NOTE: This is a completely new Attachment

Attachment V.E.3

Ecological Screening Process

Note: The CSSAB Risk Assessment Subcommittee asked that a Department contractor (Ogden Environmental Services) assist in developing the rationale for the ecological screen. This Attachment is based upon the work done by Ogden and presented in their report, but has been modified as necessary to conform to changes in the screening process made after the report was written.

Ecological Health Evaluation - Screening Procedure for Sites in Pennsylvania

Introduction

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 proposed procedure is to quickly evaluate whether surface soils or sediments at a site have the potential to pose substantial ecological impact. The site screening procedure defines substantial impact as the potential for constituents detected on-site 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 composition or diversity of a habitat of concern compared to an appropriate reference area (Suter, 1993; Suter et al., 1995; U.S. EPA, 1989). 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. This goal can be accomplished by recognizing:

- the sources of regulated substances in the environment will be controlled;
- natural physical and chemical attenuation mechanisms act on the released regulated compounds, resulting in degradation or sequestration and consequent reduced bioavailability of remaining chemical residuals;
- that at many sites, risks to unmanaged habitats (*e.g.*, areas that are not landscaped) are likely to be low because of human activity / use (such as residential, commercial or industrial), which may preclude the existence of unmanaged habitats;
- the substantial acclimation capacity of natural populations[1] to exposure to low or moderate concentrations of chemical residuals;
- that most remedial actions cause substantial injury to areas of concern beyond the toxicological impacts, as well as impacts to previously unimpacted areas along the perimeter of the remediation area; and,
- that natural systems are self-organizing, and attempts to manage these processes to produce a particular result require long-term management, and even then can result in less than desirable results.

The site ecological screening procedure has been divided into eight discrete steps, as discussed below and illustrated in Figure 1, Ecological Screening Flowchart. Upon completion of this screening procedure, a site will be identified as either:

- not the source of substantial ecological impact and therefore not requiring further ecological evaluation, or
- having the potential to cause a substantial ecological impact and therefore requiring further ecological evaluation.

The key elements of the screening procedure include the following: the presence of light petroleum-product constituents only; the size of the site; the presence or absence of Constituents of Potential Ecological Concern (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.

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[1]Population is defined as an aggregate of individuals of a species within a specified location in space and time (U.S. EPA, 1994a).

Regardless of the outcome of the ecological screening, the results are documented in a written report. It is important to note that if the impacted area of surface soil is equal to or greater than 2 acres, or if the impacted area of sediments is greater than or equal to 1000 square feet, completion of the site ecological screening process requires a site walk. Using a streamlined set of guidelines, this site walk 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 visit, 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, 1994a). The remainder of this paper discusses each of the eight steps of the ecological screening procedure in more detail.

Step 1: Presence of Light Petroleum-Product Constituents

The first step in the site ecological screening process is to determine whether gasoline, jet fuel A, kerosene, or #2 fuel oil / diesel fuel, which have relatively low PAH content (ASTM Designation: E1739-95), are present. If light petroleum-product constituents (including BTEX) are the only constituents detected on-site, then the screening process moves to Step 9 (No Further Ecological Evaluation Required), and the results are documented in the final report. 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 probable based on:

- their rapid attenuation (through multiple fate and transport mechanisms) in surface soils and sediments such that prolonged exposure of species of concern to elevated concentrations is unlikely;
- the likelihood that potential human exposures and risks (through consumption of groundwater (BTEX) and ingestion of soil (PAH)) are greater than potential ecological impacts and, as such, remediation at such sites would be driven by protection of human health; and,
- elevated concentrations of petroleum constituents will be remediated for protection of human health.

Step 2: Site Size

The second step in the site ecological screening process is a comparison of the area of the site[2] to pre-specified minimum areas of exposed and contaminated surface soil (excluding areas covered by pavement, buildings, or other structures) and sediments that are of potential ecological concern. The minimum areas are: greater than or equal to 2 acres of exposed and contaminated surface soil, and greater than or equal to 1000 square feet of contaminated sediment.

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

[2] The site is defined as the extent of contamination originating within the property boundaries and all areas in close proximity (Act 2 of 1995, the Land Recycling and Environmental Remediation Standards Act).

minimum areas, then the screening process moves to Step 9 (No Further Ecological Evaluation Required), and the results are documented in the final report.

For ecological impact to be considered substantial, the minimum size thresholds must be exceeded. Considerations in setting the 2 acre and 1,000 ft^2 size thresholds were:

- sources of regulated substances will be removed and natural attenuation / acclimation processes in relatively small areas will mitigate impacts naturally to the point that they cannot be regarded as substantial;
- compliance with waste management regulations and human health standards would require remediation of elevated levels of constituents that pose a risk to human health. Such compliance would also protect ecological health to a certain degree;
- regardless of size, the requirements of the Clean Streams Law and the Endangered Species Act must be met; and,
- the smaller the area of contamination, the greater the proportionate risk associated with remedial action posed to adjacent areas unimpacted by chemical residuals, such that the environmental injury caused by remedial actions will be greater than the impacts attributable to the residual regulated substances (U.S. EPA, 1991b).

Incorporation of a minimum size criterion in the ecological screening process is based on the two general types of adverse effects that are of concern when conducting ecological risk assessments: (1) direct toxic effects to the receptors contacting an environmental medium (soil or sediment in this case) or (2) indirect effects (*i.e.*, effects that manifest themselves through the food chain) to higher trophic level receptors that consume organisms living on the site that are directly contacting either surface soils or sediments. Sites smaller than the minimum areas listed above are assumed to not pose a substantial risk through the food chain, even if CPECs are present, because higher trophic level receptors that are likely to be of concern at most sites have feeding ranges substantially greater than the minimum areas used in the site ecological screening process. For example, the red tail hawk or bald eagle has a home range of several hundred to over 2,500 acres (U.S. EPA, 1993a). Consequently, the average concentration of CPECs, if any, in the diet of such species is not assumed to pose a substantial risk. The size threshold for sediment areas of concern is smaller than for surface soils, based on the propensity for constituents to concentrate as a result of differential particle size transport and sorting processes, the sedentary nature of the species making up the benthic community, and the generally greater sensitivity of many aquatic species to constituents (*e.g.*, health-based soil screening criteria for a small mammal, calculated in accordance with standard EPA protocol, are generally higher than effects-based ER-Ls for sediment).

"Sediment" is defined as 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. This recommended definition of sediment is a combination of definitions from two U.S. EPA documents (U.S. EPA, 1993b; U.S. EPA, 1991a), with modification to accommodate recommendations of the CSSAB.

CPECs in soils and sediments at sites smaller than the critical minimum area are assumed not to pose substantial impact to populations of lower trophic level species. Moreover, any

possible localized changes to populations of lower trophic level species are not likely to impact higher trophic level species of concern because these species forage in areas greater than 2 acres.

Step 3: Obvious pathway elimination

The third step in the site ecological screening process is the consideration of exposure pathways. If all current and potential exposure pathways are eliminated, then the screening process proceeds to Step 9 (No Further Ecological Evaluation Required), and the results are documented in the final report. If all current and potential pathways are not eliminated, the screen moves on to Step 4 (Presence of Constituents of Potential Ecological Concern).

This step in the screen identifies those sites, particularly those in heavily industrialized or developed areas, where complete pathways to ecological receptors do not exist as the result of factors other than the release(s) associated with the property being remediated.

Step 4: Presence of Constituents of Potential Ecological Concern (CPECs)

The fourth step in the site ecological screening process is the determination of whether any of the constituents detected at the site are considered to be constituents of potential ecological concern (CPECs). The Risk Assessment Subcommittee notes that, as with human health risk assessment, all chemicals are potentially toxic to some component of any ecosystem, given certain conditions. However, it is not practical to evaluate in detail the potential ecological threats posed by all regulated chemicals present at any particular site. Therefore, the Risk Assessment Subcommittee has included a step in the site ecological screening process to identify the presence of constituents of potential ecological concern associated with a release under Act 2 that may substantially alter the structure or function of the ecosystem, and determine whether further evaluation is warranted.

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 are detected at the site, then the screening process moves to Step 6 (Detailed Onsite Evaluation).

For the list of CPECs, the Risk Assessment Subcommittee has selected the 67 chemicals for which U.S. EPA has identified Ecotox Thresholds as CPECs (U.S. EPA, 1996). There are several advantages to using this list, including the following:

- the chemicals on the list are those that typically account for most of the ecological impact at contaminated sites (U.S. EPA, 1994b);
- it would be uncommon for a site to pose substantial ecological impact and not contain some of these chemicals;
- the listed chemicals are those chemicals for which the potential ecological impacts are generally better understood; adding chemicals will increase the frequency of more intensive and academic study, because the necessary toxicity data for quantitative evaluation are not available; and,

- the list contains a reasonable and workable subset of the substances regulated under Act 2.

In addition to this list of 67 constituents, the Risk Assessment Subcommittee has added 4 pesticides (aldrin, chlordane, kepone, and mirex) because of their potential to pose substantial impact to species and habitats of concern, either because of their inherent toxicity or their potential to biomagnify in the food chain. Thus, the final list of CPECs includes 71 constituents, as shown in Table 8 of the regulations.

The ecological evaluation process that has been developed includes additional evaluation criteria for sites where CPECs are not found. Step 5 (Preliminary Onsite Evaluation) 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 ecological receptors, such as the Endangered Species Act.

Step 5: Preliminary Onsite Evaluation

The fifth step of the site ecological screening process is a preliminary onsite evaluation, to be conducted by a qualified environmental scientist (minimum of a bachelor's degree in an environmental science field and 5 years of experience in an environmental field), using written criteria presented in this step. If, after conducting the preliminary site 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 (No Further Ecological Evaluation Required), and the results are documented in the final report. If after conducting the preliminary site evaluation, the qualified environmental scientist determines that substantial ecological impacts are or may be present, the screening process continues to Step 6 (Formal Onsite Evaluation).

The objective of the ecological evaluation conducted during the preliminary site evaluation is to ensure that substantial ecological impacts resulting from non-CPECs are detected. The preliminary site evaluation involves three steps:

- Review of readily available site background information including: 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.
- A preliminary site visit to identify physical and habitat features of the area and to identify nearby reference areas[3] (if available) that are outside of the probable site (area of contamination associated with a particular release) The following should be noted during the site visit:
    1. signs of stressed or dead vegetation (*e.g.*, chlorotic vegetation);
    2. discolored soil, sediment or water (*i.e.*, a sheen);

[3]Reference area defined as an area not contaminated by regulated substances originating on the site and used for comparison to the site (U.S. EPA, 1994a). In addition, a reference area should be near the site and have similar geochemical, physical, and biological conditions, but be uncontaminated with regulated substances from the subject site (*i.e.*, unimpacted by the site).

3. presence of non-native materials in sediments resulting from seeps or other discharges emanating from the subject site; and,
4. presence of deformed organisms (if encountered).

- 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, any differences in the abundance of endangered and threatened species would trigger further evaluation, in addition to requirements under the Endangered Species Act.

Based on all of the information collected as part of the preliminary site 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 site evaluation, is summarized in bulleted format.

The Risk Assessment Subcommittee recognizes there are limitations in the ability of such a preliminary site evaluation to detect impacts which result in sub-lethal effects or subtle changes in species density or diversity from non-CPEC constituents. However, the Risk Assessment Subcommittee also recognizes that most ecological restoration efforts result in considerable ecological injury in the area of contamination and surrounding areas which are unimpacted by chemical effects, but which would be injured by restoration activities in the adjacent contaminated area. Consequently, the Risk Assessment Subcommittee is confident that, as long as sources of environmental releases are controlled, the completion of the CPEC screening and preliminary onsite evaluation will identify those situations where adverse toxicological effects to ecological receptors from exposure to regulated substances would result in substantial ecological impacts. The subsequent steps of the screening process determine if the ecological evaluation process should go forward. The environmental effects from less substantive releases will naturally attenuate or be remediated for protection of human health, consistent with the no further action alternative, which would most probably be selected if a more detailed evaluation were to be conducted.

Step 6: Detailed Onsite Evaluation

The sixth step in the site 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 site in its current or intended use. If, during the detailed onsite evaluation, no species or habitats of concern are identified on the site and no threatened and endangered species exist within a 2,500 ft. radius of the site, the screening process moves to Step 9 (No Further Ecological Evaluation Required), and the results are documented in the final report. 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 by a certified ecologist or a trained environmental biologist or ecologist. At a minimum, the

person conducting the detailed onsite evaluation must be a certified ecologist or hold a college degree in ecology or environmental science and 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 site ecological screening process. The detailed onsite evaluation is to be conducted by a qualified ecologist, as described above, and has the following components:

- Review of readily available site background information including:
  1. operational history, chemicals used, and probable sources of releases of CPECs;
  2. environmental setting with emphasis on physical, chemical and biological factors that would influence the nature and extent of contamination; and,
  3. readily available literature and other relevant documents related to recognition of species and habitats of concern, including endangered and threatened species.(·)The qualified investigator shall conduct the following evaluation:
  4. complete a preliminary walk of the site 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 site);
- qualitatively evaluate whether species or habitats of concern are present at the site and in the reference area; and,
- in comparison to reference areas (if available), the qualified investigator shall evaluate the following to the extent that they can be readily evaluated at a site:
  1. signs of stressed or dead vegetation (*e.g.*, chlorotic vegetation);
  2. discolored soil, sediment or water;
  3. presence of non-native materials in sediments resulting from seeps or other discharges emanating from the subject property;
  4. community composition differences readily distinguished by U.S. EPA protocols such as the Rapid Bioassessment procedures (U.S. EPA, 1989);
  5. absence of biota (especially keystone species and ecological dominants) compared with similar areas of the same system;
  6. presence of non-native or exotic species compared with reference areas (*e.g.*, *Phragmites*);
  7. presence of deformed organisms (if encountered); and,
  8. potential for residual contamination to habitats of concern and areas utilized by species of concern.
- 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, any differences in the abundance of endangered and

threatened species would trigger further evaluation, in addition to requirements under the Endangered Species Act.

Species of concern are species that have been designated as of special concern, rare, endangered, threatened or candidate by the Pennsylvania Game Commission, Pennsylvania Fish & Boat Commission, and the Bureau of Forestry, if the species has not also been designated as threatened or endangered by the Federal government. A list of such species is presented in Attachment V.I to this Manual. Note that species on the list may be deleted and new species added; therefore an updated list of endangered, threatened and candidate species should be used for the detailed onsite evaluation. Contact the Pennsylvania Game Commission or Pennsylvania Fish & Boat Commission for the most recent listing;

Habitats of concern are:

- wetlands and wetland transition areas;
- breeding areas for species of concern;
- migratory stopover areas for some 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[4] as wild, scenic, recreational; and,
- areas otherwise designated as critical or of concern by the Pennsylvania Game Commission, Pennsylvania Fish & Boat Commission, or the Department of Conservation and Natural Resources.

Step 7: Existence of Completed Exposure Pathways

The seventh step in the site 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[5] is determined during the detailed site 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 completed pathwayexists at the site, then the screening process moves to Step 8 (Document Attainment of a Standard). If no complete exposure pathways are identified during the formal site walk, then the screening process continues to Step 9 (No Further Ecological Evaluation Required), and the results are documented in the final report.

[4]as defined by guidance.

[5]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 be capable of contacting 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).

Step 8: Document Attainment of a Standard

The eighth step of the site ecological screening process requires that a report be written describing each of the steps in the site ecological screening process and the findings from each step. The report shall provide:

- some indication of the magnitude of potential adverse ecological effects expected, given current and intended future site use;
- the types of species and habitats that potentially may be affected;
- the possible changes or adverse impacts that might result if natural attenuation were the only mitigation process;
- the results of the formal site evaluation;
- the types of ecological impacts should be characterized as direct or indirect, permanent or reversible, and immediate or delayed; and,
- recommendations based on a weight of evidence evaluation. The recommendations may include but are not limited to: no further action; further evaluation of exposure pathways; exposure reduction / elimination plans; consideration of ecological risk reduction due to human health-based remedial actions; completion of a quantitative ecological risk assessment; collection of additional data and completion of a quantitative ecological risk assessment; and immediate response followed by additional study. In addition, if the adverse effects from remedial actions are likely to have a higher probability of causing substantial environmental injury than no further action, then no further action can be warranted at this stage of the screening process.

Step 9: Final Report: No Further Ecological Evaluation Required

The ninth step of the site ecological screening process requires that a brief report be written documenting the findings of the completed steps of the screening process, and the basis for the conclusion that a substantial ecological impact is unlikely and that further ecological evaluation is not required. The conclusion that substantial ecological impact is unlikely 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 Step 2);
- all pathways are obviously eliminated because of site features such as paving (from Step 3;
- no CPECs are present on-site and the preliminary onsite evaluation indicates that substantial ecological impacts have not been overlooked (findings from Steps 4 and 5);
- no species or habitats of concern were identified on the site during the formal onsite evaluation (findings from Step 6); or,
- no completed exposure pathways from CPECs to species or habitats of concern were identified during the formal site evaluation (findings from Step 7).

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