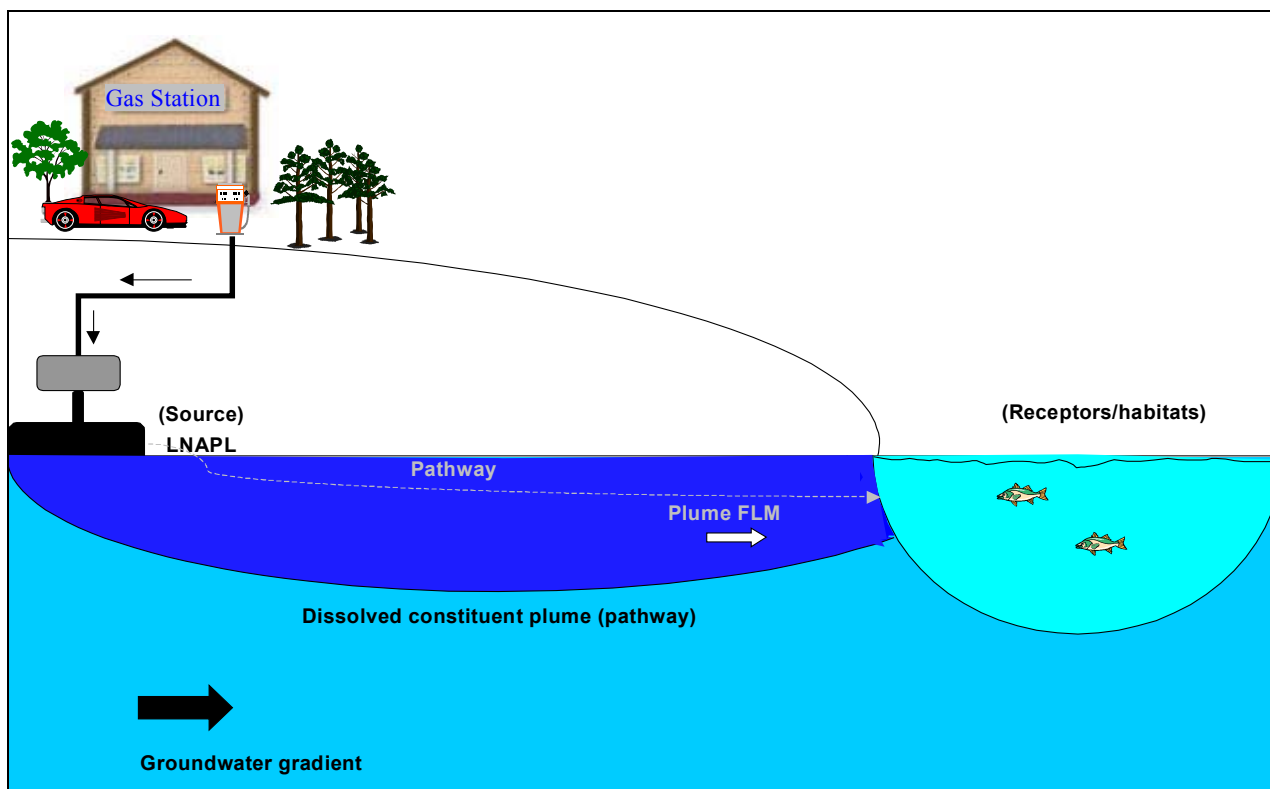


PRIMER FOR EVALUATING ECOLOGICAL RISK AT PETROLEUM RELEASE SITES

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PREFACE

To assist site or facility managers, this primer provides brief, simplified guidance for “screening” petroleum release sites for ecological risk to local plants, animals, and/or natural habitats. This project was undertaken to provide an elementary companion to the human health component of the *Decision Support System for Exposure and Risk Assessment* (DSS software program, API, 1999). The DSS model estimates site-specific human health risks, assists in determining the need for site remediation, and evaluates the uncertainties of model input parameters.

This document focuses on “downstream” facilities (refining and marketing, including retail gas stations) and on petroleum products (versus crude oil), although the concepts in this primer could be modified and usefully applied to other petroleum industry sites. In this primer, the goal of the screening process presented is a documented determination of the likelihood of adverse ecological effects. A low probability of adverse effects indicates that no further ecological assessment is warranted; whereas a high probability of adverse effects—or analytical uncertainty—indicates that more detailed analyses may be appropriate.

Every effort has been made to focus on a few critical ecological risk assessment elements, use existing information/data, and simplify instructions for a preliminary evaluation of ecological risk. When relevant information is unavailable, or when the site investigator is uncertain in an evaluation, an expert should be consulted. Internal company environmental staff, or subject-area consultants with relevant experience, should be able to complete and document the evaluation process presented in this primer in less than one work week, even for complicated sites with documented soil/groundwater impacts. For sites where impacts are localized and limited to surface/subsurface soils, the analysis should require less than one work week.

This document does not address petroleum “spills” that may require immediate, emergency response activities.

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This document is intended to facilitate the decision-making process. Under no circumstances does this guidance contradict the spill reporting and response requirements under various Federal and state statutes and regulations. The user should consult with the appropriate regulatory agency and follow regulatory requirements.

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INTRODUCTION

Evaluating ecological risk is increasingly important when making environmental risk management decisions.

The purpose of this document is to help site or facility managers acting as site investigators decide how and to what degree they should address ecological risks that may result from a petroleum products release. This primer focuses on “downstream” operations related to the transportation, distribution, and marketing of petroleum products. Evaluation of ecological risk is becoming an increasingly important input when making environmental risk management decisions. Human health risk, cost, availability and effectiveness of remedial technology, and stakeholder concerns (e.g., property owners, property users, and local community members) are examples of other elements that must be considered. To assist in evaluating ecological risk at petroleum release sites, this primer:

- Briefly describes the ecological risk assessment process
- Provides guidance on a tiered process’s initial steps—preliminary evaluation—that identify the nature and extent of ecological risk at a release site.

Spills or hydrocarbon releases may occur during downstream operations, as shown in **Table 1**.

**TABLE 1.
SOME POTENTIAL DOWNSTREAM SOURCES OF PETROLEUM RELEASES.**

CATEGORY	SOURCES
Transportation	Pipelines (pressure, products) Pump stations ASTs USTs Road/rail transport
Refining (retail/marketing)	Pipelines Tank farms Terminals Bulk/distribution plants Distribution pipelines ASTs (aboveground storage tanks) USTs (underground storage tanks)

This primer complements the DSS software program.

Under no circumstances does this guidance contradict the spill reporting and response requirements under various Federal and state statutes and regulations.

Various regulatory and voluntary industry programs govern the assessment and remediation of petroleum releases from these downstream operations. Increasingly, these programs use risk-based approaches for guiding actions associated with spills or petroleum product releases. The American Petroleum Institute's (API's) *Decision Support System for Exposure and Risk Assessment* (DSS software program, API, 1999) is an example of a risk-based approach that was developed with human health concerns in mind. The DSS software program estimates site-specific risks to human health, identifies the need for site remediation, develops site-specific cleanup levels for subsurface soil and groundwater, and evaluates the uncertainty associated with human health risk estimates.

Protecting human health, however, will not necessarily protect ecosystems sufficiently. Providing the initial steps to evaluate ecological risk, this primer complements the DSS software program by explaining:

- How to identify conditions that may require attention to mitigate imminent ecological risk
- How to decide if tiered ecological risk assessment is necessary at a petroleum release site
- How to use preliminary evaluation results to develop a site conceptual model that can guide further tiered assessment.

While the primer is intended for site or facility managers acting as site investigators, experts in risk assessment and environmental monitoring may be needed if more thorough or sophisticated analyses are indicated. Internal company environmental staff, or consultants with relevant experience, should be consulted when making decisions at petroleum release sites.

WHAT IS ECOLOGICAL RISK ASSESSMENT?

Ecological risk assessment is an analytical tool for determining the likelihood of adverse environmental effects resulting from human activities.

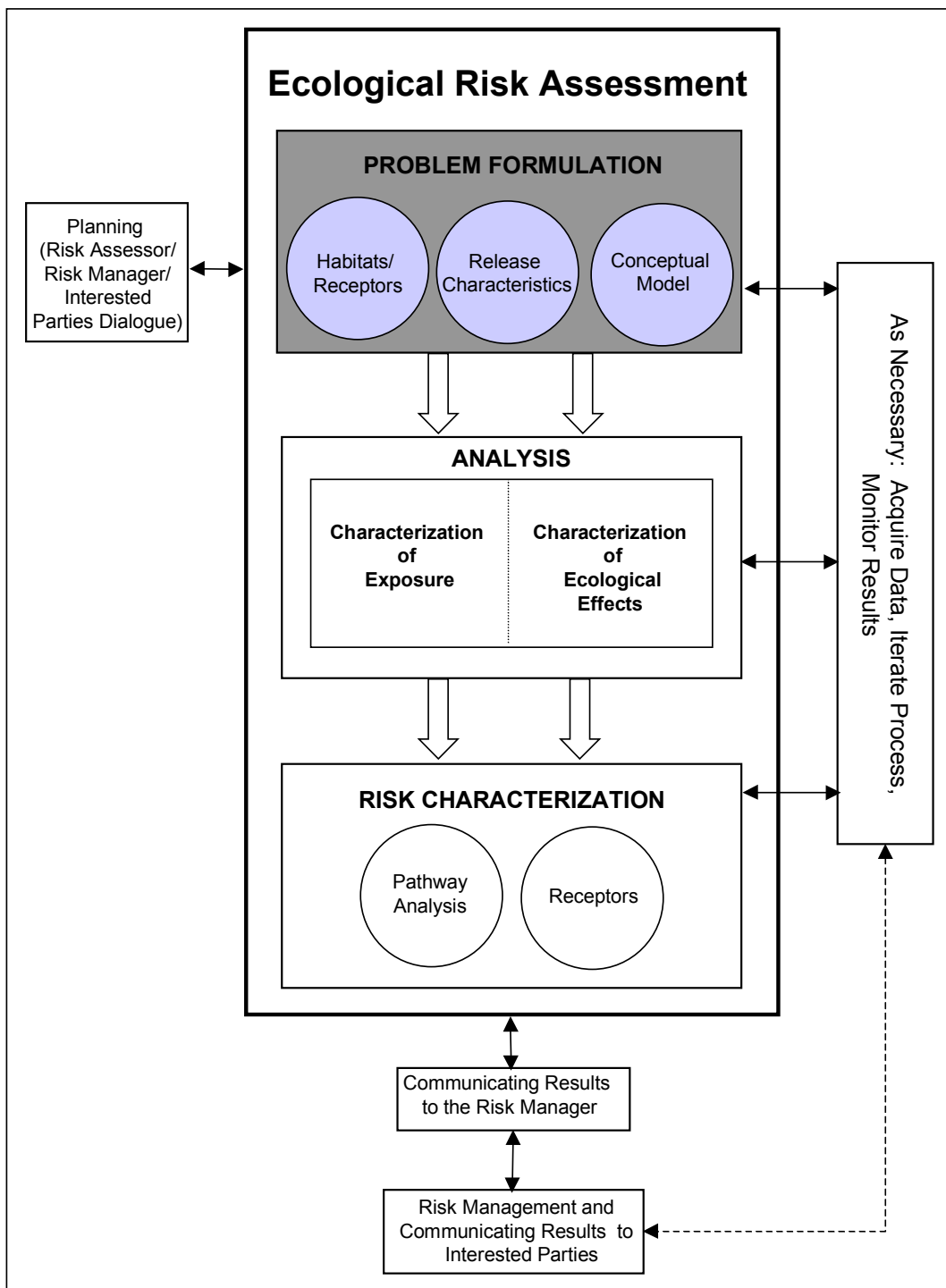
As defined by the U.S. Environmental Protection Agency (EPA, 1998), ecological risk assessment is a systematic “process for organizing and analyzing data, information, assumptions, and uncertainties to evaluate the likelihood of adverse ecological effects” to ecological receptors. Ecological risks associated with petroleum or petroleum product releases may occur:

- When relevant ecological receptors are in the vicinity of the release
- When these receptors have potential exposure to the released products or their constituents
- When potentially harmful effects are associated with the released products or their constituents.

Ecological risk assessment is used to assess the likelihood of adverse effects on the environment and to facilitate environmental risk management decision making.

The EPA has designed a general framework for conducting ecological risk assessment. An adaptation of this framework is illustrated in **Figure 1**. Many Federal, state, and industry-based groups have adopted this framework as a starting point for addressing ecological risk. This primer is consistent with the EPA ecological risk assessment framework, but is written specifically for the assessment of downstream petroleum release sites. With respect to **Figure 1**, this primer provides guidance related to “problem formulation” for site investigators to decide whether a potential problem exists.

FIGURE 1.
THE FRAMEWORK FOR ECOLOGICAL RISK ASSESSMENT.



The shading in the figure represents this primer's focus—guidance related to problem formulation—in relation to the framework for ecological risk assessment. Modified from EPA (1992).

WHAT ARE RELEVANT ECOLOGICAL RECEPTORS AND HABITATS?

Identifying relevant receptors and habitats is integral to ecological risk assessment.

Guided by the American Society for Testing and Materials definition of relevant receptors and habitats (ASTM, 2000), this primer defines relevant ecological receptors and habitats as ecological resources requiring protection. At a site, identifying relevant resources from all resources is difficult, but integral to the problem formulation phase of the ecological risk assessment framework. Some relevant ecological resources include communities with threatened or endangered species, recreationally or commercially important species, regionally or nationally rare habitats, or habitats with high-aesthetic quality or special protection afforded by law or regulation.

This definition is consistent with guidance provided by the EPA (1997) and many states. For example, guidance on what is important to protect—which may be difficult to determine because of varying viewpoints—can be found in various Federal and state regulations governing ecological resources. The EPA (1997) states that the process of selecting what to protect often includes ecological resources that are:

- Protected by law
- Critical resources
- Key components of the ecological system.

The EPA notes that identifying valued ecological resources is central to ecological risk assessment.

Various state resource management and environmental regulatory documents provide guidance on which receptors commonly are considered valued ecological entities, and often list receptors and habitats that are to be protected by environmental regulations. Protected receptors usually include:

- Rare, threatened, or endangered species
- Ecologically important species
- Recreationally or commercially important species.

Protected habitats usually include:

- Wetlands
- Aquatic habitats, such as streams, rivers, lakes, and estuaries
- Forests and other ecologically important terrestrial habitats
- Habitats designated as sensitive or of special interest.

Certain site-specific receptors and habitats typically are not included in an ecological risk assessment.

Based on guidelines being developed by the EPA and some states, certain receptors and habitats typically are not included in an ecological risk assessment. Some receptors include animals that may inhabit urban or industrial areas (e.g., rats and pigeons), domestic animals, and livestock. It is possible, however, that such species might be included in a food chain evaluation of human health impact, where relevant.

Areas committed to industrial or commercial use generally are not considered valuable resources for ecological risk assessment. For example, the following areas usually are not considered:

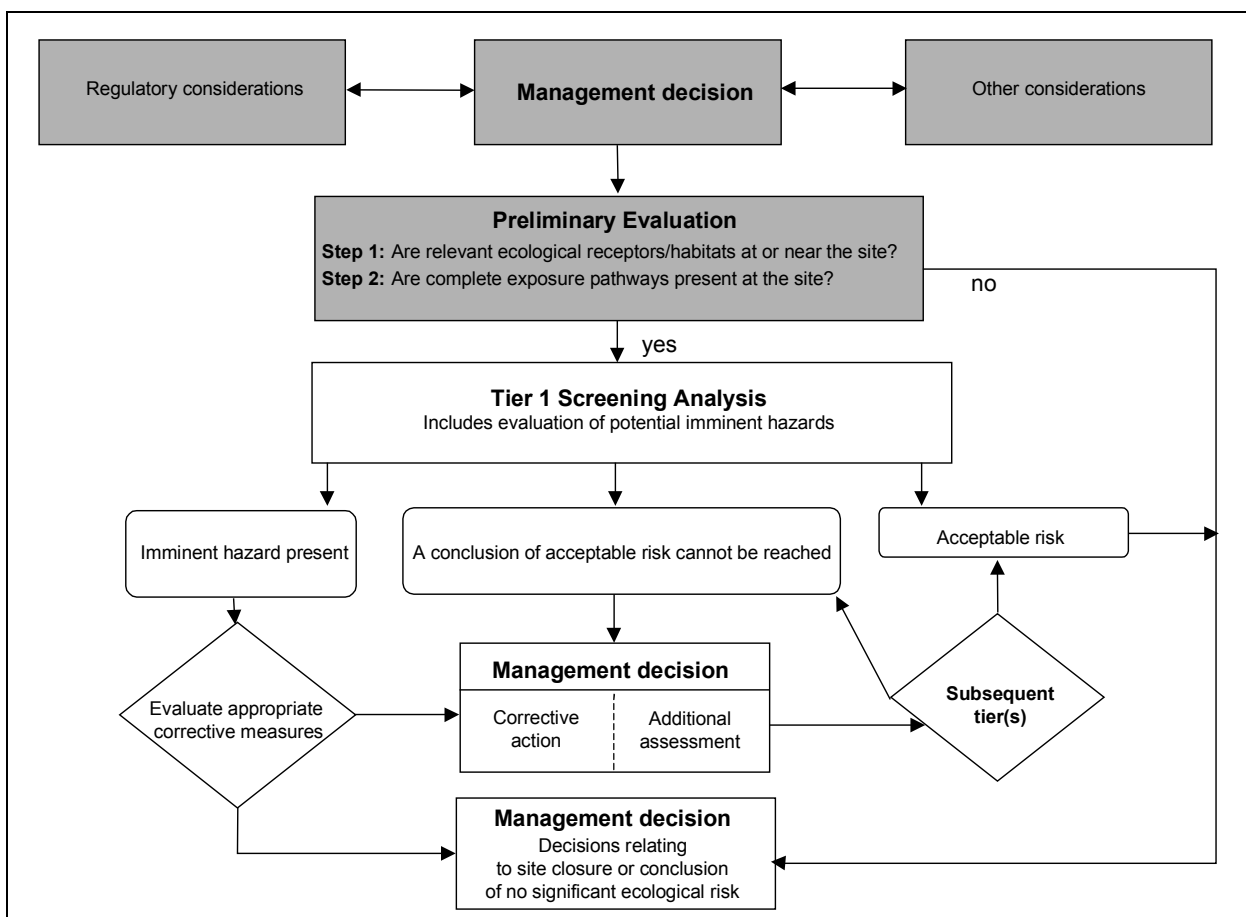
- Paved areas (e.g., parking lots, roads, storage areas)
- Areas in active industrial or commercial use
- Median strips and other small isolated areas (which may be vegetated)
- Sumps and other water collection systems used for industrial purposes.

HOW DO I EVALUATE ECOLOGICAL RISK?

Many Federal, state, and industry-related agencies emphasize a tiered approach to ecological risk assessment.

A tiered approach for ecological risk assessment is presented in **Figure 2** and is consistent with the process described in the ASTM Risk-Based Corrective Action process (ASTM, 2000). This primer describes the initial steps to this tiered approach—a preliminary evaluation. Several state regulatory agencies (California, Massachusetts, Pennsylvania, Texas, and Washington) have adopted some tiered approach form, which has the flexibility to assess risk at various detail levels. In some cases, a simple preliminary evaluation suffices, while other cases warrant more-detailed ecological risk assessment.

FIGURE 2.
TIERED ECOLOGICAL ASSESSMENT PROCESS.



The figure's shading represents this primer's focus—the preliminary evaluation and the steps preceding it.

The tiered approach allows the site investigator to focus only on those chemicals and pathways that potentially pose risk to relevant ecological receptors and habitats. Chemicals and/or pathways that do not pose a substantial risk are eliminated early from consideration. Likewise, if it is apparent that significant ecological impacts already are occurring or likely to occur at the petroleum release site, then the site or facility manager can consider appropriate initial response actions.