Golder Associates Inc.
200 Century Parkway, Suite C
Mt. Laurel, NJ 08054
Tel: (856) 793-2005
Fax: (856)793-2006

Golder Associates

REVISED
ADDENDUM NUMBER ONE
SOIL SOURCE AREA REMOVAL WORK PLAN
LIGHTMAN DRUM SUPERFUND SITE
WINSLOW TOWNSHIP
CAMDEN COUNTY, NEW JERSEY

10/08

Prepared by:

Golder Associates Inc.
200 Century Parkway
Suite C
Mount Laurel, New Jersey 08054

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October 2008

Project No.: 013-6054-001

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Golder Associates Inc.
200 Century Parkway, Suite C
Mt. Laurel, NJ 08054
Tel: (856) 793-2005
Fax: (856)793-2006

Golder Associates

October 3, 2008

Our Ref.: 013-6054-001

Emergency and Remedial Response Division
U.S. Environmental Protection Agency
2890 Woodridge Avenue
Edison, New Jersey 08837-3679

Attn: Ms. David Rosoff, On-Scene Coordinator

RE: REVISED ADDENDUM NUMBER ONE TO THE REVISED WORK PLAN FOR SOIL SOURCE REMOVAL LIGHTMAN DRUM SUPERFUND SITE WINSLOW TOWNSHIP, CAMDEN COUNTY, NEW JERSEY

Dear Mr. Rosoff:

On behalf of the Lightman Drum Source Removal Group (Group), we enclose this Addendum Number 1 to the Revised Soil Source Area Removal Work Plan (Work Plan), which addresses the removal of Un-Naturally Colored Soil at the above site. Two copies of the Work Plan have also been transmitted directly to the NJDEP. This Work Plan is an addendum to the Revised Final Work Plan for Soil Source Removal submitted October 30, 2007, and approved by the USEPA on November 6, 2007. This Work Plan expands upon and supersedes Addendum No. 1 to the Work Plan for Soil Source Removal submitted August 7, 2008.

This additional removal action is being conducted under the existing Administrative Order on Consent for Removal Action (AOC) and in accordance with the Group's letter dated July 10, 2008.

As discussed, we are tentatively scheduled to commence field mobilization in mid-October and so your expedited review of this Addendum to the Work Plan will be appreciated. Please do not hesitate to contact us if any questions arise during your review.

Very truly yours,

GOLDER ASSOCIATES INC.

for Jonathan P. Rizzo
Removal Action Task Manager

Robert J. Illes, P.G.
Alternate Project Coordinator

JPR\RI:bjb
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cc: Renee Gelblat, USEPA (1 copy)
Michael Van Itallie, Esq. USEPA (1 copy)
James DeNoble, NJDEP (2 copies)
Lightman Drum Source Removal Group (1 copy)

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1.0 INTRODUCTION

A Soil Source Removal Action was implemented at the Lightman Drum Company Superfund Site (Site) pursuant to the Administrative Settlement Agreement and Order on Consent (AOC), dated September 13, 2007 between USEPA and the Lightman Yard Source Removal Group (Group) for the localized removal of contaminated soils in the vicinity of the former Waste Storage Tank Area (Source Area). The Soil Source Removal was performed at the Site between October 29, 2007 and March 27, 2008 with Golder Associates Inc. (Golder) serving as the General Contractor/Remedial Designer on behalf of the Group, and Compass Environmental, Inc. (Compass), as the Remedial Contractor. The work was conducted pursuant to the AOC and the USEPA approved Soil Source Removal Work Plan (Work Plan) dated October 30, 2007.

During the Source Area Removal, discrete areas of un-naturally colored soils; primarily purple, yellow, green, blue and red were observed at the Site. At the request of USEPA, investigations were conducted in January and March 2008 to define the nature and extent of the colored soils. The investigations revealed that un-naturally colored surface soils are present generally within 4-inches of ground surface that contain concentrations of lead, and to a lesser frequency and degree other constituents above risk-based levels. These soils are present in portions of the former drum storage and handling areas of the Site.

The USEPA requested that the Group consider conducting an additional removal action under the existing AOC to remove the un-naturally colored soils at the Lightman Yard Site. In response, the Group sent a letter to USEPA on July 10, 2008 requesting that the AOC remain open in anticipation of conducting the additional source removal pursuant to Paragraph 93 of the AOC.

This Addendum Number 1 to the Source Area Removal Work Plan (Work Plan Addendum) addresses the removal of un-naturally colored soils. The objective of the un-naturally colored soil removal is to remove soils at the Site that would otherwise potentially pose an unacceptable risk to human or ecological receptors.

The following sections of this Work Plan Addendum provide a description of the proposed work, which will be conducted in accordance with the procedures specified in the approved Soil Source Removal Work Plan (October 2007), including the associated Sampling and Analysis Plan (SAP) and Health and Safety Plan (HASP). Where necessary, additional sampling procedures,

analytical requirements, and health and safety information specific to the un-naturally colored soil removal are also provided herein.

2.0 BACKGROUND

During fieldwork for the Soil Source Area Removal in the Former Waste Storage Tank Area, discrete areas of un-naturally colored soils; primarily purple, yellow, green, blue and red were observed at the Site. The un-naturally colored soil was observed to be within several inches of ground surface in former drum staging areas, with the exception of the purple soil which was observed in and adjacent to the Source Area Removal area excavation.

The purple stained soil was found to extend to a depth of approximately 6 feet and was partially removed and disposed during the Source Area Removal. Analysis of a sample of this purple stained soil taken in November 2007 revealed the presence of two tentatively-identified semi-volatile organic compounds that may account for the purple color: Cinnamyl cinnamate, at an estimated concentration of 9.5 ppm and bis (4-(dimethylamino)phenyl)-methanone, which is otherwise known as Michler's ketone at an estimated concentration of 0.48 mg/kg. The precise extent of the purple stained soil is unknown although it is limited to the vicinity of the former Waste Storage Tank Area.

Subsequent investigations were conducted at the request of USEPA in January and March 2008 to define the nature and extent of the other surficial colored soils. The results were submitted to USEPA on June 6, 2008 in an Addendum to the Remedial Investigation Report. The investigations revealed that un-naturally colored soils are present at depths of less than 6-inches in portions of the former drum storage and handling areas of the Site. Lead is the primary contaminant of concern, which exceeded New Jersey's risk-based screening criteria in seven of nine samples. Arsenic and pesticides were each present in one sample above screening criteria and hexavalent chromium was detected in two samples above the preliminary inhalation criteria. The horizontal extent of these impacted areas has been delineated and encompasses approximately 2,250 square yards. Vertical delineation sampling confirmed that impacts do not extend below the visually identifiable colored zone, which generally does not extend below 4-inches below ground surface (bgs). Based on the horizontal and vertical delineation, approximately 250 cubic yards of soil is present within the impacted areas.

3.0 SCOPE OF WORK

3.1 Overview

As illustrated in Figure 1, the proposed areas of excavation cover approximately 2,250 square yards in plan dimensions and encompass locations where un-naturally colored soil was observed including purple stained soil in the vicinity of the Source Removal Area.

The scope of work includes removal of un-naturally colored soil including removal of purple stained soil, secured staging of the impacted soil in a stockpile, waste characterization, transportation and disposal of impacted soil, and site restoration.

3.2 Soil Excavation

Excavation will be performed at eight discrete areas as shown on Figure 1. Prior to excavation, the extent of the proposed excavation areas will be staked by a surveyor based on the survey of the previous sampling and marked with high-visibility flagging.

Un-naturally colored soil will be removed, including purple stained soil, to the horizontal extents as shown on Figure 1, with excavations terminating based on visual observations. During excavation, if additional un-naturally colored soil is observed at the perimeter of the proposed excavation area, the excavation area will be expanded to remove the un-naturally colored soil. Although not anticipated based on previous investigations, should un-naturally colored soil extend beyond the property boundary, the USEPA will be notified and the Group will evaluate approaches to address these soils, including requirement for access.

3.3 Soil Staging

Excavated soils will be staged on site in a controlled manner consistent with the previous source removal work for unsaturated soils until the soils are characterized and accepted by the approved disposal facility. The un-naturally colored soil will be stockpiled on plastic sheeting in a staging area and covered to mitigate wind dispersal and rain water contact. Appropriate erosion and sediment controls will be implemented as discussed in Section 3.7.

3.4 Field Screening and Confirmatory Soil Sampling

Soil samples will be collected for field screening and for confirmatory laboratory analyses following removal of the un-naturally colored soil, including the purple stained soil. Field screening for lead of the samples will be performed with a portable X-Ray Fluorescence (XRF) device and confirmatory soil samples for laboratory analysis will be collected. XRF screening data will be used to guide decisions on the extent of excavation in areas of un-naturally colored soil.

Screening for lead using the XRF will be conducted on prepared samples consistent with instrument manufacturer's instructions and SW-846 Method 6200. Procedures for use of the XRF are included in Appendix A and screening will be performed at a minimum frequency of one location per 400 square feet. A minimum of one location per discrete area will be screened using the XRF.

XRF screening results will be compared to the New Jersey Non-Residential Direct Contact Soil Cleanup Criteria (NRDCSCC) for lead of 600 milligrams per kilogram (parts per million (ppm)). An additional 6 inches of soil will be removed from any area where lead XRF screening results exceed 600 ppm in an approximate 10 foot by 10 foot area surrounding the soil sample with the lead exceedance. If additional excavation is necessary additional soil screening samples will be collected from the base of the excavation for XRF screening.

Ten (10) percent of the prepared XRF screening samples from each area will be submitted for confirmatory laboratory analyses for lead. The confirmatory samples will be selected from the lower, middle, and upper range of concentrations measured by the XRF.

Additional sample volume will be collected at the confirmatory XRF screening locations for additional analyses. The additional sample volume from the confirmatory sample XRF screening locations will be collected according to the procedures in the RI/FS work plan (July 2002) for surface soil sampling.

The confirmatory laboratory samples will be analyzed for Target Compound List (TCL) semi-volatile organic compounds (SVOCs), TCL pesticides, and Total Analyte List (TAL) metals (including speciation for hexavalent chromium) using the methods specified in the addendum to

the SAP (Appendix A). If laboratory results exceed direct contact risk-based standards for industrial use then additional soil will be removed and further confirmatory soil samples will be analyzed. The extent of the additional soil excavation, if necessary, will be discussed with the USEPA prior to excavation.

3.5 Waste Characterization and Disposal

Stockpiled soils will be sampled and characterized for disposal at an approved off-site facility. Soil samples will be collected from the soil staging pile according to the Soil Source Removal Work Plan (October 2007). Methods for the collection of the waste pile soil samples are included in the SAP (Appendix A of the Soil Source Removal Work Plan).

The frequency of sample collection will be dependent on the selected disposal facility's permit and other requirements. Based on the anticipated staging pile size of approximately 250 cubic yards, not less than two samples will be collected.

Samples will be analyzed according to the Source Removal SAP (Appendix A of the Soil Source Removal Work Plan) for RCRA Waste Characteristics including ignitability, corrosivity, reactivity, and toxicity according to the most current version of SW-846 Methods published by the USEPA's Office of Solid Waste. A Toxicity Characteristic Leaching Procedure (TCLP) analysis will be performed with the TCLP extract analyzed for appropriate VOCs (if required by disposal facility), SVOCs, pesticides, herbicides, and metals. Based on disposal facility requirements from the Soil Source Removal action, analysis for total PCBs and oil and grease is also anticipated. All analyses will be conducted by a New Jersey certified laboratory.

If the testing results indicate that the soil is a hazardous waste based on characteristics (ignitability, corrosivity, reactivity, or toxicity) then the soil will be disposed at a hazardous waste facility that is permitted to handle such wastes. If the soil does not exhibit characteristics of hazardous waste then it will be disposed of in accordance with applicable solid waste regulations. Based on the maximum concentrations (total constituent analysis) of un-naturally colored soil identified during previous sampling, it is uncertain as to whether the soil will be characteristically hazardous, and so plans will be made for both hazardous and non-hazardous disposal so as to remove the soil from the Site in a timely manner. Analytical results for the waste characterization will be provided to the USEPA prior to selection of a disposal facility and USEPA approval of the disposal facility will be requested.

At this time it is anticipated that non-hazardous soil will be disposed at the Gloucester County Improvement Authority (GCIA) Landfill in Swedesboro, New Jersey (the facility approved by USEPA for non-hazardous soils from the Soil Source Area). It is anticipated that characteristically hazardous soil will be disposed at the CWM Chemical Services, LLC facility in Model City, New York.

3.6 Backfill and Restoration

Clean imported material will be used to backfill the excavated areas. Imported backfill material will be environmentally clean soil from a known off-site borrow source located within the Pinelands and shall be naturally occurring, granular type material, free of deleterious and organic material. The Dun-Rite Sand and Gravel facility in Monroe Township, Gloucester County, New Jersey provided the backfill material for the Soil Source Removal action performed between October 2007 and March 2008. The USEPA approved Dun-Rite as the source of backfill material for the Soil Source Removal action in a letter dated November 16, 2007 and it is anticipated that the same source will be used for this project. If an alternate imported backfill material source is proposed the procedures in Section 3.7 of the Soil Source Removal Work Plan (October 2007) will be followed for USEPA approval of the source prior to use.

Backfill will be placed and spread by mechanical equipment (excavator or bulldozer) and compacted with the bucket of the excavator or the treads/tracks of the equipment. The surface layer will comprise gravel compatible with the current use of the property and will approximate the pre-excavation grades.

3.7 Soil Erosion and Sediment Control

The proposed excavation area for the un-naturally colored soil removal at the Site is greater than 5,000 square feet. Therefore, in accordance with N.J.A.C. 2:90-1 a Soil Erosion and Sediment Control (SESC) Plan was submitted to the Camden County, New Jersey Soil Conservation District. The proposed erosion and sedimentation control measures are similar to those previously used as part of the Soil Source Removal and will include the installation of silt fence around the perimeter of the excavation areas and the impacted soil stockpile, covering the impacted soil stockpile, and the use of two stabilized construction entrances that were installed during the Soil Source Removal. Use of the construction entrances will minimize the potential

for tracking soil onto public roadways. Certification of the SESC Plan was received from Camden County, New Jersey Soil Conservation District on September 17, 2008

3.8 Dust Monitoring and Control

The Remedial Contractor's Site-specific, Health and Safety Plan (HASP), Appendix E of the Soil Source Removal Work Plan (October 2007), includes performance of on-Site air monitoring to ensure the health and safety of the on-site workers and potential off-site receptors and to provide contingencies for dust controls that may be necessary. At a minimum, worker breathing zone and perimeter air monitoring for particulates will be conducted with appropriate action levels to upgrade worker respiratory protection and/or provide dust controls.

3.9 Site Security

The Site Security Plan included in provided in Appendix D of the Soil Source Removal Work Plan (October 2007) will be followed.

4.0 CONSTRUCTION QUALITY ASSURANCE

The proposed activities will be subject to on-Site inspection and oversight by the Remedial Designer to document conformance to the Source Removal Work Plan (October 2007) as modified by this addendum. Activities requiring construction quality assurance include, but are not limited to, the following sections.

4.1 Soil Excavation

The excavation by the Remedial Contractor will be monitored to confirm that all un-naturally colored soil is removed.

4.2 Soil Screening and Confirmatory Soil Sampling

Post excavation samples for soil screening and laboratory analyses will be collected by the Remedial Contractor from the base of the completed excavations (Section 3.4) to characterize the remaining soil in the removal areas. Soil screening will be performed on prepared samples using an XRF instrument and confirmatory samples will be collected and analyzed to evaluate underlying soil following removal of the un-naturally.colored soil as described in Section 3.4 and Appendix A.

The sampling of the base of the excavations will be monitored for consistency with the specification and the results will be reviewed by the Remedial Designer to determine if additional excavation is required.

4.3 Backfill Verification

It is anticipated that soil from the Dun-Rite Sand and Gravel facility in Monroe Township, NJ, previously approved by USEPA will be used as backfill. If an alternate source is proposed, samples shall be analyzed to document that all fill material used to backfill the excavated area is free from chemical and radiological contamination and is consistent with background soil levels for the Pinelands area. No fill will be shipped to the site until analytical results have been submitted to the USEPA for review. Sample location information (i.e. sample map) will be provided to the USEPA along with the soil analytical results. This information will include a certification statement indicating that the soil excavated from the borrow source and sent to the site for backfill will be from the area of the borrow pit where the samples were collected.

The Remedial Designer will visit the borrow pit during excavation and loading of the soil that will be brought to the Site to observe and document that the soil being brought to the Site is from the area that samples were collected.

4.4 Backfilling and Compaction

The backfill compaction will be monitored to confirm that the Remedial Contractor is following the reviewed procedures from this work plan.

4.5 Waste Characterization and Disposal

The Remedial Designer will review the waste characterization test results to confirm that the Contractor's proposed disposal methods are appropriate.

At least five (5) days before shipping any hazardous substances, pollutants, or contaminants from the Site to an off-site location, USEPA's certification that the proposed receiving facility is operating in compliance with the requirements of CERCLA Section 121(d)(3), 42 U.S.C. § 9621(d)(3), and 40 C.F.R. § 300.440 shall be obtained. Hazardous substances, pollutants, or contaminants shall only be sent from the Site to an off-site facility that complies with the requirements of the statutory provisions and regulations cited in the preceding sentence.

Prior to contracting for the services of any transportation and disposal company, the following documentation will be provided to the USEPA:

i. The valid RCRA transporter and disposal identification numbers for each transporter and disposal company;

ii. The most recent six-month State or EPA regulatory inspection results of each disposal company; and

iii. The date of the most recent State or EPA regulatory inspection, and any special provisions or conditions attached to the RCRA disposal permits as a result of the most recent inspection.

5.0 REMOVAL ACTION HEALTH AND SAFETY PLAN

The Remedial Contractor's site-specific Health and Safety Plan (HASP) was included as Appendix E of the Soil Source Removal Work Plan (October 2007). The contractor's plan was developed to comply with Safety and Health Regulations promulgated by the U.S. Department of Labor: 29 CFR Part 1904 - Recording and Reporting Occupational Injuries and Illness, 29 CFR Part 1910 - Occupational Safety and Health Standards, and 29 CFR Part 1926 - Safety and Health Regulations for Construction and with EPA's Standard Operating Safety Guide (PUB 9285.1-03, PB 92-963414, June 1992). Appendix C of this work plan provides Addendum No. 2 to the site-specific HASP to include amendments to plan to include the un-naturally colored soil removal action.

6.0 PERMITTING

A Soil Erosion and Sediment Control Plan was submitted to the Camden County, New Jersey Soil Conservation District on August 15, 2008 since the area to be disturbed is greater than 5,000 square feet. Certification of the SESC Plan was received from the Camden County Soil Conservation District on September 17, 2008.

7.0 SCHEDULE AND REPORTING

The proposed schedule for remedial activities is included as Figure 2.

Monthly Progress Reporting

The Group's Representative will continue submittal of written monthly progress reports to the USEPA during un-naturally colored soil removal detailing activities performed during the previous month and activities planned for the following month until termination of the AOC.

Weekly Progress Reporting

During field activities associated with the un-naturally colored soil removal, the Group's Representative will submit written progress reports to the USEPA concerning actions undertaken pursuant to the Order. Each Friday, the Group's Representative will submit to USEPA a report that details the activities planned to be undertaken by Group for the following week and activities that were performed during the previous week.

Final Report

A construction completion report has been prepared for the previously completed Source Removal Activities and a draft final version was submitted to the USEPA on June 5, 2008. The USEPA has reviewed the Draft Final Construction Report for the Soil Source Removal and provided comments on the report to Golder. An updated report will be prepared that will include the un-naturally colored soil removal activities. A final construction completion report, including comments on the draft final report, and the un-naturally colored soil removal will be submitted 30 days following completion of all work.

8.0 REFERENCES

Golder Associates Inc., 2002. Remedial Investigation/Feasibility Study Work Plan, Lightman Drum Company Site, Winslow Township, New Jersey, July 2002.

Golder Associates Inc., 2007. Soil Source Area Removal Work Plan, Lightman Drum Company Site, Winslow Township, New Jersey, October 2007

Golder Associates Inc., 2008. Draft Construction Completion Report Soil Source Area Removal, Lightman Drum Company Site, Winslow Township, New Jersey, June 2008

NJDEP, 2005. Field Sampling Procedures Manual. August 2005

NJDEP, Guidance Document for Waste Classification as found at:
http://www.state.nj.us/dep/dshw/resource/hwm009.htm on 1/25/2007

USEPA, Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (OSWER Directive #9355.4-12 August 1994)

USEPA, Management of Remediation Waste Under RCRA, October 1998; EPA 530-F98-026.

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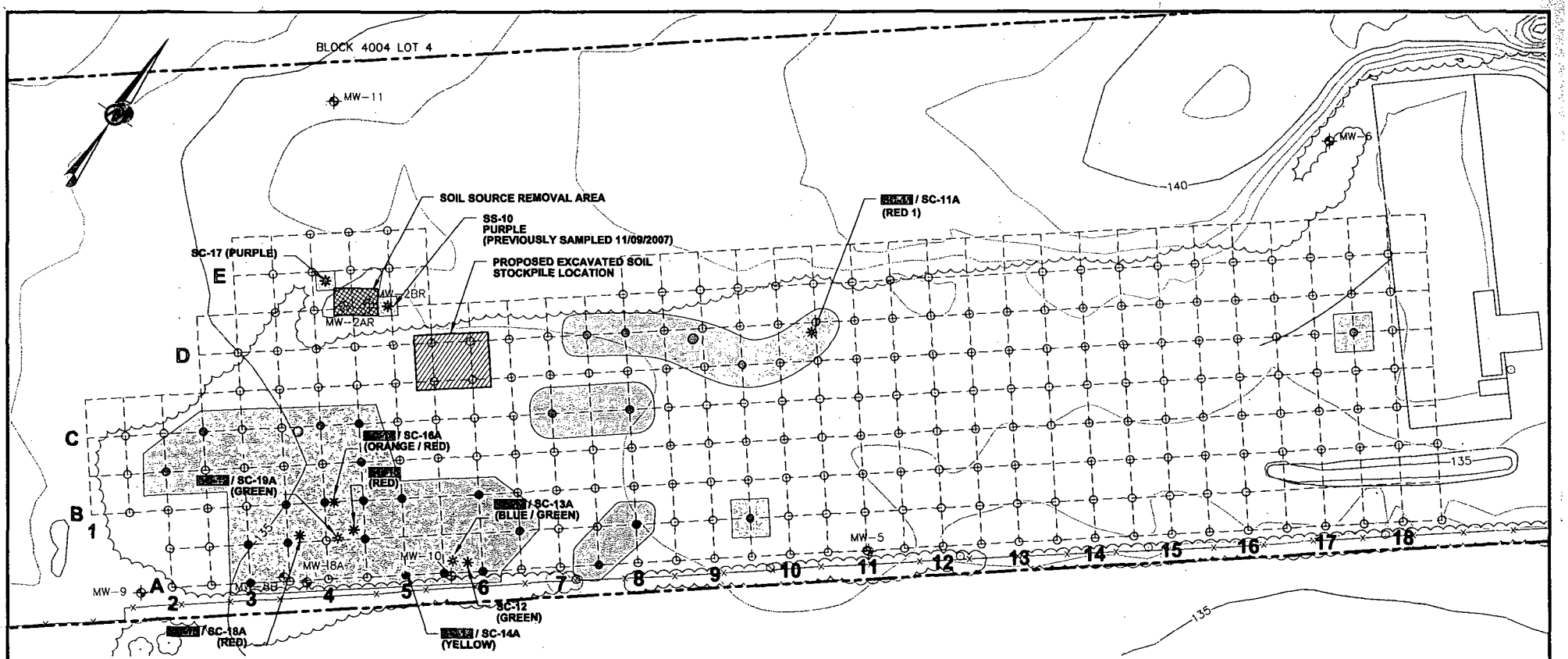

LEGEND

- MONITORING WELL
- UN-NATURALLY COLORED SOIL SAMPLE LOCATION (SEE NOTE 5)
- UN-NATURALLY COLORED SOIL DELINEATION LOCATION
- UN-NATURALLY COLORED SOIL FOUND AT DELINEATION LOCATION
- UN-NATURALLY COLORED SOIL FOUND BETWEEN DELINEATION LOCATIONS
- PROPOSED EXTENT OF UN-NATURALLY COLORED SOIL REMOVAL (SEE NOTE 6)

NOTES

1.) SOIL SAMPLES SC-11 THROUGH SC-19 COLLECTED JANUARY 17, 2008 AND SOIL SAMPLES SC-11A, SC-13A, SC-14A, SC-16A, SC-18A, AND SC-19A COLLECTED MARCH 26, 2008.

2.) UN-NATURALLY COLORED SOIL DELINEATION PERFORMED MARCH 26, 2008 THROUGH MARCH 28, 2008.

3.) COLORED SOIL SAMPLE LOCATIONS SC-11, SC-13, SC-14, SC-16, SC-18, SC-19, AND SELECT DELINEATION LOCATIONS WITH UN-NATURALLY COLORED SOIL WERE SURVEYED APRIL 10, 2008 BY JAMES M. STEWART, INC. SURVEY DATA PROVIDED IN APPENDIX C OF ADDENDUM TO THE REMEDIAL INVESTIGATION REPORT, DATED JUNE 6, 2008.

4.) NON-SURVEYED LOCATIONS ARE APPROXIMATE.

5.) SOIL SAMPLE LOCATIONS WHERE ANALYTES WERE DETECTED ABOVE NEW JERSEY NON-RESIDENTAL DIRECT CONTACT SOIL CLEANUP CRITERIA AND/OR IMPACT TO GROUNDWATER SOIL CLEANUP CRITERIA (NJSCC) ARE SHADED GRAY.

6.) THE HORIZONTAL EXTENT OF UN-NATURALLY COLORED SOIL SHOWN ON THE FIGURE IS THE INTERPRETED EXTENT OF SOIL WITH DETECTIONS ABOVE NJSCC.

REFERENCE

1.) BASE MAP TAKEN FROM FILE 2702-01.DWG, TITLED "PLAN OF SURVEY", PROVIDED BY JAMES M. STEWART, INC.

50 0 50
SCALE FEET

Golder Associates
Philadelphia USA
NJ Authorization #24GA28029100

SCALE	AS SHOWN
DATE	08/07/08
DESIGN	JPR
CADD	RG
CHECK	JPR
REVIEW	DBW
FILE No.	0136054T006
PROJECT No.	013-6054 REV. 0

TITLE

UN-NATURALLY COLORED SOIL REMOVAL

LIGHTMAN DRUM SITE

FIGURE 1

Drawing file: 0136054T006.dwg Oct 02, 2008 - 8:50am

Figure 2
Estimated Schedule
Soil Source Removal
Un-Naturally Colored Soil Removal
Lightman Drum Superfund Site - Winslow, New Jersey

Activity	Duration (2)	Start Date	End Date
Addendum No. 1 Work Plan Preparation & Approval	**26 days**	**07/11/08**	**10/02/08**
Add. No. 1 Work Plan Preparation	21 days	07/11/08	08/08/08
Work Plan Submittal to USEPA	0 days	08/08/08	08/08/08
Revised Add. No. 1 Work Plan Preparation	34 days	08/11/08	09/24/08
Revised Work Plan Submittal to USEPA	1 day	09/25/08	09/25/08
USEPA Revised Work Plan Review & Approval	5 days	09/26/08	10/02/08
Subcontractor Procurement / Planning	**14 days**	**10/03/08**	**10/17/08**
Field Implementation	**36 days**	**10/20/08**	**12/15/08**
Mobilization (1)	1 day	10/20/08	10/20/08
Install Silt Fence, Staging Area	2 days	10/21/08	10/22/08
Excavate / Stockpile Soil	5 days	10/23/08	10/29/08
XRF Screening	3 days	10/30/08	11/03/08
Waste Characterization / Facility Approval	20 days	11/04/08	12/03/08
Loadout Disposal Items	2 days	12/04/08	12/05/08
Backfill	3 days	12/08/08	12/10/08
Restoration	2 days	12/11/08	12/12/08
Demobilization	1 day	12/15/08	12/15/08
Reporting	**41 days**	**12/16/08**	**02/13/09**
Golder Prepare Final Construction Report	20 days	12/16/08	01/15/09
Construction Report to USEPA	1 day	01/16/09	01/16/09
USEPA Approval of Construction Report	20 days	01/19/09	02/13/09

Notes:

1.) Schedule dependent upon USEPA approval of Addendum No. 1 to the Soil Source Removal Work Plan for Un-Naturally Colored Soil Removal, site accessiblity to affected areas, contractor procurement, and disposal facility profile approvals.

2.) Day = Work days during the work week Monday through Friday. No work to be performed on 11/27/08, 11/28/08, 12/25/08, 12/26/08, 01/01/09 due to holidays and not included in schedule.

APPENDIX A

ADDENDUM NUMBER FOUR
TO THE SAP FOR THE RI/FS WORK PLAN
SAMPLING AND ANALYSIS PLAN FOR UN-NATURALLY COLORED SOIL REMOVAL

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A.1.0 PROJECT MANAGEMENT

A.1.1 Project Background

This Addendum Number Four (No. 4) to the Sampling and Analysis Plan has been prepared by Golder Associates Inc. (Golder Associates) on behalf of the Lightman Drum Source Removal Group (Group) for removal of un-naturally colored soil at the Lightman Drum Superfund Site (Site). This amendment has been prepared to amend the existing Sampling and Analysis Plan (SAP) included as part of the approved Remedial Investigation/Feasibility Study RI/FS Work Plan (Golder, 2002) and amend the SAP for Soil Source Removal (Appendix A of Soil Source Removal Work Plan). This SAP addendum supports Addendum No. 1 to Work Plan for Soil Source Removal and describes field, sampling, analytical and quality assurance/quality control (QA/QC) procedures for the removal of un-naturally colored soil at the Site.

A.1.2 Project Organization

Contact information for the project team members are provided in Table A-1. Notably the listed project team members have primary responsibility for the project, although other individuals within their respective organizations will be involved.

The lead regulatory Agency for the Site is USEPA Region II. Mr. David Rosoff is USEPA's On-Scene Coordinator (OSC) for the source removal. Ms. Renee Gelbat is USEPA's Remedial Project Manager (RPM). The New Jersey Department of Environmental Protection (NJDEP) will also provide regulatory oversight on this project.

Golder Associates Inc. will serve as the Remedial Designer/Quality Assurance Officer. The Remedial Contractor will be Compass Environmental, Inc. (Compass), of Windsor, New Jersey. CompuChem, of Cary, North Carolina, will provide analytical services for sampled media. If at any time during this project, the identity or role of any of these key organizations or personnel changes, the USEPA would be notified.

A.1.3 Project Description

As illustrated in Figure 1 of Addendum No. 1 to the Soil Source Removal Work Plan for Removal of Un-naturally Colored Soil, the proposed area of excavation is approximately 20,350 square feet in plan dimensions and encompass purple stained soil in the soil source removal area (Former Waste Storage Tanks) and areas where un-naturally colored soil was observed and contained samples that exceeded the most stringent New Jersey Soil Cleanup Criteria (NJDEP SCC) in the Lightman Yard.

Further details of the activities are further described in Addendum No. 1 to the Soil Source Removal Work Plan for removal of un-naturally colored soil.

A.1.4 Quality Assurance Objectives for Measurement

The USEPA Data Quality Objectives (DQO) Guidance document specifies that the sampling program be designed in order to meet the requirements of the investigation and achieve the DQOs. Part of this process is to determine what data is being collected and how it will be used in assessing Site conditions. For the purposes of this project, two types of data will be produced. Definitive data will be collected from samples that are submitted to an approved laboratory for analysis. Screening data will be produced using field measurement instruments.

As part of the evaluation component of the QA program, results are compared with certain data quality indicators. These data quality indicators are part of the overall DQOs for the project. DQOs for field and laboratory analysis are provided in Table A-2. Tables A-3 through A-6 provide details regarding the planned chemical analyses and the quality criteria used to assess the data. QA program objectives for the analytical laboratory are in the laboratory's QAP. In general, data quality indicators include precision, accuracy, representativeness, completeness, and comparability (PARCC).

Samples collected during the project will be analyzed for the parameters outlined in Tables A-2, A-3, A-5, and A-7. The DQOs, as summarized by the PARCC criteria in Tables A-3 through A-6, may not always be achievable. The USEPA Region II data validation guidelines provide direction for the determination of data usability. Qualified data can often provide useful information, although the degree of certainty associated with the results may not be as planned. Professional judgment will be used to determine data usability with respect to project goals.

A.2.0 MEASUREMENT/DATA ACQUISITION

A.2.1 Source Removal Activities

This section presents a description of the activities as described in Section 3.0 through 7.0 of the Addendum No. 1 to the Soil Source Removal Work Plan for the Removal of Un-Naturally Colored Soils. Specific sections of Addendum No. 1 to Source Removal WP are referenced below to avoid potential conflicts with the Work Plan text:

- Excavation of contaminated soils is described in Section 3.2 of Addendum No. 1 to the Soil Source Removal WP for Un-Naturally Colored Soil Removal;
- Staging of excavated soils is described in Section 3.3 of Addendum No. 1 to the Soil Source Removal WP for Un-Naturally Colored Soil Removal;
- Soil Screening and Confirmatory Soil Sampling are described in Section 3.4 of Addendum No. 1 to the Soil Source Removal WP for Un-Naturally Colored Soil Removal;
- Waste Characterization and Disposal are described in Section 3.5 of Addendum No. 1 to the Soil Source Removal WP for Un-Naturally Colored Soil Removal;
- Backfilling and restoration are described in Sections 3.6 and 3.7 of Addendum No. 1 to the Soil Source Removal WP for Un-Naturally Colored Soil Removal;
- Erosion and sediment control are described in Section 3.8 of the Addendum No. 1 to the Soil Source Removal WP for Un-Naturally Colored Soil Removal;
- Health and Safety plans, including plans for air monitoring and control are described in Sections 3.9 and 5.0 of Addendum No. 1 to the Soil Source Removal WP for Un-Naturally Colored Soil Removal;
- Construction Quality Assurance is described in Section 4.0 of the Addendum No. 1 to the Soil Source Removal WP for Un-Naturally Colored Soil Removal;
- Permitting and scheduling are described in Sections 6.0 and 7.0 of the Addendum No. 1 to the Soil Source Removal WP for Un-Naturally Colored Soil Removal.

A.2.2 Soil Screening

A.2.2.1 Field Measurement Procedures

X-Ray Fluorescence

X-Ray Fluorescence (XRF) is a common qualitative and quantitative analytical technique used to determine the chemical composition of a sample. X-rays are emitted from an X-ray tube or a

sealed radioisotope source and used to irradiate the sample. Each element present in the sample will emit their characteristic X-ray line spectra, which is converted by the instrument into a quantitative result.

Soil samples from the base of the excavation areas of the Site will be collected in accordance with Appendix A of the RI/FS SAP (July 2002) and will be screened for lead using XRF. The XRF would solely be used as a screening tool to confirm that remaining soil is not impacted with elevated levels of lead and as a guide for the locations of soil samples collected for laboratory analysis. Screening will be conducted on prepared samples in accordance with SW-846 Method 6200 and S2C2, Inc Standard Operating Procedure for use of Innov-X Alpha 4000 Analyzer (Attachment A-1). Field personnel will use the manufacturer's instructions and their prior experience and training to operate the instrument.

A.2.2.2 Field Calibration

The portable XRF analyzer will be calibrated in accordance with the manufacturer's specifications. The XRF will be calibrated once at the beginning of each work day. The following information is documented in the field notebook:

- Date and time;
- Meter identification (make, model, serial number);
- Calibration results including source and lot number of standards; and,
- Sampler's initials.

A.2.3 Confirmatory Soil Sampling

Sampling procedures for the confirmatory soil samples are included in Section 3.4 of Addendum No. 1 to the Soil Source Area Removal Work Plan and in Section A.2.7 of the RI/FS SAP (July 2002).

A.2.4 Impacted Soil/Waste Soil Pile Sampling Procedure

Sampling procedures for the contaminated soil staging pile are included Section 3.5 of the Soil Source Removal Work Plan and Section A.2.7.2.2 (Soil Sampling for Parameters Other than VOCs) of Appendix A of the RI/FS Work Plan (Golder, July 2002).

A.3.0 ASSESSMENT/OVERSIGHT

As described in the guidance documents, assessment includes surveillance, peer review, management systems review, readiness review, technical systems audit, performance evaluation, data quality audit, and data quality assessment. For performance monitoring, the following assessment activities are planned:

- Surveillance;
- Peer review;
- Technical systems audit; and,
- Data quality assessment

Details on assessment and oversight are provided in Section A.3.0 of Appendix A (SAP) of the RI/FS Work Plan (Golder, July 2002).

A.4.0 DATA VALIDATION AND USABILITY

Accurate data reduction, validation and reporting methods will support decision analysis. The laboratory chosen for this project will have further data reduction, validation and reporting procedures which will be described in the laboratory QAP or SOPs. Data reduction techniques for both field and laboratory activities are described in this Section A.4.0 of Appendix A (SAP) of the RI/FS Work Plan (Golder, July 2002).

TABLE A-1
PROJECT PERSONNEL
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

USEPA Remedial Project Manager:	Renee Gelblat USEPA Region II New Jersey Remediation Branch 290 Broadway 19th Floor NY, NY 10007-1866 Telephone: (212) 637-4414 Facsimile: (212) 637-4429
USEPA On-Scene Coordinator ("OSC")	David Rosoff (Alternate: Shawna Rigby) Removal Action Branch, Region 2 2890 Woodbridge Avenue Edison, New Jersey 08837-3679 (732) 906-6879
NJDEP Project Manager:	James DeNoble NJ Department of Environmental Protection Site Remediation Program 401 East State Street, 5th Floor P.O. Box 028 Trenton, NJ 08625 Telephone: (609) 777-4101 Facsimile: (609) 633-1439
Project Coordinator:	P. Stephen Finn, C.Eng. (Alternate : Robert J. Illes) Golder Associates Inc 200 Century Parkway, Suite C Mount Laurel, NJ 08054 Telephone: (856) 793-2005 Facsimile: (856) 793-2006
Un-Naturally Colored Soil Removal Manager:	David B. Walsh, P.E. Golder Associates Inc 200 Century Parkway, Suite C Mount Laurel, NJ 08054 Telephone: (856) 793-2005 Facsimile: (856) 793-2006
RI Consultant Project Manager:	Robert J. Illes, P.G. Golder Associates Inc 200 Century Parkway, Suite C Mount Laurel, NJ 08054 Telephone: (856) 793-2005 Facsimile: (856) 793-2006
Un-Naturally Colored Soil Removal Task Manager and Site QAO:	Jonathan P. Rizzo Golder Associates Inc 200 Century Parkway, Suite C Mount Laurel, NJ 08054 Telephone: (856) 793-2005 Facsimile: (856) 793-2006

TABLE A-1
PROJECT PERSONNEL
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

Quality Assurance Manager:	Peter Guy Golder Associates Inc 200 Century Parkway, Suite C Mount Laurel, NJ 08054 Telephone: (856) 793-2005 Facsimile: (856) 793-2006
Laboratory Coordinator and Data Validator:	Cindi Lucas Golder Associates Inc 200 Century Parkway, Suite C Mount Laurel, NJ 08054 Telephone: (856) 793-2005 Facsimile: (856) 793-2006
CompuChem Project Manager: Alternate Laboratory Project Manager:	Mitch Zimmerman Cathy Dover CompuChem 501 Madison Ave Cary, NC 27513 Telephone: (919) 379-4013 Facsimile: (919) 379-4040
CompuChem Quality Assurance Director:	Robert Meierer CompuChem 501 Madison Ave Cary, NC 27513 Telephone: (919) 379-4004 Facsimile: (919) 379-4050
Remedial Contractor:	Kevin Corradino Compass Environmental, Inc. 92 North Main Street Unit 20B PO Box 10 Windsor, New Jersey 08561 Phone: 609.371.7500 Fax: 609.371.7508
Disposal Facility:	CWM Chemical Services, LLC 1550 Balmer Road Model City, NY 14107 Disposal-RCRA Hazardous Soils Gloucester County Improvement Authority (GCIA) Solid Waste Complex 503 Monroeville Road Swedesboro, NJ 08085 Tel: 856-478-6045 NJDEP Facility ID#132199

TABLE A-2
DATA QUALITY OBJECTIVES
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL

Source Removal Activity	Matrix	Number of Samples	Parameters of Interest	Frequency of Monitoring	Purpose/Objective of Activity	Estimate Volume (cubic yards)
XRF Soil Screening	Soil	53	Lead	1 per 400 sq ft Minimum 1 per discrete area	Soil screening using XRF following excavation to assure that remaining soil has lead concentration less than NJ NRSCC.	NA
Confirmatory Soil Samples of XRF Screening Samples	Soil	11	Lead	10-percent of prepared XRF Screening Samples Minimum 1 per discrete area	Confirm XRF Screening Results	NA
Confirmatory Soil Samples	Soil	11	TCL - SVOCS TCL Pesticides TAL Metals (excluding lead) Hexavalent Chromium	10-percent of XRF Screening Samples Minimum 1 per discrete area	Following excavation to confirm remaining soil has no concentrations of TCL SVOCs, TCL Pesticides, TAL Metals, and Hexavalent Chromium above NJ NRSCC.	NA
Impacted Soil Stockpile Characterization	Soil	2	RCRA Characteristics TCLP TCL PCBs Oil& Grease Paint Filter Test	Once	Characterization of impacted soil for acceptance and disposal at waste disposal facility.	250 to 375
Backfill Borrow Source Characterizaation	Soil	1 per source	TCL - VOCs, SVOCs, PCBs, and Pesticides TAL - Metals Gamma radiation screening	Once	Ensure that all fill material used to backfill the excavated area is free from chemical and radiological contamination and is consistent with background soil levels for the Pinelands area.	250 to 375

Notes:

1. The Target Compound List (TCL) VOC, SVOC, Pesticide and PCB lists are defined in CLP Statements of Work OLM04.3. The Target Analyte List (TAL) parameters are listed in CLP Statement of Work ILM05.4 Hexavalent Chromium USEPA SW846 Method 7196A.
2. RCRA Characteristics include ignitability, corrosivity, reactivity, and toxicity. TCLP extract will be analyzed for VOCs (if required by disposal facility), SVOCs, Pesticides, Herbicides, and Metals. Samples to also be analyzed for TCL PCBs and Oil & Grease SW-846 Method 9071B.
3. The methodologies that will be used for analysis are listed in SAP Tables A-3 and A-5.
4. Confirmatory Quality control samples will be collected per matrix at the following frequency : 1 field duplicate per twenty primary samples; 1 MS/MSD pair per twenty primary + field duplicate samples; 1 rinsal blank per day per type of decontamination event where non-dedicated equipment is used.
5. XRF in-situ field screening SW-846 Method 6200 and S2C2 Standard Operating Procedure for Innov-X Alpha 4000 Analyzer. Quality control samples shall be collected and analyzed in accordance with Metho 6200 and the S2C2 SOP for XRF screening.
6. NJDEP Residential and Non-Residential Direct Contact Soil Cleanup Criteria (SCC)
7. Gamma radiation screening will be performed using a Ludlum Model 19 MicroR meter at the source or upon arrival at the Site.
8. Disposal facilities for soil may require additional analyses.
9. Confirmatory soils samples of the XRD Screening Samples will be analyzed for lead in accordance with CLP SOW ILM05.4.

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TABLE A-3
PARCC DATA FOR AQUEOUS SAMPLES
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

MEASUREMENT PARAMETER	METHOD REFERENCE	LABORATORY PRECISION	FIELD & LABORATORY PRECISION	ACCURACY	COMPLETENESS (a)
TCL Volatile Organics	CLP SOW OLM04.3	see Table A-4	±50%	see Table A-4	85%
TCL Semi-Volatile Organics	CLP SOW OLM04.3	see Table A-4	±50%	see Table A-4	85%
TCL Pesticides/PCBs	CLP SOW OLM04.3	see Table A-4	±50%	see Table A-4	85%
TAL Metals	CLP SOW ILM05.4	see Table A-4	±50%	see Table A-4	85%
TAL Cyanide	CLP SOW ILM05.4	see Table A-4	±50%	see Table A-4	85%
Hexavalent Chromium	SM3500 CrD	see Table A-4	±50%	see Table A-4	85%

NOTES:

(a) While the goal for completeness of laboratory measurements is 90%, the goal for total completeness (sampling and analytical) is 85%.

1. PARCC = Precision, Accuracy, Representativeness, Comparability, and Completeness
2. TCL = CLP Target Compound List, see CLP Statement of Work OLM04.3; TAL = CLP Target Analyte List, see CLP Statement of Work ILM05.4. See Table A-7
3. SM3500 CrD = Standard Methods for the Examination of Water and Wastewater, Hexavalent Chromium, Colorimetric Method.
4. Precision expressed as either percent relative standard deviation (%RSD) or relative percent difference (%RPD).
5. Accuracy expressed as percent recovery of a surrogate, matrix spike or laboratory control sample.
6. Precision and accuracy for TCL/TAL parameters provided in Table A-4.
7. Representativeness and Comparability are non-quantitative parameters.
8. Accuracy and precision criteria for laboratory measurements will be consistent with the criteria cited in the individual methodologies for the natural attenuation parameters.

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TABLE A-4
LABORATORY PRECISION AND ACCURACY CRITERIA FOR AQUEOUS TCL/TAL SAMPLES
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

VOLATILE ORGANICS:	QC LIMITS	
Target Spike Compound	**% Recovery**	**% RPD**
1,1-Dichloroethene	61%-145%	0%-14%
Trichloroethene	71%-120%	0%-14%
Benzene	76%-127%	0%-11%
Toluene	76%-125%	0%-13%
Chlorobenzene	75%-130%	0%-13%
Surrogate Compound		
Toluene-d8	88%-110%	Not Applicable
Bromofluorobenzene	86%-115%	Not Applicable
1,2-Dichloroethane-d4	76%-114%	Not Applicable

SEMI-VOLATILE ORGANICS:	QC LIMITS	
Target Spike Compound	**% Recovery**	**% RPD**
Phenol	12%-110%	0%-42%
2-Chlorophenol	27%-123%	0%-40%
N-Nitroso-di-n-propylamine	41%-116%	0%-38%
4-Chloro-3-methylphenol	23%-97%	0%-42%
Acenaphthene	46%-118%	0%-31%
4-Nitrophenol	10%-80%	0%-50%
2,4-Dinitrotoluene	24%-96%	0%-38%
Pentachlorophenol	9%-103%	0%-50%
Pyrene	26%-127%	0%-31%
1,4-Dioxane	10%-90%	0%-50%
Surrogate Compound		
Nitrobenzene-d5	35%-114%	Not Applicable
2-Fluorobiphenyl	43%-116%	Not Applicable
Terphenyl-d14	33%-141%	Not Applicable
Phenol-d5	10%-110%	Not Applicable
2-Fluorophenol	21%-110%	Not Applicable
2,4,6-Tribromophenol	10%-123%	Not Applicable
2-Chlorophenol-d4 (advisory)	33%-110%	Not Applicable
1,2-Dichlorobenzene-d4 (advisory)	16%-110%	Not Applicable

PESTICIDES:	QC LIMITS	
Target Spike Compound	**% Recovery**	**% RPD**
gamma-BHC	56%-123%	0%-15%
Heptachlor	40%-131%	0%-20%
Aldrin	40%-120%	0%-22%
Dieldrin	52%-126%	0%-18%
Endrin	56%-121%	0%-21%
4,4'-DDT	38%-127%	0%-27%
Surrogate Compound		
Tetrachloro-m-xylene	30%-150%	Not Applicable
Decachlorobiphenyl	30%-150%	Not Applicable

TABLE A-4
LABORATORY PRECISION AND ACCURACY CRITERIA FOR AQUEOUS TCL/TAL SAMPLES
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

POLYCHLORINATED BIPHENYLS:	QC LIMITS	
Target Spike Compound	**% Recovery**	**% RPD**
Aroclor 1254	50%-100%	0%-20%
Surrogate Compound		
Tetrachloro-m-xylene	30%-150%	Not Applicable
Decachlorobiphenyl	30%-150%	Not Applicable
INORGANICS		
TARGET ANALYTE LIST:	**QC LIMITS**	
Target Spike Compound	**% Recovery**	**% RPD**
Metals	75%-125%	±20%
Cyanide	75%-125%	±20%
Hexavalent Chromium	75%-110%	±20%

1. VOC, SVOC, and Pesticide accuracy and precision criteria based upon CLP SOW OLM04.3.
2. PCB and Hexavalent Chromium accuracy and precision criteria based upon CompuChem established limits.
3. TAL accuracy and precison criteria based upon CLP SOW ILM05.4

TABLE A-5
PARCC DATA FOR SOIL SAMPLES
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

MEASUREMENT PARAMETER	METHOD REFERENCE	LABORATORY PRECISION	FIELD & LABORATORY PRECISION	ACCURACY	COMPLETENESS (a)
TCL Volatile Organics	CLP SOW OLM04.3	see Table A-6	±100%	see Table A-6	85%
TCL Semi-Volatile Organics	CLP SOW OLM04.3	see Table A-6	±100%	see Table A-6	85%
TCL Pesticides/PCBs	CLP SOW OLM04.3	see Table A-6	±100%	see Table A-6	85%
TAL Metals	CLP SOW ILM05.4	see Table A-6	±100%	see Table A-6	85%
TAL Cyanide	CLP SOW ILM05.4	see Table A-6	±100%	see Table A-6	85%
Hexavalent Chromium	USEPA SW846 7196A	see Table A-6	±100%	see Table A-6	85%
Oil & Grease	USEPA SW846 9071B	see Table A-6	Not Applicable	see Table A-6	85%
Paint Filter Liquids Test	USEPA SW846 9095B	Not Applicable	Not Applicable	Not Applicable	85%

NOTES:

(a) While the goal for completeness of laboratory measurements is 90%, the goal for total completeness (sampling and analytical) is 85%.

1. PARCC = Precision, Accuracy, Representativeness, Comparability, and Completeness
2. TCL = CLP Target Compound List, see CLP Statement of Work OLM04.3; TAL = CLP Target Analyte List, see CLP Statement of Work ILM05.4. See Table A-7
3. USEPA SW846 = Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW846): 3rd Edition.
4. Precision expressed as either percent relative standard deviation (%RSD) or relative percent difference (%RPD).
5. Accuracy expressed as percent recovery of matrix spike or laboratory control sample.
6. Precision and accuracy for TCL/TAL parameters provided in Table A-6.
7. Representativeness and Comparability are non-quantitative parameters.
8. PARCC Data for the aqueous extract of soil samples for TCLP are provided in Tables A-3 and A-4
9. Lead XRF Screening accuracy and precison criteria based upon SW-846 Method 6200 and S2C2 SOP.

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TABLE A-6
LABORATORY PRECISION AND ACCURACY CRITERIA FOR SOIL TCL/TAL SAMPLES
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

VOLATILE ORGANICS:	QC LIMITS	
Target Spike Compound	% Recovery	% RPD
1,1-Dichloroethene	52%-172%	0%-22%
Trichloroethene	62%-137%	0%-24%
Benzene	66%-142%	0%-21%
Toluene	59%-139%	0%-21%
Chlorobenzene	60%-133%	0%-21%
Surrogate Compound		
Toluene-d8	84%-138%	Not Applicable
Bromofluorobenzene	59%-113%	Not Applicable
1,2-Dichloroethane-d4	70%-121%	Not Applicable

SEMI-VOLATILE ORGANICS:	QC LIMITS	
Target Spike Compound	% Recovery	% RPD
Phenol	26%-90%	0%-35%
2-Chlorophenol	25%-102%	0%-50%
N-Nitroso-di-n-propylamine	41%-126%	0%-38%
4-Chloro-3-methylphenol	26%-103%	0%-33%
Acenaphthene	31%-137%	0%-19%
4-Nitrophenol	11%-114%	0%-50%
2,4-Dinitrotoluene	28%-89%	0%-47%
Pentachlorophenol	17%-109%	0%-47%
Pyrene	35%-142%	0%-36%
Surrogate Compound		
Nitrobenzene-d5	23%-120%	Not Applicable
2-Fluorobiphenyl	30%-115%	Not Applicable
Terphenyl-d14	18%-137%	Not Applicable
Phenol-d5	24%-113%	Not Applicable
2-Fluorophenol	25%-121%	Not Applicable
2,4,6-Tribromophenol	19%-122%	Not Applicable
2-Chlorophenol-d4 (advisory)	20%-110%	Not Applicable
1,2-Dichlorobenzene-d4 (advisory)	20%-110%	Not Applicable

PESTICIDES:	QC LIMITS	
Target Spike Compound	% Recovery	% RPD
gamma-BHC	46%-127%	0%-50%
Heptachlor	35%-130%	0%-31%
Aldrin	34%-132%	0%-43%
Dieldrin	31%-134%	0%-38%
Endrin	42%-139%	0%-45%
4,4'-DDT	23%-134%	0%-50%
Surrogate Compound		
Tetrachloro-m-xylene	30%-150%	Not Applicable
Decachlorobiphenyl	30%-150%	Not Applicable

TABLE A-6
LABORATORY PRECISION AND ACCURACY CRITERIA FOR SOIL TCL/TAL SAMPLES
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

POLYCHLORINATED BIPHENYLS:	QC LIMITS	
Target Spike Compound	% Recovery	% RPD
Aroclor 1254	50%-100%	0%-20%

Surrogate Compound		
Tetrachloro-m-xylene	30%-150%	Not Applicable
Decachlorobiphenyl	30%-150%	Not Applicable

INORGANICS:	QC LIMITS	
Target Spike Compound	% Recovery	% RPD
Metals	75%-125%	±20%
Cyanide	75%-125%	±20%
Hexavalent Chromium	75%-110%	+20%
Oil and Grease	75%-125%	±20%

NOTES:

1. VOC, SVOC, and Pesticide accuracy and precision criteria based upon CLP SOW OLM04.3.
2. PCB, Hexavalent Chromium, and Oil and Grease accuracy and precision criteria based upon CompuChem established limits.
3. TAL accuracy and precison criteria based upon CLP SOW ILM05.4
4. Lead XRF Screening accuracy and precison criteria based upon SW-846 Method 6200 and S2C2 SOP.

TABLE A-7
TARGET COMPOUNDS/ANALYTES OF INTEREST
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

TARGET PARAMETERS	AQUEOUS REPORTING LIMITS [ug/l]	SOLID REPORTING LIMITS [ug/kg]
Volatile Organic Compounds		
Dichlorodifluoromethane	10	10
Chloromethane	10	10
Bromomethane	10	10
Vinyl chloride	10	10
Chloroethane	10	10
Trichlorofluoromethane	10	10
1,1,2-Trichloro-1,2,2-trifluoroethane	10	10
Methyl acetate	10	10
Methylene chloride	10	10
Acetone	10	10
Carbon disulfide	10	10
tert-Butyl methyl ether	10	10
1,1-Dichloroethene	10	10
1,1-Dichloroethane	10	10
cis-1,2-Dichloroethene	10	10
trans-1,2-Dichloroethene	10	10
Chloroform	10	10
1,2-Dichloroethane	10	10
2-Butanone	10	10
Bromochloromethane	NA	10
1,1,1-Trichloroethane	10	10
Cyclohexane	10	10
Carbon Tetrachloride	10	10
Bromodichloromethane	10	10
1,2-Dichloropropane	10	10
cis-1,3-Dichloropropene	10	10
Trichloroethene	10	10
Methylcyclohexane	10	10
Dibromochloromethane	10	10
1,1,2-Trichloroethane	10	10
Benzene	10	10
trans-1,3-Dichloropropene	10	10
Bromoform	10	10
4-Methyl-2-pentanone	10	10
2-Hexanone	10	10
Tetrachloroethene	10	10
Isopropylbenzene	10	10
1,1,2,2-Tetrachloroethane	10	10
1-2-Dibromoethane	10	10
Toluene	10	10
Chlorobenzene	10	10
Ethylbenzene	10	10
Styrene	10	10
Xylenes (total)	10	10
1,3-Dichlorobenzene	10	10
1,4-Dichlorobenzene	10	10
1,2-Dichlorobenzene	10	10

TABLE A-7
TARGET COMPOUNDS/ANALYTES OF INTEREST
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

TARGET PARAMETERS	AQUEOUS REPORTING LIMITS [ug/l]	SOLID REPORTING LIMITS [ug/kg]
1,2-Dibromo-3-chloropropane	10	10
1,2,4-Trichlorobenzene	10	10
Semi-Volatile Organic Compounds		
Benzaldehyde	10	330
Phenol	10	330
bis-(2-Chloroethyl)ether	10	330
2-Chlorophenol	10	330
2-Methylphenol	10	330
2,2'-oxybis(1-Chloropropane)	10	330
Acetophenone	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-propylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
bis-(2-Chloroethoxy) methane	10	330
2,4-Dichlorophenol	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
Caprolactam	10	330
4-Chloro-3-methylphenol	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	25	830
1,1'-Biphenyl	10	330
2-Chloronaphthalene	10	330
2-Nitroaniline	25	830
Dimethylphthalate	10	330
2,6-Dinitrotoluene	10	330
Acenaphthylene	10	330
3-Nitroaniline	25	830
Acenaphthene	10	330
2,4-Dinitrophenol	25	830
4-Nitrophenol	25	830
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
Fluorene	10	330
4-Chlorophenyl-phenyl ether	10	330
4-Nitroaniline	25	830
4,6-Dinitro-2-methylphenol	25	830
N-Nitroso-diphenylamine	10	330
4-Bromophenyl-phenyl ether	10	330
Hexachlorobenzene	10	330

TABLE A-7
TARGET COMPOUNDS/ANALYTES OF INTEREST
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

TARGET PARAMETERS	AQUEOUS REPORTING LIMITS [ug/l]	SOLID REPORTING LIMITS [ug/kg]
Atrazine	10	330
Pentachlorophenol	25	830
Phenanthrene	10	330
Anthracene	10	330
Carbazole	10	330
Di-n-butyl phthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzyl phthalate	10	330
3,3'-Dichlorobenzidine	10	330
Benzo(a)anthracene	10	330
Chrysene	10	330
bis -(2-Ethylhexyl) phthalate	10	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenzo(a,h)anthracene	10	330
Benzo(g,h,I)perylene	10	330
Pesticides/PCBs		
alpha-BHC	0.05	1.7
beta-BHC	0.05	1.7
delta-BHC	0.05	1.7
gamma-BHC	0.05	1.7
Heptachlor	0.05	1.7
Aldrin	0.05	1.7
Heptachlor epoxide	0.05	1.7
Endosulfan I	0.05	1.7
Dieldrin	0.1	3.3
4,4'-DDE	0.1	3.3
Endrin	0.1	3.3
Endosulfan II	0.1	3.3
4,4'-DDD	0.1	3.3
Endosulfan sulfate	0.1	3.3
4,4'-DDT	0.1	3.3
Methoxychlor	0.5	17
Endrin ketone	0.1	3.3
Endrin aldehyde	0.1	3.3
alpha-Chlordane	0.05	1.7
gamma-Chlordane	0.05	1.7
Toxaphene	5.0	17
Aroclor-1016	1.0	33
Aroclor-1221	2.0	67
Aroclor-1232	1.0	33
Aroclor-1242	1.0	33
Aroclor-1248	1.0	33
Aroclor-1254	1.0	33

TABLE A-7
TARGET COMPOUNDS/ANALYTES OF INTEREST
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

TARGET PARAMETERS	AQUEOUS REPORTING LIMITS [ug/l]	SOLID REPORTING LIMITS [ug/kg]
Aroclor-1260	1.0	33
Target Analyte List	[ug/l]	[mg/kg]
Aluminum	200	20
Antimony	60	6
Arsenic	10	1
Barium	200	20
Beryllium	5	0.5
Cadmium	5	0.5
Calcium	5000	500
Chromium	10	1
Cobalt	50	5
Copper	25	2.5
Iron	100	10
Lead	10	1
Lead (XRF) [1]	na	16
Magnesium	5000	500
Manganese	15	1.5
Mercury	0.2	0.1
Nickel	40	4
Potassium	5000	500
Selenium	35	3.5
Silver	10	1
Sodium	5000	500
Thallium	25	2.5
Vanadium	50	5
Zinc	60	6
Cyanide	10	2.5
Additional Inorganics	[ug/l]	[mg/kg]
Hexavalent Chromium	10.0	5
Oil and Grease	NA	10

NA = Not Applicable
ug/l = micrograms per liter or parts per billion (ppb)
ug/kg = micrograms per kilogram or ppb
mg/kg = milligrams per kilogram or parts per million (ppm)
VOC, SVOC, Pesticide and PCB Lists from CLP SOW OLM04.3
TAL Metals List from CLP SOW ILM05.4

1 = Analysis for lead using XRF. SW-846 Method 6200. Based on information supplied by S2C2 and MDLs based on the EPA Innovative Technology Verification Report dated February 2006. The Reporting Limits shown for the Target Analyte List are the maximum reporting limits that may be used for an undiluted sample. The laboratory will report results to the Instrument Detection Limit (IDL) which are generated every quarter. Reporting Limits will be modified on an individual sample basis depending upon dilution, percent solids, and sample matrix considerations.

TABLE A-8
ANALYTICAL METHODS, SAMPLE CONTAINERS, PRESERVATION AND ANALYTICAL HOLD TIMES FOR AQUEOUS SAMPLES
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

PARAMETER	METHODOLOGY	CONTAINER	MINIMUM SAMPLE	PRESERVATION [1]	HOLD TIME [2]
TCL Volatile Organics	CLP SOW OLM04.3	3-40 ml G	3 - 40 ml	Cool 4 °C;HCl,pH<2	14 days [3]
TCL Semi-Volatile Organics	CLP SOW OLM04.3	2-1000ml G	1000ml	Cool 4° C	7 days [4]
TCL Pesticides/PCBs	CLP SOW OLM04.3	2-1000ml G	1000ml	Cool 4° C	7 days [4]
TAL Metals	CLP SOW ILM05.4	1-500 ml P	250 ml	Cool 4° C; HNO_3, pH<2	180 days [5]
Hexavalent Chromium	SM3500 CrD	1-500 ml P	50 ml	Cool 4° C	24 hours
TAL Cyanide	CLP SOW ILM05.4	1-1000ml P	500ml	Cool 4° C; NaOH, pH>12	14 days

Notes:

1. Sample preservation is performed by sampler immediately upon sample collection.
2. Hold time based upon day of sample collection.
3. If sample cannot be preserved due to foaming, unpreserved sample will be analyzed within 7 days.
4. Hold time is 7 days until start of sample extraction, 40 days following extraction for analysis.
5. Hold Time for metals is 180 days, except for Mercury which is 28 days.
6. Vials that have specially designed, teflon lined septa to prevent loss of light hydrocarbons will be used.

P indicates that a Plastic bottle should be used.
G indicates that a Glass bottle should be used.

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TABLE A-9
ANALYTICAL METHODS, SAMPLE CONTAINERS, PRESERVATION AND ANALYTICAL HOLD TIMES FOR SOIL SAMPLES
LIGHTMAN DRUM SOURCE REMOVAL WORK PLAN
UN-NATURALLY COLORED SOIL REMOVAL
SAMPLING AND ANALYSIS PLAN

PARAMETER	METHODOLOGY	CONTAINER	MINIMUM SAMPLE	PRESERVATION [1]	HOLD TIME [2]
TCL Volatile Organics	CLP SOW OLM04.3	4 EnCore samplers	20 gm	Cool 4 °C	14 days [3]
TCL Semi-Volatile Organics	CLP SOW OLM04.3	4 oz G	30 gm	Cool 4 °C	7 days [4]
TCL Pesticides/PCBs	CLP SOW OLM04.3	4 oz G	30 gm	Cool 4 °C	7 days [4]
TAL Metals	CLP SOW ILM05.4	4 oz G	30 gm	Cool 4 °C	180 days [5]
Lead	USEPA SW846 Method 6200	1 gallon plastic bag	50 gm	None	None
Hexavalent Chromium	USEPA SW846 7196A	4 oz G	30 gm	Cool 4 °C	28 days
TAL Cyanide	CLP SOW ILM05.4	4 oz G	30 gm	Cool 4 °C	14 days
Ignitability	EPA Method 1030	16 oz G	50 gm	None	14 days
Corrosivity	EPA Method 9040	16 oz G	50 gm	None	14 days
Reactivity (sulfide)	SW 7.3.3 or SW 7.3.4	16 oz G	50 gm	None	14 days
Toxicity (TCLP) Volatile Fraction	SW 1311/ SW846 8260B	16 oz G	500 gm	Cool 4 °C	14 days/7 days/40 days[7]
Toxicity (TCLP) Extractable Fraction	SW 1311/ SW846 8270C	16 oz G	500 gm	Cool 4 °C	14 days / NA /14 days[7]
TCLP Inorganic Fraction	SW 1311/ SW846 6010B	16 oz G	500 gm	Cool 4 °C	180 days / NA /180 days[7]
Oil & Grease	SW846 9071B	4 oz G	100 gm	Cool 4 °C	28 days
Paint Filter Liquid Test	SW846 9095B	4 oz G	100 gm	None	None

Notes:

1. Sample Preservation is performed by sampler immediately upon sample collection except for VOCs which is performed by laboratory upon receipt (see Note 3).
2. Hold time based upon day of sample collection.
3. Hold time is 48 hours for preservation using methanol and/or sodium bisulfate and 14 days to analysis.
4. Hold Time for SVOCs, Pesticides/PCBs is 7 days for extraction and 40 days for analysis.
5. Hold Time for metals is 180 days, except for Mercury which is 28 days.
   G indicates that a Glass bottle should be used.
6. CWM - Clear wide-mouth glass jar(s) with Teflon-lined lid(s).
7. Holding times shown: from collection to toxicity characteristic leaching procedure (TCLP) extraction/from TCLP extraction to preparative procedure/from preparative procedure to analysis.

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ATTACHMENT A-1

S2C2, INC.
STANDARD OPERATING PROCEDURE
INNOVX ALPHA 4000 FIELD X-RAY FLUORESCENCE ANALYZER

S_2C_2 Inc.
Mobile Laboratory Programs

Standard Operating Procedure
InnovX Alpha 4000 Field X-RAY FLUORESCENCE ANALYZER

December 11, 2007

Prepared by: _____ Date: _____

Reviewed by: _____ Date: _____

S_2C_2 STANDARD OPERATING PROCEDURE
Innov-X Alpha 4000 SERIES HANDHELD X-RAY FLUORESCENCE ANALYZER

1.0 Scope and Application

This document addresses the application of energy dispersive X-ray fluorescence spectrometry (EDXRF) to the determination of contaminant metals in soil and sediments. The Innov-X Alpha 4000 Analyzer is a handheld EDXRF instrument equipped for rapid field analysis.

1.1 Principles of Operation

The EDXRF technique is capable of both qualitative and quantitative analysis of elements with atomic numbers 11 (sodium) through 92 (uranium). This operating procedure discusses the determination of the elements listed in Table 1.

Table 1. Elements and their atomic symbols analyzed by the EDXRF method.

Arsenic (As)	Potassium (K)
Antimony (Sb)	Rubidium (Rb)
Barium (Ba)	Selenium (Se)
Cadmium (Cd)	Silver (Ag)
Calcium (Ca)	Thallium (Tl)
Chromium (Cr)	Thorium (Th)
Cobalt (Co)	Tin (Sn)
Copper (Cu)	Titanium (Ti)
Iron (Fe)	Vanadium (V)
Lead (Pb)	Zinc (Zn)
Manganese (Mn)	Zirconium (Zr)
Mercury (Hg)	
Molybdenum (Mo)	
Nickel (Ni)	

1.2 Fundamentals of X-ray Spectrometric Measurements

The basis of X-ray fluorescence spectrometry is the interaction of X-rays produced by the X-ray tube with the constituents of the soil or sediment sample.

When atoms in a soil sample absorb the tube x-radiation, the energy causes the ejection of an electron from the atomic cloud. Next, electronic transitions occur to return the excited atom to a ground energy state. These transitions result in emission of a characteristic X-ray. The energy of the characteristic X-ray indicates the atomic number of the emitting atom and the specific electronic transition that occurred.

The Lithium drifted silicon (Si(Li))detector converts the characteristic X-ray energy into an electronic signal. The electronics in the Spectrace units further processes the signal and displays the X-ray spectrum on a personal computer.

1.2.1 Generation of Spectral Background

When the X-ray tube shines on the soil sample some of the X-rays are scattered toward the detector rather than absorbed by the soil. The X-ray spectrum then shows the scattered radiation as background under the elemental emission lines.

The magnitude of the background limits the achievable minimum detectable limit for the target contaminant elements.

The peak fitting and deconvolution software of the Spectrace EDXRF filters background signals prior to quantitative analysis. Each soil spectrum can be compared with another without regard to background variations.

1.2.2 Detection Limits

Detection limits depend on several factors, the analyte of interest, the type of detector used, the type of excitation source, the strength of the excitation source, count times used to irradiate the sample, physical matrix effects, chemical matrix effects, and interelement spectral interferences. General instrument detection limits for analytes of interest in environmental applications are shown in Table 2. These detection limits apply to a clean matrix of quartz sand (silicon dioxide) free of interelement spectral interferences using (200-second) count times. A discussion of field performance-based detection limits is presented in Section 9.6 of this Standard Operating Procedure (SOP). The clean matrix and field performance-based detection limits should be used for general planning purposes, and a third detection limit discussed, based on the standard deviation around single measurements, should be used in assessing data quality. This detection limit is discussed in Section 9.6.

Table 2. Interference Free Detection Limits

Analyte	Chemical Abstract Series Number	Detection Limit in Quartz Sand (mg/kg)
Antimony (Sb)	7440-36-0	50
Arsenic (As)	7440-38-0	10
Barium (Ba)	7440-39-3	50
Cadmium (Cd)	7440-43-9	50
Chromium (Cr)	7440-47-3	10
Cobalt (Co)	7440-48-4	10
Copper (Cu)	7440-50-8	10
Iron (Fe)	7439-89-6	10
Lead (Pb)	7439-92-1	10
Manganese (Mn)	7439-96-5	10
Mercury (Hg)	7439-97-6	10
Nickel (Ni)	7440-02-0	10
Rubidium (Rb)	7440-17-7	10
Selenium (Se)	7782-49-2	10
Silver (Ag)	7440-22-4	10
Strontium (Sr)	7440-24-6	10
Thallium (Tl)	7440-28-0	10
Tin (Sn)	7440-31-5	50
Titanium (Ti)	7440-32-6	10
Vanadium (V)	7440-62-2	10
Zinc (Zn)	7440-67-6	10
Zirconium (Zr)	7440-67-7	10

2.0 Overview of the Method

Spectra are acquired for each EDXRF measurement. Each spectrum optimizes one or more target elements or matrix constituents of the sample. Standardization of the EDXRF method relies on National Institutes of Standards and Technology (NIST) certified soil standard materials.

Elemental emission peak deconvolution is followed by quantitative analysis with a fundamental parameters method. The fundamental parameters method can accurately determine the composition of a sample even though the standards used do not cover the range of concentrations expected. Additionally, fundamental parameters can address matrix interactions from widely varying soil types.

Calibration by fundamental parameters proceeds by completely defining for the program each standard sample's composition including the major components (ex. Fe, Ca). Many instances arise when a portion of the matrix may be better estimated by a difference component. For soil, the difference component is defined as SiOx where X can be 2-5.

3.0 Sample Containers and Handling

After sample collection by EPA approved protocol, samples should be stored in either metal free glass jars or polyethylene bags. In the lab, only disposable wooden, plastic, or stainless steel spatulas, and clean glass or aluminum drying containers should contact the soil samples.

4.0 Interferences

The total method error for EDXRF analysis is defined as the square root of the sum of squares of both instrument precision and user-or application-related error. Generally, instrument precision is the least significant source of error in EDXRF analysis. User- or application-related error is generally more significant and varies with each site and method used. Some sources of interference can be minimized or controlled by the instrument operator, but others cannot. Common sources of user-or application-related error are discussed below.

4.1 Sample Preparation Error

The nature of soil samples require an approach to such variables as moisture, particle size, and heterogeneity and representativeness of the sample to the soil at the site. Sample preparation as outlined in this SOP minimizes or eliminates the effects of many of these variables on the EDXRF results.

4.2 Spectral Interference

When present in a sample, certain x-ray lines from different elements can be very close in energy and; therefore, can cause interference by producing a severely overlapped spectrum. The degree to which a detector can resolve the two different peaks depends on the resolution of the detector. If the energy difference between the two peaks in electron volts is less than the resolution of the detector in electron volts (i.e., approximately 180 eV for QuanX EDXRF), then the detector will not be able to fully resolve the peaks.

The most common spectrum overlaps involve the K_β line of element Z-1 and K_α of element Z. This is called the K_α/K_β interference. Because the K_α/K_β intensity ratio for a given element usually is about 7:1, the interfering element, Z-1 must be present at large concentrations to cause a problem. Two examples of this type of spectral interference involve the presence of large concentrations of vanadium (V) when attempting to measure Chromium (Cr) or the

presence of large concentration of iron (Fe) when attempting to measure cobalt (Co). Other interferences can arise from K/L, K/M, and L/M line overlaps, although these overlaps are less common. Examples of such overlaps involve arsenic (As) K_α/lead (Pb) L_α.

Emission line overlap can be severe depending on the spectral peak position and relative concentrations of the overlapping elements. The Spectrace Wintrace software utilizes a multiple linear least squares deconvolution method producing accurate analyte peak intensities for subsequent quantification. However, no instrument can fully compensate for all interferences. It is important for the operator to understand this limitation of EDXRF and to try to minimize the effect of spectral interferences when possible.

4.3 Chemical Matrix Interferences

Quantitative X-ray fluorescence analysis is a comparison analytical method; EDXRF spectrometer response for an elemental emission line is evaluated with respect to the known concentration of the element in a standard material. Contaminated soils are complex samples in regard to their overall elemental composition. Matrix effects are defined as the impact that the concentration variations of major soil components (ex. Ca, Fe, Si) has on measured analyte X-ray emission intensity. The fundamental parameters method mathematically corrects analyte intensities with respect to concentration variations of sample matrix components.

4.4 Moisture Content

Moisture content may affect the accuracy of analysis of soil and sediment sample analyses. When the moisture content is between 5 and 20 percent, the overall error from moisture may be minimal. However, moisture content may be a major source of error when analyzing samples of surface soil or sediments that are saturated with water. This error will be minimized by drying the samples in a convection oven. (Note: Mercury samples will not be dried due to volatilization of mercury)

4.5 Ambient Temperature

Ambient temperature changes can affect the gain of the amplifiers producing instrument drift. Gain or drift is primarily a function of the electronics (amplifier or preamplifier) and the detector. The QuanX instrument detector is cooled to a constant temperature. The QuanX has a built-in automatic gain control. If the automatic gain control is allowed to make periodic adjustments, the instrument will compensate for the influence of temperature changes on its energy scale. The performance of an energy calibration check to assess drift is a quality control measure discussed in Section 9.2.

5.0 Equipment and Apparatus

5.1 Description of Innov-X Alpha 4000 Analyzer

The Innov-X Alpha 4000 Analyzer is a handheld EDXRF spectrometer. They have found wide application in the analysis of soils, sediments, hazardous waste, and waste oil materials.

This instrument produces an excitation source from an X-ray tub utilizing a W anode creating a 10-40 kV, 10-50uA energy source. The detector is a Si PiN diode detector with <230 FWHM at 5.95 keV. The system is powered by rechargeable Li-ion batteries or standard electrical outlet power.

Pulse processing electronics in the analyzer communicate spectral data to a PDA display. The PDA displays and processes spectral information, and outputs elemental concentration data.

5.2 Equipment and apparatus list

5.2.1 Innov-X Alpha 4000 Analyzer

The complete system includes:

- Alpha 4000 analyzer with PDA and software
- Replacable Li-ion batteries
- Charging station for batteries
- Electrical power adaptors for XRF
- Optional Table-top stand
- Operators manual
- PDA with pre-loaded software
- NIST standards
- Stainless Steel calibration standard

5.2.2 Sample Preparation and Presentation Materials

Sample preparation and presentation materials include:

- Sample communication device – mechanical grinder (tungsten carbide or agate) or manual grinding device – mortar and pestle (tungsten carbide or agate)
- Drying oven – conventional (115 degrees Celsius)
- Drying containers (Aluminum drying pans)
- Disposable X-ray cups (32mm diameter closed end)
- Polypropylene window film (0.25 mil thickness)
- Disposable plastic bags

5.2.3 Limits and Precautions

Operator should take care not to activate X-ray tube near hands or other body parts. Samples should not be held during analysis. X-rays are only generated when the analyzer is engaged (i.e., the trigger is activated).

Beryllium windows are present on the X-ray tube and detector. Do not allow any sample or debris to fall on the window to avoid puncturing it. If a window should break, note that beryllium metal is poisonous. Use extreme caution when collecting broken beryllium pieces. Consult your Spectrace Instruments service engineer for advice on cleanup of broken windows.

6.0 Reagents and Standards

6.1 Pure Element Standards

Pure element peaks are acquired by the manufacturer. Information regarding pure elemental standards acquisition and fundamental parameters methods is proprietary to the manufacturer.

6.2 Standard Reference Materials

Standard reference materials (SRM) are standards containing certified amounts of metals in soil or sediment. These standards are used for accuracy and performance checks of EDXRF analyses. SRMs are obtained from the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), or other certified sources. The SRMs currently used for fundamental parameters by the QuanX EDXRF are the following:

- NIST 2704 Buffalo River Sediment
- NIST 2709 San Joaquin Soil
- NIST 2710 Montana Soil
- NIST 2711 Montana Soil

Other SRMs maybe used depending on site specific requirements.

6.3 Site Specific Calibration Standards

Site specific calibration standards (SSCS) can be used to calibrate the EDXRF when data quality objectives for the site require SSCS or when SRMs are not representative of site conditions. The samples used for calibration standards must be representative of the site and must accurately reflect the concentrations of the contaminants of concern at the site. Analytical results of representative samples reflect variations in the presence and concentration ranges of contaminants throughout a site. Variables affecting sample representativeness include differences in soil type, contaminant concentration variability, sample collection and preparation variability, and analytical variability, all of which should be minimized as much as possible when collecting and analyzing SSCS samples.

7.0 Procedures

7.1 Prerequisites

7.1.1 Site Location

The instrument is field rugged. Care should be taken to prevent falls. Operating temperature is between -10 – 50 deg C.

7.1.2 Energy Calibration

At least once every twenty-four hours, the gain setting of the instrument must be checked using the copper calibration disk supplied by the manufacturer. Execute the automated energy calibration function from the Acquisition Menu (See Chapter 4 in the QuanX Wintrace Software Manual. The computer automatically adjusts electronics gain to ensure proper calibration. This function normally takes between 8 and 10 minutes.

7.1.3 Acquisition of Reference Peak Shape Spectra

The acquisition of reference spectra is only required once. Reference spectra acquisition is performed by the manufacturer.

7.2 Standardization of the Method

Standardization of the Spectrace QuanX is completed by the manufacturer. Standardization should be checked using NIST SRMs. If calibration check standards are outside QC limits contact the manufacturer. u

7.3 Analysis of Unknown Soil Samples

7.3.1 Prepare samples as indicated in Section 8.

7.3.2 Follow directions provided in Operators Manual.

8.0 Sample Preparation

8.1 Powdered Sample Preparation
Powdered samples should be prepared by following the following methods. Powdered samples provide a highly homogenized sample, but require labor intensive preparation methodology.

8.1.1 First agitate the sample in its glass or bag container to mix the soil material.

8.1.2 Using a spatula, transfer approximately 10 grams of sample material onto the drying container. Use care not to transfer large rocks, organic, or other non-representative debris.

8.1.3 Place sample in the drying oven and drive off moisture (2-4 hours)

8.1.4 Transfer the material into the grinding vessel and grind for 2-3 minutes or until a 250 mesh material is achieved.

8.1.5 Transfer approximately 8 grams of dried material into a labeled disposable x-ray cup and seal with one sheet of polypropylene window film. The x-ray cup should be approximately 80 % full.

8.2 Field homogenized Sample Preparation
8.2.1 Collect field sample utilizing approved composite sampling techniques
8.2.2 Agitate the sample in its glass or bag container to mix the soil material
8.2.3 Analyze the sample directly through the bag.

8.3 Direct Analysis
8.3.1 Use a clean knife to cut surface of soil core
8.3.2 Place analyzer directly on surface and analyze sample

9.0 Quality Assurance Quality Control

9.1 Documentation

All QA/QC and field samples as well as adjustments to the Innov-X EDXRF will be entered into the EDXRF project log book by the operator. A copy of the log book format is given in Appendix C.

9.2 Energy Calibration Check

To determine whether the Innov-X EDXRF instrument is operating within resolution and stability tolerances, an energy calibration check should be run. The energy calibration check determines whether the characteristic x-ray lines are shifting, which would indicate drift within the instrument. This also serves as a gain check in the event that ambient temperatures are fluctuating greatly (>10 to 20 degree F)

Energy calibration check should be run at least once a day and when temperature variations are greater than 10 to 20 degrees F.

9.3 Blank Samples

Two types of blank samples should be analyzed for EDXRF analysis: instrument blanks and method blanks. An instrument blank is used to verify that no contamination exists in the spectrometer. A method blank is used to monitor for laboratory-induced contaminants or interferences.

9.3.1 Instrument Blanks

A "clean" sand instrument blank should be run at the beginning and end of each workday to verify that no element concentrations above the MDLs are found. In addition, an instrument blank should be run once per every twenty samples. If concentrations exceed MDLs, the system should be recalibrated and samples re-analyzed or flagged with a qualifier.

9.3.2 Method Blanks

A method blank should be run once daily to determine if laboratory-induced contaminants have been introduced to the samples. To be acceptable, a method blank must not contain any analyte at a concentration above MDL. If an analyte's concentration exceeds its MDL, the cause of the problem must be identified, and all samples analyzed with the method blank should be re-analyzed or qualified.

9.4 Calibration Verification Checks

A calibration verification check sample is used to check the accuracy of the instrument and to assess the stability and consistency of the analysis for the analytes of interest. A check sample should be analyzed at the beginning and end of each working day. The frequency of calibration checks during active analysis will depend on the data quality objectives of the project. The check should be done on at least one of the NIST SRMs (2704, 2710, 2711). The measured value for each target analyte should be within 20% (%D) of the true value for the calibration verification check to be acceptable. See Section 10.1 for example calculations. If a measured value falls outside this range, then the check sample should be re-analyzed. If the value continues to fall outside the acceptance range, the instrument should be re-calibrated, and the batch of samples analyzed before the unacceptable calibration verification check must be re-analyzed.

9.5 Precision Measurements

The precision of the method is monitored by analyzing a sample with low, moderate, or high concentrations of target analytes. The frequency of precision measurements will depend on the data quality objectives for the project. A minimum of one precision sample should be run per project. Each precision sample should be analyzed 7 times in replicate. Precision measurements should be obtained for samples with varying concentration ranges to assess the effect of concentration on method precision. The precision sample is analyzed by the instrument for the same field analysis time as used for other project samples. The relative standard deviation (RSD) of the sample mean is used to assess method precision. The RSD should not be greater than 20% with the exception of chromium. RSD value for chromium should not be greater than 30%. See Section 10.2 for calculations.

9.6 Detection Limits

Table 2 provides manufacture interference free method detection limits. Reporting limits are calculated and exported for each analyte analyzed and will vary for each sample.

9.7 Confirmatory Samples

The comparability of the EDXRF analysis is determined by submitting EDXRF-analyzed samples for analysis at a laboratory. The method and number of confirmatory analyses must meet the project data quality objectives and should be determined by the project team and oversight personnel. It is recommended that sample splits be used from the prepared soil as described in Section 8.

10.0 Calculations

10.1 Percent Difference

$$\%D = | C_s - C_k | / (C_k) \times 100$$

Where:

%D = Percent Difference
C_k = Certified concentration of standard sample
C_s = Measured concentration of standard sample

10.2 Relative Standard Deviation

$$RSD = (SD/Mean\ Concentration) \times 100$$

Where:

RSD = Relative standard deviation for the precision measurement for the analyte

SD = Standard deviation of the concentration for the analyte

Mean Concentration = Mean concentration of the analyte

11.0 Maintenance

The QuanX analyzer is inherently a low maintenance instrument. The maintenance procedures prescribed in this section and in the Operators manual are of a preventative nature. By periodically performing inspections, unscheduled down-time will be reduced. This section does not include procedures for application related operational maintenance tasks such as standardization of the instrument. Maintenance of the QuanX will be done in accordance to manufacture specifications.

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Appendix A: Prerequisites for Site Specific Calibration Standards

Site-specific calibration standards can be used when SRMs do not adequately represent conditions at an individual site or when data quality objectives require SSCS. A minimum of ten samples spanning the concentration ranges of analytes of interest and of the interfering elements must be obtained form the site. A sample size of 4 to 8 ounces is recommended. Samples should be collected following approved sampling methodologies.

Each sample should be oven-dried for 2 to 4 hours at a temperature of less than 150 degrees C. If mercury is to be analyzed, a separate sample portion must remain un-dried, as heating may volatilize the sample. When the sample is dry, all large, organic debris and other non-representative material should be removed. The sample should be ground with in a grinding vessel for 2-3 minutes or until a 250 mesh material is achieved.

Following sample preparation, the sample should be split. Approximately 5 grams of sample should be removed and placed in a sample cup for EDXRF analysis following procedures outlined in Section 7 of this SOP. The remaining prepared sample should be sent off site for ICP or AA analysis. The method use for confirmatory analysis should meet the data quality objectives of the project.

Following analysis of the split sample by ICP/AA, the EDXRF SSCS samples should be used to generate a FP method using the Wintrace Software (See Section 7 of this SOP). The SSCS method should be confirmed using QAQC objectives discussed in Section 9 of this SOP.

Appendix B: XRF Excitation Conditions

Handheld, High-performance X-ray Fluorescence Analyzers

Featuring X-ray Tube Technology – No Radioactive Isotopes.

Detection Limit Guidelines

Low-Density Sample Types (Soils, powders, liquids)

Detection Limit Guidelines:

- LOD 1% – 5%
- 250 – 2,500 ppm
- 10 – 100 ppm
- 50 – 150 ppm
- Not measured

Symbol → Ag ← Atomic number

Principal lines keV → $K_{\alpha 1}$ $K_{\beta 1}$

Principal lines keV → $L_{\alpha 1}$ $L_{\beta 1}$

Alloy Elements and Detection Limit Guidelines:

Elements Detected Titanium (Ti, Z=22) through Plutonium (Pu, Z=94)

typically 0.1% – some elements as low as 0.01%

H 1	IIA											IIIA	IVA	VA	VIA	VIIA		He 2
0.05 Li 3	0.11 Be 4											0.18 B 5	0.28 C 6	0.39 N 7	0.52 O 8	0.68 F 9		0.85 Ne 10
1.04 1.07 Na 11	1.25 1.3 Mg 12	IIIB	IVB	VB	VIB	VIIB	Group VIII			IB	IIB	1.49 1.56 Al 13	1.74 1.84 Si 14	2.01 2.14 P 15	2.31 2.46 S 16	2.62 2.82 Cl 17		2.96 3.19 Ar 18
3.31 3.59 K 19	3.69 4.01 Ca 20 0.34 0.34	4.09 4.46 Sc 21 0.4 0.4	4.51 4.93 Ti 22 0.45 0.46	4.95 5.43 V 23 0.51 0.52	5.41 5.95 Cr 24 0.57 0.58	5.9 6.49 Mn 25 0.64 0.65	6.4 7.06 Fe 26 0.71 0.72	6.93 7.65 Co 27 0.78 0.79	7.48 8.26 Ni 28 0.85 0.87	8.05 8.91 Cu 29 0.93 0.95	8.64 9.57 Zn 30 1.01 1.03	9.25 10.26 Ga 31 1.1 1.12	9.89 10.98 Ge 32 1.19 1.22	10.54 11.73 As 33 1.28 1.32	11.22 12.5 Se 34 1.38 1.42	11.92 13.29 Br 35 1.48 1.53		12.65 14.11 Kr 36 1.59 1.64
13.4 14.96 Rb 37 1.69 1.75	14.17 15.84 Sr 38 1.81 1.87	14.96 16.74 Y 39 1.92 2	15.78 17.67 Zr 40 2.04 2.12	16.62 18.62 Nb 41 2.17 2.26	17.48 19.61 Mo 42 2.29 2.39	18.37 20.62 Tc 43 2.42 2.54	19.28 21.66 Ru 44 2.56 2.68	20.22 22.72 Rh 45 2.7 2.83	21.18 23.82 Pd 46 2.84 2.99	22.16 24.94 Ag 47 2.98 3.15	23.17 26.1 Cd 48 3.13 3.32	24.21 27.28 In 49 3.29 3.49	25.27 28.49 Sn 50 3.44 3.66	26.36 29.73 Sb 51 3.6 3.81	27.47 31 Te 52 3.77 4.03	28.61 32.29 I 53 3.94 4.22		29.78 33.62 Xe 54 4.11 4.42
30.97 34.99 Cs 55 4.29 4.62	32.19 36.38 Ba 56 4.47 4.83		55.79 63.23 Hf 72 7.9 8.02	57.53 65.22 Ta 73 8.15 9.34	59.32 67.24 W 74 8.4 9.67	61.14 69.31 Re 75 8.65 10.01	63 71.41 Os 76 8.91 10.36	64.9 73.56 Ir 77 9.18 10.71	66.83 75.75 Pt 78 9.44 11.07	68.8 77.98 Au 79 9.71 11.44	70.82 80.25 Hg 80 9.99 11.82	72.87 82.59 Tl 81 10.27 12.21	74.97 84.94 Pb 82 10.55 12.61	77.11 87.34 Bi 83 10.84 13.02	79.29 89.8 Po 84 11.13 13.45	81.52 92.3 At 85 11.43 13.88		83.78 94.87 Rn 86 11.73 14.32
86.1 97.47 Fr 87 12.03 14.77	88.47 100.13 Ra 88 12.34 15.24																	

Lanthanides 57-71	33.44 37.8 La 57 4.65 5.04	34.72 39.26 Ce 58 4.84 5.26	36.03 40.75 Pr 59 5.03 5.49	37.36 42.27 Nd 60 5.23 5.72	38.72 43.83 Pm 61 5.43 5.98	40.12 45.41 Sm 62 5.64 6.21	41.54 47.04 Eu 63 5.85 6.46	43 48.7 Gd 64 6.06 6.71	44.48 50.38 Tb 65 6.27 6.98	46 52.12 Dy 66 6.5 7.25	47.55 53.88 Ho 67 6.72 7.53	49.13 55.68 Er 68 6.95 7.81	50.74 57.52 Tm 69 7.18 8.1	52.39 59.37 Yb 70 7.42 8.4	54.07 61.28 Lu 71 7.66 8.71			
Actinides 89-103	90.88 102.85 Ac 89 12.65 15.71	93.35 105.61 Th 90 12.97 16.2	95.87 108.43 Pa 91 13.29 16.7	98.44 111.3 U 92 13.61 17.22	101.08 114.18 Np 93 13.95 17.74	103.65 117.15 Pu 94 14.28 18.26	106.38 120.16 Am 95 14.62 18.83	109.18 123.24 Cm 96 14.96 19.39	111.90 126.38 Bk 97 15.31 19.97	114.78 129.54 Cf 98 15.66 20.56	117.68 132.78 Es 99 16.02 21.17	120.60 136.08 Fm 100 16.38 21.79	Md 101	No 102	Lr 103			

Interference-free detection limits are intended as guidelines; please contact **Innov-X Systems** to discuss your specific application.

Detection limits are estimates based on 1–2 minute test times and detection confidence of 3σ (99.7% confidence).

Detection limits are a function of testing time, sample matrix and presence of interfering elements.

Innov-X Systems, Worldwide Headquarters, Woburn, MA 01801 p: 866-4-INNOV-X, p: 781-938-5005, f: 781-938-0120 info@innov-xsys.com www.innov-xsys.com
Netherlands: p: +31(0) 73-6272 590, f: +31(0) 73-6272 599 **Hong Kong:** p: 852 2 515 0999, f: 852 2 505 6129

Appendix C: XRF Log Book

XRF Log Book

Sample ID	Lab Sample ID	Date	Time	Analyst	Comments

200060

APPENDIX B

SUMMARY OF UN-NATURALLY COLORED SOIL ANALYTICAL RESULTS (FROM ADDENDUM TO REMEDIAL INVESTIGATION REPORT UN-NATURALLY COLORED SOIL INVESTIGATION LIGHTMAN DRUM COMPANY SITE WINSLOW TOWNSHIP, NJ, JUNE 6, 2008)

TABLE 1
Lightman Drum Colored Soil Sampling
Summary of Detect Soil Results

Parameter	NJ NRDSCC	NJ IGWSCC	Unit	Sample ID:	SS-10			SC-11			SC-11A			SC-12			SC-13			SC-13A			SC-13A (Dup)			SC-14			SC-14A		
				Sample Depth:	0 - 3"			0 - 3"			3" - 6'			0 - 4"			0 - 4"			4" - 8"			4" - 8"			1 - 4"			4" - 8"		
				Color:	Purple			Red			NA			Green			Blue/Green			NA			NA			Yellow			NA		
				Sample Date:	11/06/2007			01/17/2008			03/26/2008			01/17/2008			01/17/2008			03/26/2008			03/26/2008			01/17/2008			03/26/2008		
					Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit
Volatile Organic Compounds																														
Acetone	1000	100	mg/kg		0.009	J	0.01				NST									NST			NST						NST		
Trichloroethene	54	1	mg/kg		0.017		0.01				NST									NST			NST						NST		
Tetrachloroethene	6	1	mg/kg		0.16		0.01				NST									NST			NST						NST		
Xylenes, Total	1000	67	mg/kg		0.004	J	0.01				NST									NST			NST						NST		
1,2,4-Trichlorobenzene	1200	100	mg/kg		0.003	J	0.01				NST									NST			NST						NST		
Semivolatile Organic Compounds																														
Dimethyl Phthalate	10000	50	mg/kg								NST						1.4	J	1.9	NST			NST						NST		
Diethyl Phthalate	10000	50	mg/kg								NST			0.92		0.73	0.75	J	1.9	NST			NST						NST		
Di-n-Butyl Phthalate	10000	100	mg/kg					4.3		3.2	NST			1.9		0.73	2.6		1.9	NST			NST			20		4.4	NST		
Butylbenzyl Phthalate	10000	100	mg/kg					1.5	J	3.2	NST			0.89		0.73	3.7		1.9	NST			NST						NST		
Bis(2-ethylhexyl) Phthalate	210	100	mg/kg		0.16	J	0.35	19		3.2	NST			3.6		0.73	9.7		1.9	NST			NST			29		4.4	NST		
Di-n-octyl Phthalate	10000	100	mg/kg								NST						1.4	J	1.9	NST			NST						NST		
Pesticides																														
beta-BHC	NS	NS	mg/kg		0.0033	J	0.0018													0.00068	J	0.0018	0.00054	J	0.0018						
Heptachlor	0.65	50	mg/kg					0.23	J	0.041	0.0032		0.0019	0.003	JN	0.0019										0.0038	J	0.0019			
Aldrin	0.17	50	mg/kg								0.0019	JN	0.0019																		
Heptachlor Epoxide	NS	NS	mg/kg					0.025	J	0.0041	0.028		0.0019				0.0043	J	0.002							0.0037	J	0.0019			
alpha-Endosulfan	NS	NS	mg/kg														0.0078		0.002							0.0023	J	0.0019			
Dieldrin	0.18	50	mg/kg					0.024	JN	0.008				0.016		0.0036	0.02	JN	0.0038							0.0072	JN	0.0036			
4,4-DDE	9	50	mg/kg					0.012		0.008				0.0043		0.0036				0.0015	J	0.0035	0.0012	J	0.0035	0.002	J	0.0036	0.0015	J	0.0036
Endrin	310	50	mg/kg					0.017	JN	0.008	0.12		0.0037	0.013	J	0.0036										0.004		0.0036			
beta-Endosulfan	NS	NS	mg/kg		0.0047		0.0035				0.0053	JN	0.0037																		
4,4-DDD	12	50	mg/kg											0.0067		0.0036															
Endosulfan Sulfate	NS	NS	mg/kg														0.01	J	0.0038												
4,4-DDT	9	500	mg/kg					0.042	JN	0.008	0.32		0.0037	0.026	J	0.0036	0.014	J	0.0038	0.0013	JN	0.0035	0.0012	JN	0.0035	0.0065		0.0036	0.0027	J	0.0036
Methoxychlor	5200	50	mg/kg								0.047	J	0.019																		
Endrin Ketone	NS	NS	mg/kg					0.012	J	0.008				0.0036	J	0.0036	0.0094	JN	0.0038												
Endrin Aldehyde	NS	NS	mg/kg					0.093		0.008	0.63	JN	0.0037	0.03	J	0.0036															
alpha-Chlordane	NS	NS	mg/kg		0.021		0.0018	0.12		0.041	0.38		0.0019	0.038		0.0093	0.058		0.0098	0.0044	J	0.0018	0.0034		0.0018	0.043	J	0.0093	0.0019		0.0018
gamma-Chlordane	NS	NS	mg/kg		0.024		0.0018	0.46		0.041	0.46		0.0019	0.049		0.0093	0.069		0.0098	0.0051	J	0.0018	0.0047		0.0018	0.051		0.0093			
Polychlorinated Biphenyls																														
Aroclor 1254	2	50	mg/kg		0.19	J	0.035				NST									NST			NST						NST		
Metals																														
Aluminum	NS	NS	mg/kg		7450		43.1	5800		48.5	3240		22.2	6100		44.1	5900		44.4	2970		21.2	2990		21.3	7110		44.1	3810		21.2
Antimony	340	NS	mg/kg		0.99	J	12.9	5.5	J	14.5				1.4	J	13.2	17.1		13.3	0.94	J	6.4	0.77	J	6.4	1.2	J	13.2			
Arsenic	20	NS	mg/kg		3.9		2.2	**31.6**		2.4	1.2	J	1.1	2.4		2.2													1.2	J	1.1
Barium	47000	NS	mg/kg		24.5	J	43.1	241		48.5	10.9	J	22.2	86.6		44.1	119		44.4	16.8	J	21.2	14.6	J	21.3				15.8	J	21.2
Beryllium	2	NS	mg/kg		0.14	J	1.1				0.063	J	0.56							0.052	J	0.53	0.1	J	0.53				0.077	J	0.53
Cadmium	100	NS	mg/kg					19.7		1.2				0.78	J	1.1	1.2		1.1							0.48	J	1.1			
Calcium	NS	NS	mg/kg		121	J	1080				77.4	J	556							65.6	J	529	58.5	J	532				57.6	J	531
Chromium	NS	NS	mg/kg		12		2.2	517		2.4	8.7	J	1.1	539		2.2	2020		2.2	550	J	1.1	563	J	1.1	1450		2.2	21.6	J	1.1
Chromium, hexavalent	6100; 20*	NS	mg/kg		NST			NST			NST			NST			**146**		4.57	NST			NST			**161**		4.41	NST		
Cobalt	NS	NS	mg/kg		0.54	J	10.8	8.6	J	12.1				1.1	J	11	2.2	J	11.1							1.5	J	11			
Copper	600	NS	mg/kg		6		5.4	246		6.1	9.3		2.8	230		5.5	252		5.6	10.2		2.6	12.6		2.7	140		5.5	11		2.7
Iron	NS	NS	mg/kg		8360		21.6	104000		24.2	4100		11.1	13100		22.1	17300		22.2	4130		10.6	4970		10.6	10400		22	4020		10.6
Lead	600	NS	mg/kg		17.5		0.65	**2060**		0.73	36.7		1.1	336		0.66	**1090**		0.67	24.6		1.1	26.7		1.1	**5460**		0.66	244		1.1
Magnesium	NS	NS	mg/kg		395	J	1080				89.7	J	556							120	J	529	120	J	529				154	J	531
Manganese	NS	NS	mg/kg		23.6		3.2	458		3.6	5.1		1.7	21.4		3.3	39.9		3.3	7.3		1.6	6.8		1.6	16.3		3.3	11.2		1.6
Mercury	270	NS	mg/kg					2.6		0.12				0.75		0.1	2		0.11							0.13		0.11			
Nickel	2400	NS	mg/kg		3.5	J	8.6	86.2	J	9.7	1.6	J	4.4	19.1		8.8	75.2	J	8.9	2.8	J	4.2	2.3	J	4.2	8.5	J	8.8	1.6	J	4.2
Potassium	NS	NS	mg/kg		145	J	1080				54.2	J	556							83.9	J	529	80.9	J	532				46.6	J	531
Selenium	3100	NS	mg/kg								0.33	J	3.9							0.39	J	3.7	0.54	J	3.7				0.38	J	3.7
Silver	4100	NS	mg/kg					3.2		2.4				0.47	J	2.2	0.8	J	2.2							0.41	J	2.2			
Sodium	NS	NS	mg/kg		79.3	J	1080																								
Vanadium	7100	NS	mg/kg		15		10.8	13.1		12.1	9.6		5.6	19.7		11	17.6		11.1	9.7		5.3	10.9		5.3	42.9		11	7.2		5.3
Zinc	1500	NS	mg/kg		20.7		4.3	549		4.8	8.5		6.7	55.8		4.4	117		4.4	10.9		6.4	14		6.4	30.9		4.4	6.5		6.4
Cyanide	21000	NS	mg/kg		0.24	J	0.53	6.1		0.61		NST		1.9		0.55	2.8		0.57		NST			NST		1.6		0.55		NST	

Notes:
* 6100 mg/kg Cr^{+6} is the ingestion exposure pathway, with 20 mg/kg being the preliminary inhalation exposure pathway.
NJ NRDSCC = NJ Nonresidential Direct Contact Soil Cleanup Criteria
NJ IGWSCC = NJ Impact to Groundwater Soil Cleanup Criteria
Site specific NJ IGWSCC for metals not available
Bold = Greater than the NRDSCC
Grey shaded = Greater than the IGWSCC

Definitions:
J = Estimated Concentration
JN = Tentatively Identified, Estimated Concentration
NST = No Sample Taken
NS = No Standard
NA = Not Applicable
Blank = Analyzed but not detected

TABLE 1
Lightman Drum Colored Soil Sampling
Summary of Detect Soil Results

Parameter	NJ NRDSCC	NJ IGWSCC	Unit	Sample ID:	SC-15			SC-15 DUP			SC-16			SC-16A			SC-17			SC-18			SC-18A			SC-19			SC-19A		
				Sample Depth:	1 - 4"			1 - 4"			0 - 3"			3" - 6"			0 - 4"			0 - 3"			NA			0 - 3"			NA		
				Color:	Red			Red			Orange/Red			NA			Purple			Red			NA			Green			NA		
				Sample Date:	01/17/2008			01/17/2008			01/17/2008			03/26/2008			01/17/2008			01/17/2008			03/26/2008			01/17/2008			03/26/2008		
					Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit	Result	Qualifier	Reporting Limit
Volatile Organic Compounds																															
Acetone	1000	100	mg/kg											NST									NST						NST		
Trichloroethene	54	1	mg/kg											NST									NST						NST		
Tetrachloroethene	6	1	mg/kg											NST			0.004	J	0.012				NST						NST		
Xylenes, Total	1000	67	mg/kg											NST									NST						NST		
1,2,4-Trichlorobenzene	1200	100	mg/kg											NST									NST						NST		
Semivolatile Organic Compounds																															
Dimethyl Phthalate	10000	50	mg/kg											NST									NST						NST		
Diethyl Phthalate	10000	50	mg/kg		3.3	J	11	5.3		1.8	0.66	J	0.74	NST			0.077	J	0.37	75		11	NST			0.87	J	1.8	NST		
Di-n-Butyl Phthalate	10000	100	mg/kg		57	J	11	6.9	J	1.8	1.9		0.74	NST						42		11	NST			4.9		1.8	NST		
Butylbenzyl Phthalate	10000	100	mg/kg								0.71	J	0.74	NST									NST			0.52	J	1.8	NST		
Bis(2-ethylhexyl) Phthalate	210	100	mg/kg		5.2	J	11	9.3	J	1.8	3.4		0.74	NST			0.28	J	0.37	56		11	NST			12		1.8	NST		
Di-n-octyl Phthalate	10000	100	mg/kg											NST									NST						NST		
Pesticides																															
beta-BHC	NS	NS	mg/kg																												
Heptachlor	0.65	50	mg/kg		0.027		0.0037	0.023		0.0037	0.046		0.0096							340		98	0.11		0.018	0.047		0.0094	0.00083	J	0.0018
Aldrin	0.17	50	mg/kg														0.001	J	0.0019				0.0096	JN	0.018						
Heptachlor Epoxide	NS	NS	mg/kg														0.004		0.0019	26	JN	9.8	0.086	J	0.018						
alpha-Endosulfan	NS	NS	mg/kg		0.0097	J	0.0037	0.0054	J	0.0037	0.019		0.0096										0.077		0.018	0.012		0.0094	0.00042	J	0.0018
Dieldrin	0.18	50	mg/kg		0.025	JN	0.0073	0.025	JN	0.0072	0.038	JN	0.019	0.0024	J	0.0035	0.012	J	0.0037				0.13		0.035	0.034	J	0.018	0.00088	J	0.0035
4,4-DDE	9	50	mg/kg		0.016	J	0.0073	0.0088	JN	0.0072	0.033		0.019	0.0027	J	0.0035	0.0051	J	0.0037				0.051	JN	0.035	0.025	J	0.018	0.0039		0.0035
Endrin	310	50	mg/kg																												
beta-Endosulfan	NS	NS	mg/kg		0.01	JN	0.0073				0.016	J	0.019							19	J	19	0.079		0.035						
4,4-DDD	12	50	mg/kg																												
Endosulfan Sulfate	NS	NS	mg/kg					0.004	J	0.0072	0.0083	J	0.019													0.01	J	0.018			
4,4-DDT	9	500	mg/kg		0.016	JN	0.0073	0.013	J	0.0072	0.03	J	0.019	0.0027	J	0.0035	0.0049	JN	0.0037	9.9	J	19	0.039	J	0.035	0.022	J	0.018	0.0042		0.0035
Methoxychlor	5200	50	mg/kg		0.023	J	0.037																0.042	J	0.18						
Endrin Ketone	NS	NS	mg/kg					0.0099		0.0072																					
Endrin Aldehyde	NS	NS	mg/kg		0.013	J	0.0073																			0.013	J	0.018			
alpha-Chlordane	NS	NS	mg/kg		0.44		0.037	0.44		0.037	0.62		0.096	0.0059		0.0018	0.019		0.0019	900		98	1.5		0.018	0.66		0.094	0.0078		0.0018
gamma-Chlordane	NS	NS	mg/kg		0.52		0.037	0.51		0.037	0.69		0.096	0.0075		0.0018	0.024		0.0019	980		98	1.5		0.018	0.76		0.094	0.011		0.0018
Polychlorinated Biphenyls																															
Aroclor 1254	2	50	mg/kg											NST									NST						NST		
Metals																															
Aluminum	NS	NS	mg/kg		7480		42.5	7280		42.8	5300		43.1	3320		21.3	3130		44.4	7550		45.7	2320		21.5	5910		44.5	2920		21.2
Antimony	340	NS	mg/kg					0.94	J	12.8	6.7	J	12.9																		
Arsenic	20	NS	mg/kg		1.8	J	2.1	1.8	J	2.1				1.1	J	1.1	1.3	J	2.2	8.1		2.3	1.5	J	1.1	11		2.2	1.3	J	1.1
Barium	47000	NS	mg/kg		763		42.5	717		42.8	116		43.1	17.6	J	21.3				1940		45.7	32.6		21.5	172		44.5	14.9	J	21.2
Beryllium	2	NS	mg/kg											0.09	J	0.53							0.058	J	0.54				0.052	J	0.53
Cadmium	100	NS	mg/kg		2.8		1.1	3.3		1.1	10.3		1.1	4.6		0.53	0.46	J	1.1	2.5		1.1	0.12	J	0.54	1.4		1.1	0.21	J	0.53
Calcium	NS	NS	mg/kg								1340	J	1080	155	J	531							233	J	536				68.8	J	529
Chromium	NS	NS	mg/kg		499		2.1	511		2.1	5240		6.6	14.3	J	1.1	17.1	J	2.2	267		2.3	6.8	J	1.1	201		2.2	7	J	1.1
Chromium, hexavalent	6100; 20*	NS	mg/kg			NST			NST						NST			NST			NST			NST				NST		
Cobalt	NS	NS	mg/kg		1.3	J	10.6	1.5	J	10.7	1.6	J	10.8				0.56	J	11.1	1.4	J	11.4				1	J	11.1			
Copper	600	NS	mg/kg		173		5.3	183		5.3	118		5.4	13.7		2.7	4.9	J	5.6	112		5.7	5.5		2.7	121		5.6	12.3		2.6
Iron	NS	NS	mg/kg		16100		21.3	14100		21.4	13200		21.6	3340		10.6	4470		22.2	21700		22.9	2630		10.7	11900		22.3	3390		10.6
Lead	600	NS	mg/kg		**1630**		0.64	**1740**		0.64	**23800**		2	38.8		1.1	64.1		0.67	**850**		0.69	9.3	J	1.1	**714**		0.67	11.3		1.1
Magnesium	NS	NS	mg/kg											134	J	531							79.7	J	536				61	J	529
Manganese	NS	NS	mg/kg		27.9		3.2	25.4		3.2	183		3.2	15.8		1.6	16.8		3.3	48.5		3.4	11.8		1.6	22.7		3.3	6.3		1.6
Mercury	270	NS	mg/kg		0.32		0.11	0.35		0.11	0.52		0.11	0.13		0.11				0.095	J	0.11				0.31		0.11			
Nickel	2400	NS	mg/kg		19.5	J	8.5	22	J	8.6	34.1	J	8.6	5.9		4.3	3.1	J	8.9	35.1	J	9.1	2.5	J	4.3	20.4	J	8.9	5.3		4.2
Potassium	NS	NS	mg/kg											60.3	J	531							38	J	536				47.8	J	529
Selenium	3100	NS	mg/kg																										0.3	J	3.7
Silver	4100	NS	mg/kg		0.94	J	2.1	0.87	J	2.1	1	J	2.2							2.4		2.3				0.59	J	2.2			
Sodium	NS	NS	mg/kg																				44.5	J	536						
Vanadium	7100	NS	mg/kg		23.7		10.6	22.5		10.7	19		10.8	6.3		5.3	6.6	J	11.1	24.8		11.4	5.2	J	5.4	20.8		11.1	8.9		5.3
Zinc	1500	NS	mg/kg		72.6		4.3	79.2		4.3	608		4.3	24.6		6.4	17.7	J	4.4	70.9		4.6	8		6.4	84.9		4.5	13.2		6.3
Cyanide	21000	NS	mg/kg		4.6		0.55	3		0.55	4.1		0.56		NST					3.4		0.57		NST		2.3		0.56		NST	

Notes:
* 6100 mg/kg Cr^{+6} is the ingestion exposure pathway, with 20 mg/kg being the preliminary inhalation exposure pathway.
NJ NRDSCC = NJ Nonresidential Direct Contact Soil Cleanup Criteria
NJ IGWSCC = NJ Impact to Groundwater Soil Cleanup Criteria
Site specific NJ IGWSCC for metals not available
Bold = Greater than the NRDSCC
Grey shaded = Greater than the IGWSCC

Definitions:
J = Estimated Concentration
JN = Tentatively Identified, Estimated Concentration
NST = No Sample Taken
NS = No Standard
NA = Not Applicable
Blank = Analyzed but not detected

APPENDIX C

ADDENDUM NO. 2 TO SITE-SPECIFIC HEALTH AND SAFETY PLAN COMPASS ENVIRONEMTAL, INC.

WRSCOMPASS

92 N. Main Street
Unit 20B, P.O.Box 10
Windsor, New Jersey 08561
609-371-7500 Phone
609-371-7508 Fax

August 4, 2008

Mr. David B. Walsh, P.E.
Golder Associates, Inc.
200 Century Parkway, Suite C
Mount Laurel, NJ 08054

Subject: Amendment #2 – Colored Soil Excavation and Removal

Mr. Walsh,

WRScompass is generating this letter to document the reason for the above referenced amendment to the Site Specific Health and Safety Plan for the Soil Source Area Removal Project at the Lightman Drum Superfund Site located in Winslow Township, NJ.

Under a work directive from Golder Associates, WRScompass is being requested to remobilize the project site, install erosion and sediment controls, excavate and stockpile impacted soil for waste characterization, backfill excavated areas and complete site restoration and demobilization.

A detailed description of the work, the steps to be taken to protect site personnel and the environment and the steps to complete the excavation and removal of impacted soils at the project site are contained within the original SSHASP and this Amendment #2.

Please review the attached amendment, should you have any questions or comments, contact me at 609-371-7500 or on my cell phone at 732-496-2763.

Best Regards,

Jeffrey Krug
WRScompass

AMENDMENT 2
TO LIGHTMAN DRUM SSHASP

Colored Soil Excavation and Removal

- Approvals
- Scope of Work
- Emergency Telephone Numbers
- Site Organization and Responsibilities
- Revised Table 4.1 for Site Contaminants
- Levels of Protection
- Environmental and Personal On-Site Air Monitoring Plan
- Forms (JSA, Task Safety Evaluation, Excavation Checklist)

Approvals

By their signatures, the undersigned certify that this Site Specific Health and Safety Plan is approved and will be utilized for the Colored Soil Removal at the Lightman Drum Project

_____ _____

Jerry Resnik
N. E. Regional Manager

Date

_____ _____

Doug Nelson, CIH, CHMM
Vice President, Health and Safety

Date

_____ _____

Jeffrey Krug
Site Manager

Date

_____ _____

Josh Kelly
Manager of Health and Safety

Date

Scope of work

Activities conducted as part of the Colored Soil Removal at the Lightman Drum Project are divided into discrete tasks. A discussion of these activities can be found in Section 5. The tasks covered are as follows:

TASK NO.	DESCRIPTION
1	Mobilization
2	Install Erosion and Sediment Controls
3	Excavation and Staging Impacted Soils
4	Waste Characterization and Disposal
5	Backfill
6	Site Restoration
7	Demobilization

Emergency Telephone Number

ALL IMMEDIATE EMERGENCIES BE SURE TO CALL 911

AGENCY	TELEPHONE NUMBERS
EMERGENCY	911
POLICE – Berlin Police Department	856-783-4900
NEARBY HOSPITAL- Virtua Hospital	856-322-3000
NJDEP	877-927-6337
STATE HEALTH DEPARTMENT	800-367-6543
POISON CONTROL CENTER	800-336-6997
NATIONAL RESPONSE CENTER (NRC)	800-424-8802
SPILL HOTLINE	800-424-8802
CHEMTREC	800-424-9300
HEALTH BRIDGE	800-633-4350
WRSCOMPASS VICE PRESIDENT, HEALTH AND SAFETY (Doug Nelson)	813-267-7416
WRSCOMPASS MANAGER OF HEALTH AND SAFETY (Josh Kelly)	317-401-1815
WRSCOMPASS REGIONAL MANAGER (Jerry Resnik)	317-716-0493
WRSCOMPASS SITE MANAGER (Jeffrey Krug)	327-446-9858

Site Organization and Responsibilities

3.1 Overview

All personnel will be responsible for continuous adherence to the procedures set forth by this plan and as administered by the Site Safety and Health Officer (SSHO) during the performance of on-site removal activities. In no case may work be performed which conflicts with the intent of or the inherent safety and environmental cautions expressed in these procedures. WRScompass Environmental employees and subcontractors will also follow all site specific requirements defined by Lightman Drum and its representatives. If WRScompass or subcontractor personnel are found violating safety and health procedures they will promptly be dismissed from the Site.

3.2 Project Safety and Health Representative

WRScompass will provide a Project Safety and Health Representative (PSHR) to administer the health and safety program outlined in this HASP. Minimum qualifications for the PSHR include formal training in Industrial Hygiene and Occupational Health, completion of a 40-hour HAZWOPER training course as mandated by OSHA in 29 CFR 1910.120, and familiarity with the requirements specifically set forth for this type of work in that regulation.

The PSHR will be responsible for:

- Work with the SSHO to ensure that medical examination and training requirements for all on-site WRScompass and subcontractor personnel are current and comply with 29 CFR 1910.120 and .134.
- Ensure a pre-job briefing is given to all WRScompass personnel, subcontractors, and vendors with regard to this HASP and other safety requirements including but not limited to (a) potential hazards; (b) personal hygiene principles; (c) personal protective equipment; (d) respiratory equipment usage; (e) emergency procedures for dealing with fire and medical emergency situations; and (f) Material Safety Data Sheets (MSDS);
- Ensure the site is complying with OSHA health and safety regulations as well as WRScompass health and safety policies and procedures
- Overseeing site audits of WRScompass Environmental jobsites on a regular basis.

The PSHR is given the authority to take the appropriate steps that are required to ensure adherence of operations to the adopted HASP. The PSHR will not be assigned to the site on a full time basis. The PSHR for this site is Doug Nelson, CIH and CHMM

3.3 Site Safety and Health Officer

The Site Safety and Health Officer (SSHO) responsibilities will be delegated to the full time Site Manager for the duration of the project. Specifically, the Site Manager or his designee will inspect operations, equipment, and procedures for adherence to this plan. Where deviations are discovered, he will take immediate steps to correct the deviation, up

to and including stopping the operation until the situation is adequately resolved. The Site Manager will have experience in the area of safety and health, a sound working knowledge of federal and state occupational safety and health regulations, training in occupational safety and health, and demonstrable experience in air monitoring techniques and the administration of respiratory protection programs. The Site Manager will also hold current certifications in CPR and basic first aid.

The Site Manager will have functional responsibility and authority for implementation and enforcement of the HASP. He will conduct daily employee exposure assessments for target contaminants for each functional task performed where exposure could reasonably be expected to occur. The Site Manager will inspect protective equipment and protective clothing for proper maintenance and use by employees who are assigned personal protective equipment.

All confined space entry, hot electrical work, cutting and welding operations, lockout/tagout, and any other hazardous work will require advanced inspection (monitoring, testing, and verification) by the Site Manager. Work permits will be issued to perform the requested task for a specific period only upon completion of a permit application and his concurrence (inspection) that the work can be performed safely.

The Site Manager shall immediately investigate all accidents/incidents that may have occurred. Each will be documented as to when it occurred, who was involved, and what corrective action needs to be implemented. The Site Manager will post the OSHA 300 log of injuries and illnesses, as well as ensure that the required log is made available to personnel.

The Site Manager will have the authority to suspend work during on-site emergencies and noncompliance with the HASP. The Site Manager will report to WRScompass Project Manager.

3.4 Project Manager

The WRScompass Project Manager is ultimately responsible for field implementation of the safety and health program. This includes communicating specific health and safety requirements to site supervision and consulting with the SSHO regarding planned activities, unforeseen conditions, and resolution of any questions with identified safety procedures or levels of protection to be used. The duties of the Project Manager will be delegated to the Site Manager.

3.5 Site Manager

The Site Manager is responsible for ensuring that all employees working on the site are complying with the requirements set forth in this HASP. As stated above, the Site Manager will serve dual roles to include SSHO responsibilities. The Site Manager will also ensure that employees and subcontractors are conducting themselves in compliance with the health and safety requirements of the plan. The Site Manager is responsible for completing the **Supervisor Weekly Inspection Checklist** every week. The Site

Manager is responsible for immediately investigating injury circumstances and completing the **WRScompass Environmental Incident Report** *(Attachment A)* for any work-related incident that could have resulted in injury/illness. The Site Manager for this job will be Jeffrey Krug.

3.6 Laborers/Operators/Technicians

Employees who will be working on-site are responsible for understanding and complying with HASP requirements and for notifying either the SSHO or the site manager of any concerns they might have for their health and safety on the job. Site workers and all other support personnel are responsible for conducting themselves in a safe manner, mindful of the inherent hazards associated with working around contaminated materials, heavy equipment, and extreme environmental conditions. Disregard of the HASP or standard operating procedures will be grounds for immediate dismissal.

TABLE 4.1

MOST PREVALENT HAZARDOUS CHEMICALS ASSOCIATED

WITH REMEDIATION ACTIVITIES AT THE SITE

Substance [CAS]	IP (eV)	Odor Threshold (ppm)	Route	Symptoms of Exposure	Treatment	TWA	STEL	Source	IDLH (NIOSH)
Arsenic and soluble inorganic compounds (as As) [7440-38-2]	NA	NA	Inh Abs Ing Con	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances; hyper pigmentation of the skin (carcinogenic); peripheral neuropathy, respiratory irritation.	Eye: Irrigate immediately (15 min) Skin: Soap wash immediately Swallow: Immediately medical attention	0.01 mg/m^3 0.01 mg/m^3 (Ca-29CFR 1910.1018 Inorganic compounds)		PEL REL	5 mg/m3
Chromium metal (as Cr) [7440-47-3]	NE	NE	Inh Ing	Histologic fibrosis of lungs	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 0.5 mg/m^3 0.5 mg/m^3		PEL TLV REL	NE
4,4'-DDT [50-29-3]	NE	NE	Ing Con	Tremors, convulsions headache, nausea, vomiting, disturbance of sensation in the skin of the lower face and lips, dizziness, loss of equilibrium, confusion, malaise, fatigue, skin and eye irritation	Eye: Irrigate immediately Skin: Water flush Breath: Respiratory support Swallow: Medical attention immediately	1 mg/m^3 1 mg/m^3 0.5 mg/m^3		PEL TLV REL	500 mg/m^3
Alpha-Chlordane [5103-71-9]	NE	NE	Ing Con Inh	Depression, impaired memory, impaired concentration, lack of energy and general inability to function	Eye: Irrigate immediately Skin: Water flush Breath: Respiratory support Swallow: Medical attention immediately	0.5 mg/m^3 0.5 mg/m^3 0.5 mg/m^3		PEL TLV REL	100 mg/m^3
Heptachlor Epoxide [1024-57-3]	-	-	Inh Abs Ing Con	In animals: tremor, convulsions; liver damage; [potential occupational carcinogen]	Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately	0.5 mg/m^3		PEL TLV REL	-
Lead inorganic dusts & fumes (as Pb)	NA	NA	Inh Ing Con	Weakness, lassitude, insomnia; facial pallor, eye pallor, anorexia, low body weight, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremors; wrist and ankle paralysis, brain damage; kidney damage; irritated eyes; hypotension.	Eye: Irrigate immediately Skin: Soap flush promptly Breath: Respiratory support Swallow: Immediate medical attention	0.05 mg/m^3 0.15 mg/m^3 <0.1 mg/m^3 See 29 CFR 1910.1025 Blood lead <0.060 mg/ 100g whole blood		PEL TLV REL	

Levels of Protection

Minimum initial levels of protection for anticipated tasks to be considered are specified under the sections listed below:

1	Mobilization	Level D
3	Install Erosion and Sediment Controls	Level D
4	Excavation and Staging of Soil	Modified D/Level D
5	Waste Characterization and Disposal	Level D
6	Backfill	Level D
7	Site Restoration	Level D
8	Demobilization	Level D

WRScompass will provide its personnel with appropriate personal safety equipment and protective clothing. WRScompass will ensure that all safety equipment and protective clothing is properly used, kept clean, and well maintained. ,

Environmental and Personal On-Site Air Monitoring Plan

No personal sampling will be conducted during excavation activities.

Perimeter air monitoring will not be conducted by WRScompass.

Real-time monitoring for particulates will be conducted according to the site HASP.

FORMS

- TSE (TASK SAFETY EVALUATION)
- JSA
- EXCAVATION CHECKLIST

These forms will be completed and reviewed by site personnel prior to the commencement of site activities.

Project Name: LIGHTMAN DRUM
Project Number: _____

Date: _____
Supervisor Field Review: _____

Task Safety Evaluation

(TSE must be immediately accessible to personnel while work is in progress)

Job Task/Title: EXCAVATE COLORED SOILS
Location of Job: _____
Person in charge of task: J. KRUG Person completing TSE: L. ENDICOTT
What special training is required for this task? N/A

Basic Job Steps associated with Task

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Physical Hazards (Remove these Hazards where possible)

- ☑ Personnel could fall
- ☐ Trip Hazard
- ☐ Flying Debri
- ☑ Noise
- ☐ Heat stress
- ☐ Contact with hot or cold temperatures
- ☐ Obstructions/Interferences
- ☑ Struck by
- ☐ Pinch Points
- ☐ Electrical Contact
- ☐ Rigging
- ☐ Material Handling
- ☑ Excavations
- ☐ Entanglement
- ☐ Asbestos
- ☑ Lead
- ☐ Arsenic
- ☐ Chemical
- ☐ Weld Flash
- ☐ Muscle Strain
- ☐ Explosive Material
- ☐ Hazardous Materials
- ☐ Power Lines_____
- ☐ Other_____

Work Practice/Engineering Controls

- ☐ Consult with Safety
- ☐ HEPA ventilation/vacuuming
- ☑ Preplan meeting
- ☐ Enclosure
- ☐ Surface must stay wet
- ☐ Other_____

Signs/ Barricades required

- ☑ Caution tape/rope
- ☐ Danger tape/rope
- ☐ Confined Space
- ☐ No sources of ignition
- ☐ Hazardous Materials
- ☐ Other_____

Personal Protective Equipment required

- ☑ **Hardhat**
- ☑ **Safety Glasses** (w/sideshields)
  - ☐ Dark lenses
- ☐ **Monogoggles**
- ☐ **Faceshield**
- ☑ **Work Boots** (steel or composite toe)
- ☐ **Metatarsal Protection**
- ☑ **Hearing protection**
  - ☑ Ear Plugs
  - ☐ Ear Muffs
- ☐ **Fall Protection**
  - ☐ Body Harness
  - ☐ Safety Net
  - ☐ Guardrails
- ☐ **Coveralls/suits**
  - ☐ Fire retardant
  - ☐ Tyvek
  - ☐ Chemical suits
  - ☐ Welding Jackets
  - ☐ Leathers
- ☑ **Gloves**
  - ☐ Cotton
  - ☐ Welding
  - ☐ Electrical
  - ☐ PVC
  - ☐ Latex
  - ☑ Leather
  - ☐ Cut resistant
- ☐ **Shoe Covers**
- ☐ **Rubber Boots**
- ☐ **Respirator**
  - ☐ Voluntary
  - ☐ Mandatory
  - ☐ ½ Face APR
  - ☐ PAPR
  - ☐ Full Face APR
  - ☐ Air Supplied
- ☐ **Respirator Cartridge**
  - ☐ HEPA
  - ☐ Organic Vapor
  - ☐ Other _____
- ☐ **Ice Vest**
- ☐ **Life Vest**
- ☐ **Sandblasting Hood**
- ☐ **Other**_____

Permits/Procedures required

- ☐ Hot work
- ☐ Confined space
- ☐ Lockout/Tagout
- ☐ Critical Lift
- ☐ Hot Tap
- ☐ Radio Communication
- ☐ Working Partner
- ☐ Fire watch
- ☐ Lifting Techniques

Inspections/monitoring required

- ☑ Excavation
- ☐ Ladders
- ☐ Scaffolding
- ☐ Attendant
- ☐ Equipment inspection
- ☐ IH Monitoring
- ☑ Atmospheric Monitoring
- ☐ Other_____

Employee Certifications Required

- ☐ Crane Operator
- ☐ Fork-lift Operator
- ☐ Mobile Equipment Operator
- ☐ Powder Actuated Tool User
- ☐ Lead
- ☐ Asbestos
- ☐ Excavation
- ☐ Confined Space
- ☐ Scaffold
- ☐ Other_____

List below any additional hazards and or controls needed to perform this task

_____

_____

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Task Safety Evaluation

Emergency Phone Numbers and Assembly Point

Phone 911 Radio _____ Fire _____ Medical _____

Assembly Point TBD

Questions for the Supervisor to ask the Crew:

1. Is there anyone unfamiliar with performing this task?
   If yes, team the individual(s) up with an experienced person.
2. Has the appropriate MSDS been reviewed?
3. Are there any additional hazards or concerns not discussed during this TSE brief?
   List any additional hazards identified below.

_____

_____

TSE Briefing with work crew:

Person Completing TSE briefing: _____ Time: _____

Crew Signatures:

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

By signing this document, you understand and agree with the safety requirements identified, the Williams/Site policies and procedures outlined for the completion of this task and that failure to follow these requirements and/or procedures properly may result in termination

Task Completion

Task area is cleaned up and safe?		Barricades are removed from task area?		Locks removed from plant equipment?	
☐ YES	☐ NO	☐ YES	☐ NO	☐ YES	☐ NO

If No, Why Not? _____

List any problems/improvements encountered with task assignment: _____

_____

_____

Events

TSE must be kept on file for the duration of the job if any of the below events occur otherwise TSE may be disposed of after 30 days

* Requires Regional Safety Manager notification within 24 hours

**Requires Immediate Regional Safety Manager notification

Environmental Event

- ☐ Near miss*
- ☐ Air contaminant release*
- ☐ Chemical Spill
- ☐ EPA Event**

Injury Event

- ☐ Near Miss*
- ☐ Medical Attention*
- ☐ First Aid
- ☐ Hospital**

Property Event

- ☐ Near Miss*
- ☐ Equipment Damage*

Event Documentation

Has the event been reported to the Safety Representative?

☐ Yes ☐ No ☐ NA

If No, Why not? _____

_____ _____

Crew Supervisor/Foreman signature **Supervisory Review**

Job Safety Analysis

Control No: **Status:** Initial **Original Date:** 08 / 04 / 08
Last Date Closed:

Organization: WRScompass Environmental Inc.

JSA Type: Construction Activities
Work Type: Environmental
Work Activity: Excavation

Personal Protective Equipment (PPE)	Selected	Comments
Safety Shoes	Y	
Hard Hat	Y	
Safety Glasses	Y	
Safety Vest	Y	
Gloves	Y	
Tyvek Suit		
Yellow Boot Covers		
Fire Resistant Clothing		
Face Shields		
Goggles		
Lifeline/Body Harness		
Hearing Protection	Y	Protection to be adequate for the task. See supervisor for special instructions
Air Purifying Respirator		
Supplied Air Respirator - SCBA		
Welding Hood		
Welding/Pipe Clothing		
Welding Mask/Goggles		
Personal Floatation Device		
Safety Cones/Barricades	Y	Protection to be adequate for the task. See supervisor for special instructions
Substantial leather footwear		

Reviewers

Reviewer Name	Position	Date Approved
Larry Endicott	NE Region Health and Safety	08/04/2008

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Job Steps

No	Job Steps	Potential Hazard	Critical Actions
1	1. Inspect area were the earth-moving equipment is to be placed for the excavation.	1A. Slips, trips, and falls 1B. Electrical shock	1A. Clear area of tripping hazards 1A. Keep alert to terrain changes. 1A. Practice secured footing when the ground is wet. 1B. Locate underground utilities
2	2. Move earth-moving equipment into area where excavation is to take place.	2A. Individual struck by equipment during positioning 2B. Overhead/Buried power lines- Electrocution 2C. Equipment damage 2D. Slips, Trips, Falls	2A. Standard site PPE including, Hard Hat, Reflective Vest, Safety Glasses with side shields, Leather Steel toe work Boots, Gloves. 2A. Only trained equipment operators will be allowed to operate equipment. 2A. Path of equipment into area will be predetermined and site by the operator. 2A. A ground guide or spotter will be used to direct equipment into position. 2A. Equipment must have properly functioning back up alarms. 2B. Equipment will be shut down whenever operator leaves the seat or cab. 2B. No equipment will be left running unattended. 2C. Proper clearance will be maintained between any obstacles during movement. 2D. Operators will use proper mounting/climbing procedures when accessing equipment. (3-point contact)
3	3. Excavate to limits/depths required.	3A. Side wall collapse 3B. Individual struck by debris/dirt 3C. Individual struck by equipment 3D. Fall in by Individuals 3E. Dust	3A. Excavation will have proper 1 ½ - 1 slope if entry is required. 3A. Excavation competent person to inspect the excavation for hazards and correct as necessary on a daily basis and after adverse weather (rain) 3B. Keep workers a minimum of 6 feet away from the equipment while in operation 3C. Keep workers out of the radius of equipment 3D. Erect barricade with orange snow fence to warn of trench 3E. Dust control will be implemented as appropriate
4	4. Release Material from truck for back fill	4A. Individual struck by vehicle 4B. Runaway Equipment	4A. Be aware of workers in area 4A. Backup alarms on all heavy equipment and trucks 4B. Equipment will be shut down when operator leaves seat

5	5. Place backfill in acceptable lifts into trench/ excavation with loader or other appropriate piece of equipment.	5A. Side wall collapse 5B. Individual struck by debris/materials 5C. Fall from ladder 5D. Fall into excavation 5E. Runaway equipment 5E. Dust	5A. Maintain proper slope 1-1/2 to 1 or shoring 5A. Proper access to excavations with ladders every 25', properly sloped,4 to 1, extend 3ft. minimum above landing, secured ladders or sufficient stairs or ramps 5A. Inspection of excavation by competent person daily 5B. Maintain eye contact with employees in or near excavation before dumping. 5B. Operator shall follow standard hand signals 5B. Proper PPE- Hard Hats, Reflective Vests, Leather work boots, Safety glasses with side shields 5C.Ladder safety, i.e.,3-point contact, don't carry items, no step ladders 5D. Barricade excavations with orange snow fence or k-rails 5E. Equipment will be shut down when operator leaves seat. 5F. Dust control will be implemented as appropriate
6.	6. Pump excavation (if needed)	6A. Electrical shock	6A. Inspection of electrical cords and equipment by a competent person 6A. Use GFCI and Assured Grounding Program
7.	7. Compact materials	7A. Crushed foot/feet 7B. Runaway equipment	7A. Steel toed boots with metatarsal guards 7B. Equipment will be shut down when operator leaves seat, or releases controls on walk-behind equipment

Name	Date	Q&A

Excavation Checklist and Trenching Log

WRSCOMPASS

SITE LOCATION:		
DATE:	TIME:	COMPETENT PERSON:
SOIL TYPE: (See attached form):		
SOIL CLASSIFICATION:	EXCAVATION DEPTH:	EXCAVATION WIDTH:
TYPE OF PROTECTIVE SYSTEM USED:		

Indicate for each item: YES - NO - or N/A for not applicable

1. General Inspection of Jobsite:		
A.	Excavations, adjacent areas, and protective systems inspected by a competent person daily before the start of work.	
B.	Competent person has the authority to remove employees from the excavation immediately.	
C.	Surface encumbrances removed or supported.	
D.	Employees protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation.	
E.	Hard hats worn by all employees.	
F.	Spoils, materials, and equipment set back at least two feet from the edge of the excavation.	
G.	Barriers provided at all remotely located excavations, wells, pits, shafts, etc.	
H.	Walkways and bridges over excavations four feet or more in depth are equipped with standard guardrails and toeboards.	
I.	Warning vests or other highly visible clothing provided and worn by all employees exposed to public vehicular traffic.	
J.	Employees required to stand away from vehicles being loaded or unloaded.	
K.	Warning system established and utilized when mobile equipment is operating near the edge of the excavation.	
L.	Employees prohibited from going under suspended loads.	
M.	Employees prohibited from working on the faces of slopes or benched excavations above other employees.	
2. Utilities:		
A.	Utility companies contacted and/or utilities located.	
B.	Exact location of utilities marked.	
C.	Underground installations protected, supported, or removed when excavation is open.	
3. Means of Access and Egress:		
A.	Lateral travel to means of egress no greater than 25 feet in excavations four feet or	

	more in depth.	
B.	Ladders used in excavations secured and extended three feet above the edge of the trench.	
C.	Structural ramps used by employees designed by a competent person.	
D.	Structural ramps used for equipment designed by a registered professional engineer (RPE).	
E.	Ramps constructed of materials of uniform thickness, cleated together on the bottom, equipped with no-slip surface.	
F.	Employees protected from cave-ins when entering or exiting the excavation.	
4. Wet Conditions:		
A.	Precautions take to protect employees from the accumulation of water.	
B.	Water removal equipment monitored by a competent person.	
C.	Surface water or runoff diverted or controlled to prevent accumulation in the excavation.	
D.	Inspections made after every rainstorm or other hazard-increasing occurrence.	
5. Hazardous Atmosphere:		
A.	Atmosphere within the excavation tested where there is a reasonable possibility of an oxygen deficiency, combustible or other harmful contaminant exposing employees to a hazard.	
B.	Adequate precautions taken to protect employees from exposure to an atmosphere containing less than 19.5% oxygen and/or to other hazardous atmospheres.	
C.	Ventilation provided to prevent employee exposure to an atmosphere containing flammable gas in excess of 10% of the lower explosive limit of the gas.	
D.	Testing conducted often to ensure that the atmosphere remains safe.	
E.	Emergency equipment, such as breathing apparatus, safety harness and lifeline, and/or basket stretcher readily available where hazardous atmospheres could or do exist.	
F.	Employees trained to use personal protective and other rescue equipment.	
G.	Safety harness and lifeline used and individually attended when entering bell bottom or other deep confined excavations.	
6. Support Systems:		
A.	Materials and/or equipment for support systems selected based on soil analysis, trench depth, and expected loads.	
B.	Materials and equipment used for protective systems inspected and in good condition.	
C.	Materials and equipment not in good condition have been removed from service.	
D.	Damaged materials and equipment used for protective systems inspected by a registered professional engineer (RPE) after repairs and before being placed back into service.	
E.	Protective systems installed without exposing employees to the hazards of cave-ins, collapses, or threat of being struck by materials or equipment.	
F.	Members of support system securely fastened to prevent failure.	
G.	Support systems provided in ensure stability of adjacent structures, buildings, roadways, sidewalks, walls, etc.	
H.	Excavations below the level of the base or footing supported, approved by an RPE.	
I.	Removal of support systems progresses from the bottom and members are	

	released slowly as to note any indication of possible failure.	
J.	Backfilling progresses with removal of support system.	
K.	Excavation of material to a level no greater than two feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth.	
L.	Shield system placed to prevent lateral movement.	
M.	Employees are prohibited from remaining in shield system during vertical movement.	

CORRECTIVE ACTIONS AND REMARKS: