can also be taken by using the EnCore™ sampler and preserved in the lab within 48 hours of sampling. Maximum holding time for Encore™ sampler is 48 hours (before the sample is added to methanol). Cool, 4°C[12]
Semivolatiles	Water	1L	625	1 liter amber glass with Teflon®-lined lid. Cool, 4°C. Extraction, 7 days. Analysis, 40 days.	8270C	1 liter amber glass with Teflon®-lined lid, If residual chlorine present, add 3 mL sodium thiosulfate per gallon. Cool, 4°C. Extraction, 7 days. Analysis, within 40 days of extraction.
	Solid	50 g	---	N/A	8270C	8 or 16 oz glass wide mouth with Teflon-lined lid. Cool, 4°C. Extraction, 14 days. Analysis, within 40 days of extraction.
	Waste	50 g	---	N/A	8270C	8 or 16 oz glass wide mouth with Teflon®-lined lid. Cool, 4°C. Extraction, 14 days. Analysis, within 40 days of extraction.

Analytical Parameters	Matrix	Minimum Sample Size [1]	NPDES [2, 3]		RCRA (SW846) [3, 4]	
			Method	Requirements	Method [6]	Requirements
Volatile Organics	Water	40 mL	624	40 mL glass, VOA vial (in triplicate) with Teflon®-lined septa without headspace. Cool to 4°C. Add sodium thiosulfate if residual chlorine, 7 days with pH > 2, 14 days with pH ≤ 2[8].	8260B	40 mL glass, VOA vial (in triplicate) with Teflon®-lined septa without headspace. Cool to 4°C. Add sodium thiosulfate if residual chlorine, 1:1 HCl to pH ≤ 2, 14 days with pH ≤ 2[9].
	Solid[5]	5 g or 25 g	--	N/A	8260B	4 or 8 oz glass with Teflon®-lined lid. Cool to 4 °C, 14 days. Field preserved with sodium bisulfate solution for low level analysis, or with methanol for medium level analysis. Soil sample can also be taken by using the EnCore™ sampler and preserved in the lab within 48 hrs of sampling. Maximum holding time for EnCore™ sampler is 48 hrs (before the sample is added to methanol or sodium bisulfate). Cool to 4°C[(12)]
	Waste	5 g or 25 g	--	N/A	8260B	4 or 8 oz glass with Teflon®-lined lid, Cool 4 °C, 14 days. Field preserved with sodium bisulfate solution for low level analysis, or with methanol for medium level analysis. Soil sample can also be taken by using the EnCore™ sampler and preserved in the lab within 48 hrs of sampling. Maximum holding time for Encore™ sampler is 48 hrs (before sample is added to methanol or sodium bisulfate). Cool to 4°C[12]

Footnotes

[1] Minimum sample size indicates sample amount needed for a single analysis. Matrix spikes or duplicates will require an additional sample amount of at least this amount for each additional QC sample aliquot required.

[2] National Pollutant Discharge Elimination System - 40 CFR Part 136, Appendix A.

[3] Holding times are calculated from the date of collection.

[4] Resource Conservation and Recovery Act, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA (August 1993), Final Update II (September 1994), Final Update IIB (January 1995), and Final Update III (December 1996).

[5] Solid matrix type includes soil, sediment, sludge or other solids not classified as waste.

[6] Only one determination method is listed when separate methods are required for preparation and analysis.

[7] Method 1664 was promulgated by the EPA with an effective date of June 14, 1999.

[8] For acrolein and acrylonitrile the pH should be adjusted to 4-5. This pH adjustment is not required if acrolein is not measured. Samples requiring analysis of acrolein that received no pH adjustment must be analyzed within three days of sampling.

[9] For acrolein and acrylonitrile the pH should be adjusted to 4-5.

[10] Method not listed in 40 CFR Part 136.

[11] Should only be used in the presence of residual chlorine.

[12] Depending on regulatory programs, EnCore™ samplers may be preserved for up to 14 days from sampling by freezing at -5 to-12°C until analysis. Alternatively the EnCore™ sample may be transferred to a 40-ml VOA vial and preserved by freezing at -5 to -12°C until analysis. Some regulatory agencies may require 4 or 8 oz glass with Teflon®-lined lid, Cool 4°C, 14 days. This technique is not recommended, but will be supported where required. (Preservation and holding times are subject to client specifications.)

Table 23-3.

Sample Containers, Preservatives, and Holding Times for TCLP[1] and SPLP[2]

Analytical Parameters	Matrix	Minimum Sample Size	TCLP Method 1311 and SPLP Method 1312 Requirements	
			From Field Collection to TCLP/SPLP Extraction	From TCLP/SPLP Extraction to Analysis
Mercury	Liquid Solid Waste	1L	1L glass, Cool, 4°C, 28 days	Glass or polyethylene 28 days
Metals (except mercury)	Liquid Solid Waste	1L	1L glass, Cool, 4°C, 180 days	Glass or polyethylene 180 days
Semivolatiles	Liquid Solid Waste	1L	1L glass, Cool 4°C, 14 days	1L glass Extraction of leachate within 7 days of TCLP extraction, Analyze extract within 40 days
Volatiles	Liquid Solid Waste	6 oz	4 oz glass, Cool 4°C, 14 days	40 mL glass, 14 days

Footnotes

1 TCLP = Toxicity Characteristic Leaching Procedure

2 SPLP = Synthetic Precipitation Leaching Procedure

SECTION 24

HANDLING OF SAMPLES
(NELAC 5.5.8)

Sample management procedures at TestAmerica North Canton ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

24.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and can be initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 24-1.

24.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 24-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

The samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory. The sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. Samples are only considered to be received by lab when personnel at the laboratory have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The COC is stored with project information and the report.

24.1.2 Legal / Evidentiary Chain-of-Custody

The lab does not accept samples that require legal chain-of-custody.

24.2 SAMPLE RECEIPT

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections. SOP NC-SC-0005, Sample Receiving and Sample Control, describes the laboratory's sample receipt procedure.

24.2.1 Laboratory Receipt

Samples shall be received and logged in at TestAmerica by a designated sample custodian or other properly trained associate. Upon sample receipt, the sample custodian shall, as appropriate:

- Wear appropriate personal protective equipment. At a minimum, this consists of cut-resistant gloves, a lab coat, and safety glasses
- Examine the shipping containers to verify that the custody tape is intact
- Examine all sample containers for damage
- Open shipping containers in adequately ventilated areas to assure worker safety
- Determine if the temperature required by the requested testing program has been maintained during shipment. Document the shipping container temperature on the Cooler Receipt Form
- Compare samples received against those listed on the COC
- Verify that sample holding times have not been exceeded
- Examine all shipping records for accuracy and completeness
- Determine sample pH (if required for the scheduled analysis) (except VOA and TOX samples) and record on the Cooler Receipt Form (CRF)
- Sign and date the COC immediately (only after shipment is accepted) and attach the waybill
- Note any problems associated with the coolers and samples on the cooler receipt form and notify the PM who in turn notifies the client

- Attach durable (water-resistant) laboratory sample container labels with unique laboratory identification number and test
- Place the samples in proper laboratory storage.

A Cooler Receipt Form (CRF) or an equivalent form/system is generated by sample control during the sample log-in process to document anomalies identified upon the receipt of samples in the laboratory. These anomalies are outside of laboratory control and do not require corrective actions to be taken within the laboratory. The affected client shall be notified by the PM or designee of all CRFs generated for their samples. The PM is responsible for resolving with the client how to proceed with the samples and documenting the decision to proceed with the analysis of compromised samples. CRFs must be resolved prior to sample preparation and analysis. The completed CRF shall be stored in the project file. An example CRF is shown in Figure 24-4. The report narrative will include an explanation of sample receiving related anomalies.

24.2.2 Exceptions or Discrepancies

TestAmerica reserves the right to reject samples for any of the following reasons:

- No custody seals as required by project
- No chain of custody documentation provided
- Preservation inappropriate for analysis requested
- Sample container inappropriate for analysis requested
- Sample received out of holding time for analysis requested
- Incomplete sample information provided
- Discrepancies between COC and sample labels
- Samples have high levels of polychlorinated dibenzo-p-dioxins/ dibenzo furans (PCDD/PCDFs)
- Samples have a high level gross alpha or beta radiation
- Samples are from a site known to contain chemical warfare agents (CWAs) and the samples have not been screened for them.
- Samples containing high levels of PCBs, Cyanides, Sulfides, and Hydrofluoric Acid.
- Tissue samples that may contain viruses harmful to humans.
- Samples with percent levels of Target analytes must be discussed in advance before receipt.

These or any other project exceptions or discrepancies are discussed with the client and agreed upon action taken.

24.2.3 Sample Log-In

Sample log-in activities at TestAmerica North Canton are fully documented in SOP NC-SC-0005, Sample Receiving and Sample Control. The following is a general description of the log-in process:

- Client Name, Project Name, Address, Phone, Fax, Report to information, invoice to information. (Most of this information is "default information" that is stored in the LIMS.)
- Date and time sampled
- Date and time received
- Job and/or project description, sample description
- Sample matrix, special sample remarks
- Reporting requirements, i.e., QC level, report format, invoicing format
- Turn-around-time requirements
- Parameters (methods and reporting limits or MDLs are default information for a given parameter)

24.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy outlined in SOP NC-SC-0005, Sample Receiving and Sample Control, that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- A COC filled out completely
- Samples must be properly labeled
- Proper sample containers with adequate volume for the analysis and necessary QC
- Samples must be preserved according to the requirements of the requested analytical method
- Sample holding times must be adhered to
- All samples submitted for water/solid Volatile Organic analyses must have a Trip Blank submitted at the same time
- The Project Manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined. A copy of the sample acceptance policy is provided to each client prior to shipment of samples.

24.4 SAMPLE STORAGE

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators suitable for the sample matrix. Metals samples may be unrefrigerated. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

The primary considerations for sample storage are:

- Maintenance at the method prescribed temperature, if required
- Maintenance of sample integrity through adequate protection from contamination from outside sources or from cross-contamination of samples. Low-level and high-level samples,

when known, must be stored separately. Samples and standards must be stored in separate refrigerators or freezers. Storage areas for volatile organic test requests must be monitored weekly by the analysis of a holding (refrigerator) blank (an aliquot of contaminant-free water stored in a VOA vial)

- Security of samples within the laboratory.

The requirements listed in Tables 23-1 through 23-3 for temperatures and holding times shall be used. Placing of samples in the proper storage environment is the responsibility of sample control personnel. TestAmerica will assign individuals the responsibility of notifying the Group/Team Leaders or their designees if there are any samples which must be analyzed immediately because of holding time requirements.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

24.5 HAZARDOUS SAMPLES AND FOREIGN SOILS

All samples per SOP are treated as hazardous. If any extra or known hazards are present in the sample, the sample is flagged and precautions / instructions are put in the comments. Hazardous samples are segregated out, and go into the waste stream profile for the nature of the hazard. All soils--foreign and domestic--go to a USDA approved incinerator.

24.6 SAMPLE SHIPPING

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses. The Chain-of-Custody form is signed by the Sample Control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

24.7 SAMPLE DISPOSAL

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP NC-SC-0005, Sample Receiving and Sample Control, and the Facility Addendum to the Corporate

Safety Manual.) All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), and names of individuals who conducted the arrangements and physically completed the task. Sample labels are destroyed through the disposal method, e.g., samples are incinerated. A Waste Manifest is completed.

Figure 24-1. Example: Chain of Custody (COC)

TestAmerica North Canton
4101 Shuffle Drive N.W.
North Canton, OH 44720
phone 330-497-9396 fax 330-497-0772

Chain of Custody Record

Client Contact	Project Manager:	Site Contact:	Date:
Your Company Name here	Tel/Fax:	Lab Contact:	Carrier:
Address	Analysis Turnaround Time		
City/State/Zip	Calendar (C) or Work Days (W)		
(xxx) xxx-xxxx Phone	TAT if different from Below _____		
(xxx) xxx-xxxx FAX	☐ 2 weeks		
Project Name:	☐ 1 week		
Site:	☐ 2 days		
P O #	☐ 1 day		

Sample Identification	Sample Date	Sample Time	Sample Type	Matrix	# of Cont.	Filtered Sample																	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* _____ *Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:
Relinquished by:	Company:	Date/Time:	Received by:	Company:
Relinquished by:	Company:	Date/Time:	Received by:	Company:

Figure 24-2.

Example: Custody Seals

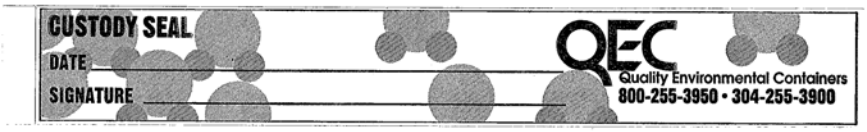


Figure 24-3.

Example: Internal Chain of Custody (COC)

TestAmerica Laboratories, Inc.
Sample Control Record

Client:

Lot Number:

Case Number/SDG:

Storage Location:

Laboratory Sample ID	Transferred By	Date	Entered	Removed	Reason	Date Returned

Figure 24-4.

Example: Cooler Receipt Form (Page 1)

TestAmerica Cooler Receipt Form/Narrative **Lot Number:_____**

North Canton Facility

Client _____ Project _____ Quote # _____

Cooler Received on _____ Opened on _____ By _____

FedEx ☐ Client Drop Off ☐ UPS ☐ DHL ☐ FAS ☐ TestAmerica Courier☐

Stetson ☐ US Cargo ☐ Other _____ (Signature)

TestAmerica Cooler # _____ Foam Box ☐ Client Cooler ☐ Other_____

1. Were custody seals on the outside of the cooler? Yes ☐ No ☐ Intact? Yes ☐ No ☐ NA ☐
   If YES, Quantity_____
   Were custody seals on the outside of cooler signed and dated? Yes ☐ No ☐ NA ☐
   Were custody seals on the bottles? Yes ☐ No ☐
   If YES, are there any exceptions _____
2. Shipper's packing slip attached to this form? Yes ☐ No ☐
3. Did custody papers accompany the sample(s)? Yes ☐ No ☐ Relinquished by client? Yes ☐ No ☐
4. Did you sign the custody papers in the appropriate place? Yes ☐ No ☐
5. Packing material used: Bubble Wrap ☐ Foam ☐ None ☐ Other _____
6. Cooler temperature upon receipt _____ °C (see back of form for multiple coolers/temps)

METHOD: IR ☐ Other ☐ _____

COOLANT: Wet Ice ☐ Blue Ice ☐ Dry Ice ☐ Water ☐ None ☐

7. Did all bottles arrive in good condition (Unbroken)? Yes ☐ No ☐
8. Could all bottle labels and/or tags be reconciled with the COC? Yes ☐ No ☐
9. Were samples at the correct pH upon receipt? Yes ☐ No ☐ NA ☐
10. Were correct bottles used for the tests indicated? Yes ☐ No ☐
11. Were air bubbles >6 mm in any VOA vials? Yes ☐ No ☐ NA ☐
12. Sufficient quantity received to perform indicated analyses? Yes ☐ No ☐
13. Was a Trip Blank present in the cooler? Yes ☐ No ☐ Were VOAs on the COC? Yes ☐ No ☐

Contacted PM _____ Date _____ by _____ via Voice Mail ☐ Verbal ☐ Other ☐

Concerning_____

14. CHAIN OF CUSTODY

The following discrepancies occurred:

_____

_____

_____

15. SAMPLE CONDITION

Sample(s)_____ were received after the recommended holding time had expired.

Sample(s)_____ were received in a broken container.

16. SAMPLE PRESERVATION

Sample(s) _____ were further preserved in sample receiving to meet recommended pH level(s). *Nitric Acid Lot #*071707-*HNO3 - Sulfuric Acid Lot #* 092006-*H2SO4; Sodium Hydroxide Lot #* 122805 -*NaOH; Hydrochloric Acid Lot #* 092006-*HCl; Sodium Hydroxide and Zinc Acetate Lot #* 050205-*CH3COO2ZN/NaOH*

What time was preservative added to sample(s)? _____

Sample(s)_____were received with bubble > 6 mm in diameter (Notify PM)

Client ID	pH	Date	Initials

Example: Cooler Receipt Form (Page 2)

TestAmerica Cooler Receipt Form/Narrative
North Canton Facility

Client ID	pH	Date	Initials
Cooler	**Temp °C**	**Method**	**Coolant**

Discrepancies Cont'd

SECTION 25.0

ASSURING THE QUALITY OF TEST RESULTS
(NELAC 5.5.9)

25.1 OVERVIEW

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 21, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

25.2 CONTROLS

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps may include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

25.3 NEGATIVE CONTROLS

25.3.1 **Method Blanks** are used to assess preparation and analysis for possible contamination during the preparation and processing steps.

25.3.1.1 The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples.

25.3.1.2 The method blank goes through all of the steps of the process, including as necessary, filtration, clean-ups, etc.

25.3.1.3 The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is one for each batch of samples--not to exceed 20 environmental samples.

25.3.1.4 Evaluation criteria and corrective action for method blanks is defined in the specific standard operating procedure for each analysis. Generally, corrective action is taken if the concentration of a target analyte in the blank is at or above the reporting limit as established by the method or regulation. Refer to Policy QA-003, TestAmerica North Canton Quality Control Program.

- The source of contamination is investigated
- Measures are taken to minimize or eliminate the source of the contamination
- Affected samples are reprocessed or the results are qualified on the final report.

25.3.2 **Calibration Blanks** are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

25.3.3 **Instrument Blanks** are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

25.3.4 **Trip Blanks** are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples. Trip Blanks are also sometimes referred to as Travel Blanks.

25.3.5 **Field Blanks** are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)

25.3.6 **Equipment Blanks** are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)

25.3.7 **Holding Blanks**, also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory**.** Refer to SOP NC-QA-0020, Laboratory Holding Blanks, for additional information on holding blank criteria.

25.3.8 **Field blanks**, equipment blank and trip blanks, when received, are analyzed in the same manner as other field samples. When known, blanks should not be selected for matrix QC, as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB".

25.4 POSITIVE CONTROLS

Control samples, e.g., QC indicators, are analyzed with each batch of samples to evaluate data based upon:

1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps

2) Matrix Effects (Matrix Spike (MS) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

25.4.1 <u>Method Performance Control - Laboratory Control Sample (LCS)</u>

25.4.1.1 The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

25.4.1.2 The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

25.4.1.3 Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

25.4.1.4 As stated in the opening of this section, the LCS goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).

25.4.1.5 The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally one for each batch of samples; not to exceed 20 environmental samples.

25.4.1.6 If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable, e.g., no spike of pH. However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in

Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

25.4.1.6.1 For methods that have 1-10 target analytes, spike all components.

25.4.1.6.2 For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.

25.4.1.6.3 For methods with more than 20 target analytes, spike at least 16 components.

25.4.1.6.4 Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.

25.4.1.6.5 Exception: Due to analyte incompatibility between the various PCB Aroclors, Aroclors 1016 and 1260 are used for spiking as they cover the range of all of the Aroclors. Specific Aroclors may be used by request on a project specific basis.

25.4.1.7 **Accuracy Calculation**: Percent Recovery (%R) Calculation (applies to LCS, CCV, Surrogates, and Matrix Spikes.

$$\%R = \frac{AV}{TV} \times 100$$

Where: AV = Analyzed Value
TV = True Value

25.5 SAMPLE MATRIX CONTROLS

25.5.1 Matrix Spikes (MS)

25.5.1.1 The Matrix spike is used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used.

25.5.1.2 An MS is essentially a sample fortified with a known amount of the test analyte(s). At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects.

25.5.1.3 If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, a representative number of the listed

components (see LCS analytes in Section 25.4.1.6 above) may be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit-specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

25.5.1.4 The percent recovery calculation for matrix spikes is essentially the same as the calculation shown in Section 25.4.1.7, except that:

AV = Sp – Sa

Where: Sp = Spike result
Sa = Sample result

25.5.2 **Surrogate Spikes**

25.5.2.1 Surrogate Spikes are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.

25.5.2.2 Surrogate compounds are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method (also refer to Section 25.5). Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.

25.5.3 **Duplicates**

25.5.3.1 For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure. Duplicate samples are usually analyzed with methods that do not require matrix spike analysis. LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

25.5.3.2 **Precision Calculation** (Relative Percent Difference - RPD)

$$RPD = \frac{|S - D|}{\frac{(S + D)}{2}} \times 100$$

Where: S=Sample Concentration
D=Duplicate Concentration

25.5.4 Internal Standards

25.5.4.1 In most organic analyses, internal standards are spiked into all environmental and quality control samples (including the initial calibration standards). An internal standard is also used with some metals analyses. It is added to sample extracts after the extraction (post-prep). The acceptance criteria in most methods are 50% to 200% of the responses in the mid-point of the corresponding calibration curve. Consult the method-specific SOPs for details on the internal standard compounds, calculations and acceptance criteria.

25.5.4.2 When the internal standard recoveries fall outside these limits, if there are not obvious chromatographic interferences, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets internal standard recovery criteria, the second run is reported (or both are reported if requested by the client).

25.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

25.6.1 Each individual analyte in the LCS, MS, or Surrogate Spike are evaluated against the control limits as published in the test method. Where there are no established acceptance criteria, the laboratory calculates control limits with the use of control charts or, in some cases, utilizes client project specific or regulatory mandated control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data, e.g., unusual matrices not analyzed often, interim limits are established using available data or by analogy to similar methods or matrices.

25.6.2 Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating (e.g. EPA SW846 8000 series methods). Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

25.6.2.1 The lab should consider the effects of the spiking concentration control limits, and to avoid censoring of data. The acceptance criteria for recovery and precision are often a function of the spike concentration used. Therefore, caution must be used when pooling data to generate control limits.

25.6.2.2 Not only should the results all be from a similar matrix, but the spiking levels should also be approximately the same (within a factor of 2). Similarly, the matrix spike and surrogate results should all be generated using the same set of extraction, cleanup and analysis techniques. For example, results from solid samples extracted by ultrasonic extraction are not mixed with those extracted by Soxhlet.

25.6.2.3 The laboratory should try and avoid discarding data that do not meet a preconceived notion of acceptable performance. This results in a censored data set, which, when used to develop acceptance criteria, will lead to unrealistically narrow criteria. For a 99% confidence interval, one out of every 100 observations likely will still fall outside

the limits. For methods with long analyte lists this may mean occasional failures every batch or two. While professional judgment is important in evaluating data to be used to develop acceptance criteria, specific results are not discarded simply because they do not meet one's expectations. However, data points shall be discarded if they were the result of human or mechanical error or sample concentration exceeded spike level by > 4x.

25.6.3 Laboratory generated % Recovery acceptance (control) limits are generally established by taking ± 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

25.6.3.1 Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).

25.6.3.2 In-house limits cannot be any wider than those mandated in a regulated analytical method.

25.6.3.3 The lowest acceptable recovery limit will be 10% (the analyte must be detectable).

25.6.3.4 The maximum acceptable recovery limit will be 200%.

25.6.3.5 The maximum acceptable RPD limit will be 30% for organic methods and 20% for inorganic methods. The minimum RPD limit is 10%.

25.6.3.6 If either the high or low end of the control limit changes by ≤ 10% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

25.6.4 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits. Refer to NC-QA-0018, Statistical Evaluation of Data and Development of Control Charts, for details.

25.6.4.1 One example: The QA Department generates a Quality Control Limit Summary that contains tables that summarize the precision and accuracy acceptability limits for analyses. Unless otherwise noted, limits within these tables are laboratory generated. Once reviewed and approved, the limits are entered into LIMS and are effective immediately. The Quality Assurance department maintains an archive of all limits used within the laboratory.

25.6.5 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 13) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

25.6.5.1 The analyte results are below the reporting limit and the LCS is above the upper control limit.

25.6.5.2 If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

25.6.5.3 Or, for NELAC and Department Of Defense (DOD) work, there are an allowable number of Marginal Exceedances (ME):

- <11 analytes 0 marginal exceedances are allowed.
- 11 – 30 Analytes 1 marginal exceedance is allowed
- 31-50 Analytes 2 marginal exceedances are allowed
- 51-70 Analytes 3 marginal exceedances are allowed
- 71-90 Analytes 4 marginal exceedances are allowed
- > 90 Analytes 5 marginal exceedances are allowed

25.6.5.3.1 Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (NELAC).

25.6.5.3.2 Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random.

25.6.5.3.3 Though marginal excedences may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

25.6.6 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in Appendix 4 and in Section 13.

25.6.7 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client).

25.7 METHOD DETECTION LIMITS (MDLs)

MDLs, calculated as described in Section 20.7, are updated or verified annually, or more often if required by the method.

25.8 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

25.8.1 The laboratory has written procedures to assure the accuracy of the test method including calibration (see Section 21), use of certified reference materials (see Section 22), and use of PT samples (see Section 16).

25.8.2 A discussion regarding MDLs, Limit of Detection (LOD), and Limit of Quantitation (LOQ) can be found in Section 20.

25.8.3 Use of formulae to reduce data is discussed in the method Standard Operating Procedures and in Section 21.

25.8.4 Selection of appropriate reagents and standards is included in Sections 9 and 22.

25.8.5 A discussion on selectivity of the test is included in Section 5.

25.8.6 Constant and consistent test conditions are discussed in Section 19.

25.8.7 The laboratory sample acceptance policy is included in Section 24.

SECTION 26.0

REPORTING RESULTS
(NELAC 5.5.10)

26.1 OVERVIEW

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is a conflict between the client requested formats and accreditation requirements or data usability information, accreditation requirements and data usability information will take precedence over client requests. A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client.

Review of reported data is included in Section 20.

26.2 TEST REPORTS

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed, reviewed, and signed by the appropriate Project Manager. At a minimum, the standard laboratory report shall contain the following information:

26.2.1 A report title with a “Sample Result” header.

26.2.2 Each report page printed includes the laboratory name, address, and telephone number.

26.2.3 A unique identification of the report, e.g. Work Order number, and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented at the bottom of each page. The report is sequentially paginated. The final page of the report is labeled as “End of Report”.

26.2.4 A copy of the Chain-of-Custody (COC).

- Any COCs involved with subcontracting are included.
- Any additional addenda to the report must be treated in a similar fashion so it is a recognizable part of the report and cannot accidentally get separated from the report (e.g. Sampling information).

26.2.5 The name and address of client and a project name/number, if applicable.

26.2.6 Client project manager or other contact

26.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

26.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

26.2.9 Date reported or date of revision, if applicable

26.2.10 Method of analysis including method code (EPA, Standard Methods, etc)

26.2.11 Reporting limit

26.2.12 Method detection limits (if requested)

26.2.13 Definition of Data qualifiers and reporting acronyms, e.g., ND

26.2.14 Sample results

26.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits

26.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (refer to Section 26.2.4 – Item 3, regarding additional addenda).

26.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

26.2.18 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.

26.2.19 When NELAC accreditation is required, the lab shall certify that the test results meet all requirements of NELAC or provide reasons and/or justification if they do not.

26.2.20 The laboratory includes a cover page.

26.2.21 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

26.2.22 When Soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.

26.2.23 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

26.2.24 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report, e.g., partial report, or how your lab identifies it. A complete report will follow once all of the work has been completed.

26.2.25 Any out-of-network subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All in-network subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

26.3 REPORTING LEVEL OR REPORT TYPE

TestAmerica North Canton offers two levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Standard report – all features in Section 26.2
- Expanded deliverable – standard report

Presented on CLP-like forms and relevant calibration information. All supporting raw data is supplied.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Procedures used to ensure client confidentiality are outlined in Section 26.7.

26.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services. TestAmerica North Canton offers a variety of EDD formats.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

26.4 SUPPLEMENTAL INFORMATION FOR TEST

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report. Refer to Appendix 8 for a list of the laboratory's standard footnotes and qualifiers.

26.4.1 Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

26.4.2 Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications, including identification of test results derived from any sample that did not meet NELAC sample acceptance requirements such as improper container, holding time, or temperature.

26.4.3 Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

26.4.4 Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

26.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If TestAmerica North Canton is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in Section 8.

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of the TestAmerica network are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

26.6 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore,

information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

26.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

"Confidentiality Notice: The information contained in this message is intended only for the use of the addressee, and may be confidential and/or privileged. If the reader of this message is not the intended recipient, or the employee or agent responsible to deliver it to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify the sender immediately."

26.7 FORMAT OF REPORTS

The format of reports are designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

26.8 AMENDMENTS TO TEST REPORTS

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 13).

If, after issuance of a report, TestAmerica North Canton observes any mistake that affects the results reported or the QC interpretation of those results, the client will be notified. After issuance of the report, the laboratory report remains unchanged. Any material amendments to a report after issue made only in the form of a further document, or data transfer must include the statement "Supplement to Test Report" or otherwise identified.

When the report is re-issued, a notation is placed on the cover/signature page of the report or at the top of the narrative page with a brief explanation of reason for the re-issue.

26.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

26.9.1 Sample Reanalysis Policy

Because there is a certain level of uncertainty with any analytical measurement a sample reanalysis may result in either a higher or lower value from an initial sample analysis. There are

also variables that may be present (e.g. sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. Client specific arrangements for reanalysis protocols can be established.

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Group Leader, QA Manager, or Laboratory Director/Manager if unsure.

26.9.2 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results, including data qualifiers, or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested, e.g., COC lists 8315 but client wanted 8310. A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

26.9.3 Multiple Reports

TestAmerica does not issue multiple reports for the same workorder where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. TestAmerica Ethics Policy CA-L-P-001

TESTAMERICA
ETHICS POLICY No. CA-L-P-001

Refer to CA-L-P-001 for complete policy.

TestAmerica
EMPLOYEE ETHICS STATEMENT

I understand that TestAmerica is committed to ensuring the highest standard of quality and integrity of the data and services provided to our clients. I have read the Ethics Policy of the Company.

- *With regard to the duties I perform and the data I report in connection with my employment at the Company, I agree that:*
- *I will not intentionally report data values that are inconsistent with the actual values observed or measured.*
- *I will not intentionally report the dates, times, sample or QC identifications, or method citations of data analyses that are not the actual dates, times, sample or QC identifications, or method citations.*
- *I will not intentionally misrepresent another individual's work as my own or represent my own work as someone else's.*
- *I will not intentionally misrepresent any data where data does not meet Method or QC requirements. If it is to be reported, I will report it with all appropriate notes and/or qualifiers; I shall not modify data (either sample or QC data) unless the modification can be technically justified through a measurable analytical process, such as one deemed acceptable to the laboratory's Standard Operating Procedures, Quality Assurance Manual or Technical Director. All such modifications must be clearly and thoroughly documented in the appropriate laboratory notebooks/worksheets and/or raw data and include my initials or signature and date.*
- *I shall not make false statements to, or seek to otherwise deceive, members of Management or their representatives, agents, or clients/customers. I will not, through acts of commission, omission, erasure, or destruction, improperly report measurement standards, quality control data, test results or conclusions.*
- *I shall not compare or disclose results for any Performance Testing (PT) sample, or other similar QA or QC requirements, with any employee of any other laboratory, including any other TestAmerica laboratory, prior to the required submission date of the results to the person, organization, or entity supplying the PT sample.*
- *I shall immediately inform my supervisor or other member of management regarding any intentional or unintentional reporting of my own inauthentic data. Such report shall be given both orally and in writing to the supervisor or other member of management contacted and to the local Quality Assurance Manager. The Quality Assurance Manager will initial and date the information and return a copy to me. I shall not condone any accidental or intentional reporting of inauthentic data by other employees and will immediately report its occurrence. If I have actual knowledge of such acts committed by any other employees, and I do not report such information to designated members of Management, it shall be considered as serious as if I personally committed the offense. Accordingly, in that event, I understand that I may be subject to immediate termination of employment.*

- *I understand that if any supervisor, manager, or representative of TestAmerica management instructs, requests, or directs me to perform any of the aforementioned improper laboratory practices, or if I am in doubt or uncertain as to whether or not such laboratory practices are proper, I will not comply. In fact, I must report such event to all appropriate members of Management including, but not limited to, the Lab Director, all supervisors and managers with direct line reporting relationship between me and the Lab Director, and the local Quality Assurance representative, excluding such individuals who participated in such perceived improper instruction, request, or directive. In addition, I may contact Corporate Quality Assurance / Ethics Compliance Officer(s) for assistance.*
- *I understand the critical importance of accurately reporting data, measurements, and results, whether initially requested by a client, or retained by TestAmerica and submitted to a client at a later date, or retained by TestAmerica for subsequent internal use;*
- *I will not share the pricing or cost data of Vendors or Suppliers with anyone outside of the TestAmerica family of companies.*
- *I shall not accept gifts of a value that would adversely influence judgment.*
- *I shall avoid conflicts of interest and report any potential conflicts to the management (e.g. employment or consulting with competitors, clients, or vendors).*
- *I shall not participate in unfair competition practices (e.g. slandering competitors, collusion with other labs to restrict others from bidding on projects).*
- *I shall not misrepresent certifications and status of certifications to clients or regulators.*
- *I shall not intentionally discharge wastes illegally down the drain or onto the ground.*
- *I understand that any attempt by management or an employee to circumvent these policies will be subject to disciplinary action.*

As a TestAmerica employee, I understand that I have the responsibility to conduct myself with integrity in accordance with the ethical standards described in the Ethics Policy. I will also report any information relating to possible kickbacks or violations of the Procurement Integrity Act, or other questionable conduct in the course of sales or purchasing activities. I will not knowingly participate in any such activity and will report any actual or suspected violation of this policy to management.

I understand that if my job includes supervisory responsibilities, I shall not instruct, request, or direct any subordinate to perform any laboratory practice which is unethical or improper. Also, I shall not discourage, intimidate, or inhibit an employee who may choose to appropriately appeal my supervisory instruction, request, or directive which the employee perceives to be improper, nor retaliate against those who do.

The Ethics Policy has been explained to me by my supervisor or at a training session, and I have had the opportunity to ask questions if I did not understand any part of it. I understand that any violation of this policy subjects me to disciplinary action, which can include termination of my employment. In addition, I understand that any violation of this policy which relates to work under a government contract or subcontract could also subject me to the potential for prosecution under federal law.

EMPLOYEE SIGNATURE _____ Date _____

Supervisor/Trainer: _____ Date _____

Work Instruction No. CA-WI-005

TestAmerica

CONFIDENTIALITY AND PROPRIETARY INFORMATION AGREEMENT

TestAmerica and their predecessors, in their businesses, have developed and use commercially valuable technical and non-technical information and to guard the legitimate interests of TestAmerica and its clients, it is necessary to protect certain information as confidential and proprietary.

I, _____ , understand and acknowledge that during the term of my employment by TestAmerica, I will be privy to and entrusted with certain confidential information and trade secrets of TestAmerica and its clients.

Confidential information and trade secrets include, but are not limited to: customer and client lists; price lists; marketing and sales strategies and procedures; operational and equipment techniques; standard operating procedures; business plans and systems; quality control procedures and systems; special projects and technological research, including projects, research and reports for any government entity or client; client's plans and processes; client's manner of operation; the trade secrets of clients; client's data; vendor or supplier pricing; employee lists and personal information, and any other records, data, files, drawings, inventions, discoveries, applications, or processes which are not in the public domain.

I agree as follows:

1. I will not in any way, during the term of my employment, or at any time thereafter, except as authorized in writing by the Legal Department of TestAmerica or the client where client data is involved, disclose to others, use for my own benefit, remove from TestAmerica's premises (except to the extent off-site work is approved by my supervisor), copy or make notes of any confidential information and/or trade secrets of TestAmerica or its clients, excepting only that information which may be public knowledge. Technical and business information of any previous employer or other third party which I may disclose to TestAmerica shall be limited to that which was acquired legitimately and disclosed to me without restriction as to secrecy.

2. I agree that all inventions (whether or not patentable) conceived or made by me during the period of my employment by TestAmerica shall belong to TestAmerica, provided such inventions grow out of my work for TestAmerica and are related to the business of TestAmerica. I agree to disclose and assign such inventions to TestAmerica. In California, this provision shall not apply to any invention which qualifies fully under Section 2870 of the California Labor Code.

3. On termination of my employment from TestAmerica, I will deliver to TestAmerica all documents, records, notes, data, memoranda, files, manuals, equipment and things of any nature which relate in any way to confidential information and/or trade secrets of TestAmerica or its clients and which are in my possession or under my control.

4. I agree that during the period of my employment and for one (1) year from and after the termination (for any reason) of my employment with TestAmerica, I shall not directly or indirectly (without first obtaining the written permission of TestAmerica), recruit for employment, or induce to terminate his or her employment with TestAmerica, any person who is an active employee of TestAmerica on the last day of my employment with TestAmerica.

