State of Alaska

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF SPILL PREVENTION AND RESPONSE

CONTAMINATED SITES PROGRAM

Ecoscoping Guidance

A Tool for Developing an Ecological Conceptual Site Model

March 2014

ECOSCOPING GUIDANCE
MARCH 2014

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Introduction and Overview

The Alaska Department of Environmental Conservation (DEC) has established a simple, systematic scoping process to determine whether more in-depth ecological risk evaluation is required at sites contaminated with hazardous substances. It is intended for use by those involved in the investigation and cleanup of contaminated sites addressed under 18 Alaska Administrative Code (AAC) 75 and 18 AAC 78.[1]

Ecological scoping (ecoscoping) is the first part of the process to assess the risk to the environment presented by contamination. This document (the *Ecoscoping Guidance*) outlines the process for developing an ecological conceptual site model. Two companion documents provide additional background on the process for evaluating ecological risk. These are:

1. The State of Alaska's *Risk Assessment Procedures Manual* (RAPM), adopted in regulation, is the overarching document that covers how to assess risk to humans and the environment; and

2. The *Policy Guidance on Conceptual Site Models* gives instructions to prepare a model that "paints a picture" of how people, plants and/or animals would be exposed to contamination. Human health and ecological conceptual site models are prepared separately.

By following the ecological scoping process in this document, DEC will be able to determine whether a screening level ecological risk assessment or a full baseline ecological risk assessment is warranted.

During the scoping process the following factors are evaluated:

1) Direct visual impacts or signs of acute toxicity;
2) Terrestrial and aquatic exposure routes;
3) Quality and availability of habitat;
4) Quantity of contaminated media; and
5) Toxicity benchmark levels.

This systematic evaluation includes "off-ramps" from the scoping process at various steps, thereby reducing the level of effort required for many sites. For example, it may be unnecessary to evaluate habitat, contaminant quantity, and toxicity if no terrestrial or aquatic exposure routes are present.

The preliminary scoping should be completed with available information and presented for DEC review prior to submittal of the site characterization workplan. Evaluating the site at this early phase has two advantages: 1) the evaluation can be completed quickly and easily at sites that clearly have no ecological concerns; and 2) site characterization activities can be focused based

[1] The minimum recommended level of expertise to conduct an ecological scoping includes biologists, botanists, ecologists, environmental scientists or similar with at least one year of experience conducting environmental assessment or cleanup.

on the outcome of the scoping. In the early stages, best professional judgment will need to be applied based on limited site information. A precautionary approach should be applied during the evaluation of the five individual factors unless or until there is sufficient information to support taking the applicable off-ramp.

As more information becomes available (i.e., through sampling and other site characterization activities), or as site conditions change, the preliminary scoping results should be refined. The results of the refined scoping may be submitted as a stand-alone document following the completion of site characterization, or it may be incorporated into the site characterization report. It is important to note that, with the exception of endangered or threatened species, ecological risks are evaluated on a population basis. The formal ecological definition of a population is a group of organisms within the same species that freely interbreed. Trying to define this at a site is not expected during a scoping level evaluation. However, at this level of evaluation it is a pertinent question to ask if contamination is extensive enough to affect the home ranges of at least a handful of members of a given species. For example, a herd of caribou that ranges over thousands of acres is not going to be affected by a site the size of a gas station lot. The area of contamination is probably the greatest issue, but concentration or sheer quantity should also be considered, especially if the compounds are persistent and bioaccumulative. Bioaccumulative compounds may affect species beyond the area of contamination because they accumulate in the food chain and the food chain is mobile.

Instructions

Evaluate each factor detailed in the following sections. The user must work through each factor separately for the terrestrial and for the aquatic/wetland environments. **Appendix A** provides a list of contaminant properties to evaluate transport mechanisms. **Appendix B** provides a completed Ecoscoping Form for the user to refer to as a guide. **Appendix C** provides a blank Ecoscoping Form for the user to document the results.

Scoping Factor 1: Direct Visual Impacts and Acute Toxicity

Direct impacts, such as visibly stressed or dead biota, are typically associated with acute toxicity, rather than a more subtle chronic toxicity that may negatively affect populations over time. An observed direct impact may also be a clue that contaminant concentrations are very high and that contaminant migration is likely.

Decision Point - If direct impacts that may result from the site contaminants are evident, or if acute toxicity from high contaminant concentrations is suspected, evaluate all of the remaining scoping factors without taking any off-ramps. Otherwise, evaluate remaining scoping factors, taking off-ramps as appropriate.

Scoping Factor 2: Terrestrial and Aquatic Exposure Routes

"Terrestrial and aquatic exposure routes" describes the many ways that contaminants are transported to and can be taken up by plants or animals, collectively known as "ecological receptors." Ecological receptors may be present at a contaminated site without there being a viable or complete exposure route. For example, contaminants that are buried in the soil or beneath a structure may not be accessible to plants or animals living at the soil surface. On the other hand, ecological receptors located some distance from the site may be affected by contaminant migration. For example, a contaminant spilled to land may migrate through the soil and leach into groundwater. It may then be carried some distance and enter a stream, where it causes acute or chronic impacts to fish.

Once contaminants reach various environmental media they may come in contact with avian, terrestrial or aquatic receptors differently. For instance, aquatic receptors may spend their full life cycle in surface water, while terrestrial receptors may only be exposed to surface water through its use as a drinking water source. For the purposes of this scoping process, **terrestrial receptors**, including many avian species, are those that generally use the land to meet their life needs. **Aquatic receptors** are those that primarily use water. Some species, such as the mink or great blue heron, may use both the aquatic and terrestrial environments.

To evaluate the terrestrial and aquatic exposure routes at a site, consider the following possible exposure pathways for both the terrestrial and aquatic/wetland environments. Note that there may be others besides those listed.

