Lockheed Martin Corporation
6801 Rockledge Drive MP: CCT-246
Bethesda, MD 20817
Telephone 301-548-2209

July 28, 2020

VIA EMAIL AND PRIVATE CARRIER

Gary Schold, Project Manager
Land Restoration Program
Land and Materials Administration
Maryland Department of the Environment
1800 Washington Boulevard, Suite 625
Baltimore, Maryland 21230

Subject: Soil Management Plan for Blocks E and I
Lockheed Martin Corporation – Middle River Complex
2323 Eastern Boulevard, Middle River, Baltimore County, Maryland

Dear Mr. Schold,

For your review, please find enclosed two hard copies with a CD of the above-referenced document. This document is an update to the Soil Management Plan for the referenced tax blocks of the Middle River Complex in Middle River, Maryland. As the revisions to the previous version were relatively minor, for your convenience we have also included a redline/strikeout version of the revisions from the 2019 Soil Management Plan on the CD.

If possible, we respectfully request to receive MDE's document review comments by September 8, 2020.

Please let me know if you have any questions. My office phone is (301) 548-2209.

Sincerely,

Thomas D. Blackman
Project Lead, Environmental Remediation

cc: (via email without enclosure)
Christine Kline, Lockheed Martin
Norman Varney, Lockheed Martin
Tom Green, LMCPI
Michael Martin, Tetra Tech
Cannon Silver, CDM Smith

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Christopher Keller, LMCPI
Glen Harriel, LMCPI

cc: (via mail with enclosure)
Budd Zahn, MRAS

SOIL MANAGEMENT PLAN
FOR BLOCKS E AND I
MIDDLE RIVER COMPLEX
MIDDLE RIVER, MARYLAND

Prepared for:
Lockheed Martin Corporation

Prepared by:
Tetra Tech, Inc.

July 2020

Approved by:
Lockheed Martin, Inc.

Revision: 1

Michael Martin, P.G.
Regional Manager

IMPORTANT NOTICE: A hardcopy of this document may not be the version currently in effect. The current version is posted on the Lockheed Martin Network. Employees will verify the current version on the network prior to using this document.

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ACRONYMS

CESH	Corporate Energy, Environment, Safety, and Health
CFR	Code of Federal Regulation*s*
COMAR	Code of Maryland Regulations
HAZMAT	hazardous materials
HDPE	high density polyethylene
IDW	investigation-derived waste
LLDPE	linear low-density polyethylene
LMCPI	Lockheed Martin Corporation Properties, Inc.
Lockheed Martin	Lockheed Martin Corporation
MDE	Maryland Department of the Environment
mg/kg	milligrams per kilogram
MRC	Middle River Complex
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
RSL	regional screening level
TCLP	toxicity characteristic leaching procedure
Tetra Tech	Tetra Tech, Inc.
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facilities
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency

SECTION 1
PURPOSE/OBJECTIVES

On behalf of Lockheed Martin Corporation (Lockheed Martin), Tetra Tech, Inc. (Tetra Tech) has prepared this soil management plan (the plan) to address management of soil and groundwater that may be disturbed during excavation activities within Blocks E (known locally as "the D-Lot.") and I at the Lockheed Martin Middle River Complex (MRC). The purpose of this document is to ensure soil management within the referenced tax blocks is handled, characterized, and disposed or reused appropriately.

This soil management plan applies to all intrusive activities conducted in the referenced Middle River Complex blocks that include handling soil and groundwater. Activities covered by this soil management plan include, but are not limited to, site maintenance, facility improvements, emergency utility repair, environmental remediation, or any other activity that disturbs the ground. These activities include those conducted by all site occupants, including LMC Properties, Inc. (LMCPI), on-site tenants (e.g., Lockheed Martin Corporation's Rotary and Mission Systems business area [RMS], MRA Systems, Inc., ([MRAS], formerly Middle River Aircraft Systems,) and/or their respective contractors), and Lockheed Martin Corporate Energy, Environment, Safety, and Health (CESH) environmental restoration program activities conducted under Administrative Consent Order ACO-SAR-MDE0746-2015-1-01.

This plan is specific to the handling, characterization, and disposition of soil or groundwater removed as part of the subject activities described above. This plan is not intended to address all requirements related to these activities, which may include, but are not limited to, utility clearance; health and safety considerations; safe work practices; permitting requirements; sediment and erosion control measures; or any other aspect of the subject work other than management of soil or groundwater. Although spill reporting requirements are not specifically addressed in this document, they are pertinent for all site activities. For example, in accordance with Code of Maryland Regulation (COMAR) 26.10.01.03, all oil spills, regardless of volume, are reportable to

the Maryland Department of the Environment within two hours of the spill. The 24-hour phone number for reporting spills is 1-866-633-4686.

The objective of this plan is to ensure that any soil or groundwater removed from the ground is managed appropriately. In addition, the handling and disposal of any wood block flooring removed from within any building in Block I is also subject to the requirements in this plan. This plan ensures that any contaminated or possibly contaminated material is properly characterized and disposed of in a Lockheed Martin approved facility, and that no soil from Blocks E and I will be moved and reused elsewhere on the facility unless characterization data and acceptable risk-based screening criteria as described in the plan are met. Excavations in areas not known to be contaminated where all excavated material is returned to the excavation (and is not determined to be impacted based on visual and olfactory evidence) are not required to be characterized under this plan. The plan is applicable to excavations in Middle River Complex Blocks E and I. Blocks E and I do not have recorded environmental covenants, but Maryland Department of Environment has requested that all activities subject to this plan are reported per the requirements described in this plan.

The plan is organized as follows:

> Section 2—Soil Management Procedures: describes the sequence of activities to be followed to ensure appropriate handling of soil and groundwater generated from excavations performed at the Middle River Complex.
>
> Section 3—Excavation Reporting Requirements.

SECTION 2
SOIL MANAGEMENT PROCEDURES

This section describes the sequence of activities to be followed to ensure appropriate handling of soils and groundwater at the Middle River Complex (MRC). This plan pertains to Blocks E and I as depicted on Figure 2-1. The site contact list is attached as Appendix A.

2.1 CONTACT CESH FOR HISTORICAL DATA REVIEW

Once an area requiring excavation has been identified, data from the relational database for that location and associated data from investigations conducted by Lockheed Martin Corporate Energy, Environment, Safety, and Health (CESH) must be consulted to determine if known contamination is present in the excavation area(s). The excavation process should be started as follows:

1. Submit a drawing showing the location and approximate dimensions of the excavation to CESH

2. CESH will consult the list of Recognized Environmental Conditions (RECs), records of historical investigations, and the database, then provide a summary of existing data either within the excavation or nearby the excavation (i.e., within 25 feet of planned excavation)

A preliminary understanding of site conditions in Blocks E and I, based on current investigation data, is provided in Figures 2-2 and 2-3 (respectively). These graphics, in relative terms, provide an understanding of where contaminated soil or groundwater is more likely to be encountered. Use of this information is limited by the degree of investigation conducted in any specific area of the site, and it is not intended to be a substitute for submission of the excavations' boundaries to CESH.

Note that as of publication of this plan, soil within certain areas of Block E is subject to specific regulatory requirements, as some areas within Block E soil contain polychlorinated biphenyl (PCB) concentrations above the Toxic Substances Control Act (TSCA) regulatory limit of 50 milligrams per kilogram (mg/kg). (Note: Tax Block E is known locally as "the D-Lot.") In addition, subsurface piping associated with former Building D in Block E may contain radiological constituents that require special handling, transportation, and disposal. A preliminary

determination of listed hazardous waste (F001) was determined for the southeastern corner of Block E and is discussed further in Section 2.2. This area of concern is depicted on Figure 2-2. Note that any excavation conducted within Block E must be coordinated in advance through CESH.

2.2 SOIL MANAGEMENT

2.2.1 Characterization Sampling and Analysis

Soil characterization for disposal or off-site recycling may be performed by either *in situ* pre-characterization or by sampling and analysis of stockpiled soil. Pre-characterization can be beneficial from both a cost and project execution perspective. Sample frequency, analytical methods, and acceptability of pre-characterization results must be coordinated with the Lockheed Martin-approved receiving facility. Sampling of *in situ* or excavated soil and material must be done at sufficient and adequately distributed locations so that the concentrations of the contaminants of concern are adequately characterized as required by the disposal or recycling facility. Asphalt and concrete that does not have residual soil adhering are typically not required to be tested subject to approval by the receiving facility. Note that *in situ* pre-characterization is required for soils which may contain PCBs at concentrations regulated by the Toxic Substances Control Act (TSCA), as discussed below.

Lockheed Martin maintains an approved list of nonhazardous waste disposal, Resource Conservation and Recovery Act (RCRA) hazardous waste Treatment, Storage, and Disposal Facilities (TSDF); and, radioactive waste disposal facilities. In addition, hazardous waste must be transported by a Lockheed Martin approved vendor. These lists are updated generally quarterly and, as such, the most current version should be obtained from CESH to ensure the most current version is in use. Recycling facilities for soil, asphalt, or concrete also require prior CESH approval.

Hazardous waste determinations must be made in accordance with 40 Code of Federal Regulations (CFR) 262.11, combining process knowledge and/or analytical evaluation of waste samples. Hazardous waste resulting from excavation activities is generally limited to waste that is characterized as hazardous based on the toxicity characteristic leaching procedure (TCLP). A preliminary determination of listed waste (F001) was determined for the southeastern corner of

Block E due to the discovery in 2013 of an underground storage tank containing high concentrations of trichloroethene (at former Building D), not far from the existing firewater storage tank. Therefore, groundwater and soil encountered in this area must be appropriately categorized for proper handling and disposal in consultation with CESH.

As stated earlier, some areas of Block E soil contain PCB concentrations above the TSCA and Maryland Hazardous Waste limit (both at 50 mg/kg). Regulations governing the management of investigation-derived waste (IDW) containing PCBs, which are generally based on *in situ* concentrations, are included in 40 CFR 761. Therefore, Block E soil sampling must be conducted in accordance with the applicable TSCA regulations including *in situ* pre-characterization sampling. PCB-contaminated material with concentrations less than 50 mg/kg are generally not regulated under TSCA and may be disposed in approved Subtitle D facilities per their discretion and permitted limits. Acceptance concentrations for PCB-contaminated waste vary with each facility and must be verified with each disposal facility used. Subsurface piping (and soil) associated with the former Building D in Block E may also contain radiological constituents that require special handling, transportation, and disposal. Due to these unique conditions specific to Block E, any excavation there must be coordinated through CESH.

Chemical data required by the selected disposal or recycling facilities must be used to develop a waste profile. The minimum data requirements for waste characterization are defined in Table 2-1, but any additional analysis required by the receiving facility must also be completed. The selected receiving facility may also require that the waste profile includes an estimate of the type and quantity of non-soil materials such as concrete, bricks, or other debris. For concrete and asphalt the receiving facility may have sizing requirements or limits on the content of reinforcing metal bars. The waste profile must be approved by LMC Properties, Inc. (LMCPI), CESH, or CESH-authorized representatives before transportation and disposal can occur. Recycling facilities have similar characterization requirements that must be met before granting approval for acceptance and the appropriate Lockheed Martin authorized representatives must also approve this information per facility requirements. Characterization is not required (except as noted in Section 2.2.2) for exploratory excavations where all the soil will be returned to the same excavation.

2.2.2 Excavation Activities

Soil segregation must be performed on all excavated material. Any soil exhibiting visual or olfactory evidence of contamination must be segregated from possible non-impacted soil. Initial segregation must be performed during excavation using field screening, visual, and odor criteria. If potentially contaminated material is encountered, CESH must be contacted immediately. To the extent possible, an attempt must be made to segregate soils contaminated only with petroleum products from soil that may be contaminated with other hazardous materials. In general, more options are available for managing soil contaminated only by petroleum, as compared to other chemical contaminants; different materials which are already mixed together are to be managed based on their worst/most restrictive constituents.

Soil excavated from areas not previously identified as contaminated (e.g., based on existing data from screening the CESH relational database) and showing no visual or olfactory evidence of significant contamination can be used as backfill in their original excavation without testing.

Blocks E and I have not presently met Maryland Department of the Environment (MDE) remedial action requirements that would enable the implementation of Land Use Controls or MDE's assignment of any Environmental Covenants. Therefore, soil from within Blocks E and I may not be transported to, or used as backfill in, any other block within the MRC property unless it meets Category 1 requirements defined in Section 2.3.2. Soil may be used as backfill in other then the originating excavation (but only within the same block) if characterization data and risk screening requirements defined in Section 2.3.1 (Category 2) are met.

2.2.3 Soil Storage

Excavated soil that will be stored onsite must be stockpiled or stored in roll-off containers or drums.

Stockpiled Materials— Excavated soil and materials must be stored on 20-mil (minimum or equivalent, such as doubled 10-mil plastic) polyethylene plastic (high density polyethylene [HDPE] or linear low-density polyethylene [LLDPE]) to prevent contamination of surface soil/storage materials. The material used under the stockpile must be a continuous product, without seams or overlap where leakage could occur. The stockpile must be securely covered with 6-mil (minimum) polyethylene sheeting. Excavated soil and materials must be stockpiled on a clear surface free of

anything that may serve to puncture or otherwise damage the plastic. The polyethylene sheeting must be bermed around the edges to prevent infiltration of stormwater, exfiltration of leachate, or transport of contaminated soil by stormwater. If excavated soil contains free liquids, the base of the temporary stockpile must be sloped to create leachate collection points. All leachate generated from the stockpiles must be collected and disposed of per proper characterization as required by the disposal facility.

Roll-off Containers— Roll-off containers for soil storage must be lined with polyethylene to contain any free water present, and containers should be securely covered to protect them from wind and precipitation. Roll-off containers that contain only asphalt or concrete free of residuals soils are not required to be lined.

Drums— Secondary containment apparatus must be placed under material stored in United States Department of Transportation (USDOT)-approved 55-gallon drums to contain any potential spills or leaks. Containment must include either a temporary spill containment system, consisting of 10-mil (minimum) polyethylene sheeting and two-inch by six-inch wooden boards that create a bermed edge, and/or a manufactured polyethylene spill containment pallet. The dimensions of the temporary spill-containment area will depend on the number of drums at the site. Drum capacity of the polyethylene spill–containment pallets ranges between two to four drums. The integrity of the containment systems must be monitored periodically. All secondary containment systems must be large enough to hold 55 gallons (i.e., the largest volume container stored in the system). Fifty-five-gallon drums must be stored on wooden pallets, with four or fewer drums per pallet. The wooden pallets must be stored on a hard, flat surface inside the spill containment system. It may be advisable to cover the drums and secondary containment with polyethylene sheeting to prevent accumulation of precipitation in the secondary containment structure.

Hazardous-waste designated soil and other material must be stored in a separate containment area from non-hazardous materials. This area must be demarcated with orange safety fencing (or similar) and identified as a "restricted area" with signage indicating hazardous waste to prevent site worker exposure to the material. PCB-contaminated material, identified as PCB remediation waste greater than or equal to 50 mg/kg, must be stored as for hazardous waste in accordance with 40 CFR 761.65 (c) (9).

Temporary storage containers and stockpiles must be secured and clearly labeled with a unique identifier to clearly identify the source of the material in accordance with all regulatory requirements. A form must be maintained by the organization conducting the excavation that tracks all excavated material from point of excavation, through stockpiling, and final disposition. An example waste tracking form is provided in Appendix B. Signs must be posted in front of the IDW storage area identifying the site, location, date of collection, number of containers, contents, volume, site and emergency contact information, and the location of spill control materials for the storage areas wastes.

Appropriate onsite personnel (e.g., Lockheed Martin Security, EMCOR [maintenance contractor]) must be informed when RCRA hazardous waste materials are on-site and be informed of the emergency response procedures regarding these materials.

2.3 BACKFILL REQUIREMENTS

2.3.1 Tax Blocks E and I

For excavations that require backfill, either being reused from a different excavation within the same tax block or imported from an off-site source, the backfill must meet the standards for Category 2 – Non-Residential Unrestricted Use Soil and Fill Material as defined in the Maryland Department of the Environment *Fill Material and Soil Management* fact sheet (MDE, 2017; see Appendix C). In order to meet this specification, the concentration of all chemicals must be less than or equal to the current industrial United States Environmental Protection Agency (USEPA) regional screening levels (RSLs) for soil (USEPA, 2020) set at a hazard quotient (HQ) of 0.1 for non-carcinogens and at a lifetime cancer risk of 1×10^{-6} for carcinogens. The user should refer to the Composite Worker Soil Table on the USEPA website, selecting the lower of the RSLs in the Carcinogenic SL and Noncarcinogenic SL columns for comparison to site data. Exceptions to the RSLs include acceptable background concentrations defined as anticipated typical concentrations (ATCs) for eastern Maryland for total chromium (28 mg/kg) and thallium (3.9 mg/kg) in the MDE guidance document *Cleanup Standards for Soil and Groundwater, October 2018 Interim Final Guidance* (MDE, 2018a; see Appendix D), or MDE-approved site-specific background concentrations for arsenic (12 mg/kg), mercury (1 mg/kg), and vanadium (91 mg/kg) (Tetra Tech, 2010).

Analytical requirements for on-site sourced backfill or off-site sourced backfill are defined in Table 2-2. This table also specifies bottle ware, preservation, and holding time requirements for the specified analysis. If all chemicals are below the screening levels listed above, the material is suitable for use. Each analysis may represent a maximum of 350 cubic yards of material; sampling and analysis of each additional 350 cubic yards must be completed thereafter.

2.3.2 Soil Reuse off Middle River Complex

If soil excavated in Block E or I is planned to be sent off-site for unrestricted use such as backfilling or recycling, it must meet the standards for Category 1 – Residential Unrestricted Use Soil and Fill Material as defined in the Maryland Department of the Environment *Fill Material and Soil Management* fact sheet (MDE, 2017; see Appendix C). In order to meet this specification, the concentration of all chemicals must be less than or equal to the current USEPA residential RSLs for soil (USEPA, 2020), set at a hazard quotient (HQ) of 0.1 for non-carcinogens and at a lifetime cancer risk of 1×10^{-6} for carcinogens. The user should refer to the Resident Soil Table on the USEPA website, selecting the lower of the RSLs in the Carcinogenic SL and Noncarcinogenic SL columns for comparison to site data. Each analysis may represent a maximum of 350 cubic yards of material; additional sampling and analysis of each 350 cubic yards must be completed thereafter or as required by the receiving facility.

2.4 GROUNDWATER MANAGEMENT

Free groundwater encountered during an excavation must be collected, containerized, and disposed at a Lockheed Martin approved facility. Characterization data in accordance with the requirement of the disposing facility must be collected to profile the wastewater for disposal. The minimum data requirements for waste characterization are defined in Table 2-1, but any additional analysis required by the receiving facility must also be completed. Other options such as treatment, disposal to storm drains, or disposal to the sanitary sewer may be viable, but these require lengthy permitting procedures and are beyond the scope of this document.

Groundwater can be stored in 55-gallon drums (as described above for soil) or tanks. Drums must have secondary containment to accommodate a release from a single drum. Tanks must have secondary containment capable of holding 110 percent of the total volume of the tank. Labeling

requirements are described above. Under no circumstances should groundwater be discharged unless an appropriate permit for the discharge is secured (e.g., National Pollutant Discharge Elimination System [NPDES] permit for discharge to storm drains or surface waters or an Industrial User Permit for discharge to the sanitary sewer).

2.5 TRANSPORTATION AND MANIFESTS/BILLS OF LADING

The following parameters are applicable to transport of all contaminated material:

- All contaminated materials transported from the MRC to the disposal facility must be in accordance with all USDOT, United States Environmental Protection Agency (USEPA), and MDE regulations.
- Transporters must be licensed in all states affected by transport.
- The soil must be handled in a manner ensuring that free-liquid does not develop during transport.
- All transport vehicles must be inspected before leaving the site.
- All contaminated soil residue on the wheels, exterior body, or undercarriage of the truck must be removed before it leaves the facility, and all residue must be collected and handled as part of the waste stream being disposed.
- The transporter will be responsible for any and all actions necessary to remedy situations involving waste spilled in transit, or any contamination tracked off-site.

USDOT hazardous materials (HAZMAT) employee training is required for anyone involved in preparation and transportation of hazardous waste, including signing hazardous waste manifests (see 49 CFR 172, Subpart H). The manifest for the shipped waste must be certified as accurate. Non-hazardous materials do not require the signature of a USDOT HAZMAT-trained individual. Waste manifests must be signed for all hazardous wastes, and bills of lading must be signed for all non-hazardous wastes, by an LMCPI or a CESH-authorized representative. When hazardous waste is being shipped, then an approved transporter and an appropriate waste generator number must be utilized.

2.6 POST-SHIPMENT REQUIREMENTS

Records of waste characterization, chains of custody, transportation, and destruction will be maintained by the organization responsible for handling and disposing of the waste material.

This includes profile sheets, the generator's copy of the waste manifest, a copy of the signed TSDF manifest, land disposal restriction forms, and certificates of waste destruction (where applicable). The documentation noted above must be retained for three years. All documents should be properly stored and be available for review upon request.

2.7 BIENNIAL REPORTING REQUIREMENTS

The Code of Maryland Regulations (COMAR) 26.13.03.06B requires hazardous waste management facilities to file biennial hazardous waste reports every other year that includes hazardous waste activity for the preceding calendar year. Facilities are required to submit the biennial report for a given site if:

1. The facility either (a) generates hazardous waste and ships it off-site to a facility in the United States, **or** (b) treats, stores, or disposes of hazardous waste on-site; and

2. The facility is regulated under Maryland's hazardous waste regulations because it (a) generates 220 pounds or more of hazardous waste (or more than 2.2 pounds of acute hazardous waste) in a calendar month, **or** (b) accumulates, at any time, more than 220 pounds of hazardous waste (or more than 2.2 pounds of acute hazardous waste).

Guidance for completing the biennial report form is available at the MDE Biennial Report web page, which is available at:

https://mde.maryland.gov/programs/land/hazardouswaste/pages/biennialreport.aspx

The report must be completed, typically by March 1 of even numbered years (e.g., 2018, 2020, etc.), and filed with:

Maryland Department of the Environment
Land and Materials Administration
Technical Services & Operations Program
1800 Washington Boulevard, Suite 650
Baltimore, Maryland 21230-1719

Before each report is filed, the Maryland hazardous waste regulations must be consulted to confirm or update regulatory thresholds. This/these report(s) will be filed by LMCPI, Lockheed Martin Corporation (through CESH or Lockheed Martin Rotary and Mission Systems [RMS]), and/or MRA Systems, Inc. (MRAS), but contractor input may be necessary.

SECTION 3
SOIL MANAGEMENT REPORTING REQUIREMENTS

3.1 ENVIRONMENTAL COVENANTS

Neither Tax Block E nor Tax Block I have been closed in accordance with the requirements of Administrative Consent Order ACO-SAR-MDE0746-2015-1-01. At the time this plan was published, there are no established environmental covenants recorded on the property deed.

3.2 SOIL MANAGEMENT REPORTING REQUIREMENTS

Excavation activities in Blocks E and I require monthly reporting via electronic mail to the Maryland Department of the Environment Land Management Administration. This reporting will be completed by Lockheed Martin Corporate Energy, Environment, Safety, and Health (CESH), as defined in the administrative consent order. This notification is not specifically required for environmental restoration conducted under Maryland Department of the Environment-approved planning documents in accordance with the order.

The information required to be submitted by LMC Properties, Inc., (LMCPI) or any site tenants to CESH within three days following completion of the excavations in Blocks E and I, and includes the following:

1. Copy(ies) of facility-approved dig permit
2. Figure(s) depicting excavation area
3. Excavation date(s)
4. Brief summaries of the work completed
5. Waste Profiles, original laboratory reports of all chemical data, and manifests or other shipping documentation

Additionally, for any major excavations that are known in advance, notification of the following information must be transmitted to CESH at least seven days before the excavation occurs:

1. Figure(s) depicting excavation area
2. Estimated excavation date(s)
3. Brief summaries of the work to be completed

SECTION 4
REFERENCES

Maryland Department of the Environment, 2017. *Fill Material and Soil Management: What You Need to Know.* Fact Sheet. Land and Materials Administration. August.

Maryland Department of the Environment (MDE), 2018a. *Cleanup Standards for Soil and Groundwater, October 2018 Interim Final Guidance.* https://mde.maryland.gov/programs/LAND/MarylandBrownfieldVCP/Documents/www.mde.state.md.us/assets/document/MDE%20Soil%20and%20Groundwater%20Cleanup%20Standards%2010-2018%20Interim%20Final%20Update%203-2.pdf

Maryland Department of the Environment (MDE), 2018b. Biennial Report Form. https://mde.maryland.gov/programs/land/hazardouswaste/pages/biennialreport.aspx

Tetra Tech, 2010. "Statistical Summary of Pre- and Post-Removal Data Block B Lockheed Martin Middle River Complex Middle River, Maryland," Final Soil Response Action Plan Block B. Lockheed Martin Middle River Complex, Middle River, Maryland. May.

United States Environmental Protection Agency (USEPA), 2020. Regional screening levels (RSLs) for soil. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

FIGURES

FIGURE 2-1

SITE LAYOUT AND TAX BLOCKS
MIDDLE RIVER COMPLEX

LEGEND

TAX BLOCK

2014 aerial photograph provided by U.S. Geological Survey.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 225 450 Feet

N

DATE MODIFIED: 03/14/18

CREATED BY: JEE

TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\mrc_tax_blocks_jul2017_aerial.mxd)
03/14/18 -- JEE

BLOCK 'I'

BLOCK 'D'

BLOCK 'E'

BLOCK 'E2'

BLOCK 'F'

FIGURE 2-2

POTENTIALLY IMPACTED SOIL AREAS
BLOCK E

LEGEND

- CONTAMINATION KNOWN
- CONTAMINATION UNLIKELY
- UNTREATED GROUNDWATER TO BE CATEGORIZED AS F001-LISTED HAZARDOUS WASTE
- PCB AND POTENTIALLY RADIOLOGICAL IMPACTS UNDER FOUNDATION OF FORMER BUILDING D
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 60 120 Feet

N

DATE MODIFIED: 04/21/20

CREATED BY: JEE

TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\block_e_potential_contamination_apr2020.mxd)
04/21/20 -- JEE

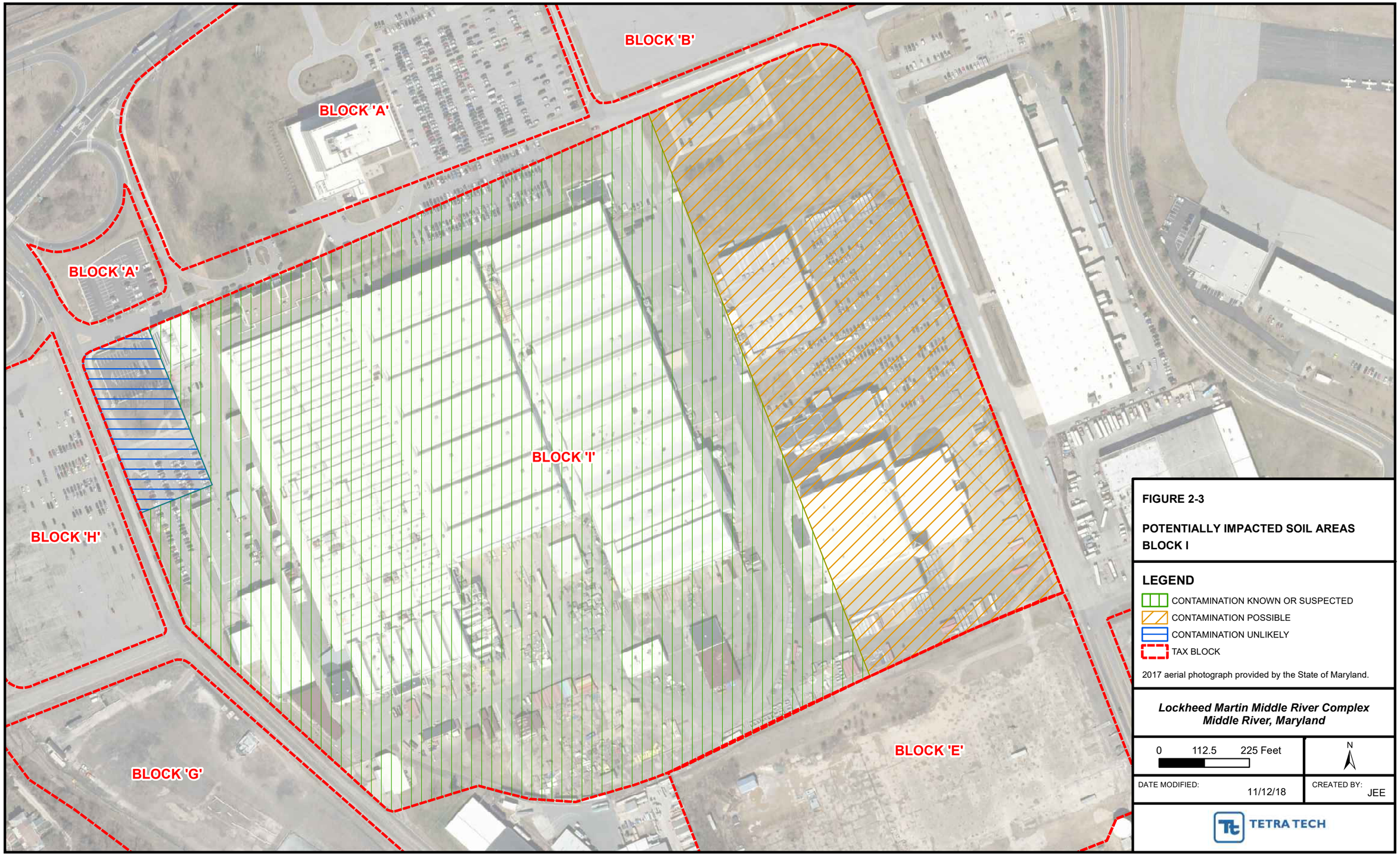

FIGURE 2-3

POTENTIALLY IMPACTED SOIL AREAS
BLOCK I

LEGEND

- CONTAMINATION KNOWN OR SUSPECTED
- CONTAMINATION POSSIBLE
- CONTAMINATION UNLIKELY
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 112.5 225 Feet

N

DATE MODIFIED: 11/12/18

CREATED BY: JEE

TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\block_i_potential_contamination_2018.mxd)
11/12/18 -- JEE

TABLES

Table 2-1 – Investigation-Derived Waste Characterization Table

Table 2-2 – Backfill Analytical Summary Table

Table 2-1

Investigation-Derived Waste Analytical Summary Table
Lockheed Martin Middle River Complex
Middle River, Maryland

Matrix	Analytical Group	Analytical and Preparation Method	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation / analysis)
SOIL INVESTIGATION DERIVED WASTE (1)	VOCs	SW-846 8260C	one 4-oz glass jar no headspace	Cool to ≤ 4°C	14 days to analysis
	TCLP Metals	SW-846 6010B/7470A	one 8oz glass jar	Cool to ≤ 4°C	180 days to analysis
	PCBs	SW-846 8082A	one 8-oz glass jar	Cool to ≤ 4°C	14 days to extraction, 40 days after extraction for analysis
	Ignitabiliy	SW-846 1030	included with PCBs jar	Cool to ≤ 4°C	14 days to analysis
LIQUID INVESTIGATION DERIVED WASTE (1)	VOCs	SW-846 8260C	three 40mL glass vials	Hydrochloric Acid, Cool to ≤ 4°C	14 days to analysis
	TCLP Metals	SW-846 6010B/7470A	two 1L glass ambers	Cool to ≤ 4°C	180 days to analysis
	PCBs	SW-846 8082A	two 1L glass ambers	Cool to ≤ 4°C	7 days to extraction, 40 days after extraction for analysis
	Ignitabiliy	SW-846 1010A	one 250mL poly	Cool to ≤ 4°C	14 days to analysis
	PFAS/PFOA	EPA Method 537	two 250mL polys	Cool to ≤ 4°C	14 days to analysis

mL - milliliter
L – liter
PCB - polychlorinated biphenyls
PFAS - per- and polyfluoroalkyl substances
PFOA - perfluorooctanoic acid
TCLP - toxicity characteristic leaching procedure
VOC - volatile organic compound
(1) Minimum data requirements are presented in this table, other analysis may be required by the receiving facility

Table 2-2

Backfill Analytical Summary Table
Lockheed Martin Middle River Complex
Middle River, Maryland

Matrix	Analytical Group	Analytical and Preparation Method	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation / analysis)
SOIL GENERATED ON-SITE FOR REUSE	VOCs	SW-846 8260C	one 2-oz glass jar no headspace	Cool to ≤ 6°C	14 days to analysis
	SVOCs	SW-846 8270C	one 4oz glass jar no headspace	Cool to ≤ 6°C	14 days to analysis
	Metals	SW-846 6020A	one 4-oz glass jar	Cool to ≤ 6°C	180 days to analysis
	Total Mercury	SW-846 7471	one 4-oz glass jar	Cool to ≤ 6°C	28 days to analysis
	PCBs	SW-846 8082A	one 4-oz glass jar	Cool to ≤ 6°C	1 year to analysis
	TPH DRO/GRO	SW-846 8015C	one 4-oz glass jar	Cool to ≤ 6°C	14 days to analysis
SOIL FROM OFF-SITE SOURCE	VOCs	SW-846 8260C	one 2-oz glass jar no headspace	Cool to ≤ 6°C	14 days to analysis
	SVOCs	SW-846 8270C	one 4oz glass jar no headspace	Cool to ≤ 6°C	14 days to analysis
	Metals	SW-846 6020A	one 4-oz glass jar	Cool to ≤ 6°C	180 days to analysis
	Total Mercury	SW-846 7471	one 4-oz glass jar	Cool to ≤ 6°C	28 days to analysis
	PCBs	SW-846 8082A	one 4-oz glass jar	Cool to ≤ 6°C	1 year to analysis
	TPH DRO/GRO	SW-846 8015C	one 4-oz glass jar	Cool to ≤ 6°C	14 days to analysis
	Asbestos	ASTM D7521 13	one zip lock bag	None	None
	Herbicides	SW-846 8151A	one 4-oz glass jar	Cool to ≤ 6°C	14 days to analysis
	Pesticides	SW-846 8081B	one 4-oz glass jar	Cool to ≤ 6°C	14 days to analysis

TPH - Total Petroleum Hydrocarbons

DRO/GRO - Diesel Range Organics and Gasoline Range Organics

PCB - polychlorinated biphenyls
VOC - volatile organic
compound

APPENDICES

Appendix A—Site Contact List

Appendix B—Example Waste Tracking Form

Appendix C—MDE Fact Sheet for Fill Material and Soil Management

Appendix D—MDE Cleanup Standards for Soil and Groundwater

APPENDIX A—SITE CONTACT LIST

APPENDIX A
SITE CONTACT LIST

Lockheed Martin Project Lead	Tom Blackman
Office Telephone	301-548-2209
Cell Number	240-460-7508
Email	tom.d.blackman@lmco.com
LMCPI ESH/Projects	Scott Heinlein
Cell Number	240-888-6581
Email	scott.g.heinlein@lmco.com
LMCPI ESH/Projects	Glen Harriel (facility manager)
Office Telephone	410-682-1328
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LMCPI ESH/Projects	Christopher Keller
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Remediation Technical Operations Coordinator	CDM Smith: Cannon Silver
Cell Number	703-595-5814
Email	silvercf@cdmsmith.com
Lockheed Martin Communications Lead	Trent Perrotto
Office Number	301-214-3504
Email	Trent.j.perrotto@lmco.com
Lockheed Martin Head of Security	Chief Philip Johnston
Office Telephone	410-682-1050
EMCOR Facilities Supervisor	Anthony Califano
Cell Number	484-256-9452
Email	ACalifano@emcor.net
EMCOR Safety /Permits	Scott Lapp
Office Telephone	410-682-0365
Cell Number	410-967-8745
Email	Scott.lapp@lmco.com

EMCOR Facilities Electrician	John Wells
Office Telephone	410-682-1307
Tetra Tech Program Lead	Michael Martin
Office Telephone	301-528-3022
Cell Number	410-707-5259
Email	Michael.martin@tetratech.com
AECOM Point of Contact	Holly Brown
Office Telephone	301-820-3492
Cell Number	301-674-3199
Email	Holly.brown@aecom.com
Emergency Response	
A&A Environmental/Spill Response	1-800-404-8037
Baltimore County Police & Fire Department	911
State of Maryland Emergency Response Center	410-974-3551

APPENDIX B—EXAMPLE WASTE TRACKING FORM

IDW Tracking Form
Middle River Complex
Middle River, Maryland

Drum	Contents	Project	First generation date	Waste characterization sample collected (date)	Profile (nonhaz or haz)	Date removed from the site	75 day deadline for removal	90 day deadline for removal (only applies to haz waste)	Field inspection date	Field inspector	Action/Repairs from inspection

Rolloff	Contents	Project	First generation date	Waste characterization sample collected (date)	Profile (nonhaz or haz)	Date removed from the site	75 day deadline for removal	90 day deadline for removal (only applies to haz waste)	Field Inspection Date	Field Inspector	Action/Repairs from inspection

APPENDIX C—MDE FACT SHEET FOR FILL MATERIAL AND SOIL MANAGEMENT

Maryland
Department of
the Environment

Fill Material and Soil Management

What You Need to Know

The purpose of this fact sheet is to describe how fill material and excess soil can be reused properly during the cleanup and redevelopment of properties throughout Maryland. In many cases, excess soil is generated and fill material is necessary during the cleanup and development phases of a project. To assure that all projects are addressed consistently, the Land and Materials Administration (LMA) has prepared this guidance document for assisting parties that generate or need soil or fill material at sites under the purview of LMA's regulatory programs. This document does not, however, substitute for Maryland Department of the Environment (MDE) regulations, nor is it a regulation itself and does not impose legally binding requirements, and may not apply to a particular situation based upon the circumstances. MDE retains the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. Any decisions regarding a particular site will be made based on the applicable statutes and regulations.

Introduction

The LMA has created this fact sheet to assist property owners with the management and reuse of fill material and excess soils generated or used at properties under LMA oversight. This fact sheet is to be used in conjunction with the Voluntary Cleanup Program's (VCP) Clean Imported Fill fact sheet and the Innovative Reuse and Beneficial Use of Dredged Material Guidance Document.

What Soils and Fill Material are Subject to this Fact Sheet?

This document lays out guidelines for persons that generate or import soil or fill material for reuse at LMA regulated sites. The fact sheet applies to soil and fill material that is impacted or potentially impacted by polluting substances. These pollutants may include petroleum or hazardous substances listed in the current MDE Soil and Groundwater Cleanup Standards (Cleanup Standards) document or the current U.S. Environmental Protection Agency's (EPA) Regional Screening Levels (RSLs) table. The guidance does not apply to soils or fill material that are subject to federal and state hazardous waste regulations (see 40 Code of Federal Regulations [CFR] Part 260 and the Code of Maryland Regulations [COMAR] 26.13 for requirements and applicability). Soils subject to hazardous waste regulations are any soils contaminated by a listed hazardous waste, or that display a characteristic of a hazardous waste. LMA maintains enforcement authority over soils or fill material when it is used in a manner that creates a threat to human health or the environment, in accordance with Environment Article, § 7-201 *et seq*.

Definitions

The following terms are defined for the purpose of this fact sheet.

Background Level means the level of a substance occurring naturally at the site prior to any manmade spill or release, as defined by § 7-501 of the Environment Article, Annotated Code of Maryland.

Category 1 - Residential Unrestricted Use Soil and Fill Material means a soil or fill material that is impacted by a hazardous substance or oil at concentrations less than or equal to the current residential EPA soil

RSLs (residential soil, https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-june-2017) for non-carcinogens set at a HQ of 0.1 and carcinogens at a lifetime cancer risk of $1x10^{-6}$. The Category 1 screening levels incorporate the most common human exposure pathways (ingestion, dermal contact, and inhalation of contaminants from soil in outdoor air) using generic exposure assumptions and are protective of acute and chronic health effects for residential populations, including young children. If the soil or fill material background level contains naturally occurring substances at concentrations not exceeding the concentrations of such substances occurring naturally in the environment and in which all other substances are less than or equal to the residential standards, such soils and fill material are considered "Residential Unrestricted Use Soil and Fill Material."

Category 2 - Non-Residential Restricted Use Soil and Fill Material means a soil or fill material that is impacted by a hazardous substance or oil at concentrations less than or equal to the current industrial EPA soil RSLs for non-carcinogens set at a hazard quotient (HQ) of 0.1 and carcinogens at a lifetime cancer risk of $1x10^{-6}$. The Category 2 screening levels incorporate the most common human exposure pathways (ingestion, dermal contact, and inhalation of contaminants from soil in outdoor air) using generic exposure assumptions and are protective of acute and chronic health effects for commercial and industrial populations. If the soil or fill material background level contains naturally occurring substances at concentrations not exceeding the concentrations of such substances occurring naturally in the environment and in which all other substances are less than or equal to the non-residential standards (industrial soil, https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-june-2017), such soils and fill material are considered "Non-Residential Restricted Use Soil and Fill Material."

Category 3 - Restricted Use Soil and Fill Material, Cap Required means any soil or fill material that is impacted by a hazardous substance or oil at concentrations meeting the restricted use screening criteria for soil and fill material in the Innovative and Beneficial Use of Dredged Material Guidance Document (http://mde.maryland.gov/programs/Marylander/Pages/dredging.aspx). Category 3 means soil or fill material that is impacted by any hazardous substance or oil at concentrations less than or equal to the current industrial EPA soil RSLs for non-carcinogens set at a HQ of 1 and carcinogens at a lifetime cancer risk of $1x10^{-5}$.

Category 4 - Ineligible Soil and Fill Material means a soil or fill material that is impacted by any hazardous substance or oil at concentrations exceeding the restricted use screening criteria for soil and fill material in the Innovative and Beneficial Use of Dredged Material Guidance Document (http://mde.maryland.gov/programs/Marylander/Pages/dredging.aspx) but does not display a characteristic of a hazardous waste; has not been contaminated by a listed hazardous waste; and does not exceed the regional emergency removal management levels used by the EPA (https://www.epa.gov/risk/regional-removal-management-levels-chemicals-rmls).

Disposal Facility means a facility permitted to accept solid wastes by the State of Maryland or other State. In Maryland, such facilities must be permitted in accordance with Title 9 of the Environment Article and the regulations promulgated in COMAR 26.04 or COMAR 26.10.13.

Dredged Material means material excavated or dredged from the waters of State.

Dredged Material Containment Facility means an artificial confinement structure, site or area used for the dewatering of dredged material from the interstitial or carriage water.

Earthen Materials means any mixture of soil, stones or rocks that have been excavated or extracted from a quarry, borrow pit, earthen bank, gravel pit, or mine and have not been affected by a release of oil products, oils, chemicals or by any other polluting substance.

Eligible Property means property that is contaminated or perceived to be contaminated but does not include a site on the National Priority List, a site that is subject to a controlled hazardous substance permit, or a site that is subject to an enforcement action.

Engineered Cap means a system composed of a layer or several layers of natural and synthetic materials used to reduce the infiltration of water into the subsurface and/or to limit the possibility of human exposure to buried materials. A typical cap may consist of a vegetated or otherwise stabilized protective layer of clean soil on the surface, which overlies one or more additional layers that are intended to act as a barrier to infiltration of water; a drainage layer; a capillary break; a gas collection layer; a load dispersion layer; or other purpose depending on the design and intended purpose for the cap. Maryland and federal regulations include specific design requirements for caps depending on the purpose (e.g., solid waste or hazardous waste landfills, etc.).

Engineering Controls means remedial actions directed toward containing or controlling the migration of contaminants through the environment. These include, but are not limited to, storm water conveyance systems, slurry walls, liner systems, caps, leachate collection systems, pump and treat systems, and groundwater recovery systems.

Excess Soil means any soil or earthen material generated as a result of excavation, grading, or other activity that results in soil or earthen material that cannot be reused beneficially onsite.

Fill Material (construction) means soil or dewatered dredged material used to create a foundation for the construction of a structure, such as a road or building, to reclaim lost land such as gullies or mines, to raise the grade on a property, or to provide final cover material for a property.

Hazard Quotient means the ratio of a single substance exposure level over a specified time period to a reference dose for that substance derived from a similar exposure period.

Hazardous Substance means any substance that is defined as a hazardous substance under § 101(14) of the federal act (the Comprehensive Environmental Response, Compensation and Liability Act or CERCLA); or is identified as a controlled hazardous substance by the Department under COMAR 26.14.01.02.

Impervious Surface means a synthetic material with a minimum thickness of 20 mil and a maximum permeability of 1×10^{-10} centimeters/second, or a minimum of 1 foot of clay or other natural fine-grained material having an in-place permeability less than or equal to 1×10^{-5} centimeters/second.*Innovative Reuse* means utilizing excess soil and fill material as resource materials in productive ways as a substitute for other materials subject to certain land use controls. For dredged material, innovative reuse includes use of dredge material in the development or manufacturing of commercial, industrial, horticultural, agricultural, or other products.

Institutional Controls means legal or administrative tools designed to prevent or reduce human exposure to remaining contamination and to prevent activities that may result in increased exposure to or spread of such contamination, including the use of an environmental covenant in accordance with Maryland's Uniform Environmental Covenant Act, Environment Article, § 1-801 *et seq.*

Land Use Controls means any restriction or control that serves to protect human health and the environment by limiting use of or exposure to any portion of the property, including water resources.

Natural Soil means a soil in which all substances naturally occurring therein are present in concentrations not exceeding the concentrations of such substances occurring naturally in the environment and in which no other polluting substance is analytically detectable.*Oil* has the same meaning stated in § 4-401(h) of the Environment Article, Annotated Code of Maryland and COMAR 26.10.01.01 and includes petroleum, petroleum by-products, kerosene, and other compounds.*Risk Assessment* means the process to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media, now or in the future. Human health risk assessments are based on the populations and land uses of the property in question and may include residential and non-residential scenarios.

Soil means unconsolidated geologic and organic materials overlying bedrock, if present.

Soil and Fill Material Management Guidelines

The following guidelines apply to management of soil and fill material received at eligible properties. These guidelines are also illustrated in Figure 1.

- Soil or fill material may not be placed where it is subject to intrusion by groundwater or surface water. It must be placed at least three (3) feet above the maximum expected groundwater elevations at all locations of placement or other sufficient protective measures must be implemented to ensure soil and fill material do not adversely impact groundwater or surface water resources;
- Soil and fill material placed in groundwater use areas may be subject to additional environmental measures and evaluations to ensure placement of soil or fill material will not adversely impact groundwater or surface water resources.
- Soil or fill material shall conform with all appropriate sediment and erosion control regulations during placement and construction.
- Impervious surfaces placed over soil or fill material shall be continuous in all areas that overlie the soil or fill material.

Land use controls may include, but are not limited to, engineering controls and institutional controls.

Residential Unrestricted Use Soil and Fill Material (Category 1)

Soil or fill material with concentrations of hazardous substances or oil less than or equal to the residential unrestricted use screening criteria may be innovatively reused at all sites without restriction. If potential contaminant concentrations in soil or fill material exceed the Category 1 screening criteria, then a more detailed soil or fill material residential risk assessment (considering factors such as magnitude and frequency of detections, land use, exposure parameters and factors, and toxicity values) may be performed that meets a HQ of 1 for non-carcinogens and a lifetime cancer risk of $1x10^{-5}$ for carcinogens. When the residential risk assessment is performed and meets a HQ of 1 for non-carcinogens and a lifetime cancer risk of $1x10^{-5}$ for carcinogens the soil or fill material may be innovatively reused at all sites without soil exposure restrictions and will be considered Category 1 soil and fill material. For soil or fill material that meets the Residential Unrestricted Use Soil and Fill Material definition, a person may send such soil or fill material to any offsite location. The owner or operator of the receiving site may be required to submit written acknowledgement regarding the volume and nature of such soil or fill material to LMA prior to transporting and accepting the materials at the receiving location. Additional documentation from a person placing or transporting the soil or fill material may be required by the LMA program regulating the receiving site, if applicable. Please contact the appropriate regulatory program for additional details.

Non-Residential Restricted Use Soil and Fill Material (Category 2)

Soil or fill material with concentrations of hazardous substances or oil less than or equal to the non-residential restricted use screening criteria may be innovatively reused at all non-residential and non-recreational sites without restriction. If potential contaminant concentrations in the soil or fill material exceed the Category 2 screening criteria, then a more detailed soil or fill material non-residential risk assessment may be performed that meets a HQ of 1 for non-carcinogens and a lifetime cancer risk of $1x10^{-5}$ for carcinogens. When a non-residential risk assessment on soil or fill material is performed and meets a HQ of 1 for non-carcinogens and a lifetime cancer risk of $1x10^{-5}$ for carcinogens, the soil or fill material may be innovatively reused at non-residential and non-recreational sites. The owner or operator of the receiving site may be required to submit written acknowledgement regarding the volume and nature of such soil or fill material to the LMA prior to the transport and acceptance of the material. Additional documentation from a person who places or transports the soil and fill material may be required by the LMA program regulating the receiving site, if applicable. Please contact the appropriate regulatory

program for additional details. The receiving site may also be required to encumber the property with land use controls to ensure that exposure to the soil or fill material meeting the Non-Residential Restricted Use Soil and Fill Material definition is appropriately managed. The land use controls may include a recorded environmental covenant that complies with the Maryland Uniform Environmental Covenants Act (UECA). The environmental covenant shall include a map drawn to scale identifying where the soil or fill material has been placed and copies of the manifests, bill of lading, or other documentation demonstrating the transport and acceptance of soil or fill material. The Department may sign on to the environmental covenant as agency and holder of the environmental covenant.

Restricted Use Soil and Fill Material, Cap Required (Category 3)

If the soil or fill material concentrations of hazardous substances or oil are less than or equal to the Category 3 -- Restricted Use Soil and Fill Material, Cap Required screening criteria (http://mde.maryland.gov/programs/Marylander/Pages/dredging.aspx), an a person may transport such soil or fill material for innovative reuse to a commercial or industrial property with existing soil and fill material containing hazardous substances or oil at concentrations within or less than the same Category 3 parameters for placement beneath an environmental cap. The receiving site may be required to submit a written acknowledgement regarding the volume and nature of the soil or fill material to the LMA prior to transporting the material to the receiving location. The program regulating the receiving site may require additional documentation from a person who places or transports material at Category 3 sites. The receiving site must also agree to encumber the property with land use controls to ensure that exposure to the soil or fill material meeting the Category 3 definition is appropriately managed. The land use controls may include a recorded environmental covenant that complies with the Maryland's UECA. The environmental covenant shall include a map drawn to scale identifying where the soil or fill material has been placed and copies of the manifests, bill of lading, or other documentation demonstrating the transport and acceptance of soil or fill material. The Department may sign on to the environmental covenant as agency and holder of the environmental covenant.

Ineligible Soil and Fill Material (Category 4)

For soil or fill material that exceeds the Category 3 -- Restricted Use Soil and Fill Material, Cap Required screening criteria (http://mde.maryland.gov/programs/Marylander/Pages/dredging.aspx), a person may not use the material for an innovative reuse. Any soil or fill material that exceeds the Category 3 screening levels must be disposed of at either (1) an offsite disposal facility or dredge material containment facility that is permitted by the State of Maryland or another state to accept solid wastes; (2) for dredged material, to a dredged material containment facility; or (3) remain in place with appropriate land use controls. The owner or operator of the receiving site shall provide the Department with appropriate documentation, including but not limited to copies of the manifests, bill of lading, or other documentation demonstrating the transport and acceptance of soil or fill material.

Criteria for Total Petroleum Hydrocarbon

In addition to the criteria described above for each category, the following screening criteria apply for total petroleum hydrocarbon (TPH) diesel range organics (DRO) and gasoline range organics (GRO). These criteria are based upon the residential and non-residential soil cleanup standards set at a HQ equal to 0.1 for TPH published in the MDE Cleanup Standards for Soil and Groundwater, June 2008: Interim Final Guidance (Update No. 2.1).

- Category 1 TPH screening criteria: 230 mg/kg for TPH, DRO and 230 mg/kg for TPH, GRO
- Category 2 TPH screening criteria: 620 mg/kg for TPH, DRO and 620 mg/kg for TPH, GRO

- Category 3 TPH screening criteria: 620 mg/kg for TPH, DRO and 620 mg/kg for TPH, GRO
- Category 4 TPH screening criteria: exceeds Category 3 standard

Additional Resources

Cleanup Standards for Soil and Groundwater, June 2008: Interim Final Guidance (Update No. 2.1), Maryland Department of the Environment.

Facts About…VCP Clean Imported Fill Material, Maryland Department of the Environment.

Innovative and Beneficial Use of Dredge Material Guidance Document, August 2017, Maryland Department of the Environment in collaboration with Maryland Department of Transportation's Port Administration.

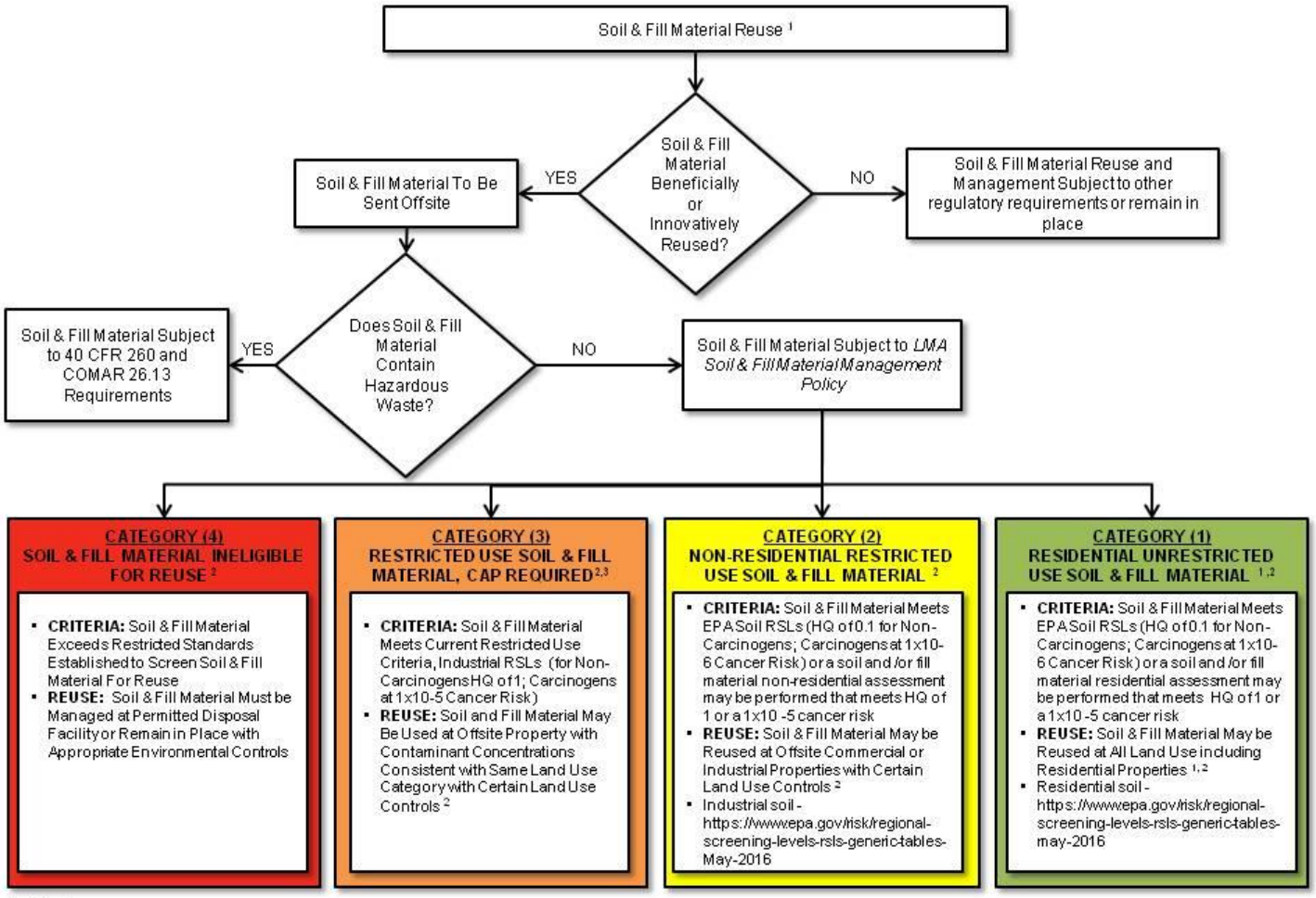
United States Environmental Protection Agency. Regional Screening Levels (RSLs) - Generic Tables (June 2017). https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-june-2017.

Maryland
Department of
the Environment

Fill Material and Soil Management

What You Need to Know

Figure 1: Soil & Fill Material Management Flow Chart



Footnotes:

(1) Placement of soil or fill material within groundwater use area may be subject to additional environmental measures and evaluations to ensure placement of soil or fill material will not adversely impact groundwater resources.

(2) Soil and fill material transfer is limited to transfers only to a site having existing soils meeting the same or less stringent cleanup standard or within the same land use category as defined in the VCP. The VCP land use categories are: Industrial; Commercial; Recreational; and Residential.

(3) Site-specific factors may be considered for reuse of Category 3: Restricted Use Soil and Fill Material Cap as fill in excess of the Category 3 criteria.

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www.mde.maryland.gov

LMA/LRP/August /2017

APPENDIX D—MDE CLEANUP STANDARDS FOR SOIL AND GROUNDWATER

STATE OF MARYLAND

DEPARTMENT OF THE ENVIRONMENT

CLEANUP STANDARDS FOR SOIL AND GROUNDWATER

OCTOBER 2018

INTERIM FINAL GUIDANCE

(UPDATE No. 3)

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State of Maryland

Department of the Environment

Cleanup Standards for Soil and Groundwater

1.0 INTRODUCTION

This document presents the approach and supporting documentation used to develop numeric Cleanup Standards for hazardous substances in the soil and groundwater media, and remedial action categories for the State of Maryland. The Cleanup Standards are screening levels developed to represent concentration levels at which no further remedial action or land use controls would be required at a property based upon the harm posed by these substances to human health within the constraints of current knowledge (i.e., applicable only to the soil media Residential Cleanup Standard and the groundwater media Cleanup Standard). The Cleanup Standards have been developed by incorporating applicable land uses and the current or projected use of the groundwater media for potable use. Tables 1 and 2 lists the hazardous substances included in the Cleanup Standards.

The Cleanup Standards for hazardous substances in soil and groundwater media are to be considered as guidance.

2.0 PURPOSE AND APPLICABILITY

The intent of this guidance is to:

a) Provide uniform and consistent human-health based numerical Cleanup Standards for the most frequently encountered hazardous substances encountered in the soil and groundwater media at properties within the state;

b) Identify the conditions for requiring remedial action at a property, or the conditions for not requiring further investigation or remedial action at a property;

c) Describe the general requirements for applicants conducting environmental assessments at properties with hazardous substances, and

d) Provide detail and specificity on the important elements of remedial actions, including the responsibilities of persons who use this guidance and the Department.

This guidance is intended to be a technical supplement for other Department programs (including the Voluntary Cleanup Program, Controlled Hazardous Substance/State Superfund Program, Hazardous Waste Program, Solid Waste Program, Oil Control Program, and affected programs in the Department's Water and Science Administration).

Notwithstanding the information conveyed in this document, persons must also adhere to all applicable federal and state environmental laws and regulations. Persons may also use the United States Environmental Protection Agency (EPA) Regional Screening Level User's Guide, May 2018 and associated EPA risk assessment guidance to conduct a property specific risk assessment. If this option is chosen, then the risk assessment must include an evaluation of the risk at the property to the Department's

upper end exposure pathway risk threshold for carcinogenic compounds of 1E-5 or, a non-cancer Hazard Quotient of 1.

3.0 DEFINITIONS

A. In this guidance, the following terms have the meanings indicated.

B. Terms defined.

(1) “Applicant” means a person who applies to participate in the Voluntary Cleanup Program, or any person that the Department determines can use this guidance.

(2) "Aquifer" means a geologic formation, group of formations, or part of a formation capable of yielding groundwater to wells or springs.

(3) "Biased Sampling" means sampling which focuses on a specific property area based upon knowledge or modeling.

(4) “Cancer risk” (CR) means the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen.

(5) "Composite Sampling" means a mixture of a minimum of two or more grab samples to represent the average properties of the hazardous substances of concern within the extent of the area sampled.

(6) “Department” means the Maryland Department of the Environment.

(7) "Environment" means the navigable waters, the waters of the contiguous zone, ocean waters, and any other surface water, groundwater, drinking water supply, land surface or subsurface strata or ambient air within the state.

(8) "Environmental Assessment" means an Environmental Phase I and Phase II Assessment that conforms to the principles established by the American Society for Testing and Materials, or a Site Assessment that conforms to the Code of Maryland Regulations 26.14.02.03.

(9) “Exposure pathway” means the course a contaminant takes from it's source to a receptor organism.

(10) "Field Screening Technology" means analytical methods approved by the Department to determine a concentration, or range of concentrations for a particular hazardous substance; or a total concentration for a suite of genetically related hazardous substances (e.g., carcinogenic polycyclic aromatic hydrocarbons, pesticides). Field Screening Technologies usually have lower quality assurance/quality control standards than EPA Contract Laboratory Program (CLP) requirements. As a consequence, the data generated by Field Screening Technologies cannot be used exclusively in the conduct of a human health risk assessment. For the same reasons, Field Screening Technologies cannot be used exclusively to demonstrate compliance with numerical cleanup standards.

(11) "Free Product" means a hazardous substance which occurs as an immiscible (i.e., either Dense Non-Aqueous Phase Liquid (DNAPL) or a Non-Aqueous Phase Liquid (NAPL) liquid in surface water, groundwater, the vadose zone, or the ground surface.

(12) "Grab Sample" means a discrete sample that is representative of a specific location at a specific point in time.

(13) "Groundwater" means water below the land surface in the zone of saturation.

(14) "Groundwater Standard" means either the Maximum Contaminant Level (MCL) value for a chemical, the Secondary Drinking Water Regulation value for a chemical, or the highest value from the criteria identified in section 4.0 (B) 1 –2.

(15) "Groundwater use area" means a property located within ½ mile of a potable use well, or an area not served by a public water distribution system and reliant on groundwater for potable consumption, or an area where there is a potential for future groundwater use as a potable water supply source, or wellhead protection areas for public supply wells that have been approved by the Department.

(16) "Hazard Quotient" (HQ) means the ratio of a single chemical exposure level over a specified time period to a reference dose for that hazardous substance derived from a similar exposure period. A reference dose is EPA's preferred toxicity value for evaluating non-cancer effects from exposure to hazardous substances.

(17) "Hazardous Substance" means any substance defined as a hazardous substance under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986; or identified as a controlled hazardous substance by the Department in the Code of Maryland Regulations.

(18) "Land Use Controls" (LUCs) means any restriction or control that serves to protect human health and the environment by limiting use of exposure to any portion of the property, including water resources.

(19) "Lower explosive limit" (LEL) means the lowest concentration of gas or vapor that burns or explodes, at ambient temperatures, if an ignition source is present.

(20) "MCL" means maximum contaminant level as defined in COMAR 26.04.01.06 through 6.04.01.10.

(21) "Non-residential land use" means land that has a zoning designation by either county or local government jurisdiction that is not intended for residential land use. Typical non-residential land uses include, but are not limited to, land zoned for commercial or industrial uses.

(22) "Non-residential exposure scenario" means the set of default assumptions, as defined in this chapter (Appendix 1) that are used to calculate a representative chemical intake for a population in a non-residential setting. Exposure scenarios would typically include any setting on which commercial, industrial, manufacturing, or any other activity is done to further either the development, manufacturing, or distribution of goods and services,

intermediate and final products, including but not limited to: administration of business activities, research and development, warehousing, shipping, transport, remanufacturing, stockpiling of raw materials, storage, repair and maintenance of commercial machinery and equipment, and solid waste management.

(23) "Person" means an individual, firm, corporation, association, partnership, consortium, joint venture, commercial entity, state government agency, unit of local government, school district, conservation district, federal government agency, Indian Tribe or interstate body.

(24) "Phased Sampling" means using information obtained from a previous event to refine a subsequent sampling event.

(25) "Practical Quantitation Limit" (PQL) means the lowest amount of a chemical that can be accurately and reproducibly quantified by an analytical instrument or method. The PQL values presented are the lowest from among the most commonly required by the EPA Contract Laboratory Program (CLP) and SW-846 analytical methods.

(26) "Property" means any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works) well, pit, pond lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, vessel, aircraft or any land, site or area where a hazardous substance has been generated, manufactured, refined, transported, stored, treated, handled, recycled, disposed of, released, placed or otherwise located. Where there is or has been a release or threat of release on a parcel of real estate, the entire real estate may be considered the property for the purposes of performing a remedy. A property also includes all adjacent properties where hazardous substances may have migrated since being released.

(27) “Recreational use exposure scenarios” means the set of default assumptions as defined in this chapter (Appendix 1) that are used to calculate a representative chemical intake for a population in a recreational setting used in conjunction with the exposure frequencies defined in Section 11.2 Recreational Use Soil Cleanup Requirement.

(28) "Release" means the addition, introduction, leaking, spilling, emitting, discharge "as defined in Environment Article, Titles 4 and 7", escaping, or leaching of any hazardous substance or oil into the environment.

(29) "Remedy" or "Remedial Action" means those actions consistent with a permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of a hazardous substance or oil into the environment, to prevent or minimize the release of hazardous substances so that the substances do not migrate or otherwise cause substantial danger to present or future public health, welfare, or the environment, and incorporates the elements of a Response Action Plan conveyed in Environmental Article Title 7, Subtitle 5, Voluntary Cleanup Program. This term includes, but is not limited to, the remedies described in CERCLA.

(30) "Residential exposure scenario" means the set of default assumptions, as defined in thischapter (Appendix 1), that are used to calculate a representative chemical intake for a population in a residential setting. Residential use settings would typically include residential land uses, as well as land uses where there is potential for more extensive soil ingestion. Residential exposure scenario could also include agricultural land use

associated with the propagation of vegetation or livestock under certain conditions. The Residential exposure scenario for the soil media is applicable from 0-15' Below Ground Surface (BGS) or to the zone of saturation.

(31) "Residential land use" typically means land that has a zoning designation by either a county or local government that exclusively requires that the land shall be used as a place in which a person resides.

(32) "Risk assessment" means a scientific process used to estimate the probability of adverse effects from chemicals present at a property.

(33) "Regional Screening Levels" (RSLs) means the EPA Regional Screening Levels dated May, 2018. The concentration levels for individual chemicals that correspond to a specific cancer risk level of 1E-6 or an HQ of 0.1. The HQ values have been adjusted from 1.0 to 0.1 to account for potential additivity.

(34) "Secondary Drinking Water Regulation" means a non-mandatory water quality standard established by the EPA for aesthetic considerations, such as taste, odor and color.

(35) "Soil Standard – Non-Residential Cleanup Standard" means the EPA RSLs for Industrial use."

(36) "Soil Standard – Protection of Groundwater" means the EPA RSLs for soil to groundwater migration with a Dilution/Attenuation Factor (DAF) of 20. This value is intended to be protective of groundwater quality in "groundwater use areas."

(37) "Soil Standard – Residential Cleanup Standard – Inorganic Chemicals" means the highest value from the following options: a) the EPA RSLs for residential soil, the PQL of laboratory instrumentation, or c) a value determined by the Department to be the reference level for metals in soil in the State of Maryland.

(38) "Soil Standard – Residential Cleanup Standard - Organic Compounds" means the highest value from the following options: a) the EPA RSLs for residential soil, or b) a value based on the PQL of laboratory instrumentation.

(39) "Surface Water" means the waters of the State of Maryland, occurring on the surface of the earth.

(40) "Tentatively Identified Compound" means a non Target Analyte List organic compound detected from laboratory analysis of a sample using a Gas Chromatograph/Mass Spectrometer (GC/MS) under an approved EPA laboratory method. Tentatively Identified Compounds (TICs) are identified from reconstructed chromatograms. TICs should have a 80% spectral match, however, professional judgment is considered by the Department in the determination and identification of the TIC. A standard must be run to make a positive identification of a TIC. The analytical results are considered estimates of concentration.

(41) "Time weighted average" (TWA) means the time weighted average concentration for a hazardous substance that nearly all workers may be routinely exposed to during an 8 hour workday and 40 hour workweek without suffering adverse health effects.

(42) "Type I aquifer" means an aquifer having a transmissivity greater than 1,000 gallons/day/foot and a permeability greater than 100 gallons/day/square foot, and for natural water with a total dissolved solids concentration less than 500 milligrams/liter.

(43) "Type II aquifer" means an aquifer having either:

A) a transmissivity greater than 10,000 gallons/day/foot, a permeability greater than 100 gallons/day/square foot and natural water with a total dissolved solids concentration of between 500 and 6,000 milligrams/liter; or

B) a transmissivity between 1,000 and 10,000 gallons/day/foot, a permeability greater than 100 gallons/day/square foot and natural water with a total dissolved solids concentration of between 500 and 1,500 milligrams/liter.

4.0 DERIVATION OF STANDARDS

A. The derivation of the soil standards were based on the following criteria:

1a) RSLs as calculated from two exposure pathways:

(i) ingestion;
(ii) dermal contact;

(iii) inhalation of volatiles/fugitive dust; and

1b) The derivation of RSL soil concentrations based on a target HQ of 0.1 and a target cancer risk of 1E-6 for each chemical;

2) The PQL of laboratory instrumentation if the RSL value for a chemical is lower than the PQL; and

3) Reference levels for metals in soil.

4) TPH soil standards were calculated based solely on an ingestion exposure pathway. TPH soil cleanup numeric standards were derived using equation 7 and reference dose information for hydrocarbon fractions published by the Massachusetts Department of Environmental Protection (Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of MADEP VPH/EPH Approach, October 31, 2002, Policy # WSC-02-0411). Gasoline Range Organics (GRO) standards were defined as the lowest risk derived value calculated for the C5-C8 aliphatic, C9-C12 aliphatic, and C9-C10 aromatic fractions. Diesel Range Organics (DRO) standards were defined as the lowest risk derived value calculated for the C9-C18 aliphatic, C19-C36 aliphatic, and C11-C22 aromatic fractions.

B. Groundwater Standards. The derivation of the groundwater standards were based on MCLs or Secondary Drinking Water Regulation (SDWR) standards where available. In the event that an MCL or the SDWR did not exist, the groundwater standard was based on the (highest) value derived from the following criteria:

1) RSL as calculated from the tap water exposure pathway:

(i) ingestion;
(ii) dermal contact;
(iii) inhalation;
1b) the derivation of RSLRBC groundwater concentrations based on a target HQ of 0.1 and a target cancer risk of 1E-6 for each chemical;

2) The PQL of laboratory instrumentation if the RSL value for a chemical is lower than the PQL.

C. MDE calculated soil cleanup standard numerical values for methyl tert-butyl ether (MTBE) per the guidelines established in (EPA) Regional Screening Level User's Guide, May 2018 and associated EPA risk assessment guidance documents. In addition, MDE has provided in this guidance all the pertinent reference documents to calculate a site-specific risk derived value for the groundwater and soil media. Please refer to the references identified in Appendix 1 for these default parameters.

The MTBE groundwater cleanup standard was set at the level defined by the Department's Oil Control Program. TPH groundwater standards were calculated based solely on an ingestion exposure pathway. TPH groundwater numeric cleanup standards were derived using equation 1 and reference dose information for hydrocarbon fractions published by the Massachusetts Department of Environmental Protection, October 31, 2002. Gasoline Range Organics (GRO) standards were defined as the lowest risk derived value calculated for the C5-C8 aliphatic, C9-C12 aliphatic, and C9-C10 aromatic fractions. Diesel Range Organics (DRO) standards were defined as the lowest risk derived value calculated for the C9-C18 aliphatic, C19-C36 aliphatic, and C11-C22 aromatic fractions.

5.0 GENERAL PROVISIONS

A. Use of these standards will be at the discretion of the applicant and subject to approval by the Department. The Department may request or the applicant may choose to develop property specific Cleanup Standards using approved risk assessment techniques. The Department may deny the option to use these Cleanup Standards in situations where property conditions or expected exposures differ significantly from the assumptions used to derive the Cleanup Standards.

B. The Cleanup Standards are usually best applied at properties where there are fewer than five hazardous substances that exceed any standard for an environmental media. In general, the Cleanup Standards are based on the potential risk posed to a human receptor based upon standard EPA exposure scenarios. Other methods used to develop Cleanup Standards are described in Section 4.

Hazardous substances that are classified as non-cancer causing generally have a Cleanup Standard concentration established at Hazard Quotient of 0.1. This level is one order of magnitude more protective than the Department remedial action standard of a Hazard Quotient of 1. This safety factor allows for potential additive risk factors from multiple hazardous substances at a property.

Hazardous substances classified as cancer causing generally have a Cleanup Standard concentration established at a target cancer risk of 1E-6. This level is one order of magnitude

more protective than the remedial action standard of 1E-5 established by the Department. This safety factor allows for potential additive risk factors from multiple hazardous substances at a property.

C. When a change to an EPA RSL occurs for a specific Cleanup Standard or when updates occur to the underlying toxicological information utilized in the derivation of a Cleanup Standard the most up to date toxicity values in the RSL table should be utilized.

D. The Cleanup Standards defined in this chapter were developed for the protection of human health and do not in any way imply protection of ecological receptors. At properties where adverse effects to ecological receptors may be of concern, an ecological risk assessment following methods approved by the Department will be required.

E. At properties where the presence of unknown hazardous substances may exist (facilities conducting chemical research) the Department recommends chemical analysis submitted for the purposes of property characterization include a maximum of 30 tentatively identified compounds (TICs). The 30 reported TICs would include the highest concentrations for up to 10 Volatile Organic Compounds (VOCs) and up to 20 Semi-Volatile Organic Compounds (SVOCs). The Department may also require additional sampling based upon an inventory of potential chemicals utilized at the facility if the reported chemicals are deemed potentially harmful to human health or the environment. The basis for recommending TICs and analysis for chemicals utilized at a facility are listed below:

i) The property history suggests that the chemicals were used at the property; or

ii) The estimated concentration or toxicity of the chemicals would drive overall risk at the property; or

iii) The spatial distribution of the chemicals indicates that they are concentrated in specific areas of the property (i.e. a contamination source area).

If the Department determines that none of the criteria listed above are met, then evaluation of TICs or experimental research chemicals will not be required. However, a qualitative discussion of all reported TICs and chemicals should be included in the property specific risk assessment.

F. Reference levels for several inorganic soil constituents have been developed by the Department (see Appendix 2). The use of a reference level instead of an established soil cleanup standard will require prior approval from the Department. The use of MDE reference levels may be denied in situations where the chemical speciation of an inorganic constituent is known or believed to be in a form that may pose an unacceptable risk to current or expected users of the property.

G. **Reservation of Rights:** Notwithstanding the use of this guidance by applicants in support of environmental assessments of hazardous substances at properties, the Department reserves the right to inspect properties, to collect soil, sediment, soil gas, indoor air or groundwater samples, and/or to determine the adequacy and validity of submitted information.

6.0 APPLICATION OF CLEANUP STANDARDS

The soil and groundwater Cleanup Standards have been designed to be applied in conjunction with a property specific environmental assessment or remedial action. The Cleanup Standards may be used by

an applicant to request either a No Further Requirements determination under the VCP, or a No Further Action determination under the State Superfund program. The Cleanup Standards may also be applied to demonstrate attainment of a Remedial Action under either the VCP or State Superfund program.

6.1 Voluntary Cleanup Program

The Cleanup Standards may be applied under the VCP only after an applicant has satisfactorily completed an Environmental Phase I and Phase II Site Assessment that conforms to the principles established by the American Society for Testing and Materials, and which only pertains specifically to the environmental assessment requirements identified in Sections 7.0 – 10.0 (i.e., not the remedial action elements described in Sections 7.0 – 10.0). VCP applicants who fulfill both these requirements may request a No Further Requirements determination from the Department if property hazardous substance concentrations are at or below Cleanup Standards and requirements for the applicable land use and groundwater use.

Properties that have hazardous substance concentrations in exceedance of an applicable Cleanup Standard and/or requirements (i.e., based upon the requested land use determination) may be required to prepare a Response Action Plan (RAP) in conformance with Environment Article 7-508. Under this condition, applicants may request a waiver from conducting the Risk Assessment component of the RAP and substitute the applicable Cleanup Standard(s) to satisfy the requirements of Environment Article 7-508.b., Selection of Protective Criteria.

The Cleanup Standards may also be used to demonstrate attainment of a remedial action for the VCP. Applicants must comply with sections 7.0 –10.0 in order to use the Cleanup Standards for these purposes.

VCP Applicants may also use the presumptive remedies identified in Section 11 as part of the RAP.

6.2 Controlled Hazardous Substance Enforcement Program (State Superfund)

The Cleanup Standards are also applicable to the Controlled Hazardous Substance Enforcement Program when an applicant satisfactorily completes a site assessment that conforms to:

a) the Code of Maryland Regulations (COMAR) 26.14.02.03, the Hazardous Substance Response Plan, and
b) the environmental assessment requirements conveyed in Sections 7.0 –10.0.

Applicants that satisfy these requirements may request a No Further Action from the Department provided that hazardous substance concentrations are at or below applicable land use and groundwater use Cleanup Standards and requirements. For non-residential land use properties the issuance of a No Further Action by the Department may be contingent on the placement of institutional LUCs such as groundwater use restrictions and deed restrictions limiting a property to non-residential uses only.

Properties that have hazardous substance concentrations in exceedance of an applicable Cleanup Standard must conduct a remedial action in conformance with COMAR 26.14.02.05-06. Applicants may request a waiver from conducting a Risk Assessment required in COMAR 26.14.02.06, and substitute the applicable Cleanup Standard requirements.

The Cleanup Standard may also be used to demonstrate attainment of a remedial response activity as defined in COMAR 26.14.02.06. Under this condition, applicants must comply with sections 7.0 –10.0 to use the Cleanup Standards for these purposes.

Applicants may use the presumptive remedies identified in Section 11 in support of the remedial action plan for a property.

Sections 7.0 – 10.0 of the document describe minimum investigatory and remedial action requirements that should be applied in order to demonstrate attainment of a cleanup standard for the soil and/or the groundwater media. However, since most property environmental cases have unique investigatory or remedial action issues, additional actions may need to be taken to demonstrate attainment of an environmental media cleanup standard.

Figures 1 and 2 are "Decision- Tree" flow charts for the application of the groundwater and soil Cleanup Standards. These flow charts have been developed from information in Sections 7.0 – 10.0 of the Cleanup Standards document.

Additional guidance on hazardous substance environmental assessment work plan development is contained in Appendix 3.

7.0 INVESTIGATIVE REQUIREMENTS – SOIL MEDIA

To apply the Cleanup Standards at a property subject to environmental assessment for release of hazardous substance(s) to the soil media, the Department requires that surface soil (0 to 1 foot in depth) and deeper soil (1 foot in depth to a maximum of 15 feet) be sampled. The extent of soil sampling required at properties is dependent on a number of variables including: 1) the size of the property, 2) the historical use of the property, 3) the chemicals used at the property and 4) the extent of environmental studies conducted at the property. Properties that have had a Phase I Environmental Site Assessment completed in accordance with Standard E 1527-13 of the American Society for Testing and Materials (ASTM), an environmental assessment that conforms to 40 Code of Federal Regulations (CFR) 312, an EPA Preliminary Assessment, or a State Site Assessment which thoroughly documents the use history of the property and types and quantities of chemicals associated with the property use, may use this information to tailor the soil sampling and chemical analysis requirements to include just chemicals known or suspected to be used, stored or manufactured at the property, either currently or in the past. If a thorough property history has not been documented, soil sampling and laboratory analysis should include, at a minimum, priority pollutant metals, VOCs, DRO, GRO, SVOCs, pesticides and Polychlorinated Biphenyls.

Under certain circumstances the extent of the soil media environmental assessment may be based on the results of the Phase I assessment, or equivalent property assessment. Specifically, if the assessment thoroughly documents the property history and indicates that past activities had been confined to a discrete portion of the property, the Phase II, or equivalent property assessment sampling may be concentrated in this area, and a minimal number of representative samples may be collected across the remainder of the property.

The Voluntary Cleanup Program will typically accept soil sample analytical results as part of an applicant's application if the samples were collected from the property within one year of submittal of the application. Use of analytical data collected greater than one year prior to application submittal will be considered on a site-specific basis.

At a minimum, 10* grab samples are recommended to be taken from a property in order to demonstrate attainment of an applicable soil Cleanup Standard. The spatial distribution, sample depth and number of samples required to demonstrate attainment of an applicable Cleanup Standard is dependent on property specific conditions. In general, the 10 minimum soil sampling requirement is restricted to chemicals known or suspected to be used, stored or manufactured at the property, either currently or in the past. However, sampling work plans should adequately address the variables identified in section 7.0 (i.e., size of the property, historical use, chemical use, extent of previous environmental assessments) to satisfactorily address this requirement.

For properties that are two acres in size or larger, sampling approaches that should be considered include:

a) Grid Sampling
b) Biased Sampling, or
c) Phased Sampling.

Grid Sampling should be conducted when property conditions indicate widespread and uniformly distributed release of hazardous substances. Biased Sampling is a preferred sampling approach when property conditions have been reasonably characterized, and testing is conducted to refine the conceptual site model. Phased Sampling is recommended when limited information exists regarding the presence of hazardous substances at a property. This approach may necessitate multiple sampling activities in order to demonstrate attainment of a Cleanup Standard, or may indicate that Biased or Grid Sampling should be conducted.

Composite Sampling may be used to demonstrate compliance with a cleanup standard during a remedial action. The following criteria must be adhered to when collecting composite samples:

a) The environmental assessment of a property must be considered complete by the Department,
b) Composite sampling shall be conducted under a grid or systematic sampling framework,
c) A minimum of two or more sample locations may be composited to represent a discrete sample location,
d) Samples to be composited should be located adjacent to each other in the sample framework,
e) An equal volume (gravimetric) of soil must be composited from each sample collected from the sampling framework.
f) Composite sampling is typically not recommended for VOC, DRO and GRO samples.
g) Samples should be homogenized in the field.

The data collected from any sampling approach must be evaluated by statistical means to determine if more than one population of data exists at a property. Statistical measurements may also indicate that additional samples should be taken at the property. In the event that more than one population of data is identified at a property, attainment of an applicable Cleanup Standard must be demonstrated for each population. The Department accepts the following statistical methods to determine if more than one population data exists at a property:

a) Non-Parametric statistical methods that compare the means of two populations – Wilcoxon Rank Sum or the Quantile test as described in the EPA Guidance Document Statistical

* sampling requirement based on EPA Supplemental Guidance to RAGS: Calculating the Concentration Term. This Guidance indicates that fewer than 10 samples per exposure area provides poor estimates of the mean concentration between the sample mean and the 95th percent upper confidence limit.

Methods for Evaluating the Attainment of Cleanup Standards for Soils and Solid Media, EPA Office of Policy, Planning and Evaluation, PB94-176831, July, 1992.

b) Parametric statistical methods for evaluation of one population of data. This evaluation would include the calculation of the mean, mode, standard deviation and upper confidence limit of a population of data. The use of this method must be appropriate for the data gathered at the property and must also be consistent with the underlying assumptions of the method being used.

Exceptions to the number of samples required to demonstrate attainment of a Soil Standard may be granted by the MDE on a property-specific basis.

The threshold established for attainment of a soil cleanup standard when at least 10 soil samples are collected from a soil horizon is when either:

a) The 95% upper confidence limit (UCL) of the arithmetic mean is equal to or below the standard. The preferential method for deriving UCLs is the EPA ProUCL (version 5.1.00) software or equivalent. A minimum of 10 samples is necessary within a soil horizon when deriving a UCL.

b) All samples are below the applicable cleanup standard.

c) A site-specific risk assessment demonstrates risks are below the Department remedial action noncancer standard of a HQ of 1 and the cancer remedial action standard of 1E-5.

Biased Sampling for the sole purpose of demonstrating attainment of the standard is not allowed. Attainment of a soil cleanup standard may not be applicable using 95% UCL methods at most residential unrestricted use properties as the exposure unit would be represented by each home and not the entire property. In a residential development scenario if each exposure unit is characterized attainment of the standard may be achieved.

If any sample result exceeds a soil standard by five (5) times, then the Department reserves the right to require additional delineation sampling to eliminate the possibility of a source area in close proximity to any of the threshold attainment soil samples.

At properties where an existing building(s) exceeds 25% of the property area under evaluation and testing under the building footprint(s) is not considered feasible, the Department approval with respect to demonstration of attainment of the soil standard will reflect that limited to no data was collected from this area(s). If at a later date the building is removed, the Department, pursuant to Environment Article 7-201, may require additional environmental assessment work by persons considered responsible for the hazardous substances in this area of a property.

7.1 Exceptions to Soil Cleanup Standards

Exceptions to the application of the soils Cleanup Standards are:

a) Where it is technically impractical to reach the standard and a risk assessment demonstrates no risk is posed by the current or intended property use;

b) Where a risk assessment demonstrates no risk is posed by the current or intended property use. In this case, a restriction may need to be placed on the deed of a property with a current non-residential use or other approved use that is protective of public health and the environment that prohibits the use of the property under a residential exposure scenario; and

c) Where the Department determines that it is technically impracticable to reach the standard and a risk assessment demonstrates that a risk is posed by the current or intended use. In this case, an appropriate containment or isolation remedy is required to prevent exposure to potential receptors. In addition, a restriction and LUCs may need to be placed on the deed of a property with a current non-residential use or other approved use that is protective of public health and the environment that prohibits the use of the property under a residential exposure scenario and maintains the LUCs.

8.0 USE OF FIELD SCREENING TECHNOLOGY FOR ENVIRONMENTAL MEDIA

Field Screening Technology (i.e., Mobile Gas Chromatograph/Mass Spectrometer Laboratory, Immunoassay Technology and X-Ray Fluorescence equipment) for the soil media may be used in combination with a Fixed Laboratory sampling and chemical analysis program to reduce the total number of samples sent to a Fixed Laboratory for analysis in order to demonstrate attainment of a cleanup standard or to completely characterize the presence of hazardous substances at a property. Field Screening Technology may also be used to reduce/eliminate possible hazardous substances of concern from further evaluation at a property following an acceptable demonstration of positive correlation for accuracy and precision of analytical results between a Fixed Laboratory and Field Screening Technology results.

Generally, a 30% Fixed Laboratory confirmation is required for 20 or more samples tested using Field Screening Technologies. A 50% Fixed Laboratory confirmation is required for 10 – 19 samples tested using Field Screening Technologies.

8.1 Immunoassay Field Screening Technology

With respect to the use of Immunoassay Field Screening Technology or any other technology approved for use by the Department for use at properties subject to hazardous substance environmental assessment, a positive correlation of sample locations tested using both the field screening technology and the fixed laboratory analytical result must be demonstrated by the applicant. This correlation is demonstrated by satisfying the following requirements:

a) The fixed laboratory data meets the quality assurance project plan requirements identified in Appendix 3,

b) The field screening technology data was produced in conformance with the manufacturer's specifications, and adhered to the manufacturer's quality assurance/quality control requirements. The later information must be supplied to the Department with the data submission,

c) The field screening technology result, which is conveyed as either: 1) less than the total concentration of a contaminant suite (e.g., total polycyclic aromatic hydrocarbons, total pesticides, total Polychlorinated Biphenyls), 2) bound by concentration limits, or 3) exceeds a lower bound concentration, correlates with the fixed laboratory analytic result for the hazardous substance suite being evaluated.

A positive correlation between the Immunoassay Technology result and the fixed laboratory result is demonstrated when the total concentration of a particular suite of hazardous substances in the fixed laboratory result falls within the concentration bounds conveyed by the immunoassay result for the same sample location (e.g., a sample is analyzed by a fixed laboratory for individual Aroclor PCBs. The individual Aroclor concentrations, including Aroclor TICs are summed. This summed value is compared against the total PCB concentration value/range from the immunoassay test result. If the fixed lab result conforms with the immunoassay value/range result, then a positive correlation has been demonstrated).

Immunoassay Field Technology Screening data that has been accepted by the Department as demonstrating a positive correlation with the complementary Fixed Laboratory result may be used to represent the concentration of the contaminant of interest at the property with the lowest cleanup standard value in the analytic suite of compounds (e.g., a positive Carcinogenic Polycyclic Aromatic Hydrocarbon result using Immunoassay Technology would be used to represent the concentration of Benzo(a)Pyrene for the sample result in the application of the Cleanup Standards). Please contact the Department at 410-537-3493 for scheduling the use of the Department's Field Screening Technology.

8.2 X-Ray Fluorescence Field Screening Technology

Applicants may also use X-Ray Fluorescence (XRF) Technology to support demonstration of attainment of a cleanup standard. As with the use of the Immunoassay Technology, the same sample point from both the fixed laboratory and the XRF must have been analyzed in conformance with the QAPP requirements conveyed in Appendix 3 (i.e. for the fixed laboratory result) and in conformance with the Quality Assurance/Quality Control (QA/QC) procedures assigned by the manufacturer of the XRF. Applicants that use the XRF must supply the QA/QC procedures to the Department for review.

Since the XRF provides quantitative results for individual metal constituents, a regression analysis can be applied between the XRF and fixed laboratory data points to produce a corrected XRF data result to demonstrate positive correlation between XRF and fixed lab results.

9.0 HOT SPOTS/REMEDIAL ACTION REQUIREMENTS FOR THE SOIL MEDIA

Hot Spots may be identified during either a property environmental assessment or a remedial action. The following contaminant characteristics shall be considered Hot Spots:

a) Contaminant concentrations in the soil media exceeds one of the following criteria at a sampling location:

   1. The EPA Removal Action Guidelines for Soil,

   2. Depending upon the existing land use, an EPA RSL value in excess of 1E-4 cancer risk or Hazard Index of 100,

   3. Exceeds a traditional risk calculation of 1E-4 or Hazard Index of 100, or

b) Visible discoloration of soil and/or standing pools of discolored liquid that is later confirmed by laboratory analysis or field screening technology to be a hazardous substance(s), or

c) Controlled Hazardous Substances in drums, tanks, bulk storage containers, or any other container that pose an imminent threat of release as function of the poor integrity of the storage vessel, or

d) Free Product, or

e) Actual or potential exposure to nearby human populations, animals or the food chain from controlled hazardous substances that exceed the criteria identified in 9.a. Examples of direct exposure scenarios include but are not limited to dust generation/migration to residential areas, playgrounds, sensitive populations nearby, or

f) Threat of fire or explosion.

All identified Hot Spots have to be addressed in accordance with a Department approved Remedial Action Plan. The Department's expectation is that treatment shall be used to remediate Hot Spot contamination, wherever practicable. Engineering controls, such as containment, may be used when the applicant has demonstrated to the satisfaction of the Department that treatment or removal is technically impracticable. Land Use Control remedial actions may be used in conjunction with treatment or containment of Hot Spots, but may not solely be used as an acceptable method to remedy Hot Spot contamination.

10.0 GROUNDWATER ASSESSMENT/REMEDIAL ACTION REQUIREMENTS

A. The groundwater Cleanup Standards are to be applied to groundwater from Type I and Type II aquifers and Groundwater Use Areas. Assessment of the groundwater media must cover the lateral and vertical extent of contamination irrespective of property ownership. The number of groundwater samples and the spatial distribution of samples taken at a property shall be determined on a property specific basis.

B. Groundwater must be remediated if any of the following conditions occur:

1) Free product is discovered – (All Free Product/LNAPL /DNAPL must be removed).

2) The concentration of the hazardous substance(s) exceed either the target cancer risk threshold of 1E-5 or the Hazard Quotient threshold = 1 via the Inhalation Pathway Exposure Scenario (this determination would be conducted from a property specific risk calculation).

3) A drinking water well is contaminated above a Department groundwater cleanup standard, or a traditional risk assessment indicates an exceedance of a target cancer risk threshold of either 1E-5 or the non-carcinogenic Hazard Quotient threshold = 1 at a well head, or the Department determines that a drinking water well is at risk of becoming contaminated above a groundwater cleanup standard.

The groundwater Cleanup Standards are generally applicable to groundwater when, at the interface of a surface water body, mass loading calculations indicate that exceedance of:

1) a State of Maryland Surface Water Quality Criteria will occur from the transfer of hazardous substances in groundwater across an interface with a surface water body, or

2) a groundwater cleanup standard will occur and the surface water body is either used for drinking water, or may be used for drinking water in the future.

C. Groundwater Cleanup Standards are generally applicable to groundwater from Type I and II aquifers. Exceptions to this are:

1) It is technically impractical to complete a remedial action to a groundwater cleanup standard. The standard for determining Technical Impracticability shall adhere to the EPA Guidance Documents: OSWER Directive 9234.2-25 (September 1993) - Interim Final "Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration" and OSWER Directive 9200.4-14 (January 1995) “Consistent Implementation of the FY 1993 Guidance on Technical Impracticability of Ground-Water Restoration at Superfund Sites.”, and “Clarification of the Consultation Process for Evaluating the Technical Impracticability of Groundwater Restoration at CERCLA Sites”, December 28, 2016, OLEM Directive 9200.3-117.

2) Where the person can demonstrate that there is no current use or projected future use of groundwater within one half mile of the property, where it can be shown that the contaminant(s) in the groundwater are at asymptotic levels but do not exceed any groundwater cleanup standard by an order of magnitude, a risk assessment demonstrates no risk is posed from the current or intended property use, and where a groundwater management zone has been implemented by the Department that restricts or prohibits the use of groundwater for the property.

3) When a hazardous substance(s) exceeds a groundwater cleanup standard, an applicant or responsible person can select either of the following alternative cleanup goals:
   a) Demonstrate that the hazardous substance(s) will not migrate off the property. Demonstration of this condition may be accomplished by the following actions:
      i) Establish a monitoring system, including perimeter sentry wells to demonstrate no off-property migration at concentrations exceeding the applicable standards.
      ii) Develop a contingency remedial action plan in the event that concentrations in the perimeter wells exceed the standards.
      iii) Conduct a risk assessment to demonstrate that no risk is posed by the current or intended property use.
      iv) Adhere to a groundwater management zone that has been implemented by the Department that restricts or prohibits the use of groundwater for the property.
      v) Secure a bond or other financial security instrument that has been approved by the Department to fund the implementation of i and ii.
      vi) With respect to sections 10.C 1 and 3, the Department shall require a minimum of two rounds of groundwater data be collected on a semi-annual basis before approving of this groundwater cleanup exception.

4) Where natural groundwater concentrations for metals exceed groundwater cleanup standards. Demonstration of this condition is required to apply this exception.

11.0 PRESUMPTIVE REMEDIAL ACTIONS FOR THE SOIL MEDIA

The Department has developed presumptive remedial actions for hazardous substances in the soils under a restricted use residential scenario, mixed-use commercial/residential scenario, recreational scenarios and commercial and industrial scenarios. Presumptive remedial actions are intended to provide the applicant with readily understood requirements in order to facilitate an expedited remedial action of the property while still being protective of public health. The Department has also developed recreational use soil cleanup scenarios whereby site-specific soil cleanup goals may be derived.

11.1 Residential Use Soil Cleanup Requirements

a) Tier IA Residential Unrestricted

Properties that have a residential unrestricted use or have a projected future unrestricted residential use are required to remedy hazardous substances in the soil to the applicable residential soil standard. Use of either treatment technologies or removal of hazardous substances in the soil to the applicable soil standard is required for this land use. Attainment of the soil standard must be demonstrated following the remedial action. The residential soil standard extends to a depth of 15 feet or the zone of saturation. Demonstration of attainment of the soil cleanup standard must also include evaluation of temporal variations in the depth of the zone of saturation.

b) Tier 1B Residential Restricted

Properties that have a residential restricted use or have a projected future residential restricted use are required to remedy hazardous substances in the surficial soil to the applicable residential soil standard. Use of either treatment technologies or removal of hazardous substances in the soil to the applicable soil standard is required for this land use. Attainment of the soil standard must be demonstrated following the remedial action. A residential restricted land use may use one or more LUCs imposed as a condition of residential use to mitigate potential exposures to hazardous substances in subsurface soils.

11.2 Recreational Use Soil Cleanup Requirement

Property that has a recreational land use or has a similar projected future land use shall utilize the residential soils Cleanup Standards to evaluate risk. To evaluate risk at such properties, the person undertaking the environmental action at the property shall use a residential scenario or select one of the three recreational scenarios in the site-specific risk assessment process:

Level 1: Public Recreational Areas (High Frequency Use)
Definition: A high frequency public recreational area is any area that is available for recreational use by all populations at the highest potential exposure frequency (youth, child, adult, senior, etc.). Examples may include, but are not limited to, playgrounds, day care facilities, schools with day care, golf courses, and picnic areas.

Frequency: The frequency of visits by all populations is 250 days per year or less.

Level 2: Public Recreational Areas (Moderate Frequency Use)
Definition: A moderate frequency use public recreational area is any area that is available for recreational use by all populations but the frequency of use is less than a high frequency use public recreational area. Such areas may be restricted through the use of fencing, permitting requirements, or other similar restrictions or LUCs that prevent or hinder unimpeded access to the recreational area. Examples include, but are not limited to, outdoor aquatic facilities, athletic facilities, dog parks, and limited access parks.

Frequency: The frequency of visits by all populations is 182 days per year or less.

Level 3: Open Space Public Recreational Area (Low Frequency Use)
Definition: An open space public recreational use area is defined as any area where access and use is restricted by a combination of:

a) Covenants or other legal restrictions that prohibit the use of the property where such use may impair the flora and fauna in the open space; and
b) Physical environmental barriers impede the use of the open space, including but not limited to swamps, marshes, dense vegetation, and areas with steep inclines that limit the use of open space.

Frequency: The frequency of visits by all populations is 52 days per year or less.

11.3 Commercial and Industrial Use Soil Cleanup Requirements

a) Tier 2A Commercial Unrestricted
Properties that have commercial unrestricted use or projected commercial unrestricted use are required to remedy hazardous substances in the soil to the applicable non-residential soil standard. Use of either treatment technologies or removal of the hazardous substances in the soil to the applicable soil standard is required for this land use. Attainment of the soil standard must be demonstrated following remedial action. The non-residential soil standard extends to a depth of 15 feet or the zone of saturation. Demonstration of attainment of the soil cleanup standard must also include evaluation of temporal variations in the depth of the zone of saturation. A commercial LUC is required for the property.

b) Tier 2B Commercial Restricted
Properties that have commercial restricted use or projected commercial restricted use are required to remedy hazardous substances in the surface soil to the applicable non-residential soil standard. Use of either treatment technologies or removal of the hazardous substances in the soil to the applicable soil standard is required for this land use. Attainment of the soil standard must be demonstrated following remedial action. A restricted commercial land use may use one or more LUCs or engineering controls imposed as a condition of restricted commercial use to mitigate potential exposure to hazardous substances in subsurface soils.

Industrial use or planned use of property would include workers over the age of 18, adult workers and construction workers as well as intermittent visitors and trespassers whose exposure to hazardous substance at the property would be at a reduced frequency. Industrial properties are required to remedy or remove hazardous substances following the same procedures identified in Section 11.3 a) and b) and would be required to have an Industrial LUC on the property.

11.4 Mixed Use (Commercial/Residential) Soil Cleanup Minimum Requirements

Property that has a non-residential/residential land use or has a similar projected future land use shall utilize the residential soil Cleanup Standards to evaluate risk. Hazardous substances identified at a property above the applicable soil cleanup standard must adhere to the following remedial action requirements:

a) Remedial actions at the property can either:

1) Utilize a treatment technology or perform a removal action for contaminant of concentrations that exceed an EPA RSL target cancer risk threshold value of 1e-4 Cancer and/or the Hazard Quotient threshold = 100 or,

2) Remove hazardous substances that exceed the standards identified in 11.1 and place under a Department-approved cap. Department approval of this remedial action is contingent on the applicant demonstrating that the placement of soil hazardous substances under the cap will not result in an unacceptable risk to a human receptor from the inhalation of contaminant vapors, and

b) Options a) 1 and 2 must also consider the Groundwater use area scenario and adhere to the Hot Spots/Remedial Action Criteria.

c) Open Space areas of the properties (i.e. not park land, but including land between buildings, etc.) with identified hazardous substance above the residential cleanup standard for soil are required to have a minimum placement of a clean fill soil cap cover that is a minimum of 30 inches thick over a Department-approved Geotextile Marker Fabric Material or an equivalent engineering control that is protective of public health and the environment. This provision is applicable under an engineering control – containment remedy.

d) Areas identified for paving that have identified hazardous substances above the residential cleanup standard for soil are required to have a minimum placement of a clean fill soil cap cover that is a minimum of 30 inches thick or a combination of clean fill/road base and asphalt/cement over a Department approved Geotextile Marker Fabric Material or an equivalent engineering control that is protective of public health and the environment. This provision is applicable under an engineering control – containment remedy.

e) With respect to the criteria identified in 11.4. c-d., the applicant will be required to have a LUC restriction placed on the Deed that restricts excavation activities below the ground surface. With respect to the criteria identified in 11.4.a.2, the restriction would be at the ground surface. This provision is applicable under an engineering control – containment remedy.

f) Underground utilities (i.e., water, sewer, gas, electric, telephone, cable, communication, and others, as appropriate) that are to be installed at the property with identified contamination above a residential cleanup standard for soil are recommended to over-excavate to a foot below normal placement of the utility line and a foot wider on each side of the line. A Department approved geotextile fabric must be placed in the bottom and sides of the trench and covered with a minimum of one foot of clean fill. The utility line is then placed and covered with clean fill. This provision is applicable under an engineering control – containment remedy.

g) Items c-f must also consider Contaminant Soil leaching to Groundwater Use Scenario. This provision shall only apply to Groundwater use areas.

12. REFERENCES

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f. USEPA, Risk Assessment Guidance for Superfund (RAGS): Part C, Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part C, Risk Evaluation Remedial Alternatives). October 1991. Publication 9285.7-01C.

g. USEPA, Risk Assessment Guidance for Superfund (RAGS): Part D, Risk Assessment Guidance for Superfund: Volume I , Human Health Evaluation Manual (Part D Standardized Planning, Reporting and Review of Superfund Risk Assessments), December 2001. Publication 9285.7-47.

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m. American Society for Testing and Materials (ASTM), Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, Designation E 1527 –13, November 1, 2013.

n. USEPA, Hazard Evaluation Handbook – A Guide to Removal Actions, Fourth Edition, EPA 903/B-97-006, 1997.

o. USEPA, Statistical Methods for Evaluating the Attainment of Cleanup Standards for Soils and Solid Media, EPA Office of Policy, Planning and Evaluation, PB94-176831, July, 1992.

p. USEPA, OSWER Directive 9234.2-25 (September 1993) - Interim Final Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration.

q. USEPA, OSWER Directive 9200.4-14 (January 1995) Consistent Implementation of the FY 1993 Guidance on Technical Impracticability of Ground-Water Restoration at Superfund Sites.

r. Massachusetts Department of Environmental Protection, Characterizing Risks posed by Petroleum Contaminated Sites: Implementation of MADEP VPH/EPA Approach, October 31, 2002, Policy#WSC-02-0411.

s. American Society for Testing and Materials (ASTM), Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process, Designation E1903-11 (June 15, 2011).

TABLE 1 - GENERIC NUMERIC CLEANUP STANDARDS FOR GROUNDWATER AND SOIL

Chemical (RSL Name)		CAS Number	Groundwater Standards Type I and II Aquifers (ug/L)	Soil Standards Residential Clean-up Standard (mg/Kg)	Soil Standards Non-Residential Clean-up Standard (mg/Kg)	Protection of Groundwater (a) (mg/Kg)
Inorganic Compounds						
Aluminum		7429-90-5	2000	7700	110000	60000
Antimony (metallic)		7440-36-0	6.0	3.1	47000	0.07
Arsenic, Inorganic		7440-38-2	10	0.68	3	0.03
Barium		7440-39-3	2000	15000	22000	320
Beryllium and compounds		7440-41-7	4.0	16	230	38
Cadmium (Water& diet)		7440-43-9	5.0	7.11	98	1.4
Chromium(III), Insoluble Salts		16065-83-1	2200	12000	180000	80000000
Chromium(VI)	(e)	18540-29-9	0.035	0.3	6.3	0.013
Chromium, Total		7440-47-3	100			
Copper		7440-50-8	1300	310	4700	56
Cyanide (CN-)		57-12-5	200	2.3	15	0.030
Iron		7439-89-6	1400	5500	700	700
Lead and Compounds		7439-92-1	15	400	800	
Manganese (Non-diet)		7439-96-5	43	180	2600	560
Mercuric Chloride		7487-94-7	2.0	2.3	35	
Mercury (elemental)	(d)	7439-97-6	2.0	1.1	4.6	0.066
Methyl Mercury		22967-92-6	0.2	120	28	
Nickel Soluble Salts		7440-02-0	39	150	2200	52
Perchlorate and perchlorate salts		14797-73-0	15	5.5	82	
Selenium		7782-49-2	50	39	580	1.04
Silver		7440-22-4	9.4	39	580	1.6
Thallium (Soluble Salts)		7440-28-0	2.0	0.078	1.2	0.028
Tin		7440-31-5	1200	4700	70000	6000
Vanadium and Compounds		7440-62-2	8.6	39	580	17
Zinc and Compounds		7440-66-6	600	2300	35000	740
Petroleum Hydrocarbon (TPH)						
Diesel Range Organics (DRO)			47	230	620	
Gasoline Range Organics (GRO)			47	230	620	

Chemical (RSL Name)	CAS Number	Groundwater Standards Type I and II Aquifers (ug/L)	Soil Standards Residential Clean-up Standard (mg/Kg)	Soil Standards Non-Residential Clean-up Standard (mg/Kg)	Protection of Groundwater (a) (mg/Kg)
Polychlorinated Biphenyl					
Alachlor	15972-60-8	2.0	9.7	41	0.017
Aldrin	309-00-2	0.00092	0.039	0.18	0.003
Aroclor 1016	12674-11-2	0.14	0.41	5.1	0.26
Aroclor 1221	11104-28-2	0.0047	0.20	0.83	0.0016
Aroclor 1232	11141-16-5	0.0047	0.17	0.72	0.0016
Aroclor 1242	53469-21-9	0.0078	0.23	0.95	0.024
Aroclor 1248	12672-29-6	0.0078	0.23	0.95	0.024
Aroclor 1254	11097-69-1	0.0078	0.12	0.97	0.04
Aroclor 1260	11096-82-5	0.0078	0.24	0.99	0.11
Atrazine	1912-24-9	3.0	2.4	10	0.004
Chlordane	12789-03-6	2.0	1.7	7.7	0.054
Dalapon	75-99-0	200	190	2500	0.24
DDD	72-54-8	0.0063	0.19	2.5	0.03
DDE, p,p'-	72-55-9	0.046	2.0	9.3	0.22
DDT	50-29-3	0.23	1.9	8.5	1.5
Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	70	70	960	0.09
Dieldrin	60-57-1	0.0018	0.034	0.14	0.0014
Dinoseb	88-85-7	7.0	6.3	82	0.26
Endosulfan	115-29-7	10	47	700	2.8
Endrin	72-20-8	2.0	1.9	25	0.184
Glyphosate	1071-83-6	700	630	8200	18
Heptachlor	76-44-8	0.40	0.13	0.63	0.0024
Heptachlor Epoxide	1024-57-3	0.20	0.07	0.33	0.00056
Hexachlorocyclohexane, Alpha-	319-84-6	0.0072	0.086	0.36	0.00084
Hexachlorocyclohexane, Beta-	319-85-7	0.025	0.30	1.3	0.003
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	.20	.57	2.5	0.0048
Methoxychlor	72-43-5	40	32	410	4
Oxamyl	23135-22-0	200	160	2100	0.22
Polychlorinated Biphenyls (low risk) (PCB Total)	1336-36-3	0.50	0.23	0.94	0.024
Simazine	122-34-9	4.0	4.5	19	0.006
Toxaphene	8001-35-2	3.0	0.49	2.1	0.22

Chemical (RSL Name)	CAS Number	Groundwater Standards Type I and II Aquifers (ug/L)	Soil Standards Residential Clean-up Standard (mg/Kg)	Soil Standards Non-Residential Clean-up Standard (mg/Kg)	Protection of Groundwater (a) (mg/Kg)
Polychlorinated Biphenyl					
Trichlorophenoxypropionic acid, -2,4,5(2,4,5-TP)(Silvex)	93-72-1	50	51	660	0.12

Chemical (RSL Name)		CAS Number	Groundwater Standards Type I and II Aquifers (ug/L)	Soil Standards Residential Clean-up Standard (mg/Kg)	Soil Standards Non-Residential Clean-up Standard (mg/Kg)	Protection of Groundwater (a) (mg/Kg)
Semivolatile Organic Compounds						
Acenaphthene		83-32-9	53	360	4500	11
Anthracene		120-12-7	180	1800	23000	116
Benz[a]anthracene	(e)	56-55-3	0.03	1.1	21	0.22
Benzo[a]pyrene	(e)	50-32-8	0.2	0.11	2.1	0.58
Benzo[b]fluoranthene	(e)	205-99-2	0.25	1.1	21	6
Benzo[k]fluoranthene	(e)	207-08-9	2.5	11	210	58
Bis(2-chloroethyl)ether		111-44-4	0.014	0.23	1	0.28
Bis(2-ethylhexyl)phthalate		117-81-7	6	39	160	26
Chloroaniline, p-		106-47-8	0.37	2.7	11	0.0032
Chloronaphthalene, Beta-		91-58-7	75	480	6000	7.8
Chlorophenol, 2-		95-57-8	9.1	39	580	0.18
Chrysene	(e)	218-01-9	25	110	2100	230
Cresol, o-		95-48-7	93	320	4100	1.5
Cresol, p-		106-44-5	190	63	8200	3
Di(2-ethylhexyl)adipate		103-23-1	65	450	1900	94
Dibenz[a,h]anthracene	(e)	53-70-3	0.025	0.11	2.1	1.9
Dibenzofuran		132-64-9	0.79	7.3	100	0.30
Dibutyl Phthalate		84-74-2	90			4.6
Dichlorobenzene, 1,2-		95-50-1	600	180	930	0.6
Dichlorobenzene, 1,4-		106-46-7	75	2.6	11	0.0092
Dichlorobenzidine, 3,3'-		91-94-1	0.13	1.2	5.1	0.016
Dichlorophenol, 2,4-		120-83-2	4.6	19	250	0.046
Diethyl Phthalate		84-66-2	1500	5100	66000	10.2
Dimethylphenol, 2,4-		105-67-9	36	130	1600	0.84
Dinitrophenol, 2,4-		51-28-5	3.9	13	160	0.088
Dinitrotoluene, 2,4-		121-14-2	0.24	1.7	7.4	0.0064
Dinitrotoluene, 2,6-		606-20-2	0.049	0.36	1.5	0.0013
Fluoranthene		206-44-0	80	240	3000	178
Fluorene		86-73-7	29	240	3000	10.8
Hexachlorobenzene		118-74-1	1	0.21	0.96	0.0024
Hexachlorobutadiene		87-68-3	0.14	1.2	5.3	0.054

Chemical (RSL Name)		CAS Number	Groundwater Standards Type I and II Aquifers (ug/L)	Soil Standards Residential Clean-up Standard (mg/Kg)	Soil Standards Non-Residential Clean-up Standard (mg/Kg)	Protection of Groundwater (a) (mg/Kg)
Semivolatile Organic Compounds						
Hexachlorocyclopentadiene		77-47-4	50	0.18	0.75	0.0026
Hexachloroethane		67-72-1	0.33	1.8	8	0.004
Indeno[1,2,3-cd]pyrene	(e)	193-39-5	0.25	1.1	21	20
Isophorone		78-59-1	78	57	240	0.52
Methylnaphthalene, 2-		91-57-6	3.6	24	300	0.38
Naphthalene		91-20-3	0.17	3.8	17	0.011
Nitrobenzene		98-95-3	0.14	5.1	22	0.0018
Nitroso-di-N-propylamine, N-		621-64-7	0.011	0.078	0.33	0.00016
Nitrosodiphenylamine, N-		86-30-6	12	110	470	1.34
Pentachlorophenol		87-86-5	1.0	1.0	4.0	0.0011
Phenanthrene		85-01-8	12	180	2300	26
Phenol		108-95-2	580	1900	25000	6.6
Pyrene		129-00-0	12	180	2300	26
Trichlorobenzene, 1,2,4-		120-82-1	70	5.8	26	0.024
Trichlorophenol, 2,4,5-		95-95-4	120	630	8200	8
Trichlorophenol, 2,4,6-		88-06-2	1.2	6.3	82	0.024

Chemical (RSL Name)		CAS Number	Groundwater Standards Type I and II Aquifers (ug/L)	Soil Standards Residential Clean-up Standard (mg/Kg)	Soil Standards Non-Residential Clean-up Standard (mg/Kg)	Protection of Groundwater (a) (mg/Kg)
Volatile Organic Compounds						
Acetone		67-64-1	1400	6100	61000	5.8
Benzene		71-43-2	5.0	1.2	5.1	0.0046
Bromodichloromethane(THM)	(b)	75-27-4	80	0.29	1.3	0.00072
Bromoform	(b)	75-25-2	80	19	86	0.017
Bromomethane		74-83-9	0.75	0.68	3.0	0.0038
Carbon Disulfide		75-15-0	81	77	350	0.48
Carbon Tetrachloride		56-23-5	5	0.65	2.9	0.0036
Chlorobenzene		108-90-7	100	28	130	0.11
Chloroform	(b)	67-66-3	80	0.32	1.4	0.00012
Chloromethane		74-87-3	19	11	46	0.098
Cumene		98-82-8	45	190	990	1.5
Dibromo-3-chloropropane, 1,2- (DBCP)	(e)	96-12-8	0.20	0.0053	0.064	0.0000028
Dibromochloromethane	(b)	124-48-1	80	8.3	39	0.0046
Dibromoethane, 1,2-		106-93-4	0.050	0.036	0.16	0.000042
Dichloroethane, 1,1-		75-34-3	2.8	3.6	16	0.016
Dichloroethane, 1,2-		107-06-2	5.0	0.46	2.0	0.00096
Dichloroethylene, 1,1-		75-35-4	7.0	23	100	0.20
Dichloroethylene, 1,2-cis-		156-59-2	70	16	230	0.022
Dichloroethylene, 1,2-trans-		156-60-5	100	160	2300	0.22
Dichloropropane, 1,2-		78-87-5	5.0	1.6	6.6	0.0054
Ethyl Chloride		75-00-3	2100	1400	5700	12
Ethylbenzene		100-41-4	700	5.8	25	0.034
Methyl Ethyl Ketone (2-Butanone)		78-93-3	560	2700	19000	2.4
Methyl Isobutyl Ketone (4-methyl-2-pentanone)		108-10-1	630	3300	14000	2.8
Methyl tert-Butyl Ether (MTBE)	(c)	1634-04-4	20	47	210	
Methylene Chloride	(e)	75-09-2	5.0	35	320	0.054
Styrene		100-42-5	100	600	3500	2.6
Tetrachloroethane, 1,1,2,2-		79-34-5	0.076	0.60	2.7	0.00060
Tetrachloroethylene		127-18-4	5.0	8.1	39	0.036
Toluene		108-88-3	1000	490	4700	1.52
Trichloroethane, 1,1,1-		71-55-6	200	810	3600	5.6

Chemical (RSL Name)		CAS Number	Groundwater Standards Type I and II Aquifers (ug/L)	Soil Standards Residential Clean-up Standard (mg/Kg)	Soil Standards Non-Residential Clean-up Standard (mg/Kg)	Protection of Groundwater (a) (mg/Kg)
Volatile Organic Compounds						
Trichloroethane, 1,1,2-		79-00-5	5.0	0.15	0.63	0.00026
Trichloroethylene	(e)	79-01-6	5.0	0.41	1.9	0.0020
Trimethylbenzene, 1,2,4-		95-63-6	5.6	30	180	0.16
Trimethylbenzene, 1,3,5-		108-67-8	6.0	27	150	0.17
Vinyl Chloride (adult)	(e)	75-01-4	2.0	0.059	1.7	0.00013
Xylenes		1330-20-7	1000	58	250	0.38

Note: When updated toxicity information on a contaminant is identified in the RSL table the updated toxicity information must be utilized to assess the contaminant.

a. Standard based on EPA RSLs May 2018 SSLs for protection of groundwater migration using a dilution attenuation factor (DAF) of 20. (10/31/2007)

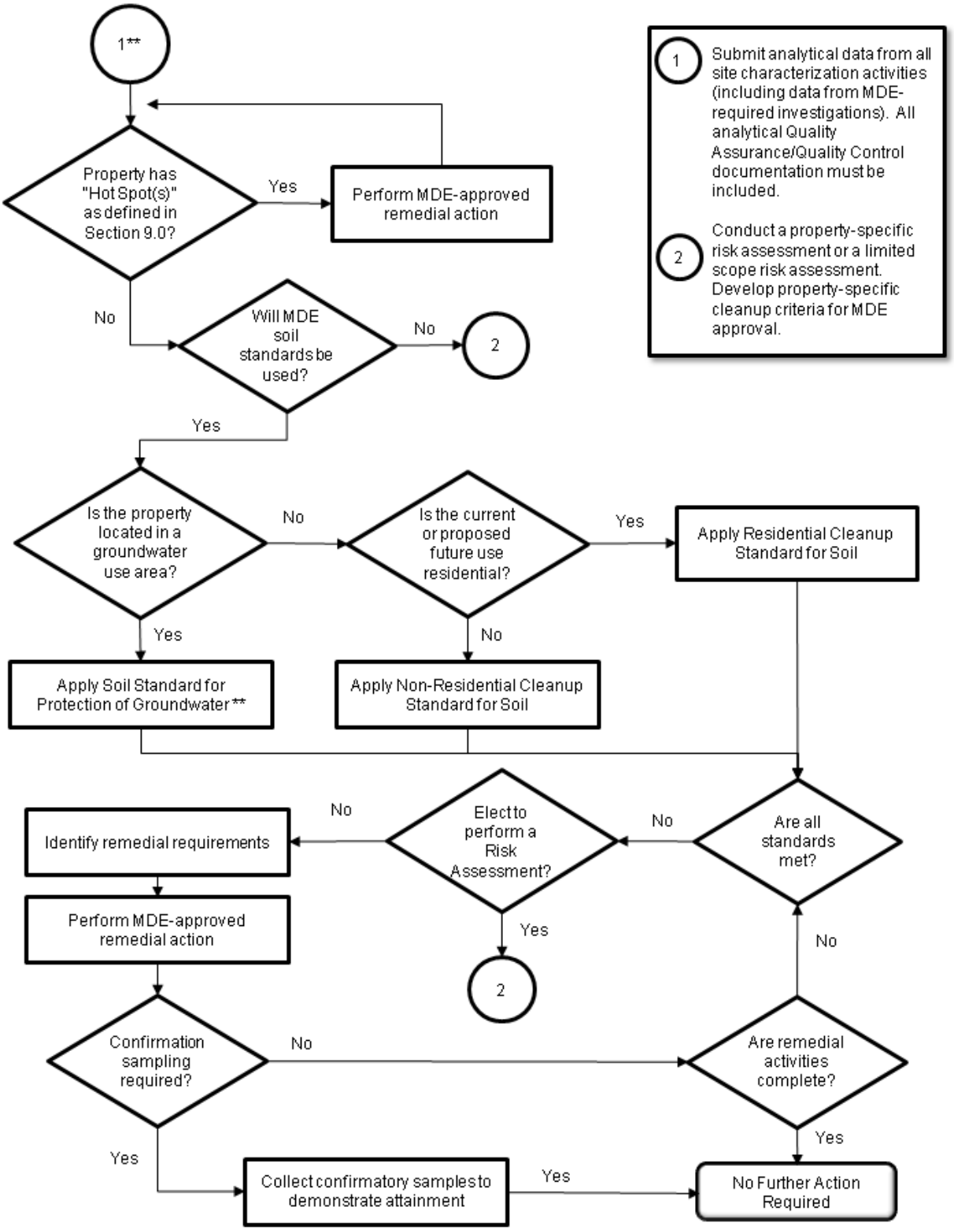
b. THM (trihalomethanes) Contaminants within this group are disinfection byproducts sometimes added to drinking water.

c. MTBE action level in Maryland is 20 ug/L.

d. The vapor intrusion and inhalation of volatiles and fugitive dust exposure pathways must be evaluated when mercury detections on a site exceed the regional mercury Anticipated Typical Concentration (ATC).

e. Carcinogenic chemicals with a Mutagenic Mode of Action (MOA).

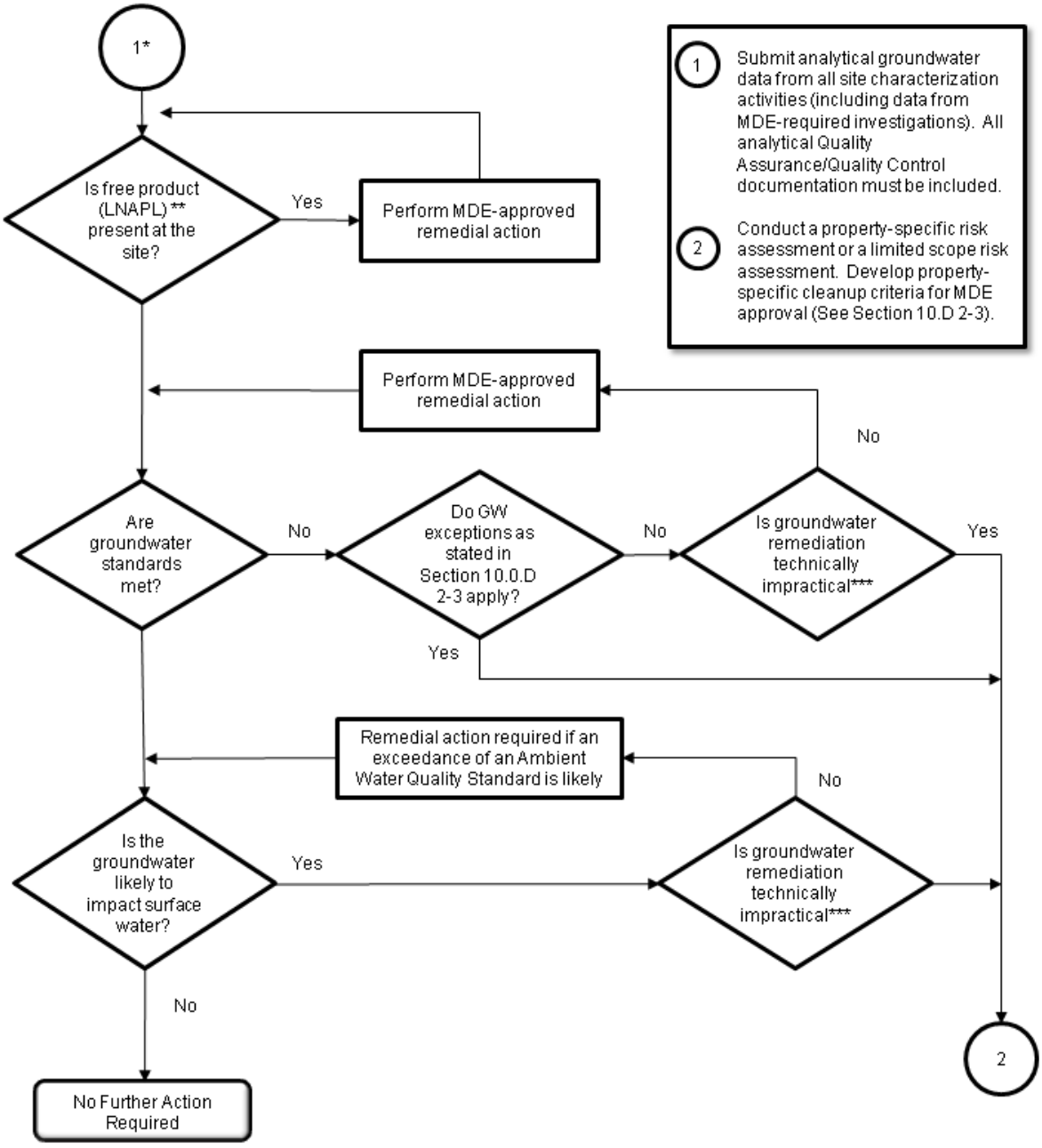
Figure 1. Flowchart for the Application of MDE Soil Cleanup Standards



* Contingent on MDE approval of either a soil investigation or remediation.

** Apply the soil standard for the protection of groundwater or the appropriate land use soil standard, whichever is lower. If no soil standard for the protection of groundwater exists then apply the appropriate land use soil standard.

Figure 2. Flowchart for the Application of MDE Groundwater Cleanup Standards



* Contingent on MDE approval of either a groundwater investigation or remediation.
** Light non-aqueous phase liquids.
III See Section 10.0.D.1

Appendix 1. Risk Assessment Equations and Exposure Factors Are Identified in the Most Current Version of the EPA Regional Screening Level User's Guide, May 2018.

Appendix 1 - Table 1. MDE default exposure populations that must be evaluated for applicable land use scenarios.

Land Use Scenario	Population				
Residential	Adult	Youth (>6 - <18 Years)	Child (<6 Years)	Construction Worker	Age-Adjusted Resident
Recreational	Adult	Youth (>6 - <18 Years)	Child (<6 Years)	Construction Worker	Age-Adjusted Resident
Commercial	Adult	Youth (>6 - <18 Years)	Child (<6 Years)	Construction Worker	
Industrial	Adult			Construction Worker	

Appendix 2

REFERENCE LEVELS OF METALS AND TRACE ELEMENTS IN SOILS OF MARYLAND

As Indicated by Background Soil Samples
Collected As Part of National Priorities List, Federal Facility,
And CERCLA Investigations Conducted
Throughout Maryland

INTRODUCTION

The 1980 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) established a national process for investigating and remediating sites contaminated with hazardous substances. Since that time the environmental industry and government sectors have labored to establish cleanup standards that are practical and protective of human health and the environment.

One remediation approach commonly considered is clean up to “background.” Many regulatory agencies define “background” as the concentration of a hazardous substance, if any, existing in the environment at the site prior to the release of a hazardous substance. The establishment of “background” as a cleanup standard results in the necessity of determining the concentration of a chemical prior to any releases. This approach is particularly significant when cleanup standards are being developed for naturally occurring metals and trace elements that are present in the soil.

The soil media is of particular concern during site investigations since it is commonly the first media that is impacted by a release of hazardous material. Soils also serve as the pathway to other environmental media, such as air (via dust) or groundwater (via seepage), or surface water (via runoff). As a result, establishing the “background” concentration for metals and trace elements in soils is one of the most critical components of a site investigation.

OBJECTIVE

The Annotated Code of Maryland § 7-501 defines "background level" as the level of a substance occurring naturally at the site prior to any manmade spill or release.

The objective of this study is to evaluate previously collected information on "background" concentrations of metals and trace elements in Maryland and use statistical methods to develop "reference levels" for metals and trace elements in the soil. The information generated from this study has been used by the MDE in developing cleanup standards for metals and trace elements in soil.

PROCESS

For the purpose of this study, the geographic area of the state has been divided into three provinces based upon broad differences in age, chemistry, and structure of the geologic units in each province. These provinces include Eastern Maryland, Central Maryland, and Western Maryland. Figure 1 depicts the boundaries of these provinces.

This study utilized laboratory derived analytical data collected on metals in soil from environmental investigations overseen by the MDE. The soil data used in this study were extracted from Federal Facility, National Priorities List, and CERCLA investigations completed throughout the state of Maryland. These soil samples were identified as "background" grab surface soil samples for the particular site subject to investigation by the MDE. A complete list of sites included in this study and the analytic results are provided in Attachment 1.

All soil samples were collected after 1990. The samples were analyzed using methods approved by the United States Environmental Protection Agency (EPA) and/or other approved methods for various programs within the MDE. Therefore, the data set used in this study is considered to be acceptable for the objectives identified.

STATISTICAL ANALYSIS

Statistical analyses were conducted on data for each analyte included in the investigation. The statistical analyses included the mean, standard deviation, and maximum and minimum values. Since each particular site investigation has specific sampling objectives, not all samples were analyzed for all metals included in this study. Analytes that were not analyzed were not included in the statistical analysis. If an analyte was not detected, then a value equivalent to half the detection limit was used in the statistical analysis unless otherwise noted. The results of the analysis are presented in Attachment 2.

Values defined as the "Anticipated Typical Concentration" represent "reference levels" for each analyte. The Anticipated Typical Concentration (ATC) represents the mean concentration plus one standard deviation. The ATC represents a value that either matches or exceeds the majority of background concentration samples. ATC values were calculated for metals and trace elements in each of the three provinces of the state of Maryland identified in this study.

SUMMARY TABLES

Background soil concentration data collected from environmental investigations overseen by the MDE for each geologic province is summarized in Attachment 1. Information present in Attachment 2 includes a statistical summary of metal species, the ATC, United States Geologic Survey (USGS) concentrations, and the proposed Maryland cleanup standards. The USGS concentrations represent the average concentrations of metals and trace elements in soils and other surficial material in the conterminous United States as reported by the USGS in 1984[1].

The proposed Maryland Cleanup Standards represent concentration levels at which no further remedial response action would be required based upon the potential threat posed by these substances to human health within the constraints of current knowledge. The soil concentration values for residential sites are intended for properties that are zoned for residential use, or have a projected future residential use.

RESULTS

Comparison of the ATC to the Proposed Maryland Cleanup Standards for Residential sites shows that the reference levels for the following elements exceed the Maryland Cleanup Standards:

	Anticipated Typical Concentration (ATC)			**Proposed Maryland Cleanup Standards**
Analyte	**Eastern Maryland**	**Central Maryland**	**Western Maryland**	**(residential)**
Aluminum	1.1 E+04	1.9 E+04	2.0 E+04	7.7 E+03
Arsenic	3.6 E+00	4.9 E+00	1.1 E+01	6.8 E-01
Chromium (total)	2.8 E+01	3.0 E+01	4.2 E+01	3.0 E-01
Iron	1.5 E+04	2.6 E+04	3.9 E+04	5.5 E+03
Manganese	4.8 E+02	1.4 E+03	1.5 E+03	1.8 E+02
Thallium	3.9 E+00	1.5 E+00	4.6 E+00	7.8 E-02
Vanadium	3.0 E+01	35 E+01	1.2 E+02	3.9 E+01

All values are reported in parts per million.

When an ATC concentration for a given province exceeds the “Proposed Maryland Cleanup Standards (Residential)”, the ATC value for the appropriate province may be proposed as an acceptable alternative to the risk derived value presented in the “Proposed Maryland Cleanup Standards (Residential).”

DISCUSSION OF RESULTS

Several of the MDE derived reference levels for metals in soils exceed the proposed Maryland Cleanup Standards under a residential use setting. This result is a consequence of multiple factors and does not necessarily indicate that a hazard is posed to either human health or the environment in areas of the state where the reference levels exceed the proposed Residential Cleanup Standards.

The concentration of metals in soil under natural conditions are a result of both chemical and physical weathering processes on parent rock. The degree to which soils contain naturally occurring metals is dependent on the chemical make-up of the parent rock from which the soil was derived, and the degree of chemical and physical weathering and transport of eroded parent rock material to the soil media. This erosion and deposition relationship results in a high degree of variability with respect to the concentration of metals in soil.

All soil types contain metals. In most cases, the metals in the soil media are not present in their elemental form, but are present as ionic compounds. Ionic compounds are chemical combinations of metals (i.e. cations) and non-metals (i.e. anions) that bond together through a process of electron transfer. Metal compounds can form stable chemical complexes that exhibit markedly different characteristics from their elemental forms, and may pose less of a risk (i.e. lower bioavailability) to human health or the environment.

Metals that are bound up in relatively stable mineral complexes do not readily degrade and are not as readily bioavailable as metals in a pure form. Different valences of metals can produce dramatically different toxicities and different matrices may render them more or less bioavailable. These factors have ramifications for determining the potential health risks associated with metal reference concentrations that exceed soil Cleanup Standards. For example, property specific soil conditions such as moisture content, PH, cation exchange capacity, and total organic carbon content and the use of the land will affect the amount of metal species that are available to pose a health risk.

State and federal environmental regulatory programs routinely require the soil media to be tested by approved analytical laboratories for metal concentrations at properties subject to investigation. The laboratory analytical methods commonly used by regulatory programs do not, however, differentiate between metals that are in a pure form and metals that are bound up in chemical complexes. These analytical methods use acid digestions and other destructive methods to dissolve the soil, parent rock or organic complexes which results in the release of metals in a free state. The outcome of these analytical methods are concentrations that reflect the total amount of the elemental metal in the soil and do not typically consider the percentage of metal bound up in mineral or organic complexes.

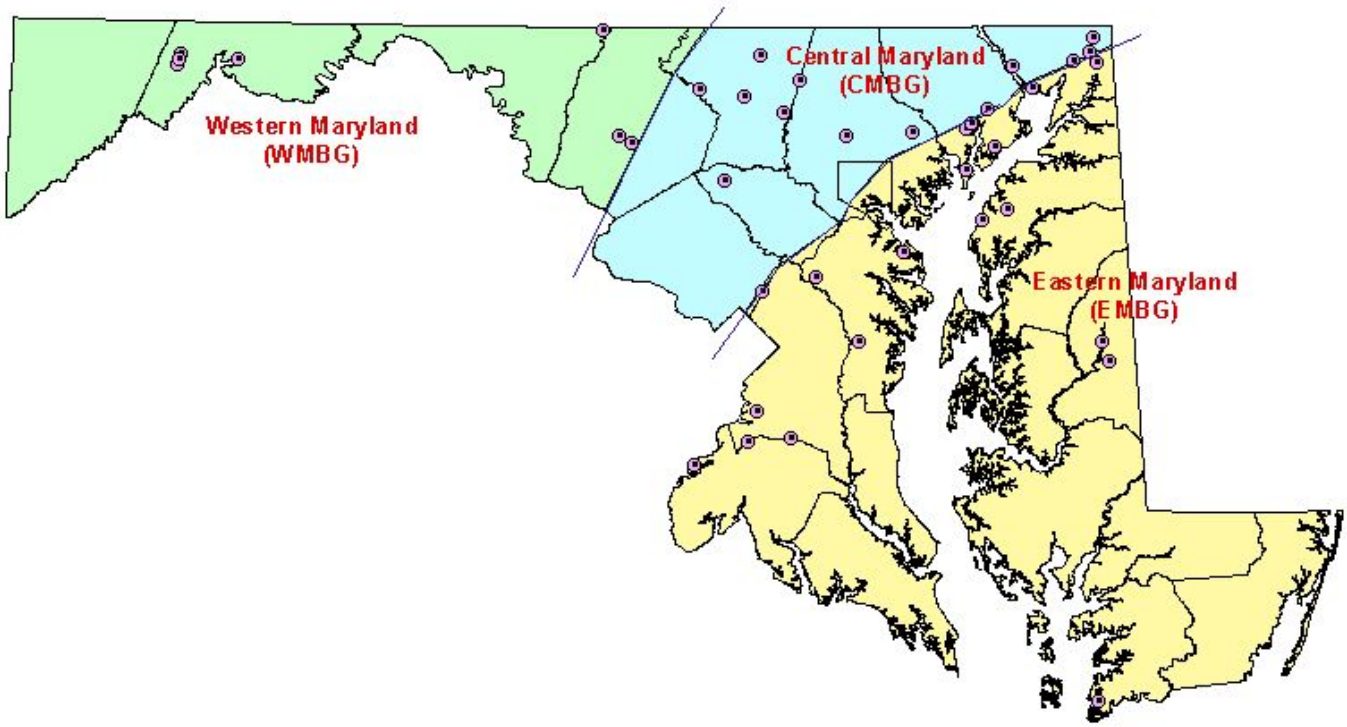
MDE derived reference levels for metals in the soil are intended to represent concentrations that exist in the natural environment absent anthropogenic effects. Comparison of the reference levels to USGS background metal concentrations in native soil for the Conterminous United States indicates a good correlation exists between the data sets. With the exception of Selenium and Antimony, all derived reference concentrations are within one order of magnitude of the USGS average concentrations. In many instances the reference concentrations are lower than the USGS background concentrations. In light of the conservative risk based approach used to derive the cleanup standards for metals (i.e. all metals present in soil are assumed to exist as bioavailable free metals), the option to use reference levels rather than the proposed Maryland Cleanup Standards is not expected to result in unacceptable levels of risk. This may be a viable alternative when analytical data indicates metal concentrations are above the standards.

STUDY LIMITATIONS

This investigation does not constitute a rigorous scientific analysis conducted in a controlled experimental setting. However, ATC reference levels can serve as general indicators of background levels of metals and trace elements in soil until a more rigorous and thorough background investigation can be completed.

REFERENCES

1) Shacklett, H.T. and Boerngenm, J.G., 1984: Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States; USGS Professional Paper 1270.



Appendix 2 – Figure 1

Location of hazardous substance properties used to derive reference levels for metals in Maryland. The State has been divided into three geological provinces for the purposes of developing regional reference levels.

APPENDIX 2 - ATTACHMENT 1

BACKGROUND SOIL METAL DATA FROM

MDE SITE INVESTIGATIONS USED IN THIS STUDY

EASTERN

Site Name	Province	Designation	Aluminum	Antimony	Arsenic	Barium
Aberdeen Proving Ground	EMBG	S-1	3.7E+03	*3.5E+00*	2.8E+00	1.8E+01
Aberdeen Proving Ground	EMBG	S-1 DUP	3.3E+03	*3.5E+00*	2.4E+00	2.1E+01
Aberdeen Proving Ground	EMBG	S-2	5.8E+03	*3.0E+00*	1.7E+00	2.7E+01
Aberdeen Proving Ground	EMBG	S-3	8.4E+03	*3.5E+00*	2.5E+00	6.5E+01
Aberdeen Proving Ground	EMBG	S-4	9.2E+03	*4.9E+00*	2.7E+00	4.7E+01
Aberdeen Proving Ground	EMBG	S-5	1.4E+03	*2.7E+00*	1.3E+00	1.1E+01
Aberdeen Proving Ground	EMBG	S-6	3.2E+03	*2.8E+00*	1.2E+00	1.0E+01
Aberdeen Proving Ground	EMBG	S-6 DUP	3.4E+03	*2.8E+00*	1.0E+00	1.1E+01
Aberdeen Proving Ground	EMBG	S-7	6.9E+03	*2.9E+00*	1.5E+00	5.7E+01
Aberdeen Proving Ground	EMBG	S-8	5.8E+03	*3.3E+00*	2.1E+00	4.2E+01
Aberdeen Proving Ground	EMBG	S-9	8.3E+03	*3.0E+00*	2.7E+00	4.4E+01
Aberdeen Proving Ground	EMBG	S-10	2.7E+03	*3.1E+00*	1.1E+00	1.2E+01
Aberdeen Proving Ground	EMBG	S-11	2.8E+03	*2.9E+00*	1.1E+00	1.7E+01
Aberdeen Proving Ground	EMBG	S-12	1.7E+04	*3.6E+00*	1.5E+00	9.0E+01
Aberdeen Proving Ground	EMBG	S-13	7.7E+03	*3.1E+00*	2.3E+00	5.6E+01
Aberdeen Proving Ground	EMBG	S-13 DUP	1.1E+04	*3.3E+00*	2.1E+00	6.4E+01
Aberdeen Proving Ground	EMBG	S-14	7.7E+03	*3.2E+00*	1.2E+00	9.0E+01
Aberdeen Proving Ground	EMBG	S-15	2.6E+03	*3.0E+00*	*1.2E-01*	9.8E+00
Aberdeen Proving Ground	EMBG	S-16	9.6E+03	*3.1E+00*	3.0E+00	3.6E+01
Aberdeen Proving Ground	EMBG	S-17	4.8E+03	*3.1E+00*	2.1E+00	3.3E+01
Aberdeen Proving Ground	EMBG	S-17 DUP	5.6E+03	*3.0E+00*	2.0E+00	3.5E+01
Aberdeen Proving Ground	EMBG	S-18	5.9E+03	*3.2E+00*	1.3E+00	2.0E+01
Aberdeen Proving Ground	EMBG	S-19	1.6E+04	*3.1E+00*	2.4E+00	7.4E+01
Aberdeen Proving Ground	EMBG	S-20	8.5E+03	*3.1E+00*	2.2E+00	3.4E+01
Aberdeen Proving Ground	EMBG	S-21	9.8E+03	*3.0E+00*	3.7E+00	4.5E+01
Aberdeen Proving Ground	EMBG	S-23	6.1E+03	*3.2E+00*	2.9E+00	5.4E+01
Aberdeen Proving Ground	EMBG	S-24	1.3E+04	*3.2E+00*	3.5E+00	6.3E+01
Aberdeen Proving Ground	EMBG	S-25	1.1E+04	*3.5E+00*	3.2E+00	8.1E+01
Aberdeen Proving Ground	EMBG	S-26	7.3E+03	*3.3E+00*	2.8E+00	6.2E+01
Aberdeen Proving Ground	EMBG	S-27	8.4E+03	*3.0E+00*	3.7E+00	4.4E+01
Aberdeen Proving Ground	EMBG	S-28	9.1E+03	*2.9E+00*	1.5E+00	4.7E+01
Aberdeen Proving Ground	EMBG	S-29	4.6E+03	*3.5E+00*	2.2E+00	1.8E+01
Aberdeen Proving Ground	EMBG	S-30	5.9E+03	*3.3E+00*	3.5E+00	2.4E+01
Indian Head	EMBG	BGDSS0010101	1.1E+04	*5.1E-01*	2.1E+00	5.2E+01
Indian Head	EMBG	BGDSS0020101	2.0E+03	*2.1E-01*	7.8E-01	1.3E+01
Indian Head	EMBG	BGDSS0030101	1.0E+04	*5.1E-01*	3.2E+00	6.7E+01
Indian Head	EMBG	BGDSS0040101	7.5E+03	*7.1E-01*	2.8E+00	4.8E+01
Indian Head	EMBG	BGDSS0050101	7.5E+03	*5.3E-01*	2.5E+00	3.6E+01

EASTERN

Indian Head	EMBG	BGDSS0060101	2.6E+03	*5.4E-01*	1.7E+00	1.9E+01
Indian Head	EMBG	BGDSS0070101	1.1E+04	*4.2E-01*	2.1E+00	3.7E+01
Indian Head	EMBG	BGDSS0080101	1.3E+04	*4.2E-01*	3.1E+00	4.6E+01
Indian Head	EMBG	BGDSS0090101	6.5E+03	*2.8E-01*	8.5E-01	3.4E+01
Indian Head	EMBG	BGDSS0100101	6.2E+03	*4.8E-01*	2.5E+00	3.1E+01
Indian Head	EMBG	S25-MW03-001	4.0E+03	*1.8E-01*	2.2E+00	3.0E+01
Indian Head	EMBG	S26-MW03-001	1.3E+04	*1.9E-01*	3.3E+00	8.5E+01
Fort Meade	EMBG	SSB-1	7.0E+03	*2.5E+00*	1.0E+00	*2.0E+01*
Fort Meade	EMBG	SSB-2	5.6E+03	*2.5E+00*	2.8E+00	*2.0E+01*
Fort Meade	EMBG	SSB-3	2.5E+03	*2.5E+00*	1.1E+00	*2.0E+01*
Fort Meade	EMBG	SSB-4	1.8E+03	*2.5E+00*	1.2E+00	*2.0E+01*
Fort Meade	EMBG	SSB-4X	1.8E+03	*2.5E+00*	1.3E+00	*2.0E+01*
Fort Meade	EMBG	SSB-5	3.0E+03	*2.5E+00*	1.3E+00	*2.0E+01*
Tolchester	EMBG	MCHT13-S-4	1.1E+04	*4.0E+00*	4.0E+00	7.9E+01
Crisfield City Dump	EMBG	Background Soil	1.1E+04	*6.0E+00*	1.5E+00	3.8E+01
Old Fort Road	EMBG	Background Soil	1.8E+04	*6.0E+00*	2.9E+00	5.0E+01
Nicholson Landfill	EMBG	Background Soil	5.5E+03	NA	2.7E+00	3.0E+01
Union Road	EMBG	Background Soil	8.4E+03	1.7E+00	3.9E+00	7.2E+01
Braxton Property	EMBG	Background Soil	1.6E+04	*6.0E+00*	6.1E+00	5.5E+01
Abingdon Landfill	EMBG	Background Soil	7.3E+03	*4.0E+00*	2.6E+00	3.9E+01
Waldorf Control	EMBG	Background Soil	6.3E+03	*6.0E+00*	4.0E+00	5.2E+01
Vicon	EMBG	Background Soil	5.0E+03	9.6E+00	2.6E+00	2.0E+01
Firestone Perryville	EMBG	Background Soil	4.6E+03	5.2E+00	2.2E+00	3.4E+01
SkipJack Chemicals	EMBG	Background Soil	6.8E+03	6.0E+00	*1.0E+00*	3.2E+01
Old West Denton Landfill	EMBG	Background Soil	2.4E+03	NA	*1.0E+00*	1.7E+01
Fort Smallwood Control	EMBG	Background Soil	1.9E+03	*6.0E+00*	*1.0E+00*	1.0E+01
Fort Smallwood Launch	EMBG	Background Soil	1.9E+03	*6.0E+00*	2.1E+00	1.1E+01
Davidsonville Launch	EMBG	Background Soil	1.1E+04	*1.6E+01*	6.9E+00	1.2E+02
US Naval Research Lab Waldorf	EMBG	SO 54A	2.3E+03	*6.0E+00*	*1.0E+00*	*2.0E+01*
US Naval Research Lab Waldorf	EMBG	SO 54B	3.4E+03	*6.0E+00*	*1.0E+00*	*2.0E+01*
US Naval Research Lab Waldorf	EMBG	SO 55A	7.3E+03	*6.0E+00*	*1.0E+00*	5.8E+01
US Naval Research Lab Waldorf	EMBG	SO 55B	4.5E+03	*6.0E+00*	2.5E+00	*2.0E+01*
US Naval Research Lab Waldorf	EMBG	SO 56	6.6E+03	*6.0E+00*	1.8E+00	4.1E+01
US Naval Research Lab Waldorf	EMBG	SO 57	6.4E+03	*6.0E+00*	2.5E+00	*2.0E+01*
US Naval Research Lab Waldorf	EMBG	S0 58	1.1E+04	*6.0E+00*	2.5E+00	*2.0E+01*
US Naval Research Lab Waldorf	EMBG	SO 59	1.0E+04	*6.0E+00*	4.9E+00	1.7E+02
US Naval Research Lab Waldorf	EMBG	SO 59(D)	1.0E+04	*6.0E+00*	5.2E+00	1.6E+02
US Naval Research Lab Waldorf	EMBG	SO 60	1.1E+04	*6.0E+00*	3.7E+00	7.4E+01

EMBG = Eastern Maryland Background, CMBG = Central Maryland Background, WMBG = Western Maryland Background. All values reported in parts per million. Not detected analytes reported at one half the detection limit. Not detected analytes italicized. NA = not applicable.

EASTERN

Site Name	Province	Designation	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt
Aberdeen Proving Ground	EMBG	S-1	*3.5E-01*	*3.5E-01*	1.4E+02	6.7E+00	2.6E+00
Aberdeen Proving Ground	EMBG	S-1 DUP	*3.5E-01*	*3.5E-01*	1.9E+02	7.0E+00	2.0E+00
Aberdeen Proving Ground	EMBG	S-2	*3.0E-01*	*3.0E-01*	1.4E+02	6.1E+00	6.4E+00
Aberdeen Proving Ground	EMBG	S-3	*3.5E-01*	*3.5E-01*	1.3E+03	3.5E+01	9.2E+00
Aberdeen Proving Ground	EMBG	S-4	1.4E+00	*4.9E-01*	1.1E+03	1.2E+01	1.6E+01
Aberdeen Proving Ground	EMBG	S-5	*2.7E-01*	*2.7E-01*	6.7E+01	3.5E+00	1.2E+00
Aberdeen Proving Ground	EMBG	S-6	*2.8E-01*	*2.8E-01*	7.6E+01	3.6E+00	6.8E-01
Aberdeen Proving Ground	EMBG	S-6 DUP	*2.8E-01*	*2.8E-01*	6.4E+01	4.4E+00	1.2E+00
Aberdeen Proving Ground	EMBG	S-7	6.2E-01	*2.9E-01*	4.8E+02	*1.2E+01*	6.9E+00
Aberdeen Proving Ground	EMBG	S-8	*3.3E-01*	*3.3E-01*	6.9E+02	1.4E+01	9.1E+00
Aberdeen Proving Ground	EMBG	S-9	*3.0E-01*	*3.0E-01*	7.2E+02	1.7E+01	3.9E+00
Aberdeen Proving Ground	EMBG	S-10	*3.1E-01*	*3.1E-01*	7.1E+01	7.5E+00	*6.2E-01*
Aberdeen Proving Ground	EMBG	S-11	*2.9E-01*	*2.9E-01*	1.4E+03	5.3E+00	1.1E+00
Aberdeen Proving Ground	EMBG	S-12	1.1E+00	*3.6E-01*	8.6E+02	2.9E+01	1.5E+01
Aberdeen Proving Ground	EMBG	S-13	*3.0E-01*	*3.0E-01*	1.0E+03	7.1E+01	1.9E+01
Aberdeen Proving Ground	EMBG	S-13 DUP	*3.2E-01*	*3.2E-01*	1.1E+03	6.7E+01	1.6E+01
Aberdeen Proving Ground	EMBG	S-14	*3.2E-01*	*3.2E-01*	6.4E+02	9.4E+00	5.2E+00
Aberdeen Proving Ground	EMBG	S-15	*3.0E-01*	*3.0E-01*	8.2E+01	*1.9E+01*	1.8E+00
Aberdeen Proving Ground	EMBG	S-16	*3.0E-01*	*3.0E-01*	9.2E+01	1.8E+01	5.1E+00
Aberdeen Proving Ground	EMBG	S-17	*3.1E-01*	*3.1E-01*	2.2E+03	1.3E+01	3.6E+00
Aberdeen Proving Ground	EMBG	S-17 DUP	*3.0E-01*	*3.0E-01*	1.8E+03	1.3E+01	3.9E+00
Aberdeen Proving Ground	EMBG	S-18	*3.2E-01*	*3.2E-01*	7.2E+01	1.0E+01	1.5E+00
Aberdeen Proving Ground	EMBG	S-19	7.6E-01	*3.1E-01*	7.4E+02	1.8E+01	1.2E+01
Aberdeen Proving Ground	EMBG	S-20	*3.1E-01*	*3.1E-01*	1.3E+02	1.2E+01	3.6E+00
Aberdeen Proving Ground	EMBG	S-21	*3.0E-01*	*3.0E-01*	3.6E+02	1.4E+01	5.3E+00
Aberdeen Proving Ground	EMBG	S-23	9.0E-01	*3.1E-01*	6.2E+02	1.3E+01	1.4E+01
Aberdeen Proving Ground	EMBG	S-24	7.5E-01	*3.1E-01*	1.2E+02	1.6E+01	2.6E+01
Aberdeen Proving Ground	EMBG	S-25	*3.5E-01*	1.4E+00	9.2E+02	1.7E+01	5.0E+00
Aberdeen Proving Ground	EMBG	S-26	*3.2E-01*	*3.2E-01*	1.3E+03	1.5E+01	9.1E+00
Aberdeen Proving Ground	EMBG	S-27	*3.0E-01*	*3.0E-01*	9.8E+02	1.1E+01	6.6E+00
Aberdeen Proving Ground	EMBG	S-28	*2.9E-01*	*2.9E-01*	1.8E+02	2.8E+01	1.6E+01
Aberdeen Proving Ground	EMBG	S-29	*3.5E-01*	*3.5E-01*	1.1E+02	8.7E+00	2.0E+00
Aberdeen Proving Ground	EMBG	S-30	*3.3E-01*	*3.3E-01*	1.1E+02	4.3E+01	2.7E+00
Indian Head	EMBG	BGDSS0010101	5.6E-01	*6.5E-02*	1.2E+02	1.3E+01	4.2E+00
Indian Head	EMBG	BGDSS0020101	*5.0E-02*	*5.5E-02*	9.9E+01	3.5E+00	5.8E-01
Indian Head	EMBG	BGDSS0030101	5.3E-01	*6.0E-02*	1.3E+02	1.9E+01	1.5E+01
Indian Head	EMBG	BGDSS0040101	5.3E-01	*6.5E-02*	1.4E+02	1.3E+01	7.9E+00
Indian Head	EMBG	BGDSS0050101	1.7E-01	*7.0E-02*	1.1E+02	1.3E+01	2.3E+00

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Indian Head	EMBG	BGDSS0060101	4.7E-01	2.5E-01	2.8E+02	1.2E+01	3.0E+00
Indian Head	EMBG	BGDSS0070101	3.4E-01	2.2E-01	1.4E+02	1.3E+01	2.5E+00
Indian Head	EMBG	BGDSS0080101	6.0E-01	2.6E-01	1.5E+02	1.6E+01	4.2E+00
Indian Head	EMBG	BGDSS0090101	2.4E-01	1.5E-01	1.5E+02	7.7E+00	2.2E+00
Indian Head	EMBG	BGDSS0100101	1.5E-01	*1.4E-01*	1.2E+02	9.2E+00	2.7E+00
Indian Head	EMBG	S25-MW03-001	2.0E-01	5.4E-01	1.0E+02	1.1E+01	3.5E+00
Indian Head	EMBG	S26-MW03-001	6.1E-01	*2.9E-01*	4.1E+02	2.1E+01	1.5E+01
Fort Meade	EMBG	SSB-1	3.8E-01	*2.5E-01*	8.3E+02	1.4E+01	4.3E+00
Fort Meade	EMBG	SSB-2	6.3E-01	*2.5E-01*	7.7E+02	9.4E+00	4.4E+00
Fort Meade	EMBG	SSB-3	1.1E-01	*2.5E-01*	*5.0E+01*	6.0E+00	*1.0E+00*
Fort Meade	EMBG	SSB-4	1.7E-01	*2.5E-01*	*5.0E+01*	6.4E+00	*1.0E+00*
Fort Meade	EMBG	SSB-4X	1.2E-01	*2.5E-01*	*5.0E+01*	7.0E+00	*1.0E+00*
Fort Meade	EMBG	SSB-5	1.7E-01	*2.5E-01*	*5.0E+01*	1.2E+01	2.7E+00
Tolchester	EMBG	MCHT13-S-4	*5.0E-01*	3.1E-01	9.5E+02	1.4E+01	9.0E+00
Crisfield City Dump	EMBG	Background Soil	2.3E-01	*5.0E-01*	4.3E+03	1.1E+01	1.2E+00
Old Fort Road	EMBG	Background Soil	4.8E-01	*5.0E-01*	7.7E+01	1.8E+01	3.5E+00
Nicholson Landfill	EMBG	Background Soil	7.1E-01	NA	7.7E+02	9.2E+00	3.8E+00
Union Road	EMBG	Background Soil	4.8E-01	*5.0E-01*	1.2E+03	5.7E+01	1.3E+01
Braxton Property	EMBG	Background Soil	5.3E-01	*5.0E-01*	3.5E+02	2.4E+01	1.2E+01
Abingdon Landfill	EMBG	Background Soil	3.9E-01	*1.0E+00*	2.8E+02	8.3E+00	7.0E+00
Waldorf Control	EMBG	Background Soil	NA	*5.0E-01*	1.3E+03	1.4E+01	6.5E+00
Vicon	EMBG	Background Soil	1.8E-01	9.0E-01	9.9E+01	1.7E+01	1.9E+00
Firestone Perryville	EMBG	Background Soil	4.0E-01	*5.0E-01*	9.7E+02	2.0E+01	4.8E+00
SkipJack Chemicals	EMBG	Background Soil	*5.0E-01*	*5.0E-01*	1.3E+03	7.1E+00	*5.0E+00*
Old West Denton Landfill	EMBG	Background Soil	*5.0E-01*	*5.0E-01*	3.8E+02	2.0E+00	*5.0E+00*
Fort Smallwood Control	EMBG	Background Soil	*5.0E-01*	*5.0E-01*	*5.0E+02*	3.4E+00	*5.0E+00*
Fort Smallwood Launch	EMBG	Background Soil	*5.0E-01*	*5.0E-01*	1.1E+02	3.9E+00	*5.0E+00*
Davidsonville Launch	EMBG	Background Soil	9.2E-01	1.0E+00	1.8E+03	2.6E+01	3.5E+00
US Naval Research Lab Waldorf	EMBG	SO 54A	*5.0E-01*	*5.0E-01*	*5.0E+02*	4.0E+00	*5.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 54B	*5.0E-01*	*5.0E-01*	*5.0E+02*	7.4E+00	*5.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 55A	*5.0E-01*	*5.0E-01*	*5.0E+02*	1.1E+01	*5.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 55B	*5.0E-01*	*5.0E-01*	*5.0E+02*	6.3E+00	*5.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 56	*5.0E-01*	*5.0E-01*	*5.0E+02*	1.1E+01	*5.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 57	*5.0E-01*	*5.0E-01*	*5.0E+02*	1.8E+01	*5.0E+00*
US Naval Research Lab Waldorf	EMBG	S0 58	*5.0E-01*	*5.0E-01*	*5.0E+02*	1.9E+01	*5.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 59	1.0E+00	1.9E+00	1.4E+03	1.7E+01	*5.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 59(D)	*5.0E-01*	1.3E+00	1.4E+03	1.7E+01	*5.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 60	*5.0E-01*	1.3E+00	*5.0E+02*	2.5E+01	*5.0E+00*

EMBG = Eastern Maryland Background, CMBG = Central Maryland Background, WMBG = Western Maryland Background. All values reported in parts per million. Not detected analytes reported at one half the detection limit. Not detected analytes italicized. NA = not applicable.

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Site Name	Province	Designation	Copper	Iron	Lead	Magnesium	Manganese
Aberdeen Proving Ground	EMBG	S-1	8.4E+00	5.1E+03	5.0E+01	2.0E+02	5.9E+01
Aberdeen Proving Ground	EMBG	S-1 DUP	8.6E+00	4.7E+03	5.0E+01	2.1E+02	5.0E+01
Aberdeen Proving Ground	EMBG	S-2	5.1E+00	5.4E+03	1.0E+01	3.6E+02	1.9E+02
Aberdeen Proving Ground	EMBG	S-3	2.8E+01	1.8E+04	1.2E+02	2.1E+03	3.0E+02
Aberdeen Proving Ground	EMBG	S-4	1.3E+01	8.9E+03	3.0E+01	1.5E+03	1.8E+02
Aberdeen Proving Ground	EMBG	S-5	4.8E+00	2.6E+03	1.4E+01	9.5E+01	6.9E+00
Aberdeen Proving Ground	EMBG	S-6	3.3E+00	3.6E+03	8.0E+00	2.0E+02	1.2E+01
Aberdeen Proving Ground	EMBG	S-6 DUP	3.4E+00	3.6E+03	9.8E+00	2.2E+02	9.2E+00
Aberdeen Proving Ground	EMBG	S-7	5.9E+00	1.0E+04	1.1E+01	1.1E+03	4.0E+02
Aberdeen Proving Ground	EMBG	S-8	1.4E+01	1.2E+04	3.0E+01	7.1E+02	2.6E+02
Aberdeen Proving Ground	EMBG	S-9	7.7E+00	1.5E+04	1.3E+01	1.2E+03	1.1E+02
Aberdeen Proving Ground	EMBG	S-10	3.7E+00	4.2E+03	8.6E+00	1.3E+02	8.4E+00
Aberdeen Proving Ground	EMBG	S-11	4.0E+00	4.5E+03	1.1E+01	2.0E+02	4.0E+01
Aberdeen Proving Ground	EMBG	S-12	2.3E+01	2.4E+04	2.1E+01	3.9E+03	1.0E+03
Aberdeen Proving Ground	EMBG	S-13	1.3E+01	1.6E+04	3.0E+01	1.4E+03	6.5E+02
Aberdeen Proving Ground	EMBG	S-13 DUP	1.4E+01	1.7E+04	2.7E+01	1.7E+03	5.3E+02
Aberdeen Proving Ground	EMBG	S-14	5.6E+00	8.6E+03	1.6E+01	8.8E+02	2.7E+02
Aberdeen Proving Ground	EMBG	S-15	4.6E+00	3.2E+03	5.5E+00	6.3E+01	5.0E+00
Aberdeen Proving Ground	EMBG	S-16	5.7E+00	1.5E+04	2.2E+01	6.9E+02	1.5E+02
Aberdeen Proving Ground	EMBG	S-17	9.3E+00	9.3E+03	3.0E+01	8.1E+02	1.7E+02
Aberdeen Proving Ground	EMBG	S-17 DUP	8.7E+00	9.4E+03	2.7E+01	8.7E+02	1.5E+02
Aberdeen Proving Ground	EMBG	S-18	3.0E+00	7.6E+03	1.2E+01	3.6E+02	2.1E+01
Aberdeen Proving Ground	EMBG	S-19	1.6E+01	1.9E+04	1.6E+01	3.1E+03	5.6E+02
Aberdeen Proving Ground	EMBG	S-20	5.0E+00	1.2E+04	1.6E+01	1.0E+03	7.2E+01
Aberdeen Proving Ground	EMBG	S-21	7.5E+00	1.4E+04	2.2E+01	9.8E+02	2.9E+02
Aberdeen Proving Ground	EMBG	S-23	8.0E+00	9.8E+03	2.0E+01	4.7E+02	1.1E+03
Aberdeen Proving Ground	EMBG	S-24	6.7E+00	1.7E+04	3.4E+01	1.1E+03	1.1E+03
Aberdeen Proving Ground	EMBG	S-25	1.3E+01	2.0E+04	5.7E+01	1.4E+03	4.4E+02
Aberdeen Proving Ground	EMBG	S-26	1.5E+01	1.5E+04	2.1E+01	1.2E+03	4.5E+02
Aberdeen Proving Ground	EMBG	S-27	6.2E+00	1.4E+04	2.0E+01	1.3E+03	2.2E+02
Aberdeen Proving Ground	EMBG	S-28	1.2E+01	1.9E+04	1.7E+01	5.7E+02	7.1E+02
Aberdeen Proving Ground	EMBG	S-29	9.3E+00	8.9E+03	2.8E+01	3.4E+02	3.7E+01
Aberdeen Proving Ground	EMBG	S-30	3.6E+00	1.8E+04	1.2E+01	3.7E+02	5.2E+01
Indian Head	EMBG	BGDSS0010101	4.6E+00	9.4E+03	7.4E+00	7.1E+02	2.5E+02
Indian Head	EMBG	BGDSS0020101	1.8E+00	2.8E+03	9.0E+00	1.4E+02	2.5E+01
Indian Head	EMBG	BGDSS0030101	5.4E+00	1.5E+04	1.0E+01	7.5E+02	3.8E+02
Indian Head	EMBG	BGDSS0040101	5.4E+00	1.2E+04	9.4E+00	5.7E+02	1.8E+02
Indian Head	EMBG	BGDSS0050101	4.6E+00	9.6E+03	1.5E+01	4.8E+02	6.3E+01

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Indian Head	EMBG	BGDSS0060101	2.1E+00	7.3E+03	6.7E+00	3.5E+02	1.1E+02
Indian Head	EMBG	BGDSS0070101	5.3E+00	1.0E+04	9.8E+00	6.7E+02	4.7E+01
Indian Head	EMBG	BGDSS0080101	1.7E+01	1.3E+04	1.5E+02	1.1E+03	8.1E+01
Indian Head	EMBG	BGDSS0090101	3.1E+00	4.4E+03	5.5E+00	4.5E+02	2.3E+01
Indian Head	EMBG	BGDSS0100101	3.3E+00	6.5E+03	7.8E+00	4.0E+02	2.0E+02
Indian Head	EMBG	S25-MW03-001	2.5E+00	7.9E+03	1.0E+01	2.4E+02	1.2E+02
Indian Head	EMBG	S26-MW03-001	4.4E+00	2.5E+04	9.9E+00	1.1E+03	8.8E+02
Fort Meade	EMBG	SSB-1	8.2E+00	1.2E+04	1.4E+01	1.2E+03	1.2E+02
Fort Meade	EMBG	SSB-2	4.6E+00	7.7E+03	1.6E+01	8.4E+02	1.5E+02
Fort Meade	EMBG	SSB-3	3.2E+00	5.1E+03	*3.8E+00*	2.1E+02	2.0E+01
Fort Meade	EMBG	SSB-4	4.6E+00	7.7E+03	9.8E+00	1.1E+02	2.5E+01
Fort Meade	EMBG	SSB-4X	4.2E+00	8.9E+03	1.1E+01	1.2E+02	2.5E+01
Fort Meade	EMBG	SSB-5	6.6E+00	1.2E+04	1.6E+01	3.1E+02	3.0E+01
Tolchester	EMBG	MCHT13-S-4	9.3E+00	1.1E+04	3.8E+01	1.5E+03	2.3E+02
Crisfield City Dump	EMBG	Background Soil	4.8E+00	5.5E+03	*1.6E+01*	9.1E+02	2.8E+01
Old Fort Road	EMBG	Background Soil	5.3E+00	1.5E+04	9.4E+00	1.1E+03	4.9E+01
Nicholson Landfill	EMBG	Background Soil	8.7E+00	1.1E+04	9.2E+00	8.5E+02	1.2E+02
Union Road	EMBG	Background Soil	1.5E+01	1.4E+04	4.2E+01	1.7E+03	9.0E+02
Braxton Property	EMBG	Background Soil	1.1E+01	2.3E+03	1.3E+01	2.6E+03	2.3E+02
Abingdon Landfill	EMBG	Background Soil	6.7E+00	8.4E+03	6.7E+01	7.1E+02	3.5E+02
Waldorf Control	EMBG	Background Soil	1.0E+01	7.9E+03	4.4E+01	8.3E+02	1.2E+02
Vicon	EMBG	Background Soil	1.5E+01	1.2E+04	9.9E+00	3.4E+02	5.1E+01
Firestone Perryville	EMBG	Background Soil	1.2E+01	9.8E+03	2.2E+01	7.4E+02	2.7E+02
SkipJack Chemicals	EMBG	Background Soil	*2.5E+00*	5.3E+03	6.0E+01	5.0E+02	1.8E+02
Old West Denton Landfill	EMBG	Background Soil	5.0E+00	1.0E+03	2.3E+01	1.2E+02	4.3E+01
Fort Smallwood Control	EMBG	Background Soil	1.1E+01	2.1E+03	4.1E+00	*5.0E+02*	1.9E+01
Fort Smallwood Launch	EMBG	Background Soil	6.1E+00	3.0E+03	2.0E+01	9.5E+01	2.0E+01
Davidsonville Launch	EMBG	Background Soil	1.3E+01	1.3E+04	3.5E+01	1.7E+03	1.0E+02
US Naval Research Lab Waldorf	EMBG	SO 54A	*2.5E+00*	3.7E+03	7.3E+00	*5.0E+02*	1.4E+02
US Naval Research Lab Waldorf	EMBG	SO 54B	*2.5E+00*	5.4E+03	4.0E+00	*5.0E+02*	1.0E+01
US Naval Research Lab Waldorf	EMBG	SO 55A	*2.5E+00*	1.2E+04	1.7E+01	*5.0E+02*	3.0E+02
US Naval Research Lab Waldorf	EMBG	SO 55B	*2.5E+00*	8.3E+03	5.0E+00	*5.0E+02*	1.1E+02
US Naval Research Lab Waldorf	EMBG	SO 56	*2.5E+00*	5.8E+03	3.0E+01	*5.0E+02*	1.3E+01
US Naval Research Lab Waldorf	EMBG	SO 57	*2.5E+00*	7.6E+03	7.8E+00	*5.0E+02*	1.0E+02
US Naval Research Lab Waldorf	EMBG	S0 58	*2.5E+00*	1.4E+04	7.7E+00	*5.0E+02*	8.0E+01
US Naval Research Lab Waldorf	EMBG	SO 59	6.3E+00	1.5E+04	3.1E+01	*5.0E+02*	1.9E+02
US Naval Research Lab Waldorf	EMBG	SO 59(D)	6.7E+00	1.4E+04	3.3E+01	*5.0E+02*	1.7E+02
US Naval Research Lab Waldorf	EMBG	SO 60	5.0E+00	1.4E+04	1.7E+01	1.1E+03	2.5E+02

EMBG = Eastern Maryland Background, CMBG = Central Maryland Background, WMBG = Western Maryland Background. All values reported in parts per million. Not detected analytes reported at one half the detection limit. Not detected analytes italicized. NA = not applicable.

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Site Name	Province	Designation	Mercury	Nickel	Potassium	Selenium	Silver
Aberdeen Proving Ground	EMBG	S-1	NA	4.3E+00	1.6E+02	4.6E-01	*3.5E-01*
Aberdeen Proving Ground	EMBG	S-1 DUP	NA	4.8E+00	1.8E+02	4.8E-01	*3.5E-01*
Aberdeen Proving Ground	EMBG	S-2	*6.2E-02*	6.1E+00	1.8E+02	*1.6E-01*	*3.0E-01*
Aberdeen Proving Ground	EMBG	S-3	*3.5E-02*	1.7E+01	3.2E+02	4.4E-01	*3.5E-01*
Aberdeen Proving Ground	EMBG	S-4	NA	2.0E+01	5.4E+02	*3.0E+00*	*4.9E-01*
Aberdeen Proving Ground	EMBG	S-5	*5.0E-02*	2.6E+00	7.1E+01	*1.3E-01*	*2.7E-01*
Aberdeen Proving Ground	EMBG	S-6	*5.5E-02*	1.4E+00	1.0E+02	*1.4E-01*	*2.8E-01*
Aberdeen Proving Ground	EMBG	S-6 DUP	*4.6E-02*	2.6E+00	1.6E+02	*1.4E-01*	*2.8E-01*
Aberdeen Proving Ground	EMBG	S-7	*5.8E-02*	8.0E+00	3.5E+02	*1.5E-01*	*2.9E-01*
Aberdeen Proving Ground	EMBG	S-8	7.0E-02	1.0E+01	2.4E+02	*1.7E-01*	*3.3E-01*
Aberdeen Proving Ground	EMBG	S-9	*5.9E-02*	6.4E+00	3.4E+02	*1.5E-01*	*3.0E-01*
Aberdeen Proving Ground	EMBG	S-10	*6.1E-02*	*9.3E-01*	1.2E+02	*1.5E-01*	*3.1E-01*
Aberdeen Proving Ground	EMBG	S-11	*2.9E-02*	*8.6E-01*	9.6E+01	*1.4E-01*	*2.9E-01*
Aberdeen Proving Ground	EMBG	S-12	*3.3E-02*	2.1E+01	1.7E+03	*1.8E-01*	*3.6E-01*
Aberdeen Proving Ground	EMBG	S-13	*6.0E-02*	2.4E+01	3.7E+02	*1.6E-01*	*3.0E-01*
Aberdeen Proving Ground	EMBG	S-13 DUP	*6.2E-02*	2.4E+01	4.2E+02	*1.6E-01*	*3.2E-01*
Aberdeen Proving Ground	EMBG	S-14	*3.2E-02*	6.2E+00	2.2E+02	NA	*3.2E-01*
Aberdeen Proving Ground	EMBG	S-15	*3.1E-02*	*9.1E-01*	*3.6E+01*	NA	*3.0E-01*
Aberdeen Proving Ground	EMBG	S-16	*3.1E-02*	4.5E+00	1.8E+02	NA	*3.0E-01*
Aberdeen Proving Ground	EMBG	S-17	*6.3E-02*	6.7E+00	3.1E+02	*1.6E-01*	*3.1E-01*
Aberdeen Proving Ground	EMBG	S-17 DUP	*6.2E-02*	6.8E+00	2.8E+02	*1.6E-01*	*3.0E-01*
Aberdeen Proving Ground	EMBG	S-18	*6.7E-02*	2.7E+00	1.8E+02	*1.6E-01*	*3.2E-01*
Aberdeen Proving Ground	EMBG	S-19	*6.1E-02*	1.4E+01	1.5E+03	*1.6E-01*	*3.1E-01*
Aberdeen Proving Ground	EMBG	S-20	*3.1E-02*	6.4E+00	2.1E+02	NA	*3.1E-01*
Aberdeen Proving Ground	EMBG	S-21	*3.0E-01*	6.9E+00	3.8E+02	NA	*3.0E-01*
Aberdeen Proving Ground	EMBG	S-23	*3.1E-02*	9.0E+00	2.2E+02	NA	*3.1E-01*
Aberdeen Proving Ground	EMBG	S-24	*3.3E-02*	7.8E+00	2.5E+02	5.0E-01	*3.1E-01*
Aberdeen Proving Ground	EMBG	S-25	*6.9E-02*	1.1E+01	5.6E+02	*1.7E-01*	*3.5E-01*
Aberdeen Proving Ground	EMBG	S-26	*3.2E-02*	9.0E+00	4.6E+02	NA	*3.2E-01*
Aberdeen Proving Ground	EMBG	S-27	*3.1E-02*	8.0E+00	3.4E+02	NA	*3.0E-01*
Aberdeen Proving Ground	EMBG	S-28	*3.1E-02*	1.5E+01	1.8E+02	NA	*2.9E-01*
Aberdeen Proving Ground	EMBG	S-29	*7.0E-02*	3.2E+00	2.3E+02	*1.8E-01*	*3.5E-01*
Aberdeen Proving Ground	EMBG	S-30	*6.7E-02*	4.5E+00	3.1E+02	*1.7E-01*	*3.3E-01*
Indian Head	EMBG	BGDSS0010101	4.0E-02	5.8E+00	4.7E+02	3.0E-01	*3.5E-02*
Indian Head	EMBG	BGDSS0020101	3.0E-02	1.7E+00	1.3E+02	*1.1E-01*	6.0E-02
Indian Head	EMBG	BGDSS0030101	3.0E-02	7.8E+00	5.2E+02	7.0E-01	*3.0E-02*
Indian Head	EMBG	BGDSS0040101	3.0E-02	5.5E+00	3.1E+02	8.3E-01	*3.5E-02*
Indian Head	EMBG	BGDSS0050101	4.0E-02	3.2E+00	2.5E+02	5.1E-01	7.0E-02

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Indian Head	EMBG	BGDSS0060101	3.0E-02	2.5E+00	7.5E+02	5.4E-01	1.0E-01
Indian Head	EMBG	BGDSS0070101	5.0E-02	4.9E+00	5.1E+02	5.3E-01	*3.5E-02*
Indian Head	EMBG	BGDSS0080101	5.0E-02	8.6E+00	7.9E+02	7.9E-01	*3.5E-02*
Indian Head	EMBG	BGDSS0090101	3.0E-02	4.5E+00	4.5E+02	4.6E-01	1.0E-01
Indian Head	EMBG	BGDSS0100101	2.0E-02	3.4E+00	3.0E+02	5.3E-01	*7.5E-02*
Indian Head	EMBG	S25-MW03-001	8.0E-02	2.3E+00	2.2E+02	1.7E-01	*5.5E-02*
Indian Head	EMBG	S26-MW03-001	7.0E-02	1.1E+01	7.8E+02	*8.5E-02*	*5.5E-02*
Fort Meade	EMBG	SSB-1	*5.0E-02*	9.4E+00	5.0E+02	*5.0E+00*	*2.5E-01*
Fort Meade	EMBG	SSB-2	*5.0E-02*	6.3E+00	3.5E+02	*5.0E+00*	*2.5E-01*
Fort Meade	EMBG	SSB-3	*5.0E-02*	4.0E+00	1.3E+02	*5.0E+00*	*2.5E-01*
Fort Meade	EMBG	SSB-4	*5.0E-02*	3.9E+00	1.2E+02	*5.0E+00*	*2.5E-01*
Fort Meade	EMBG	SSB-4X	*5.0E-02*	4.4E+00	*5.0E+01*	*5.0E+00*	*2.5E-01*
Fort Meade	EMBG	SSB-5	*5.0E-02*	7.9E+00	2.1E+02	*5.0E+00*	*2.5E-01*
Tolchester	EMBG	MCHT13-S-4	1.4E-01	1.2E+01	4.9E+02	6.2E-01	*1.0E+00*
Crisfield City Dump	EMBG	Background Soil	*5.0E-02*	5.7E+00	6.2E+02	*2.3E-01*	*1.0E+00*
Old Fort Road	EMBG	Background Soil	*5.0E-02*	5.7E+00	7.7E+02	2.3E-01	*1.0E+00*
Nicholson Landfill	EMBG	Background Soil	3.5E+00	3.6E+00	4.4E+02	2.1E-01	1.0E+00
Union Road	EMBG	Background Soil	*5.0E-02*	2.8E+01	3.3E+02	*5.0E-01*	*1.0E+00*
Braxton Property	EMBG	Background Soil	*5.0E-02*	1.3E+01	5.8E+02	*5.0E-01*	*1.0E+00*
Abingdon Landfill	EMBG	Background Soil	*1.0E-01*	5.8E+00	2.6E+02	NA	*1.5E+00*
Waldorf Control	EMBG	Background Soil	*5.0E-02*	5.6E+00	6.1E+02	*5.0E-01*	*1.0E+00*
Vicon	EMBG	Background Soil	1.2E-01	3.0E+00	1.5E+02	3.5E-01	9.0E-01
Firestone Perryville	EMBG	Background Soil	*5.0E-02*	1.0E+01	2.9E+02	*5.0E-01*	*1.0E+00*
SkipJack Chemicals	EMBG	Background Soil	*5.0E-02*	*4.0E+00*	*5.0E+02*	*5.0E-01*	*1.0E+00*
Old West Denton Landfill	EMBG	Background Soil	*5.0E-02*	*4.0E+00*	9.1E+01	*5.0E-01*	*1.0E+00*
Fort Smallwood Control	EMBG	Background Soil	*1.0E-01*	*4.0E+00*	*5.0E+02*	*5.0E-01*	*2.7E-01*
Fort Smallwood Launch	EMBG	Background Soil	*1.0E-01*	*4.0E+00*	*5.0E+02*	*5.0E-01*	*2.6E-01*
Davidsonville Launch	EMBG	Background Soil	*1.0E-01*	7.3E+00	1.1E+03	2.0E+00	NA
US Naval Research Lab Waldorf	EMBG	SO 54A	*5.0E-02*	*4.0E+00*	*5.0E+02*	*5.0E-01*	*1.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 54B	*5.0E-02*	*4.0E+00*	*5.0E+02*	*5.0E-01*	*1.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 55A	*5.0E-02*	*4.0E+00*	*5.0E+02*	*5.0E-01*	2.7E+00
US Naval Research Lab Waldorf	EMBG	SO 55B	*5.0E-02*	*4.0E+00*	*5.0E+02*	*5.0E-01*	*1.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 56	*5.0E-02*	*4.0E+00*	*5.0E+02*	*5.0E-01*	*1.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 57	*5.0E-02*	*4.0E+00*	*5.0E+02*	*5.0E-01*	*1.0E+00*
US Naval Research Lab Waldorf	EMBG	S0 58	*5.0E-02*	*4.0E+00*	*5.0E+02*	*5.0E-01*	*1.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 59	*5.0E-02*	8.3E+00	*5.0E+02*	*5.0E-01*	*1.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 59(D)	*5.0E-02*	9.1E+00	*5.0E+02*	*5.0E-01*	*1.0E+00*
US Naval Research Lab Waldorf	EMBG	SO 60	*5.0E-02*	7.5E+00	1.4E+03	*5.0E-01*	*1.0E+00*

EMBG = Eastern Maryland Background, CMBG = Central Maryland Background, WMBG = Western Maryland Background. All values reported in parts per million. Not detected analytes reported at one half the detection limit. Not detected analytes italicized. NA = not applicable.

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Site Name	Province	Designation	Sodium	Thallium	Vanadium	Zinc
Aberdeen Proving Ground	EMBG	S-1	4.4E+02	*1.8E-01*	1.8E+01	1.4E+01
Aberdeen Proving Ground	EMBG	S-1 DUP	4.4E+02	*1.8E-01*	2.0E+01	1.8E+01
Aberdeen Proving Ground	EMBG	S-2	3.8E+02	*1.6E-01*	1.1E+01	1.7E+01
Aberdeen Proving Ground	EMBG	S-3	6.6E+02	*1.7E-01*	4.7E+01	9.6E+01
Aberdeen Proving Ground	EMBG	S-4	9.4E+02	*2.4E-01*	2.0E+01	7.4E+01
Aberdeen Proving Ground	EMBG	S-5	2.3E+02	*1.3E-01*	1.3E+01	1.1E+01
Aberdeen Proving Ground	EMBG	S-6	2.0E+02	*1.4E-01*	7.9E+00	6.6E+00
Aberdeen Proving Ground	EMBG	S-6 DUP	2.1E+02	*1.4E-01*	9.7E+00	7.5E+00
Aberdeen Proving Ground	EMBG	S-7	3.8E+02	*1.5E-01*	1.8E+01	2.6E+01
Aberdeen Proving Ground	EMBG	S-8	4.5E+02	*1.7E-01*	2.3E+01	4.1E+01
Aberdeen Proving Ground	EMBG	S-9	4.2E+02	*1.5E-01*	2.7E+01	3.4E+01
Aberdeen Proving Ground	EMBG	S-10	4.9E+02	*1.5E-01*	1.6E+01	4.9E+00
Aberdeen Proving Ground	EMBG	S-11	3.4E+02	*1.4E-01*	1.2E+01	1.1E+01
Aberdeen Proving Ground	EMBG	S-12	5.5E+02	*1.8E-01*	4.1E+01	6.1E+01
Aberdeen Proving Ground	EMBG	S-13	4.0E+02	*1.6E-01*	2.9E+01	4.0E+01
Aberdeen Proving Ground	EMBG	S-13 DUP	4.4E+02	*1.6E-01*	3.2E+01	4.6E+01
Aberdeen Proving Ground	EMBG	S-14	4.8E+02	*1.6E-01*	1.6E+01	2.9E+01
Aberdeen Proving Ground	EMBG	S-15	4.7E+02	*1.6E-01*	2.2E+01	2.1E+01
Aberdeen Proving Ground	EMBG	S-16	4.3E+02	*1.5E-01*	2.9E+01	2.1E+01
Aberdeen Proving Ground	EMBG	S-17	4.5E+02	*1.6E-01*	1.7E+01	3.5E+01
Aberdeen Proving Ground	EMBG	S-17 DUP	3.4E+02	*1.6E-01*	1.8E+01	3.7E+01
Aberdeen Proving Ground	EMBG	S-18	4.4E+02	*1.6E-01*	1.6E+01	1.1E+01
Aberdeen Proving Ground	EMBG	S-19	4.0E+02	*1.6E-01*	3.2E+01	5.0E+01
Aberdeen Proving Ground	EMBG	S-20	4.4E+02	*1.5E-01*	2.0E+01	2.0E+01
Aberdeen Proving Ground	EMBG	S-21	4.3E+02	*1.5E-01*	2.3E+01	2.8E+01
Aberdeen Proving Ground	EMBG	S-23	4.6E+02	*1.6E-01*	1.9E+01	2.9E+01
Aberdeen Proving Ground	EMBG	S-24	3.8E+02	*1.7E-01*	2.6E+01	2.8E+01
Aberdeen Proving Ground	EMBG	S-25	4.7E+02	*1.7E-01*	2.9E+01	3.2E+01
Aberdeen Proving Ground	EMBG	S-26	4.6E+02	*1.6E-01*	2.7E+01	2.4E+02
Aberdeen Proving Ground	EMBG	S-27	4.9E+02	*1.5E-01*	3.1E+01	4.7E+01
Aberdeen Proving Ground	EMBG	S-28	4.3E+02	*1.5E-01*	1.8E+01	3.0E+01
Aberdeen Proving Ground	EMBG	S-29	4.4E+02	*1.8E-01*	5.9E+01	2.7E+01
Aberdeen Proving Ground	EMBG	S-30	5.0E+02	*1.7E-01*	1.6E+01	1.5E+01
Indian Head	EMBG	BGDSS0010101	*1.2E+01*	*1.3E-01*	2.2E+01	2.2E+01
Indian Head	EMBG	BGDSS0020101	2.2E+01	*1.1E-01*	1.3E+01	6.2E+00
Indian Head	EMBG	BGDSS0030101	4.1E+01	3.8E-01	2.8E+01	2.6E+01
Indian Head	EMBG	BGDSS0040101	5.1E+01	5.2E-01	2.3E+01	2.2E+01
Indian Head	EMBG	BGDSS0050101	2.6E+01	5.2E-01	1.9E+01	1.6E+01

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Indian Head	EMBG	BGDSS0060101	3.9E+01	*1.3E-01*	1.2E+01	2.3E+01
Indian Head	EMBG	BGDSS0070101	5.2E+01	*1.3E-01*	2.4E+01	2.0E+01
Indian Head	EMBG	BGDSS0080101	5.0E+01	2.6E-01	2.9E+01	2.8E+01
Indian Head	EMBG	BGDSS0090101	5.2E+01	*1.4E-01*	1.2E+01	1.5E+01
Indian Head	EMBG	BGDSS0100101	5.3E+01	*2.7E-01*	1.3E+01	1.1E+01
Indian Head	EMBG	S25-MW03-001	*9.6E+00*	*1.4E-01*	9.8E+00	1.1E+01
Indian Head	EMBG	S26-MW03-001	*1.0E+01*	*1.4E-01*	3.9E+01	3.1E+01
Fort Meade	EMBG	SSB-1	3.5E+02	*1.0E+01*	2.4E+01	2.3E+01
Fort Meade	EMBG	SSB-2	3.7E+02	*1.0E+01*	1.6E+01	2.2E+01
Fort Meade	EMBG	SSB-3	4.0E+02	*1.0E+01*	1.1E+01	7.4E+00
Fort Meade	EMBG	SSB-4	3.3E+02	*1.0E+01*	1.4E+01	1.2E+01
Fort Meade	EMBG	SSB-4X	3.3E+02	*1.0E+01*	1.6E+01	1.3E+01
Fort Meade	EMBG	SSB-5	3.3E+02	*1.0E+01*	2.0E+01	1.7E+01
Tolchester	EMBG	MCHT13-S-4	5.7E+01	NA	2.2E+01	5.5E+01
Crisfield City Dump	EMBG	Background Soil	5.5E+02	*3.4E-01*	1.6E+01	1.9E+01
Old Fort Road	EMBG	Background Soil	3.8E+01	*1.0E+00*	3.1E+01	2.3E+01
Nicholson Landfill	EMBG	Background Soil	1.9E+01	NA	1.4E+01	NA
Union Road	EMBG	Background Soil	1.0E+02	*1.0E+00*	2.6E+01	6.6E+01
Braxton Property	EMBG	Background Soil	7.7E+01	*1.0E+00*	3.8E+01	3.6E+01
Abingdon Landfill	EMBG	Background Soil	7.8E+01	2.5E-01	4.3E+01	9.0E+00
Waldorf Control	EMBG	Background Soil	2.3E+01	*1.0E+00*	1.6E+01	1.0E+02
Vicon	EMBG	Background Soil	2.9E+01	3.5E-01	2.0E+01	2.4E+01
Firestone Perryville	EMBG	Background Soil	3.5E+01	*1.0E+00*	1.4E+01	4.3E+01
SkipJack Chemicals	EMBG	Background Soil	8.5E+01	*1.0E+00*	1.1E+01	3.4E+01
Old West Denton Landfill	EMBG	Background Soil	*5.0E+02*	*1.0E+00*	2.5E+00	5.5E+01
Fort Smallwood Control	EMBG	Background Soil	*5.0E+01*	*1.0E+00*	6.1E+00	2.2E+01
Fort Smallwood Launch	EMBG	Background Soil	1.6E+01	*1.0E+00*	9.1E+00	4.4E+01
Davidsonville Launch	EMBG	Background Soil	7.0E+01	1.0E+00	2.3E+01	6.6E+01
US Naval Research Lab Waldorf	EMBG	SO 54A	*5.0E+02*	*1.0E+00*	*5.0E+00*	1.5E+01
US Naval Research Lab Waldorf	EMBG	SO 54B	*5.0E+02*	*1.0E+00*	1.1E+01	7.0E+00
US Naval Research Lab Waldorf	EMBG	SO 55A	*5.0E+02*	*1.0E+00*	1.9E+01	2.8E+01
US Naval Research Lab Waldorf	EMBG	SO 55B	*5.0E+02*	*1.0E+00*	1.5E+01	1.1E+01
US Naval Research Lab Waldorf	EMBG	SO 56	*5.0E+02*	*1.0E+00*	1.3E+01	1.2E+01
US Naval Research Lab Waldorf	EMBG	SO 57	*5.0E+02*	*1.0E+00*	1.2E+01	2.1E+01
US Naval Research Lab Waldorf	EMBG	S0 58	*5.0E+02*	*1.0E+00*	2.5E+01	1.8E+01
US Naval Research Lab Waldorf	EMBG	SO 59	*5.0E+02*	*1.0E+00*	2.2E+01	4.1E+01
US Naval Research Lab Waldorf	EMBG	SO 59(D)	*5.0E+02*	*1.0E+00*	2.3E+01	4.2E+01
US Naval Research Lab Waldorf	EMBG	SO 60	*5.0E+02*	*1.0E+00*	2.3E+01	5.2E+01

EMBG = Eastern Maryland Background, CMBG = Central Maryland Background, WMBG = Western Maryland Background. All values reported in parts per million. Not detected analytes reported at one half the detection limit. Not detected analytes italicized. NA = not applicable.

CENTRAL

Site Name	Province	Designation	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium
Ordnance Products (7/99)	CMBG	BG-01 (0 - 0.5 feet)	6.9E+03	*6.0E+00*	2.2E+00	4.5E+01	4.2E-01	*5.0E-01*
Ordnance Products (7/99)	CMBG	BG-02 (0 - 0.5 feet)	9.3E+03	7.3E-01	3.1E+00	5.6E+01	5.8E-01	*5.0E-01*
Ordnance Products (7/99)	CMBG	BG-03 (0 - 0.5 feet)	9.8E+03	*6.0E+00*	3.1E+00	4.2E+01	5.4E-01	*5.0E-01*
Ordnance Products (7/99)	CMBG	BG-04 (0 - 0.5 feet)	9.0E+03	NA	3.4E+00	4.3E+01	3.9E-01	*5.0E-01*
Bush Valley Landfill	CMBG	SUS1 (8/92, 0-6")	9.7E+03	NA	*1.6E+00*	3.8E+01	*1.3E-01*	*1.2E+00*
Bush Valley Landfill	CMBG	SUS2 (8/92, 0-6")	9.5E+03	NA	*7.5E-01*	6.2E+01	2.9E-01	*1.3E+00*
Bush Valley Landfill	CMBG	SUS3 (8/92, 0-6")	1.1E+04	NA	*8.0E-01*	6.4E+01	4.3E-01	*1.3E+00*
Mullinex Farms	CMBG	Background Soil	1.3E+04	*8.5E+00*	1.5E+00	8.5E+01	5.1E+00	*1.0E+00*
MullinexFarms	CMBG	Background Soil	1.0E+04	*8.5E+00*	4.3E+00	1.1E+02	7.0E-01	*1.0E+00*
Hopkins Quarry	CMBG	Background Soil	1.7E+04	*5.0E-01*	2.8E+00	8.2E+01	9.0E-01	*2.5E-01*
Childs Property	CMBG	Background Soil	1.1E+04	*6.0E+00*	5.3E+00	6.7E+01	6.4E-01	*5.0E-01*
Big Elk Chapel Road	CMBG	Background Soil	2.2E+04	*2.1E+00*	3.4E+00	7.3E+01	7.2E-01	*4.7E-01*
Power Matic	CMBG	Background Soil	1.4E+04	1.1E+01	*1.0E+00*	7.0E+01	8.7E-01	1.8E+00
LeHigh Portland Cement	CMBG	Background Soil	1.6E+04	*6.0E+00*	5.3E+00	2.0E+02	9.4E-01	*5.0E-01*
Langs Junkyard	CMBG	Background Soil	9.7E+03	NA	3.8E+00	8.0E+01	8.1E-01	*1.0E+00*
Kate Wagner Landfill	CMBG	Background Soil	1.5E+04	*6.0E+00*	3.8E+00	7.1E+01	6.7E-01	*5.0E-01*
Bachmans Valley Landfill	CMBG	Background Soil	1.2E+04	*6.0E+00*	6.5E+00	4.3E+01	3.7E-01	1.6E+00
Maryvale Prep School	CMBG	Background Soil	1.2E+03	NA	2.9E+00	1.0E+02	8.1E-01	*1.3E-01*
Fork Control	CMBG	Background Soil	3.7E+04	9.2E-01	2.5E+00	9.0E+01	2.1E+00	*5.0E-01*
White Oak	CMBG	BG 04 SS	8.5E+03	5.7E-01	3.1E+00	4.2E+01	6.0E-02	*3.5E-02*
White Oak	CMBG	BG 05 SS	1.0E+04	5.6E-01	4.2E+00	5.3E+01	1.9E-01	*3.0E-02*
White Oak	CMBG	BG 06 SS	7.6E+03	5.6E-01	2.2E+00	4.9E+01	2.0E-02	1.2E-01
White Oak	CMBG	BG 101 SS	6.5E+03	5.6E-01	2.1E+00	4.3E+01	2.0E-02	1.1E-01
White Oak	CMBG	BG 07 SS	9.5E+03	5.5E-01	4.2E+00	4.1E+01	1.6E-01	*3.0E-02*
White Oak	CMBG	BG 10 SS	1.2E+04	5.8E-01	4.6E+00	7.7E+01	5.0E-02	8.0E-02
White Oak	CMBG	BG 09 SS	1.7E+04	6.6E-01	5.2E+00	4.3E+01	*1.0E-02*	3.6E-01
White Oak	CMBG	BG 100 SS	2.1E+04	6.4E-01	6.7E+00	4.9E+01	2.0E-02	5.9E-01
White Oak	CMBG	BG 102 SS	5.2E+03	6.6E-01	2.5E+00	2.0E+01	*1.0E-02*	1.5E-01

EMBG = Eastern Maryland Background, CMBG = Central Maryland Background, WMBG = Western Maryland Background. All values reported in parts per million. Not detected analytes reported at one half the detection limit. Not detected analytes italicized. NA = not applicable. Not detected XRF data excluded from analysis due to elevated detection limits.

CENTRAL

Site Name	Province	Designation	Calcium	Chromium(Total)	Cobalt	Copper	Iron	Lead
Ordnance Products (7/99)	CMBG	BG-01 (0 - 0.5 feet)	3.9E+02	2.0E+01	8.2E+00	5.6E+00	1.2E+04	1.2E+01
Ordnance Products (7/99)	CMBG	BG-02 (0 - 0.5 feet)	3.4E+02	2.1E+01	9.0E+00	5.9E+00	1.3E+04	1.8E+01
Ordnance Products (7/99)	CMBG	BG-03 (0 - 0.5 feet)	1.3E+02	2.8E+01	6.7E+00	1.3E+01	2.1E+04	1.6E+01
Ordnance Products (7/99)	CMBG	BG-04 (0 - 0.5 feet)	*5.0E+02*	1.3E+01	3.3E+00	7.0E+00	9.1E+03	3.3E+01
Bush Valley Landfill	CMBG	SUS1 (8/92, 0-6")	1.6E+03	1.9E+01	3.6E+00	1.1E+01	1.6E+04	2.9E+01
Bush Valley Landfill	CMBG	SUS2 (8/92, 0-6")	1.4E+03	2.0E+01	1.0E+01	1.8E+01	1.8E+04	1.1E+01
Bush Valley Landfill	CMBG	SUS3 (8/92, 0-6")	1.4E+03	2.1E+01	8.9E+00	1.9E+01	2.0E+04	1.3E+01
Mullinex Farms	CMBG	Background Soil	8.1E+02	3.2E+01	5.7E+01	3.4E+01	2.5E+04	1.4E+01
MullinexFarms	CMBG	Background Soil	3.3E+03	7.1E+00	7.7E+01	1.6E+01	1.9E+04	4.1E+01
Hopkins Quarry	CMBG	Background Soil	1.4E+03	6.0E+00	6.1E+00	1.6E+01	2.1E+04	3.2E+01
Childs Property	CMBG	Background Soil	3.5E+03	1.9E+01	4.6E+00	1.2E+01	1.6E+04	5.3E+01
Big Elk Chapel Road	CMBG	Background Soil	8.0E+02	1.3E+01	6.1E+00	3.5E+01	1.7E+04	7.4E+00
Power Matic	CMBG	Background Soil	3.7E+04	3.4E+01	1.8E+01	4.4E+01	2.6E+04	1.8E+02
LeHigh Portland Cement	CMBG	Background Soil	3.0E+04	2.0E+01	1.3E+01	2.9E+01	2.5E+04	3.4E+01
Langs Junkyard	CMBG	Background Soil	1.6E+03	1.2E+01	1.1E+01	9.1E+00	1.7E+04	3.8E+01
Kate Wagner Landfill	CMBG	Background Soil	2.5E+03	2.2E+01	4.1E+01	2.8E+01	3.7E+04	3.4E+00
Bachmans Valley Landfill	CMBG	Background Soil	7.9E+02	1.8E+01	1.6E+01	2.5E+01	2.9E+04	3.8E+01
Maryvale Prep School	CMBG	Background Soil	8.9E+02	3.0E+01	NA	1.9E+01	2.6E+03	1.9E+01
Fork Control	CMBG	Background Soil	6.7E+02	3.1E+01	4.7E+01	2.9E+01	3.4E+04	1.4E+01
White Oak	CMBG	BG 04 SS	9.3E+01	1.2E+01	7.1E+00	4.8E+00	1.1E+04	2.8E+01
White Oak	CMBG	BG 05 SS	1.7E+02	2.1E+01	1.4E+01	9.4E+00	1.6E+04	2.5E+01
White Oak	CMBG	BG 06 SS	3.8E+02	1.2E+01	3.5E+00	1.9E+01	9.6E+03	4.2E+01
White Oak	CMBG	BG 101 SS	3.0E+02	1.0E+01	2.8E+00	1.7E+01	8.7E+03	3.6E+01
White Oak	CMBG	BG 07 SS	2.6E+02	1.3E+01	3.0E+00	5.5E+00	1.0E+04	1.8E+01
White Oak	CMBG	BG 10 SS	1.1E+03	5.6E+01	6.3E+00	1.3E+01	1.6E+04	3.1E+01
White Oak	CMBG	BG 09 SS	2.8E+02	1.9E+01	7.3E+00	1.2E+02	1.9E+04	1.3E+01
White Oak	CMBG	BG 100 SS	8.8E+01	2.7E+01	3.7E+00	1.1E+01	2.6E+04	1.2E+01
White Oak	CMBG	BG 102 SS	8.3E+01	8.4E+00	7.9E-01	3.4E+00	6.0E+03	1.8E+01

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CENTRAL

Site Name	Province	Designation	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium
Ordnance Products (7/99)	CMBG	BG-01 (0 - 0.5 feet)	6.4E+02	3.8E+02	*5.0E-02*	7.9E+00	2.6E+02	7.9E-01
Ordnance Products (7/99)	CMBG	BG-02 (0 - 0.5 feet)	9.7E+02	4.9E+02	*5.0E-02*	7.9E+00	3.6E+02	9.0E-01
Ordnance Products (7/99)	CMBG	BG-03 (0 - 0.5 feet)	1.8E+03	2.7E+02	*5.0E-02*	9.0E+00	5.7E+02	1.8E+00
Ordnance Products (7/99)	CMBG	BG-04 (0 - 0.5 feet)	7.2E+02	1.3E+02	*5.0E-02*	6.8E+00	3.7E+02	8.2E-01
Bush Valley Landfill	CMBG	SUS1 (8/92, 0-6")	1.1E+03	9.6E+01	*6.5E-02*	5.1E+00	4.2E+02	8.1E-01
Bush Valley Landfill	CMBG	SUS2 (8/92, 0-6")	3.2E+03	4.4E+02	*6.5E-02*	1.3E+01	1.6E+03	7.5E-01
Bush Valley Landfill	CMBG	SUS3 (8/92, 0-6")	3.4E+03	4.7E+02	1.4E-01	1.2E+01	1.6E+03	6.4E-01
Mullinex Farms	CMBG	Background Soil	2.5E+03	2.2E+03	NA	4.1E+01	4.4E+02	NA
MullinexFarms	CMBG	Background Soil	5.0E+02	3.4E+03	NA	*8.0E+00*	2.2E+02	NA
Hopkins Quarry	CMBG	Background Soil	2.8E+03	8.0E+02	*5.0E-02*	8.0E+00	4.1E+03	*2.5E-01*
Childs Property	CMBG	Background Soil	1.6E+03	2.6E+02	2.1E-01	1.9E+01	8.2E+02	9.2E-01
Big Elk Chapel Road	CMBG	Background Soil	2.3E+03	2.3E+02	*6.0E-02*	6.1E+00	1.4E+03	6.3E-01
Power Matic	CMBG	Background Soil	8.3E+03	4.3E+02	1.0E-01	3.0E+01	2.9E+03	*1.0E+00*
LeHigh Portland Cement	CMBG	Background Soil	3.1E+03	2.0E+03	1.2E-01	1.5E+01	1.4E+03	*5.0E-01*
Langs Junkyard	CMBG	Background Soil	6.4E+02	6.8E+02	*1.0E-01*	5.1E+00	8.3E+02	*1.5E+00*
Kate Wagner Landfill	CMBG	Background Soil	1.1E+03	NA	*8.5E-02*	*4.0E+00*	NA	*5.0E-01*
Bachmans Valley Landfill	CMBG	Background Soil	2.3E+03	6.4E+02	1.7E-01	1.7E+01	1.5E+02	*5.0E-01*
Maryvale Prep School	CMBG	Background Soil	9.4E+02	1.1E+03	*5.5E-02*	1.1E+01	5.2E+02	*4.8E-01*
Fork Control	CMBG	Background Soil	6.7E+03	5.4E+02	4.0E-02	3.3E+01	6.9E+03	6.9E-01
White Oak	CMBG	BG 04 SS	6.5E+02	2.4E+02	7.0E-02	4.9E+00	3.1E+02	*3.1E-01*
White Oak	CMBG	BG 05 SS	9.2E+02	3.0E+02	6.0E-02	8.0E+00	5.4E+02	*3.1E-01*
White Oak	CMBG	BG 06 SS	3.7E+02	7.4E+01	2.1E-01	6.5E+00	3.6E+02	6.2E-01
White Oak	CMBG	BG 101 SS	3.1E+02	5.5E+01	1.8E-01	5.4E+00	3.0E+02	7.4E-01
White Oak	CMBG	BG 07 SS	7.7E+02	1.5E+02	4.0E-02	6.4E+00	3.6E+02	*3.0E-01*
White Oak	CMBG	BG 10 SS	1.2E+03	4.9E+02	1.1E-01	2.9E+01	8.6E+02	6.5E-01
White Oak	CMBG	BG 09 SS	1.7E+03	1.8E+02	4.0E-02	1.0E+01	1.0E+03	5.5E-01
White Oak	CMBG	BG 100 SS	1.2E+03	7.2E+01	2.0E-02	7.5E+00	1.0E+03	7.3E-01
White Oak	CMBG	BG 102 SS	3.2E+02	2.0E+01	5.0E-02	2.8E+00	2.4E+02	5.4E-01

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CENTRAL

Site Name	Province	Designation	Silver	Sodium	Thallium	Vanadium	Zinc
Ordnance Products (7/99)	CMBG	BG-01 (0 - 0.5 feet)	3.6E-01	1.7E+02	1.3E+00	2.6E+01	1.8E+01
Ordnance Products (7/99)	CMBG	BG-02 (0 - 0.5 feet)	5.6E-01	2.5E+02	1.7E+00	2.6E+01	2.5E+01
Ordnance Products (7/99)	CMBG	BG-03 (0 - 0.5 feet)	6.9E-01	2.3E+02	2.9E+00	3.2E+01	3.1E+01
Ordnance Products (7/99)	CMBG	BG-04 (0 - 0.5 feet)	*1.0E+00*	2.3E+02	*1.0E+00*	2.0E+01	2.3E+01
Bush Valley Landfill	CMBG	SUS1 (8/92, 0-6")	*7.5E-01*	7.9E+01	*2.5E-01*	2.6E+01	3.9E+01
Bush Valley Landfill	CMBG	SUS2 (8/92, 0-6")	*8.0E-01*	7.0E+01	*2.7E-01*	3.3E+01	5.1E+01
Bush Valley Landfill	CMBG	SUS3 (8/92, 0-6")	*8.0E-01*	1.0E+02	*2.6E-01*	3.4E+01	5.9E+01
Mullinex Farms	CMBG	Background Soil	*5.0E-01*	1.1E+02	NA	3.3E+01	7.2E+01
MullinexFarms	CMBG	Background Soil	*5.0E-01*	8.0E+01	NA	1.9E+01	4.4E+01
Hopkins Quarry	CMBG	Background Soil	*5.0E-01*	*1.0E+02*	*2.5E-01*	1.7E+01	7.2E+01
Childs Property	CMBG	Background Soil	*1.0E+00*	1.4E+02	*1.0E+00*	2.0E+01	1.1E+02
Big Elk Chapel Road	CMBG	Background Soil	*2.2E-01*	5.9E+01	*5.5E-01*	5.6E+00	1.7E+01
Power Matic	CMBG	Background Soil	1.0E+00	8.6E+01	4.3E-01	4.2E+01	1.1E+02
LeHigh Portland Cement	CMBG	Background Soil	1.5E+00	3.8E+02	3.4E-01	3.2E+01	6.0E+01
Langs Junkyard	CMBG	Background Soil	NA	3.8E+01	NA	1.9E+01	3.2E+01
Kate Wagner Landfill	CMBG	Background Soil	*1.0E+00*	8.8E+01	*1.0E+00*	1.6E+01	4.3E+01
Bachmans Valley Landfill	CMBG	Background Soil	*1.0E+00*	3.6E+01	*1.0E+00*	1.9E+01	7.5E+01
Maryvale Prep School	CMBG	Background Soil	*6.0E-01*	5.0E+01	*2.4E-01*	3.8E+01	2.9E+01
Fork Control	CMBG	Background Soil	*1.0E+00*	*5.0E+02*	3.1E+00	3.7E+01	1.1E+02
White Oak	CMBG	BG 04 SS	*8.5E-02*	4.4E+01	*3.2E-01*	2.6E+01	1.9E+01
White Oak	CMBG	BG 05 SS	*8.5E-02*	*4.3E+01*	*3.2E-01*	*1.2E+01*	2.6E+01
White Oak	CMBG	BG 06 SS	1.3E+00	7.7E+01	*3.2E-01*	3.1E+01	2.3E+01
White Oak	CMBG	BG 101 SS	9.9E-01	5.8E+01	*3.1E-01*	2.7E+01	1.8E+01
White Oak	CMBG	BG 07 SS	*8.5E-02*	*4.2E+01*	*3.1E-01*	2.2E+01	2.0E+01
White Oak	CMBG	BG 10 SS	*9.0E-02*	6.5E+01	*3.3E-01*	2.8E+01	4.4E+01
White Oak	CMBG	BG 09 SS	*1.1E-01*	1.2E+02	*2.8E-01*	3.2E+01	3.1E+01
White Oak	CMBG	BG 100 SS	*1.1E-01*	1.3E+02	*2.7E-01*	4.3E+01	2.6E+01
White Oak	CMBG	BG 102 SS	*1.1E-01*	*1.5E+01*	*2.7E-01*	1.4E+01	7.8E+00

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Site Name	Province	Designation	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium
Ft. Detrick	WMBG	BORMWA1-A	NA	NA	2.3E+01	5.5E+02	NA	NA
Ft. Detrick	WMBG	BORMWA1-B	NA	NA	2.2E+01	5.3E+02	NA	NA
Ft. Detrick	WMBG	BORMWA2-B	NA	NA	NA	5.5E+02	NA	NA
Ft. Detrick	WMBG	BORMWA3-A	NA	NA	1.1E+01	5.0E+02	NA	NA
Ft. Detrick	WMBG	BORMWA3-B	NA	NA	NA	5.6E+02	NA	NA
Ft. Detrick	WMBG	BORMW9D-A	NA	NA	NA	6.4E+02	NA	NA
Ft. Detrick	WMBG	BORMW9D-B	NA	NA	1.2E+01	5.6E+02	NA	NA
Ft. Detrick	WMBG	BMW36D-A	2.4E+04	5.0E+00	1.0E+01	1.6E+02	8.7E-01	2.5E-01
Ft. Detrick	WMBG	AMWA3—0	2.0E+04	5.0E+00	1.0E+01	1.5E+02	1.1E+00	2.5E-01
Ft. Detrick	WMBG	AMWA1-0.5	2.5E+04	5.0E+00	2.7E+01	1.1E+02	2.1E+00	2.5E-01
Ft. Detrick	WMBG	AMWA2-0.5	2.1E+04	5.0E+00	2.0E+01	1.7E+02	2.7E+00	2.5E-01
Ft. Detrick	WMBG	BMW47D-0	2.1E+04	5.0E+00	1.0E+01	1.2E+02	8.3E-01	2.5E-01
Frederick Tool and Die	WMBG	Background Soil	1.9E+04	3.3E+00	6.0E+00	1.1E+02	9.5E-01	3.7E-01
Vale Summit	WMBG	Background Soil	7.2E+03	NA	NA	1.6E+02	1.7E+00	1.2E+01
Old Cumberland Land Fill	WMBG	Background Soil	7.0E+03	4.3E+00	8.2E+00	1.5E+02	6.1E-01	8.1E-01
Hoffman Land fill	WMBG	Background Soil	8.3E+03	NA	7.9E+00	1.4E+02	1.1E+00	4.3E-01
Cabin Run Land Fill	WMBG	Background Soil	6.3E+03	6.0E+00	6.1E+00	3.7E+01	3.0E-01	5.0E-01
Fort Ritchie	WMBG	BKSS07	7.3E+03	2.5E-01	1.1E-01	6.5E+01	2.1E-01	3.1E-01
Fort Ritchie	WMBG	BKSS08	9.3E+03	2.6E-01	5.5E-02	1.1E+02	3.7E-01	3.7E-01
Fort Ritchie	WMBG	BKSS09	8.0E+03	2.6E-01	5.5E-02	1.4E+02	4.0E-01	3.7E-01
Fort Ritchie	WMBG	BKSS11	4.9E+03	2.6E-01	4.1E-01	6.2E+01	1.2E-01	3.6E-01
Fort Ritchie	WMBG	BKSS12	7.1E+03	2.5E-01	2.1E-01	3.4E+01	1.5E-01	4.0E-01
Fort Ritchie	WMBG	BKSS13	5.4E+03	2.6E-01	1.4E-01	4.3E+01	1.3E-01	3.0E-01
Fort Ritchie	WMBG	BKSS14	7.7E+03	NA	4.5E-01	3.9E+01	4.0E-02	7.6E-01
Fort Ritchie	WMBG	BKSS15	6.2E+03	3.9E-01	5.9E-01	3.2E+01	4.0E-02	5.4E-01
Fort Ritchie	WMBG	BKSS16	7.4E+03	2.8E-01	4.4E-01	8.2E+01	2.3E-01	3.5E-01
Fort Ritchie	WMBG	BKSS17	9.1E+03	2.6E-01	5.5E-02	1.1E+02	4.2E-01	3.5E-01
Fort Ritchie	WMBG	BKSS18	1.6E+04	2.8E-01	6.5E-01	2.9E+02	1.3E+00	5.5E-01
Fort Ritchie	WMBG	BKSS37	8.1E+03	3.9E-01	3.0E+00	3.8E+01	1.9E-01	1.5E-01
Fort Ritchie	WMBG	BKSS38	6.6E+03	3.8E-01	2.3E+00	5.0E+01	1.6E-01	9.8E-01
Fort Ritchie	WMBG	BKSS39	5.6E+03	3.2E-01	2.7E+00	3.4E+01	1.2E-01	1.2E-01
Fort Ritchie	WMBG	BKSS40	5.2E+03	3.2E-01	2.3E+00	2.3E+01	6.0E-02	1.3E-01
Fort Ritchie	WMBG	BKSS19	1.8E+04	2.6E-01	1.1E-01	4.8E+01	3.4E-01	1.8E-01
Fort Ritchie	WMBG	BKSS20	1.9E+04	7.6E-01	4.7E-01	7.0E+01	4.0E-01	3.6E+00
Fort Ritchie	WMBG	BKSS21	1.5E+04	2.8E-01	6.0E-02	2.9E+01	3.0E-01	2.1E-01
Fort Ritchie	WMBG	BKSS22	1.8E+04	2.6E-01	2.1E-01	5.7E+01	4.9E-01	2.1E-01
Fort Ritchie	WMBG	BKSS23	1.4E+04	2.8E-01	3.2E-01	7.2E+01	5.5E-01	2.5E-01
Fort Ritchie	WMBG	BKSS24	1.9E+04	8.6E-01	8.5E-01	6.6E+01	3.9E-01	3.8E+00

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Fort Ritchie	WMBG	BKSS25	2.1E+04	2.7E-01	6.0E-02	9.0E+01	4.3E-01	2.3E-01
Fort Ritchie	WMBG	BKSS26	2.2E+04	2.8E-01	6.0E-02	1.6E+02	5.1E-01	2.0E-01
Fort Ritchie	WMBG	BKSS27	1.9E+04	3.1E-01	7.0E-02	1.3E+02	4.6E-01	5.4E-01
Fort Ritchie	WMBG	BKSS28	1.5E+04	2.9E-01	6.0E-02	1.1E+02	8.3E-01	3.8E-01
Fort Ritchie	WMBG	BKSS29	1.6E+04	2.8E-01	1.9E-01	8.1E+01	5.2E-01	3.1E-01
Fort Ritchie	WMBG	BKSS30	2.0E+04	1.0E+00	1.2E-01	7.3E+01	2.8E-01	4.0E+00
Fort Ritchie	WMBG	BKSS31	1.5E+04	7.3E-01	3.4E-01	5.2E+01	2.0E-01	2.1E+00
Fort Ritchie	WMBG	BKSS32	2.0E+04	4.8E-01	1.2E-01	4.6E+01	3.1E-01	1.5E+00
Fort Ritchie	WMBG	BKSS33	1.9E+04	1.5E+00	1.2E+00	2.0E+02	3.9E-01	3.0E+00
Fort Ritchie	WMBG	BKSS34	2.0E+04	1.0E+00	1.2E-01	8.5E+01	3.0E-01	2.4E+00
Fort Ritchie	WMBG	BKSS35	1.7E+04	1.1E+00	1.0E+00	3.5E+01	3.2E-01	5.1E+00
Fort Ritchie	WMBG	BKSS36	1.6E+04	8.4E-01	1.6E-01	1.1E+02	3.3E-01	2.1E+00

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Site Name	Province	Designation	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead
Ft. Detrick	WMBG	BORMWA1-A	2.3E+03	NA	NA	2.8E+01	3.8E+04	2.8E+01
Ft. Detrick	WMBG	BORMWA1-B	2.7E+03	NA	NA	3.2E+01	6.1E+04	2.3E+01
Ft. Detrick	WMBG	BORMWA2-B	1.9E+03	NA	2.3E+01	NA	3.6E+04	1.5E+01
Ft. Detrick	WMBG	BORMWA3-A	1.5E+03	NA	NA	NA	2.3E+04	2.0E+01
Ft. Detrick	WMBG	BORMWA3-B	3.5E+02	NA	NA	NA	3.5E+04	1.2E+01
Ft. Detrick	WMBG	BORMW9D-A	2.3E+03	NA	NA	2.0E+01	4.1E+04	2.3E+01
Ft. Detrick	WMBG	BORMW9D-B	3.5E+03	NA	NA	NA	3.9E+04	2.0E+01
Ft. Detrick	WMBG	BMW36D-A	1.4E+03	2.1E+01	9.7E+00	1.2E+01	2.6E+04	2.2E+01
Ft. Detrick	WMBG	AMWA3--0	5.4E+03	2.0E+01	1.3E+01	9.0E+00	2.1E+04	1.7E+01
Ft. Detrick	WMBG	AMWA1-0.5	4.3E+03	3.7E+01	1.5E+01	2.4E+01	3.6E+04	2.7E+01
Ft. Detrick	WMBG	AMWA2-0.5	1.9E+04	1.9E+01	1.6E+01	1.4E+01	2.6E+04	2.2E+01
Ft. Detrick	WMBG	BMW47D-0	3.3E+03	2.1E+01	1.0E+01	1.2E+01	2.4E+04	3.3E+01
Frederick Tool and Die	WMBG	Background Soil	3.3E+03	2.6E+01	1.2E+01	2.5E+01	2.2E+04	1.4E+02
Vale Summit	WMBG	Background Soil	1.6E+03	2.3E+01	3.0E+01	4.8E+01	7.1E+04	4.5E+01
Old Cumberland Land Fill	WMBG	Background Soil	3.7E+03	2.1E+01	5.8E+00	1.6E+01	2.1E+04	3.4E+01
Hoffman Land fill	WMBG	Background Soil	2.6E+03	1.2E+01	1.9E+01	2.9E+01	3.4E+04	3.5E+01
Cabin Run Land Fill	WMBG	Background Soil	5.9E+02	1.0E+01	3.6E+00	2.0E+01	2.5E+04	1.2E+01
Fort Ritchie	WMBG	BKSS07	5.7E+01	3.7E+00	1.1E+00	1.4E+00	5.1E+03	3.7E+00
Fort Ritchie	WMBG	BKSS08	1.2E+02	4.2E+00	2.6E+00	1.6E+00	5.4E+03	5.4E+00
Fort Ritchie	WMBG	BKSS09	2.1E+02	3.4E+00	2.3E+00	1.4E+00	4.8E+03	7.6E+00
Fort Ritchie	WMBG	BKSS11	1.3E+02	3.7E+00	8.7E-01	2.6E+00	5.2E+03	1.4E+01
Fort Ritchie	WMBG	BKSS12	6.1E+01	5.2E+00	1.3E+00	1.3E+00	6.7E+03	6.6E+00
Fort Ritchie	WMBG	BKSS13	9.5E+01	3.6E+00	8.0E-01	2.9E+00	4.5E+03	2.8E+01
Fort Ritchie	WMBG	BKSS14	1.0E+02	3.1E+00	3.8E-01	9.0E-02	5.6E+03	3.0E+00
Fort Ritchie	WMBG	BKSS15	7.2E+01	1.7E+00	4.3E-01	4.4E-01	4.3E+03	2.2E+01
Fort Ritchie	WMBG	BKSS16	1.4E+02	3.4E+00	2.0E+00	1.8E+00	4.8E+03	1.4E+01
Fort Ritchie	WMBG	BKSS17	1.3E+02	3.7E+00	2.3E+00	2.0E+00	4.8E+03	1.1E+01
Fort Ritchie	WMBG	BKSS18	3.9E+02	4.5E+00	5.8E+00	5.7E+00	6.9E+03	2.0E+01
Fort Ritchie	WMBG	BKSS37	8.9E+02	7.8E+00	2.1E+00	3.8E+00	1.0E+04	1.5E+01
Fort Ritchie	WMBG	BKSS38	7.2E+02	5.4E+00	1.0E+00	3.2E+00	7.1E+03	1.8E+01
Fort Ritchie	WMBG	BKSS39	8.7E+01	1.9E+01	3.9E-01	1.1E+00	7.0E+03	7.4E+00
Fort Ritchie	WMBG	BKSS40	9.9E+01	4.9E+00	3.8E-01	1.7E+00	6.8E+03	8.9E+00
Fort Ritchie	WMBG	BKSS19	8.1E+02	5.1E+01	4.2E+01	3.8E+01	3.0E+04	6.7E+00
Fort Ritchie	WMBG	BKSS20	8.3E+02	3.8E+01	3.3E+01	2.4E+01	2.9E+04	1.4E+01
Fort Ritchie	WMBG	BKSS21	9.4E+02	5.1E+01	2.4E+01	1.4E+01	2.5E+04	5.3E+00
Fort Ritchie	WMBG	BKSS22	6.1E+02	5.5E+01	4.8E+01	3.8E+01	3.2E+04	5.0E+00
Fort Ritchie	WMBG	BKSS23	9.3E+02	5.1E+01	4.5E+01	1.7E+01	2.7E+04	2.1E+01
Fort Ritchie	WMBG	BKSS24	3.5E+03	3.8E+01	4.5E+01	2.4E+01	3.3E+04	1.8E+01

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Fort Ritchie	WMBG	BKSS25	8.4E+02	3.8E+01	3.1E+01	3.3E+01	3.0E+04	7.7E+00
Fort Ritchie	WMBG	BKSS26	7.6E+02	3.5E+01	3.8E+01	4.2E+01	3.4E+04	1.1E+01
Fort Ritchie	WMBG	BKSS27	2.2E+03	3.0E+01	3.1E+01	4.3E+01	3.1E+04	3.4E+01
Fort Ritchie	WMBG	BKSS28	2.3E+03	5.3E+01	4.5E+01	3.0E+01	3.4E+04	1.9E+01
Fort Ritchie	WMBG	BKSS29	2.5E+03	7.4E+01	3.7E+01	3.2E+01	3.0E+04	1.4E+01
Fort Ritchie	WMBG	BKSS30	1.7E+03	3.0E+01	3.0E+01	2.7E+01	3.5E+04	2.2E+01
Fort Ritchie	WMBG	BKSS31	3.9E+02	1.7E+01	1.7E+01	1.4E+01	2.4E+04	1.4E+01
Fort Ritchie	WMBG	BKSS32	4.4E+02	2.1E+01	2.2E+01	1.5E+01	2.3E+04	1.1E+01
Fort Ritchie	WMBG	BKSS33	2.2E+03	4.0E+01	3.0E+01	6.1E+01	3.7E+04	1.7E+02
Fort Ritchie	WMBG	BKSS34	3.5E+03	3.3E+01	3.1E+01	2.3E+01	3.0E+04	2.3E+01
Fort Ritchie	WMBG	BKSS35	1.6E+03	5.0E+01	3.2E+01	3.9E+01	3.5E+04	7.0E+00
Fort Ritchie	WMBG	BKSS36	1.7E+03	2.8E+01	3.3E+01	2.6E+01	3.2E+04	1.7E+01

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Site Name	Province	Designation	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium
Ft. Detrick	WMBG	BORMWA1-A	NA	1.0E+03	NA	NA	4.3E+04	NA
Ft. Detrick	WMBG	BORMWA1-B	NA	4.8E+02	NA	NA	3.9E+04	NA
Ft. Detrick	WMBG	BORMWA2-B	NA	2.7E+02	NA	NA	2.7E+04	NA
Ft. Detrick	WMBG	BORMWA3-A	NA	1.0E+03	NA	NA	1.8E+04	NA
Ft. Detrick	WMBG	BORMWA3-B	NA	3.1E+02	NA	NA	2.1E+04	NA
Ft. Detrick	WMBG	BORMW9D-A	NA	1.5E+03	NA	NA	2.0E+04	NA
Ft. Detrick	WMBG	BORMW9D-B	NA	1.7E+03	NA	NA	2.0E+04	NA
Ft. Detrick	WMBG	BMW36D-A	2.7E+03	4.3E+02	5.0E-02	1.6E+01	2.6E+03	5.0E+00
Ft. Detrick	WMBG	AMWA3--0	2.6E+03	1.1E+03	5.0E-02	1.5E+01	2.5E+03	8.2E+00
Ft. Detrick	WMBG	AMWA1-0.5	6.2E+03	9.0E+02	5.0E-02	2.9E+01	4.4E+03	9.6E+00
Ft. Detrick	WMBG	AMWA2-0.5	4.1E+03	1.5E+03	5.0E-02	2.0E+01	3.6E+03	5.0E+00
Ft. Detrick	WMBG	BMW47D-0	2.5E+03	5.5E+02	5.0E-02	1.4E+01	1.7E+03	5.0E+00
Frederick Tool and Die	WMBG	Background Soil	2.2E+03	8.3E+02	6.0E-02	1.6E+01	1.6E+03	7.3E-01
Vale Summit	WMBG	Background Soil	1.4E+03	1.7E+03	4.0E-02	4.7E+01	1.9E+03	8.6E-01
Old Cumberland Land Fill	WMBG	Background Soil	6.5E+02	1.1E+02	6.0E-02	8.8E+00	5.7E+02	1.2E+00
Hoffman Land fill	WMBG	Background Soil	1.0E+03	1.2E+03	1.0E-01	2.2E+01	1.2E+03	3.5E-01
Cabin Run Land Fill	WMBG	Background Soil	2.5E+02	4.1E+01	5.0E-02	1.8E+00	1.0E+03	NA
Fort Ritchie	WMBG	BKSS07	3.3E+02	5.7E+01	6.0E-02	1.9E+00	7.0E+02	9.0E-01
Fort Ritchie	WMBG	BKSS08	4.8E+02	1.8E+02	6.0E-02	4.0E+00	8.7E+02	4.1E-01
Fort Ritchie	WMBG	BKSS09	4.4E+02	4.5E+02	6.0E-02	3.0E+00	5.6E+02	1.0E+00
Fort Ritchie	WMBG	BKSS11	2.7E+02	1.7E+02	8.0E-02	2.1E+00	1.5E+02	7.0E-01
Fort Ritchie	WMBG	BKSS12	4.1E+02	1.7E+02	8.0E-02	2.6E+00	1.9E+02	7.1E-01
Fort Ritchie	WMBG	BKSS13	2.4E+02	9.9E+01	8.0E-02	2.0E+00	1.7E+02	9.6E-01
Fort Ritchie	WMBG	BKSS14	1.9E+02	4.4E+01	7.0E-02	1.4E+00	2.4E+02	5.9E-01
Fort Ritchie	WMBG	BKSS15	9.1E+01	1.5E+02	9.0E-02	7.5E-01	6.2E+02	9.0E-01
Fort Ritchie	WMBG	BKSS16	2.9E+02	1.9E+02	8.0E-02	2.4E+00	5.3E+02	6.7E-01
Fort Ritchie	WMBG	BKSS17	4.2E+02	1.6E+02	8.0E-02	4.0E+00	5.7E+02	9.9E-01
Fort Ritchie	WMBG	BKSS18	5.8E+02	2.4E+03	1.2E-01	1.3E+01	6.1E+02	1.8E+00
Fort Ritchie	WMBG	BKSS37	6.6E+02	1.1E+02	7.0E-02	4.7E+00	5.7E+02	3.6E-01
Fort Ritchie	WMBG	BKSS38	3.7E+02	5.9E+01	8.0E-02	2.9E+00	5.2E+02	6.4E-01
Fort Ritchie	WMBG	BKSS39	2.4E+02	4.0E+01	7.0E-02	8.4E+00	3.7E+02	5.3E-01
Fort Ritchie	WMBG	BKSS40	2.5E+02	2.3E+01	6.0E-02	2.1E+00	3.9E+02	4.0E-01
Fort Ritchie	WMBG	BKSS19	1.3E+04	9.5E+02	7.0E-02	5.3E+01	1.1E+02	1.7E+00
Fort Ritchie	WMBG	BKSS20	8.9E+03	1.1E+03	1.3E-01	4.4E+01	1.4E+02	1.8E+00
Fort Ritchie	WMBG	BKSS21	1.2E+04	3.3E+02	3.5E-02	5.2E+01	1.1E+02	1.5E+00
Fort Ritchie	WMBG	BKSS22	8.3E+03	9.1E+02	6.0E-02	4.9E+01	1.3E+02	1.6E+00
Fort Ritchie	WMBG	BKSS23	4.4E+03	1.9E+03	9.0E-02	3.4E+01	1.8E+02	1.9E+00
Fort Ritchie	WMBG	BKSS24	8.6E+03	1.4E+03	1.0E-01	3.8E+01	2.2E+02	2.4E+00

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Fort Ritchie	WMBG	BKSS25	1.3E+04	8.0E+02	7.0E-02	4.8E+01	1.5E+02	1.7E+00
Fort Ritchie	WMBG	BKSS26	1.4E+04	1.1E+03	8.0E-02	5.3E+01	1.5E+02	1.6E+00
Fort Ritchie	WMBG	BKSS27	1.2E+04	1.8E+03	1.3E-01	4.2E+01	4.3E+02	2.2E+00
Fort Ritchie	WMBG	BKSS28	6.9E+03	2.1E+03	1.1E-01	3.8E+01	1.5E+02	2.2E+00
Fort Ritchie	WMBG	BKSS29	1.1E+04	1.9E+03	9.0E-02	5.2E+01	1.3E+02	2.2E+00
Fort Ritchie	WMBG	BKSS30	9.8E+03	8.6E+02	9.0E-02	3.8E+01	1.8E+02	2.1E+00
Fort Ritchie	WMBG	BKSS31	4.1E+03	1.4E+03	8.0E-02	1.9E+01	1.9E+02	1.0E+00
Fort Ritchie	WMBG	BKSS32	1.3E+04	4.4E+02	1.2E-01	3.0E+01	1.6E+02	1.5E+00
Fort Ritchie	WMBG	BKSS33	1.3E+04	2.0E+03	1.7E-01	4.6E+01	2.1E+02	2.4E+00
Fort Ritchie	WMBG	BKSS34	1.4E+04	1.3E+03	1.8E-01	4.3E+01	2.0E+02	2.1E+00
Fort Ritchie	WMBG	BKSS35	1.3E+04	6.3E+02	8.0E-02	5.8E+01	1.3E+02	2.4E+00
Fort Ritchie	WMBG	BKSS36	1.1E+04	1.9E+03	1.5E-01	3.7E+01	1.2E+02	2.1E+00

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Site Name	Province	Designation	Silver	Sodium	Thallium	Vanadium	Zinc
Ft. Detrick	WMBG	BORMWA1-A	NA	NA	NA	1.9E+02	7.9E+01
Ft. Detrick	WMBG	BORMWA1-B	NA	NA	NA	1.5E+02	6.3E+01
Ft. Detrick	WMBG	BORMWA2-B	NA	NA	NA	1.7E+02	6.1E+01
Ft. Detrick	WMBG	BORMWA3-A	NA	NA	NA	1.7E+02	6.2E+01
Ft. Detrick	WMBG	BORMWA3-B	NA	NA	NA	1.6E+02	6.6E+01
Ft. Detrick	WMBG	BORMW9D-A	NA	NA	NA	1.9E+02	9.0E+01
Ft. Detrick	WMBG	BORMW9D-B	NA	NA	NA	2.4E+02	7.5E+01
Ft. Detrick	WMBG	BMW36D-A	1.0E+00	9.6E+01	1.0E+01	5.4E+01	6.2E+01
Ft. Detrick	WMBG	AMWA3--0	1.0E+00	1.0E+02	1.0E+01	4.7E+01	5.4E+01
Ft. Detrick	WMBG	AMWA1-0.5	1.0E+00	9.3E+01	1.0E+01	6.1E+01	6.1E+01
Ft. Detrick	WMBG	AMWA2-0.5	1.0E+00	7.2E+01	1.0E+01	5.3E+01	5.9E+01
Ft. Detrick	WMBG	BMW47D-0	1.0E+00	7.4E+01	1.0E+01	5.2E+01	6.3E+01
Frederick Tool and Die	WMBG	Background Soil	1.7E+00	5.3E+01	4.8E-01	3.5E+01	1.1E+02
Vale Summit	WMBG	Background Soil	NA	NA	NA	3.4E+01	1.6E+02
Old Cumberland Land Fill	WMBG	Background Soil	2.2E-01	8.9E+01	4.3E-01	1.9E+01	1.3E+02
Hoffman Land fill	WMBG	Background Soil	1.0E+00	1.2E+02	1.0E+00	1.8E+01	7.8E+01
Cabin Run Land Fill	WMBG	Background Soil	1.0E+00	3.8E+01	1.0E+00	2.3E+01	2.5E+01
Fort Ritchie	WMBG	BKSS07	1.7E+00	7.2E+01	6.0E-02	7.8E+00	1.0E+01
Fort Ritchie	WMBG	BKSS08	1.7E+00	7.7E+01	1.2E-01	8.4E+00	1.8E+01
Fort Ritchie	WMBG	BKSS09	3.5E+00	7.4E+01	1.2E-01	7.2E+00	1.6E+01
Fort Ritchie	WMBG	BKSS11	1.8E+00	7.6E+01	1.2E-01	8.9E+00	1.0E+01
Fort Ritchie	WMBG	BKSS12	1.7E+00	7.0E+01	1.2E-01	1.1E+01	1.1E+01
Fort Ritchie	WMBG	BKSS13	1.7E+00	7.2E+01	1.2E-01	8.0E+00	1.0E+01
Fort Ritchie	WMBG	BKSS14	9.5E-02	8.4E+01	6.0E-02	7.5E+00	8.4E+00
Fort Ritchie	WMBG	BKSS15	2.1E-01	9.7E+01	6.5E-02	4.1E+00	5.5E+00
Fort Ritchie	WMBG	BKSS16	1.9E+00	7.5E+01	1.3E-01	7.5E+00	1.4E+01
Fort Ritchie	WMBG	BKSS17	1.7E+00	7.3E+01	1.2E-01	7.8E+00	2.0E+01
Fort Ritchie	WMBG	BKSS18	1.9E+00	8.0E+01	6.5E-02	7.4E+00	6.4E+01
Fort Ritchie	WMBG	BKSS37	9.5E-02	9.5E+01	6.0E-02	1.4E+01	2.5E+01
Fort Ritchie	WMBG	BKSS38	1.0E-01	1.1E+02	1.9E-01	9.7E+00	2.2E+01
Fort Ritchie	WMBG	BKSS39	9.5E-02	9.3E+01	6.0E-02	8.2E+00	1.0E+01
Fort Ritchie	WMBG	BKSS40	9.5E-02	9.4E+01	2.5E-01	8.6E+00	9.7E+00
Fort Ritchie	WMBG	BKSS19	1.7E+01	9.2E+01	6.0E-02	9.3E+01	6.3E+01
Fort Ritchie	WMBG	BKSS20	2.1E-01	1.0E+02	6.5E-02	7.3E+01	5.7E+01
Fort Ritchie	WMBG	BKSS21	1.9E+01	8.8E+01	6.5E-02	8.2E+01	5.3E+01
Fort Ritchie	WMBG	BKSS22	1.8E+01	7.7E+01	1.6E-01	1.1E+02	5.6E+01
Fort Ritchie	WMBG	BKSS23	1.9E+01	8.2E+01	1.5E-01	9.2E+01	4.7E+01
Fort Ritchie	WMBG	BKSS24	2.1E-01	1.2E+02	6.5E-02	7.8E+01	6.2E+01

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Fort Ritchie	WMBG	BKSS25	1.8E+01	8.1E+01	1.5E-01	8.5E+01	8.7E+01
Fort Ritchie	WMBG	BKSS26	1.8E+01	8.0E+01	1.3E-01	1.1E+02	9.9E+01
Fort Ritchie	WMBG	BKSS27	2.1E+01	9.5E+01	7.5E-02	9.7E+01	1.0E+02
Fort Ritchie	WMBG	BKSS28	1.9E+01	1.0E+02	1.4E-01	1.1E+02	7.2E+01
Fort Ritchie	WMBG	BKSS29	1.9E+01	1.2E+02	1.4E-01	9.6E+01	7.2E+01
Fort Ritchie	WMBG	BKSS30	2.1E-01	1.3E+02	6.5E-02	8.7E+01	6.6E+01
Fort Ritchie	WMBG	BKSS31	1.0E-01	9.2E+01	6.5E-02	4.0E+01	3.2E+01
Fort Ritchie	WMBG	BKSS32	1.1E-01	1.2E+02	1.3E-01	3.7E+01	6.5E+01
Fort Ritchie	WMBG	BKSS33	1.1E-01	1.4E+02	1.3E-01	7.1E+01	2.8E+02
Fort Ritchie	WMBG	BKSS34	1.1E-01	1.8E+02	1.4E-01	6.0E+01	8.6E+01
Fort Ritchie	WMBG	BKSS35	5.0E-01	1.2E+02	1.5E-01	9.0E+01	6.0E+01
Fort Ritchie	WMBG	BKSS36	1.1E-01	1.2E+02	1.3E-01	6.0E+01	9.1E+01

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APPENDIX 2 - ATTACHMENT 2

ANTICIPATED TYPICAL CONCENTRATIONS (ATC)/REFERENCE LEVELS OF METALS IN THE STATE OF MARYLAND

Region		Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead
CMBG	Number Samples	28	22	28	28	27	28	28	28	27	28	28	28
CMBG	Mean	1.2E+04	3.4E+00	3.3E+00	6.5E+01	6.4E-01	5.9E-01	3.3E+03	2.0E+01	1.5E+01	2.1E+01	1.8E+04	2.9E+01
CMBG	Std(n-1)	6.6E+03	3.5E+00	1.6E+00	3.4E+01	9.8E-01	5.0E-01	8.6E+03	1.0E+01	1.9E+01	2.2E+01	8.2E+03	3.1E+01
CMBG	Min	1.2E+03	5.0E-01	7.5E-01	2.0E+01	1.0E-02	3.0E-02	8.3E+01	6.0E+00	7.9E-01	3.4E+00	2.6E+03	3.4E+00
CMBG	Max	3.7E+04	1.1E+01	6.7E+00	2.0E+02	5.1E+00	1.8E+00	3.7E+04	5.6E+01	7.7E+01	1.2E+02	3.7E+04	1.8E+02
CMBG	ATC(n-1)	1.9E+04	6.8E+00	4.9E+00	9.9E+01	1.6E+00	1.1E+00	1.2E+04	3.0E+01	3.3E+01	4.2E+01	2.6E+04	6.1E+01
	USGS Concentrations (average)	7.2E+04	6.6E-01	7.2E+00	5.8E+02	9.2E-01	NA	2.4E+04	5.4E+01	9.1E+00	2.5E+01	2.6E+04	1.9E+01
	Proposed Maryland Cleanup Standards Residential	7.8E+03	3.1E+00	4.3E-01	1.6E+03	1.6E+01	3.9E+00	NA	2.3E+01	NA	3.1E+02	5.5E+03	4.0E+02

Region		Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead
EMBG	Number Samples	76	74	76	76	75	75	76	76	76	76	76	76
EMBG	Mean	7.1E+03	3.6E+00	2.3E+00	4.3E+01	4.3E-01	4.2E-01	5.9E+02	1.5E+01	5.9E+00	7.4E+00	1.0E+04	2.2E+01
EMBG	Std(n-1)	3.9E+03	2.4E+00	1.2E+00	3.1E+01	2.3E-01	3.1E-01	6.6E+02	1.3E+01	4.9E+00	5.0E+00	5.2E+03	2.3E+01
EMBG	Min	1.4E+03	1.8E-01	1.2E-01	9.8E+00	5.0E-02	5.5E-02	5.0E+01	2.0E+00	5.8E-01	1.8E+00	1.0E+03	3.8E+00
EMBG	Max	1.8E+04	1.6E+01	6.9E+00	1.7E+02	1.4E+00	1.9E+00	4.3E+03	7.1E+01	2.6E+01	2.8E+01	2.5E+04	1.5E+02
EMBG	ATC(n-1)	1.1E+04	6.0E+00	3.6E+00	7.3E+01	6.6E-01	7.3E-01	1.3E+03	2.8E+01	1.1E+01	1.2E+01	1.5E+04	4.5E+01
	USGS Concentrations (average)	7.2E+04	6.6E-01	7.2E+00	5.8E+02	9.2E-01	NA	2.4E+04	5.4E+01	9.1E+00	2.5E+01	2.6E+04	1.9E+01
	Proposed Maryland Cleanup Standards Residential	7.8E+03	3.1E+00	4.3E-01	1.6E+03	1.6E+01	3.9E+00	NA	2.3E+01	NA	3.1E+02	5.5E+03	4.0E+02

Region		Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead
WMBG	Number Samples	43	40	46	50	43	43	50	43	44	46	50	50
WMBG	Mean	1.4E+04	1.3E+00	4.2E+00	1.6E+02	5.5E-01	1.2E+00	1.8E+03	2.4E+01	1.8E+01	1.9E+01	2.4E+04	2.3E+01
WMBG	Std(n-1)	6.2E+03	1.8E+00	6.9E+00	1.7E+02	5.5E-01	2.1E+00	2.8E+03	1.9E+01	1.6E+01	1.5E+01	1.5E+04	3.0E+01
WMBG	Min	4.9E+03	2.5E-01	5.5E-02	2.3E+01	4.0E-02	1.2E-01	5.7E+01	1.7E+00	3.8E-01	9.0E-02	4.3E+03	3.0E+00
WMBG	Max	2.5E+04	6.0E+00	2.7E+01	6.4E+02	2.7E+00	1.2E+01	1.9E+04	7.4E+01	4.8E+01	6.1E+01	7.1E+04	1.7E+02
WMBG	ATC(n-1)	2.0E+04	3.2E+00	1.1E+01	3.3E+02	1.1E+00	3.3E+00	4.6E+03	4.2E+01	3.4E+01	3.4E+01	3.9E+04	5.2E+01
	USGS Concentrations (average)	7.2E+04	6.6E-01	7.2E+00	5.8E+02	9.2E-01	NA	2.4E+04	5.4E+01	9.1E+00	2.5E+01	2.6E+04	1.9E+01
	Proposed Maryland Cleanup Standards Residential	7.8E+03	3.1E+00	4.3E-01	1.6E+03	1.6E+01	3.9E+00	NA	2.3E+01	NA	3.1E+02	5.5E+03	4.0E+02

USGS Concentrations as reported by Shacklette, H.T. and Boerngenm, J.G., 1984: Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States; USGS Professional Paper 1270.
Concentrations in Parts Per Million (PPM).

Region		Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
CMBG	Number Samples	28	27	26	28	28	26	27	28	25	28	28
CMBG	Mean	1.8E+03	6.0E+02	8.6E-02	1.2E+01	1.1E+03	7.0E-01	6.2E-01	1.2E+02	7.3E-01	2.6E+01	4.4E+01
CMBG	Std(n-1)	1.8E+03	7.8E+02	5.4E-02	9.7E+00	1.5E+03	3.5E-01	4.2E-01	1.1E+02	7.9E-01	9.1E+00	2.9E+01
CMBG	Min	3.1E+02	2.0E+01	2.0E-02	2.8E+00	1.5E+02	2.5E-01	8.5E-02	1.5E+01	2.4E-01	5.6E+00	7.8E+00
CMBG	Max	8.3E+03	3.4E+03	2.1E-01	4.1E+01	6.9E+03	1.8E+00	1.5E+00	5.0E+02	3.1E+00	4.3E+01	1.1E+02
CMBG	ATC(n-1)	3.7E+03	1.4E+03	1.4E-01	2.2E+01	2.6E+03	1.0E+00	1.0E+00	2.3E+02	1.5E+00	3.5E+01	7.3E+01
	USGS Concentrations (average)	9.0E+03	5.5E+02	9.0E-02	1.9E+01	1.5E+04	3.9E-01	NA	1.2E+04	9.4E+00	8.0E+01	6.0E+01
	Proposed Maryland Cleanup Standards Residential	NA	1.6E+02		1.6E+02	NA	3.9E+01	3.9E+01	NA	5.5E-01	7.8E+00	2.3E+03

Region		Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
EMBG	Number Samples	76	76	73	76	76	66	75	76	74	76	75
EMBG	Mean	7.9E+02	2.2E+02	1.0E-01	7.2E+00	4.1E+02	8.5E-01	5.0E-01	3.1E+02	1.2E+00	2.1E+01	3.2E+01
EMBG	Std(n-1)	6.8E+02	2.6E+02	4.0E-01	5.5E+00	3.1E+02	1.4E+00	4.5E-01	2.1E+02	2.7E+00	9.9E+00	3.1E+01
EMBG	Min	6.3E+01	5.0E+00	2.0E-02	8.6E-01	3.6E+01	8.5E-02	3.0E-02	9.6E+00	1.1E-01	2.5E+00	4.9E+00
EMBG	Max	3.9E+03	1.1E+03	3.5E+00	2.8E+01	1.7E+03	5.0E+00	2.7E+00	9.4E+02	1.0E+01	5.9E+01	2.4E+02
EMBG	ATC(n-1)	1.5E+03	4.8E+02	5.1E-01	1.3E+01	7.2E+02	2.2E+00	9.4E-01	5.2E+02	3.9E+00	3.0E+01	6.3E+01
	USGS Concentrations (average)	9.0E+03	5.5E+02	9.0E-02	1.9E+01	1.5E+04	3.9E-01	NA	1.2E+04	9.4E+00	8.0E+01	6.0E+01
	Proposed Maryland Cleanup Standards Residential	NA	1.6E+02		1.6E+02	NA	3.9E+01	3.9E+01	NA	5.5E-01	7.8E+00	2.3E+03

Region		Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
WMBG	Number Samples	43	50	43	43	50	42	42	42	42	50	50
WMBG	Mean	5.1E+03	8.3E+02	8.2E-02	2.4E+01	4.4E+03	1.9E+00	4.7E+00	9.3E+01	1.3E+00	6.5E+01	6.0E+01
WMBG	Std(n-1)	5.2E+03	6.8E+02	3.3E-02	2.0E+01	9.9E+03	1.9E+00	7.5E+00	2.5E+01	3.2E+00	5.9E+01	4.6E+01
WMBG	Min	9.1E+01	2.3E+01	3.5E-02	7.5E-01	1.1E+02	3.5E-01	9.5E-02	3.8E+01	6.0E-02	4.1E+00	5.5E+00
WMBG	Max	1.4E+04	2.4E+03	1.8E-01	5.8E+01	4.3E+04	9.6E+00	2.1E+01	1.8E+02	1.0E+01	2.4E+02	2.8E+02
WMBG	ATC(n-1)	1.0E+04	1.5E+03	1.2E-01	4.3E+01	1.4E+04	3.9E+00	1.2E+01	1.2E+02	4.6E+00	1.2E+02	1.1E+02
	USGS Concentrations (average)	9.0E+03	5.5E+02	9.0E-02	1.9E+01	1.5E+04	3.9E-01	NA	1.2E+04	9.4E+00	8.0E+01	6.0E+01
	Proposed Maryland Cleanup Standards Residential	NA	1.6E+02		1.6E+02	NA	3.9E+01	3.9E+01	NA	5.5E-01	7.8E+00	2.3E+03

USGS Concentrations as reported by Shacklette, H.T. and Boerngenm, J.G., 1984: Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States; USGS Professional Paper 1270.
Concentrations in Parts Per Million (PPM).

APPENDIX 3

GUIDANCE ON THE CONTENT OF ENVIRONMENTAL INVESTIGATION WORK PLANS AND QUALITY ASSURANCE PROJECT PLANS INCLUDING DATA VERIFICATION AND VALIDATION

Guidance Document on the Content of Environmental Investigation Work Plans and Quality Assurance Project Plans

1.0 APPLICABILITY AND SCOPE

This document serves as guidance for environmental investigation work plans submitted to the Land and Materials Management Administration (LMA) of the Maryland Department of the Environment. This guidance is intended to apply to investigations conducted for the Voluntary Cleanup Program, the Brownfields and Site Assessment Program, and the State Superfund Program, and may also serve as a technical supplement for the Solid Waste Program, Hazardous Waste Program and the Oil Control Program.

2.0 WORK PLAN REQUIREMENTS

The final work plan documents should explicitly describe the objectives of the work to be completed (*Data Quality Objectives Process for Superfund*, EPA 540-R-93-071, 1993), the media to be sampled, the methodology to be used for sample collection, the number and type of samples to be collected, record-keeping for field activities, and plans for the management of investigation derived media and wastes.

The work plan document must include the following:

(A) A site conceptual model which shall include:

(1) the background and purpose for the work to be performed,
(2) a site history including types of hazardous materials used at the site and known releases or disposal,
(3) description of previous site characterization,
(4) description of potential contaminant migration pathways,
(5) previous remedial actions.

(B) A statement of the project/sampling objectives including, requirements on the quality of data to be collected, and background information to provide a historical and scientific perspective for the work to be completed.

(C) A description of the work to be performed and the schedule for implementation that describes in general terms the following, as needed:

(1) media or other materials to be sampled,
(2) sample types and purpose of the sample (e.g., surface soil for metals),
(3) methodology by which samples will be collected (e.g., hand auger, split spoon), which may reference Standard Operating Procedures (SOPs),
(4) number and type of samples to be collected including quality control samples as specified in the QAPP,
(5) sample preservation and packaging,
(6) sample designations and chain of custody requirements,
(7) sample handling and analysis requirements,
(8) site restoration activities (e.g., borehole filling).

(D) Requirements for fieldwork record keeping should include a specific description of the content and style of geologic logs of all borings and well constructions, well construction diagrams, and sample data sheets. (See Attachment A for examples.)

(E) A statement that describes the methods for handling investigation derived media (IDM) that conforms to the Land and Materials Administration (WAS) policy on IDM (Attachment B). IDM are naturally occurring liquids, rocks, and soils that are generated by the activities associated with the described work and should be managed in accordance with WAS policy.

3.0 QUALITY ASSURANCE PROJECT PLAN REQUIREMENTS

The Quality Assurance Project Plan (QAPP) should detail the quality checks and requirements on the collection of all data for the given project. At a minimum, it must include a detailed description of the measurement/data acquisition, assessment/oversight, and data validation and usability processes.

(A) Measurement/Data Acquisition

This part of the QAPP should cover explicitly all aspects of measurement systems design and implementation including, sampling methods, analysis, data handling, and QC measures employed. All of these elements may be included in the QAPP as part of the laboratory methods and/or SOPs. If these requirements are addressed in the laboratory's documentation and credentials it must be cited in this section of the QAPP and provided as an appendix.

The following is a list of measurement/data acquisition elements that must be addressed in the QAPP:

(1) Sampling process design (Experimental Design) describing the type of quality control samples to be taken and protocols to be followed, including:

(a) Field duplicates (not included specifically as laboratory QC samples) should represent 10% of the total number of samples collected

(b) Trip blanks, which are samples of a laboratory reagent water which is placed in the appropriate bottle and accompanies the sample container (cooler) from the time it is shipped to the field to the time it is returned with samples from analysis to monitor contamination, should be no less than 1 per shipping episode.

(c) Rinsate blanks, which are samples of laboratory reagent water poured into the requisite sample container that are treated in the same manner as a field sample (i.e. poured over the sampling equipment after decontamination and collected), should represent no less than 1 sample per sampling episode.

(d) Field split samples, which are aliquots of field samples that the state will use for independent verification of laboratory results, will be at the discretion of the state project manager.

(2) Sampling method requirements describing the equipment and procedures for collection, identification, and preservation of samples (see Attachment C for examples). Methods including QC protocols should be identified by the appropriate regulatory citation and the specific performance requirements should be described).

With respect to laboratory QC samples, the following general protocols shall be required unless it can be demonstrated on a site-specific basis that one or more protocols are not necessary. Such a modification must be approved by MDE prior to initiation of the work.

(a) Method reagent blanks, which are samples of laboratory reagent water processed through the same analytical procedure as the sample, must be prepared and analyzed for each individual procedure every day that a sample is prepared. The method blank must contain less than or equal to three times the method detection limit (MDL) for compounds of interest. If this criterion is not met, then sample processing should be halted and corrective actions taken. All data collected during the out of control period will be reprocessed and reanalyzed.

(b) Fortified method blank spikes, consist of a standard solid matrix fortified with the analytes of interest and used to monitor analyte recovery, should be analyzed with every batch of 20 or fewer samples or as described in the accepted EPA method. Appropriate response actions to various blank levels are described in *USEPA Contract Laboratory Program National Functional Guidelines for Organic/Inorganic Data Review* (EPA 540-R-07-003, 2007/EPA 540/R-04-004, 2004).

(c) Matrix spike samples, which consist of a field sample spiked with the analytes of interest to monitor matrix effects, should be chosen at random and be performed with every batch of 20 or fewer samples for organic analyses or as described in the accepted EPA method. The final spiked concentration of each analyte in the sample should be at least ten times the MDL, or as appropriate. Appropriate response actions are described in *USEPA Contract Laboratory Program National Functional Guidelines for Organic/Inorganic Data Review* (EPA 540-R-07-003, 2007/EPA 540/R-04-004, 2004).

(d) Surrogates are organic compounds that are similar to analytes of interest in chemical composition, but not normally found in environmental samples. These compounds are spiked into all blank, standards, samples, and spiked samples prior to analysis for organic parameters or as described in the accepted EPA method. Surrogate spike recoveries shall fall within the control limits set in accordance with procedures specified in the EPA method.

(3) Sample handling and custody requirements for all samples in the field, laboratory, and during transport. This is to include provisions for preservation, packing, shipment, and storage. Examples of appropriate sample labels, custody forms, and custody logs should be included (Attachment D).

(4) Analytical method requirements should identify the analytical methods, equipment, laboratory duplicates, and extraction procedures. These requirements shall include any specific performance requirements and turnaround needed.

Analytical methods should be identified by number, date, and regulatory citation. Any non-standard methods should comply with the USEPA's "*Guidelines to Establish Modified Analytical Requirements within the Contract Laboratory Program Statements of Work.*"

(5) A description or reference for the procedures and formulas to be used to calculate QC statistics, as well as precision and bias should be included. (See *USEPA Contract Laboratory Program National Functional Guidelines for Organic/Inorganic Data Review* [EPA 540-R-07-003, 2007/EPA 540/R-04-004, 2004])

(6) Instrument/Equipment testing, inspection, and maintenance requirements should describe how inspections and acceptance testing of environmental sampling and measurement systems and their components would be performed and documented and describe how deficiencies will resolved. This section should also address how and when periodic preventative maintenance will occur.

(7) Instrument calibration frequency requirements should identify all tools, gauges, instruments, and other sampling, measuring, and test equipment used for data collection to calibrate. This section should also describe or reference the methodology for calibration checks, including the use of continuing calibration blanks, and describe the maintenance of such calibration records.

(8) Inspection/acceptance requirements for supplies and consumables should clearly state acceptance criteria for things such as sample bottles, calibration gases, reagents, hoses, de-ionized water, and potable water.

(9) Data acquisition requirements for non-direct measurements such as computer databases, programs, literature files and historical databases should be specified. This will include acceptance criteria for the use of this data in the project and discuss any limitations on the use due to uncertainty in its quality.

(10) Data management requirements should describe the project data management scheme, tracing the path of the data from their generation in the laboratory to their formal storage. This section should include a description of the standard record keeping procedures for all data including the mechanism for preventing the loss of data. The laboratory or the PRP may be designated as the ultimate repository for all project related data.

A summary of the record keeping procedures for the field and laboratory work related to the project should be provided. If there is no existing provision for laboratory record keeping the laboratory should conform to the following or submit to MDE an equivalent plan for approval:

(a) Manual records will be maintained, for a period no less than five years (preferably a period lasting the life of the project), in bound laboratory notebooks. Each page of the notebook must be dated, numbered, and signed by the person performing the indicated activities and reviewed, dated, and signed by another staff member (i.e. immediate supervisor). A single diagonal line prior to dating and signing the page will mark incomplete pages. Errors will be corrected by drawing a single line through the incorrect entry, dating and initialing the change.

(b) Electronic data files should be maintained for all current and past activities related to the project on a diskette. All files should be organized within directories and sub-directories that consist of a combination of appropriate project and/or client names.

(c) Project files will be established and maintained by the laboratory project manager (or the PRP) for each project. The project file will contain all correspondence associated with the project. All materials must be dated. Project files should include references to the location of raw analytical data for easy retrieval if necessary.

(d) Notebooks to be maintained include standards preparation log, instrument calibration log, instrument run log, sample preparation log, weighing log, and instrument maintenance log. Copies of all or some of these are to be included in the final data package.

(i) Standards Preparation Log shall be maintained and include the following information, as a minimum, for each sample prepared:

Unique sample ID #
Sample description
ID # of source or starting material
Weight/Volume of starting material
Volume and ID # of dilution solvent used
Final concentration
Date of preparation
Expiration date
Storage conditions and location
Signature of analyst preparing the solution
Initials and date of second level reviewer

(ii) Instrument Calibration Log shall be maintained for each instrument and should include the date, time, and results of each calibration and should be cross referenced with the standards preparation log, which documents the date and batch number (unique sample identification) of standard preparation for the standards used for each calibration. This can be incorporated into the instrument run log where appropriate.

(iii) Instrument Run Log must be maintained for each instrument used to analyze samples for any parameter. The analyst performing the task must complete the run log concurrently with the specific analysis. At a minimum, the following information must be contained in the instrument run log:

Sample number/ID
Preparation date (cross reference with sample preparation log)
Analysis date
Injected volume of analyte (μl or ml)
Total run time
File name

Analyst initials
Comments (i.e., signal intensity, baseline, re-run)
Calibration applied (cross-reference with instrument calibration log)

(iv) Sample Preparation Log (digestion/extraction) will be maintained to record the processing of samples prior to instrumental analyses. The log will include:

Date of processing
Samples processed
QC samples included in the analytical batch
Weights/volumes of sample aliquots
Final volume of extract/digestate
Standards used for spiking
*Note and document any deviations from SOPs

(v) Weighing Log will record the external calibrations of the balance as well as the daily calibrations. The ID for the specific set of weights used for calibration should be included as well as the last calibration date/certificate of the weight set. All sample, spike and other relevant weights should be recorded including ID #, date, and related project/client.

(vi) Instrument Maintenance Log will be required to record maintenance of any kind performed on laboratory instruments. Depending on the number of instruments in the lab, a separate log for each instrument is preferable.

(B) Assessment and Oversight

Assessment and corrective response actions should list and describe the type and frequency of field and laboratory/data assessments to be used in the project, as well as the distribution and context of project status reports. There should also be a description of the corrective response actions for deficiencies and how they are documented. The objectives of corrective action procedures are to ensure that recognized errors in performance of sample and data acquisition leads to effective remedial measures. The actions required to correct an existing condition are to be documented to provide assurance that any data quality deficiencies are recognized in later interpretation and are not recurrent in the course of the project.

The type and frequency of assessments and who will carry them out can be appropriately modified for each project but should include a Management Systems Review (MSR) and a Data Quality Assessment (DQA).

(1) The MSR is used to ensure that sufficient management controls are in place and carried out by the organization to adequately plan, implement, and assess the results of the project. See the *Guidance for the Management Systems Review Process* (EPA QA/G-3).

(2) The DQA involves the application of statistical tools to determine whether the data meet the assumptions that the DQOs and data collection design were developed under and whether the total error in the data is tolerable. See *Guidance for the Data Quality Assessment Process* (EPA QA/G-9).

(C) Data Validation and Usability

The criteria used to review and validate data should be provided. These criteria will be submitted to MDE for review and shall address the following topics:

(1) Data review, validation, and verification requirements that clearly state the criteria used to review and validate (i.e. accept, reject, or quantify) data (see *USEPA Contract Laboratory Program National Functional Guidelines for Organic/Inorganic Data Review* [EPA 540-R-07-003, 2007/EPA 540/R-04-004, 2004]). Any forms or checklists required and any project specific calculations should be included in the QAPP.

(2) Validation and verification methods must be described and precisely define the difference between verification and validation issues and the process to be used for each. This element should also describe who is responsible for data validation, how and by whom any issues will be resolved and how results are conveyed to the data users.

(a) Data Verification must include the following steps (see *Guidance on Environmental Data Verification and Validation* [EPA QA/G-8]):

(i) Compliance: This check ensures that data pass numerical quality control tests, including criteria on precision and accuracy as specified in SOPs and/or the QAPP (i.e., detection limits, bias, precision, representativeness of samples, comparability, completeness).

(ii) Correctness: This check ensures through a mechanical objective check that data collection plans and protocols have been followed and that basic operations and calculations were performed and documented properly.

(iii) Consistency (Comparability): This check ensures that data collection procedures were done in a similar manner for all sites and locations.

(iv) Completeness: This check ensures that a sufficient amount of data and information are present to perform a validation analysis.

(b) Data Validation process (see *Guidance on Environmental Data Verification and Validation* [EPA QA/G-8]):

(i) ensures that the measurement system (field and laboratory) meets the users needs;

(ii) assigns qualifiers to individual data values based on whether the analyte in question is detected and the associated degree of variability, with consideration given to the level of deviation from performance standards;

(iii) assess the relevancy of certain performance criteria used to make decisions on the observed data, given information obtained during the course of the project;

(iv) determine whether the data can proceed to Data Quality Assessment (DQA) and whether the DQOs were generally satisfied.

(3) Data Qualification

All individual analyses must be qualified so that the qualification indicates the degree to which a given value deviated from performance criteria. The preferred data qualifying codes are provided in Attachment E. The use of alternative qualifying codes should be approved by MDE prior to initiation of work.

Examples of data qualifications include:

analyte not detected above method detection limit,
quantity of analyte is approximate due to analysis limitations,
identification of the analyte is tentative,
identification of the analyte is uncertain (with a reason given, such as, interference) and,
quantity of analyte confirmed

Data may also be qualified based on the potential effect of several factors including holding times, sample condition, and QA and QC analysis results.

(4) Review of Performance Criteria

A review of the performance criteria is required to evaluate if they were specified adequately and appropriately with in the QAPP. This review should utilize information not available at the time the performance criteria were established (e.g., analytical errors) and should be performed by a qualified third party.

(5) Qualified Review

A determination by a qualified outside reviewer, unless otherwise specified in the QAPP, should be made as to whether the data are adequate to proceed to DQA.

(6) Reporting the Results of Data Validation

The report of the results of the data validation process should include an assessment of the usability of the test results. The type of assessment, who is responsible for performing the assessment, and how the results will be reported should be identified in the QAPP. Information in the data validation report should be provided in the form of tables or spreadsheets and should include a summary of environmental sample results, a summary of QA and QC results, and a full-verified copy of the raw data.

(a) Items to be included in the summary of environmental sample results include:

client and laboratory identification numbers,
sample matrix,
sample collection date,
sample extraction date,
sample extraction and/or analysis method,
ID of instrument used for analysis,
instrument specifications,
sample weight/volume,
dilution or concentration factor,
analytical results and associated units,
qualifier codes that are applied during verification and validation,
method detection limits or sample quantification units, and
definitions for any laboratory qualifiers used

(b) Items to be included in the summary of QA and QC results include:

sampling and analytical precision (field/laboratory replicates), analytical accuracy (surrogates, laboratory control samples, matrix spike samples, standard reference materials),decontamination and cross-contamination assessment (field, shipping, and method blanks),
method conformance (summary of analytical procedures), and,
a narrative statement that discusses any deviations from the QAPP, including QC failures, and the impact of those failures on the data.

SOIL AND SEDIMENT
SAMPLING DATA SHEET

HIGH CONCENTRATION EXPECTED? _____ HIGH HAZARD? _____

INSTALLATION/SITE _____ AREA _____
INST CODE _____ FILE NAME _____
SITE TYPE _____ SITE ID _____
FIELD SAMPLE NUMBER _____
DATE (MM/DD/YY) ____/____/____ TIME _____ AM PM SAMPLE PROG. _____
DEPTH (TOP) _____ DEPTH INTERVAL _____ UNIT _____
SAMPLING METHOD:
SPLIT SPOON _____ AUGER _____ SHELBY TUBE _____ SCOOP _____ OTHER _____

CHK	ANALYSIS	SAMPLE CONTAINER	NO.	REMARKS

TOTAL NUMBER OF CONTAINERS FOR SAMPLE _____

DESCRIPTION OF SITE AND SAMPLE CONDITIONS

SITE DESCRIPTION: _____

SAMPLE FORM _____ COLOR _____ ODOR _____
PID (HNu) _____ UNUSUAL FEATURES _____

WEATHER/TEMPERATURE _____
SAMPLER(S) _____

SOIL BORING LOG
Aberdeen Proving Ground

Page ___ of ___

Project: _____ Boring Identification: _____

Location: _____ Date Started: _____ Date Completed: _____

Total Depth Drilled: _____ Facility Coordinates

Land Surface Elevation: _____ North: _____ East: _____

Engineer/Geologist: _____ of Foster Wheeler Enviresponse, Inc..

Driller(s): _____ of _____

Drilling Rig/Method: _____ Drilling Fluid: _____

Auger or Bit Diameter: _____ Other/Comments: _____

Sampling Devices: _____

Depth In Feet	Soil Sample NO.	SD.	REC.	Lithologic Description	LOG	USCS	Blows per Foot or TSF	PID (ppm)	Remarks or Observations

NO. Sample Identification Number
SD. Sampling Device (See Below)
REC. Length of recovered Sample (ft or %)
USCS Unified Soil Classification System
PID Photoionization Detection Reading (highest ppm @ sample surface)
▼ Obse
TD Total Depth

Split Spoon or Core Barrel Sampler

Thin Walled Tube Sampler

Auger

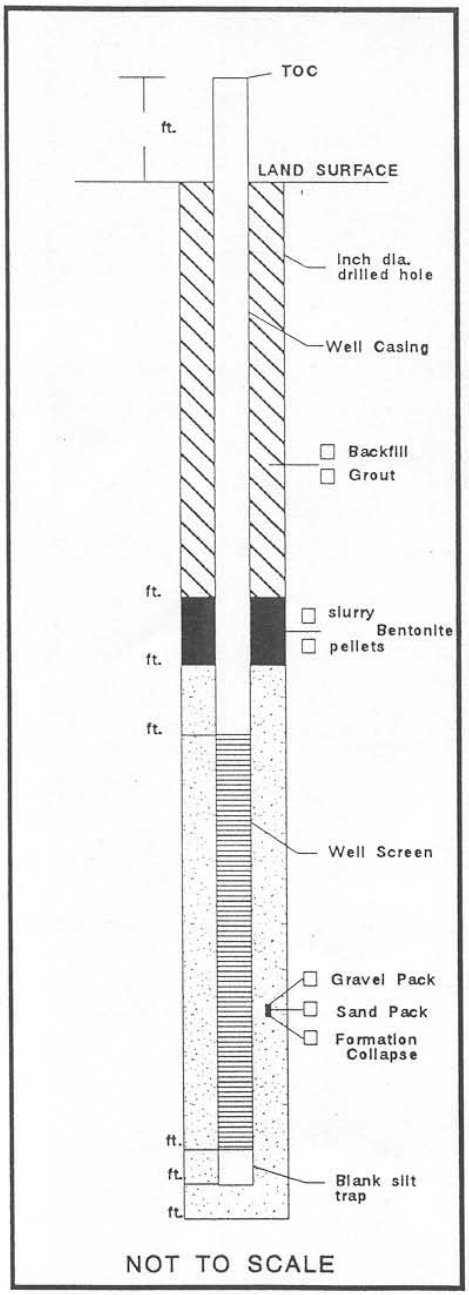
No Sample

Graphic Log Legend

- Clay (CL,CH)
- Silty Clay (CL)
- Sandy Clay (ML)
- Silt (ML)
- Sandy Silt (ML)
- Clayey Silt (MH)
- Peat (OL,OH)
- Sand (SW,SP)
- Silty Sand (SM)
- Clayey Sand (SC)
- Gravel (GW,GP)
- Fill/Debris
- Waste

Comments

WELL CONSTRUCTION LOG
Aberdeen Proving Ground



Project: Well:

Location:

County: State:

Permit No.:

Land-Surface Elevation and Datum surveyed

feet AMSL estimated

Installation Date(s):

Drilling Method:

Drilling Contractor:

Drilling Fluid:

Fluid Loss During Drilling: gallons

Development Technique(s) and Date(s)

Water Removed During Development: gallons

Static Depth to Water: feet below TOC

Pumping Depth to Water: feet below TOC

Pumping Duration: hours

Yield: gpm Date:

Specific Capacity: gpm/ft

Well Purpose:

Remarks:

Prepared By:_____

APPENDIX 3 – ATTACHMENT 2

IDM Comment

Investigatory derived media (IDM) describes the groundwater, surface water, soils and sediments that are collected during field activities to support the remedial investigation / feasibility study (RI/FS). Specifically, IDM may include development and purge water from monitoring wells, drill cuttings, and extra soils removed during sample collections. To evaluate whether the IDM must be managed as hazardous waste, the preliminary inquiry is whether the IDM is a solid waste, as defined in Maryland's Environment Article, § 7-201(t) and COMAR 26.13.02.02. Basically, uncontaminated IDM need not be considered a solid waste, as long as that IDM: 1) will not be abandoned in an environmentally unsound manner; and 2) is not inherently waste-like.

There must be some initial evaluation as to whether the IDM is contaminated or inherently waste-like. As guidance, IDM must be handled as a solid waste when:

1) It is visually or grossly contaminated;
2) It has activated any field monitoring device indicating the presence of volatile organic compounds (VOC) or metals;
3) On previous monitoring/sampling activity, it has exhibited levels of contamination above accepted environmental quality standards;
4) Based on historical information, the responsible party or the regulatory agency believes it warrants caution or additional testing.

IDM with contamination should be viewed as inherently waste-like unless or until the media is no longer contaminated, or is treated or recycled. As with any solid waste, the generator must perform a hazardous waste determination. If the waste is a hazardous waste, then it must be disposed of through an appropriate hazardous waste disposal facility. If the waste is not a hazardous waste, then that IDM may be disposed of through any permitted or authorized waste management facility willing to accept the waste, or recycled or reused in a manner permissible under the law.

Naturally occurring media which does not exhibit any of the characteristics or concerns described above need not be managed as a waste, particularly if the material will be returned to a suitable location on the facility. Unless otherwise specified, the handling or disposition of this material must be performed in such a manner, so that potential impacts to the environment are avoided. The facility must comply with all pertinent sediment and erosion control regulations. Also, seeding and the judicious discharge of non-contaminated water to ensure infiltration will be considered the minimum steps necessary to ensure non-degradation of the environment.