5. I acknowledge that if I were to breach any provision of this Confidentiality Agreement, money damages will be inadequate, and I hereby agree that TestAmerica shall be entitled, where appropriate, to specific performance and/or injunctive relief (i.e. to require me to comply with this Agreement). I further acknowledge that the willingness of TestAmerica to hire me or to continue my employment constitutes full and adequate consideration for the agreements, and obligations to which I have agreed as set forth in this document.

I have executed this Agreement, intending to be legally bound.

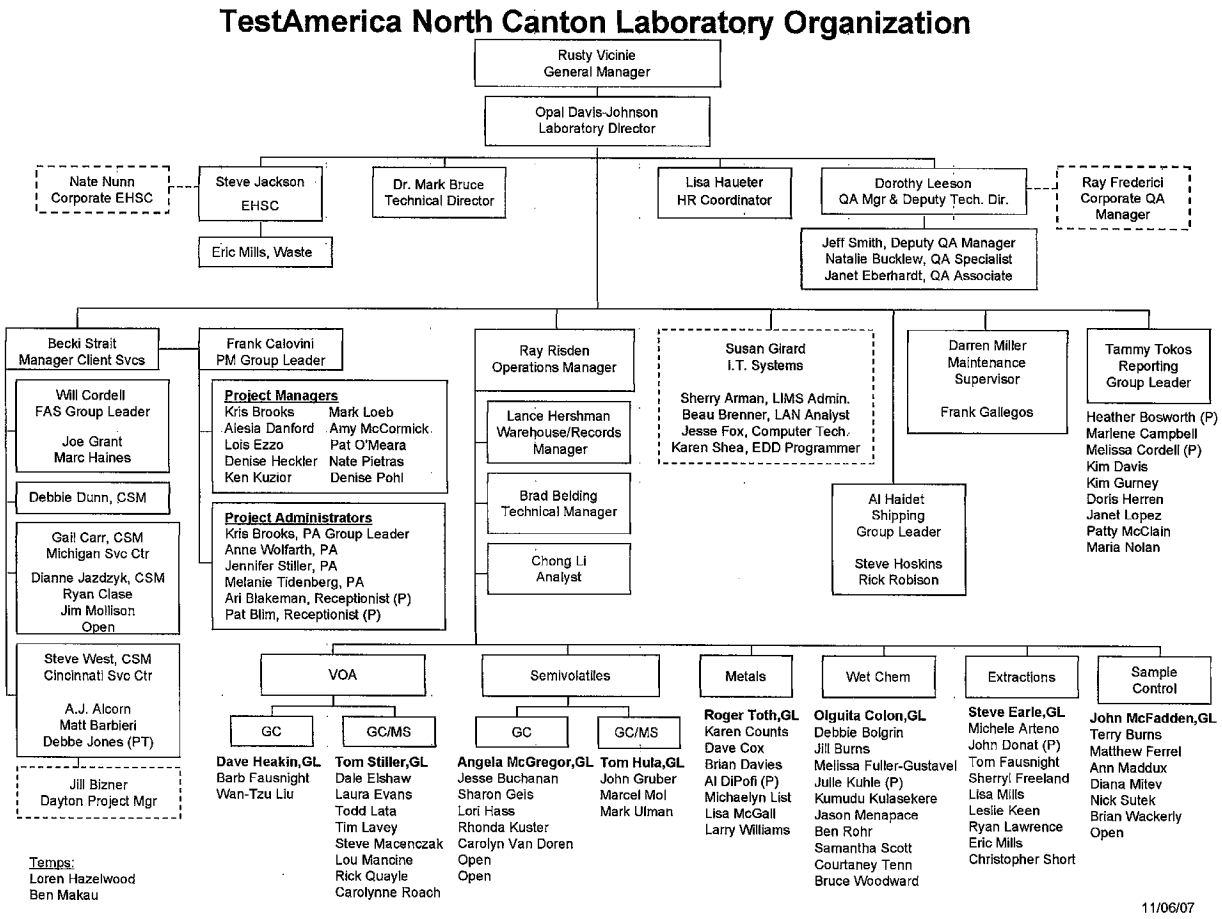
_____	_____	_____
Printed Name	*Signature*	*Date*

Work Instruction No. CA-WI-006

Appendix 2.

Example Laboratory Organization Chart

(The most current chart can be obtained from the QA Manager or Lab Director/Manager)

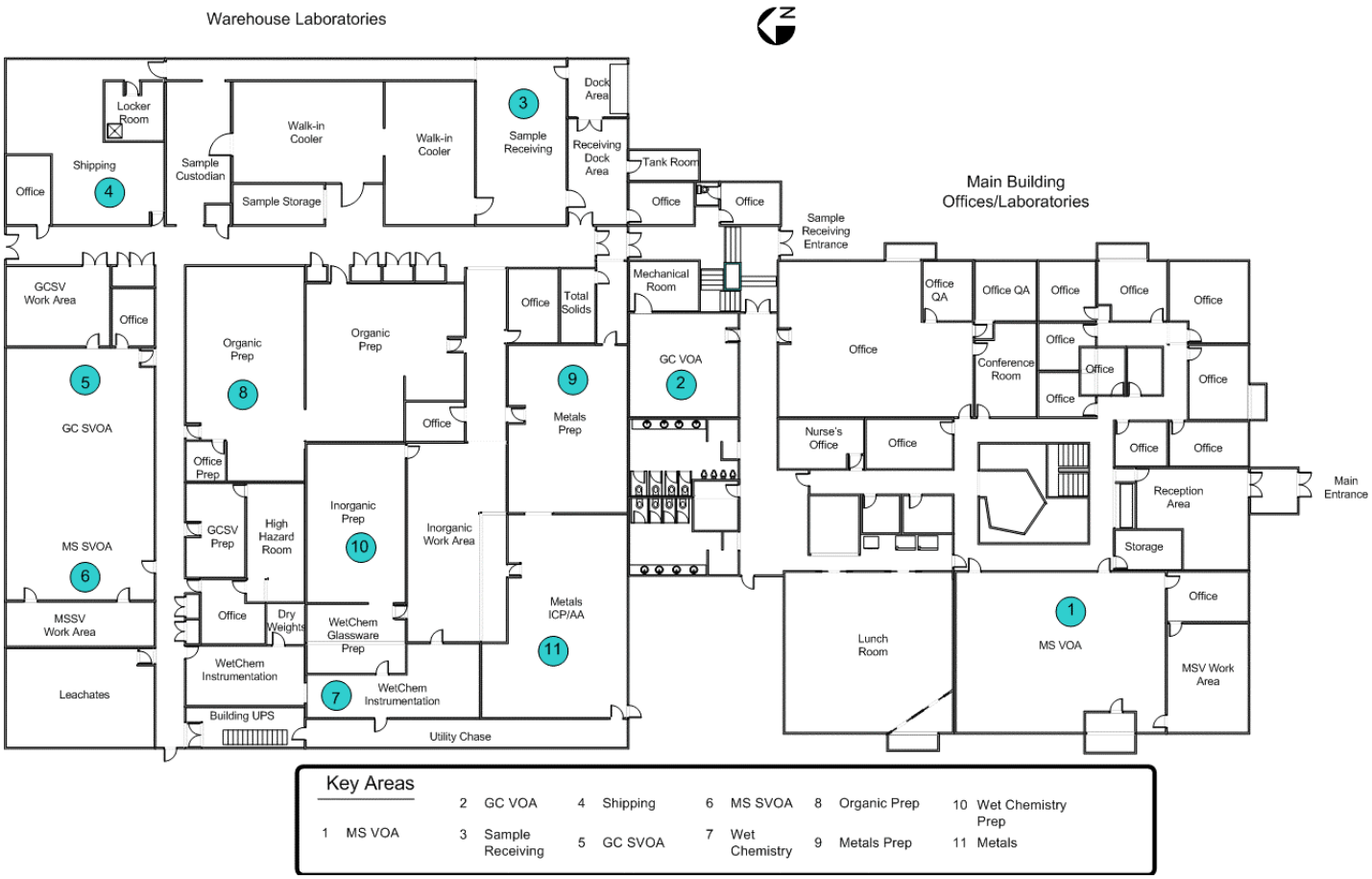


Appendix 3.

Laboratory Floor Plan

TestAmerica – North Canton

4101 Shuffel Dr NW
North Canton, OH 44720



Appendix 4.

Laboratory Method Listing

Wet Chemistry Methods [1]

Analytical Parameters	Matrix		Fields of Testing		
			CWA	RCRA (SW846)	Other
Acidity	Water		305. [2] SM 2310 B	--	--
Alkalinity, Bicarbonate, Carbonate	Water		305. [2] SM 2320 B		
	Solid		EPA 310.1[2] (M)	--	--
Arsenic (ASV) Anodic Stripping Voltammetry	Water		--	EPA 7063	--
Ash Content	Solid		--	--	ASTM D29-74
Biochemical Oxygen Demand, Carbonaceous	Water		EPA 405.1 SM 5210 B	--	--
Bromide	Water		EPA 300.0A	EPA 9056A	--
	Waste		EPA 300.0A	EPA 9056A	--
	Solid		EPA 300.0A (M)	EPA 9056A	--
Cation-Exchange Capacity	Solid		--	EPA 9081	--
Chemical Oxygen Demand	Water		EPA 410.4 SM 5220D	--	--
	Waste		EPA 410.4	--	--
Chloride	Water		EPA 300.0A EPA 325.2[2]	EPA 9056A EPA 9251	EPA 325.2[2]
	Waste		EPA 300.0A	EPA 9056A	--
	Solid		EPA 300.0A (M)	EPA 9056A EPA 9251(M)	--
Chromium, Hexavalent	Water		EPA 3500-Cr-D	EPA 7196A	--
	Waste		EPA 3500-Cr-D	EPA 7196A	--
	Solid		--	EPA 3060A EPA 7196A	--

[1] Any matrix not listed is not applicable for the associated method
[2] Removed from 40CFR

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Specific Conductance	Water		EPA 120.1 SM 2510B	EPA 9050A	--
	Waste		EPA 120.1	EPA 9050A	--
	Solid		--	EPA 9050A	--
Chlorine, Residual	Water		EPA 330.5[2] SM 3500 CL-G	--	--
Cyanide (Amenable)	Water		EPA 335.1[2] SM 4500 CN-G	EPA 9012A	--
	Solid		--	EPA 9012A	--
Cyanide (Total)	Water		SM 4500-CN E EPA 335.4	EPA 9012A	---
	Waste		--	EPA 9012A	--
	Solid		--	EPA 9012A	--
Cyanide (Weak and Dissociable) (Free)	Water		SM 4500-CN I	--	--
Dissolved Oxygen	Water		360.1[2] SM 4500 O-G	--	--
Flash Point	Waste		--	EPA 1010	ASTM D93-9
	Solid		--	EPA 1010	ASTM D93-9
Fluoride	Water		EPA 300.0A EPA 340.2[2]	EPA 9056A	SM 4500 F-C, ISE
	Waste		EPA 340.2 (M)[2] EPA 300.0A (M)	EPA 9056A	--
	Solid		EPA 340.2 (M)[2] EPA 300.0A (M)	EPA 9056A	--
Iron, Ferrous & Ferric	Water		SM 3500 FE D	--	--
Hardness	Water		EPA 130.2[2]	--	SM 2340B
Moisture	Solid		---	EPA 160.3 (M) ASTM D2216-90	---
Nitrogen, Ammonia	Water		EPA 350.1	--	EPA 350.2[2]
	Waste		EPA 350.1	--	EPA 350.2[2]
	Solid		EPA 350.1	--	EPA 350.2[2]
	Water		SM 4500 NH_3-B (Distillation)	--	--
	Water		SM 4500 NH_3-E (Titration)	--	--
	Water		SM 4500 NH_3-F (ISE)	--	--

Analytical Parameters	Matrix	Fields of Testing		
		CWA	RCRA (SW846)	Other
Nitrite (NO_2)	Water	EPA 300.0A	EPA 9056A	--
	Waste	EPA 300.0A (M)	EPA 9056A	--
	Solid	EPA 300.0A (M)	EPA 9056A	--
Nitrate (NO_3)	Water	EPA 300.0A	EPA 9056A	SM 4500 NO_3-E
	Waste	EPA 300.0A (M)	EPA 9056A	--
	Solid	EPA 300.0A (M)	--	--
Nitrate plus Nitrite NO_2/NO_3	Water	EPA 353.2	--	--
	Waste	EPA 353.2	--	--
Total Kjeldahl Nitrogen (TKN)	Water	EPA 351.3	--	SM 4500 NO_3
	Waste	EPA 351.3	--	--
	Solid	EPA 351.3	--	--
Oil and Grease (Hexane Extractable Material)	Water	EPA 1664A	EPA 9071B	--
	Waste	EPA 1664A	EPA 9071B	--
	Solid	--	EPA 9071B	--
Ortho-phosphate o-PO_4	Water	EPA 300.0A EPA 365.1	EPA 9056A	SM 4500 P-E
	Waste	EPA 300.0A (M)	EPA 9056A	--
	Solid	EPA 300.0A (M) EPA 365.1	EPA 9056A	--
pH	Water	EPA 150.1[2]	EPA 9040B	EPA 9041
	Waste	SM 4500 H-B	EPA 9045C	--
	Solid	---	EPA 9045C	--
Paint Filter	Water	--	EPA 9095A	--
Phenolics	Water	EPA 420.1	--	--
	Waste	--	EPA 9065	--
	Solid	--	EPA 9065	--
Phosphorus (Total)	Water	EPA 365.1	--	SM 4500 P-E
	Waste	EPA 365.1	--	--
	Solid	EPA 365.1	--	--
Sulfate (SO_4)	Water	EPA 300.0A EPA 375.4[2]	EPA 9056A EPA 9038	--
	Waste	EPA 300.0A (M) EPA 375.4[2]	EPA 9056A EPA 9038	--
	Solid	EPA 300.0A (M)	EPA 9056A EPA 9038 (M)	--

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA	Other
Sulfide	Water		EPA 376.1[2]	EPA 9030A SM 4500	9030B/9034
Total Organic Carbon (TOC)	Water		EPA 415.1[2]	EPA 9060	SM 5310 D
	Waste		--	EPA 9060	--
	Solid		EPA 415.1 (M)	EPA 9060 (M)	Walkley-Black
Total Organic Halides (TOX)	Water		--	EPA 9020B EPA 9023(EOX)	EPA 450.1
	Waste		--	--	--
	Solid		--	EPA 9020B	--
Total Petroleum Hydrocarbons	Water		EPA 1664A (SGT-HEM)	EPA 9071B	--
	Waste		EPA 1664A (SGT-HEM)	EPA 9071B	--
	Solid		--	EPA 9071B	--
Total Solids	Water		EPA 160.3	--	--
	Waste		EPA 160.3	--	--
	Solid		EPA 160.3 (M)	--	--
Total Dissolved Solids	Water		EPA 160.1	--	2540E
Total Suspended Solids	Water		EPA 160.2	---	2540E
Volatile and Volatile Suspended Solids	Water		EPA 160.4	--	--
Settleable Solids	Water		EPA 160.5	--	--
Turbidity	Water		EPA 180.1	--	--

Methods for Mercury by Cold Vapor Atomic Absorption

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Mercury (CVAA)	Water		EPA 245.1	EPA 7470A	--
	TCLP Leachate		--	EPA 7470A	--
	Waste		--	EPA 7471A	--
	Solid		EPA 254.5	EPA 7471A	--

Methods for Mercury by Cold Vapor Atomic Fluororescence

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Mercury, Low Level (CVAFS)	Water		EPA 245.7	--	EPA 1631E

Methods for Metals by ICP and ICPMS

Analytical Parameters	Matrix		Fields of Testing		
			CWA	RCRA (SW846)	Other
Aluminum	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Antimony	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Arsenic	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Barium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Beryllium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Boron	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		EPA 200.7	EPA 6010B	---
Calcium	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		EPA 200.7	EPA 6010B	---

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	*Other*
Cadmium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Cobalt	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Chromium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Copper	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Iron	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Lead	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Magnesium	Water		EPA 200.7	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7	EPA 6010B EPA 6020	---

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	*Other*
Manganese	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Molybdenum	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Nickel	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Potassium	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		---	EPA 6010B	---
Selenium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Silver	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Sodium	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		---	EPA 6010B	---
Tin	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Thallium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
Titanium	Water		EPA 200.7	EPA 6010B	---
	Waste		---	EPA 6010B	---
	Solid		---	EPA 6010B	---
Vanadium	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		---	EPA 6010B EPA 6020	---
Zinc	Water		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---
	Waste		---	EPA 6010B EPA 6020	---
	Solid		EPA 200.7 EPA 200.8	EPA 6010B EPA 6020	---

Metals Sample Preparation Methods

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Toxicity Characteristic Leaching Procedure (TCLP)	Water		---	EPA 1311	---
	Waste		---	EPA 1311	---
	Solid		---	EPA 1311	---
ICP Metals	Water		EPA 200.7	EPA 3005A EPA 3010A	---
	TCLP Leachate		---	EPA 3010A	---
	Waste		---	EPA 3050B	---
	Solid		---	EPA 3050B	---
ICPMS Metals	Water		EPA 200.8	EPA 3010A	---
	TCLP		---	EPA 3010A	---
	Waste		---	EPA 3050B	---
	Solid		---	EPA 3050B	---
CVAA Mercury	Water		EPA 245.1	EPA 7470A	---
	TCLP Leachate		---	EPA 7470A	---
	Waste		---	EPA 7471A	---
	Solid		---	EPA 7471A	
CVAFS Mercury Low Level	Water		EPA 245.7	---	EPA 1631E

Organic Sample Preparation Methods

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Volatiles by GC/MS	Water		EPA 624	EPA 5030B	---
	Waste		---	EPA 5030B EPA 5035	---
	Solid		---	EPA 5035 EPA 5035A	---
Halogenated Volatiles by GC	Water		EPA 601	EPA 5030B	---
	Waste		---	EPA 5030B EPA 5035	---
	Solid		---	EPA 5035 EPA 5035A	---
Aromatic Volatiles by GC	Water		EPA 602	EPA 5030B	---
	Waste		---	EPA 5030B EPA 5035	---
	Solid		---	EPA 5035 EPA 5035A	---
Semivolatiles by GC/MS	Water		EPA 625	EPA 3510C EPA 3520C	---
	TCLP Leachate		---	EPA 3510C EPA 3520C	---
	Waste		---	EPA 3550B EPA 3540C EPA 3580A EPA 3541	---
	Solid		---	EPA 3550B EPA 3540C EPA 3541	---
Pesticides/PCBs by GC	Water		EPA 608	EPA 3510C EPA 3520C	---
	TCLP Leachate		---	EPA 3510C EPA 3520C	---
	Waste		---	EPA 3550B EPA 3540C EPA 3580A EPA 3541	---
	Solid		---	EPA 3550B EPA 3540C EPA 3541	---

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Herbicides by GC	Water		EPA 615	EPA 8151A	---
	Waste		---	EPA 8151A	---
	Solid		---	EPA 8151A	---
Total Petroleum Hydrocarbons (Gasoline Range) by GC	Water		---	EPA 5030B	WI GRO
	Waste		---	EPA 5030B EPA 5035	WI GRO
	Solid		---	EPA 5035 EPA 5035	WI GRO
Total Petroleum Hydrocarbons (Diesel Range) by GC	Water		---	EPA 3510C EPA 3520C	WI DRO
	TCLP Leachate		---	EPA 3510C EPA 3520C	---
	Waste		---	EPA 3550B EPA 3580A	WI DRO
	Solid		---	EPA 3550B	WI DRO

Organic Methods of Analysis

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Volatiles by GC/MS	Water		EPA 624	EPA 8260B	---
	Waste		---	EPA 8260B	---
	Solid		---	EPA 8260B	---
Halogenated Volatiles by GC	Water		EPA 601	EPA 8021B	---
	Waste		---	EPA 8021B	---
	Solid		---	EPA 8021B	---
Aromatic Volatiles by GC	Water		EPA 602	EPA 8021B	---
	Waste		---	EPA 8021B	---
	Solid		---	EPA 8021B	---
Semivolatiles by GC/MS	Water		EPA 625	EPA 8270C	
	Waste		---	EPA 8270C	---
	Solid		---	EPA 8270C	---
Pesticides/PCBs by GC	Water		EPA 608	Pesticides 8081A PCBs 8082	---
	TCLP Leachate		---	Pesticides 8081A PCBs 8082	---
	Waste		---	Pesticides 8081A PCBs 8082	---
	Solid		---	Pesticides 8081A PCBs 8082	---

Analytical Parameters	Matrix	Fields of Testing			
			CWA	RCRA (SW846)	Other
Phenoxyacid Herbicides by GC	Water		---	EPA 8151A	---
	TCLP Leachate		---	EPA 8151A	---
	Waste		---	EPA 8151A	---
	Solid		---	EPA 8151A	---
Gasoline Range Organics by GC	Water		---	EPA 8015B (M)	WI GRO
	Waste		---	EPA 8015B (M)	---
	Solid		---	EPA 8015B (M)	WI GRO
Total Petroleum Hydrocarbons (Diesel Range) by GC/FID	Water		---	EPA 8015B (M)	WI DRO
	Waste		---	EPA 8015B (M)	---
Dissolved Gases RSK-175	Water		---	---	SOP
Formaldehyde Carbonyl Compounds	Water		---	EPA 8315	---

Appendix 5.

Laboratory Reporting Limits

General Chemistry
Reporting Limits (RL), Method Reference

Test Method	Analyte	RL	Units
305.1/SM2310B	Acidity	5	mg/L
310.1/SM2320B	Alkalinity, Total	5	mg/L
7063	Arsenic Speciation	2	ug/L
300.0 **9056A**	Bromide Chloride Nitrate Fluoride Sulfate Ortho-Phosphate Nitrite	0.5 1 0.1 1 1 0.5 0.1	mg/L mg/L mg/L mg/L mg/L mg/L mg/L
405.1/SM5210B	Biochemical Oxygen Demand	2	mg/L
410.4/SM5220D	Chemical Oxygen Demand (COD)	10	mg/L
325.2/9251	Chloride, Automated	1	mg/L
330.5 **SM4500CL-G**	Chlorine, Total Residue	0.2	mg/L
9012A/335.2 **335.4** **SM4500CN-E**	Cyanide, Total	0.01	mg/L
340.2 **SM4500F-C, ISE**	Fluoride	0.1	mg/L
130.2/SM2340B	Hardness, as CaCO3	5	mg/L
1664A	n-Hexane Extractable Material n-Hexane Extractable Material, SGT	5 10	mg/L mg/L
7196A	Hexavalent Chromium	0.02	mg/L
3500 Cr D	Hexavalent Chromium	0.02	mg/L
353.2 **SM4500NO_3E**	Nitrite Nitrate Nitrate/Nitrite	0.1 0.1 0.1	mg/L mg/L mg/L
350.2 **SM4500NH_3-E,F**	Nitrogen, as Ammonia	1	mg/L

General Chemistry
Reporting Limits (RL), Method Reference

Test Method	Analyte	RL	Units
9065	Phenols, Total	0.02	mg/L
9045B, C SM4500H-B	pH (solid)	--	No Units
4500	Phosphorus as Orthophosphate	0.1	mg/L
365.2 365.1	Ortho-Phosphate Phosphorus, as ortho-Phosphate ortho-Phosphate, Dissolved	0.1 0.1 0.1	mg/L mg/L mg/L
120.1 SM2510B	Specific Conductance	1	umhos/cm
9050A	Specific Conductance	1	umhos/cm
160.1 **SM2540E**	Solids (Residue), Dissolved Filterable Solids, Total Dissolved	10 10	mg/L mg/L
375.4	Sulfate	5	mg/L
9038	Sulfate	5	mg/L
376.1	Sulfide, Total	1	mg/L
9030A	Sulfide, Total	1	mg/L
9030A	Sulfide, Acid-Insoluble	1	mg/L
351.3	Total Kjeldahl Nitrogen	3	mg/L
415.1 SM5310D	Total Organic Carbon	1	mg/L
9060	Total Organic Carbon	1	mg/L
9020B	Total Organic Halogens	30	ug/L
180.1	Turbidity	0.5	NTU

Metals – ICP, CVAA 6000, 7000, 200 Series Reporting Limits (RL), Method Reference [1, 2]

	Analyte	RL	Units
Trace Water	Antimony	0.01	mg/L
	Arsenic	0.01	mg/L
	Cadmium	0.002	mg/L
	Chromium	0.005	mg/L
	Cobalt	0.007	mg/L
	Lead	0.003	mg/L
	Molybdenum	0.01	mg/L
	Selenium	0.005	mg/L
	Silver	0.005	mg/L
	Thallium	0.01	mg/L
	Vanadium	0.007	mg/L
Trace Solid	Antimony	1	mg/kg
	Arsenic	1	mg/kg
	Cadmium	0.2	mg/kg
	Chromium	0.5	mg/kg
	Cobalt	5	mg/kg
	Lead	0.3	mg/kg
	Molybdenum	1	mg/kg
	Selenium	0.5	mg/kg
	Silver	0.5	mg/kg
	Thallium	1	mg/kg
	Vanadium	5	mg/kg
Water	Aluminum	0.2	mg/L
	Antimony	0.06	mg/L
	Arsenic	0.3	mg/L
	Barium	0.2	mg/L
	Beryllium	0.005	mg/L
	Boron	0.2	mg/L
	Cadmium	0.005	mg/L
	Calcium	5	mg/L
	Chromium	0.01	mg/L
	Cobalt	0.05	mg/L
	Copper	0.025	mg/L
	Iron	0.1	mg/L
	Lead	0.1	mg/L
	Magnesium	5	mg/L
	Manganese	0.015	mg/L
	Molybdenum	0.04	mg/L
	Nickel	0.04	mg/L
	Potassium	5	mg/L
	Selenium	0.25	mg/L
	Silver	0.01	mg/L
	Sodium	5	mg/L
	Thallium	0.2	mg/L
	Tin	0.1	mg/L
	Titanium	0.05	mg/L
	Vanadium	0.05	Mg/L
	Zinc	0.02	mg/L

TABLE 8.2-10-2
Metals – ICP, CVAA 6000, 7000, 200 Series
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Solid	Aluminum	20	mg/kg
	Antimony	6	mg/kg
	Arsenic	30	mg/kg
	Barium	20	mg/kg
	Beryllium	0.5	mg/kg
	Boron	20	mg/kg
	Cadmium	0.5	mg/kg
	Calcium	500	mg/kg
	Chromium	1	mg/kg
	Cobalt	5	mg/kg
	Copper	2.5	mg/kg
	Iron	10	mg/kg
	Lead	10	mg/kg
	Magnesium	500	mg/kg
	Manganese	1.5	mg/kg
	Molybdenum	4	mg/kg
	Nickel	4	mg/kg
	Potassium	500	mg/kg
	Selenium	25	mg/kg
	Silver	1	mg/kg
	Sodium	500	mg/kg
	Thallium	200	mg/kg
	Tin	10	mg/kg
	Titanium	5	mg/kg
	Vanadium	5	mg/kg
	Zinc	2	mg/kg
Water	Mercury	0.0002	mg/L
Solid	Mercury	0.1	mg/kg

Metals – ICPMS, 6020
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water	Aluminum	50	ug/L
	Antimony	2	ug/L
	Arsenic	5	ug/L
	Barium	1	ug/L
	Beryllium	1	ug/L
	Cadmium	1	ug/L
	Chromium	2	ug/L
	Cobalt	1	ug/L
	Copper	2	ug/L
	Iron	20	ug/L
	Lead	1	ug/L
	Manganese	1	ug/L
	Molybdenum*	10	ug/L
	Nickel	2	ug/L
	Selenium*	5	ug/L
	Silver	1	ug/L
	Thallium	1	ug/L
	Tin*	10	ug/L
	Vanadium*	5	ug/L
	Zinc	10	Ug/L
*Molybdenum, Selenium, Tin, and Vanadium are not on the 6020 method list			
Solid	Antimony	0.2	mg/kg
	Arsenic	0.5	mg/kg
	Barium	0.1	mg/kg
	Beryllium	0.1	mg/kg
	Cadmium	0.1	mg/kg
	Chromium	0.2	mg/kg
	Cobalt	0.1	mg/kg
	Copper	0.2	mg/kg
	Lead	0.1	mg/kg
	Manganese	0.1	mg/kg
	Molybdenum*	0.2	mg/kg
	Nickel	0.1	mg/kg
	Selenium*	0.5	mg/kg
	Silver	0.1	mg/kg
	Thallium	0.1	mg/kg
	Tin*	1	mg/kg
	Vanadium*	0.5	mg/kg
	Zinc	1	mg/kg
*Molybdenum, Selenium, Tin, and Vanadium are not on the 6020 method list			

Metals – ICPMS, 200.8
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water	Aluminum	50	ug/L
	Antimony	2	ug/L
	Arsenic	5	ug/L
	Barium	1	ug/L
	Beryllium	1	ug/L
	Cadmium	1	ug/L
	Chromium	2	ug/L
	Cobalt	1	ug/L
	Copper	2	ug/L
	Iron	20	ug/L
	Lead	1	ug/L
	Manganese	1	ug/L
	Molybdenum	10	ug/L
	Nickel	2	ug/L
	Selenium	2	ug/L
	Silver	1	ug/L
	Thallium	1	ug/L
	Tin*	10	ug/L
	Vanadium	5	ug/L
	Zinc	10	ug/L

*Tin is not on the 200.8 method list

Metals – Low-Level Mercury, 1631E & 245.7
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
1631E Water	Mercury	0.5	ng/L
245.7 Water	Mercury	5	ng/L

MS Semivolatiles – Method 8270C
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
	Acenaphthene	10	ug/L
	Acenaphthylene	10	ug/L
	Anthracene	10	ug/L
	Benzo(a)anthracene	10	ug/L
	Benzo(b)fluoranthene	10	ug/L
	Benzo(k)fluoranthene	10	ug/L
	Benzo(ghi)perylene	10	ug/L
	Benzo(a)pyrene	10	ug/L
	Bis(2-chloroEthoxy)methane	10	ug/L
	bis(2-Chloroethyl) ether	10	ug/L
	bis(2-Ethylhexyl) phthalate	10	ug/L
	4-Bromophenyl phenyl ether	10	ug/L
	Butyl benzyl phthalate	10	ug/L
	Carbazole	10	ug/L
	4-Chloroaniline	10	ug/L
	4-Chloro-3-methylphenol	10	ug/L
	2-Chloronaphthalene	10	ug/L
	2-Chlorophenol	10	ug/L
	4-Chlorophenyl phenyl ether	10	ug/L
	Chrysene	10	ug/L
	Dibenz(a,h)anthracene	10	ug/L
	Dibenzofuran	10	ug/L
	Di-n-butyl phthalate	10	ug/L
Water	1,2-Dichlorobenzene	10	ug/L
	1,3-Dichlorobenzene	10	ug/L
	1,4-Dichlorobenzene	10	ug/L
	3,3'-Dichlorobenzidine	50	ug/L
	2,4-Dichlorophenol	10	ug/L
	Diethyl phthalate	10	ug/L
	2,4-Dimethylphenol	10	ug/L
	Dimethyl phthalate	10	ug/L
	4,6-Dinitro-2-methylphenol	50	ug/L
	2,4-Dinitrophenol	50	ug/L
	2,4-Dinitrotoluene	10	ug/L
	2,6-Dinitrotoluene	10	ug/L
	Di-n-octyl phthalate	10	ug/L
	Fluoranthene	10	ug/L
	Fluorene	10	ug/L
	Hexachlorobenzene	10	ug/L
	Hexachlorobutadiene	10	ug/L
	Hexachloro-cyclopentadiene	50	ug/L
	Hexachloroethane	10	ug/L
	Indeno(1,2,3-cd)pyrene	10	ug/L
	Isophorone	10	ug/L
	2-Methylnaphthalene	10	ug/L
	2-Methylphenol	10	ug/L
	4-Methylphenol	10	ug/L
	Naphthalene	10	ug/L
	2-Nitroaniline	50	ug/L

	Analyte	RL	Units
	3-Nitroaniline	50	ug/L
	4-Nitroaniline	50	ug/L
	Nitrobenzene	10	ug/L
	2-Nitrophenol	10	ug/L
	4-Nitrophenol	50	ug/L
	N-Nitrosodiphenylamine	10	ug/L
	N-Nitrosodi-n-propylamine	10	ug/L
	Pentachlorophenol	10	ug/L
	Phenanthrene	10	ug/L
	Phenol	10	ug/L
	2,2'-Oxybis(1-Chloropropane)	10	ug/L
	Pyrene	10	ug/L
	1,2,4-Trichlorobenzene	10	ug/L
	2,4,5-Trichlorophenol	10	ug/L
	2,4,6-Trichlorophenol	10	ug/L
Water Surrogates	2-Fluorobiphenyl		
	2-Fluorophenol		
	2,4,6-Tribromophenol		
	Nitrobenzene-d5		
	Phenol-d5		
	Terphenyl-d14		

MS Semivolatiles – Method 8270C
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Solid	Acenaphthene	330	ug/kg
	Acenaphthylene	330	ug/kg
	Anthracene	330	ug/kg
	Benzo(a)anthracene	330	ug/kg
	Benzo(b)fluoranthene	330	ug/kg
	Benzo(k)fluoranthene	330	ug/kg
	Benzo(ghi)perylene	330	ug/kg
	Benzo(a)pyrene	330	ug/kg
	bis(2-Chloroethoxy)-methane	330	ug/kg
	bis(2-Chloroethyl) ether	330	ug/kg
	bis(2-Ethylhexyl) phthalate	330	ug/kg
	4-Bromophenyl phenyl ether	330	ug/kg
	Butyl benzyl phthalate	330	ug/kg
	Carbazole	330	ug/kg
	4-Chloroaniline	330	ug/kg
	4-Chloro-3-methylphenol	330	ug/kg
	2-Chloronaphthalene	330	ug/kg
	2-Chlorophenol	330	ug/kg
	4-Chlorophenyl phenyl ether	330	ug/kg
	Chrysene	330	ug/kg
	Dibenz(a,h)anthracene	330	ug/kg
	Dibenzofuran	330	ug/kg
	Di-n-butyl phthalate	330	ug/kg
	1,2-Dichlorobenzene	330	ug/kg
	1,3-Dichlorobenzene	330	ug/kg
	1,4-Dichlorobenzene	330	ug/kg
	3,3'-Dichlorobenzidine	1600	ug/kg
	2,4-Dichlorophenol	330	ug/kg
	Diethyl phthalate	330	ug/kg
	2,4-Dimethylphenol	330	ug/kg
	Dimethyl phthalate	330	ug/kg
	4,6-Dinitro-2-methylphenol	1600	ug/kg
	2,4-Dinitrophenol	1600	ug/kg
	2,4-Dinitrotoluene	330	ug/kg
	2,6-Dinitrotoluene	330	ug/kg
	Di-n-octyl phthalate	330	ug/kg
	Fluoranthene	330	ug/kg
	Fluorene	330	ug/kg
	Hexachlorobenzene	330	ug/kg
	Hexachlorobutadiene	330	ug/kg
	Hexachloro-cyclopentadiene	1600	ug/kg
	Hexachloroethane	330	ug/kg
	Indeno(1,2,3-cd)pyrene	330	ug/kg
	Isophorone	330	ug/kg
	2-Methylnaphthalene	330	ug/kg
	2-Methylphenol	330	ug/kg
	4-Methylphenol	330	ug/kg
	Naphthalene	330	ug/kg
	2-Nitroaniline	1600	ug/kg
	3-Nitroaniline	1600	ug/kg

	Analyte	RL	Units
	4-Nitroaniline	1600	ug/kg
	Nitrobenzene	330	ug/kg
	2-Nitrophenol	330	ug/kg
	4-Nitrophenol	1600	ug/kg
	N-Nitrosodiphenylamine	330	ug/kg
	N-Nitrosodi-n-propylamine	330	ug/kg
	Pentachlorophenol	330	ug/kg
	Phenanthrene	330	ug/kg
	Phenol	330	ug/kg
	2,2'-Oxybis(1-Chloropropane)	330	ug/kg
	Pyrene	330	ug/kg
	1,2,4-Trichlorobenzene	330	ug/kg
	2,4,5-Trichlorophenol	330	ug/kg
	2,4,6-Trichlorophenol	330	ug/kg
Solid Surrogates	2-Fluorobiphenyl		
	2-Fluorophenol		
	2,4,6-Tribromophenol		
	Nitrobenzene-d5		
	Phenol-d5		
	Terphenyl-d14		

MS Semivolatiles – Method 625
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water	Acenaphthene	10	ug/L
	Acenaphthylene	10	ug/L
	Anthracene	10	ug/L
	Benzo(a)anthracene	10	ug/L
	Benzo(b)fluoranthene	10	ug/L
	Benzo(k)fluoranthene	10	ug/L
	Benzo(ghi)perylene	10	ug/L
	Benzo(a)pyrene	10	ug/L
	bis(2-Chloroethoxy)-methane	10	ug/L
	bis(2-Chloroethyl) ether	10	ug/L
	bis(2-Chloroisopropyl) ether	10	ug/L
	bis(2-Ethylhexyl) phthalate	10	ug/L
	4-Bromophenyl phenyl ether	10	ug/L
	Butyl benzyl phthalate	10	ug/L
	4-Chloro-3-methylphenol	10	ug/L
	2-Chloronaphthalene	10	ug/L
	2-Chlorophenol	10	ug/L
	4-Chlorophenyl phenyl ether	10	ug/L
	Chrysene	10	ug/L
	Dibenz(a,h)anthracene	10	ug/L
	Di-n-butyl phthalate	10	ug/L
	1,2-Dichlorobenzene	10	ug/L
	1,3-Dichlorobenzene	10	ug/L
	1,4-Dichlorobenzene	10	ug/L
	3,3'-Dichlorobenzidine	10	ug/L
	2,4-Dichlorophenol	10	ug/L
	Diethyl phthalate	10	ug/L
	2,4-Dimethylphenol	10	ug/L
	Dimethyl phthalate	10	ug/L
	2-Methyl-4,6-dinitrophenol	50	ug/L
	2,4-Dinitrophenol	50	ug/L
	2,4-Dinitrotoluene	10	ug/L
	2,6-Dinitrotoluene	10	ug/L
	Di-n-octyl phthalate	10	ug/L
	Fluoranthene	10	ug/L
	Fluorene	10	ug/L
	Hexachlorobenzene	10	ug/L
	Hexachlorobutadiene	10	ug/L
	Hexachloroethane	10	ug/L
	Indeno(1,2,3-cd)pyrene	10	ug/L
	Isophorone	10	ug/L
	Naphthalene	10	ug/L
	Nitrobenzene	10	ug/L
	2-Nitrophenol	10	ug/L
	4-Nitrophenol	50	ug/L
	N-Nitrosodi-n-propylamine	10	ug/L
	Pentachlorophenol	10	ug/L
	Phenanthrene	10	ug/L
	Phenol	10	ug/L
	Pyrene	10	ug/L

	Analyte	RL	Units
	1,2,4-Trichlorobenzene	10	ug/L
	2,4,6-Trichlorophenol	10	ug/L
Water Surrogates	2-Fluorobiphenyl		
	2-Fluorophenol		
	2,4,6-Tribromophenol		
	Nitrobenzene-d5		
	Phenol-d5		
	Terphenyl-d14		

MS Volatiles – Method 8260B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water 25 mL	Benzene	1	ug/L
	Bromobenzene	1	ug/L
	Bromochloromethane	1	ug/L
	Bromodichloromethane	1	ug/L
	Bromoform	1	ug/L
	Bromomethane	1	ug/L
	n-Butylbenzene	1	ug/L
	sec-Butylbenzene	1	ug/L
	tert-Butylbenzene	1	ug/L
	Carbon tetrachloride	1	ug/L
	Chlorobenzene	1	ug/L
	Chlorodibromomethane	1	ug/L
	Chloroethane	1	ug/L
	Chloroform	1	ug/L
	Chloromethane	1	ug/L
	2-Chlorotoluene	1	ug/L
	4-Chlorotoluene	1	ug/L
	1,2-Dibromo-3-chloropropane	2	ug/L
	1,2-Dibromoethane	1	ug/L
	Dibromomethane	1	ug/L
	1,2-Dichlorobenzene	1	ug/L
	1,3-Dichlorobenzene	1	ug/L
	1,4-Dichlorobenzene	1	ug/L
	Dichlorodifluoro-methane	1	ug/L
	1,1-Dichloroethane	1	ug/L
	1,2-Dichloroethane	1	ug/L
	cis-1,2-Dichloroethene	1	ug/L
	trans-1,2-Dichloroethene	1	ug/L
	1,1-Dichloroethene	1	ug/L
	1,2-Dichloropropane	1	ug/L
	1,3-Dichloropropane	1	ug/L
	2,2-Dichloropropane	1	ug/L
	1,1-Dichloropropene	1	ug/L
	Ethylbenzene	1	ug/L
	Hexachlorobutadiene	1	ug/L
	Isopropylbenzene	1	ug/L
	p-Isopropyltoluene	1	ug/L
	Methylene chloride	1	ug/L
	Naphthalene	1	ug/L
	n-Propylbenzene	1	ug/L
	Styrene	1	ug/L
	1,1,1,2-Tetrachloroethane	1	ug/L
	1,1,2,2-Tetrachloroethane	1	ug/L
	Tetrachloroethene	1	ug/L
	Toluene	1	ug/L
	1,2,3-Trichlorobenzene	1	ug/L
	1,2,4-Trichlorobenzene	1	ug/L
	1,1,1-Trichloroethane	1	ug/L
	1,1,2-Trichloroethane	1	ug/L

	Analyte	RL	Units
	Trichloroethene	1	ug/L
	Trichlorofluoromethane	1	ug/L
	1,2,3-Trichloropropane	1	ug/L
	1,2,4-Trimethylbenzene	1	ug/L
	1,3,5-Trimethylbenzene	1	ug/L
	Vinyl chloride	1	ug/L
	m-Xylene & p-Xylene	1	ug/L
	o-Xylene	1	ug/L
Water 25 mL Surrogates	4-Bromofluorobenzene		
	1,2-Dichloroethane-d4		
	Toluene-d8		
	Dibromofluoromethane		

MS Volatiles – Method 8260B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water 5 mL	Benzene	5	ug/L
	Bromobenzene	5	ug/L
	Bromochloromethane	5	ug/L
	Bromodichloromethane	5	ug/L
	Bromoform	5	ug/L
	Bromomethane	5	ug/L
	n-Butylbenzene	5	ug/L
	sec-Butylbenzene	5	ug/L
	tert-Butylbenzene	5	ug/L
	Carbon tetrachloride	5	ug/L
	Chlorobenzene	5	ug/L
	Chlorodibromomethane	5	ug/L
	Chloroethane	5	ug/L
	Chloroform	5	ug/L
	Chloromethane	5	ug/L
	2-Chlorotoluene	5	ug/L
	4-Chlorotoluene	5	ug/L
	1,2-Dibromo-3-chloropropane	10	ug/L
	1,2-Dibromoethane	5	ug/L
	Dibromomethane	5	ug/L
	1,2-Dichlorobenzene	5	ug/L
	1,3-Dichlorobenzene	5	ug/L
	1,4-Dichlorobenzene	5	ug/L
	Dichlorodifluoro-methane	5	ug/L
	1,1-Dichloroethane	5	ug/L
	1,2-Dichloroethane	5	ug/L
	cis-1,2-Dichloroethene	5	ug/L
	trans-1,2-Dichloroethene	5	ug/L
	1,1-Dichloroethene	5	ug/L
	1,2-Dichloropropane	5	ug/L
	1,3-Dichloropropane	5	ug/L
	2,2-Dichloropropane	5	ug/L
	1,1-Dichloropropene	5	ug/L
	Ethylbenzene	5	ug/L
	Hexachlorobutadiene	5	ug/L
	Isopropylbenzene	5	ug/L
	p-Isopropyltoluene	5	ug/L
	Methylene chloride	5	ug/L
	Naphthalene	5	ug/L
	n-Propylbenzene	5	ug/L
	Styrene	5	ug/L
	1,1,1,2-Tetrachloroethane	5	ug/L
	1,1,2,2-Tetrachloroethane	5	ug/L
	Tetrachloroethene	5	ug/L
	Toluene	5	ug/L
	1,2,3-Trichlorobenzene	5	ug/L
	1,2,4-Trichlorobenzene	5	ug/L
	1,1,1-Trichloroethane	5	ug/L
	1,1,2-Trichloroethane	5	ug/L
	Trichloroethene	5	ug/L

	Analyte	RL	Units
	Trichlorofluoromethane	5	ug/L
	1,2,3-Trichloropropane	5	ug/L
	1,2,4-Trimethylbenzene	5	ug/L
	1,3,5-Trimethylbenzene	5	ug/L
	Vinyl chloride	5	ug/L
	m-Xylene & p-Xylene	10	ug/L
	o-Xylene	5	ug/L
Surrogates	4-Bromofluorobenzene		
	1,2-Dichloroethane-d4		
	Toluene-d8		
	Dibromofluoromethane		

MS Volatiles – Method 8260B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Encore	Benzene	250	ug/kg
	Bromobenzene	250	ug/kg
	Bromochloromethane	250	ug/kg
	Bromodichloromethane	250	ug/kg
	Bromoform	250	ug/kg
	Bromomethane	250	ug/kg
	n-Butylbenzene	250	ug/kg
	sec-Butylbenzene	250	ug/kg
	tert-Butylbenzene	250	ug/kg
	Carbon tetrachloride	250	ug/kg
	Chlorobenzene	250	ug/kg
	Chlorodibromomethane	250	ug/kg
	Chloroethane	250	ug/kg
	Chloroform	250	ug/kg
	Chloromethane	250	ug/kg
	2-Chlorotoluene	250	ug/kg
	4-Chlorotoluene	250	ug/kg
	1,2-Dibromo-3-chloropropane	500	ug/kg
	1,2-Dibromoethane	250	ug/kg
	Dibromomethane	250	ug/kg
	1,2-Dichlorobenzene	250	ug/kg
	1,3-Dichlorobenzene	250	ug/kg
	1,4-Dichlorobenzene	250	ug/kg
	Dichlorodifluoro-methane	250	ug/kg
	1,1-Dichloroethane	250	ug/kg
	1,2-Dichloroethane	250	ug/kg
	cis-1,2-Dichloroethene	250	ug/kg
	trans-1,2-Dichloroethene	250	ug/kg
	1,1-Dichloroethene	250	ug/kg
	1,2-Dichloropropane	250	ug/kg
	1,3-Dichloropropane	250	ug/kg
	2,2-Dichloropropane	250	ug/kg
	1,1-Dichloropropene	250	ug/kg
	Ethylbenzene	250	ug/kg
	Hexachlorobutadiene	250	ug/kg
	Isopropylbenzene	250	ug/kg
	p-Isopropyltoluene	250	ug/kg
	Methylene chloride	250	ug/kg
	Naphthalene	250	ug/kg
	n-Propylbenzene	250	ug/kg
	Styrene	250	ug/kg
	1,1,1,2-Tetrachloroethane	250	ug/kg
	1,1,2,2-Tetrachloroethane	250	ug/kg
	Tetrachloroethene	250	ug/kg
	Toluene	250	ug/kg
	1,2,3-Trichlorobenzene	250	ug/kg
	1,2,4-Trichlorobenzene	250	ug/kg
	1,1,1-Trichloroethane	250	ug/kg
	1,1,2-Trichloroethane	250	ug/kg

	Analyte	RL	Units
	Trichloroethene	250	ug/kg
	Trichlorofluoromethane	250	ug/kg
	1,2,3-Trichloropropane	250	ug/kg
	1,2,4-Trimethylbenzene	250	ug/kg
	1,3,5-Trimethylbenzene	250	ug/kg
	Vinyl chloride	250	ug/kg
	m-Xylene & p-Xylene	500	ug/kg
	o-Xylene	250	ug/kg
Surrogates	4-Bromofluorobenzene		
	1,2-Dichloroethane-d4		
	Toluene-d8		
	Dibromofluoromethane		

MS Volatiles – Method 8260B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Low Level Encore	Benzene	5	ug/kg
	Bromobenzene	5	ug/kg
	Bromochloromethane	5	ug/kg
	Bromodichloromethane	5	ug/kg
	Bromoform	5	ug/kg
	Bromomethane	5	ug/kg
	n-Butylbenzene	5	ug/kg
	sec-Butylbenzene	5	ug/kg
	tert-Butylbenzene	5	ug/kg
	Carbon tetrachloride	5	ug/kg
	Chlorobenzene	5	ug/kg
	Chlorodibromomethane	5	ug/kg
	Chloroethane	5	ug/kg
	Chloroform	5	ug/kg
	Chloromethane	5	ug/kg
	2-Chlorotoluene	5	ug/kg
	4-Chlorotoluene	5	ug/kg
	1,2-Dibromo-3-chloropropane	10	ug/kg
	1,2-Dibromoethane	5	ug/kg
	Dibromomethane	5	ug/kg
	1,2-Dichlorobenzene	5	ug/kg
	1,3-Dichlorobenzene	5	ug/kg
	1,4-Dichlorobenzene	5	ug/kg
	Dichlorodifluoro-methane	5	ug/kg
	1,1-Dichloroethane	5	ug/kg
	1,2-Dichloroethane	5	ug/kg
	cis-1,2-Dichloroethene	5	ug/kg
	trans-1,2-Dichloroethene	5	ug/kg
	1,1-Dichloroethene	5	ug/kg
	1,2-Dichloropropane	5	ug/kg
	1,3-Dichloropropane	5	ug/kg
	2,2-Dichloropropane	5	ug/kg
	1,1-Dichloropropene	5	ug/kg
	Ethylbenzene	5	ug/kg
	Hexachlorobutadiene	5	ug/kg
	Isopropylbenzene	5	ug/kg
	p-Isopropyltoluene	5	ug/kg
	Methylene chloride	5	ug/kg
	Naphthalene	5	ug/kg
	n-Propylbenzene	5	ug/kg
	Styrene	5	ug/kg
	1,1,1,2-Tetrachloroethane	5	ug/kg
	1,1,2,2-Tetrachloroethane	5	ug/kg
	Tetrachloroethene	5	ug/kg
	Toluene	5	ug/kg
	1,2,3-Trichlorobenzene	5	ug/kg
	1,2,4-Trichlorobenzene	5	ug/kg
	1,1,1-Trichloroethane	5	ug/kg
	1,1,2-Trichloroethane	5	ug/kg
	Trichloroethene	5	ug/kg

	Analyte	RL	Units
	Trichlorofluoromethane	5	ug/kg
	1,2,3-Trichloropropane	5	ug/kg
	1,2,4-Trimethylbenzene	5	ug/kg
	1,3,5-Trimethylbenzene	5	ug/kg
	Vinyl chloride	5	ug/kg
	m-Xylene & p-Xylene	10	ug/kg
	o-Xylene	5	ug/kg
Surrogates	4-Bromofluorobenzene		
	1,2-Dichloroethane-d4		
	Toluene-d8		
	Dibromofluoromethane		

MS Volatiles – Method 8260B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Frozen Encore	Benzene	5	ug/kg
	Bromobenzene	5	ug/kg
	Bromochloromethane	5	ug/kg
	Bromodichloromethane	5	ug/kg
	Bromoform	5	ug/kg
	Bromomethane	5	ug/kg
	n-Butylbenzene	5	ug/kg
	sec-Butylbenzene	5	ug/kg
	tert-Butylbenzene	5	ug/kg
	Carbon tetrachloride	5	ug/kg
	Chlorobenzene	5	ug/kg
	Chlorodibromomethane	5	ug/kg
	Chloroethane	5	ug/kg
	Chloroform	5	ug/kg
	Chloromethane	5	ug/kg
	2-Chlorotoluene	5	ug/kg
	4-Chlorotoluene	5	ug/kg
	1,2-Dibromo-3-chloropropane	10	ug/kg
	1,2-Dibromoethane	5	ug/kg
	Dibromomethane	5	ug/kg
	1,2-Dichlorobenzene	5	ug/kg
	1,3-Dichlorobenzene	5	ug/kg
	1,4-Dichlorobenzene	5	ug/kg
	Dichlorodifluoro-methane	5	ug/kg
	1,1-Dichloroethane	5	ug/kg
	1,2-Dichloroethane	5	ug/kg
	cis-1,2-Dichloroethene	5	ug/kg
	trans-1,2-Dichloroethene	5	ug/kg
	1,1-Dichloroethene	5	ug/kg
	1,2-Dichloropropane	5	ug/kg
	1,3-Dichloropropane	5	ug/kg
	2,2-Dichloropropane	5	ug/kg
	1,1-Dichloropropene	5	ug/kg
	Ethylbenzene	5	ug/kg
	Hexachlorobutadiene	5	ug/kg
	Isopropylbenzene	5	ug/kg
	p-Isopropyltoluene	5	ug/kg
	Methylene chloride	5	ug/kg
	Naphthalene	5	ug/kg
	n-Propylbenzene	5	ug/kg
	Styrene	5	ug/kg
	1,1,1,2-Tetrachloroethane	5	ug/kg
	1,1,2,2-Tetrachloroethane	5	ug/kg
	Tetrachloroethene	5	ug/kg
	Toluene	5	ug/kg
	1,2,3-Trichlorobenzene	5	ug/kg
	1,2,4-Trichlorobenzene	5	ug/kg
	1,1,1-Trichloroethane	5	ug/kg
	1,1,2-Trichloroethane	5	ug/kg
	Trichloroethene	5	ug/kg

	Analyte	RL	Units
	Trichlorofluoromethane	5	ug/kg
	1,2,3-Trichloropropane	5	ug/kg
	1,2,4-Trimethylbenzene	5	ug/kg
	1,3,5-Trimethylbenzene	5	ug/kg
	Vinyl chloride	5	ug/kg
	m-Xylene & p-Xylene	10	ug/kg
	o-Xylene	5	ug/kg
Surrogates	4-Bromofluorobenzene		
	1,2-Dichloroethane-d4		
	Toluene-d8		
	Dibromofluoromethane		

MS Volatiles – Method 624
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water	Benzene	5	ug/L
	Bromodichloro-methane	5	ug/L
	Bromoform	5	ug/L
	Bromomethane	55	ug/L
	Carbon tetrachloride	5	ug/L
	Chlorobenzene	5	ug/L
	Dibromochloro-methane	5	ug/L
	Chloroethane	5	ug/L
	2-Chloroethyl vinyl ether	--	ug/L
	Chloroform	5	ug/L
	Chloromethane	5	ug/L
	1,2-Dichlorobenzene	5	ug/L
	1,3-Dichlorobenzene	5	ug/L
	1,4-Dichlorobenzene	5	ug/L
	1,1-Dichloroethane	5	ug/L
	1,2-Dichloroethane	5	ug/L
	trans-1,2-Dichloroethene	5	ug/L
	1,1-Dichloroethene	5	ug/L
	1,2-Dichloropropane	5	ug/L
	cis-1,3-Dichloropropene	5	ug/L
	trans-1,3-Dichloropropene	5	ug/L
	Ethylbenzene	5	ug/L
	Methylene chloride	5	ug/L
	1,1,2,2-Tetrachloroethane	5	ug/L
	Tetrachloroethene	5	ug/L
	Toluene	5	ug/L
	1,1,1-Trichloroethane	5	ug/L
	1,1,2-Trichloroethane	5	ug/L
	Trichloroethene	5	ug/L
	Trichlorofluoro-methane	5	ug/L
	Vinyl chloride	5	ug/L
Surrogates	Bromofluorobenzene		
	1,2-Dichloro-ethane-d4		
	Toluene-d8		

GC Semivolatiles – Method 8081A
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water	Aldrin	0.05	ug/L
	alpha-BHC	0.05	ug/L
	beta-BHC	0.05	ug/L
	delta-BHC	0.05	ug/L
	gamma-BHC (Lindane)	0.05	ug/L
	alpha-Chlordane	0.05	ug/L
	gamma-Chlordane	0.05	ug/L
	4,4'-DDD	0.05	ug/L
	4,4'-DDE	0.05	ug/L
	4,4'-DDT	0.05	ug/L
	Dieldrin	0.05	ug/L
	Endosulfan I	0.05	ug/L
	Endosulfan II	0.05	ug/L
	Endosulfan sulfate	0.05	ug/L
	Endrin	0.05	ug/L
	Endrin aldehyde	0.05	ug/L
	Endrin ketone	0.05	ug/L
	Heptachlor	0.05	ug/L
	Heptachlor epoxide	0.05	ug/L
	Methoxychlor	0.1	ug/L
	Toxaphene	2	ug/L
Surrogates	Decachloro-biphenyl		
	Tetrachloro-m-xylene		

GC Semivolatiles – 8081A
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Solid	Aldrin	1.7	ug/kg
	alpha-BHC	1.7	ug/kg
	beta-BHC	1.7	ug/kg
	delta-BHC	1.7	ug/kg
	gamma-BHC (Lindane)	1.7	ug/kg
	alpha-Chlordane	1.7	ug/kg
	gamma-Chlordane	1.7	ug/kg
	4,4'-DDD	1.7	ug/kg
	4,4'-DDE	1.7	ug/kg
	4,4'-DDT	1.7	ug/kg
	Dieldrin	1.7	ug/kg
	Endosulfan I	1.7	ug/kg
	Endosulfan II	1.7	ug/kg
	Endosulfan sulfate	1.7	ug/kg
	Endrin	1.7	ug/kg
	Endrin aldehyde	1.7	ug/kg
	Endrin ketone	1.7	ug/kg
	Heptachlor	1.7	ug/kg
	Heptachlor epoxide	1.7	ug/kg
	Methoxychlor	3.3	ug/kg
	Toxaphene	67	ug/kg
Surrogates	Decachloro-biphenyl		
	Tetrachloro-m-xylene		

GC Semivolatiles – Method 8082
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	*Units*
Water	Aroclor 1016	1	ug/L
	Aroclor 1221	1	ug/L
	Aroclor 1232	1	ug/L
	Aroclor 1242	1	ug/L
	Aroclor 1248	1	ug/L
	Aroclor 1254	1	ug/L
	Aroclor 1260	1	ug/L
	Aroclor 1262	1	ug/L
	Aroclor 1268	1	ug/L
Surrogates	Decachlorobi-phenyl Tetrachloro-m-xylene		
Solid	Aroclor 1016	33	ug/kg
	Aroclor 1221	33	ug/kg
	Aroclor 1232	33	ug/kg
	Aroclor 1242	33	ug/kg
	Aroclor 1248	33	ug/kg
	Aroclor 1254	33	ug/kg
	Aroclor 1260	33	ug/kg
	Aroclor 1262	33	ug/kg
	Aroclor 1268	33	ug/kg
Surrogates	Decachloro-biphenyl Tetrachloro-m-xylene		

GC Semivolatiles – Method 608
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water	Aldrin	0.05	ug/L
	alpha-BHC	0.05	ug/L
	beta-BHC	0.05	ug/L
	delta-BHC	0.05	ug/L
	gamma-BHC (Lindane)	0.05	ug/L
	Chlordane (technical)	0.5	ug/L
	4,4'-DDD	0.05	ug/L
	4,4'-DDE	0.05	ug/L
	4,4'-DDT	0.05	ug/L
	Dieldrin	0.05	ug/L
	Endosulfan I	0.05	ug/L
	Endosulfan II	0.05	ug/L
	Endosulfan sulfate	0.05	ug/L
	Endrin	0.05	ug/L
	Endrin aldehyde	0.05	ug/L
	Heptachlor	0.05	ug/L
	Heptachlor epoxide	0.05	ug/L
	PCB-1016	1	ug/L
	PCB-1221	1	ug/L
	PCB-1232	1	ug/L
	PCB-1242	1	ug/L
	PCB-1248	1	ug/L
	PCB-1254	1	ug/L
	PCB-1260	1	ug/L
	Toxaphene	2	ug/L
Surrogates	Decachloro-biphenyl		
	Tetrachloro-m-xylene		

GC Semivolatiles – Method 8151A
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water	2,4-D	4	ug/L
	Dalapon	2	ug/L
	2,4-DB	4	ug/L
	Dicamba	2	ug/L
	Dichlorprop	4	ug/L
	Dinoseb	0.6	ug/L
	MCPA	400	ug/L
	MCPP	400	ug/L
	2,4,5-TP (Silvex)	1	ug/L
	2,4,5-T	1	ug/L
Surrogate	2,4-Dichlorophenylacetic acid		
Solid	2,4-D	80	ug/kg
	Dalapon	40	ug/kg
	2,4-DB	80	ug/kg
	Dicamba	40	ug/kg
	Dichlorprop	80	ug/kg
	Dinoseb	12	ug/kg
	MCPA	8000	ug/kg
	MCPP	8000	ug/kg
	2,4,5-TP (Silvex)	20	ug/kg
	2,4,5-T	20	ug/kg
Surrogate	2,4-Dichlorophenylacetic acid		

GC Volatiles - Method 8021B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water 5 mL Purge	Benzene	1	ug/L
	Bromobenzene	1	ug/L
	Bromochloromethane	1	ug/L
	Bromodichloromethane	1	ug/L
	Bromoform	1	ug/L
	Bromomethane	1	ug/L
	n-Butylbenzene	1	ug/L
	sec-Butylbenzene	1	ug/L
	tert-Butylbenzene	1	ug/L
	Carbon tetrachloride	1	ug/L
	Chlorobenzene	1	ug/L
	Chlorodibromomethane	1	ug/L
	Chloroethane	1	ug/L
	Chloroform	1	ug/L
	Chloromethane	1	ug/L
	2-Chlorotoluene	1	ug/L
	4-Chlorotoluene	1	ug/L
	1,2-Dibromo-3-chloropropane (DBCP)	1	ug/L
	1,2-Dibromoethane (EDB)	1	ug/L
	Dibromomethane	1	ug/L
	1,2-Dichlorobenzene	1	ug/L
	1,3-Dichlorobenzene	1	ug/L
	1,4-Dichlorobenzene	1	ug/L
	Dichlorodifluoromethane	1	ug/L
	1,1-Dichloroethane	1	ug/L
	1,2-Dichloroethane	1	ug/L
	cis-1,2-Dichloroethene	1	ug/L
	trans-1,2-Dichloroethene	1	ug/L
	1,1-Dichloroethene	1	ug/L
	1,2-Dichloropropane	1	ug/L
	1,3-Dichloropropane	1	ug/L
	2,2-Dichloropropane	1	ug/L
	cis-1,3-Dichloropropene	1	ug/L
	trans-1,3-Dichloropropene	1	ug/L
	1,1-Dichloropropene	1	ug/L
	Ethylbenzene	1	ug/
	Hexachlorobutadiene	1	ug/L
	Isopropylbenzene	1	ug/L
	p-Isopropyltoluene	1	ug/L
	Methylene chloride	5	ug/L
	Naphthalene	1	ug/L
	n-Propylbenzene	1	ug/L
	Styrene	1	ug/L
	1,1,1,2-Tetrachloroethane	1	ug/L
	1,1,2,2-Tetrachloroethane	1	ug/L
	Tetrachloroethene	1	ug/L
	Toluene	1	ug/L
	1,2,3-Trichlorobenzene	1	ug/L
	1,2,4-Trichlorobenzene	1	ug/L

GC Volatiles - Method 8021B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
	1,1,1-Trichloroethane	1	ug/L
	1,1,2-Trichloroethane	1	ug/L
	Trichloroethene	1	ug/L
	Trichlorofluoromethane	1	ug/L
	1,2,3-Trichloropropane	1	ug/L
	1,2,4-Trimethylbenzene	1	ug/L
	1,3,5-Trimethylbenzene	1	ug/L
	Vinyl chloride	1	ug/L
	m-Xylene & p-Xylene	2	ug/L
	o-Xylene	1	ug/L
	Xylenes (total)	3	ug/L
Surrogates	1,4-Dichlorobutane		
	Trifluorotoluene		

GC Volatiles - Method 8021B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Solid 5 g	Benzene	1	ug/kg
	Ethylbenzene	1	ug/kg
	Methyl tert-butyl ether (MTBE)	1	ug/kg
	Methyl tert-butyl ether	1	ug/kg
	Naphthalene	1	ug/kg
	Toluene	1	ug/kg
	1,2,4-Trimethylbenzene	1	ug/kg
	1,3,5-Trimethylbenzene	1	ug/kg
	m-Xylene & p-Xylene	2	ug/kg
	o-Xylene	1	ug/kg
	Xylenes (total)	3	ug/kg
Surrogates	Trifluorotoluene		

GC Volatiles – Method 8021B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Solid Encore, Methanol Prep	Benzene	50	ug/kg
	Ethylbenzene	50	ug/kg
	Methyl tert-butyl ether (MTBE)	50	ug/kg
	Naphthalene	250	ug/kg
	Toluene	50	ug/kg
	1,2,4-Trimethylbenzene	50	ug/kg
	1,3,5-Trimethylbenzene	50	ug/kg
	m-Xylene & p-Xylene	100	ug/kg
	o-Xylene	50	ug/kg
	Xylenes (total)	150	ug/kg
Surrogates	Trifluorotoluene		

GC Volatiles – Method 8021B
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Frozen Encore	Benzene	1	ug/kg
	Ethylbenzene	1	ug/kg
	Methyl tert-butyl ether (MTBE)	1	ug/kg
	Methyl tert-butyl ether	1	ug/kg
	Naphthalene	1	ug/kg
	Toluene	1	ug/kg
	1,2,4-Trimethylbenzene	1	ug/kg
	1,3,5-Trimethylbenzene	1	ug/kg
	m-Xylene & p-Xylene	2	ug/kg
	o-Xylene	1	ug/kg
	Xylenes (total)	3	ug/kg
Surrogates	Trifluorotoluene		

GC Volatiles – Method 601
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water	Bromodichloromethane	1	ug/L
	Bromoform	1	ug/L
	Bromomethane	1	ug/L
	Carbon tetrachloride	1	ug/L
	Chlorobenzene	1	ug/L
	Dibromochloromethane	1	ug/L
	Chloroethane	1	ug/L
	2-Chloroethyl vinyl ether	5	ug/L
	Chloroform	1	ug/L
	Chloromethane	1	ug/L
	1,2-Dichlorobenzene	1	ug/L
	1,3-Dichlorobenzene	1	ug/L
	1,4-Dichlorobenzene	1	ug/L
	Dichlorodifluoromethane	1	ug/L
	1,1-Dichloroethane	1	ug/L
	1,2-Dichloroethane	1	ug/L
	trans-1,2-Dichloroethene	1	ug/L
	1,1-Dichloroethene	1	ug/L
	1,2-Dichloropropane	1	ug/L
	cis-1,3-Dichloropropene	1	ug/L
	trans-1,3-Dichloropropene	1	ug/L
	Methylene chloride	5	ug/L
	1,1,2,2-Tetrachloroethane	1	ug/L
	Tetrachloroethene	1	ug/L
	1,1,1-Trichloroethane	1	ug/L
	1,1,2-Trichloroethane	1	ug/L
	Trichloroethene	1	ug/L
	Trichlorofluoromethane	1	ug/L
	Vinyl chloride	1	ug/L
Surrogates	1,4-Dichlorobutane		

GC Volatiles – Method 602
Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Water	Benzene	1	ug/L
	Chlorobenzene	1	ug/L
	1,2-Dichlorobenzene	1	ug/L
	1,3-Dichlorobenzene	1	ug/L
	1,4-Dichlorobenzene	1	ug/L
	Ethylbenzene	1	ug/L
	Toluene	1	ug/L
Surrogates	Trifluorotoluene		

Total Petroleum Hydrocarbons, Diesel & Gasoline Range Organics Reporting Limits (RL), Method Reference [1,2]

	Analyte	RL	Units
Diesel Range Organics - Water	TPH (as Diesel)	100	ug/L
Surrogate	C9 (nonane)		
Diesel Range Organics - Solid	TPH (as Diesel)	10	mg/kg
Surrogate	C9 (nonane)		
Gasoline Range Organics - Water	Gasoline Range Organics TPH (as Gasoline) TPH (Purgeables)	100 100 100	ug/L ug/L ug/L
Gasoline Range Organics - Solid	Gasoline Range Organics TPH (as Gasoline) TPH (Purgeables)	100 100 100	ug/kg ug/kg ug/kg
Surrogate	TFT		
Gasoline Range Organics – Medium Level	TPH (as Gasoline) Solid TPH (as Gasoline) TPH (Purgeables)	1000 1000 1000	ug/kg ug/kg ug/kg
Surrogate	TFT		

Footnote:

[1] The latest MDLs, RLs, and Control Limits will be utilized at the time of sample analysis, and are available upon request.

[2] The compounds listed represent TAL/TCL compounds. Project specific or other regulatory lists may be available upon request.

Appendix 6. Glossary/Acronyms

Glossary

Acceptance Criteria:
Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation:
The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accrediting Authority:
The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (NELAC) [1.5.2.3]

Accuracy:
The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst:
The designated individual who performs the “hands-on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Assessment:
The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of NELAC). (NELAC)

Assessment Criteria:
The measures established by NELAC and applied in establishing the extent to which an applicant is in conformance with NELAC requirements. (NELAC)

Assessment Team:
The group of people authorized to perform the on-site inspection and proficiency testing data evaluation required to establish whether an applicant meets the criteria for NELAP accreditation. (NELAC)

Assessor:
One who performs on-site assessments of accrediting authorities and laboratories’ capability and capacity for meeting NELAC requirements by examining the records and other physical evidence for each one of the tests for which accreditation has been requested. (NELAC)

Audit:
A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity. (EPA-QAD)

Batch:
Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and /or those samples not requiring preparation, which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples. (NELAC Quality Systems Committee)

Blank:
A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Blind Sample:
A sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Calibration:
To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve:
The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Method:
A defined technical procedure for performing a calibration. (NELAC)

Calibration Standard:
A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM):
A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30–2.2)

Chain-of-Custody:
An unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples. (NELAC) [5.12.4]

Clean Air Act:
The enabling legislation in 42 U>S>C> 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and enforce them. (NELAC)

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/SUPERFUND):
The enabling legislation in 42 U.S.C. 9601-9675 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601 et seq., to eliminate the health and environmental threats posed by hazardous waste sites. (NELAC)

Compromised Samples:
Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified. (NELAC)

Confidential Business Information (CBI):
Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. NELAC and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation:
Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:

Second column confirmation
Alternate wavelength
Derivatization
Mass spectral interpretation
Alternative detectors or
Additional Cleanup procedures
(NELAC)

Conformance:
An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Corrective Action:
The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit:
A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Reduction:
The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (EPA-QAD)

Deficiency:
An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Detection Limit:
The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value. See Method Detection Limit. (NELAC)

Document Control:
The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses:
The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Environmental Detection Limit (EDL):
The smallest level at which a radionuclide in an environmental medium can be unambiguously distinguished for a given confidence interval using a particular combination of sampling and measurement procedures, sample size, analytical detection limit, and processing procedure. The EDL shall be specified for the 0.95 or greater confidence interval. The EDL shall be established initially and verified annually for each test method and sample matrix. (NELAC Radioanalysis Subcommittee)

Equipment Blank:
Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)

External Standard Calibration:
Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA):
The enabling legislation under 7 U.S.C. 135 et seq., as amended, that empowers the EPA to register insecticides, fungicides, and rodenticides. (NELAC)

Federal Water Pollution Control Act (Clean Water Act, CWA):
The enabling legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance. (NELAC)

Company Confidential & Proprietary

Field Blank:
Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Testing:
NELAC's approach to accrediting laboratories by program, method and analyte. Laboratories requesting accreditation for a program-method-analyte combination or for an up-dated/improved method are required to submit to only that portion of the accreditation process not previously addressed (see NELAC, section 1.9ff). (NELAC)

Finding:
An assessment conclusion that identifies a condition having a significant effect on an item or activity. As assessment finding is normally a deficiency and is normally accompanied by specific examples of the observed condition. (NELAC)

Holding Times (Maximum Allowable Holding Times):
The maximum times that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Inspection:
An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic. (ANSI/ASQC E4-1994)

Internal Standard:
A known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (NELAC)

Internal Standard Calibration:
Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank:
A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Response:
Instrument response is normally expressed as either peak area or peak height however it may also reflect a numerical representation of some type of count on a detector (e.g. Photomultiplier tube, or Diode array detector) and is used in this document to represent all types.

Laboratory:
A defined facility performing environmental analyses in a controlled and scientific manner. (NELAC)

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample):
A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), there is no LCS. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Note: NELAC standards allow a matrix spike to be used in place of this control as long as the acceptance criteria are as stringent as for the LCS. (NELAC)

Laboratory Duplicate:
Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Least Squares Regression (1st Order Curve):
The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit of Detection (LOD):
An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory dependent. (Analytical Chemistry, 55, p.2217, December 1983, modified) See also Method Detection Limit.

Manager (however named):
The individual designed as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. (NELAC)

Matrix:
The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

> Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with ,15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with .15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (NELAC)

Matrix Spike (spiked sample or fortified sample):
Prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix spikes shall be performed at a frequency of one in 20 samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as, total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a matrix spike may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the spike. (QAMS)

Matrix Spike Duplicate (spiked sample or fortified sample duplicate):
A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Matrix spike duplicates or laboratory duplicates shall be analyzed at a minimum of 1 in 20 samples per matrix type per sample extraction or preparation method. The laboratory shall document their procedure to select the use of an appropriate type of duplicate. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in the duplicates may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the duplicate. (QAMS)

Method Blank:
A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same

conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)

Method Detection Limit:
The minimum concentration of a substance (an analyte) 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. (40 CFR Part 136, Appendix B)

National Environmental Laboratory Accreditation Conference (NELAC):
A voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (NELAC)

National Environmental Laboratory Accreditation Program (NELAP):
The overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (NELAC)

Negative Control:
Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (NELAC)

NELAC Standards:
The plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the National Environmental Laboratory Accreditation Conference. (NELAC)

Performance Audit:
The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS):
A set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. (NELAC)

Positive Control:
Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Precision:
The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation:
Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (NELAC)

Proficiency Testing:
A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC) [2.1]

Proficiency Testing Program:
The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (NELAC)

Proficiency Test Sample (PT):
A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Quality Assurance:
An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Assurance [Project] Plan (QAPP):
A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control:
The overall system of technical activities which purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample:
An uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA-QAD)

Quality Manual:
A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System:
A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The

quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC (ANSI/ASQC-E-41994)

Quantitation Limits:
The maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user. (NELAC)

Range:
The difference between the minimum and the maximum of a set of values. (EPA-QAD)

Reagent Blank (method reagent blank):
A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Reference Material:
A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Method:
A method of known and documented accuracy and precision issued by an organization recognized as competent to do so. (NELAC)

Reference Standard:
A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.0-8)

Replicate Analyses:
The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Requirement:
Denotes a mandatory specification; often designated by the term “shall”. (NELAC)

Resource Conservation and Recovery Act (RCRA):
The enabling legislation under 42 USC 321 et seq. (1976), that gives EPA the authority to control hazardous waste from the “cradle-to-grave”, including its generation, transportation, treatment, storage, and disposal. (NELAC)

Safe Drinking Water Act (SDWA):
The enabling legislation, 42 USC 300f et seq. (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations. (NELAC)

Sample Duplicate:
Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis. (EPA-QAD)

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity:
(Analytical chemistry) the capability of a test method or instrument to respond to a target substance of constituent in the presence of non-target substances. (EPA-QAD)

Sensitivity:
The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Spike:
A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, a representative number (at a minimum 10%) of the listed components may be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period. (NELAC)

Standard:
The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of NELAC and meets the approval requirements of NELAC procedures and policies. (ASQC)

Standard Operating Procedures (SOPs):
A written document which details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standardized Reference Material (SRM):
A certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method. (EPA-QAD)

Supervisor (however named):
The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties, and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. (NELAC)

Surrogate:
A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit):
A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Director:
Individuals(s) who has overall responsibility for the technical operation of the environmental testing laboratory. (NELAC)

Test:
A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process, or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2-12.1, amended)

Test Method:
An adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP. (NELAC)

Toxic Substances Control Act (TSCA):
The enabling legislation in 15 USC 2601 et seq., (1976) that provides for testing, regulating, and screening all chemicals produced or imported into the United States for possible toxic effects prior to commercial manufacture. (NELAC)

Traceability:
The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

Uncertainty:
A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

United States Environmental Protection Agency (EPA):
The Federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends. (US-EPA)

Validation:
The process of substantiating specified performance criteria. (EPA-QAD)

Verification:
Confirmation by examination and provision of evidence that specified requirements have been met. (NELAC)

NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.

The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Work Cell:
A well-defined group of analysts that together perform the method analysis. The members of the group and their specific functions within the work cell must be fully documented. (NELAC)

Acronyms

BS – Blank Spike
BSD – Blank Spike Duplicate
CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
CRS – Change Request Form
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DU – Duplicate
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
MDL – Method Detection Limit
MS – Matrix Spike
MSD – Matrix Spike Duplicate
MSDS - Material Safety Data Sheet
NELAC - National Environmental Laboratory Accreditation Conference
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP: Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 7.

Laboratory Certifications, Accreditations, Validations

TestAmerica North Canton maintains certifications, accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

Organization	Certificate Number	Organization	Certificate Number
California	01144CA	New Jersey	OH001
Connecticut	PH-0590	New York	10975
Florida	E87225	Pennsylvania	68-00340
Georgia	--	OVAP	CL0024
Illinois	200004	US ACE (Army)	--
Kansas	E-10336	USDA (Dept.of Agriculture)	S-62345
Kentucky Underground Storage Tank Program	0058	West Virginia	210
Minnesota	039-999-348	Wisconsin	999518190

The certificates and parameter lists (which may differ) for each organization may be found on the corporate web site, the laboratory's public server, the final report review table, and in the following offices: QA, marketing, and project management.

Claims of Accreditation Status

TestAmerica North Canton has agreed to make only valid claims as to its accreditation/certification status by any authority by ensuring that the expiration dates are not exceeded and the method-specific scope or parameter lists are supportable, as required by each. Any false claims would be reported to that authority. The agreement covers the use of the authority's name, such as "Authority-Accredited," logo, or certificate number. The only valid proof of accreditation/certification is the current certificate and scope of the authority. It is the responsibility of the laboratory to make these documents available to all staff, and it is the staff's duty to reference only the current documents.

A report with scope and non-scope analytes may only be presented on the same report if the non-accredited results are clearly and unambiguously identified. No report with non-scope analytes may be associated with the logo, “Authority accredited” phrase, or the certificate number. Only the analytes specified by a unique method are valid within the scope. There shall be no intentional misleading of the users of the laboratory’s services in this regard.

No opinions and/or interpretations based on results outside the laboratory’s scope may be presented on a document referenced by “Authority-accredited, the logo, or the certificate number. If these are made, they must be written in a separate letter which is not endorsed by the authority.

The “Authority-accredited” logo may only be affixed to equipment calibrated by a laboratory that is accredited by the authority. If calibration labels contain the logo, they must also show the calibration laboratory’s name or its certificate number, the instrument’s unique identification, the date of the last calibration, and a cross-reference to the last calibration certificate.

Should the company decide to use the “Authority-accredited” logo in marketing activities, no misrepresentation may occur. Only reference to the accredited scope at a specific laboratory site is allowed. If any “Authority-accredited” language is used in proposals or quotations, any non-scope analytes must be clearly denoted as not accredited by that authority. The same is true for any use of laboratory letterhead with the “Authority-accredited” wording or logo. The logo may not be affixed to any material, item, product, part, or packaging, thereby implying accreditation status to that piece. In literature, any use of the logo must be positioned adjacent to the accredited laboratory’s name and clearly state that the presence of the logo does not imply certification/approval of the products tested. At no time may the logo appear to suggest that a person is accredited. Misrepresentation of accreditation status is never allowed and must be reported if it occurs. If in doubt, the idea of the logo’s use may be presented to the authority for approval.

If accreditation is terminated or suspended, the laboratory will immediately cease to use the “Authority-accredited” wording, the logo, or the certificate number reference in any way and inform clients impacted by the change.

Appendix 8.

Data Qualifiers

Qualifier Organic	Qualifier Inorganic	Footnote
U	U	Analyte analyzed for but was not detected.
G	G	Elevated reporting limit. The reporting limit is elevated due to matrix interference.
J	B	Estimated result. Result is less than RL.
E	I	Estimated result. Result concentration exceeds the calibration range.
M	M	Matrix spike recovery outside of limits.
B	J	Method blank contamination. The associated method blank contains the target analyte at a reportable level.
P	*	Relative percent difference (RPD) is outside stated control limits.
a	N	Spiked analyte recovery is outside stated control limits.
*		Surrogate recovery is outside stated control limits.
PG		The percent difference between the original and confirmation analyses is greater than 40%.

This is not an exhaustive list of qualifiers. All qualifiers are defined on each data sheet. Client specific qualifiers may also be used, and would also be defined on the data sheet.

APPENDIX F **Threatened and Endangered Species Report – Davey Resources Group**

DAVEY
RESOURCE GROUP
A Division of The Davey Tree Expert Company

SEP 2009
Received
Contract
Management

September 22, 2009

Corporate Headquarters
1500 North Mantua Street
P.O. Box 5193
Kent, OH 44240-5193
330•673•5685
Toll Free 1•800•828•8312
FAX: 330•673•0860

Lisa Humphreys
U.S. Army Corps of Engineers
Huntington District
502 Eighth Street
Huntington, West Virginia 25701
Attn: CELRH-EC-CE, Lisa Humphreys

RE: Plum Brook Ordnance Works TNT C Threatened/Endangered Species Survey

Dear Ms. Humphreys:

I visited the TNT C area at Plum Brook on September 17, 2009. The site mostly contains moderate to dense shrub thickets with scattered trees. There are also a few forested areas, and some areas of upland old field, primarily associated with roads, buildings, and formerly disturbed areas.

No threatened or endangered species were located at the site. I originally performed a vegetation survey at the TNT C area on September 11 and 12, 2000. No threatened or endangered species were identified at this time. During the 2000 survey, *Gentiana clausa* (closed gentian) was located. At that time, closed gentian was an Ohio potentially threatened species. Closed gentian is no longer an Ohio listed species. Closed gentian could not be relocated during the 2009 survey.

The areas of greatest plant species diversity occur in some of the old fields. The dense cover of shrubs over most of the site has prevented a high quality herbaceous layer from becoming established.

If you have any questions or need additional information, please contact me at 1-800-828-8312, ext. 33 or by email at todd.crandall@davey.com.

Sincerely,

Todd Crandall

Todd Crandall
Natural Resource Consulting

APPENDIX G Quality Control Documentation

CELRH-EC-CE Review Comments on Draft Plan of Operations

Remedial Action Construction (RA-C) for TNT Area C

Remediation of Contaminated Soil and Sediment

Plum Brook Ordnance Works

Sandusky, Ohio

Contract Number W91237-10-C-0002

July 2010

TMG Services, Inc.
Response to Comments

CELRH-EC-CE Review Comments on Draft Plan of Operations (PoO)
Remedial Action Construction (RA-C) – for TNT Area C
Remediation of Contaminated Soil and Sediment
Sandusky, Ohio
Contract Number W91237-10-C-0002, dated May 2010
11 June 2010

These comments are offered from Lisa Humphreys, CELRH-EC-CE. For clarification, please contact her at 304-399-5953, 304-617-1461 or lisa.a.humphreys@usace.army.mil.

1. Pgs 3 & 4, Section 1.2 Overview of Remedy
    a. Top of page, mid-paragraph – remove the words "and are clearly site related". By implying the nitros are clearly site related, it makes it sound like the rest of the contaminants may not be. This implication could mislead the reader to think cleanup of contaminants other than nitros might warrant this project to be designated as a PRP project if we are cleaning up contaminants not related to the manufacturing process. The COCs provided in the RI/FS are left over from the manufacturing process in TNT Area C.

        Response: Concur – The text has been revised.

    b. 2nd paragraph – AOC stands for "area of concern", not contamination.

        Response: Concur - The call-out for Area of Concern, AOC was deleted from the text.

    c. 2nd paragraph and throughout document – For clarification, "clean-up requirements" are set forth in the risk assessment portion of the RI, not the FS. The FS provides the remediation technologies for the cleanup. Throughout document, change FS to RI/FS to encompass the complete process.

        Response: Concur – References to FS were replaced with RI/FS, as appropriate.

    d. 2nd paragraph - Remove sentences about additional soil excavation may be required laterally or vertically. If needed, then SOW will be modded to request this.

        Response: Concur – The sentence was deleted.

e. 4th paragraph – Say that the representative soil samples are coming from the stockpiles generated from excavation of the AOCs and combine the next paragraph w/ this one for clarification. Also, the TCLP will be a full one which would also include PAHs along w/ the nitros, lead and PCBs (and actually the full TCLP covers a lot more than just these contaminants).

Response: Concur – The paragraph was revised to read, "Section 1.2.1 of this plan provides a brief description of each area and the contaminant(s) of concern in those areas. Pursuant to the Scope of Work, the soil will be excavated from each area and "stockpiled" next to the excavation pit in that specific area. Subsequently, representative soil samples from the stockpile(s) generated from each excavation will be analyzed for full toxicity characteristic leaching procedure (TCLP).

f. Last paragraph - change "technologies outlined were" to "selected alternative stated was". The Decision Document provides the selected alternative based on all the alternatives from the FS and Proposed Plan.

Response: Concur – the sentence was changed to read "The selected alternative stated in the approved Decision Document was not designed to treat PCBs."

g. Pg 4, same section, 1st paragraph – Add a scenario where the elevated nitros are hazardous and what will happen w/ the PCBs/nitro contaminated soil at that point. To say "elevated nitros" is confusing because it could be above RGs but not hazardous. Please clarify paragraph.

   Response: Concur – A table was added outlining the possible scenarios for soils with PCBs.

h. Pg 4, 2nd paragraph - Remove "soil above the RG levels" and replace with "the excavated stockpiled soil".
i. http://www.lrh.usace.army.mil/projects/current/derp-fuds/pbow/Pg 4, last paragraph – Great explanation – good job.

   Response: Concur – No changes were made to the text.

2. Pg 7 thru 11, Section 2.0 Project Organization and Responsibilities
   a. Change USACE POC office phone to (304) 399-5953 and add in cell phone number as well as email address.

      Response: Concur – The USACE POC's office phone number was corrected and the mobile number and email address were added.

   b. General - Add in cell phone numbers and email addresses for all (prime and subcontractors) and don't give an office number when that person is strictly in the field. It's pointless to call the TMG office in St. Albans when the field crew doesn't work/live there.

      Response: Concur – The mobile telephone numbers and email addresses were added to the contact information for the prime and subcontractors.

   c. Line space needed between C and D.

      Response: Concur – A line space was added between item C and D.

   d. H. Health and Safety Manager – Mr. Ford will not only be doing the HI calculations, but rather the analytical data coordination as well as the HI and ILCR calculations to verify if the "hot spot" has been remediated.

      Response: Concur – The text was revised to thoroughly reflect the responsibilities of the HSM.

   e. I. Field Personnel – These personnel are responsible for assisting the **On-Site** Project Manager. Also, give cell numbers for each person.

Response: Concur – The mobile phone numbers were added for each of the Field Personnel.

f. General – the lettering is off. TMG Services Independent QC Team should be J., not H. and so forth.

Response: Concur – The lettering was corrected.

g. Test America, Inc. Please state "USACE QSM-certified"

Response: Concur – The designation was added.

h. TetraTech – should include "composting" either here or under Barnes Nursery.

Response: Concur – Composting was added to the responsibilities of Tetra Tech. Although Barnes has expertise in composting, Tetra Tech is contracted to perform the composting if needed.

i. General – When providing information on Midwest Environmental or Eco First, the Contractor will need to provide the EPA ID transportation numbers and such information. This information can be placed elsewhere in the Plan of Operations under a specific section for transportation if desired.

Response: Concur – The EPA ID Numbers have been added to the PoO for each subcontractor providing waste handling services (transportation and/or disposal). This information may be found in Section 2.0 – Project Organization and Responsibilities

3. Pg 11, Section 3.1 Site Remedial Investigation – need a space between 13 and COCs.

Response: Concur – A space was inserted between 13 and COCs. Also, the numeric 13 was revised and spelled-out.

4. Pg 12, Section 3.2 RCRA – Federal needs to be capitalized.

Response: Concur – The word federal was capitalized.

5. Pg 13, Section 4.2 Excavation Area Preparation
   a. 3rd paragraph, last sentence – Remove "if approved by NASA and USACE". By getting approval of the PoO, you'll have approval to do this. You don't want to have to generate another set of approval documents.

Response: Concur – The phrase "…if approved by NASA and USACE" was deleted.

6. Pg 13, Section 4.3 Treatment Pad
    a. Change title to be treatment "Area". There's more than a pad there (i.e., sumps, berm).

       Response: Concur – The term "Pad" was revised to "Area.

    b. Mid sentence – Add a sentence that the pad was confirmed clean (through sampling and analyses) and that the 2 sumps were emptied prior to completion of last treatment efforts. Therefore any water currently accumulated in the sumps is from rain accumulation and considered clean. This eliminates any concern as to if water was left in there from last efforts or if run-off could be contaminated.

       Response: Concur – This clarification was made in the text.

7. Pg 14-17, Section 5.1 Excavation
    a. Pg 14, 3rd paragraph - reference where you got the excavation information (i.e., SOW based on detailed RI) and that large scale drawings of each AOC will be kept in the trailer and at each site (during excavation efforts) for reference.

       Response: Concur – The source of the information was provided. The sentence was also revised to note that large-scale drawing will be maintained in the office trailer and at the excavation areas during excavation activities.

    b. Pg 17, Drainage Ditch – Sediment Only – Add statement that extra care will be taken to eliminate unnecessary removal of trees in the area (see SOW for language).

       Response: Concur – A statement was added that reads, ". TMG will keep the disturbance to the trees on the uplands surrounding the ditch to a minimum so the area remains a forested wetland and also to prevent erosion along the steep ditch banks".

8. Pg 18, Section 6.1 Sampling for Disposal and Treatment
    a. 2nd paragraph – This should reflect the landfill requirements of 500 "tons", not CY or 1,500 CY for the 12 discrete samples. Revise accordingly.

       Response: Concur – The term "cubic yards" or "CY" was revised to "tons".

b. Include statement that landfill has requirements for daily disposal of 200 tons / day and that the Contractor will coordinate w/ the landfill on their requirements / shipments.

Response: Concur – A statement was included that reads, "The Erie County Landfill has a daily limit of 200 tons/day on the materials they can accept from this project. TMG will coordinate disposal of soils at the landfill to assure the volume of material for disposal does not exceed the daily limits.

9. Pg 19, Section 6.3 Lead Treatment Process – In an earlier meeting, TT said they may change the lead treatment process or amendments used. If so, please revise the PoO to reflect the new scenario or if done at a later date, then provide a statement in the PoO that says an amendment to the PoO describing the changes will be submitted if scenerios changes are made.

Response: Concur – A statement was included in the PoO that if the treatment scenario is revised, an amendment will be submitted to USACE.

10. Pg 20, Section 7.0 Analytical Requirements
    a. State that the lab is also QSM certified (per USACE requirements) and reference the lab's QAPP in Appendix D and Chain of Custody form in Appendix C. Include the lab's QSM certification sheet if possible.

    Response: Concur – A copy of the laboratory QCM certificate was included in Appendix D.

11. Pg 21, Section 7.1 Borrow Area
    a. This section needs to be expanded as to where the borrow material is coming from. The borrow material must be free from all contaminants before it can be used, not just below the RG levels for the project. Please rephrase the 2nd paragraph.

    Response: Concur – This section was expanded as follows, "The borrow material is located on the Barnes Nursery property at the corner of Hull Road and Camp Road in Huron, Ohio which is in close proximity to the site. It will not be necessary to access PBOW to conduct sampling of the borrow material. The borrow material will be sampled and analyzed to ensure that the borrow material is not contaminated. One sample per 500 cubic yards of material estimated for backfill will be collected. It is estimated that a maximum of approximately 2,300 cubic yards of borrow soil will be needed to fill the five excavations (2,300 cubic yards represents a "worst case" scenario) therefore, a total of 5 samples will be collected and analyzed. The samples will be 5 point composite samples, collected using dedicated disposable sampling equipment. The borrow material will be considered

appropriate for use in backfill of excavated pits if all chemical constituents are below the RGs listed in Section 3.1, Tables 3-1 and 3-2, and the samples pass the TCLP. Table 5-1 is presents the analytical requirements for the borrow material".

12. Pg 23, Section 7.2 Confirmation Sampling of Excavated Areas
1st paragraph, 1st sentence – also include that the excavation limit requirements are from the RI/FS and that those documents must be used as a reference too.

Response: Concur – The text was revised to include a sentence stating, "These excavation requirements were defined in the RI/FS." The FS document was added to the reference section.

a. There is no section 4.4 as stated for confirmation sampling. Revise location.

Response: Concur – The reference was revised to Section 5.2.

b. Reference is made to Appendix B for the drawings – There are only 15 AOCs for this project, yet 29 drawings provided. The Contractor only needs to include the drawings for the AOCs that are required for remediation under this SOW. Since this plan is to be referenced during field efforts, including additional maps of the clean areas will only cause confusion and possible error. Also, the maps are too small to use as reference during construction and need to be larger with a note included in this section that says the Contractor will have large full scale drawings of each AOC in the office trailer to reference/write on during field efforts.

Response: Concur – The contents of Appendix B will include only the maps of the 15 AOCs for this project. The text was revised to read, ". Larger scale maps will be used to identify the location of each confirmation sample. Each confirmation sample location will be marked on the map for each AOC. The maps will be maintained in the trailer.

c. The Contractor needs to also include language here and throughout the plan about calculating the HI and ILCR for each AOC to determine if the AOC has been remediated. It's not soley based on the RG levels.

Response: Concur – Another section (Section 7.4) was added entitled, "7.4 Evaluation of Confirmation Sample Results." The section includes language that TMG will calculate the HI and ICLR for the sample results from the confirmation sampling efforts. The paragraph reads, "Upon receipt of the results of the confirmation samples, TMG will calculate the Hazard Index (HI) and Incremental Lifetime Cancer Risk (ILCR) for each excavation. The HI must be </= 1 and the ILCR must be </= $1x10^{-5}$. Exceedance of an individual RG within an excavation will be acceptable as long as the HI and ILCR meet the criteria above.

13. Pg 25, Section 7.4 Waste Characterization

a. NASA signs ALL manifests, both Haz and Non-Haz and requires USACE (Contractor) to have them filled out in accordance w/ their numbering system and supplied to them. Neither USACE nor the Contractor has any authority to sign ANY manifests on soil or media leaving NASA PBS unless NASA transfers that authority and then the person must be certified to sign. The Contractor (with USACE help if necessary) must coordinate with Bob Lallier (NASA manifester and POC on this FUDS project) for his availability to sign these manifests. He is not always in the office and cannot sign on a minutes notice. He has to have time to review the manifests to ensure they are correctly prepared prior to signing.

Note this comment now pertains to Section 7.5, because a Section 7.4 was added to discuss the evaluation of confirmation results.

Response: Concur – Section 7.6 was added to discuss waste manifesting. The text was revised to read, "The contractor is not authorized to sign any type of waste manifest, either hazardous or non-hazardous. The contractor must have the manifests completed properly using the NASA-provided manifest numbers and must provide the completed manifest to the NASA FUDS POC, Bob Lallier. The NASA FUDS POC will review the manifest to verify the information is complete and provide the authorized signature. The contractor will coordinate with Mr. Lallier to allow sufficient time for Mr. Lallier to review the information and to obtain his signature on the manifest.

b. 2nd paragraph – Revise to show landfill requirements of 500 tons / 12-point composite, not 1,500 CY for 12 discrete samples.

Response: Concur – The text was revise to read, "For soils disposed in the Erie County Landfill, soil samples will be collected with a 12-point composite for every 500 tons of soil."

c. 2nd paragraph and throughout plan – Do not say 12 discrete samples, reword to say "a 12-point composite sample". Reader could mistake it for taking 12 discrete samples.

Response: Concur – the "search and replace" was used to find specific text referring to "discrete samples" and revise to read "12-point composite."

d. General – This section is for Waste Characterization. Another section needs to be added that discusses how the Contractor will handle manifesting and move the 2 sentences that talks about manifesting to the new section OR change title to "Waste Characterization and Manifesting" and have sub-paragraphs for each.

Response: Concur – A Section 7.6 was added to discuss waste manifesting.

14. Pg 27, Section 8.0 Equipment Decontamination

a. Can the Contractor not use the Alqonox rather than the Hexane solvent for decon? Use of a solvent could create more problems than solve.

Response: Concur – The equipment decontamination steps were revised in Table 8-1.

15. Pg 28, Section 8.1 IDW

a. 2nd sentence is incomplete.

Response: Non-concur – The sentence was reviewed and it is complete.

b. Revise title to be Transportation and Disposal of IDW

Response: Concur – The title of Section 8.1 was revised.

c. When talking about the transportation companies, the plan needs to include all the information about the companies.

Response: Concur – Contact information and EPA ID Numbers for the waste handling companies has been inserted into Section 2.0.

16. Pg 28, Section 9.0 Field Documentation Procedures
    a. This section needs to include Section 12 info here for the QCRs. That's considered field documentation. Also include discussion of the Equipment checklists and safety meeting sheets here.

       Response: Concur – two additional sections were added that include brief discussions of the Equipment Checklists and the Safety Meetings.

17. Pg 31, Section 11 Contractor Chemical Quality Control – this section or parts of the section needs to go under Section 7.0 Analytical requirements where you are talking about the lab.

    Response: Concur – Section 11.0 was combined with Section 7.0.

18. General - Where are the alkaline hydrolysis, composting and lead stabilization parts of the work plan? These efforts need to be explained in detail (i.e., reference Composting work plan for PRRWP and TNT B projects), not just the few sections included earlier. Include as requested.

    Response: Concur – The alkaline hydrolysis, lead stabilization and composting process descriptions have been incorporated into the plan and included in Appendix C. References have been revised to include the reports from the TNT Area B and PRRWP.

19. Pg 35, Section 12.0 Daily QCRs – include how daily photo documentation will correspond w/ the QCRs to show they can be cross-referenced in case issues arise (i.e., photo log and date referencing).

    Response: Concur – A statement was included to read, "Photographs will be date stamped to correspond with the daily QCRs. This will allow for cross-referencing the daily activities and to observe the activity in the photograph.

20. Pg 36, Section 13.0 Corrective Action – this title needs to be revised because it's a RCRA acronym and is confusing based on this project being under the CERCLA regulations. Also, there will be no deviation from the work plans unless a modification is awarded. I'm not sure why this section is included. The Contractor is responsible for the remediation of the TNT C AOCs and unless there's a change in site conditions, any deviations from the SOW are at the Contractor's expense.

    Response: Concur – The section was deleted.

21. Pg 36, Section 14.0 Spill Prevention, Containment and Countermeasure Plan
    a. Pg 38, Section 14.5 – Reword to say the Contractor will report the spill to the appropriate agencies, with notification to USACE POC. The USACE POC

may not be on-site when the spill occurs and would not have all the pertinent applicable information to relay to the regulatory agencies.

Response: Concur – The statement was reworded

b. Detail that there is a time-limit on reporting spills of RQ and the Contractor needs to know what the RQs are for each chemical they are using and include that information as a handy reference should a spill occur.

Response: Concur – A table listing the CASRN, RQ and notification requirements was added to this section. If the chemicals used in this project are changed based on bench-scale testing, an addendum will be prepared that will include an update or revision to this table.

22. Pg 39, Section 15.1 Erosion and Silt Control – include a bullet that states no erosion control measures constructed will allow migration of contamination on to adjacent "clean" soil.

Response: Concur – A bullet has been added that reads, "No erosion control measures that are constructed on-site will allow migration of contamination onto adjacent "clean" soil.

23. Pg 40, Section 18 References – The Contractor needs to include the references for the TNT C investigations.

Response: Concur – References for the TNT C documents have been included.

24. Appendix D Lab QA Plan – Due to the size of this document, the Contractor can include this on CD for the Final Work Plan if desired.

Response: Concur – The laboratory QA plan will be incorporated on a CD for the final PoO.

25. The plan needs to include a section(s) on how the draft and final construction completion reports will be generated, detailed and submitted. No mention of these reports were made other than the project schedule in section 17. Project Schedule. See SOW sections 3.11 and 4.3.

Response: Concur – Section 15.0 was revised to incorporate development of the draft and final reports.

26. The work plan needs a section detailing final grading / seeding requirements of the AOCs and what will be done w/ the treatment area upon completion (i.e., sampling to verify clean). Include as required.

Response: Concur – Section 16.0 was revised to detail the grading and seeding requirements outlined in the SOW.

27. The Contractor shall review the SOW section 3.3 Preparation and Submission of Plan of Operations to ensure that it has included the required information in this PoO. While the Contractor has included information on a lot of the "sub-plans" mentioned in this section, there are no individual plans for SAP, IDW, Materials Handling, etc. Please ensure that all the appropriate information has been included in this Plan of Operations whether in the sections or as in an appendix for each separate plan.

    Response: Concur – TMG has reviewed section 3.3 of the SOW and all required information has been included in the Plan of Operations.

28. General – The Contractor did mention the "site survey" but a section needs to be included on those requirements and how it was conducted to complete the picture.

    Response: Concur – Section 5.0 has been reassigned and revised to include a discussion of the Site Survey requirements and how those requirements will be met.

29. PoO needs a section on Land Disposal Requirements and what they are for the project contaminants since placement on-site is part of the selected alternative.

    Response: Concur – A presentation of the Land Disposal Restrictions was added to the discussion of the treatment section.

30. PoO needs a section on how Public Meeting Support will be handled. See SOW section 3.12

    Response: Concur – Section 17.0 has been reassigned and revised to discuss TMG's role in the Public Meeting Support.

31. PoO needs a section on Threatened and Endangered Species findings to show there is or isn't any concern during the construction effort. See SOW section 3.13

    Response: Concur – Section 18.0 has been added and is designated for the discussion of the Threatened and Endangered Species survey.

32. PoO needs a section on Wetlands findings to show there is or isn't any concern during the construction effort. See SOW section 3.6.15.

    Response: Concur – Section 19.0 was added to present a discussion of the wetlands evaluation and highlighted the sediment area in TNTC which is planned to be sampled again to verify COC contamination.

33. PoO needs section detailing road repair and when necessary and what will be done to hopefully eliminate need for road repair.

    Response: Concur – Section 20.0 was added to detail the road repairs.

34. General – The Contractor shall review the SOW sections to ensure he/she has included detailed information in the PoO pertaining to each of those sections.

    Response: TMG reviewed the sections to ensure the information required in the SOW was included in the PoO.

CELRH-EC-CE Review Comments on Draft Plan of Operations
Remedial Action Construction (RA-C) – for TNT Area C
Remediation of Contaminated soil and Sediment
Sandusky, Ohio
Contract Number W91237-10-C-0002, dated May 2010
08 June 2010

The following comments are offered from Jason Smithson, CELRH-EC-CE, 304-399-5040.

1. Pg 1, Section 1.1 Introduction and Site History, 3rd paragraph, 4th sentence – Add a comma after salvaged.

   Response: *Concur – Punctuation was added.*

2. Pg 2, Section 1.1 Introduction and Site History, 1st paragraph, last sentence –Reword this sentence. It is somewhat confusing.

   Response: *Concur – The sentence was reworded for clarification.*

3. Pg 2, Section 1.1 Introduction and Site History, 2nd paragraph, 4th sentence – Remove "of the" after remaining.

   Response: *Concur – The sentence was revised.*

4. Pg 2, Section 1.1 Introduction and Site History, 3rd paragraph, 3rd sentence – This sentence is understandable, but you will get the same conclusion if you remove "were present".

   Response: *Concur – The sentence was revised.*

5. Pg 2, Section 1.1 Introduction and Site History, 3rd paragraph, 6th sentence – Remove "The" at the beginning of the sentence.

   Response: *Concur – The sentence was revised.*

6. Pg 2, Section 1.1 Introduction and Site History, 4th paragraph, last sentence – Add a period to the end of the sentence.

   Response: *Concur – A period was added to the end of the sentence.*

7. Pg 3, Section 1.2 Overview of Remedy, 1st paragraph, 1st sentence – Reword the sentence to begin without using the number 13.

   Response: *Concur – The sentence was revised.*

8. Pg 11, Section 3.1 Site Remedial Investigation, 1st paragraph, 2nd sentence – Reword the sentence to begin without using the number 13.

   Response: *Concur – The sentence was revised.*

9. Pg 11, Section 3.1 Site Remedial Investigation – Move Table 3-2 heading to the page 12 with the table.

   Response: *Concur – The table heading was placed with the corresponding table.*

10. Pg 12, Section 4.1 Borrow Area, 1st paragraph, 4th sentence – Explain the type of auger that may be used (eg. Hand auger, auger with a drill rig, auger mounted on skid-steer, etc.) and remove "to take samples" at the end of the sentence.

    Response: *Concur – The sentence was revised to read "Samples will be collected using a gloved-hand to grab soil and composite into a plastic bag."*

11. Pg 14, Section 5.1 Excavation, 3rd paragraph, 3rd sentence – "will be considered complete" would be more appropriate considering the context of the other paragraphs.

    Response: *Concur – The text was revised as suggested.*

12. Pg 14, Section 5.1 Excavation, 3rd paragraph, 4th sentence – Remove "of any".

    Response: *Concur – The revision was made.*

13. Pg 14, Section 5.1 Excavation, 3rd paragraph, 6th sentence – Replace existing sentence with the following: The following is a list of areas to be excavated:

    Response: *Concur – The insertion was made.*

14. Pg 17, Section 5.1 Excavation, last paragraph, 1st sentence – Explain the testing of the "seed bank" material and using it for backfill only if it is acceptable based on laboratory analysis.

    Response: *Concur – The preceding paragraph was revised to include sampling and analysis of the seed bank material.*

15. Pg 23, Section 7.2 Confirmation Sampling of Excavated Areas, 1st paragraph – Remove extra space before last sentence.

    Response: *Concur – The space was removed.*

16. Pg 29, Section 9.3 Sample Identification Labeling, 1st paragraph, 3rd sentence – Add "ed" to place.

Response: *Concur – The text was revised.*

17. Pg 35, Section 12.0 Daily Quality Control Reports, 1st sentence – Remove daily in front of QCR reports.

    Response: *Concur – The word "daily" was removed from the text. (This comment was addressed in Section 11.0 in the revised PoO)*

18. General Comment – Use feet symbol to replace apostrophe. This can be found in the symbols section in word.

    Response: *Non-concur – Making this revision will not add significant technical content to the document and use of the apostrophe is widely scattered throughout the document which would make the "search and replace" effort lengthy. However, this comment will be considered during the preparation of the draft reports for the project.*

19. General Comment – The majority of the site maps are not legible due to the size conversion to 8.5″x 11″. Use 11″ x 17″ or include full size drawings with a map pocket. Be sure to indicate the proper scale if the size of the drawing is altered.

    Response: *Concur – 11″ x 17″ drawings or larger will be used in the reports and on site.*

Quality Control Certification

Final
Plan of Operations

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio

Contract No. W91237-10-C-0002

Assignment	Name	Signature	Date
Senior Review			
	Kimberlie Bumgardner	Kimberlie Bumgardner	8-2-10
Peer Review			
	Richard Armstrong	Richard Armstrong	8-2-2010

Comments on

Final
Plan of Operations

Remedial Action Construction
Remediation of Contaminated Soil and Sediment
Plum Brook Ordnance Works – TNT Area C
Sandusky, Ohio

Contract No. W91237-10-C-0002

The following comments were provided by TMG's Independent Quality Control Team. All comments resulting from this review have been resolved and/or incorporated.

TMG IQCT Comment: Section 1.2, Paragraph 6, sentence 2 states "When soil is encountered with elevated PCB concentrations and with elevated nitroaromatic concentrations, the nitroaromatic-contaminated soil will be treated and subsequently disposed of at an approved RCRA TSDF."

If soil is below 50 mg/kg for PCB and the nitroaromatics are treated, then it will go to an approved non-hazardous landfill. Revise accordingly.

TMG Response: Concur, sentence has been revised as follows "When soil is encountered with PCB concentrations of less than 50 mg/kg and with elevated nitroaromatic concentrations, the nitroaromatic-contaminated soil will be treated and subsequently disposed off-site at an approved non-hazardous waste landfill."

TMG IQCT Comment: Section 6.1, Paragraph 2, Sentence 4, states that disposal samples will be collected for every 1,500 CY. This should be every 500 CY. Revise accordingly.

TMG Response: Concur, the cubic yardage has been revised as suggested.

TMG IQCT Comment: Section 9.3, last sentence, remove "TMG" from the sample ID.

TMG Response: Revision to the sample ID has been made as suggested.