Terrestrial Exposure Routes

- Exposure to water-borne contaminants as a result of wading or swimming in contaminated waters or ingesting contaminated water.
- Contaminant uptake in terrestrial plants whose roots are in contact with contaminated surface water.
- Contaminant migration via saturated or unsaturated groundwater zones and discharge at upland "seep" locations (not associated with a wetland or water body).
- Contaminant uptake by terrestrial plants whose roots are in contact with soil moisture or groundwater present within the root zone (generally no more than 4 feet below ground surface).
- Particulates deposited on plants directly or from rain splash.
- Incidental ingestion and/or exposure while animals grub for food, burrow (up to 2 feet for small animals or 6 feet for large animals), or groom.
- Inhalation of fugitive dust or vapors disturbed by foraging or burrowing activities.
- Bioaccumulatives (other than PAHs, which bioaccumulate more readily in aquatic environments) taken up by soil invertebrates, which are in turn eaten by higher food chain organisms.[2]
- Other site-specific exposure pathways.

[2] See the *Policy Guidance on Developing Conceptual Site Models*, October 2010.

Aquatic Exposure Routes

- Contaminated surface runoff migration to water bodies through swales, drainage ditches, or overland flow.
- Aquatic receptors exposed through osmotic exchange, respiration, or ventilation of surface waters.
- Contaminant migration via saturated or unsaturated groundwater zones and discharge at "seep" locations along banks or directly to surface water.
- Deposition into sediments from upwelling of contaminated groundwater.
- Aquatic receptors may be exposed directly to contaminated sediments through foraging or burrowing, or indirectly exposed due to osmotic exchange, respiration, or ventilation of sediment pore water.
- Aquatic plants rooted in contaminated sediments.
- Bioaccumulatives taken up by sediment invertebrates, which are in turn eaten by higher food chain organisms (See the *Policy Guidance on Conceptual Site Models*).
- Other site-specific exposure pathways.

Additional Information about Contaminant Fate and Transport:

When evaluating the receptor pathway, it will be important to assess whether contamination could migrate to other locations, to other environmental media, or if it can accumulate in plants and animals and move through the food chain. Knowing a contaminant's physical, chemical, and bio-chemical characteristics such as mobility, volatility, hydrolysis, solubility and biodegradation potential will help with the terrestrial and aquatic exposure routes evaluation.

Appendix A summarizes a number of important physical and chemical parameters. The United States National Library of Medicine's TOXNET is a cluster of databases on toxicology, hazardous chemicals, and related areas. TOXNET's Hazardous Substance Database, available at http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB, is useful for determining the fate and effects of most contaminants in the terrestrial and aquatic environments.

Many chemical compounds, especially those with a hydrophobic component, partition easily into the lipids and lipid membranes of organisms and bioaccumulate. Bioaccumulation is particularly important because of the possibility of increased exposure (biomagnification) at higher trophic levels. As organisms eat and drink, bioaccumulative chemicals become more concentrated in certain body tissues in relation to the concentration in the ambient environment. Biomagnification can result in concentrations of

Bioaccumulation

Bioaccumulation is a general term for build-up over time of contaminants within an organism.

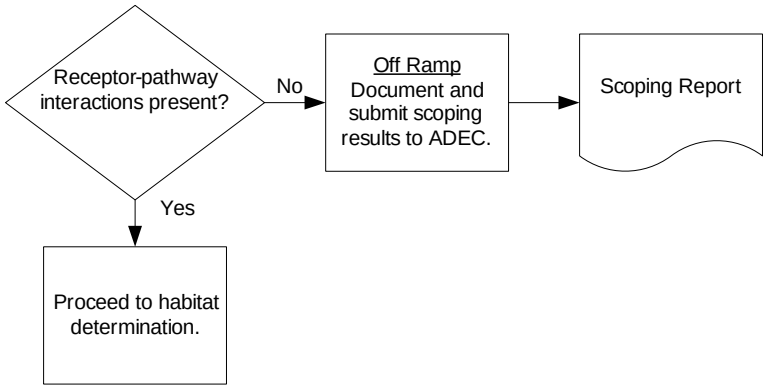
These contaminants can be present in soil, air, or water, and include some pesticides, methyl mercury, and certain other organic chemicals. The result is the organism has a higher concentration of the substance than the concentration in the organism's surrounding environment (known as bioconcentration).

The term biomagnification refers to the progressive build-up of persistent contaminants by successive levels of the food chain – it relates to the concentration ratio in a tissue of a predator organism as compared to that in its prey.

chemicals that are many times higher than found in the ambient environment. Moreover, acute or chronic laboratory toxicity benchmark concentrations developed using a limited number of organisms cannot account for the many subtle yet harmful impacts that may occur as a chemical moves through the food chain.

The *Policy Guidance on Developing Conceptual Site Models* (October 2010)[3] lists the compounds of potential concern for bioaccumulation.

Decision Point - Proceed to the habitat determination below if any terrestrial or aquatic exposure routes are present. Otherwise, end scoping here and document results for DEC review.



[3] See: http://dec.alaska.gov/spar/guidance.htm#scoping

Scoping Factor 3: Habitat for Valued Species

These instructions are intended to quickly establish whether there are one or more classes of habitats supportive of populations of a valued species. A site visit, aerial photos, maps, and/or online tools will generally be enough resources to complete this phase of the scoping process.

A valued species is one with recognized societal or cultural importance, commercial value, or that provides a recreational opportunity. It may also be a keystone or indicator species within an ecosystem, whereby its absence or impairment would upset the balance of the ecosystem. Recognizing the impracticality of evaluating all species, DEC's approach to ecological risk assessment is to focus on valued species.

Appendix D, pages D-4 through D-16 of the *Alaska Ecoregions Technical Background Document* (Shannon and Wilson 1999)[4] provides information on species with societal value in eight ecoregions. It is important to note that the species presented by ecoregion are generalized over broad areas. You may need to consult with ADF&G to accurately identify important species that may or may not be present near a site.

A habitat is the actual location in the environment where an organism lives that contains all the physical and biological resources necessary for that species. Every habitat sets limits on the population it can support, by virtue of its capability to provide food, shelter, nesting places, drinking water or the other essentials for that species. Habitat structure is the small to medium scale heterogeneity created by the interaction between environmental conditions, vegetation, and topography.

