COMMONWEALTH of VIRGINIA

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October 22, 2019

Mr. Michael Liberati
Corteva Environmental Remediation
974 Centre Road. Building 735
Wilmington, DE 19805

VIA ELECTRONIC MAIL

Re: Preliminary Phase 2 Bank Management Area Investigation RRM 2-3 Response To Comments
Former DuPont Waynesboro Plant Site, AOC4
Waynesboro, Virginia
EPA ID# VAD003114832

Dear Mr. Liberati:

This letter acknowledges the receipt and review of the response to comments and revisions to the Preliminary Phase 2 Bank Management Area of Investigation RRM 2-3 for AOC4, dated October 2019, submitted to the Virginia Department of Environmental Quality, Office of Remediation Programs (VDEQ) by Corteva Agriscience (Corteva). VDEQ accepts the revisions to the work plan and has no further comments.

If you have any questions, you may contact me at 540-574-7802 or by email at William.jordan@deq.virginia.gov.

Sincerely,

W. Calvin Jordan
Corrective Action Project Manager
Office of Remediation Programs

cc: DuPont Waynesboro Correspondence File
Joel Hennessey, US EPA
Josh Collins, AECOM

Preliminary Phase 2 Bank Management Area Investigation: RRM 2 to RRM 3

Former DuPont Waynesboro Site
Area of Concern (AOC) 4
Waynesboro, Virginia

Submitted on behalf of:

Corteva Agriscience

Submitted by:
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Project Number: 60594242
Date: October 2019

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1.0 Introduction

Phase 1 Interim Measures (IM) are currently being implemented by E.I. du Pont de Nemours and Company, a wholly-owned subsidiary of Corteva Agriscience, to address historical releases of mercury to the South River from the former DuPont facility in Waynesboro, Virginia, in accordance with the United States Environmental Protection Agency (US EPA) Resource Conservation and Recovery Act (RCRA) Corrective Action Permit No. VAD003114832. Legacy mercury releases were transported by the South River and deposited on river banks and the floodplain through storm events during the period of mercury use at the site. Although mercury use at the site ceased in 1952, legacy mercury deposits continue to be reintroduced into the South River by erosion of river banks with elevated mercury concentrations.

The approved Interim Measures Design, Implementation, and Monitoring Work Plan (IM Work Plan; Anchor QEA, et. als. 2015) identified a series of river banks within the first two relative river miles (RRM) that contributed disproportionally higher amounts of mercury loading to the South River (Figure 1). These banks, referred to as bank management areas (BMAs) accounted for approximately 90% of mercury loading from eroding riverbanks in the first two river miles. The objective of the Phase 1 IMs is to reduce or eliminate bank erosion and subsequent mercury loading to the South River within this reach. A summary of Phase 1 BMA status is provided below:

- Pilot Bank Stabilization – Completed Fall 2009
- Constitution Park BMA – Completed February 2017
- City Shops BMA – Completed March 2018
- Allied Ready Mix BMA – Completed November 2018
- Shiloh Baptist Church BMA – Construction Started February 2019
- North Park BMAs – Anticipated Construction 2019-2020

Riverbanks downstream of RRM 2 may be considered for remediation following the completion of the Phase 1 IMs. Bank soil data to support remedial decision-making in RRM 2 to RRM 5 are limited; however, elevated mercury concentrations have been documented in some areas (Figure 2). Similar to the phased sampling approach conducted to identify and refine the Phase 1 BMAs, the sampling efforts outlined below will focus on characterizing the nature and extent of mercury present in bank soils from RRM 2 to RRM 3. These data will be considered along with bank erosion rates to identify preliminary Phase 2 BMAs within this reach that will be considered for remediation following completion of the Phase 1 IMs.

The following sections detail the sampling methods (Section 2.0), quality assurance/quality control (Section 3.0), reporting requirements (Section 4.0), and health and safety procedures (Section 5.0). References used in the development of this work plan are provided in Section 6.0.

2.0 Sampling Methodology

2.1 Locations

This scope of work includes surficial (i.e. 0-5 cm) soil sampling at targeted locations in RRMs 2 to 3 to better characterize the extent of total mercury (THg) in bank soils within this reach (Figure 2). Sample locations were selected to obtain THg bank soil data on approximately 100-foot intervals along each bank when combined with historical data, which includes X-ray Fluorescence data (XRF) collected by James Madison University and the Virginia Department of Environmental Quality (VDEQ) (Figure 1; Brent, 2016 unpublished). This sampling interval is consistent with the data density used to identify and refine the Phase 1 BMAs.

Proposed sample locations are predominantly located upstream and downstream of the JMU/VDEQ XRF field demonstration project area (Figure 1). Although previous collaborative studies between JMU and AECOM have demonstrated that portable XRF devices can be accurate and reliable field screening tools for THg analysis in soil (Brent, et.al, 2017), laboratory verification samples will be collected at 10% of the XRF demonstration project transects. A complete analytical schedule is provided in Table 1.

2.2 Sample Collection

Sample transects will be located in the field using a global positioning system (GPS) capable of sub-meter accuracy (i.e., Trimble Geo xH 6000 or similar). Detailed procedures for collecting surficial bank soil samples are provided in Protocol SRSO-1 in Appendix A and summarized below.

A minimum of three samples will be collected from the 0-5 cm depth interval at each surficial bank soil transect; locations will be evenly spaced vertically along the bank face. Additional samples will be collected along banks greater than 3 feet high; all samples will be spaced at least 1 foot apart, and not more than 2 feet apart vertically. For banks higher than approximately 15 feet, all samples will be collected below the bank-full elevation. Leaf litter, twigs, vegetation, and rocks shall be removed from the sampling location prior to collecting the sample. Soil from each discrete sampling interval will be thoroughly homogenized, with large rocks and sticks removed prior to being placed into laboratory provided sample containers. Soil samples will be packed and shipped on wet ice at 4˚C to Eurofins/Lancaster Laboratories (Lancaster, PA) for further processing and analysis.

2.3 Sample Processing and Analysis

Upon sample receipt, the analytical laboratory will log samples into their laboratory information management system. A single composite sample will be prepared for each bank transect location using equal aliquots of soil from the discrete sample intervals. The composite sample will be thoroughly homogenized and analyzed for THg using EPA Method SW 846 7471A and moisture content using Method 2540 B. Remaining sample mass from the discrete sample intervals will be held at the analytical laboratory to enable finer resolution analysis at targeted locations upon receipt and review of the composite data in order to better inform remedial design, if necessary.

2.4 Documentation

Sampling activities will be documented in field notebooks and sample specific data will be collected electronically using the Locus Mobile App. Data recorded will include sample collection techniques, extent of sampling, date and time of sampling, weather conditions, and soil description. Any deviations from the work plan or additional information pertinent to sample collection will be recorded in the field notebook. Photo-documentation will be maintained with digital pictures.

The following information will be collected at each sampling location and recorded with the Locus Mobile App and/or in the field notebook:

- GPS position of the sample points
- Sample ID
- Bank height and approximate bank angle
- Limit of persistent woody vegetation/bank full elevation
- Ordinary high water
- Site description, including apparent land use, vegetation, and soil description

Soil descriptions will be documented using the Unified Soil Classification System (USCS) methodology, and will include observations on grain size, roundness of grains and sorting. Soil color will be documented using a Munsell color chart.

Consistent sampling techniques will be used at all locations to the extent practical, to maintain data comparability. Every attempt will be made to maintain data quality and comparability where physical or other conditions require any deviation from the work plan. When necessary, a specific sampling location may be moved either upstream or downstream to the nearest suitable sampling location where a boring can be retrieved. GPS coordinates will be collected at the new sample location, and a note will be made in the field notebook indicating the location was moved, and why.

3.0 Field Quality Assurance/Quality Control

Field quality assurance/quality control (QA/QC) samples are designed to help identify and minimize potential sources of contamination due to field procedures. Data from these samples can also be used to evaluate potential error introduced by sample collection and handling. This plan will follow the QA/QC guidelines outlined in the AOC 4 Quality Assurance Project Plan (AECOM, 2016).

3.1 Duplicate Samples

Duplicate samples will be collected at 5% of the sampling locations. They will be homogenized in the field prior to being placed in sample jars. Analysis for THg will be performed by the laboratory on both samples for confirmation of THg analysis.

3.2 Matrix Spikes and Matrix Spike Duplicates

Matrix spikes and spike duplicates for THg will be performed by the laboratory on 5% of the analytical samples for the confirmation of THg analysis.

3.3 Equipment Blank Samples

A rinsate of sampling equipment will be sampled and analyzed to determine whether decontamination procedures have been effective. A rinsate sample (i.e. equipment blank) will be collected from the decontaminated sampling equipment before sampling. Organic-free deionized water will be poured over the decontaminated sampling apparatus and the rinsate will be transferred to the sample bottles. The same parameters to be analyzed in the test samples, will be analyzed for in the rinsate samples. The rinsate sample will be assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory along with the actual samples collected that day.

3.4 Identification, Handling, and Chain-of-Custody (COC)

Samples will be identified, handled, and recorded as described in this work plan. Each sample container will have a label affixed to the outside. All documentation and labels will be marked using waterproof ink with a unique sample identification number. The sample identification number will be recorded in the project notebook/field logbook using the following labeling convention:

EVENT/DATE CODE - BANK SEGMENT - TRANSECT ID – BORING ID - DEPTH

The SAMPLE ID will consist of up to 25 alphanumeric characters and contain the following details:

- Event/Date Code –SS for surficial soils
- Bank Segment ID – RBH or LBH
- Transect ID – 100
- Sample Elevation – top and bottom of the interval with 0 being the top of bank or highest elevation sampled

For example:

- SS042519-RB11-100-(1-2) for discrete sample intervals
- SS042519-RB11-100-COMP for lab composite

Sample containers will be packed to minimize breakage or damage to samples, and placed in shipping containers that meet or exceed Department of Transportation requirements. Cushioning material will be added to the container as needed. COC and other relevant forms will be sealed in Ziploc® bags and placed inside of the shipping container, on top of the sample containers to ensure their availability when the container is opened at the receiving laboratory. The shipping container will be taped closed, and a signed custody seal will be affixed to the side of the container. Laboratory address labels will be placed outside, and on top of the shipping container.

All samples are assumed to contain low levels of contamination, and will be packaged and shipped as environmental samples in accordance with applicable federal and state regulations. Standard procedures to be followed for shipping environmental samples to the analytical laboratory are outlined below:

- Transported to the laboratory by personnel, shipped by Federal Express or equivalent overnight service, or picked up by a lab courier.
- Shipments from the field will be scheduled for overnight delivery, with the exception of weekends or holidays, if possible.

The laboratory will be notified so they are prepared to receive a shipment of samples; notification will include the number of samples, type, and date of shipment.

An established program of sample COC will be followed during sample handling activities for both field and laboratory operations. The primary purpose of COC procedures is to document the possession of the samples from collection through shipping, storage, and analysis to data reporting and disposal.

Tracing sample possession will be accomplished by using the COC record. A COC entry will be recorded for every sample and a COC record will accompany every sample shipment to the laboratory. At a minimum, the COC record will contain the following information for each sample:

- Sample number and identification of sampling point
- Date and time of collection
- Sample collection description
- Sample type
- Number, type, and volume of sample container(s)
- Sample preservative
- Analysis requested
- Name, address, and phone number of laboratory or laboratory contact
- Signature, dates and times of persons in possession
- Any necessary remarks or special instructions

Once the COC form is complete and the samples are ready for shipment, it will be placed inside the shipping container, and the container will be sealed. Samples are considered to be in custody if they are within sight of the individual responsible for their security, or locked in a secure location. Each person who takes possession of the samples, except the shipping courier, is responsible for sample integrity and safekeeping.

4.0 Reporting

Data collected as part of this effort will be used to inform remedial decision-making and the design process. A brief technical memorandum will be provided within 45 days after final data have been received from the laboratory and validated, summarizing sampling activities, analytical results and any deviations from the proposed sampling plan. Data collected in this program will be incorporated into the broader SRST database and used to further the understanding of mercury concentration and distribution within the focus reach.

5.0 Health and Safety

The SRST Safety Program, along with the AOC-4 Health and Safety Plan for 2019, will be reviewed to ensure that site-specific health and safety protocols are followed for this investigation. In addition, prior to the initiation of any work, a safety meeting will be held each morning by field team members to discuss health and safety issues that may be encountered during fieldwork on that day.

Potential health and safety threats encountered during sampling may include, but are not limited to, inclement weather, biological hazards (e.g., poison ivy, tick exposure), uneven terrain, pinch points and work over/adjacent to water. No field sampling or other activity that poses an unacceptable risk to personal safety will be undertaken.

6.0 References

AECOM. 2015. RCRA Quality Assurance Project Plan, Former DuPont Waynesboro Site Area of Concern (AOC) 4: South River and a Segment of the South Fork Shenandoah River, Virginia. Initial QAPP prepared by URS Corporation in August 2014; revised February 2016.

Anchor QEA, URS Corporation, E.I. du Pont de Nemours and Company. 2015. Final Interim Measures Design, Implementation, and Monitoring Work Plan. Phase I - South River Area of Concern 4.

Brent, R.N., H.M. Wines, J.C. Luther, N.L. Irving, J. Collins, and B.L. Drake. 2017. "Validation of handheld X-ray fluorescence for in situ measurement of mercury in soils." *Journal of Environmental Chemical Engineering 5 (2017): 768-776*.

Brent, R.N.. 2016. XRF Field Demonstration Project. (Unpublished).

Tables

Table 1: Analytical Schedule
Preliminary Phase 2 BMA Investigation – RRM 2-3
Former DuPont Waynesboro Site - Area of Concern 4
Waynesboro, Virginia

Sample Purpose	Number of Transects	Number of Samples	Analysis	
			THg (SW 846 7471A)	**Moisture** (2540 B)
Characterization	30	30	X	X
XRF Confirmation	7	7	X	X
Field Duplicate	5%	2	X	X
MS/MSD	5%	2	X	
Equipment Blank	1 per day	1 per day	X	

Notes:

THg, Total Mercury

MS, Matrix Spike

MSD, Matrix Spike Duplicate

Table 2: Analyte Reporting Limits
Preliminary Phase 2 BMA Investigation – RRM 2-3
Former DuPont Waynesboro Site - Area of Concern 4
Waynesboro, Virginia

Analyte	Matrix	Analytical Method	CAS Number	Laboratory Method Detection Limit (MDL)	LaboratoryReporting Limit (RL)	Units
Total Mercury	Sed/Soil	SW-846 7471A	7439-97-6	0.01	0.10	mg/kg
Moisture	Sed/Soil	SM20 2540G-1997	EVS0198	0.5	0.5	%
Total Mercury	Water (blank)	SW-846 7470A	7439-97-6	0.0081	0.0002	mg/l

Notes:

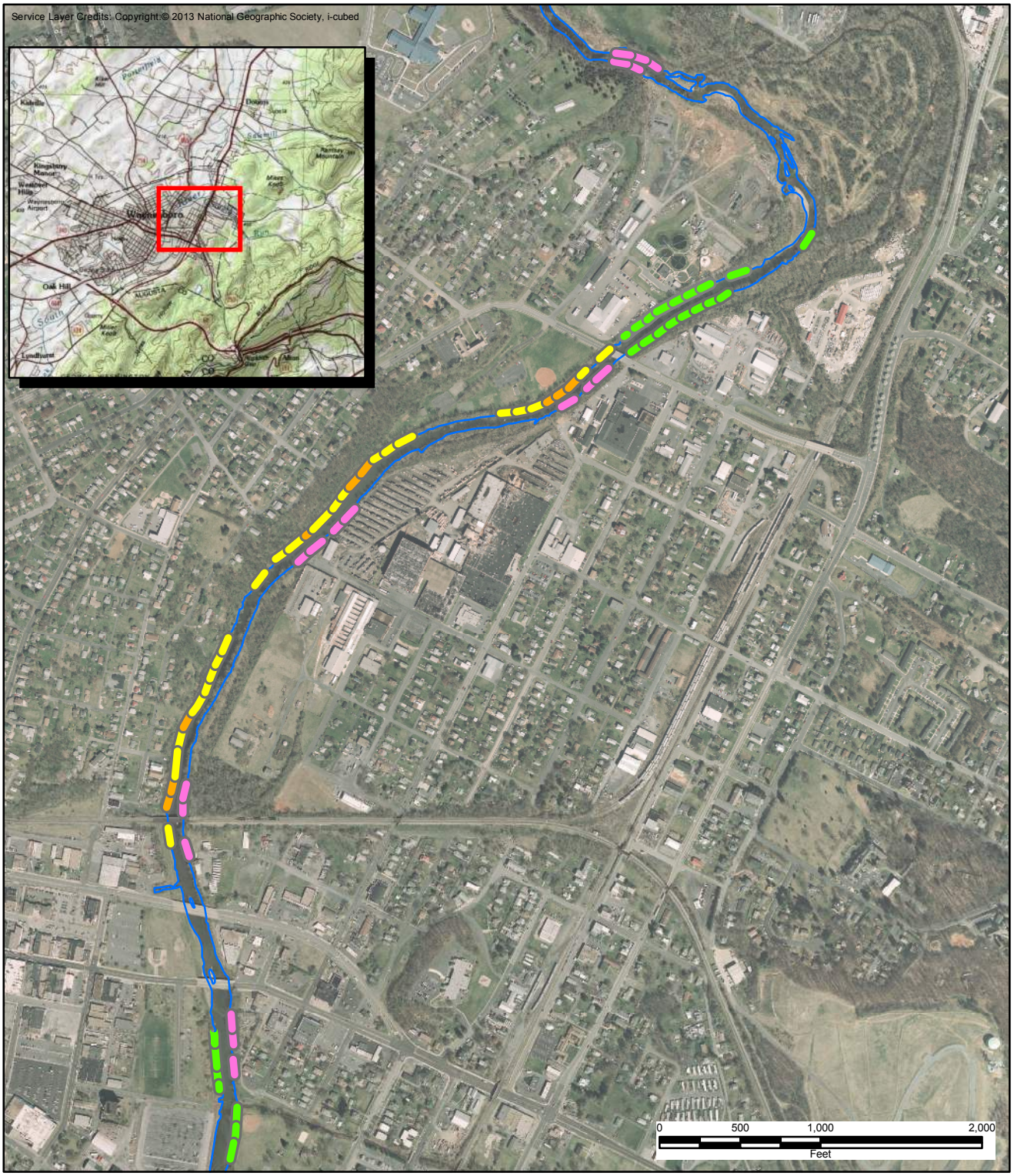
mg/kg, milligram per kilogram

mg/l, milligram per liter

Table 3: Analyte Quality Assurance Limits
Preliminary Phase 2 BMA Investigation – RRM 2-3
Former DuPont Waynesboro Site - Area of Concern 4
Waynesboro, Virginia

Parameter	Test Method	Matrix	Field Precision % RPD (Field Dup)	Laboratory Precision % RPD (LCSD)	Laboratory Accuracy % Recovery (LCS)	Laboratory Precision % RPD (MSD or lab DUP)	Laboratory Accuracy % Recovery (MSD)	Data Completeness Goal %
Mercury	SW 846 7471A	Sed/Soil	50	20	80-120	20	80-120	90
Mercury	SW 846 7470A	Water	N/A	20	80-120	20	80-120	90
Moisture	SM20 2540G-1997	Sed/Soil	50	N/A	99-101	15	N/A	90

Figures

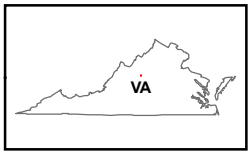


Legend

- Phase 1 Completed
- Phase 1 Capping
- Phase 1 Removal
- Phase 1 Minor BMA

Coordinate System: NAD 1983 StatePlane Virginia North FIPS 4501 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Units: Foot US

Referenes:
Basemap Imagery (ESRI)



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Prepared by: CDW	
Checked by: JC	
Date: 3/27/2019	

Figure 1
Phase 1 Bank Management Areas
Preliminary Phase 2 BMA Investigation – RRM 2-3

Former DuPont Waynesboro Site – AOC 4
Waynesboro, Virginia

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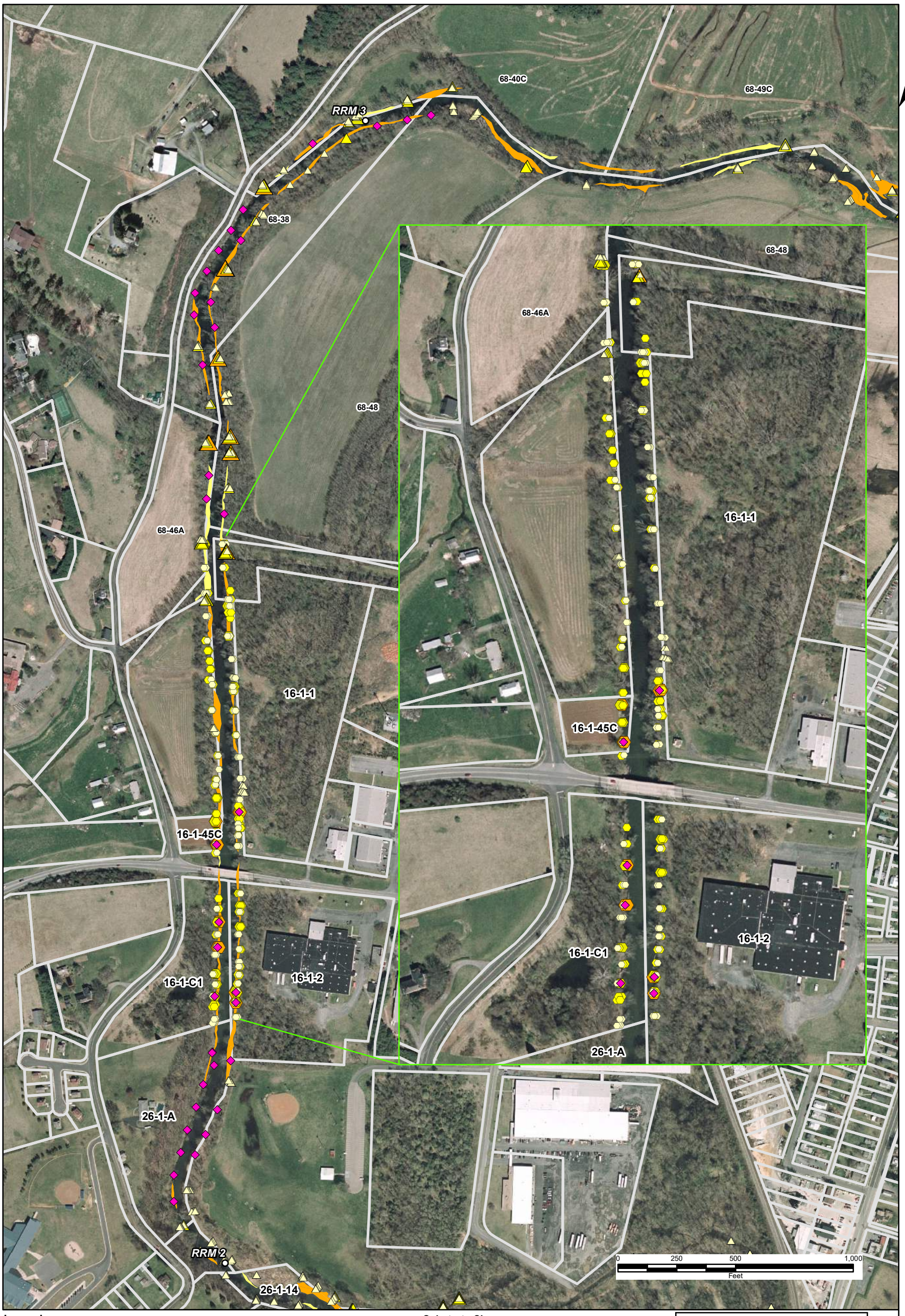


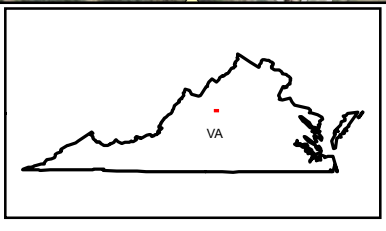
Legend

- RRM Intervals Whole Mile
- Proposed Sample Locations

Soil THg (mg/kg)	XRF Soil THg (mg/kg)
< 18	< 18
18 - 55	18 - 55
55 - 150	55 - 150
> 150	> 150

Substrate Class

- 1.) Clays and Silts
- 2.) Fine Sands
- Parcels



Reference:
World Imagery (Waynesboro)

Coordinate System: NAD 1983 StatePlane Virginia North FIPS 4501 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Units: Foot US

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Figure 2
Proposed Sample Locations
Phase 2 BMA Identification

Former Dupont Waynesboro Plant - Area of Concern 4
Waynesboro, Virginia

Path: S:\Projects\IMS\DUPONT\STHRIVER\Projects\BankConcAndLoading\2013RemediationWorkPlan\Figure 2 - Proposed Sample Locations_11x17.mxd

Appendices

Appendix A

AECOM - South River Protocol SRSO-1: Sampling Floodplain Soils

(Revised 4/9/13)

Scope of Work Summary

Floodplain soil sampling may be conducted in areas indicated as potential external sources of loading. The areas are likely to be low-lying areas of adjacent floodplain potentially wetland areas. As these areas are identified, more specific information regarding matrix types and spatial extent will allow the modification of this protocol to contain detailed sampling information, such as the number and location of samples in each area. Soil samples may be collected using the following apparatus:

- Shovel, spade or hand trowel
- Hand or bucket auger
- Split barrel sampler (12” or less)

FLOODPLAIN SOIL SAMPLING GUIDELINES

The purpose of this document is to provide guidance for the collection of soil samples for chemical or geotechnical analysis using a variety of methods. Potential hazards are addressed in the Project-specific Health and Safety Plan (HASP).

Equipment

- Shovels, spade or hand trowel
- Split-barrel sampler
- Stainless steel auger bucket
- Extension shafts
- Cross handle
- Short cores (stainless steel)
- Tape measure
- Stainless steel sampling tools
- Stainless steel bowl
- Spade or shovel/Stainless steel trowel(s)
- Appropriate sample containers
  - For soils, polyethylene bags are appropriate sample containers
- Sample container labels
- Permanent and waterproof markers
- Ice chest and ice
- Field Data Sheets
- Chain-of-custody (COC) forms
- Custody seals
- Powder-free Nitrile gloves
- Appropriate Decontamination supplies
- Dry ice (if methylmercury analysis to be requested)
- Organic free deionized water
- Sampling location maps
- GPS unit
- Camera and film
- Appropriate health and safety equipment
- Label tape (clear)

- Paper towels
- Plastic sheeting
- Plastic bags

Decontamination Procedures

Before sampling begins, the soil sampling device, stainless steel bowls, and spoons will be decontaminated. The equipment will be decontaminated between sampling locations.

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Sponges or paper towels
- Formula 409
- Potable tap water
- Deionized water
- Hand-held sprayers or spray bottles
- Trash bags
- Plastic sheeting

All non-disposable equipment used for the collection, preparation, preservation, and storage of environmental samples must be cleaned prior to use and after each subsequent use.

Decontaminating Hand Augers

Upon completion of hand-auger boring, equipment used will be decontaminated by the following procedures:

- Be aware of safety. Don appropriate personal protective equipment (PPE), as prescribed in the HASP for this project.
- Disconnect the hand auger parts such as auger head and auger extensions.
- Place the hand auger parts into a container holding Formula 409 tap water mixture (1:10). Ensure that the entire surface of the hand auger that was in contact with soil is submersed in the Formula 409 solution.
- Thoroughly rinse with distilled water.
- Reconnect the hand auger parts. Dry the parts with paper towels.
- If the hand auger is not going to be used soon, place it in a clean bag or container.

Decontaminating Shovels, Spades, and Trowels

Upon completion of the soil sample collection, miscellaneous equipment used to collect the sample will be decontaminated. Equipment that comes into contact with soil will be decontaminated using the following procedure:

- Be aware of safety. Don appropriate personal protective equipment (PPE), as prescribed in the HASP for this project.
- Remove excess soil by scraping.
- Brush-wash in the plastic container holding Formula 409 and tap water (1:10). Equipment should be brushed until all soil is removed from the item being decontaminated.
- Remove the item from the plastic container and rinse thoroughly with distilled water.
- Dry the item with a clean paper towel.

Following decontamination, the sampling equipment will be placed in a clean area and covered to prevent contact with the ground surface or other unclean surfaces. If the equipment is not to be used immediately, the equipment will be covered or wrapped in plastic sheeting or heavy-duty trash bags to minimize potential contamination.

Soil Collection and Handling Procedures

Grab Surface Soil Sampling

This method involves the collection of soil from at or near the ground surface using tools such as, spades, shovels, trowels, and scoops. The surface material is removed to the required depth and a stainless steel trowel or plastic scoop (used when sampling for semi-volatile compounds) is used to collect the sample. The following procedure describes the procedure used to collect surface soil samples:

- Remove and discard sticks, rocks, vegetation and other debris from the sampling area using a pre-cleaned sampling tool.
- Place an appropriate amount of soil, based on the analyses to be performed, into a stainless steel bowl or other appropriate container.
- Homogenize the soil using a stainless steel trowel or spoon and fill the sample containers.
- Label sample jars/sample bag
- Return unused soil to the collection location.
- Store the sample on ice in a cooler and document sample.
- Record applicable information on the Sample Collection Field Sheet and Chain-of-Custody (COC).

Split Barrel Sampler

The split-barrel sampler is generally used to collect undisturbed soil cores from a sample depth less than 12 inches. However, if accurate soil profiles are necessary, consider digging a clean face, as the split barrel sampler can compress or generate poor recovery, leading to inaccuracies. This procedure must be carried out in the following manner:

- Be aware of safety. Don appropriate PPE, as prescribed by the HASP for the project.
- Decontaminate the split-barrel sampler to be used for soil sampling.
- Drive the sampler into undisturbed soil to 12 inches maximum.
- Pull the split-barrel sampler out of the borehole and detach the sampler from the center rods.
- Disassemble the sampler.
- Using stainless steel tools, place the soil sample in appropriate sample containers.
- Place a completed sample label on the container and place the sample in a cooler.
- Pack, label, and ship the samples following the Soil Sample Packaging, Handling, and Shipping Guidelines.
- Decontaminate all equipment prior to moving to next location, following the Soil Sampling Decontamination Procedures.

Hand or Bucket Augers

The hand or bucket auger is used to collect soil from a specific depth. A large volume of soil can be collected from a discrete area in a short period of time. Soil sampling using a hand or bucket auger must be carried out in the following manner:

- Be aware of safety. Don appropriate personal protective equipment (PPE), as prescribed by the HASP for the project.
- Clear the area to be sampled of soil debris.
- Depending on the type of soil material present, attach either a regular auger bucket or a mud auger bucket to an extension shaft. Attach a cross handle to the other end of the extension shaft.
- Decontaminate the auger bucket prior to initial use (see Soil Sampling Decontamination Procedures for decontamination procedures).
- Turning the handle clockwise, auger down until the auger bucket is full of soil.
- Lift the auger out of the bore hole and deposit the excavated soil on an impermeable plastic liner to prevent any leaching of possible contaminants.
- Attach additional extension shafts as needed.
- Place the auger back in the bore hole and advance it to the required sampling depth.

- While wearing gloves, remove the soil from the auger bucket and place it in the sample container. If a sample is to be analyzed for volatile chemicals, this sample should be collected first and care should be exercised so that there is no headspace in the sample container. Non-volatile samples will be composited in a stainless steel bowl and then placed into sample containers.
- Label the sample container and place it in a cooler.
- Repeat the procedure for the desired number of soil samples.
- Decontaminate all equipment prior to moving to the next location (see Soil Sampling Decontamination Procedures).
- Pack, label, and ship the samples following the Soil Sample Packaging, Handling, and Shipping Guidelines.

Health and Safety Procedures

To avoid incidents or injuries during sampling, the following health and safety procedures should be followed:

- Toxic or otherwise harmful concentrations of metals or other constituents are unlikely to be encountered while sampling floodplain soils. However, sampling crews should be trained in the general hazards of field sampling and how to minimize risks of exposure.
- Operating in or around waterbodies carries the inherent risk of drowning. U.S. Coast Guard approved personal flotation devices must be worn when operating or sampling from a boat, when sampling in more than a few feet of water, or when sampling in swift currents.
- Collecting samples in cold weather, especially around cold waterbodies, carries the risk of hypothermia and collecting samples in extremely hot and humid weather carries the risk of dehydration and heat stroke. Sampling team members should wear adequate clothing for protection in cold weather and should carry an adequate supply of water or other liquids for protection against dehydration in hot weather.
- Sampling team members must cover exposed skin and/or use sunscreen for protection against sunburn and melanoma.
- When working on all waterbodies, sampling teams must develop and employ an emergency response plan, including the use of an onshore monitor that is accountable for the whereabouts of the team. The monitor can request aid if the team fails to report in at end of workday and can provide assistance to rescuers or the team under any emergency situation.

Field Quality Assurance/Quality Control

Field quality assurance/quality control (QA/QC) samples are designed to help identify and minimize potential sources of sample contamination due to field procedures and to evaluate potential error introduced by sample collection and handling. All field QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory with

the other samples for analyses. The frequency of QA/QC samples is specified in the WP.

Field/Equipment Blank Samples

An equipment rinsate sample of sampling equipment is intended to check if decontamination procedures have been effective. A rinsate sample (also referred to as a "field blank") will be collected from the decontaminated sampling equipment before it is used to obtain the sample. Organic-free deionized water will be rinsed over the decontaminated sampling apparatus and transferred to the sample bottles. The same parameters that are being analyzed in the samples will be analyzed in the rinsate samples. The rinsate sample is assigned a QA/QC sample identification number, stored in an iced cooler, and shipped to the laboratory along with the sediment/residue samples collected that day.

Duplicate Samples

Duplicate samples are samples collected as close as possible to each other in time and space to check for the natural sample variance and the consistency of field techniques and laboratory analysis. The duplicate samples will be collected at the same time as the primary samples and will be handled in the same manner as the primary sample. The duplicate sample will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory along with the primary sample it duplicates. For baseline constituents, one duplicate sample will be collected after every 20 samples. Additional field duplicates may be collected if conditions suggest the need for more or more are specified in the sampling and analysis plan.

Matrix Spikes and Matrix Spike Duplicates

Matrix spikes and Matrix Spike Duplicates (MS/MSDs) are used to determine the long-term precision and accuracy of the laboratory analytical method on various matrices. For this procedure, duplicate samples are collected along with the field samples and the lab does the spiking. Separate samples for matrix spikes (MS) and matrix spike duplicates (MSD) must be collected unless the laboratory specifies that these analyses can be run using an actual sample. MS/MSD samples will be labeled and shipped to the laboratory along with the primary sample from which it was collected.

Sample Identification, Handling, and Chain-of-Custody

Samples will be identified, handled, and recorded as described in this sampling guideline. Each sample container has a sample label affixed to the outside. The sampler marks each label with the following information using waterproof ink:

- Project name
- Sample identification number
- Date and time of collection
- Initials of sampling technician
- Requested analysis

- Method of preservation

Sample containers will be packed in bubble wrap to minimize breakage or damage to samples and placed in metal or plastic coolers. Dry ice will be placed around sample containers and additional cushioning material will be added to the cooler, if necessary. Paperwork will be put in a Ziploc bag and placed on top of the sample containers or taped to the inside lid of the cooler. The cooler will be taped closed and a signed custody seal will be affixed to the side of the cooler. Laboratory address labels will be placed on top of the cooler.

All samples are expected to contain low levels of contamination and will be packaged and shipped as environmental samples in accordance with applicable federal and state regulations. All shipments containing dry ice will conform to federal, state, and carrier regulations. Standard procedures to be followed for shipping environmental samples to the analytical laboratory are outlined below.

- All environmental samples collected will be transported to the laboratory by URS personnel, shipped through Federal Express or equivalent overnight service, or picked up by a lab courier.
- Shipments will be scheduled to meet holding time requirements.

The laboratory will be notified to be prepared to receive a shipment of samples. If the number, type, or date of shipment changes due to site constraints or program changes, the laboratory will be informed.

URS has established a program of sample chain-of-custody (COC) that will be followed during sample handling activities in both field and laboratory operations. The primary purpose of COC procedures is to document the possession of the samples from collection through shipping, storage, and analysis to data reporting and disposal. The Task Manager or his/her designee will be responsible for monitoring compliance with COC procedures.

Tracing sample possession will be accomplished using the COC record. A COC entry will be recorded for every sample, and a COC record will accompany every sample shipment to the laboratory. At a minimum, the COC record will contain the following information for each sample:

- Sample number and identification of sampling point
- Date and time of collection
- Sample type
- Number, type, and volume of sample container(s)
- Sample preservative
- Analysis requested
- Name, address, and phone number of laboratory or laboratory contact
- Signature, dates and times of persons in possession
- Any necessary remarks or special instructions

Once the COC is complete and the samples are ready for shipment, the COC will be placed inside the shipping container, and the container will be sealed. Samples are considered to be in custody if they are within sight of the individual responsible for their security or locked in a secure location. Each person who takes possession of the samples, except the shipping courier, is responsible for sample integrity and safekeeping.

Field Logbook and Field Data Sheet

The most important aspect of documentation is thorough, organized, and accurate record keeping. All information pertinent to the investigation will be recorded in the field logbook and/or field data sheets. All entries in logbooks will be made in waterproof ink. Corrections will consist of line-out deletions that are initialed and dated. Entries will include the following, as applicable:

- Project name and number
- Name of sampler and field personnel
- Date and time of sample collection
- Sample number, location, and depth
- Sampling method
- Sampling media
- Sample type (grab or composite)
- Sample physical characteristics
- Sample preservation
- Observations at the sampling site (e.g., weather conditions)
- Unusual conditions
- Names and addresses of field contacts
- Names and responsibilities of field crew members
- Names and titles of any site visitors
- Location, description, and log of photographs (if taken)
- References for all maps and photographs
- Information concerning sampling changes, scheduling modifications, and change orders
- Summary of daily tasks and information concerning sampling changes, scheduling modifications, and change orders dictated by field conditions
- Signature and date by personnel responsible for observations

Field investigation situations vary widely. No general rules can include each type of information that must be entered in a logbook or data sheet for a particular site. Site-specific recording will include sufficient information so that the sampling activity can be

reconstructed without relying on the memory of field personnel. The logbooks will be kept in the field team member's possession or in a secure place during the investigation. Following the investigation, the logbooks will become a part of the final project file.

Sample Collection Field Sheet

Sample Collection Field Sheets will be completed for each sample by the sampling personnel (geologist, geological engineer, or geotechnical engineer). Most of the information required on the field sheet will have been completed at the conclusion of the soil sampling.

Definitions

- *Apparatus*: Devices used for sample collection or sample preparation that will contact samples.
- *Equipment Blank* (EQBLK): An aliquot of reagent water or other water of known low analyte content that is subjected in the field to all aspects of sample collection and analysis, including contact with all sampling devices and apparatus. For this method, equipment blanks consist of rinsate from pumps and buckets.
- *Field Blank* (FLDBLK): An aliquot of reagent water or other water of known low analyte content that is placed in a sample container in the field and treated as a sample in all respects, including exposure to sampling site conditions, storage, preservation, shipping and all analytical procedures.
- *Field Duplicate* (DUP): Two identical aliquots (splits) of a field sample placed in separate bottles and treated exactly the same throughout field and laboratory procedures. Analyses of field duplicates provide a measure of the precision associated with sample collection, preservation and storage, as well as with laboratory procedures.
- *Matrix Spike and Matrix Spike Duplicate*: Aliquots of an environmental sample to which known quantities of an analyte are added in the laboratory. The MS and MSD are analyzed exactly like a sample. The purpose is to quantify the bias and precision caused by the sample matrix. The background concentration of the analyte in the sample matrix must be determined in a separate aliquot and the measured values in the MS and MSD corrected for this background concentration.
- *May*: This action, activity or procedural step is optional.
- *May Not*: This action, activity, or procedural step is prohibited.
- *Minimum Detectable Level* (MDL): The lowest concentration at which the entire analytical system gives a recognizable signal and acceptable calibration point.
- *Must*: This action, activity, or procedural step is required.
- *Reagent Water*: Water demonstrated to be very low (e.g., at or less than the MDL) in metals (and other water quality constituents) and free of potentially

interfering substances. Reagent water is usually distilled or deionized water, the purity of which must be verified by analysis.

References

USEPA, Washington, D.C., Lisa Feldt - Principal Editor, Report Number EPA/540/P-87/001, "A Compendium of Superfund Field Operations Methods," December 7.

USEPA, 1996. Region IV Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.