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## SECTION II: ACT 2 REMEDIATION PROCESS

### A. Applying Land Recycling Remediation Standards to Your Property

#### 1. Classifying your Site and Considering Options for Remediation

To select a standard for your site, a site assessment is needed to determine site conditions that may require remediation of a release. Characterization of a release includes the identification of specific contaminant concentrations throughout soil and groundwater media, discharges to surface water and air, and any other conditions that may pose a risk to human health and the environment associated with the release. The site characterization may reveal that the remediator needs to interface with other environmental laws and/or Act 2. Under Act 2, the appropriate standard or combination of standards (i.e., background, Statewide health or site-specific) must be determined. The Department will accept notices of intent to remediate (NIRs) for properties on which a release of regulated substances (i.e. contaminants, constituents or chemicals) can be documented, or for properties affected by off-property releases of regulated substances for which the remediator is not responsible. The background, Statewide health and site-specific standards may be used at any site. Only ~~certain~~ sites that meet certain requirements qualify as Special Industrial Areas (SIA).

A person with a property with multiple distinct areas of contamination may submit an NIR for a single area or for multiple individual areas and for one or more than one medium. A distinct area of contamination includes the volume of all media affected by the release causing the contamination. An Act 2 “site” consists of the entire vertical and horizontal area impacted by a release of regulated substance(s). The Act 2 site may cross property boundaries. For example, if soils were contaminated and that contamination migrated to groundwater, both the contaminated soil and groundwater would be part of the distinct area of contamination associated with the release.

In some cases, the Department may agree that characterizing all contaminated media as a distinct area is not practical and may approve a site characterization limited to a single medium. One example of this situation is when a remediator completes a soil media cleanup, and an associated groundwater cleanup will take a period of years before attainment can be demonstrated. In this case, the remediator could receive approval of a final report for soils alone (and the associated liability relief), and later when the groundwater is remediated to a point where attainment can be demonstrated, the remediator could submit a separate final report for the groundwater. A second example is where a remediator may be approaching multiple areas of concern (AOCs) on the property over a period of years such as multiple soil AOCs, and a groundwater unit which is a combination of the effects of the various soil AOCs. Here, the remediator could submit NIRs/final reports for individual soil areas of concern and, at some time in the future when the source areas (all the soil AOCs) have been remediated, submit an NIR for the groundwater unit. The liability protection afforded under Chapter 5 of Act 2 is for contamination from a release identified in the approved final report. Therefore, the more extensive and thorough a site characterization is, the more extensive the liability protection. This is true in terms of both size of area included as the site and in the listing of regulated substances which are a part of the site. By example, the lower the censoring level chosen in the site characterization, a larger area and more regulated substances

would likely be included in the site (see Section II.A.4 for an example of applying site characterization to a site).

The Department will specify details of the site in the final report approval letter and attachments, which describe the extent of the liability protection provided under Act 2.

**a) Background Standard**

A remediator cleaning up a site to the background standard must document that the concentration of any regulated substances remaining are at a level not related to any release of regulated substances at the site. Samples are required both in the area shown to be contaminated by onsite releases (i.e., the site) and in an appropriate background reference area to demonstrate attainment of the background standard. This standard is useful in cases of releases migrating from off-property, for widespread contamination, or naturally occurring conditions.

**b) Statewide Health Standard**

Chapter 250 establishes Statewide health standards (SHSs) for regulated substances in each environmental medium. These standards are referred to as medium-specific concentrations (MSCs), and they must be achieved to demonstrate attainment of the SHS. In addition to demonstrating that a site has attained MSCs based on human health, an ecological screen to demonstrate protection of ecological receptors and a vapor intrusion analysis are part of the SHS. Ecological receptors are not soils nor surface water bodies, but are the animals, plants and other organisms that would be affected by contamination of those environmental media (soil or groundwater).

**c) Site-specific Standard**

Cleanup levels may be developed which pertain specifically to the unique exposure pathways at a site. This is a more detailed process, both technically and administratively. The human and ecological receptors at the site need to be addressed either through the elimination of the exposure pathways or a risk assessment. Human receptors are the people (adults and children) who may be affected by contamination of the soil, groundwater, surface water or air around them, both now or in the future. A site-specific cleanup also provides an opportunity for public participation.

**d) Combination of Standards**

A cleanup may be performed by using any combination of the three standards. The remediator may select any one or a combination of standards by regulated substance, by medium of concern, or by distinct area of contamination (see Section II.A.1). Combinations must satisfy all of the requirements of each standard used. For example, in using any combination of standards which includes the site-specific standard, the risk assessment should include only those regulated substances for which site-specific numeric standards are being developed, and for these substances, the cumulative risk requirements of



Section 304 of Act 2 (35 P.S. § 6026.304) must be met. Attainment of these site-specific numeric standards must be demonstrated in the final report. In addition, all of the requirements of the site-specific standard, including the reporting requirements, apply. All regulated substances, media, or distinct areas of contamination meeting another standard (e.g., the SHS) must meet the requirements of that standard. Therefore, in addition to a combination of numerical standards there will be combinations of requirements for reporting, attainment tests, and points of compliance.

**e) Special Industrial Areas**

A common misconception by users of the land recycling program (LRP) is that there is a separate special industrial area SIA standard. This is not the case. Attainment of one of the three available standards (background, Statewide health or site-specific) can be demonstrated for properties being remediated as SIA sites. However, the focus of the SIA requirements is on characterizing the contamination within the property boundary and addressing immediate, direct or imminent threats to human health and the environment. For further details please refer to Section II.B.4(d)(vii) of this manual.

The SIA designation was created by Act 2 to provide special remediation requirements for a distinct set of properties that were used for industrial activity. SIAs are properties where there is no financially viable responsible party, or where the property is located within an enterprise zone (EZ). EZs are a certain type of distressed property designated by the Department of Community and Economic Development (DCED). Since DCED programs change over time, other property designations may also qualify a property to be an SIA. Remediators are encouraged to consult with DCED to verify that a specific property lies within an established EZ.

The remediator and the reuser afforded these special requirements must demonstrate that he/she did not cause or contribute to releases of regulated substances at the property. The remediator must enter into a Consent Order and Agreement (CO&A) with the Department in order to make use of the SIA designation.

**2. Immediate Response**

If an immediate hazard exists or is discovered at a site, prompt action is necessary to abate the hazardous condition and prevent future or further release of regulated substances. Leaking tanks or drums, conditions presenting a fire or explosion threat, or a situation involving a threat to human health or the environment warrant a prompt response. Act 2 does not prevent or impede an immediate response to such emergencies. Section 307 of Act 2 (35 P.S. § 6026.307) provides that the provisions under Chapter 3 of the statute, relating to remediation standards and review procedures including SIA cleanups, shall not prevent or impede applicable emergency or interim responses. Final remediation shall comply with that chapter, which will not be prejudiced by the mitigation measures (emergency or interim response) undertaken to that. It is the responsibility of the appropriate person to act in a timely manner to abate immediate



threats. The remediator still needs to follow the notification requirements of the Clean Streams Law or Solid Waste Management Act. However, if the final report demonstrating attainment of a standard is submitted within 90 days of the release, the NIR is not required to be filed, and no public notice is required.

### **3. Notice Requirements and Procedures**

#### **a) Notice of Intent to Remediate**

Intent to perform a site remediation under the provisions of Act 2 requires municipal, public, and Department notification. The formal process for conducting remediation under Act 2 is initiated with submission of the NIR to the Department. The NIR and instructions are available online at the Land Recycling web page under “Forms and Lists.” Submission of the NIR will initiate the notification procedures.

Act 2 provides that any person, firm, corporation, or other entity that proposes or is required to respond to the release of a regulated substance at a site shall comply with public notification requirements except for certain situations defined in Act 2.

The NIR provides basic information on the applicant and the site. The NIR shall include a brief description of the site, ownership information, a listing of the contaminants involved and media affected, proposed remediation (if applicable), and the proposed future use of the site. The NIR may address all of the affected property or may only address those distinct areas of contamination which the remediator chooses to address, which then become sites. Some site characterization is recommended prior to submission of an NIR to obtain sufficient site information to determine the scope of any site contamination and select the remediation standard. Communication with DEP Regional Office staff regarding procedures, assessment, and aspects of remediation is encouraged. The following are the procedures for an NIR:

- Municipal and public notification of the NIR should be submitted at the same time the NIR is submitted to the Department. These notices are accomplished by:
  - Sending a copy of the NIR with an accompanying cover letter to the municipality, or municipalities, where the site is located.
  - Publishing or arranging for the publication of a summary of the NIR in a newspaper of general circulation in the area of the site. This summary should be a legal notice and developed following the model format on the Land Recycling web page under “Forms & Lists.”
- At the same time as the submittal of the NIR to the Department, provide the Department with reasonable proof of the public and municipal notification of the NIR. Remediators should submit notices in a timely

manner; however, the Department allows some flexibility with this time frame due to potential unforeseen circumstances. Failure to submit proof of the municipal and public notices will result in the NIR being administratively incomplete and may delay the review of the first report following the NIR. –An example of reasonable proof of municipal

notification is a copy of the letter mailed to the municipality with the certified mail receipt. A copy of the proposed text of the newspaper notice and expected publication date is an example of proof of public notification. Submit the NIR and reasonable proof of public and municipal notification to the Department's Environmental Cleanup and Brownfields Program (ECB) office in the region where the site is located. Provide the name and address of a contact person to whom correspondence or communication can be addressed. Provide a copy of the NIR to the owner of the property if the NIR is being prepared and/or submitted by someone other than the property owner. Liability protection is provided to owners of a property. All owners of the properties affected should be included if the area of contamination includes more than one property.

- A 30-day period following submission of the NIR indicating use of the site-specific standard or the SIA process is required by Act 2. The municipality can request to be involved in the development of remediation and reuse plans for the site during this period. The applicant shall inform the municipality of the 30-day comment period when submitting the NIR and should inform the municipality of the provision of Act 2 for requesting a public involvement plan. The newspaper notice shall also provide a statement about the 30-day comment period and the right of a municipality to request involvement in the development of the remediation and reuse plan for the site. The municipality will have received notice prior to publication. The remediator must implement a public involvement plan if the municipality requests involvement in the remediation. The publication date of the NIR notice in the newspaper starts the 30-day comment period. If the model format previously mentioned is used, it will ensure the 30-day comment period and public involvement plan information have been provided. The DEP will not accept reports until after the 30-day comment period. Comments received from the public or a public involvement plan, along with the remediator's responses to the comments, must be submitted with the appropriate final report. A public involvement plan is described below in Section II.A.3(c).

The municipal and public notification requirements of each standard used apply if an NIR is submitted for a combination of standards.

Persons submitting an NIR for background, Statewide health, or a combination of these standards, who later decide to pursue cleanup to a site-specific standard or as an SIA, must re-notice the cleanup according to the appropriate notice provisions.

There are additional public notification requirements for sites being addressed under the One Cleanup Program. If a remediator chooses to enter the One Cleanup Program with coordinated reviews by EPA and DEP, the Memorandum of Agreement (MOA) has established specific site notification requirements. A remediator should submit NIRs to the municipality and a newspaper for publishing. The NIR should include a provision informing the public that any individual may request to receive a copy of the cleanup plan and comment on it prior to its approval and implementation.

Additionally, NIRs submitted for One Cleanup Program sites should include a provision informing the public that any person affected by the release that is the subject of the NIR may request that DEP conduct a site assessment. A DEP official will consider each of these requests and respond as appropriate.

Additional information regarding the One Cleanup Program can be found in Section III.F and in the One Cleanup Program Memorandum of Agreement located on the Land Recycling Program website.

The Department regional ECB office may acknowledge receipt of the NIR and will publish acknowledgment of receipt of the NIR in the *Pennsylvania Bulletin*.

The Department may comment on an NIR if the form is incomplete. An incomplete NIR may not have sufficient information to initiate the Act 2 process. The Department has enforcement authority to require assessment and remediation on sites for which a person does not voluntarily initiate a cleanup under Act 2.

Public notification of submission of the NIR to the Department, the municipality, and the public via the newspaper notice, and publication in the *Pennsylvania Bulletin*, are not required for background or Statewide health standard remediations if the final report demonstrating attainment of the standard is submitted within 90 days of the release.

**b) Notice of Proposal for Nonuse Aquifer Determination**

Any time a person is proposing to the Department that a site is eligible for a Nonuse Aquifer Determination, notice must be given to the associated municipalities and local water suppliers servicing that area. The notice is similar to that of an NIR in that it is a letter format and identifies the associated “who” and “where” of the proposal. In addition, a copy of the proposal sent to the Department for approval should be attached to these notice letters. Under general conditions, the municipalities and community water suppliers will have 45 days to review this material and, if desired, provide the Department with any information relative to the nonuse aquifer determination requirements specified in Section 250.303(c) of the regulations. The Department will use these conditions to base its approval decision. In the specific case where a municipality has in place an ordinance meeting the nonuse aquifer areawide certification requirements performance criteria of this Technical Guidance Manual (TGM), summarized in Section III.E.3 (relating to institutional vs. engineering controls), the 45-day review period may be waived a notice would not be required.

**c) Public Involvement Plan**

All remediators conducting cleanups are encouraged to develop programs with a proactive approach to involve communities in their plans. Remediators selecting the site-specific standard or pursuing remediation as an SIA must provide an NIR to the Department and the municipality, and to the public via notice in a newspaper serving the general area of the site. A 30-day comment period is to be included as part of the initial notice to solicit comments on whether the municipality wishes to be involved in the development of the cleanup and reuse plans for the site. The remediator of the property shall prepare a public involvement plan which meets the provisions of Section 304(o) of Act 2 if the municipality requests involvement during the comment period (35 P.S. § 6026.304(o)). If requested by a municipality, the remediator is encouraged to collaborate with the municipality in the development of the public involvement plan. This plan shall propose measures to involve the public in the development and review of the remedial investigation report, risk assessment report, cleanup plan, and final report for site-specific standard remediations, and the baseline remedial investigation for SIAs. Public involvement measures may include:

- Development of a proactive community information and consultation program that includes doorstep notice of relevant activities.
- Public meetings located within the county where the site is located.
- Roundtable discussions.
- Public access for document review and discussion, and designation of a single contact person to address questions from the community. Such access should be at locations adjacent to primary highways for the convenience of the public wishing to review the material.
- Formation of a community-based group to solicit suggestions and comments.
- Where needed, retention of a qualified independent third party to facilitate meetings and discussions and to perform mediation services.

The remediator can use these or other appropriate methods, such as a website or social media, to ensure the community has ample notice of intended remedial/reuse actions and the appropriate public concerns are properly addressed. The remediator must submit a copy of the public involvement plan to the Department as outlined in Section 250.6(d) of the regulations. DEP does not approve or disapprove public involvement plans. The reports and plans submitted to the Department must include the comments received from the public and the municipality as well as responses to those comments. The Department will consider these comments as part of its review of the plans and reports.

d) **Remediation Report Notification Requirements**

i) **Background and Statewide Health Standards**

~~When a~~ An administratively complete final report ~~is submitted~~ submission under the background and Statewide health standards ~~the remediator should provide two copies of the final report to the Department's ECB Program regional office where the site is located. One should be a paper copy and the other can be submitted in another format (CD, flash drive, etc.). A complete submission~~ consists of the final report, appropriate fee, and proof of notices. ~~The remediator~~ is encouraged to also submit a Transmittal Sheet, a ~~printout of the online~~ final report summary, and the checklist ~~(optional), and the appropriate fee to facilitate the Department's administrative process~~. The Transmittal Sheet and checklist are available on the Land Recycling website under "Forms and Lists." The name and address of a contact person to whom correspondence or communication can be addressed shall be provided. The Department will acknowledge receipt of the final report. The remediator shall provide municipal and public notification that a final report has been submitted when the final report is submitted to the Department. This notification is accomplished by:

- Sending a notice to the municipality that a final report has been submitted to the Department. (A model format for this notification is available on the Land Recycling website under "Forms and Lists.")
- Providing a notice of submission of the final report to a newspaper of general circulation in the area of the site. This notice shall be a legal notice and developed following the model format (available on the website) or other appropriate format provided by the newspaper and provide the required information.
- Providing the Department with reasonable proof of the public and municipal notification by submitting a copy of the proposed text of the newspaper notice and the anticipated publication date or a photocopy of the published notification showing the publication date. Proof of municipal notification of submission of the final report may be accomplished by submitting a copy of the certified mail receipt and cover letter of the municipal notice to the Department.

The Department has a 60-day review period for the final report and shall notify the remediator of deficiencies. It is the intent of the Department to notify the remediator of both approvals and deficiencies of the final report. The final report shall be deemed approved if the Department does not respond within 60 days.

Other reports that fall outside of the scope of the typical reporting guidelines are reviewed on a case-by-case basis and timeframes for such reviews will vary based on the complexity of the site.

The Department's regional ECB office will publish acknowledgment of receipt of the final report in the *Pennsylvania Bulletin*.

Public notification of submission of the final report to the Department, the municipality, the public via the newspaper notice, and publication in the *Pennsylvania Bulletin* is not required for background or Statewide health standard remediations if the final report demonstrating attainment of the standard is submitted within 90 days of the release.

## ii) **Site-specific Standard**

~~U~~ Administratively complete report submissions under the site-specific standard, ~~when a remedial investigation report, risk assessment report, cleanup plan, or a final report is submitted, the remediator should provide two copies of the document to the Department's ECB Program Regional Office where the site is located. One should be a paper copy, and the other can be submitted in another format (CD, flash drive, etc.). A~~ a complete submission consists of the report document, the appropriate fees, and proof of notices. The remediator is also encouraged to submit a Transmittal Sheet, and the checklist to facilitate the Department's administrative process (optional) and the appropriate fee(s). The Transmittal Sheet and checklist are available on the Land Recycling website under "Forms and Lists." In addition, remediators are encouraged to the submission of a final report should include a printout of the online final report summary with the submission of a final report. The name and address of a contact person to whom correspondence or communication can be addressed shall be provided. The Department will acknowledge receipt of the submission. The remediator shall provide municipal and public notification of the submission when the plan and/or reports are submitted to the Department. This notification is accomplished by:

- Sending a notice by certified mail to the municipality that a specific plan and/or report has been submitted to the Department. (A model format for this notification is available on the Land Recycling website under "Forms and Lists.")
- Providing a notice summarizing the findings and recommendations of the plan or report, along with the comments and responses, to a newspaper of general circulation in the area of the site. This notice shall be a legal notice or other appropriate format provided by the newspaper and provide the required information.
- Providing the Department with reasonable proof of the public and municipal notification by submitting a copy of the proposed text of the newspaper notice and the anticipated publication date or a

photocopy of the published notification showing the publication date. Proof of municipal notification of submission of the final report may be accomplished by submitting a copy of the certified mail receipt and cover letter of the municipal notice to the Department.

Remedial investigation reports, cleanup plans, and risk assessment reports may be submitted together or separately. It is recommended that the risk assessment be submitted individually because risk assessment reports are considered stand-alone reports with separate fees and are reviewed independently of other reports.

The Department has a 90-day review period for the plan and/or report and shall notify the remediator of deficiencies. It is the intent of the Department to notify the remediator of both approvals and deficiencies of the final report. The plan and/or report shall be deemed approved if the Department does not respond within 90 days.

Other reports that fall outside the scope of the typical reporting guidelines are reviewed on a case-by-case basis, and timeframes for such reviews will vary based on the complexity of the site.

### **iii) Special Industrial Areas**

Municipal and public notification is required for submission of an NIR to the Department, but it is not required for submission of a baseline environmental report.

## **e) Fees**

The Department is required to collect fees to cover some of the costs of the LRP. Section 703 of Act 2 specifies the appropriate fees involved for submission of plans and reports (35 P.S. § 6026.703). The regulations provide further specification on fees (25 Pa. Code § 250.7).

A fee of \$250 is required for the review of final reports for the background and Statewide health standards, and \$250 for each remedial investigation, risk assessment report, and cleanup plan for the site-specific standard. A fee of \$500 is required at the time of submission of the final report for site-specific standard remediations. No fee is required for submission of the work plan or baseline environmental report required for SIA remediation. It is important to note that submitting a combination of reports under the site-specific standard requires a fee for EACH report submitted. For example, if one report containing a remedial investigation/risk assessment/cleanup plan for a site undergoing a site-specific cleanup is submitted to the Department, then \$750 is required to be submitted with the report. A final report submitted under a combination of cleanup standards should be accompanied with a fee representing the higher of the two standards' final report fee.



Resubmission of any of the above required plans and reports will require payment of the above fee upon resubmission. The Department may disapprove a plan or report that does not have the appropriate fee.

Checks are to be made payable to the **Commonwealth of Pennsylvania**.

*A Transmittal Sheet for Plan/Report Submission* is available for remitting the appropriate fee with the submittal and should be used with all plan/report submissions to the Department. This form may be obtained from the LRP web site under “Forms and Lists,” or a copy may be requested from the Department’s Regional office where the site is located or from the Department’s Central office.

#### 4. Site Characterization

##### a) Importance of Site Characterization Step

Site characterization under Act 2 is a description of contaminated media, including geology and chemical and physical characteristics, that affect movement of regulated substances in environmental media. Site characterization is the process for determining the site under Act 2; i.e., the volume of contaminated media resulting from an environmental release of regulated substances within which attainment of one or a combination of standards will be demonstrated. The site is, in turn, the basis for liability protection under Chapter 5 of Act 2 when the final report is approved. In brief, the liability protection is only as good as the site characterization.

The site characterization activities conducted must result in a thorough investigation which meets the requirements of Pa. Code § 250.204. **A complete and accurate site characterization, including fate and transport analysis, and its documentation in the final report is very important, as it is the basis for making remediation decisions and is used later in identifying the appropriate area for demonstrating attainment. Except for sites involving the excavation option for petroleum-contaminated soil (see 25 Pa. Code § 250.707(b)(1)(iii)), without a proper site characterization, attainment requirements cannot be met and the final report will be disapproved by the Department.**

~~It is important to note that in to receive relief of liability (ROL) for a compound (regulated substance or contaminant), that compound should be both related to the historical release (if known) and should be included in the investigation and demonstration of attainment. This means that any compound not carried through the investigation and attainment process cannot be included in the ROL. For example, on a site with a petroleum release that also has analytical results for PAH compounds which are all reported by the laboratory as non-detect, or below the reporting limit. The remediator does not compare the PAH compounds to the MSCs in addition to the fact that the PAHs are not related to the release. Because the remediator has not included those compounds in the investigation, the remediator will not receive ROL for the PAH compounds.~~

It is important to note that to receive relief of liability (ROL) for a regulated substance (contaminant), that contaminant should be identified in both the NIR investigation and the approved final report. ROL will not be conveyed for contaminants that are not identified as above, have not been thoroughly investigated, and have not demonstrated attainment. For example, analytical results for propylene glycol are reported by the laboratory as non-detect, or below the reporting limit, on a site with a petroleum release. The propylene glycol is not related to the petroleum release and was not included on the original NIR. The remediator does not compare the propylene glycol to the MSCs. Because the remediator has not included the propylene glycol in the investigation, the remediator will not receive ROL for the propylene glycol.

A remediator must keep in mind the definition of a site under Act 2. As defined in Act 2, a site is “[t]he extent of contamination originating within the property boundaries and all areas in close proximity to the contamination necessary for the implementation of remediation activities to be conducted under the act” (35 P.S. § 6026.103). Thus, a site often does not coincide with a property. A site may occupy several properties, and, conversely, a property may contain more than one site. In this manual, whenever the term “site” is used in connection with the LRP, it is used strictly in the sense as defined in Act 2.

DEP Regional Office staff are a valuable resource and want to assist as needed in evaluating site characterization information. Although not required, working with the Department can help to facilitate approval of the submitted reports. Remediators should always feel free to contact the Department’s Regional ECB Program staff when there are questions about site characterization requirements of a property under the LRP.

## **b) Scope of Characterization**

The scope of the site characterization should be designed to help the remediator select an appropriate remedy that will meet the attainment requirements of the selected Act 2 standard. The requirements that a site characterization must meet are described in the regulations at 25 Pa. Code § 250.204. During this phase of the application of Act 2, the remediator should evaluate other applicable regulatory requirements (see Section V of this manual), since information required by other programs may be best collected during the site characterization phase. The reporting requirements for the selected standard (background, Statewide health or site-specific in Act 2 and Chapter 250 of the regulations) must be met by the person conducting the cleanup. Section II of this TGM describes in detail the reporting requirements for each of the standards available under Act 2. The procedures, documents, and required fees for each standard are summarized in Section II.A.3 (Notice Requirements and Procedures).

Characterization of sites which may require remediation begins with an evaluation of any existing historical information about the release that identifies specific regulated substances. The data objectives of the site characterization will differ somewhat depending on whether soil or groundwater is being investigated.

Depending on the size and complexity of the site, the investigation portion of the site characterization is typically an iterative process which expands and builds as the information is gathered (see Figure II-1).

**i) Soils**

Soils must be characterized horizontally and vertically to concentrations below the selected numeric standards, or to where it can be demonstrated that the pathway elimination measure is adequate to protect human health and the environment. This ensures that all soils containing regulated substances at or above the selected numeric standards have been adequately characterized to support a fate and transport analysis which shows where the contamination is currently located and those areas to which it is moving. The remediator determines the concentration level for characterization beyond the minimal level stated above. The remediator must state what factors were used in determining the level used to define the site boundaries.

A thorough site characterization for soil should be able to provide the following information:

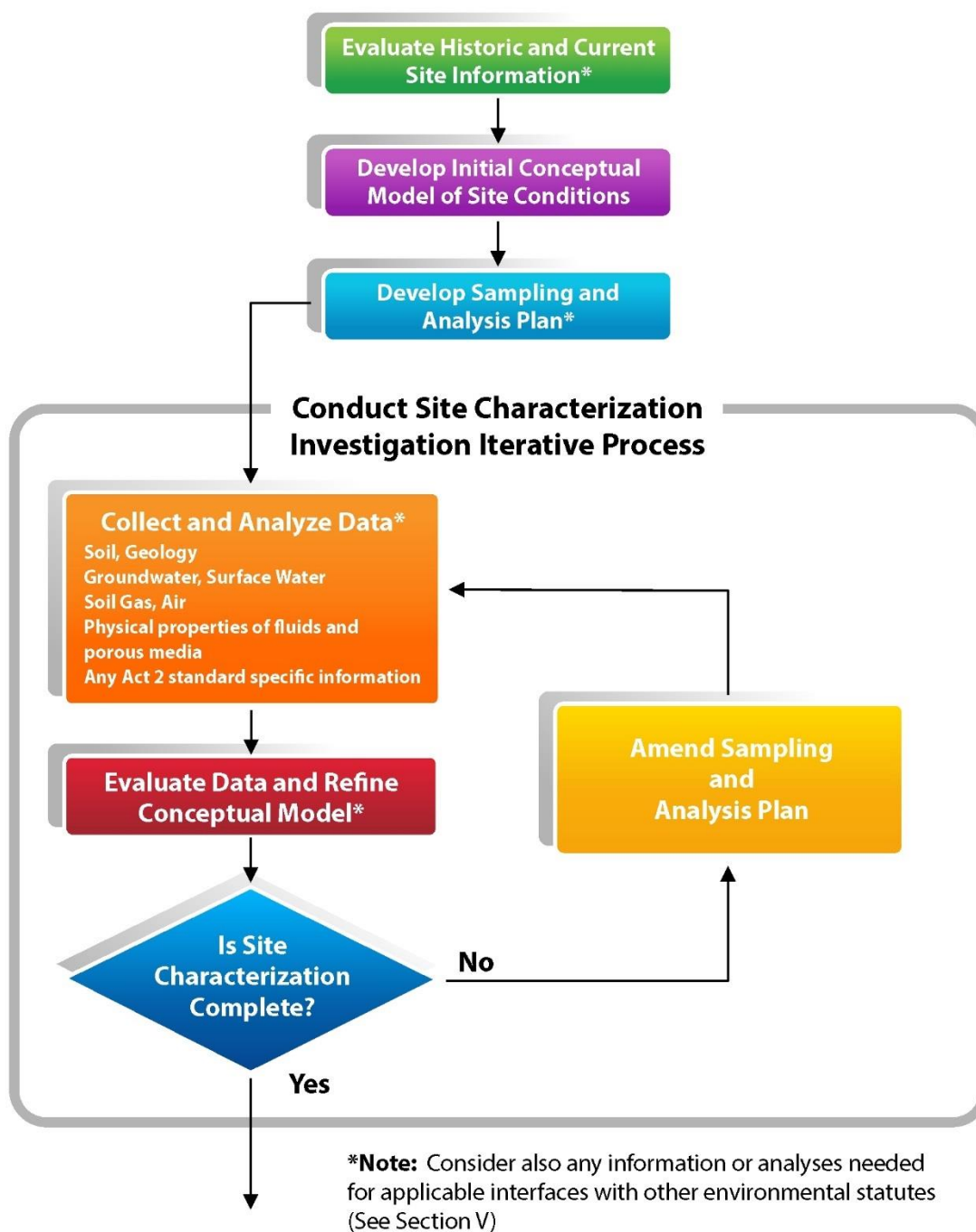
- The types of regulated substances associated with a release that are present, their concentrations, and the spatial variation in concentration of the regulated substances both horizontally and vertically.
- The physical characteristics of the soil in which the regulated substances associated with a release are present and through which they may be moving. These include the soil type (texture), dry bulk density, permeability, organic carbon content, porosity, and moisture content. Documentation of these properties and any significant variability over the site may be very important later in developing a fate and transport analysis.

Soil characterization samples should be collected from the areas with anticipated highest levels of contamination (i.e., biased sampling). This sampling method identifies the ~~areas of concern~~ (AOCs) and helps to determine the applicability of any proposed remedial action or soil handling and disposal requirements during remediation.

It is important to remember that liability relief is afforded by Act 2 only for the distinct areas of contamination identified and evaluated in reports submitted to and approved by the Department. This is explained in Section 501(a) of Act 2. Thus, liability relief applies to specific releases regardless of when the release occurred or when the data associated with that release was collected. Liability relief is not provided for the entire property unless the entire property is identified as the site. If an additional release has occurred at the site, liability relief is not provided for that release until an Act 2 standard is attained for contamination associated

with that specific release. Historical data (i.e., data more than two years old) can be used during site characterization if there is no reasonable expectation that the site conditions associated with the release being investigated have changed (e.g., changes in property use resulting in changes in exposure). Historical data should be provided in the final report as required by 25 Pa. Code § 250.204(c).

**Figure II-1: Site Characterization Decision Tree**



**Note:** Figure must be used in conjunction with the text. Reference Sections II.A.4 and IV.

## ii) **Groundwater**

If groundwater is known to be impacted by a release based on knowledge of the site or as a result of soil sampling, a similar process as that used for soils to determine the extent of the release into groundwater may be employed based on knowledge of the site, groundwater monitoring, and fate and transport analysis. A common mistake is to take a limited set of groundwater measurements from a single sampling event, and if the concentrations are below the SHS, conclude that no further Act 2 work is needed. This is not true. Proper characterization requires more than one round of sampling [25 Pa. Code § 250.204(e)]. For further guidance, see Section III.B.

Where groundwater is a medium of concern, the following information at a minimum should be provided by a thorough site characterization:

- The direction of groundwater flow.
- The hydraulic gradient.
- The permeability of the aquifer material(s) through which the groundwater moves.
- The porosity of the aquifer.
- The types of regulated substances present, their concentrations, and the spatial variation in concentration of the regulated substances both horizontally and vertically.

This information is not only necessary to describe and evaluate conditions at the site, but also is often vital to fate and transport analysis, especially when it requires a quantitative approach.

Fate and transport analysis ~~often~~ is often an important part of site characterization and demonstration of attainment and is frequently required under all three Act 2 standards. See Section III.A for guidance for conducting fate and transport analyses.

Historic groundwater monitoring data can be useful for establishing trends and under certain circumstances, delineating groundwater COCs. Remediators can use historic data for identifying trends at sites that are not reasonably expected to have changes in site conditions associated with the release being investigated (e.g., natural attenuation or degradation). Historic groundwater data can be used to delineate contaminants from a specific release provided the groundwater quality has remained consistent and no product degradation has occurred. However, be careful in the use of groundwater data collected prior to remediation for attainment purposes. This data may over estimate concentrations of COCs that have

degraded or underestimate the concentrations of daughter products generated by degradation.

**iii) Sediment**

Act 2 allows for liability relief to be granted for regulated substances in sediment. Specifically, Section 302(b)(1) of Act 2 allows for demonstration of attainment of media of concern which may include sediment.

A remediator may demonstrate attainment of the background standard as described in Subchapter B of the Chapter 250 regulations, and in 25 Pa. Code § 250.707(a). The point of compliance for sediment is not specifically discussed in the regulations but remediators are generally expected to demonstrate attainment throughout the area of the sediment that has become contaminated due to releases on the property.

The LRP has not established numeric cleanup standards for sediments. However, sediment is sometimes only a concern to ecological receptors in which case remediators can address sediment under the SHS through the application of the ecological screening process described in Pa. Code § 250.311. The numeric soil standards published in the regulations cannot be used for sediments, as the exposure assumptions used to develop those values are not applicable to sediments. For remediations under the site-specific standard, the site-specific ecological risk assessment process should be used to demonstrate attainment for sediment.

**iv) Conceptual Site Model Including Soil and Groundwater**

A complete and comprehensive site characterization will enable the development of a conceptual site model (CSM). The CSM is a representation of the site environmental system and the processes that control the transport and movement of regulated substances through the environmental media and how they interact. The CSM assists in organizing the site investigation by identifying uncertainties and data gaps and focusing data collection efforts. Information from the CSM can also be used in the development of a vapor intrusion analysis or a risk assessment.

The CSM can be depicted in different ways such as written text, a graphic illustration, or a flow chart. The investigation portion of the site characterization is typically an iterative process which expands and builds as information is gathered. Consequentially, the CSM is a dynamic tool to be updated as new information becomes available during site characterization.

The level of complexity of the CSM and the level of detail needed is directly related to the level of complexity of the site, the selected remediation standard and the applicable media of concern. Less complex



sites need only a basic CSM to illustrate contaminant migration pathways, exposure mechanisms and potential receptors. More complicated sites will most likely need a CSM with a higher level of detail to describe all the different routes of exposure through multiple environmental media to various potential receptors.

EPA, American Society for Testing and Materials (ASTM), and Interstate Technology & Regulatory Council (ITRC) all provide additional guidance that may be used when conducting the site characterization investigation and developing the CSM. Appendix A, Groundwater Monitoring Guidance, is also an appropriate source of information. Figure II-2 below provides an example of a graphical CSM. Figure II-3 provides an example CSM of a wood treatment facility in a tabular format.

**v) Conceptual Site Model Example**

A release of 1,100 gallons of jet fuel to the ground surface at a regional airport resulted from an overfill of an above ground storage tank. A total of 2,500 cubic yards of contaminated soil was excavated. Confirmatory soil samples were collected from the excavation pit and monitoring wells were installed to delineate groundwater impacts. Soil and groundwater samples revealed detections of benzene, ethylbenzene, cumene, naphthalene, toluene, and xylenes. Nine groundwater sampling events were performed over a three-year period. Groundwater monitoring results indicated that the plume had stabilized and groundwater concentrations had decreased below the SHS groundwater MSCs. However, confirmatory soil samples showed that all of these constituents, except ethylbenzene, were detected at concentrations below the SHS MSCs. Therefore, all but ethylbenzene could be carried through the SHS process.

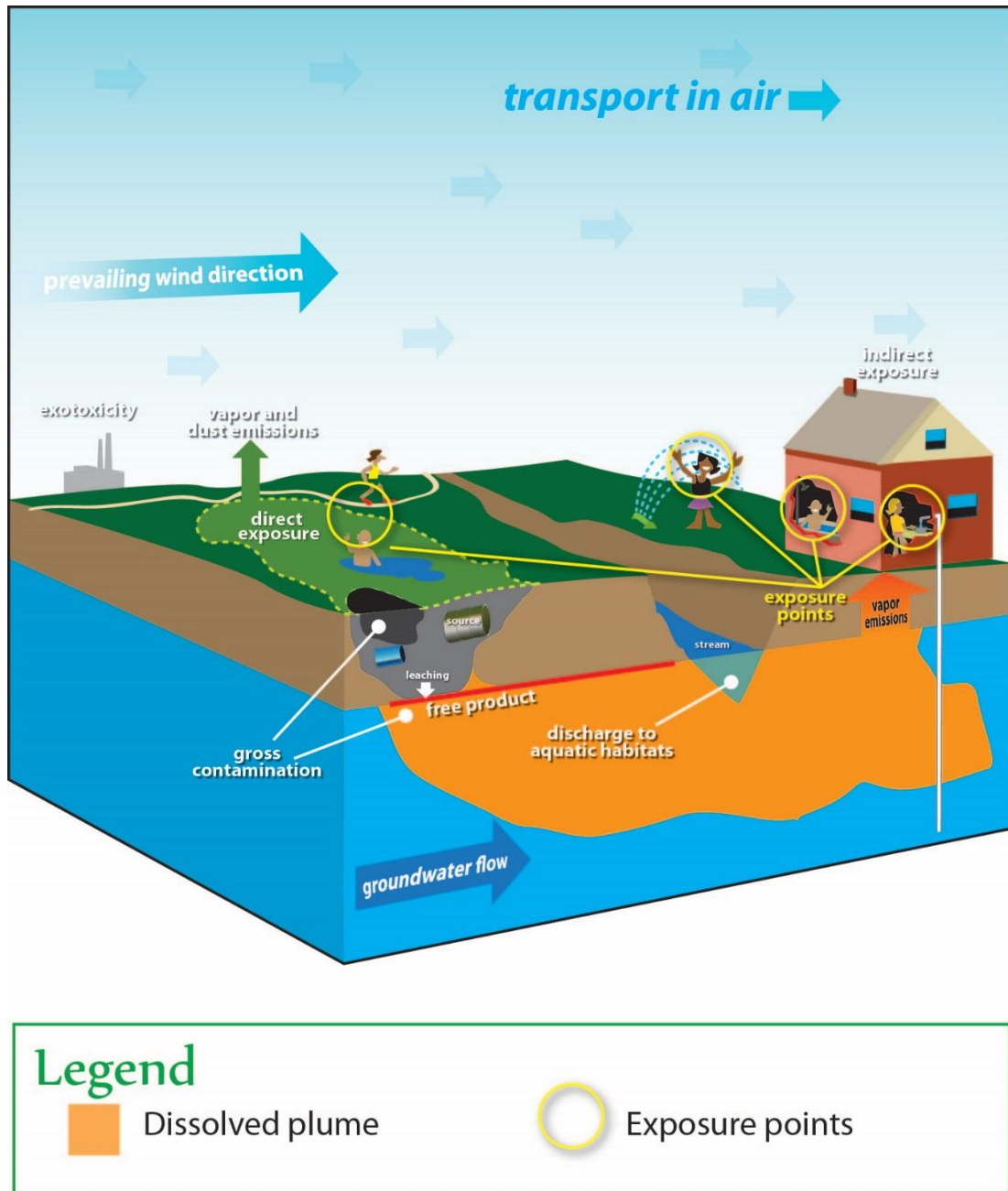
All soil and groundwater detections were compared to the SHS vapor intrusion screening values to delineate a potential vapor intrusion source. Since this was a petroleum release and concentrations exceeding the vapor intrusion screening values were more than 30 horizontal feet from any building and no future buildings were planned in this area, no additional vapor intrusion analysis was needed (see Section IV for vapor intrusion screening values and a discussion of the use of proximity distances).

An evaluation of potentially complete exposure pathways was performed by going through the SHS ecological screen process described in 25 Pa. Code § 250.311. Since jet fuel was the only substance released at the site, it was determined that no additional ecological evaluation was needed for the constituents being evaluated under the SHS (see Section II.B.2(e) for additional information on the SHS ecological screen process).

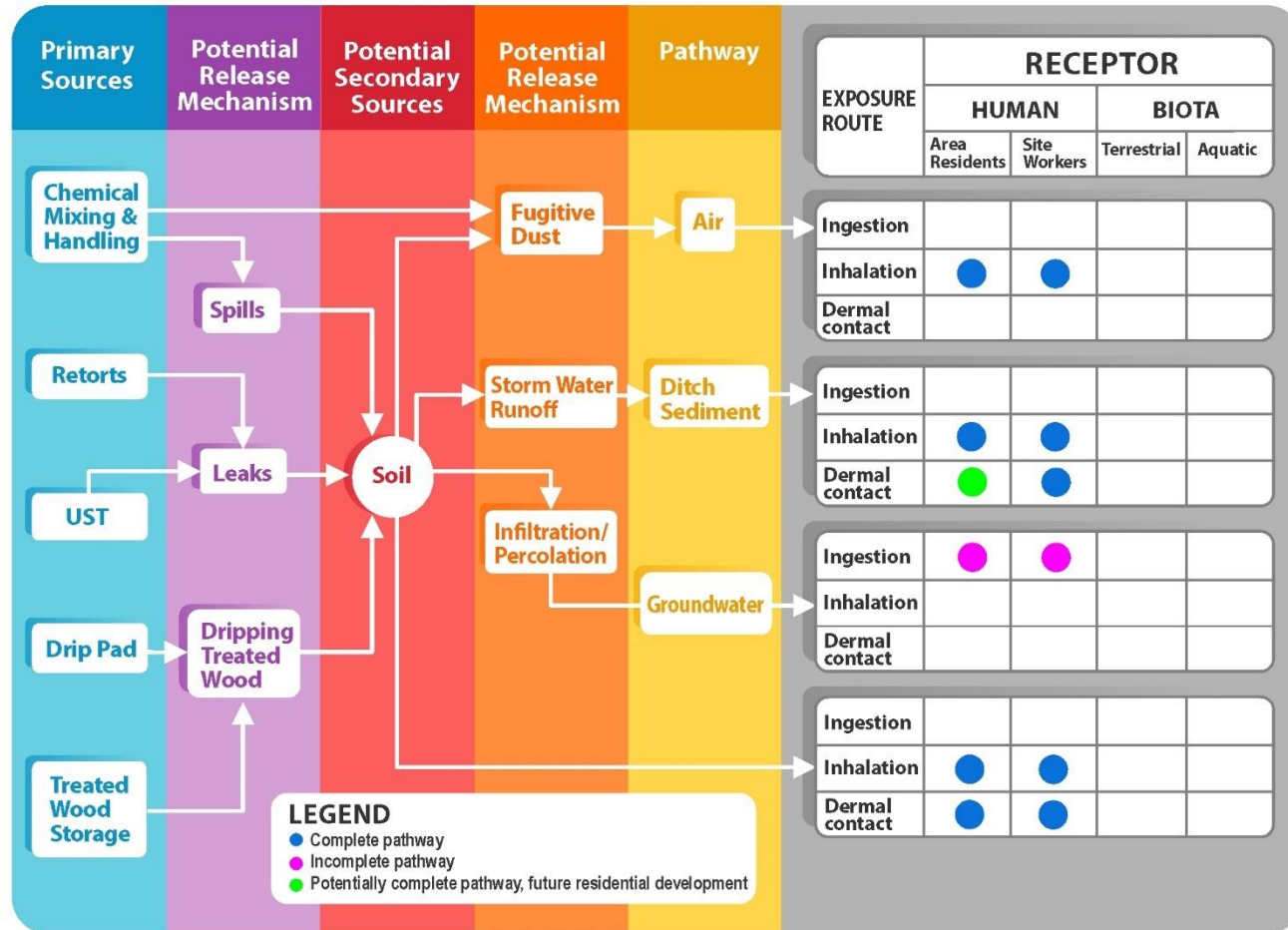
The ethylbenzene concentrations in soil that exceeded the MSC were the only remaining issue, so the remediator decided that this contaminant would be evaluated using the site-specific standard. The remediator performed a satisfactory receptor evaluation in their CSM and identified

airport workers, construction workers, utility workers, and travelers all as individual receptors with different exposure parameters.

Figure II-2: Graphic Example of Conceptual Site Model



**Figure II-3: Flow Chart Example of Conceptual Site Model**



Source: ITRC, Decision Making at Contaminated Sites, January 2015

**Note:** Figure must be used in conjunction with the text.  
Reference Section II.A.4.

Although the ecological screen process under the SHS was performed for the constituents being evaluated under the SHS, a site-specific ecological risk assessment is still required for constituents being evaluated under the site-specific standard (see Section III.I for additional information on the site-specific ecological risk assessment process). Thus, an ecological receptor evaluation was performed using the Pennsylvania Natural Diversity Index (PNDI) online search tool to identify any habitats or species of concern that may have been impacted by the release. The results of the PNDI search showed that there were no habitats or species of concern identified as potentially impacted by the release at the site.

This is an example of a complete CSM because the remediator accomplished the following characterization goals:

- Delineation of soil contamination down to SHS MSCs and to SHS vapor intrusion screening values.
- Delineation of groundwater contamination down to SHS MSCs and to SHS vapor intrusion screening values. The delineation of groundwater included a robust data set with over four consecutive quarters of groundwater monitoring, which accounted for any potential seasonal variations (while four consecutive quarters of groundwater data are not required for characterization, it helps greatly in evaluating seasonality concerns and with generating a dataset to be used for groundwater modeling, if necessary).
- The vapor intrusion pathway was adequately evaluated by identifying the potential vapor intrusion source and using proximity distances to evaluate exposure.
- Exposure pathways for ecological receptors were effectively evaluated for both the SHS process and the site-specific standard requirements.
- All potential human health receptors and exposure pathway were adequately evaluated, including the pathways that were incomplete.

By fully delineating all impacted environmental media and by performing a complete receptor analysis, the remediator could effectively evaluate all the site environmental systems and the processes that control the transport and movement of regulated substances through the environmental media and how they interact.

#### **c) Applying Site Characterization to an Act 2 NIR – Example**

A characterization of soil contamination is shown in Figure II-4. This example considers a large property with several smaller environmental releases. There are two general areas where environmental releases occurred. The remediator has

initial results which suggest these two areas of concern for further study. Furthermore, the remediator of this property wished to obtain Act 2 liability relief for this release so that the property can be more easily sold. With this objective in mind, the remediator plans a site characterization and weighs options. The following are considerations that must be made.

In addition to factors that will help to characterize the hot spots, the remediator must consider, first in designing further investigations and later in finalizing the site characterization, what is the concentration of regulated substance(s) in soil that will represent the boundary of the site. It is technically more difficult and more expensive to define the extent of the contamination to lower concentrations than it would be to define hot spots. However, the Act 2 liability protection only applies to the site, and if the extent of the site is very limited, so too is the liability protection.

To apply attainment in soils, the remediator must at a minimum define the volume which exceeds the selected standard (25 Pa. Code § 250.703(b)). Sampling beyond the initial phase indicates that two areas exceed the SHS MSCs. The remediator reasons that, by choosing the boundary of the site to be concentrations much lower than the standard, the area of the liability protection is increased. The remediator considers 25 percent of the standard, 10 percent of the standard, and the Practical Quantitation Limit (PQL) of the substance(s) as resolution options. The extra cost of characterization allows the remediator to maximize the site area (and consequently the liability protection) by choosing the PQL and applying it across the entire property. Within this site area, the remediator also characterizes factors of the media and regulated substance(s) which affect movement (see Section III.A, Fate and Transport Analysis). Another remediator may have made a different choice and ended up with several smaller sites with liability protection.

In considering the definition of the site in groundwater (i.e., the plume), some phase of the assessment must determine if the contamination extends beyond the property boundary at levels exceeding the selected standard (25 Pa. Code § 250.704). If the determination is that levels off the property do not exceed the standard, then the remediator determines that the standard can be attained at the Point of Compliance (POC). Figure II-5 illustrates this situation.

If the contamination extends beyond the property boundary at levels exceeding the selected standard, then the boundary of the site in groundwater must include the contamination exceeding the appropriately selected standard off the property. Figure II-6 illustrates this situation. A remediator must remember that if the plume exists on both residential and nonresidential properties, then different numeric standards would apply at those properties in most cases. Background values may also be determined (25 Pa. Code § 250.707(a)(2)).

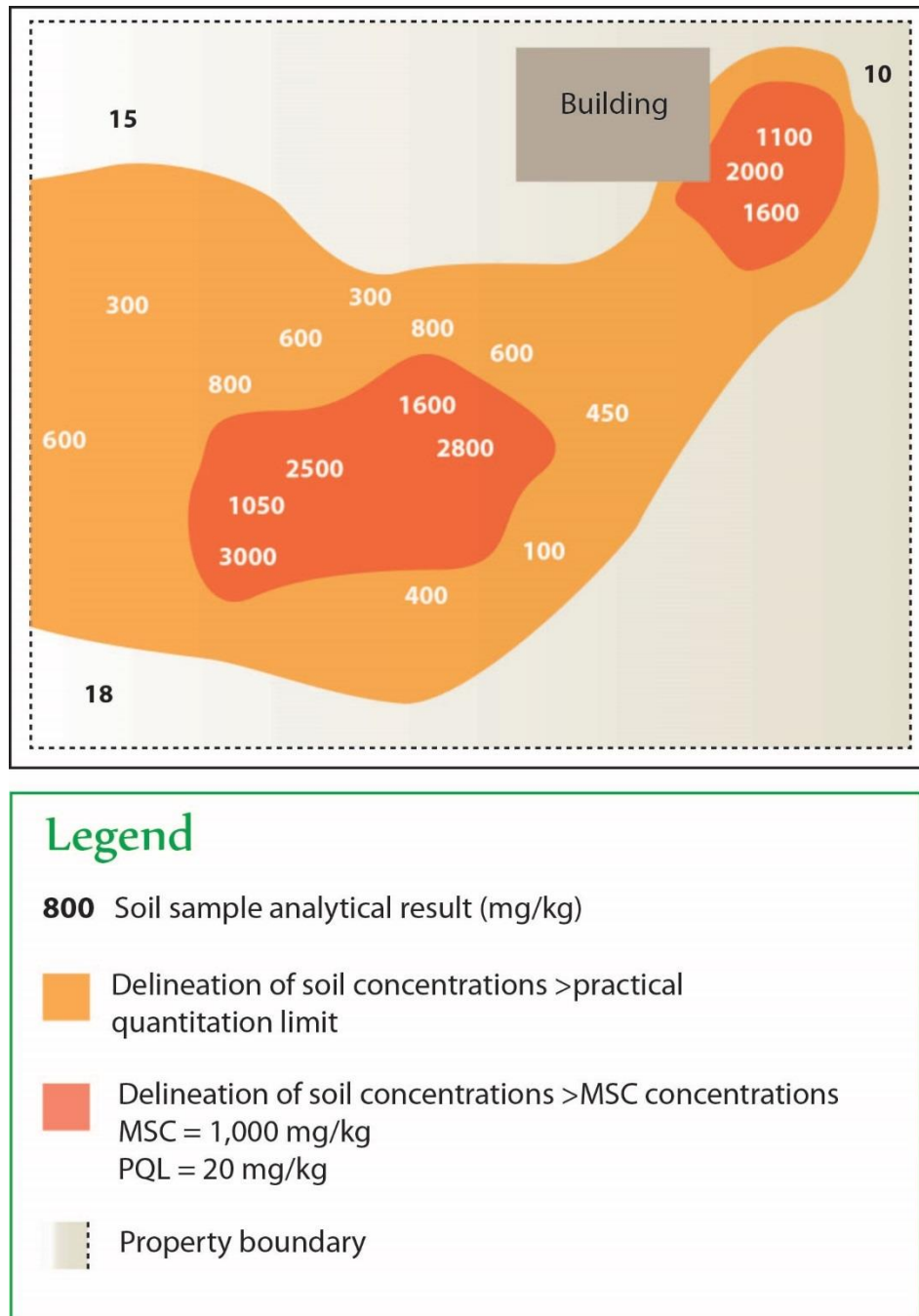
Act 2 defines a residential property as any property or portion of a property which that does not meet the definition of non-residential property. Act 2 defines a "nonresidential property" as any real property on which commercial, industrial, manufacturing or any other activity is done to further either 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. This term shall not include schools, nursing homes or other residential-style facilities or recreational areas.

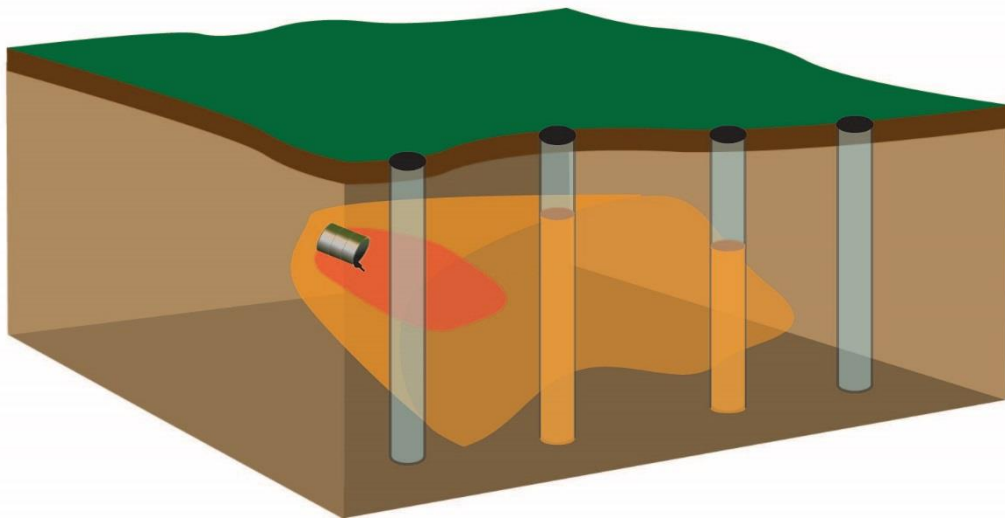
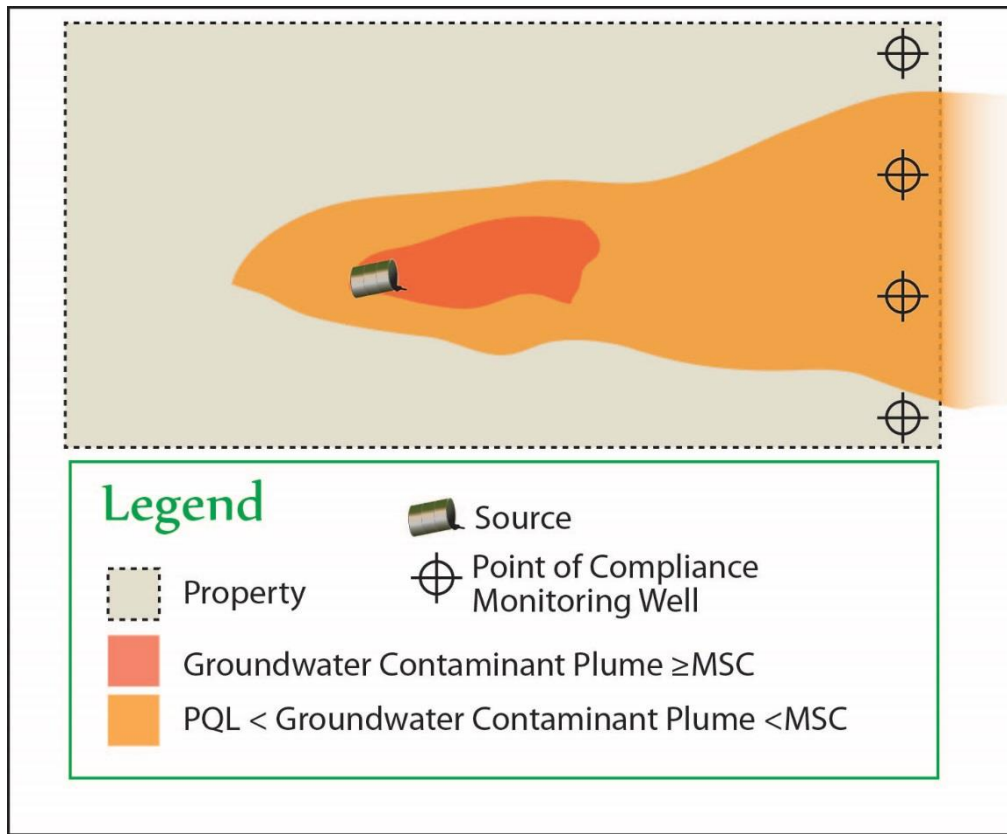
Knowledge of the specific use of the property is important because ~~it~~that is what dictates whether a property is residential or nonresidential. For example, most hotels are designed for short-term occupancy such as a few days or weeks which could be considered nonresidential, but other hotels are designed for extended stays of several months which could be considered residential. Discussing specific property use with DEP is the best way to make this determination.



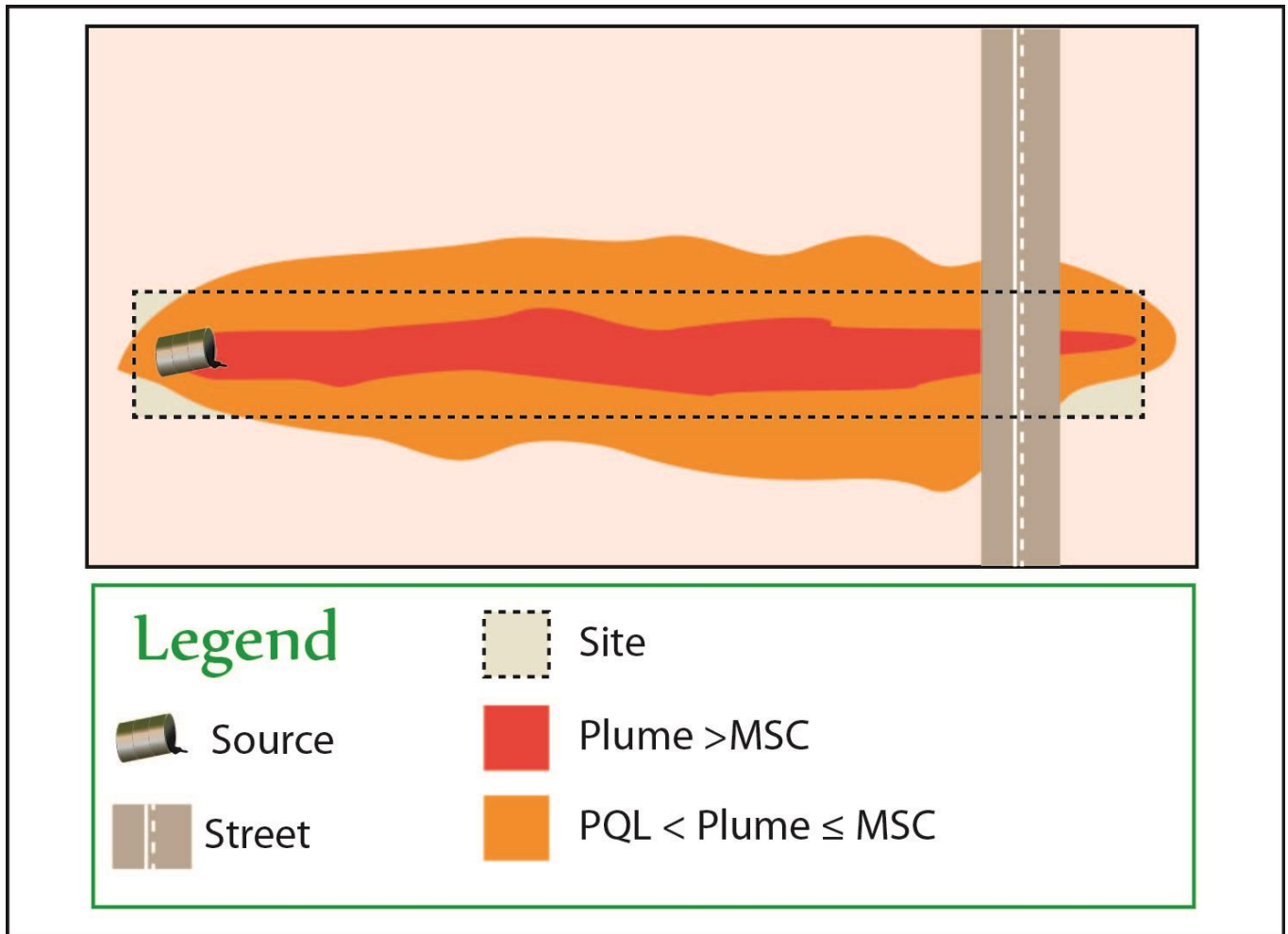
Figure II-4: Site Characterization of Soil Contamination



**Figure II-5: Site Characterization of Groundwater Contamination**  
**No Off-Property Groundwater Concentrations > MSC**



**Figure II-6: Site Characterization of Groundwater Contamination  
Under Statewide Health Standard**



Two or more rounds of sampling and analysis must be performed once the extent of contamination in groundwater is established utilizing properly constructed monitoring wells (25 Pa. Code § 250.204(e)).

If no groundwater remediation is needed (e.g., both rounds of sampling are below the selected standard), the remediator may use the site characterization sampling as part of the required attainment demonstration. The Department may approve a reduction in the number of quarters of sampling needed to demonstrate attainment provided there is appropriate justification under 25 Pa. Code § 250.704(d).

## **B. Remediation Standards**

### **1. Background Standard**

#### **a) Introduction**

This chapter presents procedures to be used in assessing site contamination and demonstrating attainment of the background standard. Use of this guidance and data submission formats should simplify reporting on the site and reduce delays in obtaining final report approval by the Department. This chapter is designed to help those involved understand and meet the requirement of the background standard under Act 2 and the regulations in 25 Pa. Code Chapter 250. Environmental Cleanup and Brownfields Program staff in the Regional Offices are a valuable resource and will assist in answering questions on the background standard.

Background is the concentration of a regulated substance that is present at a site, but is not related to the release of regulated substances at the property. Attainment of the background standard for a regulated substance may be demonstrated by an analysis of environmental media within and around the site (35 P.S. § 6026.302). Establishing the background concentration is discussed in Subsection II.B.1(d) of this manual. Subchapter B under Chapter 250 of the regulations also discusses the background standard requirements.

The background standard may result in higher than health-based level contamination (e.g. SHS MSCs) moving onto the property from an adjacent property or from constituents which are naturally occurring. Background quality is the concentration of substances which are unrelated to the release on the site.

In order to demonstrate compliance with the background standard, remediators should demonstrate that onsite media do not exceed the background standard for a regulated substance(s) by statistically developing representative contaminant concentrations through onsite and background reference samples of the environmental media. Subchapter G under Chapter 250 of the regulations establishes statistical tests recognized by the Department for the demonstration of attainment. Background statistical attainment requirements are in 25 Pa. Code § 250.707(a)(1) for background soils and Pa. Code § 250.707(a)(2) or (3) for background groundwater. Demonstration of attainment for background is discussed in Subsection II.B.1.e.vi of this manual.

Reporting the completion of a remediation to the Department requires a final report that contains a detailed description of the process taken to reach the background standard and the reasoning for choosing media for testing. Section 250.204 of the regulations discusses the requirements for a final report. Section II.B.1(e) of this manual also contains a discussion on the final report requirements for the background standard. Summaries of sampling methodology and analytical results showing attainment should be included with the report 35 P.S. § 6026.302(b)(2).

Institutional controls such as fencing and future land use restrictions on a site may not be used to attain the background standard. Institutional controls may be used to maintain the background standard after remediation occurs 25 P.S. § 6026.302(b)(4).

If the initial remediation chosen by the remediator fails to attain the background standard, the remediator may choose instead to meet the Statewide health or site-specific standards 35 P.S. § 6026.302(c). Sites attaining and demonstrating compliance with the background standard are not required to meet the deed acknowledgment requirements of the Solid Waste Management Act (SWMA) or the Hazardous Site Cleanup Act (HSCA) or the Uniform Environmental Covenants Act (UECA). An existing acknowledgment contained in a deed prior to demonstrating compliance with the background standard may be removed.

**b) Process Checklist for the Background Standard**

- ☐ Review the historic and current information and present use of regulated substances at the property.
- ☐ Begin the site investigation/characterization and gather information about the area on and around the property.
- ☐ As an option, begin using the completeness list (see LRP website) to help verify that all requirements have been met.
- ☐ Determine if property/site is affected by regulated substances not originating from the property.

For the groundwater background concentration, establish if it is naturally occurring/area-wide or from an upgradient source (see 25 Pa. Code § 250.707).

- ☐ For the soils background concentration, establish if it is a naturally occurring or area-wide problem. The Department has not established background concentrations for naturally occurring substances as they may vary considerably across the Commonwealth. Geochemical references are available for certain rock and soil types in Pennsylvania and should be cited as appropriate. Background concentrations should be determined on a site-by-site basis.
- ☐ If using the naturally occurring/area-wide background distinction, request in writing and receive back in writing the Department's approval that the site is indeed in an area of widespread contamination for the regulated substance on your property/site before submitting the NIR (see 25 Pa. Code § 250.707(a)(3)(i)).
- ☐ Continue with the site characterization and required activities needed to complete the final report (see 25 Pa. Code § 250.204).

- ☐ Submit an NIR for the background standard. Also, send a notice to the municipality, publish a notice in a local newspaper, and attach reasonable proof of required notices for inclusion with the final report to the Department 35 P.S. § 6026.302(e)(1). Procedures for submittal of notifications are contained in Section II.A.3 of this manual. Links to sample forms are located on the LRP website.
- ☐ Remediate the site to the background standard.
- ☐ Demonstrate attainment of the background standard pursuant to 25 Pa. Code § 250.203.
- ☐ Calculate mass of contaminants remediated using the procedure in Section III.D of this manual.
- ☐ Complete the final report summary and submit electronically as instructed on the LRP website.
- ☐ Prepare and submit the final report, along with the optional completeness list (if used) to the appropriate DEP Regional Office. See Section 302(b)(2) of Act 2, 35 P.S. § 6026.302(b)(2), 25 Pa. Code § 250.204, and Section II.B.1(e) of this manual.
- ☐ If the final report is approved, the liability protection set forth in Chapter 5 of Act 2 automatically applies.
- ☐ If engineering controls were used and postremediation care is required to maintain the standard, continue with the postremediation care program detailed in the final report. Postremediation care would not normally be used for the background standard.
- ☐ When the background standard can be maintained without engineering controls operating, document this to the Department and receive approval to terminate the postremediation care program.
- ☐ Submit an environmental covenant, if applicable, to the Department.

**c) Point of Compliance (POC) for the Background Standard**

For the background standard, the POC for groundwater is throughout the area of contamination (plume) both from the offsite (upgradient) release that migrates onto the property and another release within the property, including areas to which the onsite release has migrated off the property above the background standard as determined by the site characterization (see Figures II-7 and II-8). This differs from the groundwater POC for the Statewide health and site-specific standards. (See 25 Pa. Code § 250.203(a)).



For a property located within areawide contamination, the minimum required POC is the extent of plume contamination on and off the property from an on-property release, as shown in Figures II-9A and II-9B. A remediator may choose to use a larger point of compliance by including all areas on the property which have been affected by an upgradient release. In this example, the remediator could choose to use the entire area shown as being affected by the upgradient release as the POC. In such a case, the remediator would receive liability protection for the entire area affected by the upgradient release.

The POC for the background standard in soil is throughout the area of the soil that has been contaminated (see 25 Pa. Code § 250.203(b)).

For surface water, point source discharges shall be measured at the point of discharge in accordance with limits in the National Pollutant Discharge Elimination System (NPDES) permit (see 25 Pa. Code § 250.203(c)). For spring or diffuse groundwater flow to surface waters, attainment of the background standard for groundwater will satisfy Act 2.

**d) Establishing Background Concentration(s)**

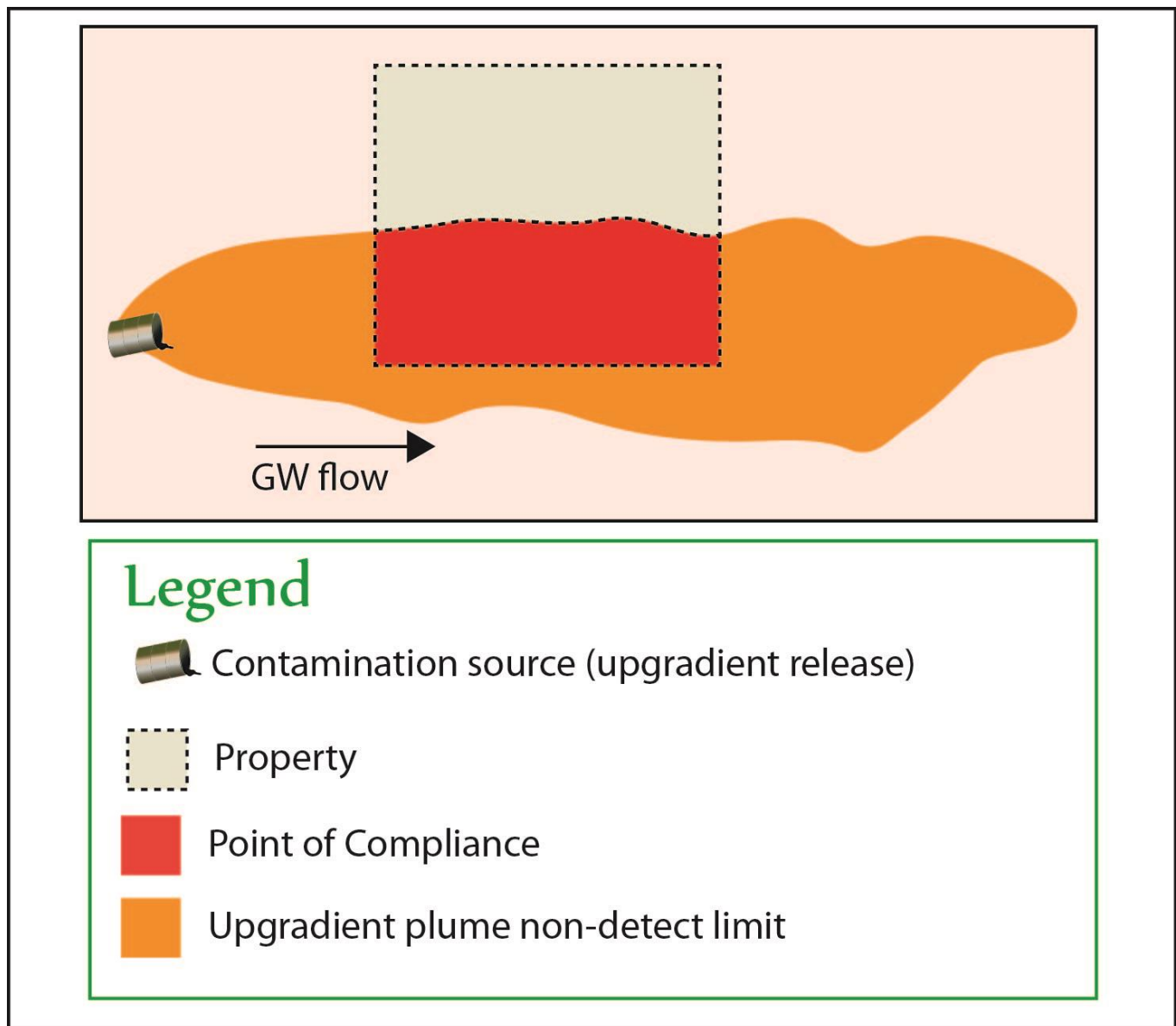
Background concentrations are determined using analysis of samples of regulated substances present at the property under investigation but not related to any release at the property. If all areas on the property are affected by a release at the property, then background samples will be taken in an area free of contamination from any release at the site, including representative off-property areas. Persons may not obtain Chapter 5 cleanup liability protection by using a contaminated area as a background reference area when they are responsible for the contamination.

Background soil sampling locations must be representative of background conditions for the site, including soil type; physical, chemical, or biological characteristics; and depth below ground surface. Randomization of sampling at background and onsite locations must be comparable (see 25 Pa. Code § 250.204(f)(7)).

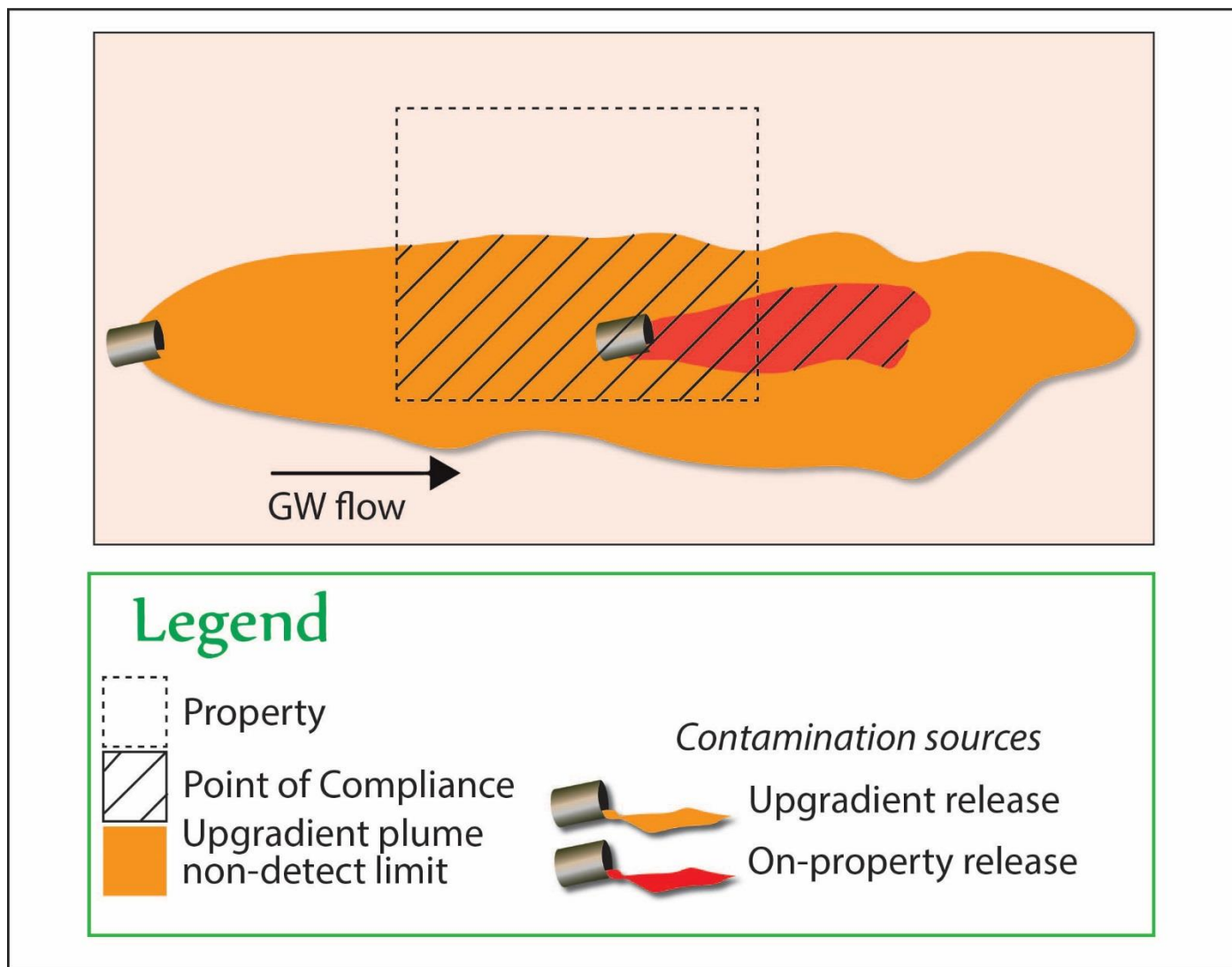
Any wells that are used to establish groundwater concentration(s) must be hydrogeologically upgradient or otherwise justified from the groundwater onsite that is affected by any release at the property and that characterizes the flow onto the site. Upgradient wells may not be appropriate to detect movement of a dense non-aqueous phase liquid (DNAPL) since geologic structure rather than hydrogeologic gradient may influence DNAPL movement.

Background concentrations determination will be by a statistically valid method that is consistent with the methods used to demonstrate attainment. Statistical methods are included in 25 Pa. Code § 250.707 and in Section II.B.1(e)(vi) of this manual.

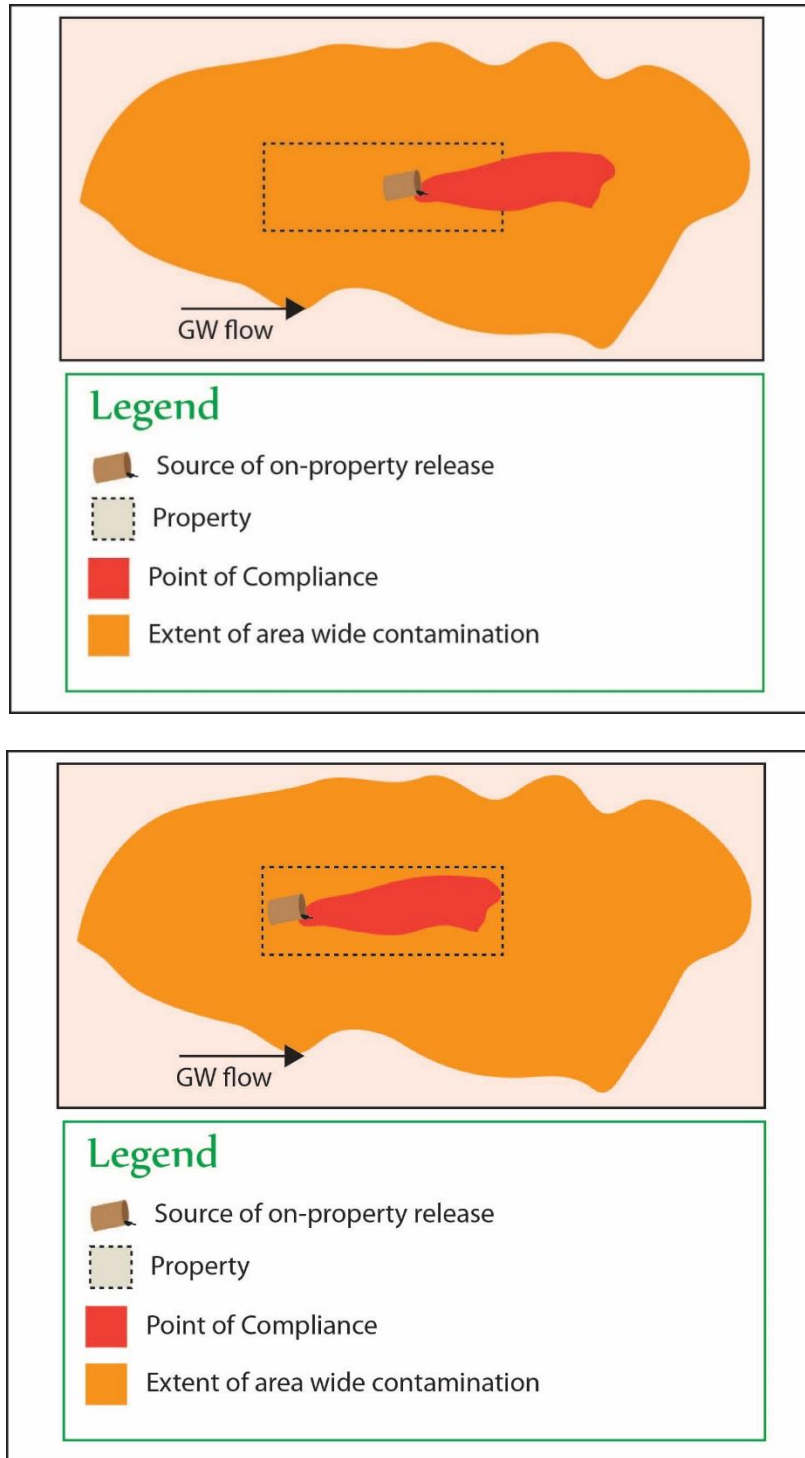
**Figure II-7: Point of Compliance for the Background Standard Compliance with Background Standard from Upgradient Release with No On-Property Release**



**Figure II-8: Point of Compliance for the Background Standard Off-Property Migration with an Upgradient Groundwater Source Area Release**



**Figure II-9A and 9B: Areawide Contamination Scenarios**



For non-naturally occurring regulated substances (primarily organic compounds), the affected area shall be shown to be related to sources other than the release of regulated substance on the site. This may include transport of regulated substances onto the property in the gaseous, liquid, or solid phases and associated mixing with or partitioning to onsite gaseous, liquid, or solid-phase media. For background conditions that are related to ongoing flux onto the site (e.g., regulated substances dissolved in groundwater flowing onto the site or soil vapor transport onto the site), the background concentrations shall be determined by monitoring the concentrations of regulated substances associated with this flux where it enters the property. For background conditions that are not related to a continuing source of chemical flux onto the property (e.g., historical accumulation of airborne contaminants including particulate and associated deposition in surficial soils), the determination of background concentrations shall include the identification of the source(s), if possible, and a demonstration that the areal distribution of the background conditions extends beyond the limits of the property.

These same determinations should be made for naturally occurring regulated substances. However, an additional determination should be made as to the naturally occurring concentrations of these regulated substances independent of impacts from the release(s) or other background sources. Therefore, for naturally occurring regulated substances, the background standard would include the naturally occurring concentration plus contributions from sources not on the property.

Use of breakdown products of a regulated substance from offsite which form on the site undergoing remediation can be included in the assessment of attainment of the background standard. The Department is willing to consider breakdown products of substances released upgradient of the property. The remediator should submit historical information and fate and transport analyses to demonstrate that the substances onsite are a result of chemical breakdown and not a result of a release on the property. Likewise, a conclusion that contamination entering a subject property which transforms or degrades to a compound similar to a spill which occurred on the subject property will be supported by the combined sample analysis and fate and transport analysis determination. The remediator must demonstrate that the concentrations are the result of transformation or direct migration of chemicals from the background area.

The establishment of the groundwater background concentrations for a site using sampling and analysis allows for two different background conditions, as described in 25 Pa. Code § 250.707(a):

- Background from a known upgradient release of regulated substance.
- Background from naturally occurring or areawide contamination (this can also apply to soils).

The Department provides different procedures to establish the background groundwater concentration depending on which background condition is present

upgradient and adjacent to the property. The method used when establishing background and determining attainment of the background standard for a site must be the same.

**i) Background from a Known Upgradient Release of a Regulated Substance**

**(a) Groundwater**

This groundwater distinction occurs when an adjacent or nearby property has had a release of the same regulated substance that flows onto the property under consideration for an Act 2 remediation. One option for determining background conditions is through the use of monitoring wells sampled during the site characterization to establish the well with the highest concentration of the groundwater migrating onto the site. Another option is to compare the statistical distribution of the background area with the impacted area onsite. Section 250.707(a)(2) in the regulations, Section II.B.1.e.vi of this manual, and the statistical requirements in Section III.B of this manual discuss the handling of the statistical requirements for groundwater attainment in the background standard.

A remediator who believes that a site meets the conditions for reducing the timeframe for implementing eight groundwater sampling events as found in 25 Pa. Code § 250.707(a)(2)(x), and already has eight or more samples collected in four quarters or less, may request that the Department accept fewer than eight quarters of sampling. The request may be submitted with supporting information to the Regional ECB Program Manager. If the Department is not satisfied that these conditions are met, the remediator shall continue to monitor for the remainder of the eight quarters.

The time frame for taking the background samples when remediation is not undertaken may start before the site characterization is completed. This will allow a remediator who has existing data to establish background without the need to monitor for an additional four or eight quarters if all the consecutive quarterly data total four or eight quarters, as applicable to that background condition.

If remediation action is undertaken, the attainment sampling is done after remediation is completed.

**(b) Soil**

Soils where a large area was affected by a release of regulated substances off-property do not typically move from one location to

another in comparison with the movement of groundwater. Natural movement of soil in Pennsylvania normally involves surface water transporting sediment, landslides, or airborne transport of soil or contaminants.

**ii) Background from Naturally Occurring or Area-wide Contamination**

Some areas of the Commonwealth have naturally occurring or widespread contamination. A remediator should obtain a written agreement from the Department if they plan to demonstrate that their site is in an area of naturally occurring or widespread contamination. This decision will be based on evidence presented to the Department in writing by the remediator seeking the determination. When the Department agrees, through written acknowledgment to the remediator that the property under investigation is within a location of areawide contamination, the following approach for establishing background is allowed.

**(a) Groundwater**

When the background groundwater condition is due to naturally occurring or areawide contamination, a minimum of 12 samples should be collected offsite and 12 samples collected onsite. The number of wells sampled onsite and offsite must be the same in each round of sampling. For example, if three wells are sampled offsite, three wells must be sampled onsite. In this example, each of the wells must be sampled a minimum of four times. The samples must be independent of one another. The onsite and offsite samples must be collected at the same time. The time frame for establishing this condition is not predetermined, as it is in the upgradient release. By increasing the number of wells onsite and offsite, the number of sampling events necessary to meet the minimum of 12 samples can be reduced (two wells will require six sampling events, six wells will require two sampling events). The offsite wells must be located upgradient of the site. The number of wells and the horizontal and vertical location of the wells onsite must be adequate to characterize any release of regulated substance at each site. All sampling data must be reported to the Department.

**(b) Soil**

When the background soil condition is due to naturally occurring or areawide contamination, the remediator shall compare the analytical results of background reference samples that are representative of naturally occurring or areawide contamination of substances on the site, with the analytical results of onsite concentrations. A minimum of 10 samples should be collected offsite or at the background referenced area, and 10 samples collected onsite. The comparison should be conducted using the

statistical methods summarized in 25 Pa. Code § 250.707(a)(1) and in Section III.B of this manual.

**(c) Historic Fill**

Some sites may be located in an area where there has been widespread use of fill (Figure II-10). This fill may contain regulated substances. If a spill or discharge of a regulated substance occurs on a site that received fill long ago (historic fill), the remediator can limit ~~their~~<sup>this</sup> remediation to the discharge that he or she has recently caused. In this case, the remediator would obtain relief from liability only for cleaning up what the remediator has recently spilled. This includes contamination resulting from the onsite release to the soil and groundwater. Remediators who wish to limit their cleanup to the levels that were already present in the fill should provide information to the Department indicating that the fill was historical (placed prior to 1980), not placed at their direction, and widespread or involved more than the subject property.

An example of contamination that may have occurred through airborne transport comes from the time when leaded gasoline was commonly used in automobiles. The surface and near-surface soils of properties along highways have been found to have elevated levels of lead. Samples taken from a number of properties near and along the highways would be required to compare the onsite and offsite conditions.

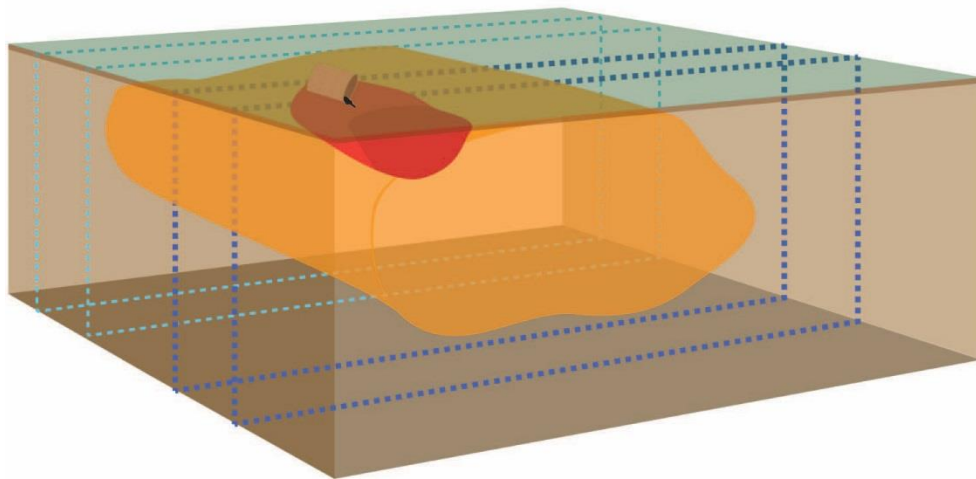
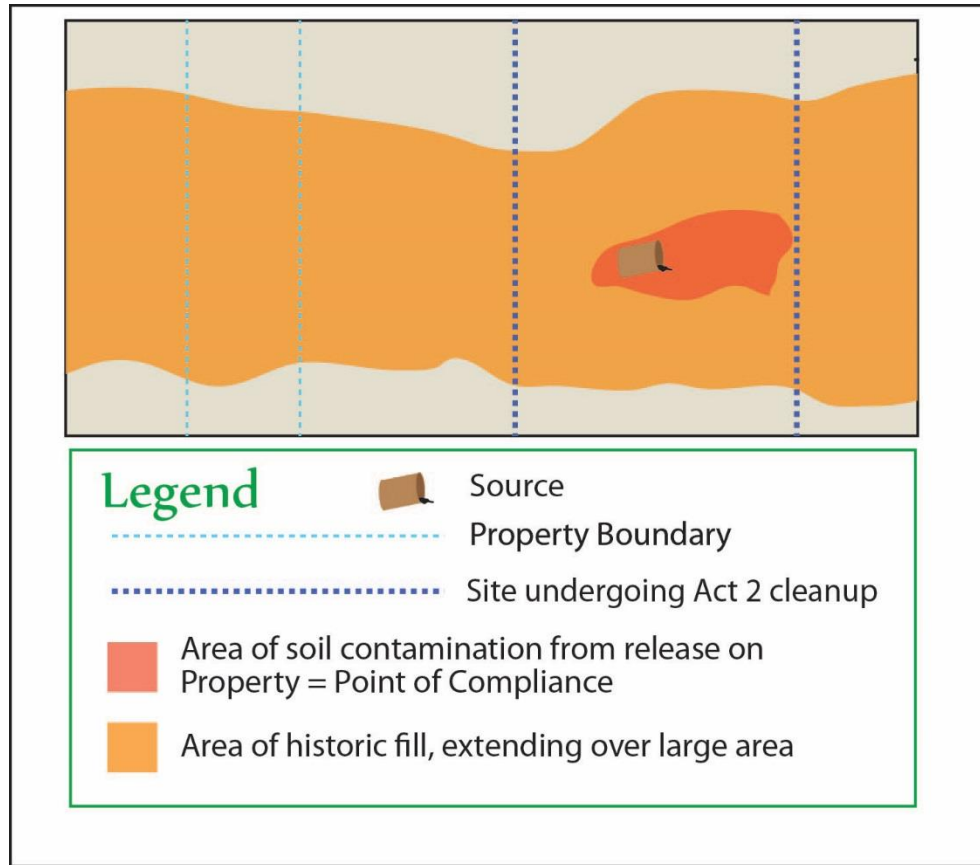
**e) Final Report Requirements for the Background Standard**

For a site remediated under the background standard, the remediator shall submit a final report to the Department which documents attainment of the selected standard. Section 250.204 of the regulations discusses final report requirements.

A complete final report is prepared in accordance with scientifically recognized principles, standards, and procedures. The report will present a thorough understanding of the site conditions. It will provide a detailed discussion on the AOC and a conceptual site model based on the results of the site characterization. Support for interpretations and conclusions will be based on data collected during all of the investigations at the site. The level of detail in the investigation and methods selected need to be sufficient to define the rate, extent, and movement of the contaminants to assure continued attainment of the remediation standard. In accordance with 25 Pa. Code § 250.204(a), all interpretations of geologic and hydrogeologic data shall be prepared by a professional geologist licensed in Pennsylvania.



**Figure II-10: Background Standard Attainment with Areawide Fill**



~~Two copies of the final report should be submitted for the Department's review. One should be a paper copy and the other should be submitted in another format (CD, flash drive, etc.).~~ The final report must include the information in paragraphs (i)-(xi) of this section, and it should be organized according to the outline in Table II-1, below.

The following paragraphs describe the information to be included in the final report:

**i) Summary**

The Final Report Summary form should be filled in and submitted to the Department electronically. The summary submitted with the final report should be a copy of that completed form.

**ii) Site Description**

~~Provide Aa~~ description of the site in sufficient detail should be provided to give the reviewer an overall understanding of the site and its location, and the types of operations that are currently and/or were formerly conducted on the site. As appropriate to the site, the description should include location, physical description of the property, ownership history, site use history, and regulatory action history (past cleanups).

**iii) Site Characterization**

The site characterization provides important information documenting the current conditions at the site and shall be based on 25 Pa. Code § 250.204. The two principal objectives of an investigation under the background standard are to determine what constitutes background for each of the regulated substances associated with the release, and to characterize the nature, extent, direction, volume and composition of regulated substances that have been released. Considerations for establishing the background concentrations are found in Section II.B.1.d. Section 250.204 of the regulations provides reporting requirements for the background standard.

For sites where there are multiple distinct areas of contamination, the site characterization process should be applied to each area individually.

**Table II-1: Suggested Outline for a Final Report under the Background Standard**

**I. Final Report Summary**

The final report summary should be a copy of the electronic form submitted to the Department.

**II. Site Description**

Provide a description of the site in sufficient detail to give an overall view of the site (Section II.B.1(e)(ii)).

**III. Site Characterization**

Document current conditions at the site (25 Pa. Code § 250.204 and Section II.B.1(e)(iii)).

**IV. Background Standard**

Describe how the background standard was established (Section II.B.1(e)(iv)).

**V. Remediation**

Describe the remedial methodologies used to attain the selected standard (Section II.B.1(e)(v)).

**VI. Attainment**

A. Soil background standard

B. Groundwater background standard

Both sections A and B should describe the statistical methods used to establish background and to demonstrate attainment of the standard (Section II.B.1(e)(vi)).

**VII. Fate and Transport Analysis**

Describe fate and transport analyses used and the results and conclusions (Section II.B.1(e)(vii)).

**VIII. Postremediation Care Plan**

This section is included only if necessary. It describes the engineering and institutional controls necessary to maintain the standard (Section II.B.1(e)(viii)).

**IX. References**

(Section II.B.1(e)(ix))

**X. Attachments**

(Section II.B.1(e)(x))

**XI. Signatures**

(Section II.B.1(e)(xi))

Along with a narrative, the results from the site characterization and all sampling and analysis work should be provided on map(s) illustrating, to the extent possible, the interrelationship of the following:

- All physical site characteristics.
- All groundwater, soil, sediment, and other sample locations, including sample depth and contaminant concentration.
- The surveyed locations for all assessment structures (monitoring wells, soil borings, test pits, etc.). All elevations should be reported in reference to mean sea level (msl), where practical.
- Appropriate number of stratigraphic cross sections that adequately depict site stratigraphy, well locations, well depths, groundwater flow directions, equipotential lines, flow lines, hydraulic conductivity intervals and values, sampling intervals and concentrations. All elevations should be reported in reference to msl, where practical.
- Variation in potentiometric surfaces(s), potentiometric surface map(s), hydraulic gradients, and groundwater flow directions.
- All identified sources of releases.
- The extent and concentrations of contaminant plumes in all media. The horizontal and vertical extent of contaminant plumes, including the relative density and thickness of any separate phase liquids (SPL) present.
- Top of bedrock contour (if encountered).

A conceptual site model should be developed and refined as information is gathered during the site characterization. The conceptual site model provides a description of the site and extent of contamination. Some of the information and data used to develop the site model would include:

- The type, estimated volume, composition, and nature of the released materials, chemicals or chemical compounds (include all calculations and assumptions).
- Source(s) and extent of release(s).
- Background concentrations for constituents of concern.
- The horizontal and vertical extent of contamination.

- Affected aquifer(s) or water bearing formation(s)/member(s), hydrostratigraphic units.
- All existing and potential migration pathways.
- The estimated volume of contaminated soil and water (include all calculations and any assumptions).

For soils, include information on samples and measurements used to characterize the horizontal and vertical extent of contamination, and the direction and rate of contaminant movement based on factors in the soil and the contaminant(s) which affect migration. Soil and boring descriptions should be included as an attachment.

For groundwater, include information on samples and measurements used to characterize the horizontal and vertical extent of contamination, and the direction and velocity of contaminant movement based on factors of the groundwater and the contaminant(s) which affect migration. Geologic boring descriptions and as-built drawings of wells should be included as an attachment. Text, tables, graphics, figures, maps, and cross sections, as appropriate, can be utilized to describe the nature, location, and composition of the regulated substances at the site. Providing the data in an appropriate format will expedite the review of the report.

**iv) Background Standard**

- How the background concentration was established.
- Type of background condition: upgradient release or area-wide contamination.
- Identify on a map the location of background soil samples and background groundwater wells.
- Document that POC attainment for groundwater is throughout the plume.
- Attainment for each medium is to be determined by the same method as the method used to establish background levels.
- Summary of sampling methodology and analytical results relating to determination of background.

**v) Remediation**

Provide a description of the remedial methodologies used to attain the selected standard. Examples of the types of information typically included in this section include:

- Identification of areas remediated based on results of site characterization.
- Descriptions of treatment, removal, or decontamination procedures performed in remediation. Description of removal, what was removed, and amount removed. Results of any treatability, bench scale, or pilot scale studies, or other data collected to support the remedial action(s).
- Description of the methodology and analytical results used to direct the remediation and determine the cessation of remediation. This description should document how the remediator determined that remediation was performed to address all areas that exceed the standard.
- Description of treatment technologies.
- Documentation of handling of remediation wastes in accordance with applicable regulations.
- Specific characteristics of the site that affected the implementation or effectiveness of the remedial action, including such characteristics as topography, geology, depth of bedrock, potentiometric surfaces, and the existence of utilities.
- All other site information relevant to the conceptual design, construction, or operation of the remedial action.

In addition to the above, this section should also include the calculation of the mass of contaminants addressed during the remediation of soil and/or groundwater, using the methodology in Section III.D.

**vi) Attainment**

Appropriate statistical methods, discussed in Section III.B, will confirm the attainment of cleanup under the background standard. Not all the statistical tests discussed in the manual are appropriate for the background standard attainment tests. Section 250.707(a) of the regulations describes statistical tests for the background standard. The following information shall be documented in a final report when a statistical method is applied, except for the highest measurement comparison test described in § 250.707(a)(1)(i) of the regulations:

- Description of the statistical method and the underlying assumptions of the method.
- A clear statement of the applicable decision rule in the form of a statistical hypothesis for each spatial unit and temporal boundary, including the applicable statistical parameter of interest and the specific cleanup standard.
- Documentation showing that the sample data set meets the underlying assumptions of the method and explaining why the method is appropriate to apply to the data.
- Specification of false positive and false negative rates.
- Documentation of input and output data for the statistical test, presented in table and figures, or both, as appropriate; and identification, by medium, contamination levels remaining onsite.
- An interpretation and conclusion of the statistical test.

In demonstrating attainment of the background standard, concentrations of regulated substances are not required to be less than the limit related to the PQL for that substance as provided for in § 250.701(c) of the regulations.

**(a) Soil Background Standards**

The determination of attainment of soil background standards will be based on a comparison of the distributions of the background concentrations of a regulated substance with the concentrations in an impacted area. Act 2 regulations allow a person to use highest measurement comparison, combination of Mann-Wilcoxon Rank Sum (WRS) test and Quantile test, or other appropriate methods to demonstrate attainment of background standards. No matter which method is used, Act 2 regulations require that the minimum number of soil samples to be collected is 10 from the background reference area and 10 from each cleanup unit. This requirement of 10 samples is to ensure that any selected statistical test has sufficient power to detect contamination.

**(b) Groundwater Background Standards**

There are two general categories of background conditions for groundwater. The first is naturally occurring background or area-wide contamination. The second is background associated with a release of regulated substances at a location upgradient from the site that may be subject to such patterns and trends.

For naturally occurring background or areawide contamination, it is recommended that a minimum of 12 samples be collected from



any combination of upgradient monitoring wells, provided that all data collected are used in determination of background concentrations. This same number of samples must then be collected from monitoring wells impacted by a release on the site during the same sampling event. In both cases, this sampling may be accelerated such that all samples are collected as quickly as possible so long as the frequency does not result in serial correlation in the data. The resulting values may be compared using either nonparametric or parametric methods to compare the two populations, such as using the combination of the WRS test and the Quantile test. When comparing with the background results, the sampling results in the plume onsite should not exceed the sum of the arithmetic average and three times standard deviation calculated for the background reference area 25 Pa. Code § 250.707(a)(3)(vii).

For background associated with a release of regulated substances at a location upgradient from a property, the background groundwater concentrations will be determined at the hydrogeologically upgradient property line of the property, or a point hydrogeologically upgradient from the upgradient property line that is unaffected by the release.

Section 250.707(a)(2) of the regulations allows the use of the nonparametric tolerance limit procedure for background associated with an upgradient release of regulated substances. The nonparametric tolerance limit procedure requires at least eight samples from each well over eight quarters in order to have sufficient power to detect contamination. Once the nonparametric upper tolerance limit is established for upgradient data, data from downgradient compliance wells can be compared to the limit. A resampling strategy can be used when an analyte-substance exceeds the nonparametric upper tolerance limit. The well is retested for the substanceanalyte of concern and the value is compared to the nonparametric upper prediction limit. These two-phase testing strategies can be very effective tools for controlling the facility-wide false positive rate while maintaining a high power of detecting contamination. See Chapter 19 of the EPA Unified Guidance (EPA 530-R-09-007, U.S. EPA, March 2009), which describes the procedures to use.

#### **vii) Fate and Transport Analysis**

The Fate and Transport Section (Section III.A) of this manual provides a discussion on fate and transport analysis. The amount of detail in the fate and transport analysis will vary from a simple narrative description to a very extensive detailed model with quantitative modeling as appropriate to the circumstances of the site. Whenever a model is used, the Department must be provided with the assumptions, data, and information on the

model necessary for Department staff to evaluate and run the model. Any parameters used in the analysis or models should use data obtained from the site during the site characterization.

The following are examples of situations where a fate and transport model/analysis is used to justify a special condition when attaining the background standard:

- When shortening the number of groundwater samples for establishing an upgradient release in the background determination (25 Pa. Code § 250.707(a)(2)(x)), it is required that fate and transport be fully evaluated.
- When contamination remains in the unsaturated soil, fate and transport must demonstrate that the contamination in the soils will not impact the groundwater and raise the level of regulated substances above the groundwater standard. This would apply to both the soils and groundwater attaining the background standard or when using a combination of standards; for example, background standard in the groundwater and SHS in the soils.
- When the contamination on the site is the result of chemical transformations (e.g., parent to daughter), fate and transport must demonstrate that the concentrations of regulated substances onsite were the result of offsite releases.

While the previous examples will require detailed evaluation, when the source and any regulated substance that could have migrated from the source are removed before contamination reached the groundwater, the fate and transport analysis could be very short and non-quantitative.

When the background standard is attained in all media, the fate and transport analysis will confirm that no cross-media contamination will cause contamination in one medium to raise the contamination in another medium above the standard.

If the standard will be exceeded in the future, a postremediation care plan is required.

#### **viii) Postremediation Care Plan (if applicable)**

If engineering or institutional controls are needed to maintain the standard, a postremediation care plan must be documented in the final report in accordance with 25 Pa. Code § 250.204(g). The plan should include reporting of any instances of non-attainment; reporting of any measure to correct non-attainment conditions; periodic reporting of monitoring; sampling and analysis as required by the Department; maintenance of records at the property where the remediation is being conducted for monitoring, sampling and analysis; and a schedule for operation and

maintenance of the controls and submission of any proposed changes. The Department may ask for documentation of financial ability to implement the remedy and to maintain the postremediation care controls. When the standard can be maintained without the controls operating and documentation of such is provided, the Department will approve termination of the postremediation care program.

**ix) References**

Any references mentioned in the final report.

**x) Attachments**

Attachments may include but are not limited to:

- Tables – monitoring well construction summary, groundwater gauging data (including elevation and non-aqueous phase liquid (NAPL) thicknesses), analytical data, historical data.
- Figures – including groundwater elevation maps, extent of NAPL, concentration data for soil/groundwater/surface water, cross-sections.
- Monitoring well construction diagrams, boring logs, stratigraphic logs (including soil/rock characteristics).
- Sampling and analysis plan(s).
- Quality Assurance (QA) and Quality Control (QC) Plan.
- Well search documentation (from PaGWIS).
- Field data sheets, such as low flow purging monitoring.
- Statistical worksheets, software outputs, graphs, etc.
- Disposal documentation of soil/groundwater.
- Remediation system operation, maintenance, monitoring data; mass removal estimates.
- Before and after remediation photographs.
- Copy of municipal notification, reasonable proof of newspaper notice publication, Department acknowledgement of natural or area-wide contamination.

**xi) Signatures**

If any portions of the submitted report were prepared or reviewed by or under the responsible charge of a registered professional geologist or engineer, the professional geologist or engineer in charge must sign and seal the report.

**2. Statewide Health Standard**

**a) Introduction**

The SHS is established by Sections 301 and 303 of Act 2 (35 P.S. §§ 6026.301 and 6026.303) and includes MSCs that must be attained to achieve the liability protection provided for in the Act. The MSCs are calculated in accordance with the methodologies in § 250.304 through 250.310 of the regulations.

The numerical MSCs are contained in Appendix A to Chapter 250, Tables 1 through 6. Cleanup liability protection provided under Act 2 is contingent upon the attainment of the appropriate MSCs determined using the procedure described in Section II.B.2(c) below.

This guidance presents the procedures to be used in assessing site contamination and demonstrating attainment of the SHS. Use of this guidance and data submission formats should simplify reporting on the site and reduce delays in obtaining final report approval by the Department. This guidance is designed to aid in understanding and meeting the requirements of the SHS under Act 2 and the regulations in Chapter 250. ECB staff in the Regional Office are a valuable resource and will assist as requested in answering questions on the SHS.

Failure to demonstrate attainment of the SHS may result in the Department requiring additional remediation measures to be taken to meet the SHS; or the remediator may elect to attain one of the other standards.

**b) Process Checklist for Remediations Under the Statewide Health Standard**

- ☐ Review the historical information and present use of regulated substances at the property.
- ☐ Begin site investigation/characterization and gather information about the area on and around the property.
- ☐ Optional: Begin using the completeness list (see LRP webpage) to help verify that all requirements have been met.
- ☐ Optional: Determine if the property/site is affected by regulated substances not from the property to determine if the background standard may be appropriate. Contact DEP Regional Office for information.

- ☐ Submit an NIR for the SHS. Also, provide notice to the municipality, publish a notice in a local newspaper, and obtain reasonable proof of submittal for inclusion with the final report. Procedures for submittal of notifications are contained in Section II.A.3 of this manual.
- ☐ Continue with the site characterization and required activities, including vapor intrusion evaluation (see Section IV of this manual), needed to complete the final report.
- ☐ Remediate the site to the SHS.
- ☐ Demonstrate attainment of the SHS. Methods for demonstrating attainment are described in 25 Pa. Code § 250.707(b) and in Section III.B of this manual.
- ☐ Calculate the mass of contaminants remediated using the procedure in Section III.D of this manual.
- ☐ Complete the Final Report Summary electronically in accordance with the instructions on the LRP webpage.
- ☐ Prepare and submit final report, along with the optional completeness list (if used), to the Department. Reporting requirements are established by 25 Pa. Code § 250.312 and are described in Section II.B.2(f) of this manual.
- ☐ A postremediation care program must be implemented and documented in the final report including the information required by § 250.204(g) of the regulations if: (1) engineering controls are needed to attain or maintain the SHS; (2) institutional controls are needed to maintain the standard; (3) the fate and transport analysis indicates that the remediation standard, including the solubility limitation, may be exceeded at the POC in the future; (4) the remediation relies on natural attenuation; (5) a postremedy use is relied upon but is not implemented to eliminate complete exposure pathways to ecological receptors; or, (6) mitigative measures are used.
- ☐ Submit an environmental covenant, if applicable, to the Department.
- ☐ Receive approval of the final report from the Department, if the final report documents that the person has demonstrated compliance with the substantive and procedural requirements of the SHS (which automatically confers the Act 2 liability protection as set forth in Chapter 5 of Act 2).
- ☐ Except for the special case of a nonuse aquifer standard (See Section II.B.4(c), when the SHS can be maintained without engineering controls operating, document this to the Department and receive approval to terminate the postremediation care program.

c) **Selection of MSCs**

The appropriate MSC for each regulated substance present at a site is determined for each environmental medium, particularly groundwater and soil. The decision tree in Figure II-11 illustrates the thought process that goes into the selection of the appropriate MSCs for groundwater and soil. If values for the compounds on a given site cannot be found in Tables 1 through 4, please check Table 6: Threshold of Regulation Compounds.

The values shown in the MSC tables, based on DEP determined risk values, are generally rounded to two significant figures. Due to rounding the numeric values for placement in the tables, the remediator is also permitted to round the concentrations reported by the laboratory to two significant figures for comparison to the MSC values. However, the values in the MSC tables that are based on EPA MCL values; however, are not rounded. Since these values are in the MSC tables based on EPA values are not rounded, remediators should not round concentrations reported by the laboratory for comparison to those MSC values.

For example: The chosen MSC value for a certain compound is 2.6 µg/L. If the laboratory reports a result of 2.629 µg/L, the remediator is permitted to round the laboratory's reported value to 2.6 µg/L and thus is able to attain the standard. However, if the laboratory's reported concentration is 2.678 µg/L, rounding to two significant figures results in a concentration of 2.7 µg/L and thus exceeds the MSC and is not able to attain the standard.

i) **Determining Groundwater MSCs**

MSCs for regulated substances in groundwater are found in Appendix A to Chapter 250, Table 1 for organic substances, and Table 2 for inorganic substances. To use the tables, the remediator needs to know the use status of the aquifer under the site, the naturally occurring level of Total Dissolved Solids (TDS) in the aquifer, and the land use of the site.

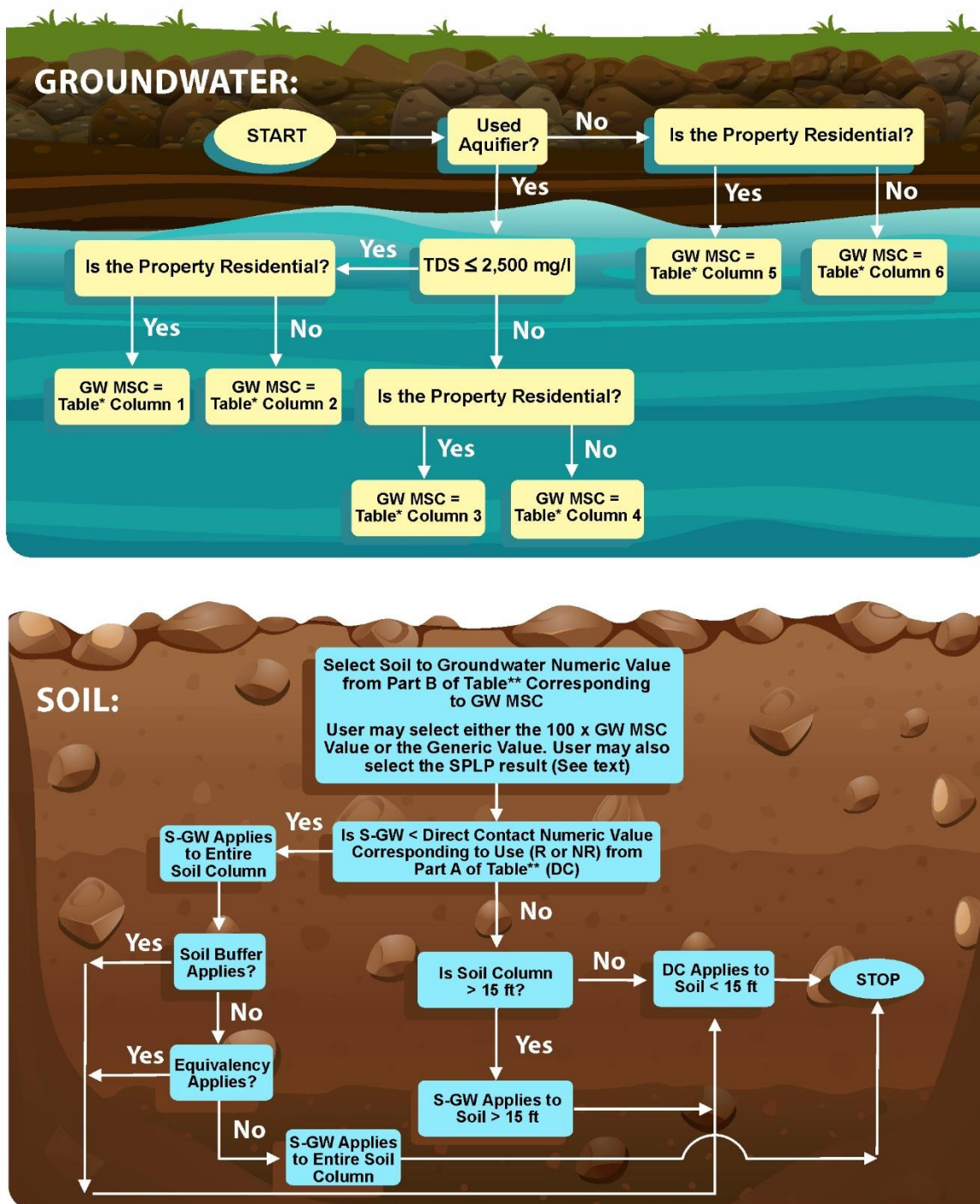
ii) **Determining Soil MSCs**

In determining the applicable soil standard, the remediator must compare the appropriate soil-to-groundwater numeric value to the direct contact numeric value for the corresponding depth interval within 15 feet from the ground surface. The lower of these two values is the applicable MSC for soil. If either the soil buffer distance (described in 25 Pa. Code § 250.308(b) and (c)) or the equivalency demonstration (described in 25 Pa. Code § 250.308(d)) is met, the soil-to-groundwater numeric value will be deemed to be satisfied, and the soil MSC will be the direct contact numeric value. The soil-to-groundwater numeric value is the MSC for soil at depths below 15 feet, unless either the soil buffer distance or the equivalency demonstration is met.

As referenced in Section 305(g) of the regulations, substances with a secondary MCL and no toxicological information are not required to attain either the direct contact or the soil-to-groundwater requirements. In these cases, the MSC would default to the applicable cap concentration or the calculated physical capacity of the soil to hold a substance. This value is described in Section 305(b). It is important to remember that these substances are still subject to the ecological evaluation process.

These applicable values are determined in the following manner:

**Figure II-11: Decision Tree for Selecting Statewide Health Standard MSCs for Groundwater and Soil**



\* For Organic Regulated Substances, use Table 1; Use Table 2 for Inorganic Regulated Substances

\*\* For Organic Regulated Substances, use Table 3; Use Table 4 for Inorganic Regulated Substances

**Note:** Figure must be used in conjunction with the text.  
Reference Section II.B.2.c)



(a) **Choosing the Soil-To-Groundwater Numeric Value**

The remediator should begin by determining the appropriate soil-to-groundwater numeric value from Part B of Table 3 for organics or Table 4 for inorganics. The numbers in the table include both the value which is 100 times the appropriate groundwater MSC and the number resulting from application of the soil-to-groundwater equation in the regulations (the “generic value”). The remediator must determine the use status of the aquifer underlying the site, its naturally occurring TDS level, and the land use characteristics of the site. The numeric value may then be selected from the appropriate column on the table and compared to the value for the Synthetic Precipitation Leaching Procedure (SPLP), if appropriate. Since the remediator has the choice of which soil-to-groundwater numeric value to use, the remediator may choose the highest of these three values (i.e., 100x GW MSC, the generic value, or the SPLP result) as the soil-to-groundwater numeric value.

The remediator must keep in mind that for ~~periodically~~-saturated soils, the generic value to use in this selection process is one-tenth the value listed in the table (see § 250.308(a)(2)(ii) and (a)(4)(ii) of the regulations). The intent of the one-tenth of the generic numeric value provision in the soil-to-groundwater numeric value calculation is to account for the lack of attenuation in saturated soils that would typically occur in unsaturated soils. Attaining this provision in saturated soils does not mean that the SHS has been met for groundwater. dilution in contaminant concentrations that occurs in soils that are periodically saturated which does not occur in unsaturated soil. For permanently saturated soils, contamination becomes a groundwater contamination issue as the soil is in constant contact with the groundwater rather than being only periodically saturated.

The value for the SPLP is the concentration of a regulated substance in soil at the site that does not produce a leachate in which the concentration of the regulated substance exceeds the groundwater MSC. Values for the SPLP could not be published in the tables of MSCs in the regulations because this test must be conducted on the actual site soil. The following procedure should be used to determine the alternative soil-to-groundwater value based upon the SPLP:

- During characterization, the remediator should obtain a minimum of ten samples from within the impacted soil area. The four samples with the highest total concentration of the regulated substance should be submitted for SPLP analysis. Samples obtained will be representative of the

soil type and horizon impacted by the release of the regulated substance.

- Determine the lowest total concentration (TC) that generates a failing (leachate concentration greater than the groundwater MSC) SPLP result. The alternative soil-to-groundwater standard will be the next lowest TC.
- If all samples have a passing (leachate concentration less than the groundwater MSC) SPLP result, the alternative soil-to-groundwater standard will be the TC corresponding to the highest SPLP result. The remediator has the option of obtaining additional samples.
- If all samples have a non-detect SPLP result, the alternative soil-to-groundwater standard will be the TC corresponding to the highest concentration of each contaminant. The remediator has the option of obtaining additional samples.
- If none of the samples generates a passing SPLP, the remediator can obtain additional samples and perform concurrent TC/SPLP analyses to satisfy the above requirements for establishing an alternative soil-to-groundwater standard.

**(b) Considering Direct Contact Value in Relation to the Soil-to-Groundwater Value and Soil Depth**

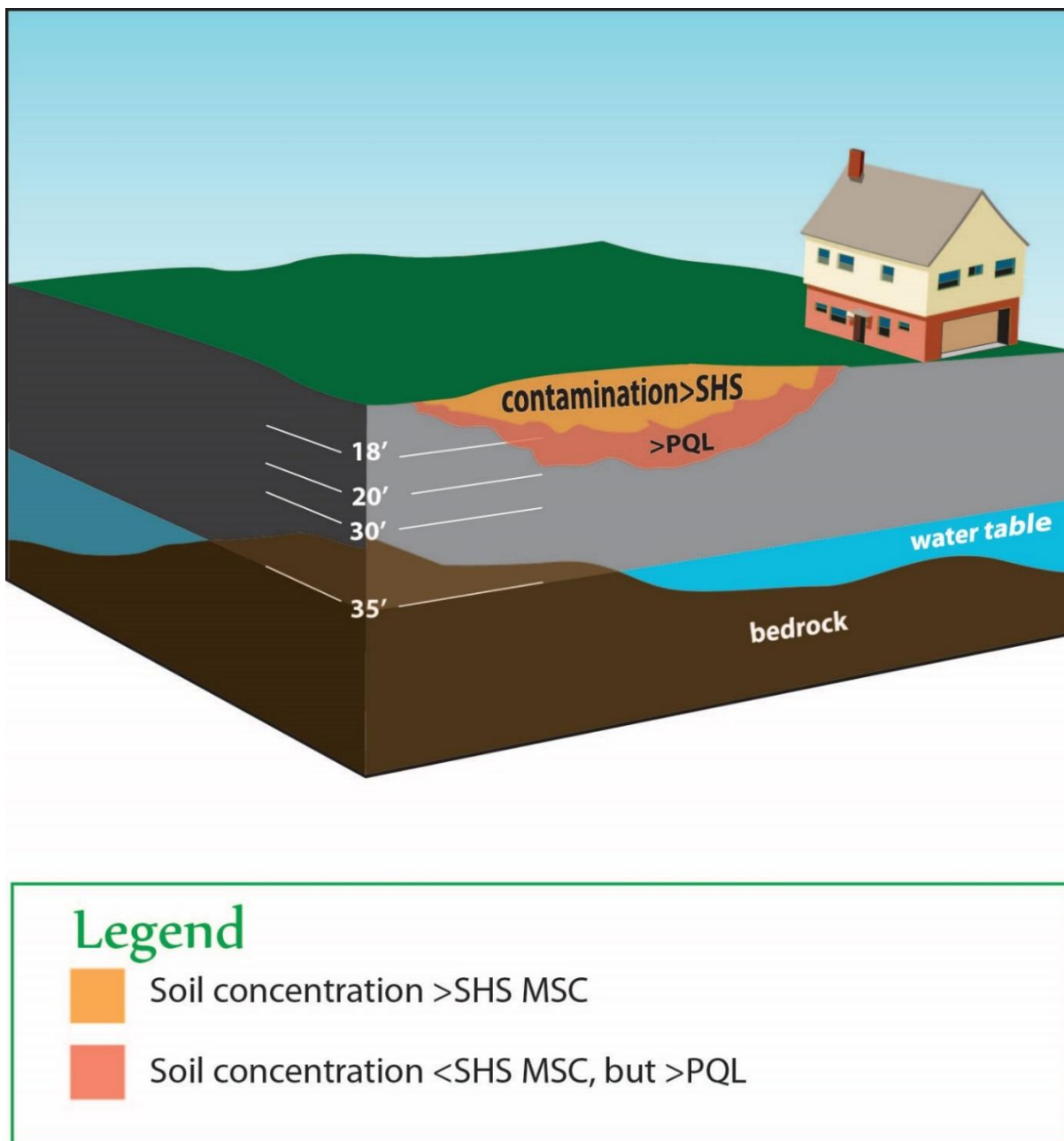
The number selected according to the process outlined in Section II.B.3.b.i of this TGM for the soil-to-groundwater pathway numeric value must then be compared to the appropriate residential or nonresidential, surface or subsurface, direct contact numeric value from Part A of Table 3 or Table 4. The lower of the two numbers is the appropriate MSC for the regulated substance. If the soil buffer distance requirements are met or the equivalency demonstration has been made, then the soil-to-groundwater numeric value is deemed to be satisfied and the MSC is the appropriate direct contact numeric value for the regulated substance. The soil buffer approach incorporates fate and transport considerations; therefore, meeting the soil buffer requirements will not require any additional fate and transport analysis.

**(c) Selecting Applicable MSCs – Example**

The process for selecting the appropriate MSCs for a site is illustrated in Figure II-12. This figure represents the cross section of a nonresidential site with soil contaminated with a petroleum product. The aquifer does not qualify as a nonuse aquifer. The remediator is interested in determining and applying the soil MSCs

under the SHS. This example shows the process applied to one of the regulated substances: cumene.

Figure II-12: Application of the MSC Selection Process



Details of the site determined during the site characterization are as follows (see also Figure II-12).

- Soil characterized as contaminated with regulated substances from the petroleum product, including cumene (concentration values > PQL, see Section III.G), is shown and extends to a depth of 20 feet. For this example, the remediator characterized the soil to the level of the PQL, but could have selected any concentration level between the SHS and the PQL, with the appropriate justification.
- Soil contaminated at levels greater than the applicable SHS is shown as a subset of the contaminated area and extends to a depth of 18 feet.
- Samples collected and analyzed according to the methodology in Section II.B.2(c)(ii)(a) established an alternative soil-to-groundwater value of 20 mg/kg.
- SPLP testing of site soil was established at 400 mg/kg.
- Shale bedrock is present at varying depths between 30 and 35 feet.
- The groundwater level is approximately 35 feet, but fluctuates (annual high and low) between 28 to 40 feet and the natural total dissolved solids level in the groundwater is 80 mg/L.
- The vertical distance from the bottom of the contaminated area to groundwater is  $h = 15$  feet.

Scenario #1 - the above conditions apply, and in addition, the results of sample analysis of the groundwater show no values greater than 3,500 µg/L.

Scenario #2 - the above conditions apply, and in addition, free floating product (approximately 1 inch) is found on top of the groundwater level, and the concentration of cumene below the groundwater level is 5,000 µg/L.

The remediator takes the following steps to determine appropriate MSCs for cumene at this site.

#### **Groundwater MSC:**

- 1) For Scenario #1 AND Scenario #2: As a first step, turn to LRP regulations, Chapter 250, Appendix A, Table 1 - Medium-Specific Concentrations (MSCs) for Organic Substances in groundwater. The remediator looks for the row for cumene, under the headings “Used Aquifers,” “TDS ≤ 2500 mg/L,” “NR” (for Nonresidential). The groundwater MSC is 3,500 µg/L.

Under Scenario #1, the remediator concludes that there is no aquifer area which exceeds the groundwater MSC (3,500 µg/L) and, therefore, no attainment demonstration is needed.

Under Scenario #2, the remediator concludes that the aquifer area exceeds the groundwater MSC (3,500 µg/L) and, therefore, attainment demonstration is needed.

#### **Soil MSC:**

- 2) The remediator turns to Chapter 250, Appendix A, Table 3 – Medium-Specific Concentrations (MSCs) for Organic Substances in Soil, Part B, Soil to Groundwater Numeric Values. The remediator looks for the row for cumene, under the Headings “Used Aquifers,” “TDS ≤ 2500 mg/L,” “Nonresidential.” The two values listed are:
  - 100x GW MSC – 350 mg/kg
  - Generic Value - 2,500 mg/kg

The remediator then looks over to the last column on the right for the soil buffer distance – 15 feet.

- 3) The remediator assesses the use of numeric soil-to-groundwater values. Three options exist under the regulations (§ 250.308).
  - 100x GW MSC – 350 mg/kg
  - Generic Value – 2,500 mg/kg
  - SPLP value – 400 mg/kg (from analysis of site soil—see site characterization).

Among the three acceptable values, the generic value of 2,500 mg/kg is the highest. The remediator considers using this option, but first wants to see if the site could qualify for the remaining two options for satisfying the soil-to-groundwater numeric value, the soil buffer and groundwater equivalency options.

- 4) In examining the soil buffer option, the remediator checks to see if the site meets the three regulatory conditions under 25 Pa. Code § 250.308(b), which states:

(b) The soil-to-groundwater pathway soil buffer is the entire area between the bottom of the area of contamination and the groundwater or bedrock and shall meet the following criteria:

(1) The soil depths established in Appendix A, Tables 3B and 4B for each regulated substance.

(2) The concentration of the regulated substance cannot exceed the limit related to the PQL or background throughout the soil buffer.

(3) No karst carbonate formation underlies or is within 100 feet of the perimeter of the contaminated soil area. Karst carbonate formations are limestone or carbonate formations where the formations are greater than 5 feet thick and present at the topmost geologic unit. Areas mapped by the Pennsylvania Geologic Survey as underlain by carbonate formations are considered karst areas unless geologic studies demonstrate the absence of the formations underlying or within 100 feet of the perimeter of the contaminated soil area.

Scenario #1 - The remediator concludes that the site meets the conditions for use of the soil buffer alternative to satisfy the soil-to-groundwater numeric value and, therefore, only the direct contact numeric value applies and becomes the soil MSC for cumene.

Alternatively, the remediator could have considered use of the groundwater equivalency option [§ 250.308(d)], but this includes the condition that he/she monitor the groundwater for 8 quarters prior to submitting the final report. The remediator instead chooses the soil buffer option above.

Scenario #2 - The remediator concludes the site DOES NOT meet the conditions for use of the soil buffer alternative because  $h=0$  since soil contamination extends to the water level and, therefore, there is no depth of clean soil between the bottom of contamination and the groundwater level.

The remediator then checks to see if the site meets the requirements for use of the groundwater equivalency option. (25 Pa. Code § 250.308(d) and Section II.B.6(d) of the Technical Manual). The site does NOT qualify because groundwater is contaminated above SHS and background.

Therefore, the remediator should consider BOTH the soil-to-groundwater numeric value and the direct contact (DC) value.

Chapter 250, Appendix A, Table 3A—Medium-Specific Concentrations (MSCs) for Organic Regulated Substances in Soil, Direct Contact Numeric Values states that the nonresidential numeric value for cumene is:

10,000 mg/kg applied to the 0'-2' zone in soil

10,000 mg/kg applied to the 2'-15' zone in soil.

The remediator chooses the soil-to-groundwater numeric value based on the generic value of 2,500 mg/kg, which applies to the zone(s) of the soil contaminated above this value:

Zone 1—0-18' (see Figure II-12)

Zone 2 – the “smear zone” in the soil column created by groundwater level movement – 28'--40.' Note that this zone also is considered saturated soil under Chapter 250.

Next, the remediator checks to see where each numeric value is applied:

	DC value	Soil-to-GW value	Resulting Soil MSC
Zone 0'-2'	10,000 mg/kg	2,500 mg/kg	2,500 mg/kg
Zone 2'-15'	10,000 mg/kg	2,500 mg/kg	2,500 mg/kg
Zone 15'-18'	NA	2,500 mg/kg	2,500 mg/kg



Zone 28' to 40'	NA	400 mg/kg	400 mg/kg
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Zone 28' to 40' is periodically saturated soil. The selection of the applicable soil MSC for this zone must consider the requirement that the published generic value be divided by 10. Therefore, the remediator may choose from the following values:

100x GW MSC	350 mg/kg
Generic Value	250 mg/kg (0.1 x published value)
SPLP Value	400 mg/kg

Therefore, the remediator chooses the SPLP result as the applicable soil MSC.

For both scenarios, analysis of any attainment samples (determined under Section II.B.2(f)(vii) of this manual) would be compared to the appropriate numeric value for the zone in which the sample was taken, and the attainment test (e.g., 75%/10x) would be applied to the sample set as a whole (e.g., the percentage of samples which exceeded the appropriate numeric value must be  $\leq 25\%$  and no sample may exceed the appropriate numeric value by more than 10 times [10x]).

#### d) Nonuse Aquifer Determinations

##### i) General

Section 250.303 of the regulations provides for options for requesting a nonuse aquifer determination. Anytime a person is proposing an area for nonuse aquifer determination, they must meet the notification requirements of 25 Pa. Code § 250.5, which are described in Section II.A.3, relating to public notice.

- A remediator may request from the Department approval to use alternative MSCs in groundwater at the POC when the aquifer under a site is not used or planned to be used for drinking water or agricultural purposes. This determination is to be requested by the remediator, and the Department's concurrence must be obtained in writing before the remediation may begin. The notice requirements under the nonuse aquifer request are made separate from those under the NIR. Note that an NIR must be submitted with, or prior to, the nonuse aquifer determination request. Although not required, the Department suggests that this request be submitted in conjunction with an NIR.

A remediator may rely on a “nonuse aquifer certification area” (see below) as documentation that they have satisfied 25 Pa. Code § 250.303(c)(1), (2) and (3) FOR THE SPECIFIC AREA defined as a “nonuse aquifer certification area.” If the area they are required to document extends beyond the nonuse aquifer certification area, the remediator still has the obligation to document those requirements in the area NOT covered by the nonuse aquifer certification area.

Another option a remediator may have is using the presence of a municipal ordinance meeting the performance requirements of Section III.E (relating to institutional controls and other postremedial measures) as documentation that the use restriction meets the requirements of 25 Pa. Code § 250.303(c)(1), (2) and (3) IN THE AREA SUBJECT TO THE ORDINANCE.

- Municipal authorities and political subdivisions may request determination that a specific geographic area meets the conditions of 25 Pa. Code § 250.303(c)(1), (2) and (3). The area in question is then referred to as a nonuse aquifer certification area.

**ii) Request Initiated by a Remediator as Part of an NIR**

This option would be used by a remediator who desires to use the alternative nonuse aquifer MSCs at a specific property. As detailed in 25 Pa. Code § 250.303(b) of the regulations, the area in which the determination is to be made includes the property itself, all areas within a radius of 1,000 ft. downgradient of the property boundary, and all areas where the contamination has migrated, or may reasonably be expected to migrate, at concentrations exceeding the MSC for groundwater used or currently planned to be used. In making the request, the remediator should provide the fate and transport analysis used to determine the area to which the contamination has migrated and is likely to migrate. The Department will accept or reject the remediator’s request based primarily upon the adequacy of this analysis. The area determined is the area of geographic interest to which the conditions of 25 Pa. Code § 250.303(c) apply. A form, Request for Nonuse Aquifer Determination, is available on the Department’s website to be used by a remediator to expedite the Department’s review of a nonuse aquifer demonstration. Use of this form is optional.

**iii) Nonuse Aquifer Conditions to be Met in the Area of Geographic Interest**

The requirements for demonstrating that an aquifer is not used are contained in 25 Pa. Code § 250.303(c) of the regulations. The remediator may make this demonstration by conducting door-to-door surveys of all downgradient properties or by using other appropriate survey methods,

and by contacting all community water suppliers downgradient of the property for service area information, including plans for future water supply well development and service area expansion. If all of the requirements are met, the Department may determine that the aquifer is not used for drinking water or agricultural purposes. The remediator may use the MSCs for groundwater in aquifers not used for drinking water or agricultural purposes in Tables 1 and 2 of Appendix A to the regulations if the nonuse aquifer determination is made. In some cases, there may be a significant lapse in time between the nonuse aquifer determination approval and the submission of the final report. It is the intent of DEP to ensure that the nonuse aquifer conditions are still representative when the final report is submitted to the Department. Therefore, at the time the final report is submitted to the Department for sites which have a nonuse aquifer determination approval, the DEP may require basic assessment of any changes which may have taken place since the nonuse aquifer determination approval was granted. This assessment would be similar to that applied under the postremediation care plan described below.

A postremediation care plan is required to provide reasonable confidence that the appropriate geographic area continues to meet the conditions of 25 Pa. Code § 250.303(c) if a final report has been submitted to the Department which includes the use of a nonuse aquifer area. Typical elements of such a postremediation care plan, which are relevant to the nonuse aquifer status, would include review of Department of Conservation and Natural Resources (DCNR) records to see if any well drilling reports have been received for the area included in the nonuse aquifer determination, inquiry to the water supplier of the area to determine if properties are still being billed for water, or communication with the municipalities to understand what changes may have taken place which may have an effect on the water use patterns in the area. The ecological screening process and the demonstration of compliance with surface water quality standards continue to apply in the area where the aquifer is determined not to be used for drinking water or agricultural purposes. Furthermore, as described in 25 Pa. Code § 250.303(d)(3), an environmental covenant should include the requirements of the postremediation care plan. This will ensure that subsequent landowners are aware of their responsibilities for postremediation care and monitoring. The postremediation care obligation will continue only until the property owner demonstrates to the Department, by fate and transport analysis, that the MSC for groundwater in aquifers used or currently planned for use is not exceeded at the property boundary and all points downgradient therefrom.

**iv) Request for Certification of a Nonuse Aquifer Area Initiated by a Local Government**

This option would be used by municipal authorities and political subdivisions which desire to receive certification that a given geographic area meets the conditions of 25 Pa. Code § 250.303(c) (i.e., nonuse aquifer

area conditions) where no specific property to be remediated has been identified. These conditions are based on 25 Pa. Code § 250.303(f), which requires an ordinance prohibiting groundwater use and requires every property to be connected to the public water supply.

**v) Example**

The following figures illustrate the process for determining the area in which the conditions of 25 Pa. Code § 250.303(c) must be met for a site to qualify for a nonuse aquifer designation. The requirements of 25 Pa. Code § 250.303(c) must be met “within the site on the property and within a radius of 1,000 feet downgradient of the points of compliance, plus any additional areas to which the contamination has migrated and might reasonably be expected to migrate.”

Figure II-13 shows this area for an idealized site with a property line parallel to the ground water contour. Note that the area includes, first, all points within 1,000 feet of all compliance points that are at a lower groundwater elevation (downgradient) of the property line compliance point itself, plus any additional area to which the plume has migrated or may be expected to migrate, as determined by site characterization and fate and transport analysis.

Figure II-14 shows the screening area for a site where the site characterization has determined that there is convergent groundwater flow. In this case the screening area is somewhat smaller than in the first figure because the area 1,000 feet downgradient (lower groundwater elevation) from the compliance points is smaller.

Figure II-15 shows the screening area for an idealized site where the site characterization has determined there is divergent groundwater flow. In this case the screening area is somewhat larger than the other figures because the area 1,000 feet downgradient (lower groundwater elevation) from the compliance points is larger.

In areas with complex groundwater flow or other special features, the Department should be consulted to determine the appropriate screening area prior to conducting the required surveys.

**e) Ecological Screening**

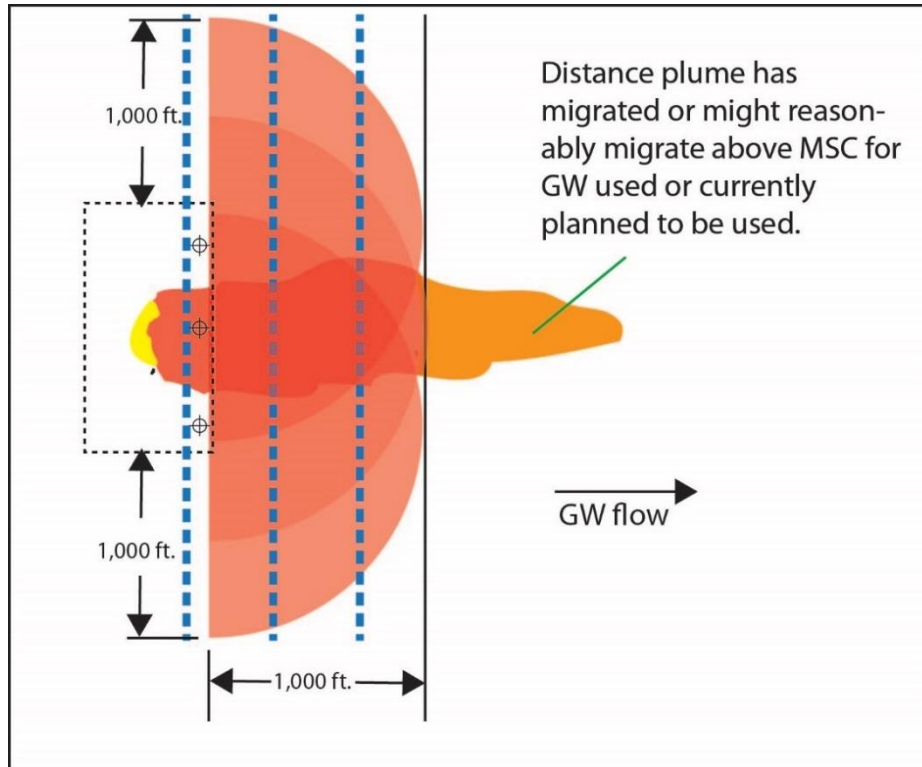
All sites remediated to the SHS must be screened for impacts to the ecological receptors identified in 25 Pa. Code § 250.311(a). The presence of threatened or endangered species as, designated by the U.S. Fish and Wildlife Service under the Endangered Species Act, requires that all requirements of that Act be met in addition to the requirements of 25 Pa. Code § 250.311. The remediator has the option of either remediating the site to one-tenth of the applicable Statewide health MSCs from Tables 3 and 4 of Appendix A to the regulations, as described in 25 Pa. Code § 250.311(b), or using the ecological screening process described

in 25 Pa. Code § 250.311 (b)-(e) and illustrated in Figure II-16. The option of remediating to one-tenth the value in Tables 3 and 4 is not available if constituents of potential ecological concern (CPECs), listed in Chapter 250, Table 8 of Appendix A, are present on the site. This choice, and the results of the screening process, if used, should be documented in the final report.

The objective of the ecological screening procedure is to quickly evaluate whether surface soils or sediments at a site have the potential to pose substantial ecological impact or impacts requiring further evaluation. The site screening procedure defines substantial impact as the potential for constituents detected onsite to cause a greater than 20% change in abundance of species of concern compared to an appropriate reference area, or a greater than 50% change in the extent or diversity of a habitat of concern compared to an appropriate reference area (Suter, 1993; Suter et al., 1995; U.S. EPA, 1989). Individuals of endangered or threatened species and exceptional value wetlands are protected regardless of the percentage of change in the abundance of species or in the extent or diversity of habitat. The goal of the screening procedure is to minimize, to the extent practicable, the number of sites which require detailed ecological risk assessment, while remaining protective of the environment.

The key elements of the screening procedure include the presence of light petroleum product constituents; the size of the site; the presence or absence of CPECs on the site; the presence or absence of species of concern or habitats of concern; and the presence or absence of completed exposure pathways, taking into account the current or planned future use of the site. The ecological screening process is described in this manual as part of the site characterization process because the information required to evaluate a site for ecological receptors is most efficiently collected at the same time as other site characterization data. A more detailed description of the rationale behind each of the steps in the ecological screen is available from the LRP website.

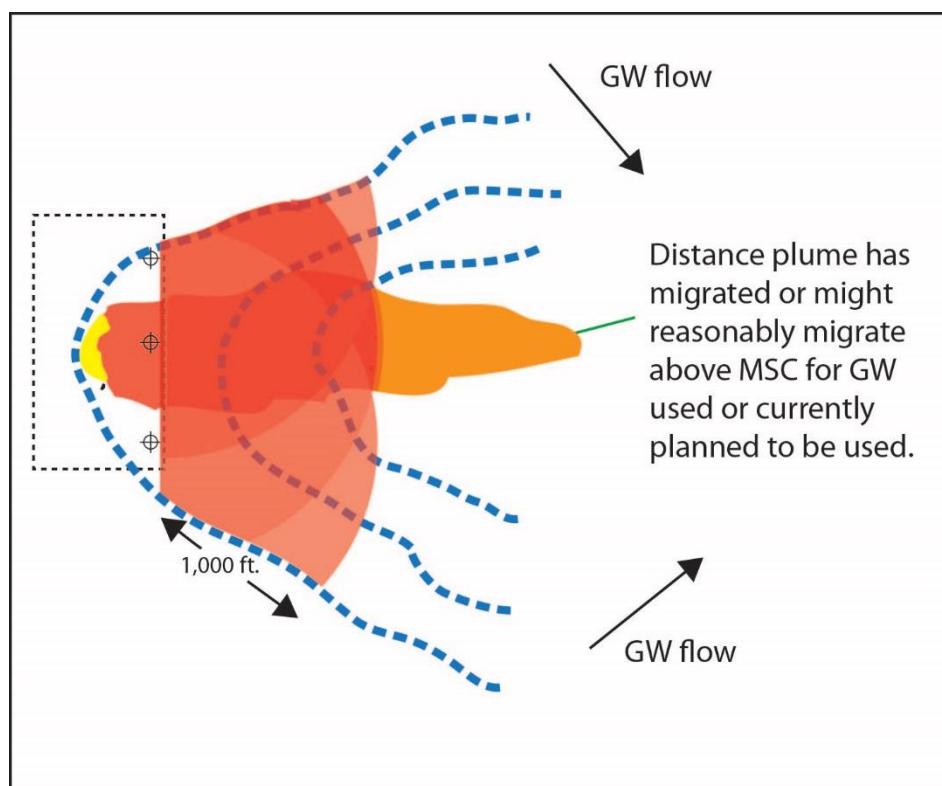
**Figure II-13: Nonuse Aquifer Screening Area (Parallel Flow)**



## Legend

- Area in all cases in which criteria of 250.303(c)(1)(2) and (3) apply.
- Additional area in which criteria may apply based on characterization and fate and transport.
- Contamination source
- Property
- Point of Compliance Monitoring Well
- Groundwater contour

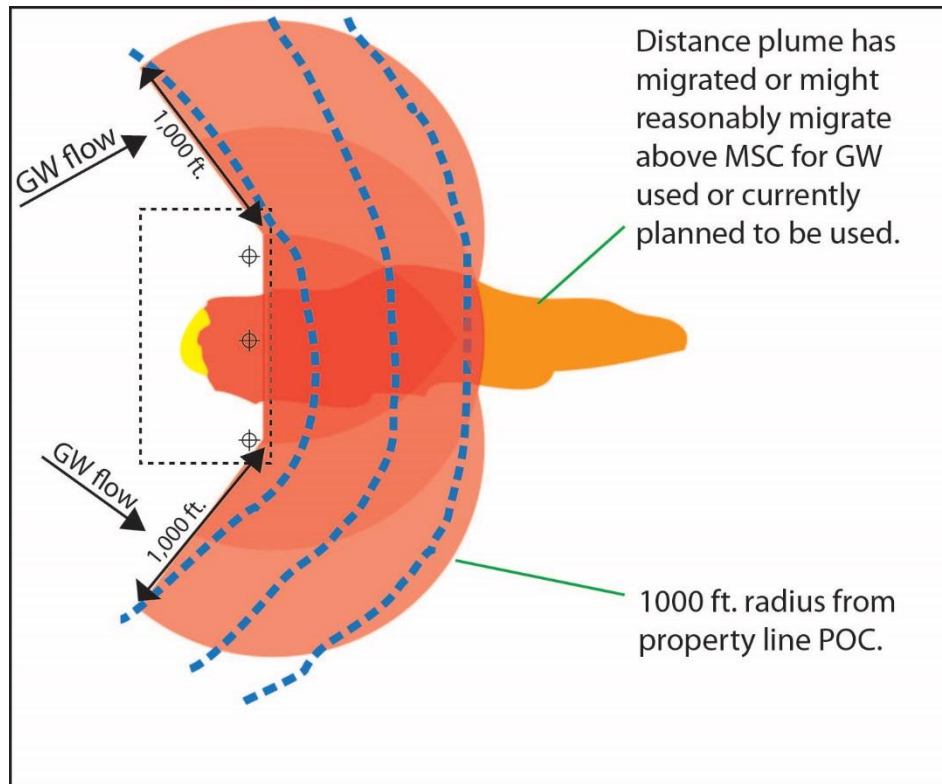
**Figure II-14: Nonuse Aquifer Screening Area (Convergent Flow)**









## Legend

- Area in all cases in which criteria of 250.303(c)(1)(2) and (3) apply.
- Additional area in which criteria may apply based on characterization and fate and transport.
- Contamination source
- Property
- Point of Compliance Monitoring Well
- Groundwater contour

**Figure II-15: Nonuse Aquifer Screening Area (Divergent Flow)**

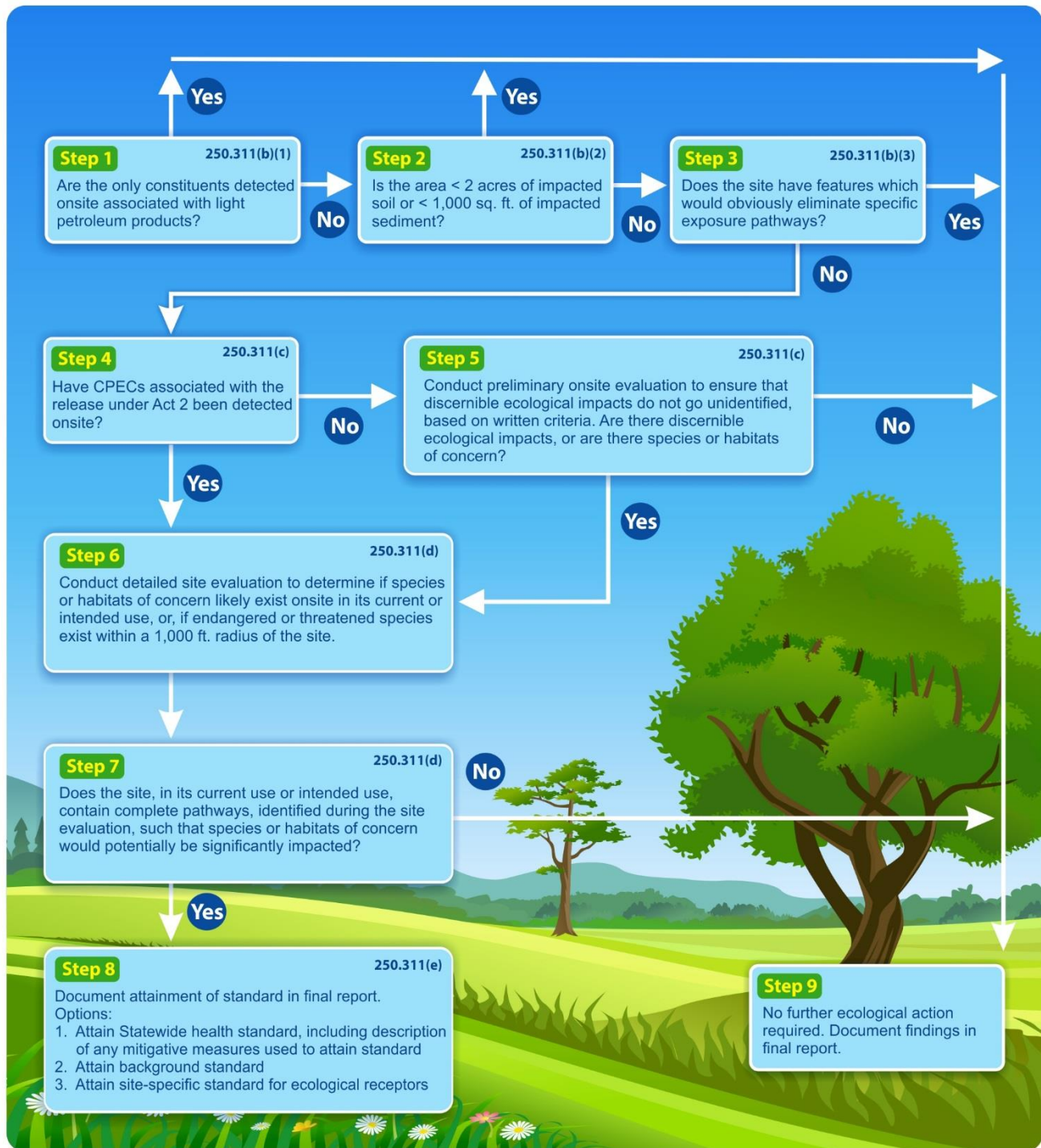


### Legend

-  Area in all cases in which criteria of 250.303(c)(1)(2) and (3) apply.
-  Additional area in which criteria may apply based on characterization and fate and transport.
-  Contamination source
-  Property
-  Point of Compliance Monitoring Well
-  Groundwater contour



**Figure II-16: Ecological Screening Decision Tree**



**Note:** Figure must be used in conjunction with the text. Reference Section II.B.2.e)

Regardless of the outcome of the ecological screening, the results are documented in a written report. It is important to note that if none of the first three steps are not met, i.e., there is contamination other than light petroleum products; the impacted area of surface soil is equal to or greater than 2 acres, or the impacted area of sediments is greater than or equal to 1000 square feet; and/or all pathways are not obviously eliminated, completion of the site ecological screening process requires an onsite evaluation. Using a streamlined set of guidelines, this onsite evaluation is a critical component of the means of identifying those sites that may pose substantial ecological impacts, and of documenting the lack of ecological impacts at other sites. Without such a site evaluation, a weight of evidence-based evaluation cannot be achieved, as required by EPA guidance (e.g., EPA's Framework for Ecological Risk Assessment, 1992) and ASTM standards (ASTM Designation: E1706-95). In addition, this screening procedure is consistent with the initial steps of EPA's ecological risk assessment guidelines for contaminated sites (U.S. EPA, 1997). The remainder of this section discusses each of the steps of the ecological screening procedure in more detail.

**i) Step 1: Presence of Light Petroleum Product Constituents**

The first step in the site ecological screening process is to determine whether the constituents present in surface soils (soils at a depth of up to two feet) or sediments are related only to light petroleum products (i.e., gasoline, jet fuel A, kerosene, #2 fuel oil/diesel fuel), which have relatively low polyaromatic hydrocarbon (PAH) content (American Society for Testing and Materials (ASTM) Designation: E1739-95). If light petroleum product constituents (including benzene, toluene, ethylbenzene, and xylenes (BTEX)) are the only constituents detected onsite, then the screening process moves to Step 9 (Final Report - No Further Ecological Evaluation Required). If constituents in addition to or other than light petroleum product constituents are present, the screening process continues to Step 2 (Site Size).

The purpose of this step is to eliminate from further evaluation those sites at which the only detected constituents are residual compounds from a release of light petroleum products. In general, remediation of light petroleum product release sites to prevent substantial ecological impacts is not required because the SHSs for these compounds are generally protective of ecological receptors.

**ii) Step 2: Site Size**

The second step in the ecological screening process is determining the area of exposed and contaminated surface soil (soils at a depth of up to two feet) and sediments that are of potential ecological concern. The minimum areas are 2 acres of exposed and contaminated surface soil, and 1,000 square feet of contaminated sediment.

Sediments are those mineral and organic materials situated beneath an aqueous layer for durations sufficient to permit development of benthic

assemblages. Indicators of benthic assemblages would include macroscopic algae, aquatic invertebrates, or aquatic plants. The aqueous layer may be static, as in lakes, ponds, or other water-covered surface depressions greater than or equal to 1,000 square feet but necessarily contiguous (excluding permitted open water management units), or flowing, as in rivers and streams located on a site (U.S. EPA, 1993b; U.S. EPA, 1991a).

If a site exceeds these specified minimum areas, then the screening process continues to Step 3 (Obvious Pathway Elimination). If the area of the site is smaller than the specified minimum areas, then the screening process moves to Step 9 (Final Report - No Further Ecological Evaluation Required).

**iii) Step 3: Obvious Pathway Elimination**

The third step accounts for those sites where features such as buildings, paving, or other development of the site are sufficiently extensive as to eliminate specific exposure pathways to ecological receptors. This primarily applies to sites in heavily industrialized or otherwise developed areas such that habitats or species of concern could not occur onsite or within a reasonable distance. Any site with features that obviously eliminate exposure pathways will drop out of the screening process at this point and proceed to Step 9 (Final Report - No Further Ecological Evaluation Required).

**iv) Step 4: Presence of Constituents of Potential Ecological Concern**

The fourth step in the ecological screening process is the determination of whether any of the constituents detected at the site and related to releases at the site are considered to be CPECs. CPECs are identified in Chapter 250, Table 8 of Appendix A.-

In this and the following step, available site information would be reviewed to determine if CPECs are likely to have been released into the environment. If CPECs are not detected at the site, then the screening process continues to Step 5 (Preliminary Onsite Evaluation). If one or more CPECs, either individually or in combination, are detected at the site, then the screening process moves to Step 6 (Detailed Onsite Evaluation and Identification of Species and Habitats of Concern).

The ecological evaluation process that has been developed includes additional evaluation criteria for sites where CPECs are not found. Step 5 is an evaluation of adverse chemical effects that may result from regulated substances other than CPECs, and as such reduces the probability that substantive adverse environmental impacts will go undetected. Also, surface water regulations and standards will remain applicable to those sites, adding to the overall protection of the environment at any site, as

will other regulations applicable to species of concern, such as the Endangered Species Act.

v) **Step 5: Preliminary Onsite Evaluation**

Prior to performing onsite evaluations, it is recommended that remediators perform internet-based habitat and species of concern searches using online tools such as the Pennsylvania Natural Heritage Program's PNHI and the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) mapper. - If the remediator chooses to perform a PNHI, it is important to select the appropriate project category (or project type) that determines the presence of any endangered or threatened species within a radius of 2,500 ft of the site. Each project category has a specific radius (screening area buffer) associated with the type of project. The Pennsylvania Natural Heritage Program website provides a list of the project categories and the associated radius (screening area buffer). The recommended project type for these evaluations is "Hazardous Waste Clean-up, Site Remediation, and Reclamation, Voluntary Cleanup (Act 2 and Chapter 250)." It is also important to note that a PNHI is only valid for two years. The fifth step of the site ecological screening process is a preliminary onsite evaluation, to be conducted by a qualified environmental scientist (common practice would use a person with a bachelor's degree in an environmental science field and 5 years of experience in an environmental field), using the criteria presented in this guidance. If, after conducting the preliminary onsite evaluation, the qualified environmental scientist determines that substantial ecological impacts are not probable or evident based on the weight of evidence available for the site, the screening process moves to Step 9 (Final Report – No Further Ecological Evaluation Required). It must also document the presence of any endangered or threatened species within a radius of 2,500 ft. of the site or exceptional value wetlands onsite. If after conducting the preliminary onsite evaluation, the qualified environmental scientist determines that substantial ecological impacts or impacts requiring further evaluation are or may be present, the screening process continues to Step 6 (Detailed Onsite Evaluation and Identification of Species and Habitats of Concern).

The objective of the ecological evaluation conducted during the preliminary onsite evaluation is to ensure that ecological impacts resulting from regulated substances which are not CPECs are detected. The preliminary onsite evaluation involves three steps:

1. Review of readily available site information, including the operational history, chemicals used, and probable sources of releases of regulated substances; and, environmental setting with emphasis on physical, chemical and biological factors that would influence the nature and extent of contamination.

2. A preliminary onsite investigation to identify physical and habitat features of the area and to identify nearby reference areas without contamination (if available) that are outside of the probable site (area of contamination associated with a particular release). The following should be noted during the evaluation:
  - signs of stressed or dead vegetation (e.g., chlorotic vegetation),
  - discolored soil, sediment or water (i.e., a sheen),
  - presence of non-native materials in sediments resulting from seeps or other discharges emanating from the subject site,
  - presence of deformed organisms (if encountered),
  - presence of exceptional value wetlands,
  - presence of federally designated threatened or endangered species.
3. Preparation of a brief written summary of findings including sketches of the suspected area of contamination and reference areas. To the extent practicable, differences of greater than 50% in the density of species of concern or in the diversity and extent of habitats of concern shall be regarded as potentially substantive (Suter, et al., 1995; U.S. EPA, 1989). However, the presence of federally endangered or threatened species within a 2,500-ft. radius of the site or exceptional value wetlands onsite would trigger further evaluation.

Based on all of the information collected as part of the preliminary onsite evaluation, the investigator makes a determination as to whether substantial ecological impacts exist or are probable even though CPECs were not detected on the site. The conclusion, which documents the weight of evidence from the onsite evaluation, is summarized in bulleted format.

**vi) Step 6: Detailed Onsite Evaluation and Identification of Species and Habitats of Concern**

The sixth step in the ecological screening process is a detailed onsite evaluation and a determination of whether species or habitats of concern exist on the site or, for endangered and threatened species, if those species exist on the site or within a 2,500-foot radius of the border of the site in its current or intended use or if exceptional value wetlands exist onsite. Species of concern are identified in the PNDI on the PA DCNR webpage. If, during the detailed onsite evaluation, no species or habitats of concern

are identified on the site, no threatened or endangered species exist within a 2,500-ft. radius of the border of the site, and no exceptional value wetlands occur onsite, the screening process moves to Step 9 (Final Report – No Further Ecological Evaluation Required). If species or habitats of concern are identified on the site, the screening process continues to Step 7 (Identification of Completed Exposure Pathways).

Identification of species and habitats of concern requires a detailed onsite evaluation. Common practice is to have a certified ecologist, or a trained environmental biologist perform this evaluation. At a minimum, the person conducting the detailed onsite evaluation should be a certified ecologist or hold a college degree in ecology or environmental science and have at least 5 years of experience conducting ecological field work and risk assessments.

The objective of the detailed onsite evaluation is to identify species or habitats of concern and to make observations that will permit a determination of whether complete exposure pathways are present at the site, as required by Step 7 of the ecological screening process. If the detailed onsite evaluation is being conducted as the result of potential impacts being identified during a preliminary onsite evaluation, the information from the preliminary onsite evaluation may be used at this stage where the information requested duplicates efforts of the previous evaluation. However, depending on the nature of the particular site, it may be necessary to supplement this previously developed information. The detailed onsite evaluation has the following components:

1. Review of readily available site background information including:
  - operational history, chemicals used, and probable sources of releases of CPECs,
  - environmental setting with emphasis on physical, chemical and biological factors that would influence the nature and extent of contamination, and
  - readily available literature and other relevant documents related to recognition of species and habitats of concern, including endangered and threatened species.
2. The qualified investigator shall conduct the following evaluation:
  - complete an onsite investigation to identify physical and habitat features of the area, then identify nearby reference areas, if available, which are outside of the probable site (area of contamination associated with a particular property),

- qualitatively evaluate whether species or habitats of concern are present at the site and in the reference area, and
  - in comparison to reference areas, the qualified investigator shall evaluate the following to the extent that they can be readily evaluated at a site:
    - signs of stressed or dead vegetation (e.g., chlorotic vegetation),
    - discolored soil, sediment, or water,
    - presence of non-native materials in sediments resulting from seeps or other discharges emanating from the subject property,
    - community composition differences readily distinguished by U.S. EPA protocols such as the Rapid Bioassessment procedures (U.S. EPA, 1989),
    - absence of biota (especially keystone species and ecological dominants) compared with similar areas of the same system,
    - presence of non-native or exotic species compared with reference areas (e.g., *Phragmites*),
    - presence of deformed organisms (if encountered), and
    - potential for residual contamination of habitats of concern and areas utilized by species of concern.
3. A brief written summary of findings including sketches of the suspected area of contamination and reference areas. Differences of greater than 20% in the density of species of concern or greater than 50% in the diversity or the extent of habitats of concern shall be regarded as potentially substantive (Suter, 1993; Suter, et al., 1995; U.S. EPA, 1989). However, the presence of exceptional value wetlands or federally designated endangered or threatened species would trigger further evaluation.
4. The site ecological screening process defines as species of concern those that have been designated as either of special concern, endangered, threatened or candidate by the Pennsylvania Game Commission, Pennsylvania Fish & Boat Commission, and the DCNR Bureau of Forestry. Links to current lists of such species are summarized on their respective webpages.

5. The ecological screening process defines as habitats of concern:

- typical wetlands with identifiable function and value, except for exceptional value wetlands, as defined by DCNR,
- breeding areas for species of concern,
- migratory stopover areas for species of concern (e.g., migrant shorebirds, raptors or passerines),
- wintering areas for species of concern,
- habitat for State endangered plant and animal species,
- Federal, State, and local parks and wilderness areas,
- areas designated<sup>1</sup> as wild, scenic, recreational, and
- areas otherwise designated as critical or of concern by the Pennsylvania Game Commission, Pennsylvania Fish & Boat Commission, and DCNR.

**vii) Step 7: Identification of Completed Exposure Pathways**

The seventh step in the ecological screening process is a determination of whether a completed exposure pathway from CPECs to species or habitats of concern exists at the site in its current or intended use. The existence of a completed exposure pathway<sup>2</sup> is determined during the detailed onsite evaluation, as described above for Step 6. Note that the CPECs in soil beneath a paved parking lot or below the root zone (top two feet) are not accessible to most species and habitats of concern, and therefore this pathway is classified as incomplete. If a complete pathway exists at the site, then the screening process moves to Step 8 (Attainment of Standard and Mitigative Measures). If no complete exposure pathways are identified during the detailed site evaluation, then the screening process continues to Step 9 (Final Report – No Further Ecological Evaluation Required).

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<sup>1</sup> as defined by guidance.

<sup>2</sup> Exposure pathway - the course a regulated substance(s) takes from the source area(s) to an exposed organism of a species of concern including absorption or intake into the organism. Each complete exposure pathway must include a source or release from a source, a point of exposure, and an exposure route into the organism. The mere presence of a regulated substance in the proximity of a receptor does not constitute a completed pathway. The receptor of concern must contact the regulated substance in such a way that there is high probability that the chemical is absorbed into the organism (ASTM E1739-95; modified to accommodate provisions of Act 2).



**viii) Step 8: Attainment of Standard and Mitigative Measures**

If the results of Steps 1 through 7 above do not result in the site being eliminated from further ecological consideration, the person conducting the remediation must demonstrate one of the following:

- attainment of the SHS is protective of ecological receptors,
- if the remediator cannot demonstrate that the SHS MSCs are protective of ecological receptors, the person shall demonstrate either that the postremedy use will result in the elimination of all complete exposure pathways at the time of the final report, or in accordance with a postremediation care plan, or that mitigative measures have been implemented and a postremediation care program has been instituted,
- attainment of the background standard, or
- that the procedures of 25 Pa. Code § 250.402(c) and 250.409 and Sections II.B.3 and III.H. of this manual have been followed to demonstrate attainment of a site-specific standard for protection of ecological receptors.

Mitigative measures that may be used to demonstrate attainment of the SHS are identified in Section 25 Pa. Code 250.311(f). These mitigative measures may only be used if no exceptional value wetlands have been identified by the screening process, and no state or federal laws or regulations prohibit the destruction of the habitats or species identified in the screening process.

The following mitigative measures may be used, and in the indicated order of preference:

- Restoration onsite of species and habitats identified in the screening process.
- Replacement onsite of species and habitats identified in the screening process.
- Replacement on an area adjacent to the site of species and habitats identified in the screening process.
- Replacement at a location within the municipality where the site is located of species and habitats identified in the screening process.

The Department shall review and approve any proposed mitigative measures prior to implementation to ensure that the intended use of the site minimizes the impact to ecological receptors identified in the screening process. In addition, the postremediation care plan requirements

in 25 Pa. Code § 250.312(e) or 250.411(f) and Section III.~~ED~~ of this manual must be implemented.

**ix) Step 9: Final Report - No Further Ecological Evaluation Required**

The ninth step of the ecological screening process requires that a report be written documenting the findings of the completed steps of the screening process, the basis for the conclusion that a substantial ecological impact does not exist, and that further ecological evaluation is not required. The conclusion that substantial ecological impact does not exist is based on one of the following:

- The presence of light petroleum-related constituents only (findings from Step 1).
- The area of impacted surface soil or sediment is less than the minimum size criterion (findings from Steps 1 and 2).
- All pathways are obviously eliminated by specific site features (findings from Steps 1 through 3).
- No CPECs are present onsite and the preliminary site evaluation indicates that substantial ecological impacts have not been overlooked (findings from Steps 1 through 5).
- No species or habitats of concern, threatened or endangered species, or exceptional value wetlands were identified on the site during the detailed site evaluation (findings from Steps 1 through 6).
- No complete exposure pathways from CPECs or other contaminants onsite to species or habitats of concern were identified during the detailed site evaluation (findings from Steps 1 through 7).
- Complete exposure pathways from CPECs or other contaminants onsite to species or habitats of concern were identified, but no significant impacts were observed during the detailed site evaluation.

**f) Final Report Requirements for the Statewide Health Standard**

To receive the liability protection afforded under Chapter 5 of Act 2 for sites remediated under the SHS, the remediator shall submit a final report to the Department which documents attainment of the standard. Section 250.312 of the regulations discusses final report requirements.

The final report shall be prepared in accordance with scientifically recognized principles, standards, and procedures. The report should present a thorough

understanding of the site conditions. It should provide a detailed discussion on the areas for concern and a conceptual site model based on the results of the site work. The report should support interpretations and conclusions with data collected during all of the investigations at the site. The level of detail in the investigation and the methods selected shall sufficiently define the rate, extent and movement of contaminants to assure continued attainment of the remediation standard. All interpretations of geologic and hydrogeologic data shall be prepared by a professional geologist licensed in Pennsylvania.

~~Two copies of the final report should be submitted to the Department for review. One should be a paper copy, and the other copy may be submitted in another format (CD, flash drive, etc.).~~ The final report must include the information in Table II-2, and the organization shown in the following outline is preferred:

## **Table II-2: Suggested Outline for a Final Report under the Statewide Health Standard**

### **I. Final Report Summary**

The final report summary should be a copy of the electronic form submitted to the Department.

### **II. Site Description**

Describe the site in sufficient detail to give an overall view of the site (Section II.B.2(f)(ii)).

### **III. Site Characterization**

Document current conditions at the site (§ 250.204 of the regulations and Section II.B.2(f)(iii)).

### **IV. Statewide Health Standard**

Describe how the SHS was established (Section II.B.2(f)(iv)).

### **V. Ecological Screening**

Provide the results of the Ecological Screen described in § 250.311 of the regulations and Section II.B.2(e).

### **VI. Remediation**

Describe the remedial methodologies used to attain the selected standard (Section II.B.2(f)(vi)).

### **VII. Attainment**

- A. Soil SHS
- B. Groundwater SHS
- C. Diffuse groundwater flow into surface water
- D. Spring flow into surface water

Sections A, B, C and D describe the statistical methods used to demonstrate attainment of the standard (Section II.B.2(f)(vii)).

### **VIII. Fate and Transport Analysis**

Describe the Fate and Transport analyses used and results and conclusions (Section II.B.2(f)(viii)).

### **IX. Postremediation Care Plan**

This section is included only if necessary. It describes the engineering and institutional controls necessary to attain or maintain the standard (Section II.B.2(f)(ix)).

**X. References**

(Section II.B.2(f)(x))

**XI. Attachments**

(Section II.B.2(f)(xi))

**XII. Signatures**

(Section II.B.2(f)(xii))

**i) Summary**

The Final Report Summary form is to be filled in and submitted to the Department electronically. The summary submitted with the final report should be a copy of that completed electronic form.

**ii) Site Description**

Provide a description of the site in sufficient detail to give the reviewer an overall understanding of the site and its location and the types of operations that are currently and were formerly conducted on the site. The description should include location, physical description of the property, ownership history, site use history, and regulatory action history (past cleanups) as appropriate to the site.

**iii) Site Characterization**

The site characterization provides important information documenting the current conditions at the site, information required by 25 Pa. Code § 250.312, and information required for the proper demonstration of attainment. Information developed during site characterization is primarily intended to describe the nature, extent and potential for movement of all contaminants present on the site or that may have migrated from the site; the information is also used as input for developing a conceptual site model and for the fate and transport analysis. For sites where there are multiple distinct areas of contamination, the site characterization process should be applied to each area individually.

Along with a narrative, the results from the site characterization and all sampling and analysis work should be provided on map(s) illustrating, to the extent possible, the interrelationship of the following:

- All physical site characteristics.
- All groundwater, soil, sediment and other sample locations, including sample depth and contaminant concentration.
- The surveyed locations for all assessment structures (monitoring wells, soil borings, test pits, etc.). All elevations should be reported in reference to mean sea level (msl), where practical.
- Appropriate number of stratigraphic cross sections that adequately depict site stratigraphy, well locations, well depths, groundwater flow directions, equipotential lines, flow lines, hydraulic conductivity intervals and values, sampling intervals and concentrations. All elevations should be reported in reference to msl, where practical.

- Variation in potentiometric surfaces(s), potentiometric surface map(s), hydraulic gradients, and groundwater flow directions.
- All identified sources of releases.
- The extent and concentrations of contaminant plumes in all media. The horizontal and vertical extent of contaminant plumes including density and thickness of any SPL present.
- Top of bedrock contour (if encountered).

A conceptual site model should be developed and refined as information is gathered during the site characterization. The conceptual site model provides a description of the site and extent of contamination. Recommended information and data used to develop the site model include:

- The type, estimated volume, composition, and nature of the released materials, chemicals or chemical compounds (include all calculations and assumptions).
- Source(s) and extent of release(s).
- Background concentrations for constituents of concern.
- The horizontal and vertical extent of contamination.
- The portion of the horizontal and vertical extent of contamination which exceeds the selected standard.
- Affected aquifer(s) or water bearing formation(s)/member(s), hydrostratigraphic units.
- All existing and potential migration pathways.
- The estimated volume of contaminated soil and water (include all calculations and any assumptions).

For soils, include information on samples and measurements used to characterize the horizontal and vertical extent of contamination, and direction and rate of contaminant movement based on factors in the soil and the contaminant which affect migration. Soil and boring descriptions should be included as an attachment.

For groundwater, include information on samples and measurements used to characterize the horizontal and vertical extent of contamination and direction and velocity of contaminant movement based on factors of the groundwater and the contaminant(s) which affect migration. Geologic

boring descriptions and as-built drawings of wells should be included as an attachment. Text, tables, graphics, figures, maps, and cross sections, as appropriate, can be utilized to describe the nature, location, and composition of the regulated substances at the site. Providing the data in an appropriate format will expedite the review of the report.

**iv) Selection of the Applicable Statewide Health Standard**

Documentation of the basis for selecting residential or nonresidential standards and for selecting the applicable MSCs according to the procedure in Section II.B.2(c) of this manual should be included in this section of the final report.

If the site is in an area where groundwater is not used or planned to be used for drinking water or agricultural purposes, provide the following documentation:

- That no groundwater derived from wells or springs is used or currently planned to be used for drinking water or agricultural purposes.
- That all downgradient properties are connected to a community water system.
- That the nonuse area does not intersect a radius of 0.5 mile from a community water supply well and does not intersect an area designated by the Department as a Zone 2 wellhead protection area as established under Chapter 109.
- Results of the fate and transport analysis used to establish the nonuse area.
- A copy of the letter from the Department approving the use of the nonuse aquifer MSCs, as described in Section II.B.2(d) of this manual.

If the soil buffer option is used to meet the requirements of the soil to groundwater numeric value, submit the following:

- Information demonstrating that the actual site soil column thickness below the contaminated soil is at least the thickness identified in Tables 3B and 4B of Appendix A to the regulations. This information should be taken from soil sample borings conducted during the site characterization.
- Laboratory analyses demonstrating that the contaminant concentrations in the entire soil column below the contaminated zone do not exceed either the limit related to the PQL or background.



- The boring logs and all other data presented in appropriate maps, cross sections, figures, and tables.

If an equivalency demonstration is used to meet the requirements of the soil-to-groundwater numeric value, submit the following:

- Information describing the actual site soil column below the contaminated soil. This information should be taken from soil sample borings conducted during the site characterization.
- Information, including laboratory analyses, gathered during the site characterization that demonstrates that the groundwater is not impacted at levels exceeding either the groundwater MSC or background.
- The boring logs and all other data presented in appropriate maps, cross sections, figures, and tables.
- Sampling data, in a tabular format, that shows no exceedance for eight quarters of groundwater MSCs or the background standard, in accordance with 25 Pa. Code § 250.308(d)(2).
- Results of the fate and transport analysis that demonstrate that the regulated substance(s) will not migrate to bedrock or the groundwater within 30 years at concentrations exceeding the greater of the groundwater MSC or background in groundwater as the end point in soil pore water directly under the site.

**v) Ecological Screening**

Provide documentation of the implementation of the ecological screen described in 25 Pa. Code § 250.311 and Section II.B.2(e) of this manual.

**vi) Remediation**

Remediation should be planned to remediate all areas to the selected standard.

Provide a description of the remedial methodologies used to remediate that portion of the contamination which exceeds the selected standard as determined by the site characterization. Examples of the types of information typically included in this section include:

- Identification of areas remediated based on results of site characterization.
- Descriptions of treatment, removal, or decontamination procedures performed in remediation. Description of removal, what was

removed, and amount removed. Results of any treatability, bench scale, or pilot scale studies or other data collected to support the remedial action(s).

- Description of treatment technologies.
- Description of the methodology and analytical results used to direct the remediation and determine the cessation of remediation. This description should document how the remediator determined that remediation was performed to address all areas known to exceed the standard.
- Documentation of handling of remediation wastes in accordance with applicable regulations.
- Specific characteristics of the site that affected the implementation or effectiveness of the remedial action including such characteristics as topography, geology, depth of bedrock, potentiometric surfaces, and the existence of utilities.
- All other site information relevant to the conceptual design, construction, or operation of the remedial action.

In addition to the above, this section should also include the calculation of the mass of contaminants addressed during the remediation of soil and/or groundwater, using the methodology in Section III.C.

Remediation of surface water will typically be accomplished by eliminating or reducing the discharge of regulated substances into surface water to the level where surface water quality standards are being achieved. Given that the usual source of regulated substance discharge to surface water will be via non-point source groundwater discharge, the measures necessary to attain the surface water standard should be incorporated into the design of any groundwater remediation system.

Abatement of air quality discharges associated with the remediation (e.g., vapor discharges from air stripping towers) shall be handled in accordance with the applicable air quality statutes and regulations.

During the implementation of any remediation plan, appropriate record keeping must be performed to provide ample documentation of the remedial actions taken, any changes made from the preplanned activities, and any sampling performed as field controls during implementation.

#### **vii) Attainment**

Provide documentation that the remediation has attained the selected standard at the POC and that the standard will not be violated in the future as a result of remaining contamination. The demonstration of attainment,

like the site characterization, should be applied to each distinct area of contamination. Attainment must meet the requirements of Chapter 250 Subchapter G (Demonstration of Attainment).

If the Statewide health standard is numerically less than the background standard, the remediator may elect the background standard, and attainment of the background standard should be demonstrated according to Section 302 of Act 2.

**(a) Point of Compliance**

**(i) Groundwater**

The POC for groundwater under SHS is the property boundary. Under certain circumstances the POC may be moved, as described below. Prior approval from the Department to move the POC is required.

The remediator may request the movement of the POC for situations described in § 250.302(a) of the regulations. If any of those conditions exist, the remediator must request, in writing, that the Department approve moving the POC. The Department will respond in writing to the request, and the response must be obtained before the adjusted POC may be used and the final report submitted.

For substances with a Secondary Maximum Contaminant Level (SMCL) established by EPA under the National Secondary Drinking Water Regulations, the remediator may request that the POC be moved for those substances with SMCLs. The Department will consider moving the POC in a range anywhere from the property boundary up to the point of use. Therefore, demonstration of attainment at a site may involve POCs for SMCLs which are different from the POCs applicable to the other identified regulated substances.

**(ii) Soil**

The POC for soil is the entire area of contamination. Demonstration of attainment of the appropriate standard is to be made in the entire volume shown in the site characterization to be contaminated by regulated substances at concentrations exceeding the SHS. Some sites may have different SHS values for varying depths or conditions of soil. For example, on a nonresidential site, if the soil-to-groundwater numeric value is lower than the direct contact number, there may be one standard for the 0-2 foot interval, another for the 2-15 foot interval, and a third for the soil at

depths greater than 15 feet. In addition, if any of these depths are in the periodically saturated zone, the appropriate standard may be different because of the requirement for reducing the generic value of the soil-to-groundwater numeric value by a factor of 10 (see Section II.B.2(c)(ii)(a)). For the purpose of demonstrating attainment, the saturated zone is considered to extend below the seasonal high water table level.

(iii) Spring flow into surface water

Unless an NPDES permit is required for purposes of complying with surface water quality in a spring, the POC is the point of first designated or existing use as defined in 25 Pa. Code §§ 93.1, 93.4, and 93.9. This could mean right by the spring itself or some point downstream from the spring discharge. Determining the point of first designated use is necessary because it establishes the point where Chapter 93 water quality standards apply.

Technical guidance to determine point of first use is found in *Policy and Procedure for Evaluating Wastewater Discharges to Intermittent and Ephemeral Streams, Drainage Channels and Swales, and Storm Sewers*, DEP document # 391-2000-014, revised April 2008. In essence this guidance relies on biological techniques to determine the first downstream point where aquatic life can be documented. It applies to both perennial and intermittent streams with definable bed and banks, but not to ephemeral streams, that is, areas of overland runoff which occur only during or immediately following rainfall events and where there is no defined stream channel and stream substrate.

**(b) Statistical Tests**

Attainment tests appropriate for SHS are described in 25 Pa. Code § 250.707(b) and in Section III.B of this manual and include:

- The 75%/10x rule for soil and groundwater at the POC, and the 75%/2x rule for groundwater off the property.
- For groundwater, no exceedance of SHS.
- The 95% upper confidence limit (UCL) test.
- For sites that are remediated without prior full site characterization, a “no exceedance” of SHS.

- A method that meets the performance requirements of 25 Pa. Code § 250.707(d).

If the 75%/10x rule is not used, appropriate statistical tests must be employed to demonstrate attainment of SHS. The following information should be documented in a final report:

- Description of the statistical method, and the underlying assumptions of the method.
- Documentation showing that the sample data set meets the underlying assumptions of the method and explaining why the method is appropriate to apply to the data.
- Specification of false positive rates.
- Documentation of input and output data for the statistical test, presented in table and figures, or both, as appropriate; and identify, by media, contamination levels remaining onsite.
- An interpretation and conclusion of the statistical test.

In addition to the attainment tests described above, the remediator must demonstrate, for groundwater remediated to the SHS, that the standard has been attained and that it will continue to be attained in the future as indicated by a fate and transport analysis.

In demonstrating attainment of SHS, concentrations of regulated substances are not required to be less than the limit related to the PQL for that substance as provided for in 25 Pa. Code § 250.4 and 250.701(c) and as listed in Section III.F of this manual. Where the plume of contamination currently impacts or may impact properties with different land use categories (i.e., residential and nonresidential), the SHS appropriate for the impacted property must be attained and maintained. For example, where a plume of contamination emanating from a nonresidential property adjoins a residential property that will be impacted by the plume, the nonresidential SHS must be attained and maintained at the downgradient boundary of the nonresidential property (see 25 Pa. Code § 250.702), and the residential SHS applies at the residential property. Demonstration that the appropriate standard will be attained and maintained must be demonstrated by a combination of sampling and fate and transport analysis.

In demonstrating attainment of the SHS in groundwater in aquifers not currently used or planned to be used, the remediator must show that the nonuse aquifer MSC has been met at the POC using the appropriate tests for demonstrating attainment described in 25 Pa.

Code § 250.707(b)(2) and further described in Section III.B of this manual. In addition, the requirements of 25 Pa. Code § 250.705 must be met regarding the use of a fate and transport analysis to show that the MSC for groundwater in aquifers used or currently planned to be used will not be exceeded at and beyond all points on a radius of 1,000 feet downgradient from the property boundary within 30 years. This fate and transport analysis should meet the requirements specified in Section III.A of this manual.

(i) 75%/10x rule

The 75%/10x rule is a statistical ad hoc rule that determines if the true site median concentration is below the cleanup standard. This rule requires that 75% of the samples collected for demonstration of attainment be equal to or below the cleanup standard and that no single sample result exceeds the standard by more than ten times.

For the 75%/10x rule, the number of soil sample points required for each distinct area of contamination is specified in the Act 2 regulations and is as follows:

- For soil volumes equal to or less than 125 cubic yards, at least eight samples.
- For soil volumes up to 3,000 cubic yards, at least 12 sample points.
- For each additional volume of up to 3,000 cubic yards, an additional 12 sample points.
- Additional sampling points may be required based on site-specific conditions.

These soil volumes may be comprised of zones where different MSCs apply (e.g., depths of 0-15 feet and greater than 15 feet). For purposes of demonstrating attainment, the analysis of samples, based on their physical location by the systematic random sampling method (Section III.B), must be compared to the applicable MSC for that physical location.

To use this rule for demonstrating attainment of groundwater MSCs, eight samples from each compliance well must be obtained during eight consecutive quarters. If a shorter sampling period is to be used, there must be written approval (preapproval is recommended) from the Department and the no exceedance rule 25 Pa. Code § 250.704(d)(3) must be used rather than the 75%/10x rule.

In groundwater monitoring wells beyond the property boundary, the rule is slightly modified. The attainment criteria are that 75% of the sampling results must be below the standard, with no individual value being more than 2 times the standard (75%/2x rule). This rule would have to be met in each individual monitoring well.

(ii) 95% UCL rule

The minimum number of samples is as specified in Section III.B of this manual.

(iii) No exceedance rule

Per § 250.707(b)(1)(iii) of the regulations: for sites with a release of petroleum products, soil remediation is often conducted based on visual observations or field screening without having conducted a full site characterization. These sites may demonstrate attainment of the SHS using the procedure described in Section III.B.5(b)(i)(c) of this Manual.

**viii) Fate and Transport Analysis**

The Fate and Transport Section (Section III.A of this manual) provides a discussion on fate and transport analysis. The amount of detail in the fate and transport analysis may vary from a simple description to a very extensive detailed model with quantitative modeling. Whenever a model is used, the Department must be provided with the assumptions, data, and information on the model necessary for Department staff to evaluate and run the model. Any parameters used in the analysis or models used should utilize data obtained from the site during the site characterization.

Following are examples of situations when the SHS will require a fate and transport analysis/model:

- The demonstration of attainment of a standard at the POC includes a fate and transport analysis to show that the standard will not be violated in the future.
- In an area where the groundwater is not used for drinking water or agricultural purposes, a fate and transport analysis is required to show that the used aquifer MSCs are not exceeded at and beyond a radius of 1,000 feet downgradient from the property boundary within 30 years.
- In using the equivalency demonstration to meet the soil-to-groundwater numeric value, a fate and transport analysis is

required to show that soils remediated to the direct contact numeric value will not result in regulated substances migrating to groundwater at concentrations exceeding either the groundwater MSC or background.

**ix) Postremediation Care Plan (if applicable)**

A postremediation care plan (PRCP), which includes the information required by 25 Pa. Code § 250.204(g), must be documented in the final report in accordance with that section of the regulations if:

(1) engineering controls are needed to attain or maintain the SHS; (2) institutional controls are needed to maintain the standard; (3) a nonuse aquifer designation has been approved for the site; (4) the fate and transport analysis indicates that the remediation standard, including the solubility limitation, may be exceeded at the POC in the future; (5) the remediation relies on natural attenuation; (6) a postremedy use is relied upon but is not implemented to eliminate complete exposure pathways to ecological receptors; or (7) mitigative measures are used. The PRCP must comply with the applicable deed acknowledgment requirements under SWMA or HSCA, Section 304(m) of Act 2, as well as the requirements of 25 Pa. Code Chapter 253 regarding the application of environmental covenants. Section III.ED of this manual provides additional information regarding the application of covenants and deed notices. The plan typically should include:

- Reporting of any instance of nonattainment.
- Reporting of any measures to correct nonattainment conditions.
- Periodic reporting of monitoring, sampling and analysis as required by the Department.
- Maintenance of records at the property where the remediation is being conducted for monitoring, sampling and analysis.
- A schedule for operation and maintenance of the controls and submission of any proposed changes.

If the postremediation care plan is being used to document the continuing applicability of an approved nonuse aquifer designation, the following are required:

- Procedures for documenting that the nonuse criteria continue to be met after the original request is approved.
- Report details and schedule for submittal to the Department.

See Section III.ED for the range of institutional controls available to a remediator.



The Department may ask for documentation of financial ability to implement the remedy and to maintain the postremediation care controls. Except for the special case of a nonuse aquifer designation under 25 Pa. Code § 250.303 (c) and (d), when the standard can be maintained without the controls operating, and the fate and transport analysis shows that the standard will not be exceeded in the future, the Department will approve termination of the postremediation care program.

Some remediators choose to use soil management plans (SMPs) and groundwater management plans (GWMPs) in place of PRCPs. This practice can be problematic because PRCPs are intended to be a plan to care for and maintain a remedy which utilizes engineering or institutional controls, while SMPs/GWMPs are often intended to address changes to a remedy that may occur at some point in the future. These plans are based on current waste management or water quality regulations or guidance. The Department cannot grant pre-approval of future soil or groundwater management plans since those guidances or regulations may change at some point in the future, therefore invalidating the SMP or GWMP.

Remediators should avoid using SMPs and GWMPs in place of PRCPs. They should instead have the PRCP and the environmental covenant address how to handle potential changes to a remedy. Any planned change to a remedy would require the approval of the Department at the time of the proposed change.

**x) References**

Any references cited in the final report.

**xi) Attachments**

Attachments may include but are not limited to:

- Tables – monitoring well construction summary, groundwater gauging data (including elevation and NAPL thicknesses), analytical data, historical data.
- Figures – including groundwater elevation maps, extent of NAPL, concentration data for soil/groundwater/surface water/vapor or indoor air, cross-sections.
- Monitoring well construction diagrams, boring logs, stratigraphic logs, including soil/rock characteristics.
- Sampling and analysis plan(s).
- QA and QC Plan.

- Ecological survey documentation (from PNDI).
- Well search documentation (from Pa. Geographic Information Systems Mapping Tools (PaGIS)).
- Field data sheets, such as low flow purging monitoring.
- Statistical worksheets, software outputs, graphs; modeling inputs/outputs.
- Disposal documentation of soil/groundwater.
- Remediation system operation, maintenance, monitoring data; mass removal estimates.
- Before and after remediation photographs.
- Copy of municipal notification, reasonable proof of newspaper notice publication.
- Laboratory reports and any voluminous attachments may be enclosed on a CD.

**xii) Signatures**

If any portions of the submitted report were prepared or reviewed by or under the responsible charge of a registered professional geologist or engineer, the professional geologist or engineer in charge must sign and seal the report.

**g) References**

ASTM Designation: E 1706-05. Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Fresh Water Invertebrates. Section 5.1.7.

ASTM Designation: E 1739-95. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites.

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Suter II, G.W., B.W. Cornaby, C.T. Haddne, R.N. Hull, M. Stack, and F.A. Zafran. 1995. An Approach for Balancing Health and Ecological Risks at Hazardous Waste Sites. Risk Analysis 15(2).

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U.S. EPA. 1991b. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation manual, Part B: Development of Risk-based Preliminary Remediation Goals. Office of Emergency and Remedial Response. Publication no. 9285.7-01B.

U.S. EPA. 1998. Guidelines for Ecological Risk Assessment. Risk Assessment Forum. EPA/630/R-95/002F.

U.S. EPA. 1993a. Wildlife Exposure Factors Handbook. Office of Research and Development. EPA/600/R-93/187.

U.S. EPA. 1993b. Sediment Quality Criteria for the Protection of Benthic Organisms: Acenaphthene. EPA-822-R-93-013.

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### **3. Site-Specific Standard**

#### **a) Introduction**

The objective of the site-specific standard is to develop and evaluate detailed site information using a rigorous scientific evaluation of a remedy to provide a protective cleanup standard unique to that site. Use of this standard requires the Department's review and approval (as required by statute) of the remedial investigation report, risk assessment report (if necessary), cleanup plan (if necessary) and final report. The relationship of these steps in the site-specific assessment process is illustrated in Figure II-17. The remedial investigation report, risk assessment report, and cleanup plan may be submitted at the same time. In some cases, only a remedial investigation report and final report are required, and these can be combined (see Section II.B.3.g of this manual). In

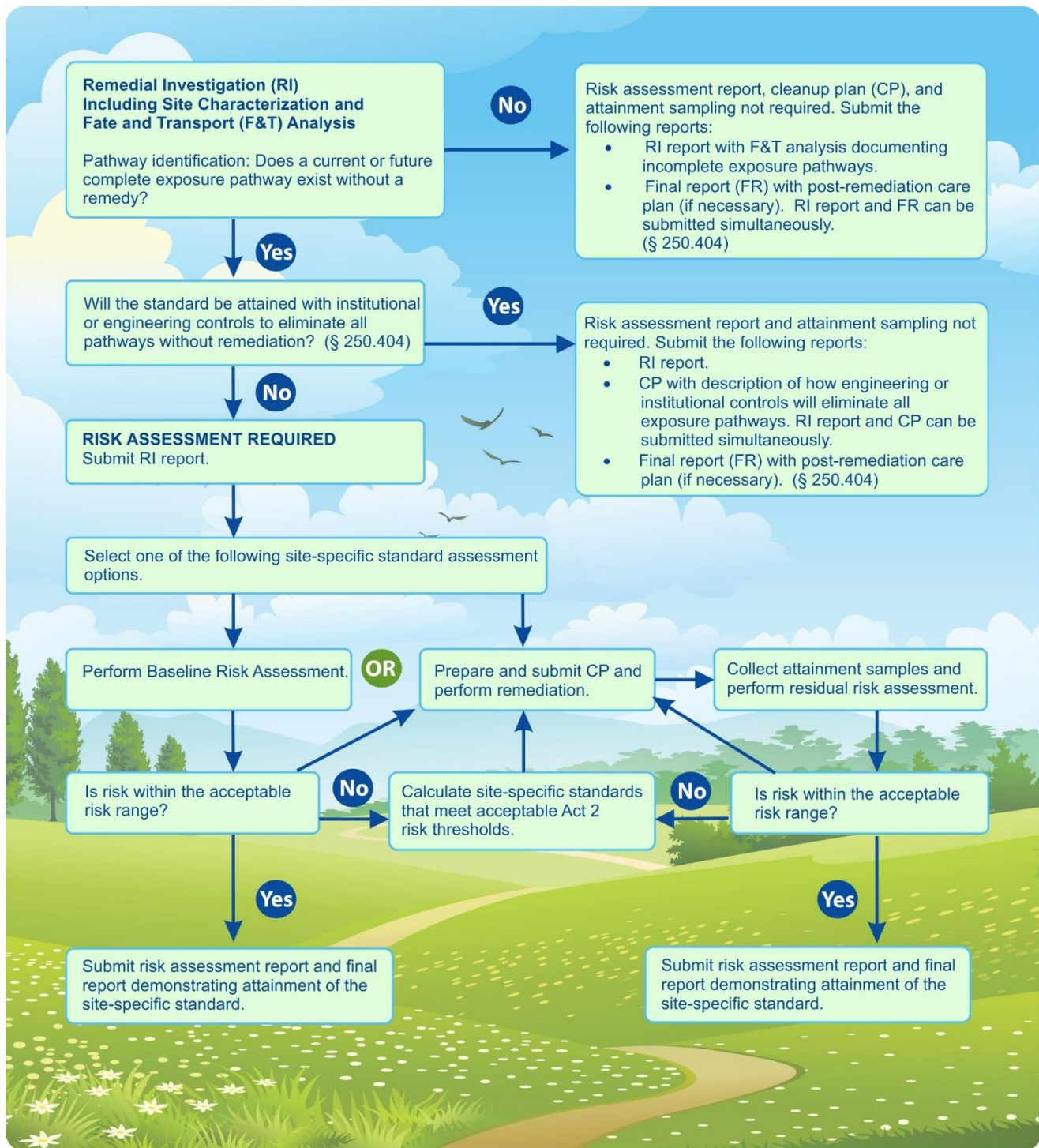
other cases (such as simple pathway elimination of all present and future exposure pathways), the risk assessment report and cleanup plan can be simplified. Note that if one part of a combined report is disapproved, then all other parts of the combined report that depend on the disapproved part will also require re-submittal, with new notices and payment of fees. For example, if a cleanup plan is disapproved, then the cleanup plan and final report must be re-submitted. However, if one part of a combined report is deficient, the remediator may have a chance to correct the deficiency in a prescribed timeframe to avoid re-submittal of notices and payment of fees.

All pathways of exposure are evaluated and the past, current, and future use of the land is considered. The resulting cleanup remedy selected to meet site-specific soil and groundwater standards may be a combination of treatment/removal efforts and engineering and institutional controls. The extent to which treatment and removal efforts are balanced with engineering and institutional controls is determined by the factors used in remedy selection. These factors are described in Section 304(j) of Act 2.

Remediators utilizing the site-specific standards must comply with the applicable deed acknowledgment requirements under the SWMA or HSCA (35 P.S. § 6026.304(m)), notice and review (35 P.S. § 6026.304(n)), and community involvement requirements (35 P.S. § 6026.304(o)) of Act 2 as well as the requirements of 25 Pa. Code Chapter 253 regarding the application of environmental covenants. Section III.ED of this manual provides additional information regarding the application of covenants and deed notices.

The site-specific standard is a risk management approach. It offers more flexibility to the person than background or Statewide health standards because detailed site-specific information is collected for the evaluation. The guidance contained in Section II.A.2 of this manual provides a structure and process for this data collection or remedial investigation. The additional information does involve more time and effort to collect, and additional reviews are required by the Department under Act 2. This approach differs in that full and total use of the site may not be possible to the extent that specific land uses were presumed and engineering and institutional controls are used in the final remedy. The site-specific standard approach addresses future use limitations by environmental covenant. Also, use of the site-specific standard requires public involvement if the municipality requests to be involved in the remediation.

**Figure II-17: Site-Specific Assessment Decision Tree**



**Note:** Figure must be used in conjunction with the text. Reference Section II.B.3.

In determining soil and groundwater standards, consideration should be given to appropriate exposure factors to receptors based on land use of the site, the effectiveness of institutional or other controls placed on the future land use, potential pathways for human exposure, and appropriate statistical techniques.

**b) Process Checklist for the Site-Specific Standard**

A checklist for the site-specific standard is provided below and can be used to ensure administrative completeness.

- ☐ Submit an NIR for the site-specific standard to the Department. Also send a copy of the NIR to the municipality, publish a summary of the notice in a newspaper of general circulation serving the area in which the site is located, and provide reasonable proof of publication to the Department. Procedures are in Section II.A.3 of this manual.
- ☐ Notify the municipality, publish a notice in a local newspaper, and provide proof of submittal to the Department each time a remedial investigation report, risk assessment report, cleanup plan or final report is submitted to the Department. Procedures are in Section II.A.3 of this manual.
- ☐ Prepare and submit public involvement plan if requested by municipality. Procedures are in Section II.A.3 of this manual.
- ☐ Begin the remedial investigation. See Sections II.B.3(c) and II.A.4 of this manual for guidance.
- ☐ As an option, begin using the completeness list (see LRP web page) to help verify that all requirements have been met.
- ☐ Prepare and submit a remedial investigation report which includes fate and transport analysis to determine if any exposure pathways including vapor intrusion (Section IV of this manual) exist at the site. A fee of \$250 is required. Reporting requirements are established by 25 Pa. Code § 250.404 and 250.408 and are described in Section II.B.3.g of this manual.
- ☐ Prepare and submit a risk assessment report (baseline risk assessment report and/or risk assessment report to develop site-specific standards) along with a fee of \$250 to the Department. A baseline risk assessment report is not required if the Department, in its remedial investigation report or cleanup plan approval, determines that a specific remedial alternative that eliminates all pathways can be implemented to attain the site-specific standard (25 Pa. Code § 250.405(c)). A simplified risk assessment describing how the pathways are eliminated by the remedial alternative should be included in the remedial investigation report. This does not include a no-action remedial alternative. A baseline risk assessment report

is not required if no present or future exposure pathways exist, as documented by a fate and transport analysis. Risk assessment requirements are established by 25 Pa. Code §§ 250.402-407 and 250.409 and Subchapter F. Guidance is provided in Sections III.G and III.H of this manual. Reporting requirements are described in Section II.B.3(g)(v) of this manual.

- ☐ Prepare a cleanup plan. A cleanup plan is not required if no present or future exposure pathways exist. The cleanup plan is also not required if the approved baseline risk assessment report indicates that the site does not pose unacceptable risks to human health and the environment under current and planned future conditions. Cleanup plan requirements are established by Section 304(j) and (l)(3) of the Act and 25 Pa. Code § 250.410. Guidance on the cleanup plan is provided in Section II.B.3(g)(ii) of this manual.
- ☐ Submit the cleanup plan, if required, and a fee of \$250.
- ☐ Remediate the site to the site-specific standard in accordance with the approved cleanup plan. A remedy is not required if no present or future exposure pathways exist.
- ☐ Establish attainment of the site-specific standard in accordance with the requirements in Chapter 250, Subchapter G, of the regulations. Guidance is provided in Sections II.B.3(g) and III.B of this manual.
- ☐ Calculate the mass of contaminants remediated using the procedure in Section III.C of this manual.
- ☐ Complete the Final Report Summary and submit electronically as instructed on the LRP web page.
- ☐ Submit final report, along with the optional completeness list (if used), and a fee of \$500 to the Department. Include information in 25 Pa. Code §§ 250.411 and 250.204(f)(1)-(5). Include postremediation care plan in accordance with § 250.204(g) as appropriate. Document cooperation of third parties where access is needed for remediation or monitoring. Reporting requirements for the final report are described in Section II.B.3(g) of this manual.
- ☐ Upon the Department's approval of the final report demonstrating compliance with substantive and procedural requirements of the site-specific standard, the site is automatically afforded the liability protection as outlined in Chapter 5 of Act 2.
- ☐ If engineering controls are used and postremediation care is needed to maintain the standard; if fate and transport analysis indicates the standard may be exceeded at the POC in the future; if remediation relies on natural

attenuation; or if mitigation measures are implemented in accordance with 25 Pa. Code § 250.311(f), continue with the postremediation care program detailed in the final report. If areas of the source property were shown to have no current or future complete exposure pathway, the postremediation controls described in Section III.~~ED~~ are needed.

- ☐ Submit an environmental covenant, if applicable, to the Department.
- ☐ When the site-specific standard can be maintained without engineering controls operating and mitigation measures have been successfully sustained, document this to the Department and receive approval to end the postremediation care program.

**c) Site Investigation**

The principal objectives of an investigation under the site-specific standard are to characterize the nature, extent, direction, volume and composition of regulated substances that have been released and to obtain detailed site information, including identification of exposure pathways, in order to develop a protective cleanup standard unique to that site.

Important tasks during the site investigation include site characterization and pathway identification. The development of a conceptual site model and identification of contaminants of concern are also important steps in the site investigation process. This section provides specific information and procedures regarding site characterization and pathway identification. At the conclusion of the site investigation, a remedial investigation report should be submitted to the Department for review and approval (35 P.S. § 6026.304(l)(1)). Section II.A.4 of this manual describes specific information required to be included in the remedial investigation report.

**i) Site Characterization**

The site characterization should be conducted in accordance with scientifically recognized principles, standards, and procedures. The level of detail in the investigation needs to sufficiently characterize the nature, extent, and composition of the regulated substances that have been released. The determination of the site conditions will be used to select the remedy used to clean up the site. All interpretations of geologic and hydrogeologic data should be prepared by a professional geologist licensed in Pennsylvania.

Chapter 250 states that remediators should characterize to the selected standard. This can be challenging to determine during the remedial investigation phase under the site-specific standard because the numeric cleanup goal would be determined in a risk assessment after characterization has been completed. Since site characterization is an initial investigative step, delineating contamination to the MSCs is generally an acceptable starting point as a numeric characterization goal.



The MSCs are based on conservative exposure and toxicity parameters that reduce the likelihood of unacceptable risks to human health and the environment usually making them acceptable targets for characterization. Keep in mind that demonstrating attainment of an Act 2 standard is a separate process from characterization and additional sampling to delineate contamination may be required after a risk assessment or an exposure pathway evaluation is performed. For example, site-specific numeric standards calculated by a remediator may be lower than their respective Statewide health standard MSCs when accounting for cumulative risk. The site-specific standard cannot be met if cumulative risks exceed the risk thresholds described in Act 2 ( $1 \times 10^{-4}$  for carcinogens and a hazard quotient of one for non-carcinogens) so additional sampling and remediation may be necessary in these instances.

To avoid the potential need to collect additional samples beyond the selected numeric characterization goal, remediators may consider delineating contamination to U.S. USEPA Regional Screening Levels (RSLs) which are based on lower risk thresholds:  $1 \times 10^{-6}$  for carcinogens and 0.1 hazard quotient for non-carcinogens. RSLs can be a useful option for remediators as characterization targets under the site-specific standard because they help account for cumulative risk. Characterizing to the RSLs is not required but they serve as useful lower-bound thresholds where applicable. Ultimately, for voluntary cleanups, the remediator determines whether the MSCs are acceptable delineation targets or if delineating to values lower than the MSCs, such as the RSLs, is best for their project. It is recommended that remediators discuss their characterization targets with DEP prior to submitting their Remedial Investigation Report.

Methodologies presented in Section II.A.4 of this manual should be followed while conducting the site investigation. When evaluating the nonpoint source groundwater discharge to surface water, a person may consult EPA guidances in “A Review of Methods for Assessing Nonpoint Source Contaminated Ground-Water Discharge to Surface Water, EPA 570/9-91-010, April 1991,” and “Handbook: Stream Sampling for Waste Load Allocation Applications. EPA/625/6-86/013.” Section III.A.3 of this manual provides guidance to evaluate impacts on surface water from diffuse flow of contaminated groundwater.

As directed from specific knowledge of the subject property, including historic use or chemical usage information, and based upon the guidance in Section II.A.4 of this manual, an appropriate number of sample locations should be investigated. These sample locations should be from the identified media of concern in order to characterize the nature and composition of the contaminants, including the characterization of the source of the regulated substances. This will allow for development of a conceptual site model taking into account the vertical and horizontal extent of contamination; the direction, rate, extent and fate of contaminant

movement within each medium of concern; and to identify the appropriate remedial technology options for each medium of concern.

When determining the relative location of soil or groundwater samples necessary to characterize the horizontal and vertical extent of contamination, factors such as hydraulic conductivity of the soils, heterogeneity of the soils, and the nature of the contaminants should be considered.

If groundwater is determined to be a medium of concern, adequate characterization of the effects of a release on groundwater will require a hydrogeologic study (as summarized in 25 Pa. Code § 250.204), which should include the study of the geological nature and physical properties of the underlying formation and aquifer. This study will determine how naturally occurring physical and geochemical characteristics define the hydrostratigraphy (position of aquifers, aquitards, and aquicludes) of the site, which includes an assessment of the homogeneity and isotropy of aquifer materials based on hydraulic conductivity values (measured or published), and local and regional groundwater flow directions as well as any influence from pumping centers.

Characterizing the horizontal extent of contamination of regulated substance(s) will be defined by a minimum of two rounds of groundwater sampling from properly constructed and developed monitoring wells. In some instances, additional rounds of quarterly sampling may be needed to evaluate seasonal impacts on groundwater contamination and to validate fate and transport assumptions. Please refer to Appendix A, Groundwater Monitoring Guidance, for additional information on construction and development of wells. The initial sampling event should be conducted no less than 14 days from the date of the most recent well development. A shorter time frame is permissible if it is demonstrated that, through development, pH and conductivity of the groundwater has stabilized. The second and subsequent sampling events should ideally occur sixty to ninety days from the preceding sampling event. Site-specific considerations may require adjustments to the time frame. Decisions regarding the duration of groundwater sampling should be made by communicating with your DEP Project Officer prior to establishing a sampling plan.

When characterizing the vertical extent of groundwater contamination, consider the specific gravity of the regulated substances identified and the potential for naturally occurring or induced downward vertical hydraulic gradients. If characterizing the vertical extent of groundwater contamination is necessary, properly constructed monitoring wells or nested monitoring wells should be utilized to focus groundwater sampling in zones of potential contaminant accumulation (i.e., directly above a confining layer).

The determination of the use of groundwater is also an important task of site characterization. The uses of groundwater may include drinking water use, agricultural use, industrial uses, etc. As mandated by Act 2, groundwater will not be considered a current or potential source of drinking water where groundwater has a background TDS concentration greater than 2,500 milligrams per liter. Other than that mandate, current and future uses of groundwater must be determined on a site-specific basis. Current ~~drinking water or agricultural~~ uses of groundwater, at the time contamination was discovered, should be identified for protection. Additional requirements on the determination of the use of groundwater are in 25 Pa. Code § 250.403.

Development of a conceptual site model is an important step in identifying additional data needs and defining exposure. A conceptual site model identifies all potential or suspected sources of contamination, types and concentrations of contaminants detected at the site, potentially contaminated media, potential exposure pathways, and receptors. Many components of exposure (such as the source, receptors, migration pathways, and routes of exposure) are determined on a site-specific basis. The conceptual site model provides a systematic way to identify and summarize this information to ensure that potential exposures at the site are accounted for accurately.

The conceptual site model may be graphical, tabular or narrative but should provide an accurate understanding of all exposure pathways (complete and incomplete) for the site. Examples of conceptual site models may be found in EPA or ASTM guidance documents, including Section 4.2 of U.S. EPA Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (RAGS/HHEM), Part A, ASTM E-1739 RBCA, Tier 2 Guidance Manual, and ASTM E1689-95, Standard Guide for Developing Conceptual Site Models for Contaminated Sites. It is suggested that the development of the conceptual site model be coordinated with the regional project officer to ensure that potential pathways are adequately and appropriately addressed prior to performing the assessment.

**ii) Pathway Identification (§ 250.404 of the Regulations)**

Once the development of the conceptual site model is completed, current and future exposure pathways should be identified based on this conceptual site model. An exposure pathway describes the course a chemical or physical agent takes from the source to the exposed receptor. An exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine the significant pathways of exposure.

A potentially complete exposure pathway generally consists of four elements:

- a source and mechanism of chemical release,
- a retention or transport medium (or media in cases involving media transfer of chemicals),
- a point of potential receptor contact with the contaminated medium (the exposure point), and
- an exposure route (e.g., ingestion) at the exposure point.

The person should consult the most recent U.S EPA or ASTM guidances to identify any potential current and future exposure pathways for both human and environmental receptors. The pathway identification should consider current pathways and the effects of engineering and institutional controls. Future exposure pathways should be based on currently planned and/or probable future land use. Guidance on land use considerations can be found in the USEPA Office of Solid Waste and Emergency Response (OSWER) Directive: *Land Use in The CERCLA Remedy Selection Process*. DEP guidance entitled *Site-Specific Human Health Risk Assessment Procedures* in Section III.G of this manual provides more information on pathway identification for human exposure. Guidance such as described in Sections 6.2 and 6.3 (relating to characterization of exposure setting and relating to identification of exposure pathways) of *U.S. EPA's Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (RAGS/HHEM), Part A*, provides a framework for pathway identification for human exposure. Subsection 6.3.2 of Risk Assessment Guidance for Superfund/Human Health Evaluation Manual (RAGS/HHEM), Part A in particular, provides guidance to perform fate and transport analysis.

Prior to the identification of exposure routes, a remediator must identify sources and receiving media, evaluate fate and transport in release media, and identify exposure points and potential receptors. The following exposure scenarios contain examples of what should be considered:

**(a) Groundwater**

The remediator shall identify routes of exposure for groundwater such as human exposure to groundwater by ingestion, inhalation, or dermal exposure routes. The remediator should consider effects of discharge of groundwater into surface water and the effects on ecological receptors. When evaluating the indoor exposure pathways, a remediator needs to address impacts of volatile organic compounds (VOCs) from soil and groundwater, not extraneous sources.

With respect to the groundwater ingestion pathway, the following guidance is provided. When determining whether groundwater on or off the source property must be protected under the site-specific standard for drinking water uses, the following will be applied (from 35 P.S. § 6026.304(d)):

- The ***current and probable*** future use of groundwater shall be identified and protected. Groundwater that has a background TDS content greater than 2,500 milligrams per liter or is not capable of transmitting water in usable quantities shall not be considered a current or potential source of drinking water.
- Site-specific sources of contaminants and potential receptors shall be identified.
- Natural environmental conditions affecting the fate and transport of contaminants, such as natural attenuation, shall be determined by appropriate scientific methods.

From 25 Pa. Code § 250.403 of the regulations, the following apply:

- Except for groundwater excluded by the TDS limitation described above, current and probable future use of groundwater ***shall be determined on a site-specific basis***.
- Drinking water use of groundwater shall be made suitable by at least meeting the primary and secondary MCLs at all points of exposure identified in § 250.404 (relating to pathway identification and elimination) of the regulations.
- Current ~~drinking water or agricultural~~ uses of groundwater, ***at the time contamination was discovered***, shall be protected.

As an example: within a city with an established public water system and groundwater contamination extending off-property, the complete exposure pathways depend on volatilization potential of contamination and the current use or “probability” that future groundwater ingestion may occur. If surrounding properties are currently developed and have public water service, then it may be assumed that the probability is that those established patterns of water use will continue into the future. Therefore, there are no current or probable future uses of groundwater as a drinking water source; and the groundwater ingestion pathway may (all other information supporting) be determined to be incomplete.

Note that even in cases where the groundwater ingestion pathway is determined to be incomplete, the final report must include one or a combination of institutional controls or postremedial measures which provide assurance that this status continues to exist in the future. See Section III.E.3 of this manual for the range of institutional controls or postremedial measures available to a remediator. If a complete groundwater ingestion pathway is found to exist in the future, then the responsible person must demonstrate attainment of one of the three Act 2 standards.

**(b) Soil**

The person shall consider current and probable future exposure scenarios, such as human ingestion, dermal contact, inhalation of volatiles and particulates, and leaching to groundwater. When evaluating the indoor exposure pathways, a person needs to address impacts of VOCs from soil and groundwater, not extraneous sources.

**(c) Cases Where No Complete Current or Future Exposure Pathway Exists**

If no current or probable future complete exposure pathways exist without remediation, then a risk assessment report (RA), cleanup plan (CP), or attainment sampling is not required (see Figure II-17). These cases are distinct from using pathway elimination, which requires a remedy (such as an engineering and/or an institutional control) to attain the standard (see Section II.B.3(c)(ii)(d) below).

A complete exposure pathway is one in which a receptor may be exposed to contamination at any level, even if that concentration equates to an acceptable risk. If the contaminant of concern is a VOC and occupied buildings are present, then the vapor intrusion pathway must be evaluated for buildings within the applicable proximity distances and for preferential pathways (Section IV of this manual). The inhalation pathway would be complete even if vapor intrusion screening values were satisfied.

If no complete exposure pathways exist, then no remedy is required, and a risk assessment is unnecessary. Attainment sampling is also not required because there is no specific numeric concentration value (standard) applied to the site. To demonstrate attainment of the site-specific standard, a pathway elimination analysis described in 25 Pa. Code § 250.702(b)(3)(i) needs to be included in the final report. When no complete current or future exposure pathways exist, it is recommended that the remedial investigation report and the final report be combined following the suggested outline provided in Table II-7.

For groundwater, a discussion of the fate and transport analyses used during site characterization to evaluate contaminant trends for plume stability needs to be provided in the final report as required by 25 Pa. Code § 250.702(b)(2). This discussion should confirm the finding of the fate and transport analysis that the absence of complete exposure pathways will remain and that continued future attainment of the site-specific standard will be maintained. A postremediation care plan may be necessary to ensure all pathways remain incomplete and to therefore maintain attainment of the site-specific standard. The postremediation care plan, if necessary, should be submitted with the final report.

**(d) Cases Where Institutional or Engineering Controls Are Needed to Eliminate Pathways**

Neither a risk assessment report nor attainment sampling is required if an institutional or engineering control is used as a remedy to eliminate all complete exposure pathways. However, a cleanup plan describing how the engineering or institutional control will eliminate all complete exposure pathways is required (see Figure II-17). A suggested outline for a cleanup plan is provided in Table II-5. The cleanup plan, the remedial investigation report, and the final report can be submitted simultaneously. Fate and transport analysis descriptions and final report requirements as described in Section II.B.3(c)(ii)(c) also apply in this scenario. Note that if one part of a combined report is disapproved, then all other parts of the combined report that depend on the disapproved part will also require re-submittal, with new notices and payment of fees. For example, if a cleanup plan is disapproved, then the cleanup plan and final report must be re-submitted. However, if one part of a combined report is deficient, the remediator may have a chance to correct the deficiency in a prescribed timeframe to avoid re-submittal of notices and payment of fees.

**d) Risk Assessment and Development of Site-Specific Standards (§ 250.402)**

This section provides general information on risk assessment, developing site-specific standards, and pathway elimination. Sections III.G and H of this manual provide guidance on site-specific human health and ecological risk assessment procedures. This guidance should be followed to conduct a baseline risk assessment or to develop site-specific standards.

Any remediator selecting the site-specific standard established by Section 304 of Act 2 should submit a risk assessment report to the Department for review and approval unless no present or future complete exposure pathways exist as demonstrated by a fate and transport analysis when the site was characterized. If no such complete exposure pathways exist, a person only needs to submit a

combined remedial investigation report and final report (see Table II-7). If complete exposure pathways exist, the fate and transport analysis, which is a part of the exposure assessment performed during site characterization, should be documented in the exposure assessment section of the risk assessment report.

Although it might be helpful in some cases to establish the leaching potential of constituents in soil, meeting toxicity characteristic leaching procedure (TCLP) limits does not automatically indicate attainment of the site-specific standard. TCLP analysis is used for Resource Conservation and Recovery Act (RCRA) hazardous waste determinations to simulate leaching in a landfill. These results determine if a waste is hazardous and can or cannot be disposed of in a landfill. TCLP analysis does not provide useful data for calculation of site-specific risk values. The risk associated with the regulated substances is considered in the site-specific risk assessment under Act 2.

To determine if a site-specific risk assessment is necessary, a conceptual site model should be developed that defines potential exposure scenarios and pathways. The exposure scenario (e.g., residential, industrial, recreational), which will define the exposure pathways, must be based on site-specific land use considerations. The pathways, which describe the mechanism by which receptors may be exposed to a source, are also site-specific. Engineering or institutional controls that are to be implemented which will eliminate exposure pathways must be incorporated into the conceptual site model. Then, a risk assessment only needs to be performed if complete exposure pathways for humans and/or ecological receptors exist under current or future planned conditions.

A complete exposure pathway exists if there is a receptor to be exposed through an exposure route. For ecological receptors, a pathway is complete even if the current ecological receptors are not present as a result of the contamination. A pathway is not complete if there is no reasonable exposure route; i.e., the contaminant is not in an available form to affect the receptors.

However, before getting into the mechanics of performing the risk assessment, it is important to clearly define the problem that is to be addressed, the objectives of the study, and how the results will be used to meet these objectives. This initial step is critical to ensure a successful outcome (accurate, protective, timely, cost-effective evaluation) and that the level of effort is commensurate with the scope of the problem.

Under Act 2, a risk assessment report may include the following:

- A baseline risk assessment report that describes the potential adverse effects to both human and ecological receptors, under both current and planned and/or probable future conditions that are caused by the presence of regulated substances in the absence of any further control, remediation, or mitigation measures.
- A risk assessment report that documents which exposure pathways will be eliminated by a pathway elimination measure so that any substantial



present or probable future risk to human health or the environment is eliminated.

- A risk assessment report that describes the methods used to develop a concentration level at which human health and the environment are protected.
- The comments obtained as a result of a public comment period, if any, and the responses to those public comments.

If an unacceptable risk is identified at a site, a person may develop site-specific standards based on a site-specific risk assessment. A baseline risk assessment report is not required if the Department, in its remedial investigation report or cleanup plan approval, determines that a specific remediation measure, other than a no-action remedial alternative, can be implemented to attain the site-specific standard (see 35 P.S. § 6026.304; 25 Pa. Code § 250.405(c)). A baseline risk assessment is that portion of a risk assessment that evaluates a risk in the absence of the proposed site-specific measure.

In developing site-specific standards, a person may use the toxicological data presented in Tables 5a and 5b of Appendix A, Chapter 250, refer to the toxicity database on the Land Recycling website, or refer to the sources listed in 25 Pa. Code § 250.605 for the most up-to-date values.

As an alternative to developing site-specific numerical cleanup standards and remediation, individuals may choose to perform a combination of engineering and institutional controls to achieve pathway elimination for regulated substances of concern. Common methodologies used to eliminate exposure pathways include permanent capping of contaminated soils with parking lots or building slab construction, groundwater and land use restrictions, vapor barriers, or sub-slab depressurization systems.

Remediation measures may require interface with the SWMA (see Section V.A of this manual), particularly for offsite removal of contaminated media or management of existing waste onsite.

To prepare the development of the site-specific standards risk assessment report, all current and probable future complete exposure pathways as identified in the fate and transport analysis should be addressed. When pathway elimination measures are planned and preapproved, the remaining pathways and the eliminated pathways under the postremedial conditions should be identified in the site-specific standard risk assessment report. Site-specific cleanup levels should be developed to address the risks associated with these remaining pathways. Where all pathways have not been eliminated, a risk assessment report is required.

In addition to human health protection, the risk assessment must evaluate ecological receptors. An ecological risk assessment should be conducted with considerations of the site-specific ecological risk assessment procedure provided in Section III.H of this manual and the most recent U.S. EPA or ASTM

guidances, including those listed in Table II-4 to determine whether an impact has occurred or will occur if a release goes unabated, to establish acceptable remediation levels or alternative remedies based on current or probable future land use that are protective of the ecological receptors.

Ecological receptors include:

- Individuals of threatened or endangered species as designated by the U.S. Fish and Wildlife Service under the Endangered Species Act.
- Exceptional value wetlands as defined in 25 Pa. Code § 105.17 (relating to wetlands).
- Habitats of concern as defined in 25 Pa. Code § 250.1.
- Species of concern as identified in the PNDI.

At the conclusion of the risk assessment, a risk assessment report should be submitted to the Department for review and approval. Section II.B.3(g) (v) of this manual describes specific information required to be included in the risk assessment report.

To ensure that any substantial present or probable future risk to the environment is eliminated, both human health and ecological risk evaluations are necessary. The objective of the Preliminary Ecological Screening is to quickly evaluate whether surface soil or sediments at a site have the potential to pose significant ecological impact or impacts requiring further evaluation. The site-specific initial screening procedure described in Section III.H of this manual may be used during or immediately after the site characterization process to assess the potential for significant ecological impact. It should be noted that the ecological screening procedures under the SHS (in Section II.B.2(e) of this manual) should not be used to replace the site-specific initial screen procedure (Steps 1-2 in Section III.H of this manual) when the site-specific standard is selected to protect human health and the environment. This is because the assumption to use the ecological screening procedures under the SHS is that the site has met SHS values to protect human health. This underlying assumption cannot be made when the site-specific standard is selected to protect human health.

- When conducting an ecological screening under the site-specific standard, a screening level ecological risk assessment to determine if an impact has occurred or will occur if the release of a regulated substance goes unabated should be performed. If this risk assessment shows that an impact has or will occur, the following are then necessary: an ecological risk assessment conducted in accordance with Department-approved EPA or ASTM guidance to establish acceptable remediation levels or alternative remedies based on current and future use that are protective of ecological receptors.

**Table II-3: List of Ecological Risk Assessment Guidances**

U.S. EPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. EPA/540-R-97-006. PB97-963211. June 16, 1997.

U.S. EPA. 1991. Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference Document. EPA/540/R-92/003. December, 1991.

U.S. EPA. 1993a. Wildlife Exposure Factors Handbook, Volume I of II. EPA/600/R-93/187a. PB94-174778. December, 1993.

U.S. EPA. 1993b. Wildlife Exposure Factors Handbook, Volume II of II, Appendix: Literature Review Database. EPA/600/R-93/187b. PB94-177789. December, 1993.

U.S. EPA. 1992. Guidelines for Exposure Assessment; 57 FR, 22888-22938, May 29, 1992

ASTM, E 1739, Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites.

Refer to the EPA website for the Region 3 BTAG (Biological Technical Assistance Group) screening tables and the SSL (Soil Screening Levels) tables, ~~as well as the National Oceanic and Atmospheric Administration (NOAA) website for the SQuiRT (Screening Quick Reference Tables) ecological screening values.~~

- Implementation of the selected remedy, which may include mitigation measures under § 250.311(f), that is protective of ecological receptors.

#### e) **Cleanup Plan**

Section II.B.3.g.ii and Table II-5 of this manual describe information required to be included in the cleanup plan. A cleanup plan is not required, and no remedy is required to be proposed or completed if neither current nor future exposure pathways exist. Subject to the Department's approval of the baseline risk assessment report, a cleanup plan is also not required if the baseline risk assessment indicates the site is within the human health and environmental protection goals specified in 25 Pa. Code § 250.402 under both current and currently planned future site conditions. After the site has been characterized using the suggested guidelines (or some equivalent technique) and a risk assessment performed to develop site-specific standards for soil and groundwater, a remediation (cleanup) plan should be developed, which consists of identification and evaluation of remedial alternatives, selection of a proposed remedy, and plans for the development, construction, and initial operation of the proposed remedy. A number of factors required by Act 2 for consideration in selecting the remedy are set forth in Section 304(j) of Act 2. As described in Section 304(i) of Act 2, remediation to site-specific standards may include treatment, removal, engineering or institutional controls as well as innovative or other demonstrated measures. However, **fences or warning signs generally may not be used as the sole means to address a complete exposure pathway.** The risk or site-specific cleanup value must be calculated for the area as if the fence or signage do not exist, except in the situation where the fence or signage was present when the release occurred or a historical release was discovered.

To evaluate the short-term and long-term effectiveness of a remedial alternative, the potential risk associated with implementation of the alternative and the risk associated with exposure to the remediated media must be evaluated. The pathways and exposure factors that were defined in the exposure assessment should be used to characterize these potential risks.

The risk characterization associated with short-term effectiveness considers the exposure of workers at the site and exposure of receptors in the vicinity surrounding the site to migrating media during the implementation of the remedial alternative. A comparison of a focused list of remedial alternatives may help predict the risks associated with the implementation of the remedial alternative or whether the implementation of alternatives may have any significant impact to human health and the environment.

The risk characterization associated with long-term effectiveness evaluates whether the remedial alternative may attain the remedial objectives (site-specific standards) and whether postremedial risks may achieve the acceptable levels of risk. At times, a specific cleanup goal for one constituent may not be attained, but the overall postremedial risk may be within acceptable levels. Evaluation of the postremedial risk is based on a prediction of what the postremedial exposure

concentration would be. If bioremediation is considered, the remedial objective would be the concentration that provides the basis for characterization of the postremedial risk. If the calculated postremedial risk is within the acceptable range, the remedial alternative would be considered a viable solution.

A remediator evaluating long-term and short-term risks of remedial alternatives should consider *EPA's Risk Assessment Guidance for Superfund* (RAGS), Volume 1, Part C, Chapter 2 for additional guidance. It should be noted that a quantitative risk assessment of remedial alternatives will not need to be conducted for all sites. In most cases, a qualitative rather than a detailed quantitative evaluation of both long-term and short-term risks is all that is needed to select the most appropriate alternative. However, the Department may require a quantitative risk assessment of the selected remedy if a quantitative risk assessment is needed to select the most appropriate remedy or a perceived risk of a selected remedy is high. No matter whether the risk evaluation is qualitative or quantitative, the cleanup plan should always discuss the degree of uncertainty associated with the risk assessment of the selected remedy.

Where there are imminent or immediate threats to human health or the environment, such as waste releasing from corroding tanks or drums, mitigating measures should be undertaken to prevent releases and further exposure as soon as these threats are identified.

The cleanup plan must document the evaluation of the factors listed in Section 304(j) of Act 2. The Department will review the alternative evaluated, the evaluation of the selected remedy in terms of the Section 304(j) criteria, public comments, and response to the comments in the cleanup plan. The Section 304(j) criteria address a few general areas, such as the effectiveness of the remedy (long/short term) to manage risk; the extent to which the risks are being reduced; the ability to implement the remedy; reduction of toxicity, mobility, or volume of regulated substances; reliability and postremediation care; and cost-benefit considerations.

The Department may require further evaluation of the selected remedy or of one or more alternative remedies on its own analysis of Section 304(j) factors in Act 2 or in response to comments received from the community surrounding the site as a result of the implementation of the community involvement plan or as a result of the Department's review of the cleanup plan. Remediators shall submit to the Department, upon request, such additional information as may reasonably be required to complete the evaluation. A final report cannot be approved prior to a remedy being in place as specified in 25 Pa. Code § 250.411(b).

**f) Remediation and Demonstration of Attainment**

Remediation to the site-specific standards should be implemented in accordance with the approved cleanup plan.

The POC for demonstration of the attainment of site-specific standards is described in 25 Pa. Code § 250.407. Site-specific standards shall be attained at

and beyond the POC, where the plume has migrated beyond the property boundary. For groundwater, the POC is the property boundary that existed at the time the contamination was discovered. The remediator may request the movement of the POC in certain circumstances described in 25 Pa. Code § 250.407(a). If any of those conditions exist, the remediator must request moving the POC in writing prior to or at the time of submission of the cleanup plan. The Department will provide a written response to the request. The Department's written approval must be obtained before using the adjusted POC.

Unless an NPDES permit is required for purposes of complying with surface water quality in a spring, the POC is the point of first designated or existing use as defined in 25 Pa. Code §§ 93.1, 93.4, and 93.9. This could mean in close proximity to the spring itself or some point downstream from the spring discharge. Determining the point of first designated use is required because it establishes the point where Chapter 93 water quality standards apply.

Technical guidance to determine point of first use is found in *Policy and Procedure for Evaluating Wastewater Discharges to Intermittent and Ephemeral Streams, Drainage Channels and Swales, and Storm Sewers*, DEP document # 391-2000-014, revised April 2008. In essence, this guidance relies on biological techniques to determine the first downstream point where aquatic life can be documented. It applies to both perennial and intermittent streams with definable bed and banks, but not to ephemeral streams, that is, areas of overland runoff which occur only during or immediately following rainfall events and where there is no defined stream channel and stream substrate.

The site characterization will be the basis on which the vertical and horizontal extent of contamination above the standard is determined. Once this volume of the site is determined and remediation, if necessary, has been performed, then attainment of the standard will focus on the environmental media contained within that volume of the site. Where multiple releases occur on a property which produce distinctly separate zones of contamination, the characterization and subsequent attainment demonstrations will apply individually to the separate releases.

The three methods to demonstrate that the site-specific standard has been met are pathway elimination using an engineering/geologic evaluation, the 95% UCL of the arithmetic mean or other appropriate statistical methods to show that the site meets numerical site-specific standards, or a residual risk assessment following implementation of the remedy to demonstrate that the risk associated with the site following remediation falls within the allowable risk range in Act 2. The residual risk assessment will be based on resampling and a reassessment of the cumulative risks associated with concentrations occurring following remediation.

If this residual risk assessment is nothing more than a presentation of the recalculation of risk values that were previously presented in an approved risk assessment report, the presentation of these calculations can be considered as part of the final report and are not subject to the fees and notification requirements of a risk assessment. However, if the residual risk assessment is following

remediation done prior to approval of a risk assessment report, or following a change in pathway and exposure factors due to remedial measures not addressed in the prior report, this must be a full report as defined in § 250.602 of the regulations and explained further in Section III.H of this manual. This type of residual risk assessment is subject to the fees and reporting requirements associated with a risk assessment.

In demonstrating attainment of the site-specific standard, concentrations of regulated substances are not required to be less than the limit related to the PQL for that substance as provided for in 25 Pa. Code § 250.701(c) and as described in Section III.F of this manual.

In demonstrating attainment of the site-specific standard, the removal of SPL is not required if attainment can be demonstrated in accordance with the requirements of 25 Pa. Code § 250.702(b)(3).

If the site-specific standard is numerically less than the background standard, the remediator may select the background standard, and attainment of the background standard should be demonstrated according to Section 303 of Act 2.

To ensure that contaminant concentration at the POC will not exceed the selected standard in the future, a statistical time trend analysis, knowledge of the plume stability, or other acceptable method must be provided in the final report to the Department for review and approval.

Guidance on applying statistical methods to demonstrate attainment can be found in Section III.B of this manual. A remediator should consider the general guidelines of risk assessment in Sections III.H and III.I of this manual to perform the residual risk assessment. When submitting the final report, a remediator should ensure that the items identified in Section II.B.3(g) and Table II-6 of this manual are included.

**g) General Report Guidelines for the Site-Specific Standard**

The remedial investigation report, risk assessment report, cleanup plan, and final report detailed below are not to be submitted to the Department until the 30-day public and municipal comment period has expired.

In general, submission of the final report simultaneously with the other required reports is only appropriate for site-specific cleanups that do not require a cleanup plan (CP). Chapter 250 and Act 2 state that the final report cannot be approved until the remedy proposed in an approved ~~CP~~ cleanup plan has been completed. There may be situations where DEP regional office staff and the remediator have been in communication throughout the process, and these communications can include agreements on report submissions. DEP encourages remediators to communicate with the regional office staff early and often throughout the process.

**i) Remedial Investigation Report (25 Pa. Code § 250.408)**

The site characterization shall be conducted in accordance with scientifically recognized principles, standards and procedures. The level of detail in the investigation and the selected methods and analyses, which may include models, shall sufficiently define the rate of movement and the present and future extent and fate of contaminants to ensure continued attainment of the remediation standard. All interpretations of geologic and hydrogeologic data shall be prepared by a professional geologist licensed in Pennsylvania. A suggested outline for a remedial investigation report is provided in Table II-4.

**ii) Cleanup Plan (25 Pa. Code § 250.410)**

The cleanup plan is not required if no current and probable future exposure pathways exist. The cleanup plan is also not required if the approved baseline risk assessment report indicates that the site does not pose unacceptable risks to human health and the environment under current and planned or probable future conditions. A suggested outline for a cleanup plan is provided in Table II-5.

**iii) Final Report (25 Pa. Code § 250.411)**

A suggested outline for a final report under the site-specific standard is provided in Table II-6.

**iv) Combined Remedial Investigation Report/Final Report**

The site characterization shall be conducted in accordance with scientifically recognized principles, standards and procedures. The level of detail in the investigation and the selected methods and analyses, that may include models, shall sufficiently define the rate of movement and the present and future extent and fate of contaminants to ensure continued attainment of the remediation standard. All interpretations of geologic and hydrogeologic data shall be prepared by a professional geologist licensed in Pennsylvania. A suggested outline for the combined remedial investigation report/final report under the site-specific standard is provided in Table II-7.

**v) Risk Assessment Report (25 Pa. Code § 250.409)**

A baseline risk assessment report is not required if the Department, in its remedial investigation report or cleanup plan approval, concurs that a specific remediation measure that eliminates all pathways, other than a no-action remedial alternative, can be implemented to attain the site-specific standard (see 25 Pa. Code § 250.405(c)). A risk assessment report is not required if no present or future exposure pathways exist, as documented in the remedial investigation report by a fate and transport analysis.



A suggested outline for a risk assessment report is provided in Table II-8. The items in the outline are suggested as minimum requirements for inclusion in the report; the order and titles are not mandatory. If a baseline risk assessment is not required and a remediator submits the development of site-specific standard numerical values as a stand-alone document, more detailed risk assessment information should be provided in the development of the site-specific standard numerical values document.

**h) Detailed Report Requirements for the Site-Specific Standard**

The following are detailed descriptions of what should to be included in each section of a report. Not all sections are necessary for each report. Please refer to the outlines in the previous section for detailed information.

**i) Summary (RIR, FR, RIR/FR)**

Provide a summary paragraph(s) which will provide the reviewer with an overview of the site. This will serve to highlight the important issues and conclusion which will be presented in the report.

The Final Report Summary form should be filled in and submitted to the Department electronically. The summary submitted with the final report should be a copy of that electronic form.

**ii) Introduction (CP, RA)**

Provide a summary of the investigation report(s) and risk assessment report and an interpretation of the conditions at the site (refined conceptual site model). Discuss the chosen method(s) of remediation. The remedy should be evaluated in accordance with the requirements of Section 304(j) of Act 2.

**iii) Site Description (RIR, RIR/FR)**

Provide a description of the site in sufficient detail to inform the reviewer of the site location and the types of operations that are currently and/or were formerly conducted on the site. As appropriate to the site, the description should include location, physical description of the property, ownership history, site use history, and regulatory action history (past cleanups).

**iv) Site Characterization (RIR, RIR/FR, RA)**

The site characterization provides important information documenting the current conditions at the site. Information developed during the site characterization is primarily intended to describe the nature, concentrations, extent, and potential for movement of all contaminants present on the site or that may have migrated from the site. For sites

where there are multiple distinct areas of contamination, the site characterization process should be applied to each area individually.

**v) Source and Identification of Constituents of Concern (Part of Characterization)**

For the area being investigated include a description of source characterization, which may be in the form of a conceptual site model.

**vi) Nature and Extent of Contamination (Part of Characterization)**

Information needed to meet the requirements below should be included here. For soil and groundwater, include information on samples and measurements used to characterize the horizontal and vertical, present and future extent and fate of contamination. Direction and velocity of contaminant movement should be based on factors of the groundwater and soil as well as the contaminant(s) which affect migration.

Text, tables, graphics, figures, maps and cross sections should be used to describe the nature, location, and composition of the regulated substances at the site. Providing the data in an appropriate format will expedite the review of the report.

**vii) Other Information Required Under the Site-Specific Standard (RIR, RIR/FR)**

Description of the existing or potential public benefits of the use or reuse of the property for employment opportunities, housing, open space, recreation or other uses. Describe the past, present, and future use of the site.

Information obtained from attempts to comply with the background or Statewide health standards, such as background concentrations for constituents of concern.

**viii) List of Contacts (ALL)**

Name, address, and telephone number of the project manager responsible for submittal of the cleanup plan.

Names, addresses, and telephone numbers of consultants or other persons responsible for preparing the cleanup plan.

Names, addresses, and telephone numbers of the property owner and party responsible for the remediation cost.

**ix) Remedial Alternative (CP)**

Identify remediation alternatives considered and evaluate the ability and effectiveness of the selected remedy to achieve the site-specific standards, based on the factors set forth in Section 304(j) of Act 2. The cleanup plan must document how each of the factors set forth in Section 304 (j) of Act 2 was evaluated. The evaluation should include an evaluation of the short-term and long-term risks and effectiveness of the proposed remedy. In evaluating the other alternatives, no risk evaluation is required; rather, a narrative describing the consideration of Section 304(j) factors relative to the proposed remedy should be included.

**x) Treatability studies (CP)**

Provide results of any treatability, bench scale, or pilot scale studies or other data collected to support the remedial action(s).

All other site information relevant to the conceptual design, construction, or operation of the remedial action.

Specific characteristics of the site that may affect the implementation or effectiveness of the remedial action including such characteristics as topography, geology, depth of bedrock, potentiometric surfaces, and the existence of utilities.

**xi) Design plans and Specifications (CP)**

Consists of adequate design plans and specifications sufficient to evaluate the proposed remedy including, but not limited to:

- Detailed description of the remedial action (treatment and/or removal) and remedial technology to be implemented. Adequate design plans and specifications for all remedial activities, including remedial design, onsite treatment, storage, removal and disposal activities.
- Estimated volume of each medium to be treated and/or removed. Provide methodology and calculations used to estimate contaminant mass.
- Remedial Action Status Plan - To evaluate the short-term and long-term effectiveness of the remedial action to include, but not limited to, the following:
  - Location and construction details of all monitoring points.
  - Sampling and Analysis Plan, including QA/QC Plan.
  - Other site-specific monitoring as appropriate.

- Construction QA/QC Plan including engineering certification.
- Locations, telephone numbers, and contacts of offsite disposal facilities, including names, addresses, and telephone numbers of waste transportation companies.
- Site-specific Health & Safety Plan which includes adherence to all applicable Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) regulations and recommendation.
- Erosion and Sedimentation Control Plan consistent with Chapter 102 (Erosion Control) relating to earth disturbance during remedial activities.
- Site Security Plan.
- A schedule for implementation of the proposed remedial action.
- Operation and Maintenance Plan which shall describe:
  - Startup testing, inspection and maintenance over the first year and subsequent years of operation.
  - Identification of equipment necessary for operation and maintenance.
  - Specification of the type, frequency, and duration of testing or maintenance to verify optimal remedial system performance.
- All federal, State and local permits and approvals and any agreements necessary for the construction and operation of the approved remedial action shall be identified.

**xii) Remediation (FR)**

Documentation of the methodologies used to attain the site-specific standard. Including removal and/or treatment technologies used, and any engineering and/or institutional controls used to attain or maintain the selected standard. This section should also include the calculation of the mass of contaminants addressed during the remediation of soil and/or groundwater, using the methodology in Section III.C.

**xiii) Attainment (FR)**

Documentation that the remedy has been completed in accordance with an approved cleanup plan.

- Descriptions of treatment, removal, or decontamination procedures performed in remediation. Documentation of handling of remediation wastes in accordance with applicable regulations.
- Descriptions of the sampling methodology and analytical results.
- All sampling data, including QA/QC data.

The demonstration of attainment should be applied separately for each distinct area of contamination. Demonstration of attainment in a final report should include one or more of the following three types of information:

- Demonstration of attainment of a numerical standard:

The information includes demonstration that the calculated numerical site-specific standards have been met through the application of appropriate statistical tests, and demonstration that shows contaminant concentration at the POC will not exceed the selected standard. The following information shall be documented in a final report when a statistical method is applied:

- A description of the statistical method.
- A clear statement of the applicable decision rule in the form of statistical hypothesis for each spatial unit and temporal boundary including the applicable statistical parameter of interest and the cleanup standard.
- A description of the underlying assumptions of the method.
- Documentation showing that the sample data set meets the underlying assumptions of the method and demonstrate that the method is appropriate to apply to the data.
- Specification of false positive rates.
- Documentation of input and output data for the statistical test, presented in tables, figures or both, as appropriate.
- An interpretation and conclusion of the statistical test.

Demonstration that contaminant concentration at the POC will not exceed the selected standard should be based on a statistical time trend analysis, knowledge of the plume stability or other acceptable method.

- Demonstration of pathway elimination:

This demonstration should be based on either an engineering or hydrogeologic analysis, or both, which includes fate and transport analysis that some or all of the exposure pathways have been eliminated. The eliminated pathways and the remaining pathways should be clearly identified. The pathway elimination demonstration should include the following:

- Identifying all exposure pathways prior to the implementation of pathway elimination technology, based on fate and transport analysis.
- Identifying all exposure pathways after the implementation of pathway elimination technology, based on fate and transport analysis.

- Residual Risk Assessment

As an alternative to demonstrating the attainment of numerical standards, a person may perform a residual risk assessment to show that the risk which remains at a site following remediation is within the acceptable risk range specified in Act 2. The residual risk assessment should be based on resampling and a reassessment of the cumulative risks associated with concentrations occurring following remediation.

If this residual risk assessment is nothing more than a presentation of the recalculation of risk values that were previously presented in an approved risk assessment report, the presentation of these calculations can be considered as part of the final report and are not subject to the fees and notification requirements of a risk assessment. However, if the residual risk assessment is following remediation done prior to approval of a risk assessment report, or following a change in pathway and exposure factors due to remedial measures not addressed in the prior report, this must be a full report as defined in 25 Pa. Code § 250.602 and explained further in Section III.H of this manual. This type of residual risk assessment is subject to the fees and reporting requirements associated with a risk assessment.

**xiv) Fate and Transport Analysis (RIR, FR, RIR/FR, RA)**

The Fate and Transport Section (Section III.A of this manual) provides a discussion on fate and transport analysis. The amount of detail in the fate and transport analysis may vary from a basic description to a very extensive detailed model with quantitative modeling. Whenever a model is used, the assumptions, data, and information on the model necessary for Department staff to evaluate and run the model should be included. Any parameters used in the analysis or models used should use data from the site obtained during the site characterization. This includes identified ecological receptors.

Modeling (optional) - Data Interpretation:

- Identify any programs or modeling used to interpret site conditions or predict plume migration. Identify codes used and any modifications made.
- Models should be developed from site-specific data.
- Identify limitations/assumptions used in the model(s).
- Models should be validated to reproduce conditions measured in the field.

**xv) Conclusions and Recommendations (RIR, RIR/FR)**

In addition to documenting the items listed above, the remedial investigation report should draw conclusions regarding the existence of exposure pathways and the potential effectiveness of institutional or engineering controls in eliminating some or all of these pathways. The report also should identify the appropriate remedial technology options for each medium of concern.

**xvi) Postremediation care plan (if applicable) and other postremedial obligations (such as monitoring or institutional controls) (CP, FR, RIR/FR)**

If engineering or institutional controls are needed to maintain a standard, if the fate and transport analysis indicates that the remediation standard may be exceeded at the POC in the future, or, if the remediation relies on natural attenuation, a postremediation care plan must be documented in the final report (see 25 Pa. Code 250.411(d)). The plan should include:

- Reporting of any instance of nonattainment.
- Reporting of any measures to correct nonattainment conditions.

- Monitoring on a quarterly basis, or as otherwise approved by the Department, that demonstrates the effectiveness of the remedy and periodic reporting of monitoring results and analysis.
- Maintenance of records at the property where the remediation is being conducted for monitoring, sampling and analysis.
- A schedule for operation and maintenance of the controls and submission of any proposed changes.
- If requested by the Department, documentation of financial ability to implement the remedy and the postremediation care plan.

If mitigation measures are implemented to restore or replace equivalent ecological resources in the local area of the site, a postremediation care plan to maintain the mitigated ecological resources is documented in the final report (see 25 Pa. Code 250.411(f)). The plan should include:

- Reporting of the ongoing success or failure of the mitigation measure implemented.
- Mitigation measures instituted at the time of the final report shall be successfully accomplished and sustained up to five years from final report approval.
- In some cases, postremedial obligations described in Section III.E could require documentation in a postremediation care plan.

**xvii) Cooperation or Agreement of Third Party (CP)**

When a person proposes a remedy that relies on access to properties owned by third parties for remediation or monitoring, documentation of cooperation or agreement shall be submitted (see 25 Pa. Code 250.410(c)).

**xviii) Public comments (ALL)**

Include the comments obtained during the public and municipal comment period and the public involvement plan, if any, and the responses to those public comments.

**xix) References (ALL)**

**xx) Attachments (ALL)**

Attachments may include but are not limited to:

- Tables – monitoring well construction summary, groundwater gauging data, including elevation and NAPL thicknesses, analytical data, historical data.



- Figures – including groundwater elevation maps, extent of NAPL, concentration data for soil/groundwater/surface water/vapor or indoor air, cross-sections.
- Monitoring well construction diagrams, boring logs, stratigraphic logs, including soil/rock characteristics.
- Sampling and analysis plan(s).
- QA/QC Plan.
- Ecological survey documentation (from PNDD).
- Well search documentation (from PaGIS).
- Field data sheets, such as low flow purging monitoring.
- Statistical worksheets, software outputs, graphs; modeling inputs/outputs.
- Disposal documentation of soil/groundwater.
- Remediation system operation, maintenance, monitoring data; mass removal estimates.
- Before and after remediation photographs.
- Copy of municipal notification, reasonable proof of newspaper notice publication.
- Laboratory reports and any voluminous attachments may be enclosed on a CD.

**xxi) Signatures (ALL)**

If any portions of the submitted report were prepared or reviewed by or under the responsible charge of a registered professional geologist or engineer, the professional geologist or engineer in charge must sign and seal the report.

**Table II-4: Suggested Outline for Remedial Investigation Report under the Site-Specific Standard**

**I. Summary**

(Section II.B.3(h)(i))

**II. Site Description**

Provide a description of the site in sufficient detail to give an overall view of the site.  
(Section II.B.3(h)(iii))

**III. Site Characterization**

Document current conditions at the site. (Section II.B.3(h)(iv-vi))

**IV. Fate and Transport Analysis**

Description of Fate and Transport analyses used and results and conclusions. Provide detailed conceptual site model including analysis of vapor intrusion pathway. (Sections II.B.3(h)(xiv) and III.A)

**V. Other Information Required under the Site-Specific Standard.**

Provide the results of ecological receptor evaluation. Describe the public benefits of the use or reuse of the property. Identify complete exposure pathways. (Section II.B.3(h)(vii))

**VI. Conclusions and Recommendations**

Draw conclusions regarding the existence of exposure pathways and the potential effectiveness of institutional or engineering controls for pathway elimination. Identify the appropriate remedial technology options. (Section II.B.3(h)(xv))

**VII. References**

**VIII. Attachments**

(Section II.B.3(h)(xx))

**IX. Public Comments**

Include the comments obtained as a result of a public involvement plan, if any, and the responses to those public comments. (Section II.B.3(h)(xviii))

**X. Signatures**

(Section II.B.3(h)(xxi))

**Table II-5: Suggested Outline for a Cleanup Plan under the Site-Specific Standard**

**I. Introduction**

(Section II.B.3(h)(ii))

**II. List of Contacts**

(Section II.B.3(h)(viii))

**III. Site Maps**

(Section II.B.3(h)(xx))

**IV. Remedial Alternative**

Identify remediation alternatives considered and evaluate the ability and effectiveness of the selected remedy to achieve the site-specific standards based on the factors set forth in Section 304 (j) of Act 2. (Section II.B.3(h)(ix))

**V. Treatability Studies**

Provide results of any treatability, bench scale, or pilot scale studies or other data collected to support the remedial action(s). (Section II.B.3(h)(x))

**VI. Design Plans and Specifications**

Consists of design plans and specifications sufficient to evaluate the proposed remedy. (Section II.B.3(h)(xi))

**VII. Postremediation Care Plan**

(Section II.B.3(h)(xvi))

**VIII. Cooperation or Agreement of Third Party**

(Section II.B.3(h)(xvii))

**IX. Public Comments**

(Section II.B.3(h)(xviii))

**X. Signatures**

(Section II.B.3(h)(xxi))

**Table II-6: Suggested Outline for a Final Report under the Site-Specific Standard**

**I. Summary**

The final report summary should be a copy of the electronic form submitted to the Department.  
(Section II.B.3(h)(i))

**II. Remediation**

Description of the remedial methodologies used to attain the selected standard.  
(Section II.B.3(h)(xii))

**III. Attainment**

Demonstration of attainment of a numerical standard.

- Soil site-specific standard
- Groundwater site-specific standard
- Surface water site-specific standard, and/or
- Sediment site-specific standard

Describe the statistical methods used to demonstrate attainment of the standard.

Demonstration of Pathway Elimination.

Residual Risk Assessment.

(Section II.B.3(h)(xiii))

**IV. Fate and Transport Analysis**

Description of Fate and Transport analyses used and results and conclusions.  
(Section II.B.3(h)(xiv) and III.A)

**V. Postremediation Care Plan (if applicable)**

This section is included only if necessary. It describes the engineering and institutional controls necessary to maintain the standard. (Section II.B.3(h)(xvi))

**VI. References**

**VII. Attachments**

(Section II.B.3(h)(xx))

## **VIII. Public Comments**

(Section II.B.3(h)(xviii))

## **IX. Signatures**

(Section II.B.3(h)(xxi))

**Table II-7: Suggested Outline for the Combined Remedial Investigation Report/Final Report under the Site-Specific Standard When No Current and Future Complete Exposure Pathways Exist**

**I. Final Report Summary**

The final report summary should be a copy of the electronic form submitted to the Department. (Section II.B.3(h)(i))

**II. Site Description**

Provide a description of the site in sufficient detail to give an overall view of the site. (Section II.B.3(h)(iii))

**III. Site Characterization**

Document current conditions at the site. (Sections II.B.3(h)(iv-vi))

**IV. Fate and Transport Analysis**

Description of fate and transport analyses used and results and conclusions. (Sections II.B.3(h)(xiv) and III.A)

**V. Other Information Required under the Site-Specific Standard**

Provide the results of ecological receptor evaluation. Describe the public benefits of the use or reuse of the property. Identify complete exposure pathways. (Section II.B.3(h)(vii))

**VI. Conclusions and Recommendations**

Draw conclusions regarding the existence of exposure pathways and the potential effectiveness of institutional or engineering controls for pathway elimination. Identify the appropriate remedial technology options. (Section II.B.3(h)(xv))

**VII. Postremediation Care Plan (if applicable)**

This section is included only if necessary. It describes the engineering and institutional controls necessary to maintain the standard. (Section II.B.3(h)(xvi))

**VIII. References**

**IX. Attachments**

(Section II.B.3(h)(xx))

**X. Public Comments**

(Section II.B.3(h)(xviii))

**XI. Signatures**

(Section II.B.3(h)(xxi))

**Table II-8: Suggested Outline for a Risk Assessment Report under the Site-Specific Standard**

## **EXECUTIVE SUMMARY**

### **PART 1 – Human Health Risk Assessment**

#### **I. Introduction**

- Objectives of Risk Assessment
- Organization of Report

#### **II. Site Characterization**

- Site history (brief)
- Site location/map
- Description of sources
- Nature and extent of contamination
- Identification of constituents of concern
- Conceptual site model

#### **III. Exposure Assessment**

- Exposure scenarios based on land use (current and future)
- Potential receptors based on land use (current and future)
- Summary of complete pathways (including fate and transport considerations)
- Quantification of exposure (not required, if all exposure pathways will be eliminated through pathway elimination measures.)

#### **IV. Toxicity Assessment**

(Not required if all exposure pathways will be eliminated through pathway elimination measures.)

- Toxicity values for constituents of concern
- Derivation of chemical-specific toxicity criteria (if applicable)
- Supporting data listing all relevant information on toxicity

## **V. Risk Characterization**

- Algorithms (not required if all exposure pathways will be eliminated through pathway elimination measures.)
- Calculations and Results (not required if all exposure pathways will be eliminated through pathway elimination measures.)
- Description and fulfillment of risk assessment objectives
- Discussion of uncertainty for all sections of report, including uncertainties associated with site characterization, toxicity assessment, exposure assessment and risk characterization

## **VI. References**

### **PART 2 – Ecological Risk Assessment**

This section reports the results of the ecological risk assessment conducted using the guidance in Section III.I and, as applicable, EPA guidance.

#### **Public Comments**

Include the comments obtained as a result of a public involvement plan, if any, and the responses to those public comments.

#### **Signatures**

If any portions of the submitted report were prepared or reviewed by or under the responsible charge of a registered professional geologist or engineer, the professional geologist or engineer in charge should sign and seal the report.



#### **4. Special Industrial Areas**

##### **a) Introduction**

The SIA provision established in Section 305 of Act 2 creates incentives to reuse industrial properties. Cleanups at these SIAs have reduced remediation requirements which are intended to allow these sites to be put back into productive use in the community. Act 2 established this provision to encourage the redevelopment of properties used for industrial activities. The remediator, reuser, and the property must meet eligibility requirements to be considered as an SIA under Act 2. Under the SIA provision, necessary remediation will be performed, and required notification and reporting requirements will be met.

##### **b) Eligibility Determination**

Specific eligibility requirements in § 250.502 of the regulations provide for qualification of a property for reuse as an SIA and for the qualification of a remediator to use this special provision of Act 2. The property must have been used for industrial activity. The extent of industrial activity is defined very broadly and is detailed in Section 103 of Act 2. If the property qualifies as having been used for industrial activity, the following additional qualifications must be met:

- The property must be one where there is no financially viable responsible person, or it is located within a designated EZ.
- The remediator must not have caused or contributed to releases at the property. A person who is interested in purchasing a property and undertaking a reuse of that property should contact the Department before the reuser purchases the property.
- The term “responsible person” includes the owner of the property, regardless of whether he has or has not caused or contributed to the contamination. Therefore, prospective purchasers of property which could be eligible as an SIA are recommended to contact the Department prior to the purchase of the property.
- Actions in themselves that do not cause or contribute to contamination taken under Section 307 of Act 2 relating to emergency and interim responses will not prejudice eligibility determinations under the SIA designation.
- It is the responsibility of the reuser to demonstrate to the Department that the reuser has not had an environmental impact on the property, just as it is the responsibility of the remediator to document that the property meets the other eligibility criteria for an SIA. To accomplish this, certain information must be presented to the Department regarding the above eligibility requirements:

- Documentation that the property has been used for industrial activities by including information on the ownership and operational history of the property as part of the work plan for the baseline remedial investigation.
- Verification that no financially viable responsible party exists to address the contamination on the property. Financial information for existing responsible parties must be included in the ownership and operational history. “Financially viable” is generally defined as having sufficient financial resources to be able to perform part or all of the cleanup required at a particular property.

To qualify as a property within an EZ or Keystone Opportunity Zone (KOZ), the municipality where the property is located must be designated by DCED as an EZ, KOZ, or Keystone Innovation Zone (KIZ). To determine whether a particular property is within an EZ, KOZ, or KIZ, contact DCED or the appropriate local contact person. If a remediator wants to determine the eligibility of a site for the SIA provisions, when a financially viable responsible party is present, the remediator will need to verify the existence of the EZ, KOZ, or KIZ designation for the area where the site is located.

A letter from either DCED or the appropriate zone contact person should be provided with the work plan to verify the status of the property. Persons remediating a site in an EZ where a viable responsible party may still exist are only responsible for remediation of contamination identified in the baseline environmental report and specified in the CO&A with the Department as required for remediation prior to the new use of the property. Additional remediation may be pursued by the Department with the responsible person. Responsible persons under HSCA must resolve their liability to the Department pursuant to HSCA. See Section V.E of this manual.

**c) Process Checklist for Special Industrial Areas**

- ☐ Evaluate the property potential for redevelopment.
- ☐ Determine if the property was used previously for industrial activity or if it is located within an EZ (35 P.S. 6026.305(a) and 25 Pa. Code § 250.502).
- ☐ Determine if there is a financially viable responsible party. If the property is located within an EZ, financial viability is not a requirement for SIA use (35 P.S. 6026.305(a) and 25 Pa. Code § 250.502).
- ☐ The remediator must demonstrate to the Department that he did not cause or contribute to contamination on the property (35 P.S. 6026.305(a) and 25 Pa. Code § 250.502).
- ☐ Review the historical information and present use of regulated substances at the property.

- ☐ Prepare a work plan for a baseline remedial investigation (35 P.S. 6026.305(b) and 25 Pa. Code § 250.503(b)).
- ☐ The work plan must be approved by the Department prior to performing the investigation (35 P.S. 6026.305(b) and 25 Pa. Code § 250.503(b)).
- ☐ Begin baseline remedial investigation (use Section II.B.4.e of this manual, 35 P.S. 6026.305(b) and 25 Pa. Code § 250.503(c)).
- ☐ Submit NIR for the SIA to the Department. Also provide notice to the municipality, publish a notice of submission of the NIR in a local newspaper, and provide reasonable proof of required notices to the Department.
- ☐ Prepare public involvement plan (if requested by municipality).
- ☐ Prepare baseline environmental report based on baseline remedial investigation (35 P.S. 6026.305(b) and 25 Pa. Code § 250.503(d)).
- ☐ Department review of baseline environmental report.
- ☐ Meet with the Department and concur on CO&A. The prospective purchaser should enter into the CO&A prior to purchasing the property (35 P.S. 6026.305(e) and 502(a)).
- ☐ Remediate the property to the SIA requirements specified in the baseline environmental report and agreed to in the CO&A (35 P.S. 6026.502(b)).
- ☐ Calculate the mass of contaminants remediated using the procedure in Section III.C of this manual.
- ☐ Complete the Final Report Summary and submit electronically as per the instructions on the Land Recycling Program web page.
- ☐ Protection from liability occurs upon the signing of the CO&A with the Department, subject to the remediator's compliance with the CO&A demonstrating attainment of the SIA requirements in accordance with Chapters 3 and 5 of Act 2.
- ☐ Submit an environmental covenant, if applicable, to the Department.

**d) Aspects of Special Industrial Areas**

**i) Immediate, Direct, or Imminent Threats to Human Health and the Environment**

One of the significant aspects of Act 2 is the cleanup liability protection provided for SIAs. The cleanup liability for the person undertaking remediation and reuse of an SIA is dependent upon the person performing remediation of immediate, direct or imminent threats to public health or the environment which would prevent the property from being occupied for the remediator's intended purpose.

The immediate, direct, or imminent threats are to be determined by the baseline remedial investigation and defined in the baseline environmental report. The baseline environmental report will become the basis for the CO&A between the Department and the remediator. The exposures, and potential exposures, presented by an SIA site must be identified in the baseline remedial investigation. Defining immediate, direct, or imminent threats is relevant to the remediator's intended use of the property. Therefore, it is necessary for the remediator to specify the intended use of the property. The identification of these threats needs to be addressed at the time of the baseline remedial investigation work plan and in performance of the investigation. Only concerns identified in the baseline environmental report and included in the agreement can be considered in any relief from liability afforded to the remediator by Act 2. For this reason, it is paramount that the remediator performs a comprehensive investigation of an SIA.

Immediate and imminent threats are pending threats likely to happen without delay or momentarily in time. Direct threats, though sometimes similar in immediacy, also include chronic exposure. At a minimum, immediate, direct, or imminent threats will entail:

- Contained wastes which present immediate, direct or imminent threats. Examples are regulated substances in drums, barrels, tanks, or other bulk storage containers; and contained wastes, such as wastes in drums, above or below ground tanks, and small containers.
- All wastes which are not containerized, and which present a direct threat to workers or other persons on the property. These may include, but are not limited to, open containers, pits, waste piles and other situations that allow wastes to be exposed and accessible on the site.
- In addition to situations listed above, actual exposure for onsite human populations to any regulated substances.

- Actual contamination of drinking water by regulated substances. Also, contaminated groundwater, if groundwater use will expose persons on the property to contaminants.
- Contaminated soil presenting a direct contact threat to workers or other persons on the property. Direct contact may occur in a zone of soil at and below the surface. The depth of consideration of surface soil shall be the first two feet from the ground surface, unless reuse of the property presents exposure threats at depths greater than two feet.
- Regulated substances presenting a threat of fire or explosion.
- Surface water and sediments contaminated with regulated substances, if persons are or may become exposed to these contaminants.
- Regulated substances contained as product may remain on the property if maintained according to appropriate regulations. The remediator is responsible for releases occurring as a result of the remediator's actions.

**ii) Consideration of Chronic Exposure in Evaluation of the Reuse of a Special Industrial Area**

25 Pa. Code Section 250.503(c)(5) pertains to property to be reused and states, "Evaluation of exposure conditions within the portion of the property to be reused to identify existing contamination that poses an immediate, direct or imminent threat to public health or the environment which is inconsistent with the intended reuse of that portion of the property." Initially, the determination of property use for nonresidential or residential purposes will focus on determination of direct contact exposure. In the use of the definition of "immediate, direct or imminent," the word "direct" includes chronic exposure. In the scope of chronic exposure, workers or other persons using a property with existing contamination are to be protected from chronic exposure levels of contaminants as well as to acute exposure levels. Direct contact includes contamination which persons may come in contact with when working, living at, or visiting a site. Direct contact may occur by several routes. Some examples are ingestion of soil, contact with soil, or inhalation of soil particles or vapor from the soil. Additional direct contact pathways may be caused by leaching from the soil to groundwater, vapor intrusion into buildings, inhalation of contaminated process water, surface water run-off to water bodies, and exposure of wildlife and ecosystems. Soil available for direct contact must meet the human health and environmental protection standards established by Act 2.

**iii) Contaminant Migration Off-Property**

There are no obligations or liability for off-property contamination placed upon an innocent person using the SIA provision. For cases where the off-property pollution is significant, there may be other available options for addressing these risks. If there is an existing viable responsible party (property located within an EZ), the viable responsible party would continue to be responsible for off-property contamination. For sites where there is no viable responsible party, the cleanup may either be remediated by a purchaser of the property (voluntary cleanup) or addressed under other State or federal programs. In either case, the innocent purchaser would not be responsible for off-property contamination, as long as he or she did not cause or contribute to that contamination. Although assessment at the time of the baseline remedial investigation is not required off-property, the remediator should determine whether contamination is moving off the property.

If contamination which requires remediation is found at a future date, and the nature, concentration, and location were not identified in the baseline environmental report, the remediator may be liable to perform cleanup of the contamination to one of the three standards.

**iv) Contamination Identified Subsequent to Remediation and Agreement Conditions**

Under Section 502(b) of Act 2 the remediator is only relieved from liability for contamination which was identified in the baseline environmental report. For this reason, it is to the remediator's benefit to conduct a comprehensive investigation.

**v) Storage Tank Closure and Corrective Action at Special Industrial Areas**

Remediators are only responsible for addressing the immediate, direct or imminent threats posed at SIAs. In all cases this includes removal of waste in containers. Materials remaining in tanks must be removed and handled in accordance with applicable laws and regulations. Product may remain in the tanks if it is rendered inert and poses no risk. The actual tanks are required to be removed or rendered safe. The remediator should follow the Storage Tank Program regulations and guidance to achieve a safe closure of tanks. Smaller containers will likely be required to be removed. Releases from tanks that occur after the remediator becomes the owner or operator are the responsibility of the remediator.

**vi) Consent Orders and Agreements**

Remediation of all threats relevant to an SIA reuse which were detailed in the baseline environmental report will be detailed in a CO&A.

Contamination not identified in the baseline environmental report will become the responsibility of the remediator.

A change in use of the property, from that defined in the Agreement, may necessitate a change in the Agreement or modification of the proposed property reuse. A land use change for an SIA may trigger a reopener under Section 505(4) of Act 2. The CO&A with the Department will require the remediator or reuser to provide the Department with written notice of any change in the use of the property and to remediate any contamination which would prevent the use of the property for its new purpose.

**vii) Remediation**

Remediation in SIAs must meet the following requirements:

- Cleanup may utilize treatment, containment, removal, control methods, or any combination of the above.
- Cleanup must address all containerized waste at the property in accordance with applicable regulations.
- Soil available for direct contact must meet one of the three remediation standards.
- Cleanup of any wastes or cleanup of any medium contaminated with regulated substances which pose an immediate, direct, or imminent threat to human health or the environment based on the intended use of the property must be to one of the three remediation standards.

If groundwater is to be used at the property, the groundwater must either be remediated in-ground or at the point of use so that it is safe for its intended use and occupation of the property.

**viii) Environmental Covenant**

An environmental covenant is necessary for SIA remediations that require an activity and use limitation. The environmental covenant may also fulfill any deed acknowledgement requirements specified by SWMA and HSCA. Future activity and use limitations due to disposal of hazardous wastes or regulated substances may be required as part of the remedy and may be identified as part of the environmental covenant.

**e) Work Plan for Baseline Remedial Investigation and Baseline Environmental Report**

**i) Work Plan for Baseline Remedial Investigation**

A baseline remedial investigation is required for evaluation of a property that will be part of an SIA agreement. The objective of the baseline remedial investigation is to establish a reference point documenting contamination that existed prior to the redevelopment. A work plan for the baseline remedial investigation is required to be prepared by the remediator and approved by the Department prior to initiation of the investigation. The findings and conclusions of the baseline remedial investigation shall be documented in a report known as a baseline environmental report.

The work plan for the baseline remedial investigation shall be designed considering the unique considerations of SIAs and tailored for the specific property. The work plan shall address how the remediator will perform the baseline remedial investigation and shall address the items below and any additional items determined to be appropriate by the person proposing remediation or requested by the Department. The work plan for the remedial investigation shall include the steps to be taken to document the following:

- A description of the property and detailed ownership history.
- Identification of the historical regulated substance use, handling and disposal activities on the property, and any known or suspected releases associated with these activities. This is obtained by conducting an environmental site characterization, a review of historical records, and interviews with persons who may have knowledge of the property.
- Characterization of the regulated substances on the property. Identification of existing contamination that poses an immediate, direct or imminent threat to public health or the environment which would prevent the property from being occupied for the intended use.
- Identification of potential migration pathways off the property, or onto the property, and any potential receptors from any release on the property. Where migration pathways and receptors have been identified, the remediator shall perform environmental sampling of the groundwater at the downgradient property boundary to determine if regulated substances from releases on the property have migrated off the property.



- In addition to the above, environmental sampling, if indicated by the investigation, in all potential media of concern to confirm whether releases have occurred.

## ii) **Baseline Environmental Report**

The baseline environmental report shall provide the results of the baseline remedial investigation and describe the historical use, location of areas of contamination, the intended reuse, sampling results, contaminant migration occurrence or potential, and the proposed remediation measures to ensure that the SIA requirements are met. Portions of the baseline environmental report containing information about geologic or hydrogeologic investigations shall be prepared and certified by a registered professional geologist licensed in Pennsylvania. The baseline environmental report shall be submitted without binding. The following is a recommended scope of a baseline environmental report:

**Summary:** Provide a summary paragraph(s) that will give the reviewer an overview of the property. This will serve to highlight the important issues and conclusion that will be presented in the report.

**Description of Property:** Provide a description of the property in sufficient detail to give the reader an overall idea of the property and its location. Describe the following:

- Buildings and other site features such as lagoons, tanks, treatment plants, and other structures on the property. Include a site map (scale of 1 inch = 200 feet).
- The location of all onsite wells, septic systems, floor drains, sumps and associated piping, storage areas, and chemicals or chemical compounds used, stored, treated or disposed.
- A description of present conditions at the property including any evidence of a release, contaminated media, tanks, and identification of areas of uncontained and/or SPL.
- The location and name of any public or private water supply on or near the property.
- The location, name and elevation of surface water bodies (springs, streams, lakes, ponds, wetlands) within 2,500 feet of the property.
- The location of utility lines at and near the area of investigation including any municipal or private water supply lines or natural gas lines, sanitary or sewer lines, and any other subsurface utilities.
- The location of active and inactive oil and gas wells, injection wells, surface and underground coal and non-coal mines, mine

pool discharge points, landfills, and surface disposal areas within 2,500 feet of the property.

- Identify sensitive features within 2,500 feet of the property, such as threatened or endangered species habitat, recreational river corridors, state and federal forests and parks, historic and archaeological sites, national wildlife refuges, state natural areas, prime farm land, wetlands, special protection watersheds designated under Chapter 93 and other features.

**Ownership History:** Provide a detailed property ownership history since the release of regulated substances onsite. Include company or individual name and address (if available), ownership period, and the general operational use of the property during each ownership period.

**Site Use History:** Provide detail on past and current uses of property and adjoining properties; including treatment, storage, and disposal of regulated substances. Indicate the type, estimated volume, composition, and nature of the released materials, chemicals or chemical compounds. Indicate the sources of regulated substances; description of spills, leaks, releases on the property; and migration or migration potential to adjacent properties; and remedial action to date. Include a brief description of agency actions such as violation notices, administrative orders, and environmental permits.

**Site Characterization:** The site characterization provides important information documenting the current conditions at the property. Information developed during the site characterization is primarily intended to describe the nature, extent, and potential for movement of all contaminants present on the property, or that may have migrated from the property. For sites where there are multiple distinct areas of contamination, the site characterization process should be applied to each area individually. The remediator must use scientifically recognized principles, standards and procedures.

**Geology/Hydrogeology:** Description should be based on existing literature and data (Soil Classification System (SCS) soil surveys, geologic maps, Water Resource reports, reports on nearby properties and sampling) including:

- Descriptions of the soils, fill materials, geologic, hydrologic and hydrogeologic conditions at and surrounding the property. These descriptions should be detailed enough to provide an understanding of the site with respect to local geologic conditions and to determine if property groundwater is in an aquifer as defined by Act 2.

- A local stratigraphic column including lithology, physical characteristics and the approximate thickness of each stratum, include location and depth of aquifer(s) (if known).
- The geologic structure within the property boundaries and its relation to the regional geologic structure (if known).
- The location(s) of sinkholes, fracture traces, outcrops, and lineaments (if known).
- Screening of soils, sediments and water (as appropriate). Submit all results, include QA/QC documentation. Identify field screening methods and sampling procedures. Cone Penetration Technologies (CPT) and other direct push technologies (DPT) may be used for sampling of solids, soil gases, and groundwater. CPT and DPT results should be useful to more accurately site permanent monitoring wells in areas of concern. Vapor intrusion assessments should be conducted in accordance with Section IV of this manual. All sample locations should be depicted on a site map. Incorporate results from past sampling, if applicable.

Soil investigations shall be performed to establish baseline quality of surface, shallow, and subsurface soils at the site. Investigations will involve actual, as well as potential, sources of contamination, underground storage tanks, stained soils, and building drains, sumps, and storm/sewer systems. Investigations of underground storage tanks will identify any potential impacts from possible leakage of the tanks. Sampling will be performed. Property boundary soil sampling may also be performed to assess soil quality conditions and compared to the appropriate residential or nonresidential standards based on the proposed use of the property. Groundwater investigations shall be performed to establish baseline quality of the shallow and aquifer groundwater conditions. Investigations will involve wells (both monitoring and supply, and including appropriate off-property wells), sample analysis and water quality, and groundwater level measurement.

**Identified Contamination:** Characterize the source and nature, concentration, location, and extent of the regulated substances. Text, tables, graphics, figures, maps and cross sections may be used to describe the nature, location, and composition of the contaminants on the property. Determine the extent, if any, of regulated substances that have migrated beyond the property boundary. Indicate all existing and potential migration pathways. Indicate the direction and rate of contaminant movement within each medium of concern.

**Proposed Remediation Measures:** The baseline environmental report shall include the proposed plan for remediation of the property and will serve as the basis for the CO&A. Therefore, the remedial action must be fully defined and described. The remediation of all threats relevant to the

special industrial area reuse will be reiterated in the CO&A. Identification of contamination is very important in establishing what the remediator will be obligated to cleanup, and the extent of the cleanup liability protection afforded by Act 2.

**Public Notice:** Provide information concerning all public notifications performed. Supply copies of the notifications and reasonable proof of required notices of the NIR in a newspaper of general circulation serving the area where the property is located. Indicate if a municipality requested a public involvement, and if so, include the public involvement plan and all comments received, and responses to those comments.

**Public Benefits:** The baseline environmental report should include a description of the existing or potential public benefits of the use or reuse of the property for employment opportunities, housing, open space, recreation or other uses. An estimate of the potential employment anticipated by the reuse of the property is also requested.

**Signatures:** If any portion of the submitted report were prepared or reviewed by or under the responsible charge of a registered professional geologist or engineer, the professional geologist or engineer in charge must sign and seal the report.

**Attachments:**

Attachments may include but are not limited to:

- Tables – monitoring well construction summary, groundwater gauging data (including elevation and NAPL thicknesses), analytical data, historical data.
- Figures – including groundwater elevation maps, extent of NAPL, concentration data for soil/groundwater/surface water/vapor or indoor air, cross-sections.
- Monitoring well construction diagrams, boring logs, stratigraphic logs, including soil/rock characteristics.
- Sampling and analysis plan(s).
- QA/QC Plan.
- Ecological survey documentation (from PNDI).
- Well search documentation (from PaGIS).
- Field data sheets, such as low flow purging monitoring.

- Statistical worksheets, software outputs, graphs; modeling inputs/outputs.
- Disposal documentation of soil/groundwater.
- Remediation system operation, maintenance, monitoring data; mass removal estimates.
- Before and after remediation photographs.
- Copy of municipal notification, reasonable proof of newspaper notice publication.
- Laboratory reports and any voluminous attachments may be enclosed on a CD.

## **APPENDIX**

## Appendix II-A: The Use of Caps as Activity and Use Limitations

Caps are one of the most common mechanisms used by remediators to eliminate exposure pathways at sites with subsurface contamination. As the term is used in this document, caps encompass a broad array of physical features that cover underlying contamination. Capping prevents exposure via direct contact by acting as a barrier between a human receptor and the underlying contaminated media. Low permeability caps can also help limit vertical movement of contaminants via stormwater infiltration or vapor migration. Different caps work more effectively in certain situations, so site-specific information should be used to determine which cap system to select.

The conceptual site model (see the site characterization discussion in Section II of this manual) should be used to identify potential receptors and related contaminant migration and exposure pathways. The receptors and pathways to be addressed should be evaluated (potentially via a risk assessment) before cap construction takes place to ensure that installation of the cap will achieve the desired result. Capping and/or characterizing to the MSCs may not be sufficient to eliminate the potential risk to receptors. Concentrations beyond the edge of the cap may still pose a cumulative risk that exceeds the acceptable risk thresholds. Remediators should clearly understand the nature and extent of contaminants at their site and the current and projected future conditions.

The guidance provided in this addendum applies solely to the use of caps in attaining an Act 2 standard. Caps used at landfills, RCRA sites, or other non-Act 2 sites may have requirements that differ from the guidance provided in this addendum and should follow the relevant regulations of the program/entity regulating the facility. Additionally, this addendum is intended to supplement existing guidance; it is not regulation and should not be interpreted as such. This addendum is provided to inform remediators of pertinent information to consider when selecting cap systems and some of the options that are available. Remediators may choose to consider alternative technologies other than those discussed herein when addressing their specific situation. Remediators may need to develop a different approach than what is described in this guidance to provide the best fit for their specific situation.

A cap is a barrier over contaminated media that eliminates an exposure pathway, controls contaminant migration, or a combination of both. Thus, a cap can be used as an engineering control and/or an institutional control (i.e., an activity and use limitation) to attain an Act 2 standard. As such, remedies that use a cap require a cleanup plan which describes the selected remedy. If a cap already exists at the site (e.g., a parking lot) and needs to be preserved as part of the remedy, then the cleanup plan should describe the way the cap will be maintained. Since a cap is used as an activity and use limitation, a remediator must properly record an environmental covenant pursuant to the Uniform Environmental Covenants Act to ensure the cap is properly maintained in the future. If applicable, the final report should include as-built plans and details of the cap construction and photographs documenting installation of the cap, when available. The post-remediation care plan and environmental covenant should include a map depicting the extent of the cap as well as monitoring and maintenance requirements.

All components of cap utilization for the purpose of attaining an Act 2 standard, including but not limited to, design, construction, and inspection, may be governed by the Engineer, Land Surveyor, and Geologist Registration Law (63 P.S. §§ 148-158.2).

General Goals for Caps – Caps are generally used to address contamination at concentrations resulting in an unacceptable risk for the following purposes:

- Protection from direct contact with contaminated soil.
- Prevention or reduction of the migration of contamination throughout the subsurface (upward, downward, and laterally).
- Prevention of the migration of contamination to surface water via stormwater runoff.

Cap Construction Considerations – The following factors should be considered during the design, construction and maintenance of most caps, where appropriate:

- Erosion from precipitation, surface water flow or wind.
- Cracking and deterioration from natural influences including water saturation and freeze/thaw cycles.
- Expected human activities on the land covered by the cap.
- Settlement and shifting of the cap and subsurface.
- Potential damage from migration of groundwater into the cap.
- Contaminant migration, including migration to the surface of the cap and potential vapor migration. Refer to Section IV of this manual when evaluating the vapor intrusion pathway.
- Construction impacts to site development including storm water management.

### **Protection from Direct Contact with Contaminants**

Design Goals – In addition to the cap construction considerations presented previously, the design should prevent direct contact exposure to contaminated soil for as long as the contaminant concentrations remain at unacceptable levels. Cap designs should consider site-specific factors, including, but not limited to:

- Current and anticipated future land use (anticipated future activities that could result in creating an exposure pathway to the soil should be addressed with land use restrictions).
- The nature of the contaminants (concentrations, mobility, toxicity, etc.).
- The types of potential exposure pathways (e.g., ingestion or inhalation).
- Contaminant degradation and daughter products resulting from such degradation, if any.
- The specifications of the capping material, the quality control of the cap construction, and the operation and maintenance (O&M) and inspection requirements.



- The reliability of the assurances that O&M, and inspections will be performed for as long as direct contact exposure to, or migration through or from the contaminants in soil beneath the cap would result in an unacceptable risk.

Soil Caps – Soil caps can be used to prevent direct contact exposure to contaminated soils. Soil containing regulated substances, at concentrations that do not constitute an unacceptable risk to human health by the direct contact pathway may be used as cap material. Cap thickness depends on various factors including the type and intensity of the land use above the cap and the contours/slope of the area being capped.

In general, it is recommended that caps used to prevent direct contact with contaminated soil are constructed with two feet of acceptable soil including a vegetated cover to prevent erosion and deterioration. The vegetated cover usually consists of six inches of topsoil, with appropriate seeding or sod to establish a good growth of grass. When a vegetated cover is used, consideration can be given to reducing the thickness of the acceptable soil layer by the same amount as the vegetated cover thickness (e.g., 1.5 feet of acceptable soil with an additional six inches of topsoil for a total cap thickness of two feet).

Cap designs of less than two feet thickness may be appropriate when additional design features, such as the use of warning fabrics, are considered or if the likelihood of deterioration is low (e.g. flat surfaces, low foot/vehicle traffic, etc.). Other materials, such as gravel, may substitute for vegetated topsoil as discussed below. Capping materials should be durable and meet the performance specifications required for the site.

DEP recommends placement of a demarcation boundary (warning fabric) on top of the contaminated soil and beneath the soil cap. The slope for an acceptable soil cap with vegetated topsoil cover should normally not be steeper than a 3:1 horizontal-to-vertical ratio. Steeper slopes may be considered on a case-by-case basis if it can be shown that erosion will be adequately controlled through additional design features and/or O&M. Steeper slopes will generally call for an evaluation of the need for slope reinforcement to provide long-term stability. However, cap design should use lower slopes when possible and good cover vegetation to slow down stormwater runoff velocities to prevent erosion. If cap material is suspected to have been impacted by a release, remediators should demonstrate that the material was evaluated using DEP's Management of Fill Policy (DEP ID 258-2182-773).

Pavement covers – Pavement systems may be used to prevent direct contact exposure to contaminated soils. Contaminated soil particles can work their way up through pavement surfaces where pavement settlement, shifting, cracking, freeze/thaw cycles, weathering, and deterioration are not adequately addressed in the design, construction, and maintenance of the cap. Pavement material should have appropriate bottom base soil preparation (grading, recompaction, dewatering, etc.) and sufficient base course to minimize freeze/thaw, settling, and shifting problems, which can cause pavement deterioration. Pavement thickness and overall design can be determined based on normal paving procedures to ensure structural integrity. Generally accepted pavement construction guidance sources should be used such as the American Association of State Highway Transportation Officials.

Buildings or Structures – An existing or new building or structure may be used to prevent direct contact exposure to contaminated soils, provided the building slab or basement walls/floor are evaluated for the general cap construction considerations discussed previously. Buildings with badly cracked slabs or basement floors or walls in contact with contaminated soil should be repaired. Dirt floors in buildings should be treated like any other portion of the site with bare soils.

Other Materials – The following materials, by themselves, might not be acceptable for a direct contact cover system because of the potential for contaminated soil to migrate through them. However, they may be substituted for the vegetated topsoil portion of the soil direct contact cover system using the thickness indicated:

- Gravel or stone – A layer of gravel or stone thick enough to prevent erosion (usually six inches) is recommended.

Note: A permeable cap constructed entirely of gravel/stone may be used to prevent direct contact if a mixed grade of aggregate is used and the layer of aggregate will pack sufficiently tightly to keep soils from migrating upward or, if the gravel/stone is used in combination with a geotextile layer to prevent soil particle migration and adequate maintenance is provided to retain the intended thickness of the cap.

- Geomembranes – A synthetic membrane liner made from thin continuous polymeric sheets is acceptable if the material is not considered an untreated geotextile. Geomembranes constructed from low density polyethylene (LDPE), high density polyethylene (HDPE), or polyvinyl chloride (PVC), are generally acceptable. If the geomembrane is not buried beneath a soil cover, resistance of the material to degradation from exposure to ultra-violet light must be considered in the design and postremediation care plan.
- Geotextiles – A woven or nonwoven geotextile is not acceptable for a direct contact cover by itself except as a very short-term temporary cover to prevent erosion. A geotextile layer may be used to:
  - Prevent contaminated soil particles from migrating to layers with concentrations of regulated substances that do not constitute an unacceptable risk.
  - Provide a demarcation layer between the cap material and contaminated soil.
  - Provide physical reinforcement and enhanced stability.

Note: Use of a geotextile warning fabric is encouraged for sites where future construction or utility work is anticipated.

Horizontal Extent of Cap – The cap should be designed and constructed to provide adequate protection from exposure to all areas that have contaminant concentrations that do not meet an acceptable risk level. The cap design thickness should extend horizontally to a perimeter line beyond where unacceptable contamination has been delineated to ensure adequate protection from direct contact.

## **Prevention of Migration of Contaminants**

Design Goals – If the control of contaminant movement is necessary to meet the chosen Act 2 standard, the cap design should minimize the migration of contaminants from contaminated soil to groundwater or to the surface via soil moisture or vapor migration. The cap construction considerations presented previously should also be considered for caps designed to prevent contaminant migration. The transport of chemicals to receptors of concern could occur via upward or downward movement of dissolved contamination in soil moisture and from volatile contaminant movement upward and downward in soil

gas by vapor diffusion or bulk soil-gas flow. The cap may require features to control these modes of transport. If the infiltration of surface water, precipitation, or snow melt through contaminated soil needs to be significantly minimized, then the cover system should include a layer or layers that reduce such infiltration to the extent necessary to achieve the required minimization. The design of these types of cap systems should consider site-specific factors, including, but not limited to:

- The nature of the contaminants (concentrations, degradation, solubility, mobility, toxicity, etc.).
- Depth of the contamination. (Note: The horizontal extent of the cap may need to extend beyond the direct contact footprint to address contamination in deeper soil horizons.)
- The quality of construction and the operation, maintenance and inspection program for the site.
- The reliability of O&M and inspections to maintain the remedy for as long as the unacceptable soil contaminant concentrations persist.
- Construction impacts to site development including storm water management.

Low-permeability Cap Designs – Typical materials used in the construction of low-permeability caps for reducing water infiltration include, but are not limited to, geomembranes, engineered mixtures of properly compacted fine sand, silt and clay, clay barriers, geosynthetic clay liners, concrete, and pavement. Typical materials used in the construction of vapor barriers include plastic membranes made of polyethylene or propylene, and semisolid barriers that are applied by spraying or pumping.

Buildings or Structures – An existing or new building or structure may be used to prevent infiltration into contaminated soils provided the building has a sound roof and roof runoff is managed to minimize runoff infiltration into contaminated soils. Dirt floors in buildings should be treated like any other portion of the site with bare soils. The potential for vapor intrusion into buildings should be evaluated in accordance with the guidance provided in Section IV of this manual.

Multiple Pathway Designs – A cap that meets the requirements for prevention of infiltration will likely be acceptable for prevention of direct contact. All cap systems should be designed and evaluated for the pathways being addressed.

Horizontal Extent – The guidance provided previously on the horizontal extent of cap designs for protection against direct contact exposure also applies to the prevention of contaminant migration to groundwater using the applicable groundwater protection standards.

VOC (Volatile Organic Compounds) Migration – VOC concentrations in soil and shallow groundwater may be a source of contaminant vapors that can migrate, transporting the VOCs to locations that may not be currently contaminated. Certain types of caps, such as pavement, may limit the upward vertical migration of vapors to the surface but may force them to migrate horizontally to create new contamination in soil and groundwater. The cap may also direct vapors into buildings, increasing indoor air contaminant concentrations. Vapors could migrate into the cap itself contaminating the previously acceptable material and potentially damaging it (for example, certain VOCs can degrade asphalt or kill vegetation). It may be necessary to treat or remove the sources of vapors or provide active or passive venting below and/or adjacent to a cap to remove soil vapors and prevent vapor migration.

## Inspections and Maintenance

Post-remediation care plans (PRCPs) and environmental covenants must contain appropriate conditions to ensure that the integrity of the cap is maintained if the cap is used to attain an Act 2 standard. Please refer to Section III.E of this manual for information on long-term stewardship obligations for post-remediation care plans and environmental covenants. Factors to consider and DEP's recommended best practices include the following:

- The extent of the cap should be well defined such that the owner, contractors, DEP, and other parties can readily identify the restricted area. The cap boundaries should be clearly marked on a map or site figure.
- A professional survey of the cap boundaries is beneficial, for instance when the cap is not readily visible, landmarks used to define the boundaries change, the cap area is large, or the cap boundaries are irregular.
- Caps should be inspected periodically depending on how likely they are expected to require routine maintenance and the potential risks from cap disturbance. In cases where caps are more likely to experience disturbance (e.g., on sloped surfaces or in high-use areas), inspections should be more frequent.
- Inspections should take place during and after any activities that disrupt or penetrate the cap, such as landscaping work, utility trenching, and construction.
- All inspections should be recorded in writing. Photographs are useful documentation of the cap condition. Inspection records should be maintained for a period of three years and must be made available for DEP review upon request.
- Contractors should consider the need to develop a health and safety plan to address potential future exposures to contaminated soil beneath the cap by construction and utility workers.
- Qualitative or quantitative criteria may be developed in the PRCP to determine when disruptions to cap integrity that could impair its effectiveness must be repaired.
- Disruptions of soil caps, including excavation, removal, penetration, erosion, loss of vegetated topsoil, or any other cumulative thinning of the original cap thickness, should be repaired within 30 days of the date of discovery.
- Disruptions of pavement, buildings, and other structural caps, including removal, penetration, significant cracking, erosion, or other opening(s), should be repaired within 30 days of the date of discovery.

Both the discovery and repair of cap disruptions should be reported to DEP as required by the PRCP and environmental covenant within one month of discovery. The reporting should describe the nature and cause of the disruption, explain the corrective actions taken, and document that repairs were made (e.g., photographs).