The habitat scoping factor is based on four decisions (more guidance to aid in evaluating this scoping factor is provided below the list):

1. **Valued Species** – Does habitat that could be affected by the contamination support valued species (i.e., species that are regulated, used for subsistence, have ceremonial importance, have commercial value, or provide recreational opportunity)?
2. **Critical Habitats and Anadromous Streams** – Is a critical habitat or anadromous stream in an area that could be affected by the contamination?
3. **Other Important Habitat** – Is there any other habitat that is important to the region that could be affected by the contamination?
4. **Parks, Preserves, and Wildlife Refuges** – Is the contamination in a park, preserve, or wildlife refuge?

In addition to the information available in the *Alaska Ecoregions Technical Background Document*, the following websites should be reviewed and checked for up-to-date information on regulated species:

1) The Alaska Department of Fish and Game (ADF&G) Division of Wildlife Conservation maintains a State of Alaska endangered species list: (http://www.adfg.alaska.gov/index.cfm?adfg=specialstatus.akendangered)

[4] The entire Alaska Ecoregions project is located on our website at http://www.dec.state.ak.us/spar/csp/guidance/ecoregion_endpoint_report99.pdf.

2) The U.S. Fish and Wildlife Service maintains a list of threatened and endangered species in Alaska: http://ecos.fws.gov/tess_public/StateListing.do?status=listed&state=AK
3) The National Marine Fisheries Service provides information on marine mammals that are protected under the Marine Mammal Protection Act of 1972: (http://www.fakr.noaa.gov/protectedresources/default.htm)
4) The U.S. Fish & Wildlife Service's Migratory Bird Management program provides species list and information about waterfowl, loons /grebes, seabirds, shorebirds, and raptors/land birds in Alaska: (http://alaska.fws.gov/mbsp/mbm/index.htm).

Critical Habitats and Anadromous Streams

Information on state designated critical habitat areas is available through the ADF&G Division of Wildlife Conservation at http://www.adfg.alaska.gov/index.cfm?adfg=protectedareas.locator. The state game refuges, sanctuaries, and ranges that are listed at this website should also be considered critical habitat.

In addition to the critical habitats designated by ADF&G, two other critical habitats have been identified by other agencies.

1) Spectacled eider: The U.S. Fish and Wildlife Service (USFWS) has designated approximately 39,000 square miles of critical habitat for the spectacled eider in Alaska in four different locations: in the Bering Sea between St. Lawrence and St. Matthew islands; in Norton Sound east of Nome; in Ledyard Bay between Cape Lisburne and Icy Cape; and on the coastal fringe of parts of the Yukon-Kuskokwim Delta. The nearest USFWS office should be consulted if a contaminated property is in any of these areas.
2) Steller sea lion: Critical habitat for this species includes a 20-nautical-mile buffer around all major haulouts and rookeries, as well as associated terrestrial, air and aquatic zones, and three large offshore foraging areas. The National Marine Fisheries Service should be consulted if your site is near a Steller sea lion rookery.

The Department of Natural Resources' ***Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes*** and its associated Atlas (the Catalog and Atlas, respectively) currently contain about 16,000 streams, rivers or lakes around the state that have been specified as being important for the spawning, rearing or migration of anadromous fish. Anadromous waters information can be found at the ADF&G site:

http://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=maps.interactive.

Other Important Habitats

The "habitat heterogeneity hypothesis" is one of the cornerstones of ecology (e.g. Simpson, 1949; MacArthur & Wilson, 1967; Lack, 1969). It assumes that structurally complex habitats may provide more niches and diverse ways of exploiting the environmental resources and thus

increase species diversity (Bazzaz, 1975). Certain combinations of environmental conditions are necessary for individuals of each species to survive and reproduce. Thus, heterogeneous or diverse habitats are generally more ecologically productive and a higher quality than homogeneous habitats. Heterogeneous habitats can generally support larger populations.

In some cases, an agency, organization, or the public will have identified a habitat as important for the area. But in other cases, the assessor will need to evaluate the habitat in the area through site visits, aerial photos, and maps. Although important habitats may be present anywhere, pay particular attention to sites located in or near publicly-managed parks, monuments, sanctuaries, forests, conservation areas, wilderness, special management areas, recreation areas, and public-use areas. Large city or borough parks, such as Kincaid Park in Anchorage, should also be considered during evaluation of this scoping factor.

Industrialized or densely populated urban areas usually do not contain important habitats. Typically, most of the natural vegetation that could support wildlife has been removed. Significant aquatic and terrestrial habitats are not within the influence of site contaminants, taking into account factors such as contaminant mobility, and known or suspected transport mechanisms. Wetlands may have existed at one time but have likely been filled in order to accommodate development. However, a site may be located adjacent to a contiguous, undeveloped wooded area or greenbelt that is a valuable bird nesting site or urban wildlife corridor. A high-value fish stream may flow through the center of an industrial zone. Known wildlife corridors in urbanized areas are considered high quality terrestrial habitat because they connect areas of habitat that a species may need to meet its life needs. Isolated, high-value wetlands that serve as a waterfowl nesting area or nursing area for juvenile salmon may also be present in urban settings.

Important terrestrial habitats are often located in undeveloped areas. Although the contaminated property may be limited in size or constitute an artificial environment (i.e., gravel pads on tundra), undeveloped land with diverse habitat features capable of supporting terrestrial and avian wildlife populations may extend outward from the site in large, contiguous tracts. Diverse, heterogeneous areas such as forest edges are usually considered important habitat even though their total acreage may be small.

Important aquatic or wetland habitats may be found in both rural and developed areas. ADF&G's Wildlife Conservation Division or ADNR's Office of Habitat Management and Permitting may need to be consulted regarding smaller wetlands, streams, ponds, or lakes that are located in developed areas. Rivers, streams, and lakes in either urban or rural areas may be sensitive habitats or classified anadromous fish waterbodies. Specific high-value wetlands include the following:

- **Near Shore Ecosystem (Tidal Fringe)** – Tidal fringe waters/wetlands occur along coasts and estuaries and are under the influence of sea level. They usually intergrade landward with riverine or slope waters/wetlands where tidal currents diminish and other sources of water (e.g. river flow; groundwater discharge) dominate.

- **Riverine** – Riverine waters/wetlands occur in floodplains and riparian corridors in association with stream channels. Dominant water sources are overbank flow from the channel or subsurface hydraulic connections between the stream channel and waters/wetlands. Additional water sources may include groundwater discharge from surficial aquifers, overland flow from adjacent uplands and tributaries and precipitation.
- **Lacustrine Fringe** – Lacustrine fringe waters/wetlands occur adjacent to lakes where the water elevation of the lake maintains the water table in the water/wetland. In some cases, they consist of a floating mat attached to land. Additional sources of water are precipitation and groundwater discharge. Surface flow is bi-directional, usually controlled by water level fluctuations such as seiches in the adjoining lake.

Parks, Preserves, and Wildlife Refuges

Federal and state parks and other public lands presumed to have high habitat value include the following (not included are parks or other public lands devoted primarily to recreational use or preserved for historical purposes or other cultural reasons):

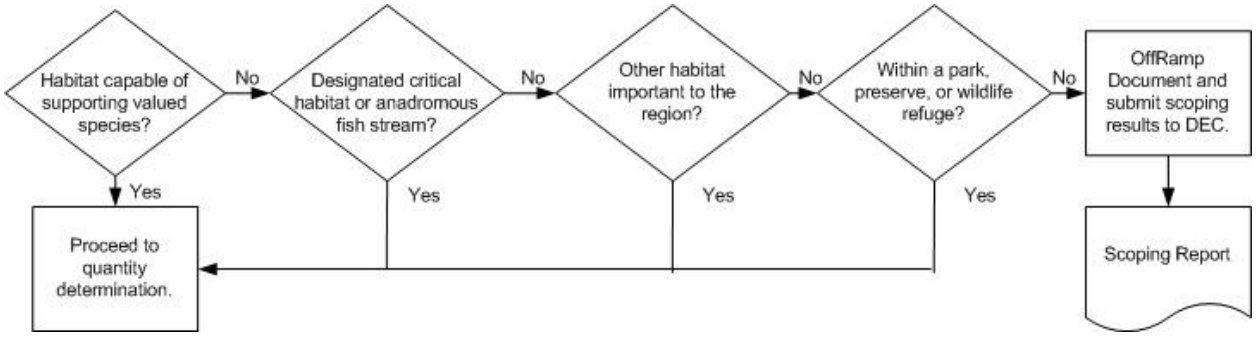
- Cape Krusenstern National Monument
- Misty Fjords National Monument
- Denali National Park and Preserve
- Gates of the Arctic National Park and Preserve
- Glacier Bay National Park and Preserve
- Katmai National Park and Preserve
- Lake Clark National Park and Preserve
- Wrangell-St. Elias National Park and Preserve
- Kenai Fjords National Park
- Kobuk Valley National Park
- Bering Land Bridge National Preserve
- Noatak National Preserve
- Yukon-Charley Rivers National Preserve
- Kenai River Special Management Area
- Shuyak Island State Park
- Wood-Tikchik State Park
- Katchemak Bay State Park and State Wilderness Park
- Delta Junction Bison State Range
- Anchorage Coastal State Refuge
- Cape Newenham State Refuge
- Creamer's Field State Refuge
- Goose Bay State Refuge
- Izembek State Refuge
- Mendenhall Wetlands State Refuge
- McNeil River State Refuge
- Minot Flats State Refuge
- Palmer Hay Flats State Refuge
- Susitna Flats State Refuge
- Trading Bay State Refuge
- Yakataga State Refuge
- Alaska Peninsula National Wildlife Refuge
- Arctic National Wildlife Refuge
- Becharof National Wildlife Refuge
- Innoko National Wildlife Refuge
- Izembek National Wildlife Refuge
- Kanuti National Wildlife Refuge
- Kenai National Wildlife Refuge
- Kodiak National Wildlife Refuge
- Koyukuk National Wildlife Refuge
- Nowitna National Wildlife Refuge
- Selawik National Wildlife Refuge
- Tetlin National Wildlife Refuge
- Togiak National Wildlife Refuge
- Yukon Delta National Wildlife Refuge

- Yukon Flats National Wildlife Refuge

The following Web links provide information on these ecologically important public lands and should be checked to determine if other parks, preserves, or public lands with potential high habitat value exist in the vicinity of the site.

Federal wildlife refuges: http://alaska.fws.gov/nwr/map.htm
Federal parks and preserves: http://home.nps.gov/applications/parksearch/state.cfm?st=ak
State refuges, sanctuaries, and ranges:
http://www.adfg.alaska.gov/index.cfm?adfg=protectedareas.locator
State parks: http://www.dnr.state.ak.us/parks/units/index.htm
Wilderness areas in Alaska:
http://www.wilderness.net/index.cfm?fuse=NWPS&sec=stateView&state=ak&map=ak

Decision Point – Proceed to the quantity determination below if contamination could impact habitat supporting valued species of fish and wildlife; critical habitats or anadromous streams, or other habitats identified as important for the region; or if the site is located within a park, preserve, or wildlife refuge. Otherwise, end scoping here and document results for DEC review.

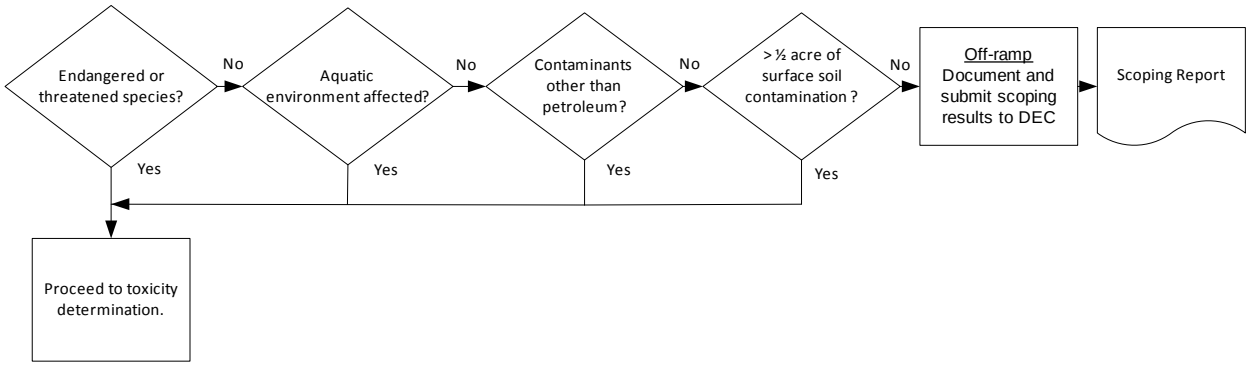


Scoping Factor 4: Contaminant Quantity

As spill volume or affected contaminated media increase in size, the likelihood that fish and wildlife populations may be at risk also increases. DEC recognizes that petroleum contamination of limited size poses minimal risk to terrestrial populations. As such, DEC has established a one-half acre *de minimis* criterion for petroleum-contaminated properties. This off-ramp does not apply to potentially impacted aquatic media. Nor does it apply if endangered or threatened species are present.

Estimate the total contaminated soil surface area. If available, also provide information regarding the spill volumes and affected media, size of contaminated groundwater plumes, aerial extent of sediment contamination, and potential migration routes.

Decision Point – Proceed to the toxicity determination if endangered or threatened species are present; if the aquatic environment is or could be affected; if there are non-petroleum contaminants present, or if the total area of petroleum-contaminated surface soil exceeds one-half acre. Otherwise, end scoping here and document results for DEC review.



Scoping Factor 5: Toxicity Determination

Using the Risk Assessment Information System (RAIS)

The Risk Assessment Information System (RAIS) at http://rais.ornl.gov/ provides a tool for calculating ecological risk-based screening level benchmarks for surface water, soil, and sediments. These benchmarks do not account for the increased exposure to higher trophic level organisms that occur as a result of bioaccumulation.

To use RAIS, navigate to the site: http://rais.ornl.gov/tools/eco_search.php. (http://rais.ornl.gov/) At the site, choose "Tools" and select "Ecological Benchmarks" from the dropdown menu. The process is then self-explanatory. The user should document which benchmarks were selected for each media, and why. In general, the most conservative benchmarks for each media should be chosen during ecoscoping. If less conservative benchmarks are chosen, the reason must be documented and the DEC project manager must approve use of the alternative benchmark.

Sediment – Applying Appropriate Screening Benchmarks

For sediment, the Department recommends the use of the TEL and PEL Sediment Quality Guidelines (SQGs), as published in NOAA's *Screening Quick Reference Tables (SQuiRTs)*.[5] SQG TEL/PEL values are listed for both fresh and marine water. Pertinent information associated with the tables can be found at: http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html. These are also found in the RAIS Tool under Sediment Choices, but are identified as the Canadian ISQG and Canadian PEL Sediment Screening Benchmarks (which are equivalent to the NOAA TEL and PEL, respectively). When choosing sediment benchmarks, the TEL (or ISQG) is typically the most conservative as it represents the level below which adverse effects are not expected to occur. If a TEL (ISQG) or PEL is not listed for a specific contaminant, the RAIS tool should be consulted for one or more appropriate sediment benchmarks for that contaminant.

Evaluating Petroleum-Specific Compounds

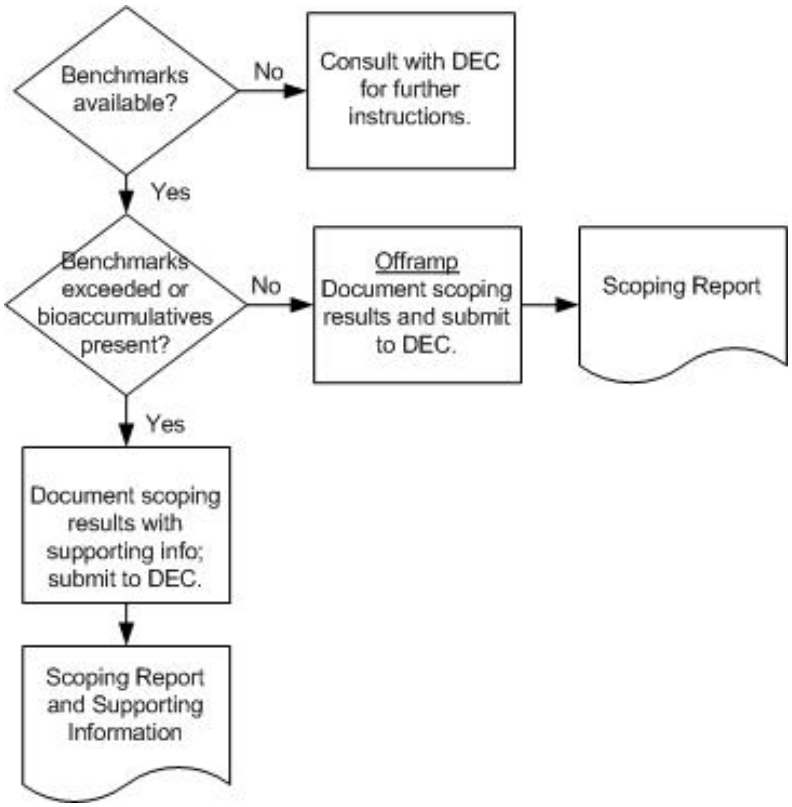
Evaluating petroleum as part of the ecoscoping process requires some additional analysis, as petroleum products are mixtures consisting of hundreds of different chemicals. There is limited information on the effect of petroleum mixtures (gasoline-, diesel- and residual range hydrocarbons) on ecological receptors. If petroleum mixtures are present at the site, individual contaminants of concern that may be associated with petroleum should be evaluated. Refer to Appendix F of DEC's *Draft Field Sampling Guidance*[6] to determine which chemicals of potential concern should be tested for based on the type of petroleum product associated with the release.

Finally, once benchmarks are generated for contaminants, representative site data is then compared to the selected benchmarks at this point in the scoping process. If site data exceed the

[5] For the tables alone, see: http://response.restoration.noaa.gov/book_shelf/122_NEW-SQuiRTs.pdf
[6] See the *Draft Field Sampling Guidance* under Site Characterization and Cleanup at: http://dec.alaska.gov/spar/guidance.htm#csp

RAIS benchmark screening levels, the next step is a more in-depth look at other applicable benchmarks. This is done through a screening-level risk assessment, discussed in the *Risk Assessment Procedures Manual*. Before proceeding with this stage of the ecological risk assessment process, planned site remediation that may address ecological concerns should be considered in collaboration with the DEC project manager. Once site remediation has been completed, a second ecological scoping may show that a risk assessment is unnecessary.

Decision Point – Document scoping results in the Ecoscoping Form. Submit a site map, habitat photos, and any additional supporting information that may assist in the DEC review if benchmarks are exceeded or if bioaccumulatives are present.



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Glossary

Acute Toxicity
Illness resulting from a single dose or exposure to a toxic substance.

Adsorption
The assimilation of gas, vapor or dissolved matter by the surface of a solid or liquid.

Bioaccumulation
The net accumulation of a chemical by an organism as a result of uptake from all routes of exposure.

Bioconcentration
The increase in concentration of a chemical in an organism resulting from tissue absorption levels exceeding the rate of metabolism and excretion.

Bioconcentration Factor (BCF)
The ratio of chemical concentration in an organism to that in surrounding water.

Biomagnification
The tendency of some chemicals to accumulate to higher concentrations at higher levels in the food web through dietary accumulation.

Chronic Toxicity
Illness caused by repeated or long-term exposure to low doses of a toxic substance.

Contaminant Transport Mechanisms
The means or method by which a hazardous substance is transferred from its source to an exposed organism or element.

Dermal Exposure
Exposures to a toxin by either direct contact (i.e., splashing or immersion) to the skin, indirect contact via a contaminated surface, or by being transported through the skin as a vapor.

Exposure Route
The way an environmental chemical enters the body after contact with a contaminated environmental medium (e.g., ingestion, inhalation, dermal absorption).

Fugitive Dust
Any solid particulate matter that becomes airborne directly or indirectly as a result of human activity (i.e., material that originates from storage, handling or hauling of aggregate material, construction activities, or land clearing).

Greenbelt

An area designated not to be developed.

Hazardous Substance

(A) An element or compound that, when it enters into or on the surface or subsurface land or water of the state, presents an imminent and substantial danger to the public health or welfare, or to fish, animals, vegetation, or any part of the natural habitat in which fish, animals, or wildlife may be found; or (B) A substance defined as a hazardous substance under 42 U.S.C. 9601-9657 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980); "hazardous substance" does not include uncontaminated crude oil or uncontaminated noncrude (refined) oil in an amount of 10 gallons or less.

Hydrolysis

Decomposition of a chemical compound by reaction with water.

Intertidal Zone

The region between the high tide mark and the low tide mark.

Lipophilic Contaminant

A contaminant that is capable of dissolving in lipids, the fatty tissue (i.e., a contaminant that when ingested or absorbed through the epidermis, is stored in the fatty tissue).

Migration Pathway

The course a hazardous substance takes from the source to a receptor. For example, hazardous substances migrate from a spilled drum (a source) to soil; it then migrates to subsurface soil where a burrowing animal (a receptor) is exposed.

Osmotic Exchange

The exchange of a weak solution through a semi-permeable membrane, which selectively excludes some solute molecules, to a more concentrated solution.

Particulates

Fine liquid or solid particles, such as dust, smoke, mist, fumes, or smog found in air or emissions that may gather together by coagulation.

Population

A group of individuals of the same species inhabiting the same area.

Riparian Zone

Of or pertaining to or located on the bank of a river or stream (i.e., serves important functions including purifying water by removing sediments and other contaminants; reducing the risk of flooding; reducing stream channel and stream bank erosion; increasing available water and stream flow duration by holding water in stream banks and aquifers; supporting a diversity of plant and wildlife species; maintaining a habitat for the healthy fish populations providing water, forage and shade for wildlife and livestock; etc.).

Swale

A hollow or depressed tract of land, especially in moist or marshy ground, that usually carries water during a rainstorm or snow melts.

Terrestrial

Living, growing, or belonging to the land (i.e., plants, animals, etc.).

Transport Mechanism

The means or methods of carrying something (a toxin) from one place to another (i.e., air dispersion, flow, migration, transportation, volatilization, etc.).

Wildlife Corridor

Narrow areas that connect separate habitats, including feeding, watering, resting, and breeding habitats.

Appendix A: Contaminant Properties Used to Evaluate Transport Mechanisms

These parameters describe chemical properties of the site contaminants. Important chemical parameters used to evaluate transport mechanisms are shown below. The values specific to each chemical determine how easily a chemical is transported by various mechanisms. The values and information about what they mean can be found at a number of sources, including the National Institute of Health's National Library of Medicine, at http://toxnet.nlm.nih.gov/. The website includes a number of databases, including the Hazardous Substances Data Bank. Other sources exist as well, and mention of this source is not meant to be an endorsement over other sources.

Table D-1: Important Physical and Chemical Parameters Used to Evaluate Transport Mechanisms.

Purpose	Parameter	Symbol	Meaning
Does the contaminant cling to organic matter or does it move with water?	**Organic carbon partition coefficient**	**K_{oc}**	Provides a measure of the extent of chemical partitioning between organic carbon and water at equilibrium. The higher the K_{oc}, the more likely a chemical is to bind to soil or sediment than to remain in water.
	Soil/water partition coefficient	**K_d**	Provides a soil or sediment-specific measure of the extent of chemical partitioning between soil or sediment and water, unadjusted for dependence upon organic carbon. The higher the K_d, the more likely a chemical is to bind to soil or sediment than to remain in water.
	Octanol coefficient	**K_{ow}**	Provides a measure of the extent of chemical partitioning between water and octanol at equilibrium. The greater the K_{ow}, the more likely a chemical is to partition to octanol than to remain in water. Octanol is used as a surrogate for lipids (fat), and K_{ow} can be used to predict bioconcentration in aquatic organisms.
Does it dissolve in water?	**Solubility**		Is the upper limit on a chemical's dissolved concentration in water at a specified temperature? Aqueous concentrations in excess of solubility may indicate sorption onto sediments, the presence of solubilizing chemicals such as solvents, or the presence of a non-aqueous phase liquid.
Does it vaporize?	**Henry's Law Constant**	**H_1**	Provides a measure of the extent of chemical partitioning between air and water at equilibrium. The higher the Henry's Law Constant, the more likely a chemical is to volatize than to remain in water.

Purpose	Parameter	Symbol	Meaning
Does it vaporize?	**Vapor Pressure**		Is the pressure exerted by a chemical vapor in equilibrium with its solid or liquid form at any given temperature? It is used to calculate the rate of volatilization of a pure substance from a surface or in estimating a Henry's Law Constant for chemicals with low water solubility. The higher the vapor pressure, the more likely a chemical is to exist in a gaseous state.
Does it spread?	**Movement of Molecules**	**Diffusivity**	Describes the movement of a molecule in a liquid or gas medium as a result of differences in concentration. It is used to calculate the dispersive component of chemical transport. The higher the diffusivity, the more likely a chemical is to move in response to concentration gradients.
Does it accumulate in living tissue?		**Bioconcentration Factor (BCF)**	Provides a measure of the extent of chemical partitioning at equilibrium between a biological medium such as fish tissue or plant tissue and an external medium such as water. The higher the BCF, the greater the accumulation in living tissue is likely to be.
How easily does it break down over time?	**Persistence**	**Media-Specific Half-Life**	Provides a relative measure of persistence of a chemical in a given medium, although actual values can vary greatly depending on site-specific conditions. The greater the half-life, the more persistent a chemical is likely to be.

Source: *Risk Assessment Guidance for Superfund, Volume 1, Part A*, Exhibit 6-4 (EPA 1989).

Appendix B: Example of Completed Ecoscoping Form

Site Name: Former Municipal Incinerator
Completed by: L&L Consulting
Date: March 18, 2005


Former incinerator site

Introduction

The City and Borough operated a municipal incinerator as a "waste-to-energy" facility from 1985 through 2000. Operation of the former facility and past waste handling practices have been linked to the detection of polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs) offsite. This report was prepared in response to DEC's request to evaluate the site according to the department's *Ecoscoping Guidance*.

1. Direct Visual Impacts and Acute Toxicity

Are direct impacts that may result from the site contaminants evident, or is acute toxicity from high contaminant concentrations suspected? C*heck the appropriate box.*

☐ Yes – D*escribe observations below and evaluate all of the remaining sections <u>without taking any off-ramps</u>.*
☒ No – *Go to next section.*

Comments:

2. Terrestrial and aquatic exposure routes

Check each terrestrial and aquatic route that could occur at the site.

<u>Terrestrial Exposure Routes</u>

☐ Exposure to water-borne contaminants as a result of wading or swimming in contaminated waters or ingesting contaminated water.
☐ Contaminant uptake in terrestrial plants whose roots are in contact with contaminated surface water.
☐ Contaminant migration via saturated or unsaturated groundwater zones and discharge at upland "seep" locations (not associated with a wetland or water body).
☐ Contaminant uptake by terrestrial plants whose roots are in contact with soil moisture or groundwater present within the root zone (generally no more than 4 feet below ground surface).
☒ Particulates deposited on plants directly or from rain splash.

☒ Incidental ingestion and/or exposure while animals grub for food, burrow (up to 2 feet for small animals or 6 feet for large animals), or groom.

☐ Inhalation of fugitive dust or vapors disturbed by foraging or burrowing activities.

☒ Bioaccumulatives (other than PAHs, which bioaccumulate more readily in aquatic environments) taken up by soil invertebrates, which are in turn eaten by higher food chain organisms (see the *Policy Guidance on Developing Conceptual Site Models*).

☐ Other site-specific exposure pathways.

Aquatic Exposure Routes

☒ Contaminated surface runoff migration to water bodies through swales, drainage ditches, or overland flow.

☐ Aquatic receptors exposed through osmotic exchange, respiration, or ventilation of surface waters.

☐ Contaminant migration via saturated or unsaturated groundwater zones and discharge at "seep" locations along banks or directly to surface water.

☐ Deposition into sediments from upwelling of contaminated groundwater.

☒ Aquatic receptors may be exposed directly to contaminated sediments through foraging or burrowing, or indirectly exposed due to osmotic exchange, respiration, or ventilation of sediment pore water.

☒ Aquatic plants rooted in contaminated sediments.

☒ Bioaccumulatives taken up by sediment invertebrates, which are in turn eaten by higher food chain organisms (see the *Policy Guidance on Developing Conceptual Site Models*).

☐ Other site-specific exposure pathways.

If any of the above boxes are checked, go on to the next section. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments: Potentially complete pathways include direct deposition from the incinerator stack onto nearby vegetation, incidental ingestion by ground dwelling species, and uptake by plants. Dioxins and furans have an affinity for soil and sediment and are not expected to go into solution easily. No groundwater seeps except those associated with the wetland are known to exist. Saturated soils in the vicinity minimize fugitive dust problems. Dioxins and furans do not volatilize easily.

Aquatic exposure routes are prevalent due to the presence of a small, forested wetland located approximately 30 meters downgradient of the site that connects to a larger surface waterbody. It is unlikely that aquatic receptors will be exposed through osmotic exchange, respiration, or ventilation of surface waters due to PCDD/Fs preference to bind with sediment organics. Contaminated groundwater is not likely a significant concern because the site is paved and surface runoff is the primary transport mechanism.

3. Habitat

Check all that may apply. See Ecoscoping Guidance *for additional help.*

☐ Habitat that could be affected by the contamination supports valued species (i.e., species that are regulated, used for subsistence, have ceremonial importance, have commercial value, or provide recreational opportunity).

☒ Critical habitat or anadromous stream in an area that could be affected by the contamination.

☐ Habitat that is important to the region that could be affected by the contamination.

☐ Contamination is in a park, preserve, or wildlife refuge.

Forested wetland - View looking back from the inlet to the flume

If any of the above boxes are checked, go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments: There are no known threatened or endangered species within the vicinity of the site. There are no unique, diverse, or heterogeneous or critical habitats. The site is not within a known wildlife corridor. The site is adjacent to a National Historical Park.

There are no riverine/riparian/tidal fringe/lacustrine wetlands present. The river is a listed ADF&G anadromous fish waterbody. A man-made diversion flume provides water to the local fish hatchery. This flume is connected by an access road culvert to a small, isolated forested wetland that receives contaminants from the upgradient source. Salmon fry have been observed in this flume and in the wetland. The hatchery is located adjacent to the flume approximately 100 meters downstream.

4. Contaminant Quantity

Check all that may apply. See Ecoscoping Guidance for additional help.

☐ Endangered or threatened species are present.
☒ The aquatic environment is or could be affected.
☒ Non-petroleum contaminants may be present, or the total area of petroleum-contaminated surface soil exceeds one-half acre.

If any of the above boxes are checked, go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

5. Toxicity Determination

Check all that apply.

☒ Bioaccumulative chemicals are present (see *Policy Guidance on Developing Conceptual Site Models*).
☐ Contaminants exceed benchmark levels (see RAIS Ecological Benchmark Tool available at: http://rais.ornl.gov/tools/eco_search.php).

If either box is checked, please complete a detailed Ecological Conceptual Site Model (see DEC's Policy Guidance on Conceptual Site Models*) and submit it to the assigned DEC project manager with this report.*

If neither box is checked, check the box below and submit this form to the assigned DEC project manager.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

Applicable sediment benchmarks were compared to limited, screening-level sampling results. The TEQ PCDD/Fs concentration for the wetland sediment sample was 94 ng/kg. The concentration for the flume sediment sample was 736 ng/kg.

Additional research was conducted for sediment benchmarks for dioxins and furans. The results of this research are shown below.

Screening Benchmark	Concentration (ng/kg

CCME PEL	21.5
EPA Birds	21/210
EPA Mammals	2.5/25
EPA Fish	60/100

Conclusions and Recommendations

The presence of bioaccumulatives above ecological screening benchmarks, the observed presence of aquatic receptors in the wetland and flume, and the presence of a downstream fish hatchery indicates the need for a screening-level risk assessment.

Appendix C: Blank Ecoscoping Form

Site Name:
Completed by:
Date:

Instructions: Follow the italicized instructions in each section below. "Off-ramps," where the evaluation ends before completing all of the sections, can be taken when indicated by the instructions. Comment boxes should be used to help support your answers.

1. Direct Visual Impacts and Acute Toxicity

Are direct impacts that may result from the site contaminants evident, or is acute toxicity from high contaminant concentrations suspected? C*heck the appropriate box.*

☒ Yes – D*escribe observations below and evaluate all of the remaining sections <u>without taking any off-ramps</u>.*
☐ No – *Go to next section.*

Comments:

2. Terrestrial and Aquatic Exposure Routes

Check each terrestrial and aquatic route that could occur at the site.

<u>Terrestrial Exposure Routes</u>

☐ Exposure to water-borne contaminants as a result of wading or swimming in contaminated waters or ingesting contaminated water.
☐ Contaminant uptake in terrestrial plants whose roots are in contact with contaminated surface water.
☐ Contaminant migration via saturated or unsaturated groundwater zones and discharge at upland "seep" locations (not associated with a wetland or waterbody).
☐ Contaminant uptake by terrestrial plants whose roots are in contact with soil moisture or groundwater present within the root zone (generally no more than 4 feet below ground surface.
☐ Particulates deposited on plants directly or from rain splash.
☐ Incidental ingestion and/or exposure while animals grub for food, burrow (up to 2 feet for small animals or 6 feet for large animals), or groom.

☐ Inhalation of fugitive dust or vapors disturbed by foraging or burrowing activities.

☐ Bioaccumulatives (other than PAHs, which bioaccumulate more readily in aquatic environments) taken up by soil invertebrates, which are in turn eaten by higher food chain organisms (see the *Policy Guidance on Developing Conceptual Site Models*).

☐ Other site-specific exposure pathways.

Aquatic Exposure Routes

☐ Contaminated surface runoff migration to water bodies through swales, drainage ditches, or overland flow.

☐ Aquatic receptors exposed through osmotic exchange, respiration, or ventilation of surface waters.

☐ Contaminant migration via saturated or unsaturated groundwater zones and discharge at "seep" locations along banks or directly to surface water.

☐ Deposition into sediments from upwelling of contaminated groundwater.

☐ Aquatic receptors may be exposed directly to contaminated sediments through foraging or burrowing, or indirectly exposed due to osmotic exchange, respiration, or ventilation of sediment pore water.

☐ Aquatic plants rooted in contaminated sediments.

☐ Bioaccumulatives (see the *Policy Guidance on Developing Conceptual Site Models*) taken up by sediment invertebrates, which are in turn eaten by higher food chain organisms.

☐ Other site-specific exposure pathways.

If any of the above boxes are checked, go on to the next section. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

3. Habitat

Check all that may apply. See Ecoscoping Guidance for additional help.

☐ Habitat that could be affected by the contamination supports valued species (i.e., species that are regulated, used for subsistence, have ceremonial importance, have commercial value, or provide recreational opportunity).

☐ Critical habitat or anadromous stream in an area that could be affected by the contamination.

☐ Habitat that is important to the region that could be affected by the contamination.

☐ Contamination is in a park, preserve, or wildlife refuge.

If any of the above boxes are checked, go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

4. Contaminant Quantity

Check all that may apply. See Ecoscoping Guidance for additional help.

☐ Endangered or threatened species are present.

☐ The aquatic environment is or could be affected.

☐ Non-petroleum contaminants may be present, or the total area of petroleum-contaminated surface soil exceeds one-half acre.

If any of the above boxes are checked, go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

5. Toxicity Determination

Check all that apply.

☐ Bioaccumulative chemicals are present (see *Policy Guidance on Developing Conceptual Site Models*).

☐ Contaminants exceed benchmark levels (see the Ecological Benchmark Tool in RAIS, available at: http://rais.ornl.gov/tools/eco_search.php).

If either box is checked, complete a detailed Ecological Conceptual Site Model (see DEC's Policy Guidance on Developing Conceptual Site Models*) and submit it with the form to your DEC project manager.*

If neither box is checked, check the box below and submit this form to your DEC project manager.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments: