



Maryland Department Of The Environment Voluntary Cleanup Program

Section Three Environmental Site Assessments

This section presents standards, principles, and technical considerations for environmental site assessments at properties applying for participation in the VCP.

3.1 ENVIRONMENTAL SITE ASSESSMENT REQUIREMENTS UPON APPLICATION

Generally, a two-phase environmental assessment is required for each property participating in the VCP. The first phase, typically called Phase I, of the assessment consists of a site reconnaissance, a review of historical records pertaining to the subject property and adjacent properties, interviews with property owners and operators, and a review of State and federal regulatory databases in an effort to identify possible environmental concerns such as buried tanks, chemical use and disposal, and environmentally-sensitive land uses (see Attachment 1, VCP Checklist). The second phase, typically called Phase II, of the assessment is a field investigation and sampling program designed to confirm or deny the presence of contamination due to the environmental concerns identified by the Phase I research and site visit. Results of the environmental site assessment must be presented as a written report submitted as part of the applicant's VCP application package.

In accordance with Section 7-506(c) of the Environment Article, the applicant may delay submitting the Phase II assessment until after the application, including a Phase I site assessment, and applicable fees are submitted. In addition, the applicant may submit a Phase II work plan with the application for MDE's review and approval. If the applicant delays submitting the Phase II site assessment, all related deadlines for public notice and action by the Department will be extended accordingly to conform to the submittal date of the completed Phase II assessment.

Pursuant to Section 7-506(a)(1) of the Environment Article, a Phase II assessment may not be necessary if the Department concludes, based on a review of the Phase I, any public comments, and other available information, that there are no recognized environmental conditions as defined by the ASTM.

VCP site assessments must follow site assessment standards and principles established by the ASTM, specifically ASTM Standards E1527-00 and E1903-97 (reauthorized 2002). The primary objectives of conducting a Phase II ESA are to evaluate the recognized environmental conditions identified in the Phase I ESA or transaction screen process for the purpose of providing sufficient information regarding the nature and extent of contamination to assist in making informed business decisions about the property; and where applicable, providing the level of knowledge necessary to satisfy the innocent purchaser defense under CERCLA. The ASTM guidance notes that achieving these objectives may require the performance of more than a single iteration of assessment. The intent of ASTM guidance is to foster an iterative approach to Phase II

assessments and allows the user to terminate the Phase II ESA at the point where sufficient data have been generated to meet the user's objectives.

The ASTM assessment principles provide a solid assessment framework in the context of the stated objectives discussed above. However, the ASTM assessment principles are intended on assessing recognized environmental conditions. E1903-97 clearly acknowledges that it is not intended to satisfy the level of inquiry that may be necessary to support remedial solutions for a site. For that reason, the VCP may require the applicant to provide additional environmental assessment data to demonstrate that the proposed future land use is not impacted by the environmental conditions at the site.

For the purposes of the VCP, data from environmental site assessments should be no more than one year old. Although older reports may be useful, the Phase I and II site assessments must be updated to account for changes at the property since the date of the older reports and must include sampling data that is no more than one year old.

During the Phase II and subsequent investigations, the applicant must still adhere to regulations and reporting requirements related to oil contamination. If during the course of the initial site assessment, there are indications of petroleum saturated soil or free phase product in monitoring pipes or wells, this information must be reported to the OCP (COMAR 26.10.08.01) whether or not the property will be submitted to the VCP.

3.2 ESSENTIAL COMPONENTS OF VCP APPLICATION PACKAGES

The VCP Application Checklist (see Attachment 1) summarizes the essential components of environmental site assessments that must be submitted for potential VCP properties. The following items are presented as a supplement to the application checklist. Including this information in an application package will help minimize the need for document revisions, additional submissions, and field remobilizations.

A. Current Property Conditions: The environmental site assessment must describe the property conditions at the time of application and summarize any changes that have occurred at the property since the most recent Phase I site assessment. Photographs, site drawings, or other figures may be helpful to accurately describe the current property conditions.

B. Current and Past Uses of the Property: The environmental site assessments must provide the current zoning of the property, as well as a complete list of the entities that have owned or occupied, including tenants, the property from the time of first agricultural, commercial, or industrial use or since 1940, whichever date is earlier. The assessment should clearly identify the standard and supplementary historical sources used to determine the history of the property. An abstract of a property title search should be provided that covers records of ownership, leases, land contracts, easements, liens, and other encumbrances on the property. The name and type of each current or historical business should be identified along with years of occupancy and a description of the on-site operations. If a business was likely to have stored or handled CHS or petroleum products, the site assessment should include the storage and handling procedures and methods that business followed. The potential for environmental impact from these procedures should also be discussed.

C. Historical Maps and Aerial Photographs: The site assessment should provide legible copies of all available historical maps, aerial photographs, property tax files, United States Geological Survey 7.5 minute topographic maps, building department records, fire insurance maps, recorded land title records, local street directories, zoning and land use records, records on file and other historical sources, such as newspaper archives or interviews. The approximate boundaries of the property must be indicated on each historical map and aerial photograph provided to MDE.

D. Summary Review of Historical Site Plans and Interviews: The site assessment should summarize the review of historical site plans and interviews with individuals having knowledge of the past uses of the property. The assessment should identify historic on-site work areas, process areas, manufacturing operations, chemical and hazardous waste handling activities, aboveground and underground storage tanks, and spills or releases that may have resulted in environmental contamination at the property.

E. Property Investigations: Any previous environmental investigations at the property should be summarized chronologically in the most recent report submitted as part of the VCP application. The application should also include one copy of each previous environmental investigation, including but not limited to site assessments, subsurface investigations, and groundwater sampling reports. Applicable analytical data reports and quality assurance and quality control documentation should also be included. Duplicate copies of reports are not necessary for multiple applications filed for contiguous properties or for multiple applicants for the same property, although MDE reserves the right to request duplicate copies to expedite the application review.

The site assessment should include a discussion of any federal and State environmental records and any other available environmental records. Files at MDE may include permits, regulatory compliance history, violations, administrative orders, consent orders, and correspondence. To obtain information from MDE about a specific site, please submit a Public Information Act request to Joane Mueller, PIA Coordinator, Maryland Department of the Environment, 1800 Washington Boulevard, Baltimore, Maryland 21230, telephone 410-537-4120 or fax 410 537-3998. Additional information about PIA requests can be obtained from the MDE website at <http://www.mde.state.md.us>.

F. Current and Past Uses of Adjoining Properties: The site assessment should include a summary of the historical and current uses of all adjacent properties.

G. Property Hydrology: The site assessment should describe the property's topography, surface drainage pathways, including man-made channels and drains, and receiving surface water bodies, such as wetlands, seeps, streams, rivers, lakes, and ponds. Local surface water use for potable, recreational, irrigation, or commercial purposes should also be discussed.

H. Property Hydrogeology: The site assessment should describe the property's soil conditions, fill materials, geology, depth to groundwater, groundwater flow direction, and potential subsurface contaminant migration pathways. Regional geologic and hydrogeologic conditions should also be discussed.

I. Scaled Site Plan: The site assessment should include a scaled site plan that clearly shows the legal boundaries and acreage of the property and the locations of all existing buildings, paved areas, monitoring wells, tanks, surface water bodies, rail spurs, and other structures.

J. Site Plan with Utilities: The site assessment should include a site plan showing the approximate location and depth of each water, sanitary, storm sewer, and natural gas pipeline currently on the property, as well as service providers for each utility.

K. Tax Parcel Map: The site assessment should include a current tax parcel map that clearly defines the property boundaries. If multiple parcels are included in the VCP application, please ensure that the tax map shows each parcel. Tax parcel maps can be obtained from local county agencies and via the Internet using the Real Property Data search at the website for Maryland Department of Assessment and Taxation (<http://www.dat.state.md.us>).

L. Surface Drainage Description and Site Plan: The site assessment should include a written description of the surface drainage system at the property as well as a site plan that identifies the location of each swale, trench, culvert, catch basin, sewer, drainage pathway, interior drain, and sump on the property. The written description should describe the nature and source of historic and current runoff or releases to each identified feature. The point of discharge, such as a drain field, a named or unnamed surface water body, or municipal sanitary sewer, should be described for each identified feature.

M. Groundwater Use Investigation: The site assessment should include written documentation from the state, county, municipality, and any other water authorities concerning existing potable wells, the availability of municipal water, and potential future groundwater use areas within one-half mile of the property boundary. The documentation should include a copy of the county and municipality water plan maps that depict existing service areas, planned service areas, and no-service-planned areas within a minimum of one-half mile radius of the property boundary.

It is necessary to contact state and local government departments directly because commercial information search services do not include sufficient information on municipal or domestic wells. The MDE Water Supply Program (410-537-3702) and Water Rights Division (410-537-3714) should be contacted to obtain a survey for all area wells and other available information pertaining to groundwater use in the vicinity of the proposed property.

The site assessment should include a scale map with all of the identified wells, excluding test or observation wells. If available, the permit number, screen depth, and current use of each well should be provided. If exact well addresses are unavailable, delineate likely groundwater use areas based on reported street names, subdivision names, and other information available in the well survey and other sources.

N. Groundwater Contour Plan: The site assessment should include a groundwater contour plan for the site that is less than one year old.

O. Future Development Plans: The application package should include information regarding the anticipated future use of the property and any development plans, such as planned future construction or landscaping or any changes in current business operations. Examples of proposed

alterations to the property include grade changes, demolition of buildings, construction of new structures or additions, extensions of public water or sewer, and installation of storm water management systems. The applicant also should include a schedule for all site development activities, if available.

P. Property Reconnaissance: The application package should describe the methodology, limitations, and findings of the property reconnaissance, and discuss the interior and exterior conditions observed at the property and exterior conditions observed on the adjoining properties. The report should also discuss any limiting site conditions that could affect the results of the reconnaissance such as snow cover, thick vegetation, locked buildings, or areas that are unsafe to enter.

Q. Required Oil Information: Applicants applying to the VCP with properties with active or abandoned USTs and/or ASTs should provide the following site information with the VCP application (refer to Item O in the application checklist):

- Facility Identification number;
- Number of registered tanks (provide a copy of the registration form, if available);
- Indicate the number of active and abandoned tanks and provide a scaled site map showing the location and/or former location of all tanks (above and below ground), piping, dispensing units and tank field monitoring pipes;
- Describe the date the tank was installed/removed/abandoned;
- For each tank describe the capacity and material stored in each tank; and
- Describe if the property has any open or closed OCP cases and provide the case numbers.

a) Active Underground Storage Systems

For sites with USTs currently in use (motor fuels, heating oil, waste oil and emergency generator tanks) also provide the following:

- Date of last system tightness test.
- Date of last compliance inspection by OCP.
- If required, describe how the facility meets the financial responsibility provision of COMAR 26.10.11.01.
- Describe the release detection methods in place at the site. If an electronic tank gauging system is used, describe the manufacturer, model number and functions programmed into the unit on site.
- Describe the method used for inventory reconciliation.
- Describe if an impressed current system is in use on any tank present at the property.
- Describe if any tank has had a change in service, i.e. #6 fuel oil converted to #2 fuel oil.
- Describe if an oil/water separator tank is present and indicate the location on a site map; Describe influent into the separator tank, i.e. floor drains or parking lot runoff.
- Describe the composition of the piping system(s), i.e. fiberglass, copper, etc.
- If applicable, describe previous releases from the system and repairs or remedial actions taken to address the release.
- If a release occurred, describe if off-site impacts have been evaluated for the site.

b) Abandoned USTs

For sites with previously abandoned tanks provide the following:

- For each tank describe the method of abandonment (removal, filled in place, etc.);
- Describe site assessment activities associated with tank abandonment; and
- Provide copies of all site assessments, laboratory sampling, etc.

c) Aboveground Tanks

For sites with ASTs (total storage capacity 10,000 gallons and above)

- Provide the Oil Operations Permit Number; and
- Indicate permit expiration date.

d) Sites with Active Remediation Systems

Sites with operational remediation systems (pump and treat, soil venting, etc.), as required under an active enforcement action by the OCP, may apply to the VCP, if the applicant meets the definition of an inculpable person. The applicant should include all relevant information on active remediation systems with the VCP application:

- Brief description of system-technologies used;
- Date system operation began;
- Any changes made to the system since operations began (additional extraction points brought on-line, iron treatment installed, chemical oxidant or biological stimulants injected into wells, etc.);
- Summary of removal effectiveness since operations began (i.e. the volume of soil vapor removed, pumped volume of water, influent levels dropped x % plume has receded, etc.);
- Permits obtained for system operation (discharge, air, etc.);
- Site map showing the location of the system and extraction points, monitoring points, etc.;
- Sampling frequency for system and/or monitoring wells;
- Tabulated summary of previous sampling data; and
- Anticipated cleanup standards.

The VCP will evaluate the application, but may not issue the final sign-off until the OCP indicates the enforcement requirements have been met (i.e. the system has been shut-off after achieving the cleanup goals and the site undergone the necessary post-shut off monitoring period). The applicant should also be aware that the VCP may require institutional or engineering controls or a RAP, if contamination levels in the soil or groundwater at the site exceeds the acceptable levels of risk for the requested land usage.

e) Compliance Inspection

All sites with active oil storage and/or dispensing systems, including heating oil, will be inspected for compliance with COMAR 26.10.03 through 26.10.05 by an OCP regional inspector and the VCP project manager. The applicant will be contacted to set up a mutually convenient date and time for the inspection. All records required under COMAR 26.10.05 should be available on-site at the time of inspection. VCP cannot complete review of the application until all active store systems, including heating and waste oil, are in compliance.

A fact sheet with a brief summary of pertinent compliance issues is provided in Appendix B.

For additional information on tank registration and compliance requirements please visit the MDE website at:

www.mde.state.md.us/Programs/LandPrograms/Oil_Control/index.asp

f) Tank Removal

If an existing or previously abandoned tank(s) will be removed from a property that has applied to the VCP, then the tank removal will occur under the supervision of an OCP regional inspector. The tank removal must comply with the provisions of COMAR 26.10.10.02, which includes at a minimum:

- A certified remover must remove the tank;
- All liquid and sludges must be removed from the tank;
- All aboveground portions of vent lines shall be removed and the remaining lines capped at their bases;
- The tank shall be purged of all explosive vapors and monitored with an appropriate meter for vapors before and during removal;
- Tanks shall be disposed of at a location acceptable to MDE (disposal receipts submitted to the VCP project manager); and
- An updated registration form must be submitted to the OCP.

To obtain a list of certified removers and/or copies of registration forms contact OCP at 410-537-3442.

After the tank removal operation has been completed, any additional site assessment and on-site remediation required can be completed within the auspices of the VCP.

3.3 SOIL SAMPLING TECHNICAL CONSIDERATIONS

Generally, samples must be collected and analyzed for any potential contaminants identified in the Phase I site assessment based on historical operations at the property. Environmental sampling may be necessary for VOCs; SVOCs including PAHs; priority pollutant metals; oil; and any other contaminants that may be present at the site based on the results of environmental assessments and on-site observations. For example, limited sampling for pesticide, herbicides, and PCBs may be required for portions of the property if past activities or operations may have involved the use of these substances. For instance, PCBs would be added to the list of analytes

for samples collected in the vicinity of a former transformer storage pad. See Section 3.9 for a list of preferred analytical methods.

Properties at which historical operations are uncertain or the types and locations of activities have changed over time will require more extensive soil sampling and a more diverse set of analytical parameters for characterization.

Sample Depths: Surface (0-1') and subsurface (4-5') grab samples are generally required at each sample location for site characterization and risk evaluation purposes. Surface soil samples should only be analyzed for VOCs if there is visual or historical evidence that makes the presence of VOCs in the surface soil likely (i.e. outside the rear door of dry cleaning facility or beneath areas of staining). Deeper soil samples may be required in some areas depending on historical operations or the presence of certain features, such as underground storage tanks.

VOC Sample Collection: SW 846 Method 5035A is a closed system purge and trap collection method suggested for VOC analysis of soil samples collected at VCP projects. This method incorporates chemical preservatives and sample storage techniques to limit volatilization and biodegradation of organic compounds. The samples must be received and preserved by the laboratory within 48 hours. Please refer to the guidance document published by U.S. EPA Region III, "Field Samplers' Guide to the Collection and Handling of Soil Samples for Volatile Organic Analysis Using SW-846 Method 5035A", May 15, 2003, (http://www.epa.gov/region3/esc/QA/5035_Fact_Sheet_Final.pdf).

Chromium Analyses in Soils: If total chromium is detected in soil samples at levels exceeding the MDE cleanup standard relevant to the future use designation of the property, soil samples must be collected and speciated for Cr(VI) and Cr(III). If total chromium concentrations reported to MDE are not speciated for Cr(VI) and Cr(III), MDE will assume that the chromium concentrations reported are Cr(VI), which is the more toxic form of chromium and has lower cleanup standards than trivalent chromium.

Mercury Analyses in Soils: If mercury is detected in soil samples at levels exceeding the MDE cleanup standard relevant to the future use designation of the property, at least two samples (those with the highest mercury concentrations) must be differentiated for inorganic/elemental mercury. If total mercury concentrations are not differentiated, MDE will evaluate the reported mercury as both elemental mercury and organic mercury.

USTs: At sites where petroleum contamination is anticipated due to the presence of USTs and/or piping, a minimum of three soil borings should extend from the ground surface to the first unconfined saturated zone. The borings should be continuously cored or split spooned to accurately determine lithology and detect contamination.

3.4 GROUNDWATER SAMPLING TECHNICAL CONSIDERATIONS

Generally, groundwater samples are necessary as part of Phase II site assessments to evaluate impacts to groundwater. Groundwater samples should be taken in locations most likely to have been contaminated by past and present operations on the property. Samples must be analyzed for any potential contaminants identified in the Phase I site assessment based on current and

historical operations at the property. Analysis for a broader range of parameters will be necessary at sites with an uncertain or varying operational history.

Groundwater Sample Locations and Depths: A sufficient number of groundwater samples are necessary to evaluate impacts to groundwater in the vicinity of source areas or areas of potential concern. More extensive groundwater sampling will be necessary at properties located in groundwater use areas, including more complete plume delineation. This may include downgradient samples near the property boundary as well as upgradient samples. Considering the nature of the known or suspected contamination, groundwater samples must be collected at appropriate depths to delineate the vertical extent of contamination. Groundwater samples may also be necessary to evaluate the impact from off-site sources, such as gasoline stations.

Prior to sampling any monitoring well, or direct push borehole, the sampler should verify that floating free phase product is not present by use of a clean, clear bailer or a factory-calibrated interface probe. Monitoring wells should be purged of at least three well volumes prior to sampling. All purge water must be properly containerized and characterized to determine appropriate disposal method.

If measurable (0.01 feet) free phase petroleum product is present in a monitoring well, the groundwater should not be sampled for volatile or semi-volatile organics. Product samples may be collected for characterization of the petroleum type.

Groundwater Elevation and Flow Direction: Groundwater flow direction is necessary to evaluate potential impacts of contaminated groundwater on nearby receptors, such as drinking water wells, surface water bodies, or nearby homes and buildings via vapor intrusion. For this reason, monitoring wells, including small-diameter temporary wells or piezometers, must be surveyed to allow for the measurement of groundwater elevation. If free product is present, the water table elevation must be corrected for the differences in density.

Direct-push technology using exposed screens or well points to collect groundwater samples is not appropriate for determining groundwater elevation. Although this method may be useful for characterizing groundwater contamination and determining the horizontal and vertical extent of contamination, more permanent monitoring wells or piezometers will be required under most circumstances to evaluate groundwater flow direction.

Off-Site Plume Delineation: Off-site groundwater sampling is sometimes necessary at properties located in groundwater use areas if the contaminant plume is suspected to be migrating off site in the direction of drinking water wells. Applicants may be requested to seek permission to install and sample off-site monitoring wells on adjacent properties or in right-of-ways. Since the VCP authority does not extend to off-site issues, MDE encourages applicants to work closely with the OCP or CHS Enforcement /Fund Lead Site Assessment Division.

Monitoring Wells, Piezometers, and Direct-Push Technology: Multiple technologies may be used to obtain groundwater samples, including monitoring wells, piezometers, direct push technologies, and multi-level groundwater sampling devices. The technology should be selected based on the objectives of the site investigation. As indicated in the paragraph above, direct-push technology using exposed screens or well points to collect groundwater samples is acceptable for

initial characterization and detailed plume delineation, but not necessarily acceptable for determining groundwater gradients.

Sites potentially contaminated with petroleum products and CHS may require multilevel samplers or nested monitoring wells to accurately determine the presence of free phase light nonaqueous phase liquid or dense nonaqueous phase liquid. All monitoring wells must be installed in a manner that prevents downward migration of contamination into lower water bearing units. Wells should not be completed below confining layers without prior approval of the installation and construction methodology.

Wells or piezometers less than two inches in diameter are acceptable at VCP properties. If free product recovery is required, 4-inch, inner diameter or larger wells may be necessary. If you have any questions about acceptable well construction designs at VCP projects, please contact a VCP project manager at 410-537-3493.

Monitoring wells installed using hollow-stem augers must be developed and allowed to equilibrate for 7 to 10 days prior to sampling and measuring static water levels.

Small-diameter wells or piezometers installed using direct-push technologies must be allowed to equilibrate for at least 24 hours prior to gauging or sampling.

Copies of well logs, well installation reports and boring logs must be provided in the Phase II site assessment report. All wells must be installed by a Maryland licensed well driller, with proper permits obtained from the county or municipality in which the field investigation is conducted.

Potable Well Sampling: Drinking water well sampling may be necessary if the Department determines that site conditions pose a threat to downgradient potable wells.

Filtered Samples for Priority Pollutant Metals: Groundwater samples for metals analyses must be filtered prior to preservation because MCLs and water quality criteria are based on metals in solution (dissolved concentrations) rather than in suspension (total concentrations). However, for some sites, unfiltered groundwater samples may be required for comparison purposes or to evaluate the potential risk from dermal contact under a construction worker scenario.

3.5 SURFACE WATER AND SEDIMENT SAMPLING TECHNICAL CONSIDERATIONS

Surface water and sediment samples generally must be collected on the property and from adjacent drainage ditches, outfalls, intermittent streams, or other areas that receive significant amounts of runoff from the VCP property.

3.6 SOIL GAS AND INDOOR AIR SAMPLING TECHNICAL CONSIDERATIONS

The presence of volatile contaminants in the soil and groundwater may affect the quality of indoor air, and the inhalation pathway is evaluated to determine if volatile compounds, other than radon gas, can potentially migrate from the soil or groundwater into an existing or future building. To evaluate the potential for vapor intrusion, a comprehensive characterization of foundation air must be performed, which may include sampling of the groundwater, soil, soil gas, and indoor air. Typically, this characterization is performed in a systematic manner utilizing

the U.S. EPA Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (<http://www.epa.gov/correctiveaction/eis/vapor.htm>).

This guidance recommends using the Johnson & Ettinger model to evaluate the potential for vapor intrusion. It is a screening level model that incorporates both convective and diffusive mechanisms for estimating the transport of contaminant vapors emanating from subsurface soils or groundwater into indoor spaces. Inputs to the model are inherently conservative and include parameters such as chemical properties of the contaminants detected in the subsurface, soil type, depth to groundwater, and depth from receptor.

Evaluation of the vapor intrusion pathway may require that certain compounds, such as total mercury, be differentiated to determine their presence in the subsurface. Failure to differentiate may require MDE to evaluate risk using more conservative assumptions.

When evaluating the vapor intrusion pathway for the VCP, the most recent version of the Johnson & Ettinger model should be used. Prior to rendering any decision on a property, MDE reserves the right to review the Johnson & Ettinger results.

Indoor air models such as the Johnson & Ettinger model are valuable screening tools for estimating the human health risks for the migration of volatile compounds from soil and groundwater into an indoor air space. If the results of the screening process and modeling indicate a potential risk, the model must be verified to ascertain whether an inhalation risk actually exists at a property. MDE recommends a systematic approach that may require soil gas sampling from beneath a building foundation and indoor air sampling to validate indoor air model results.

Sub-slab Soil Gas Sampling: To confirm the results of the Johnson & Ettinger model, MDE requires that sub-slab soil gas samples be collected beneath existing buildings, including possibly impacted tenant spaces.

MDE recommends the protocols for collection of soil gas samples conveyed in the U.S. EPA Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway (Groundwater and Soils - 2002). In addition, MDE recommends the protocols for analysis of sub-slab soil gas and indoor air samples conveyed in the U.S. EPA Methods TO14, TO15, TO17, or equivalent. U.S. EPA Method 8260 may also be used depending on what detection limit is necessary to meet data requirements. At a minimum, samples should be collected in accordance with the following requirements:

- Samples should be collected between three and five feet in depth or from the layer of highest permeability;
- Sample locations should be collected beneath the building and at least several feet from the edge of the building (angled boring may be used if sub-slab sampling cannot be performed);
- To ensure that representative samples are collected, sampling periods should be greater than eight hours for commercial properties and twenty-four hours for residential properties. The sampling frequency and period should be sufficient to minimize the effects of breakthrough of ambient air into the vapor sample and changes in barometric pressure and temperature;
- At least one duplicate sample should be collected;

- The hole in the slab should be plugged immediately following initiation of sample collection with non-VOC pliable caulk or equivalent; and
- Other soil should not be disturbed.

Results reported to MDE should include the following:

- A narrative summary describing the area sampled, slab condition, sampling period, sample depth, methods used, and soil type encountered;
- Figures and photographs adequately documenting the location of the sample and condition of the slab;
- Results for all detected analytes in units of $\mu\text{g}/\text{m}^3$; and
- Copies of the laboratory analytical data sheets with minimum detection limits and practical quantitation limits.

After the results have been received, MDE will review the sub-slab soil gas data to determine whether there is a potential risk based on the specific site characteristics. Comparison to the Occupational Safety and Health Administration Permissible Exposure Limits and Threshold Exposure Limits are not acceptable. If a risk is identified, MDE will require further investigation of the exposure pathway by indoor air sampling or remediation to remove the risk.

Indoor Air Sampling: To evaluate the indoor air exposure pathway when the screening process or sub-slab sample data have identified a potential risk, MDE requires collection of indoor air samples in existing buildings or tenant spaces that may be impacted. The sampling protocol for indoor air should meet the following requirements:

- The sampling apparatus should be located in the area likely to have the highest concentrations;
- A background ambient air sample should be collected;
- A duplicate sample should be collected for each area sampled;
- If possible, the area should be closed for at least 12 to 24 hours before the sampling period begins and the use of pressure difference causing devices (e.g. clothes dryers, exhaust fans, and Heating Ventilation Air Conditioning systems) should be suspended during this time and during the sampling; and
- The sampling apparatus should be set two (2) to five (5) feet above floor level.

MDE endorses the protocols for collection of indoor air samples conveyed in the U.S. EPA Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (2002).

If the screening process identifies a potential human health risk in an active dry cleaner facility, samples do not need to be collected from the active facility but should be collected from the adjoining tenant spaces as long as the facility is active.

Results reported to MDE should include the following:

- A narrative description of the area investigated, sampling results and methods used, including a detailed list of all possible interior sources of contamination that may have affected the results;
- A detailed drawing of the building including all indoor partitions, doors, windows and other sources of outdoor air including, but not limited to exhaust fans, plumbing vents, and HVAC supply and return vents. The drawing should also include the location of samples collected and all interior sources of contamination (i.e. storage closets of cleaning products);
- A summary of all detected analytes; and
- Copies of the laboratory analytical data sheets with minimum detection limits and practical quantitation limits.

Once the results are received, MDE will review the indoor air data to determine whether there is a potential risk based on the specific site characteristics. Comparison to the OSHA PEL and TEL are not acceptable unless the facility or specific tenant space is operating and utilizes the identified chemical(s) of concern in their business operations. If a potential risk is identified, MDE will require remediation to address the risk.

3.7 INVESTIGATION DERIVED MEDIA (IDM)

IDM describes the groundwater, surface water, soils and sediments that are generated during an environmental site assessment. Specifically, IDM may include development and purge water from monitoring wells, drill cuttings, and soils removed during sample collection. IDM generated during a sampling event must be properly containerized and characterized prior to determining the appropriate disposal method.

To evaluate whether the IDM must be managed as a hazardous waste, the generator must first determine whether the IDM is a solid waste as defined in Section 7-201(t) of the Environment Article, Annotated Code of Maryland, and COMAR 26.13.02.02.

Oil-contaminated media: IDM contaminated with oil may be handled with guidance from the MDE OCP (410-537-3442).

Initial Evaluation: At a minimum, IDM must be screened to determine if it is contaminated or inherently waste-like. IDM must be handled as a solid waste when:

- It is visually or grossly contaminated;
- It has activated any field monitoring device indicating the presence of VOCs, metals, or other contaminants;
- In previous monitoring or sampling activities, it has exhibited levels of contamination above accepted environmental quality standards; or
- Based on historical information, the responsible party or the regulatory agency believes it warrants caution or additional testing.

If the appropriate analytical testing determines that the waste is hazardous, then it must be disposed at an appropriate hazardous waste disposal facility. If the waste is not hazardous, then the IDM may be disposed at an appropriate permitted waste management facility.

Naturally-occurring media and media with contaminant concentrations less than the appropriate comparison values (e.g. MDE soil and groundwater standards) need not be managed as a waste. If the appropriate analytical testing determines that purge water has no apparent contamination, it may be released to the ground surface after obtaining MDE approval.

3.8 WELL ABANDONMENT

Any boreholes, including direct push locations, that intercept the water table for groundwater monitoring purposes are considered to be wells and must be abandoned according to the State of Maryland well abandonment standards (COMAR 26.04.04.11). VCP participants should petition MDE for approval to abandon existing monitoring wells.

3.9 ACCEPTABLE ANALYTICAL METHODS

Typical Sampling Analyses	Media	Method Reference	Typical Analytical Methods (Current EPA Promulgation)
VOCs	Solid	EPA SW-846	EPA Method 8260B (Rev 2 - 12/96) Note: The soil and sediment collection method has changed to EPA Method 5035.
	Aqueous	EPA SW-846	EPA Method 8260B (Rev 2 - 12/96)
	Air Summa Canister	EPA TO15.CRF (01/00)	EPA Method TO-15 Or EPA Method TO-17 (Revised 01/99)
	Air Tedlar Bag	EPA TO15.CRF (01/00)	EPA Method TO-15 Or EPA Method TO-17 (Revised 01/99)
SVOCs including PAHs	Aqueous	EPA SW-846	EPA Method 8270C (Rev 3 - 12/96)
	Solid	EPA SW-846	EPA Method 8270C (Rev 3 - 12/96)

PCBs	Aqueous	EPA SW-846	EPA Method 8082 (Rev 0 - 12/96)
	Solid	EPA SW-846	EPA Method 8082 (Rev 0 - 12/96)
Organochlorine Pesticides	Aqueous	EPA SW-846	EPA Method 8081A (Rev 1 - 12/96)
	Solid	EPA SW-846	EPA Method 8081A (Rev 1 - 12/96)
Priority Pollutant Metals	Solid	EPA SW-846	EPA Method 6020 (Rev 0 - 9/9)
	Aqueous (Field filter sample as required prior to preservation)	EPA SW-846	EPA Method 200.8 (Rev 5.4 - 1994)
Elemental Mercury	Solid (only)	EPA SW-846	Lab specific
Chromium, Hexavalent	Aqueous (Field filter sample as required)	EPA SW-846	EPA Method 7196A (Rev 1 - 7/92)
	Solid	EPA SW-846	EPA Method 3060A (Rev 1 - 12/96)
Perchlorate	Aqueous	EPA DW	EPA Method 314.0 (Rev 1.0 - 11/99)
Dioxins	Aqueous & Solid	EPA SW-846	EPA Method 8280A (Rev 1 - 12/96)
Furans	Aqueous & Solid	EPA SW-846	EPA Method 8290 (Rev 0 - 9/94)
Chlorinated Herbicides	Aqueous	EPA SW-846	EPA Method 8151A (Rev 1 - 12/96)
	Solid	EPA SW-846	EPA Method 8151A (Rev 1 - 12/96)
Free and Total Cyanide	Aqueous & Solid	EPA SW-846	EPA Method 9014 (Rev 0 - 12/96)

TPH-DRO/GRO	Aqueous & Solid	EPA SW-846	EPA Method 8015B (Rev 2 - 12/96) Note: Although TPH results provides a gross estimate of petroleum compounds present in the media, use of this data is limited in a risk evaluation.
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Note: Alternative validated methods may be utilized for an analytical suite. Adequate detection limits must be achieved.

3.10 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC) MEASURES

MDE recommends that VCP applicants implement data validation including appropriate quality assurance and quality control measures during the sampling program. Such a program ensures the veracity of analytical results and prevents the applicant from performing additional work that may not be necessary. These measures include the collection of blind duplicate samples, matrix spikes, field blanks, rinsate or equipment blanks, and trip blanks. MDE may elect to collect split samples to verify analytical precision. The following table summarizes the type and frequency of collection for various QA/QC samples that are recommended for all site investigations conducted at properties applying to or participating in the VCP:

Type of Sample	Brief Description	Frequency of Collection
Blind Duplicate	Samples that are collected at the same time, from the same location, with the same apparatus, and placed into identical containers that were prepared and handled in the same manner. The samples are laboratory-analyzed for precision using the same analytical procedures and instruments.	One blind duplicate per matrix per every 10 samples submitted to the laboratory.
Matrix Spike(s)	Various spike recovery tests are performed at the laboratory using non-reactive compounds to determine possible matrix interferences that may affect sample reporting.	One matrix spike per matrix for every 20 samples submitted to the laboratory. Requires collection of additional sample material.
Field Blank	Prepared in the field and consists of distilled, de-ionized water which is transferred to the appropriate sample container, treated with preservatives (if necessary), and handled in the same manner as the samples. The field blank verifies the field collection procedure.	One field blank per container type per matrix for laboratory analyses.
Rinsate / Equipment Blank	Prepared in the field and verifies the effectiveness of equipment decontamination procedures. A sample container is filled with equipment rinsate (e.g. distilled, de-ionized water) after the decontamination procedures for each matrix type. The appropriate preservative must also be added, if necessary.	One rinsate blank is necessary if, for example, soil sampling equipment is decontaminated. The rinsate blank may be eliminated if dedicated sampling equipment is utilized.

Trip Blank	Prepared at the laboratory and is used to test for potential contamination of VOC samples during round-trip transit to the lab. 40 ml vials are filled with de-ionized water, preserved, and chilled to a temperature less than 4° C.	Two 40 ml vials per sample event are recommended for laboratory analyses. Do not open the vials after the laboratory seals them closed.
Split Sample	One sample is divided into equal portions. Each portion is analyzed at a different qualified laboratory to verify the precision of the analytical method.	The Department may elect to split one or more samples during a sample event.

MDE recommends that QA/QC measures follow U.S. EPA’s protocols for Level IV data, which is used in site characterization and risk assessments (refer to Data Quality Objectives for Remedial Response Activities, Volumes I and II, U.S. EPA 1987). Please include the following items when submitting project deliverables (also refer to Attachment 2 – MDE Fixed Laboratory Data Deliverables):

- Analytical data;
- Date of sample collection and laboratory receipt of samples;
- Laboratory analyses IDs & time and date of analyses;
- Sample IDs as labeled on the chain-of-custody;
- Chain-of-custody;
- Surrogate spike recovery results;
- Method and reagent blank results;
- Sample preparation and extraction dates; and
- TICs results.

Applicants should ensure that the fixed laboratory reports include the analytical results based on the lowest possible detection limits for each methodology. For example, detection limits for groundwater samples should be comparable to federal and State MCLs, whereas soil samples should be comparable to the MDE cleanup standards for soil [MDE Cleanup Standards for Soil & Groundwater –August 2001, Interim Final Guidance (Update No. 1)].

If matrix interference or high levels of contamination elevate detection limits, reasonable efforts must be made to accurately quantify contaminants of concern and a detailed explanation must be provided for these detection limits.

3.11 SCREENING SAMPLE COLLECTION PROTOCOL

MDE encourages the use of sample-screening technologies to characterize the property. In an effort to keep analytical costs down while completing a thorough site characterization, MDE can assist program participants by screening soil samples using the x-ray fluorescence, gas chromatography/mass spectrometer, and immunoassay testing equipment, which is maintained by MDE. The screening process can greatly reduce analytical costs by reducing the number of samples submitted to a fixed laboratory for certain analytical parameters, such as metals, VOCs, PCBs, and select SVOCs.

Sample screening can also be performed for pesticides; however, the test method is compound specific and requires individual tests kits. Knowledge of the specific type of pesticide present at a property allows MDE to perform sample-screening analyses for the specific pesticide of concern. Otherwise, samples requiring pesticide analyses must be sent to a fixed laboratory.

The fees charged by MDE for sample screening analysis are outlined on the attached form, "Request for Sample Screening Analytical Services" (see Attachment 3). The fees for lab services include the analytical fees and cost of labor and are not included in the application fee. The applicant will be invoiced separately for the laboratory service fees.

The applicant must complete the "Request for Sample Screening Analytical Services" form that lists all samples. Once submitted, MDE will estimate the labor costs and return the form to the applicant for authorization. Once the signed form has been returned to MDE, an invoice will be sent to the applicant. The invoice must be paid before the samples are collected and submitted for analysis.

Once the samples have been analyzed the results will be submitted to the applicant or the applicant's consultant. Based on sample screening results, MDE, in conjunction with the applicant, will select 35% to 50% of the field screen samples for fixed laboratory analysis. See Attachment 4 for MDE Field Screening Protocol.

3.12 ELECTRONIC DATA DELIVERABLES

MDE recommends that EDD be requested from the analytical laboratory for environmental reports with analytical data. Submittal of EDD to MDE allows staff to evaluate data in an efficient, time-sensitive manner. MDE can only accept EDD submitted in a Department-approved Microsoft Excel format.