U.S. Navy Ecological Screening and COPC Refinement for Sediment, Soil, and Surface Water

Abstract

This paper discusses the Navy and EPA approach for developing the initial list of the contaminants of potential concern (COPCs) for ecological risk as the outcome of the screening ecological risk assessment (SERA). It then provides a process for COPC refinement based on considerations of frequency and spatial patterns of detected concentrations, regional background conditions at the site, use of realistic exposure point concentrations and exposure parameters, and consideration of bioavailability through a defined structure for implementation of the ecological screening and refinement process that is consistent with both EPA (EPA, 1997) and Navy (Navy, 1999a) ecological risk assessment guidance and policy. (Also see Business Management System (BMS) B-9.1.1.1.4.4 and B-9.1.1.1.4.5). The screening-level ERA consists of the problem formulation that comprise the development of the initial conceptual site model, with emphasis on the compilation of available historical site information and data, and evaluation of current site conditions. A key component of data compilation is evaluation of the adequacy of the data set to make screening-level decisions. If available data are not adequate for decision-making, consideration should be given to identifying and filling data gaps prior to implementation of the screening process. The screening-level ecological effects evaluation details the selection of ecological screening benchmarks for all media of interest at the site, and stresses the importance of reaching consensus with appropriate regulatory agencies on the selected benchmarks. The screening-level ecological exposure estimate and risk calculation is designed to be a conservative estimation of exposure and risk, with a scientific management decision point at the end of this step resulting in a decision that the site poses no unacceptable ecological risk (completing the ERA process) or there is a need for further risk assessment at the site and identifies the list of COPCs that will need to be assessed further in the baseline ecological risk assessment (BERA).

Introduction

The purpose of this document is to provide details on how to clarify and document the ecological risk assessment screening and refinement process for sediment, soil and water in order to ensure consistency and agreement in the identification of the list of COPCs. The screening process, as presented in this document, tracks the Ecological Risk Assessment Guidance for Superfund (ERAGS) (EPA 1997), the Navy Ecological Risk Assessment Policy (Navy 1999a), and the Navy Ecological Risk Assessment Guidance. The process encompasses the screening-level problem formulation and ecological effects

evaluation (ERAGS Step 1), screening-level exposure estimate and risk calculation (ERAGS Step 2), and refinement of the list of contaminants of potential concern (the first portion of ERAGS Step 3) (see Figure 1). This process does not represent a change in guidance or policy, and does not supersede EPA or Navy risk assessment guidance or policy, but presents the screening process in the context of specific decisions, and provides a methodology to document site screening. This screening process tracks Tier 1 and the refinement portion of Tier 2 of the Navy's 3-tiered ERA process and is intended to apply to all Navy sites.

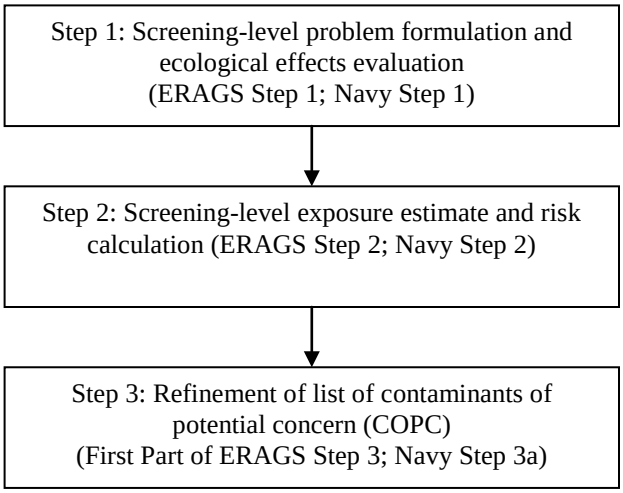

Figure 1. Overview of the Ecological Screening Process

Step 1: Screening-level Problem Formulation and Ecological Effects Evaluation

Screening-level Problem Formulation

Screening-level Problem Formulation

The first part of this step involves the screening-level problem formulation and ecological effects evaluation. The screening-level problem formulation consists of five activities:

1. Description of environmental setting and contaminants known or suspected at the site due to past Navy operations
2. Description of potential contaminant fate and transport mechanisms at the site
3. Ecotoxicity evaluation of potential chemical contaminants at the site
4. Identification of potentially complete ecological exposure pathways at the site
5. Selection of screening-level assessment endpoints

These five activities establish the initial conceptual site model (CSM) for the screening-level risk assessment, and allow the risk assessor and risk manager to compile all known historical information and data for a site and evaluate the current conditions at the site. It

is highly recommended that a site visit be conducted as part of Step 1 activities to help focus and plan the screening-level risk assessment. The five activities of the screening-level problem formulation are detailed further in the following paragraphs. For additional information on each of these activities, refer to the section of ERAGS (EPA 1997) referenced for each activity.

Description of Environmental Setting and Contaminants Known or Suspected at the Site (ERAGS Section 1.2.1): The description of the environmental setting of the site should be completed using information from both historic sources (reports, maps, photos) and the initial site visit. The description should include the site layout and topography, habitat descriptions, descriptions of disturbed/man-made areas, current, historic, and future land uses, observations of plants and animals present at the site, and a description of soil/sediment/water types. Documenting the site description will assist in merging the perspectives of all parties on this initial conceptual site model (CSM), and identify any differences in perspective needing resolution. These differences are typically what lead to disagreements on the Scientific Management Decision Points (SMDPs) and the inability to agree on site risk interpretation. As defined in the EPA Ecological Risk Assessment Guidance, an SMDP is a point during the risk assessment process when the risk assessor communicates the results of the assessment at that stage to the risk manager, and agreement is reached on whether information is sufficient to arrive at a decision and/or the need for additional data/information prior to moving forward in the risk assessment. These SMDPs occur at Steps 2, 3, 4, 5, 6, and 8 in the EPA guidance, although only the SMDPs at Steps 2 and 3 are relevant to this paper.

The list of chemical contaminants known or suspected at the site should be compiled from previous investigations and based upon historic operations at the site. If no prior sampling has been done, the list of suspected contaminants should be consistent with historical site operations. The use of full spectrum analyses to validate the list of suspected contaminants should be carefully evaluated and based upon any uncertainties that arise concerning the historical operations at the site. If the knowledge of site operations is not well documented and no historical data is available, full suite analyses should be conducted. It is the Navy's responsibility to provide sufficient historical documentation to justify the use of anything less than full suite analyses in the screening level risk assessment.

Description of Potential Environmental Fate and Transport Mechanisms (ERAGS Section 1.2.200): Potential chemical contaminant migration pathways should be identified for the site. These pathways could include air or wind-borne transport, erosion, surface water runoff, ground water, food-chain transport (bioaccumulation/ingestion of contaminated media), etc. Discussion of chemical fate in the environment should consider the propensity for physical and biological degradation of contaminants, including the formation of daughter products, and the likelihood that some chemical constituents will be readily metabolized or sequestered by organisms.

Ecotoxicity Evaluation of Potential Contaminants at the Site (ERAGS Section 1.2.3): Understanding the toxicity mechanisms of potential chemical contaminants is helpful in

understanding potential exposure pathways and focusing the selection of appropriate screening-level assessment and measurement endpoints. It is important to understand whether a constituent's mode of action makes it particularly toxic to certain groups of organisms (e.g. mammals vs. fish, or vertebrates vs. invertebrates), and what the potential toxic effects are (e.g. death, growth reduction, reproductive/developmental effects).

Identification of Potentially Complete Exposure Pathways (ERAGS Section 1.2.4): The exposure pathway is the route by which the chemical contaminant is taken-up by the receptor. In order for an exposure pathway to be classified as complete, there must be a source of chemical contaminants, a transport pathway from the chemical contaminants to the receptor, and a route of entry into the receptor. Examples of potential exposure routes are direct ingestion of media, root uptake by plants, direct contact/dermal absorption from water, soil, or sediment, and food-chain uptake. A key component of identifying potential risk is that there must be chemical contaminants present, **and** there must be complete exposure pathways. If there are **no** complete exposure pathways, there is no risk, even if chemical contaminants are present at the site. The exposure pathway evaluation should include consideration of potential future exposure pathways, as well as current exposure pathways. For instance, if no current pathway exists because a contaminant is located in subsurface soil or sediment beyond the reach of ecological receptors, the likelihood that those subsurface soils/sediments could become exposed due to erosion or displacement of surface soils/sediments should be considered.

Selection of Screening-level Assessment Endpoints and Measurement Endpoints (ERAGS Section 1.2.5): Screening-level assessment endpoints are **any** adverse effects on ecological receptors, including effects on threatened and endangered species, populations, communities, habitats, and sensitive environments. Screening-level measurement endpoints must be consistent with the identified toxicity mechanisms and exposure pathways. For instance, calculating risk to higher trophic level receptors is unnecessary if food-chain exposure is not an identified exposure pathway.

Step 1 Screening-level Ecological Effects Evaluation

The second part of Step 1 is the screening-level ecological effects evaluation, including the selection of screening ecotoxicity values (hereafter called screening values). Screening values should be chosen for each contaminant that has a complete exposure pathway to a receptor. Different regions may have differing preferred screening values based on the preferences of involved regulatory agencies. Agreement should be reached with the appropriate regulatory agencies on the preferred screening values for any given region.

The Navy Environmental Restoration and BRAC Risk Assessment webpage provides links to a variety of sources for screening values and toxicity information. If no screening values are available from listed sources, the Navy can propose screening values to the regulatory agencies as long as the values are based upon No Observed Adverse Effects levels (NOAELs) for long-term, chronic exposures, and supporting citations and references are provided to the appropriate regulatory agencies. Navy-proposed screening values should not be presented on a case-by-case or site-specific basis, but should have

utility across sites within that EPA Region. If a screening value is based upon a lowest observed adverse effect level (LOAEL), then a NOAEL-based value can be approximated by multiplying the LOAEL-based value by an adjustment factor of 0.1. Use of this adjustment factor is justified in ERAGS Section 1.3.1. Ideally, Navy proposed values should be submitted for regulatory agency approval before the start of the screening process. However, this is not always possible as unexpected chemical contaminants are sometimes found during Step 1 of the ecological screening process.

The EPA has developed some soil screening levels for use in ecological screening assessments (http://www.epa.gov/ecotox/ecossl/). At present, the number of constituents for which the EPA has developed soil-screening levels is limited. However, as more EPA soil-screening levels are published, they will become the screening-levels of choice. Moreover, the process for deriving soil screening levels laid out by EPA (2005), as well as the modeling assumptions used in the process, is recommended for deriving screening levels for constituents that currently do not have developed screening levels.

Soil screening values have been developed by and are available from a number of other sources (LANL 2000, WSRC 1998), and countries (Environment Australia 1997, CCME 1997, European Community 1996). If EPA soil screening levels are not available, these other sources can be evaluated to determine if defensible soil screening levels can be proposed. Care should be taken when evaluating other sources of benchmarks to ensure that the values were derived for the protection of ecological resources. It is important to note that contaminants present at the site that do not have published ecological screening values and for which no defensible screening values can be proposed are automatically carried forward to the COPC refinement step of the baseline ecological risk assessment (BERA).

None of the sources listed above for sediments and soils contain ecological screening levels for radionuclides. The U.S. Department of Energy has published *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2000) and has developed the RESRAD-BIOTA tool to implement it. RESRAD-BIOTA (http://web.ead.anl.gov/resrad/home2/) provides analysis capabilities, from practical, cost-effective screening to realistic dose estimates for plants and animals that can be used to assess risk from radionuclides present at a site.

Step 1 Uncertainty Discussion

The final part of Step 1 is a consideration and discussion of the uncertainties associated with the screening-level problem formulation. These uncertainties may include, but are not limited to, uncertainties associated with knowledge of operational history of the site and the potential contaminants present; uncertainties associated with exposure pathways and selection of endpoints; uncertainties associated with eco-toxicological modes of action of chemicals present at the site; uncertainties associated with the adequacy of the type and number of samples available to represent the site; and uncertainties associated with information taken from the literature and extrapolations used in choosing screening values. Of particular note in discussing uncertainties associated with ecotoxicological

effects are possible synergistic or antagonistic effects of multiple chemical constituents in combination. The uncertainty discussion should include all uncertainties associated with the ERA and not just the ones that lead to a conclusion of "fatal flaws" in the screening process. The Step 1 uncertainty discussion should also consider how site conditions might have changed since the data were collected. For instance, site conditions may have changed due to new site operations, weather events, remediation activities, building and road construction, changes in analytical methods, additional chemical releases, etc.

Step 2: Screening-level Exposure Estimate and Risk Calculation

Step 2 Screening-level Exposure Estimate

In the screening-level exposure estimates and risk calculations, only completed exposure pathways should be evaluated, but incomplete pathways must be documented, as they should be taken into account in the overall risk management decisions for the site. As Steps 1 and 2 are a screening-level risk assessment, it is incumbent that only the most conservative assumptions be used in the estimation of exposure levels. If the selected screening benchmarks account for bioaccumulation to higher trophic levels (e.g. the Oak Ridge National Laboratory screening-benchmarks for wildlife), the most conservative exposure assumptions are already built into the benchmarks, and the screening-level assessment can proceed to the risk calculation. However, many commonly used sediment screening values (e.g. ER-Ls) and surface water screening values (e.g. AWQC) do not account for bioaccumulation, so if food-chain exposure is a complete pathway at the site, decisions must be made on how bioaccumulative constituents will be addressed in the screen. One alternative is to carry all detected bioaccumulative constituents forward as COPCs to the baseline ecological risk assessment (BERA), regardless of the level at which they were detected. This is a course of action that may be considered if other evidence (e.g. too few samples to adequately represent the site, inadequate analytical detection limits, and incomplete analysis of site chemical constituents, etc.) indicates that a BERA will be necessary. However, if it is questionable whether a BERA would otherwise be necessary, bioaccumulative compounds can be addressed through the construction of screening-level food chain models. These models attempt to estimate food-chain doses to representative upper trophic level receptors using literature-derived bioaccumulation factors and highest reported receptor ingestion rates, lowest reported receptor body weights, and area use factors equal to 1. The exposure parameters needed to develop screening-level food chain models are discussed in detail in ERAGS Section 2.2.1. The maximum estimated doses to food chain receptors are then compared to appropriate NOAELs. Bioaccumulative compounds of interest may vary by region, and risk assessors should be sure they know the bioaccumulative compounds of interest to the appropriate local and regional regulatory agencies. Appropriate food-chain level receptors should be identified in Step 1 during the identification of screening-level assessment and measurement endpoints, and should be consistent with the toxicity evaluation of chemical constituents and identified exposure pathways. Any region specific issues or processes that may be in conflict with this process should be resolved with the appropriate agencies prior to conduct of Step 2.

Step 2 Screening-level Risk Calculation

In the screening-level risk calculation, the maximum observed concentration in media is divided by the media-specific screening-value, or the maximum estimated food-chain dose is divided by the appropriate NOAEL to calculate a Hazard Quotient (HQ). If the contaminant was not detected, or if laboratory reported detection limits in some samples are higher than detected concentrations, then the HQ is calculated by dividing the detection limit by the screening value or NOAEL. If the HQ ≥ 1 for a given contaminant, that contaminant is designated a COPC and is carried forward to the COPC refinement step (Step 3a). If the HQ < 1 for a given contaminant for each receptor evaluated, that contaminant is dropped from further evaluation in that media. To be screened out completely, a contaminant must have HQ values less than 1 for all receptors in all media in which it is expected.

Step 2 Uncertainty Discussion

The uncertainty discussion for Step 2 should include a discussion of the uncertainty associated with literature derived exposure parameters used in the exposure estimates. Examples include uncertainties associated with receptor body weights, ingestion rates, and diet compositions. Uncertainties associated with any extrapolations used to arrive at exposure parameters should also be discussed. Bioaccumulation Factors derived from the literature and their effects on the results of screening-level food chain modeling should also be discussed. It is important to note that uncertainties can have both positive and negative effects on the screening results, i.e. the uncertainties may cause actual risk to be lower or higher than estimated. Again, it is crucial to present a balanced presentation of uncertainties describing how the conservative nature of the screening values and other factors address the uncertainties observed.

Step 2 Scientific Management Decision Point (SMDP)

At the end of Step 2, the risk manager (the Navy RPM) and the risk assessor must decide if the results of the initial site screen indicate that the site warrants further investigation. As stated in ERAGS Section 2.4, there are three possible decisions at this point in the risk assessment process:

1. Screening results suggest that ecological risk is negligible and there is no need for further investigation or remediation.
2. Screening results indicate a potential for ecological risk, and a more thorough assessment is warranted.
3. Screening results are inadequate to make a decision at this point.

Figure 2 presents the decision flow process for the Step 2 SMDP. If the Step 2 screening results are inadequate to make a decision, a work plan should be developed to collect additional data so the process can move to Step 3a. Ideally, the situation where data are not adequate for decision-making purposes would be identified in Step 1 and additional

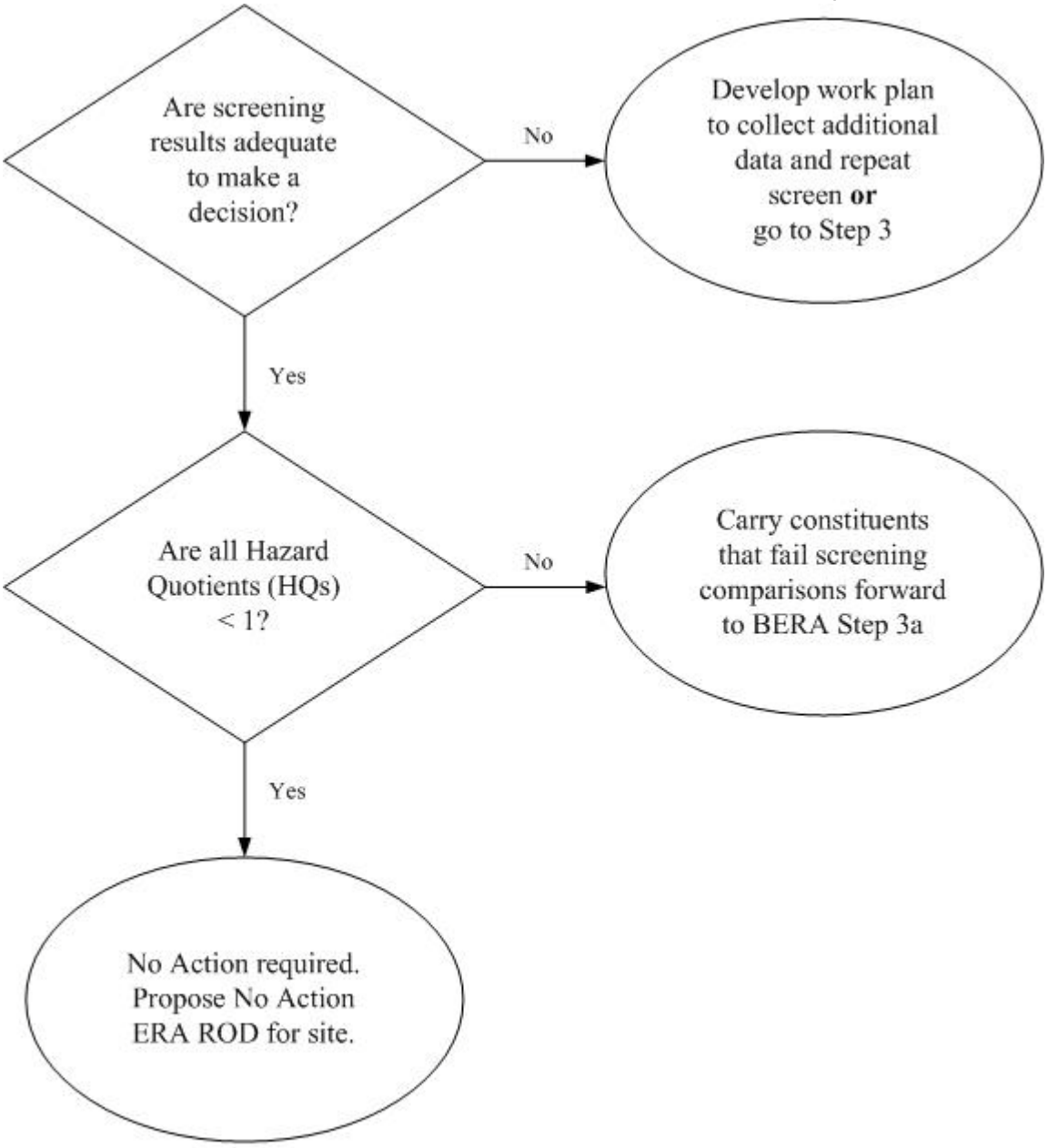

Figure 2. Step 2 SMDP Decision Process

data would be gathered prior to conducting the Step 2 screen, but sometimes data gaps are revealed by the screening process that are not feasible to address prior to Step 2. The additional data needs should be identified and concurrence should be reached with appropriate regulatory agencies prior to collection of the data on how these data will be used in Step 3a. The risk of arriving at a conclusion that the results of the screening assessment are inadequate to make a decision will be decreased if an assessment of data adequacy is made in conjunction with the regulatory agencies before beginning the screening assessment. If the results of Steps 1 and 2 indicate that risk is negligible, a No

Action management decision should be considered for the site. This SMDP finding needs to be made formally among the decision-making parties before continuing to a "No Action" record of decision or to Step 3a. If agreement cannot be attained, stop the screening process and determine what the areas of disagreement are (differences are likely to be in individual's initial CSM assumptions or initial problem formulation assumptions). The decision to proceed without agreement must be taken seriously and will be a case-by-case determination on the part of the risk manager. If the results of Steps 1 and 2 indicate that potential risk exists, then all constituents with HQs ≥ 1 should be carried forward as contaminants of potential concern (COPCs) to the COPC refinement step (Step 3a) of the BERA. At this step in the ERA process, a presumptive remedy or voluntary removal action may also be considered if the cost of such an action is estimated at less than the cost of conducting a baseline risk assessment. However, a BERA should be the logical course of action, if the presumptive remedy or other voluntary removal action could have negative impact on sensitive habitats or species.

Step 3a: Refinement of the List of Contaminants of Potential Concern (COPC)

COPC Refinement Process

In ERAGS, the first part of the BERA problem formulation is the "refinement" of the preliminary COPC list using more realistic, yet still conservative assumptions. This refinement, covered in Section 3.2 of ERAGs, is informally known as Step 3a. The Navy Ecological Risk Assessment Policy dated 5 April 1999 officially recognizes Step 3a as the COPC refinement step. ERAGS does not provide detail on specific methodologies and direction that can be used to focus the list of COPCs, but does provide a general discussion of the process. ERAGS states simply that Step 3a "should consider how the HQs would change if more realistic conservative assumptions were used instead", and that for those constituents for which the HQs are < 1 using the new assumptions, "the lead risk assessor and risk manager should discuss and agree on which can be eliminated from further consideration." Figure 3 illustrates a COPC refinement and focusing process for Navy sites that is consistent with Navy policy and guidance, as well as ERAGS. The individual aspects of this refinement process are discussed in the following paragraphs. An important assumption in all of the Step 3a activities is that **the available data adequately represents the site**. Examples of unrepresentative data include inadequate spatial coverage of samples to represent site historical operations, analytical detection limit inadequacies, and no analyses for constituents likely to be associated with historical site operations. Again, if a preliminary data assessment meeting is held with the regulators prior to starting the screening process, the chances of arriving at the conclusion data are not representative at this point in the process will be minimized. If data do not adequately represent site conditions, the COPC refinement activities in Step 3a are not appropriate and the risk assessment should proceed to the baseline problem formulation so that a work plan can be developed to collect the necessary data to support decision making. Step 3a is **not** intended as an opportunity to keep collecting data until a preconceived outcome is accomplished.

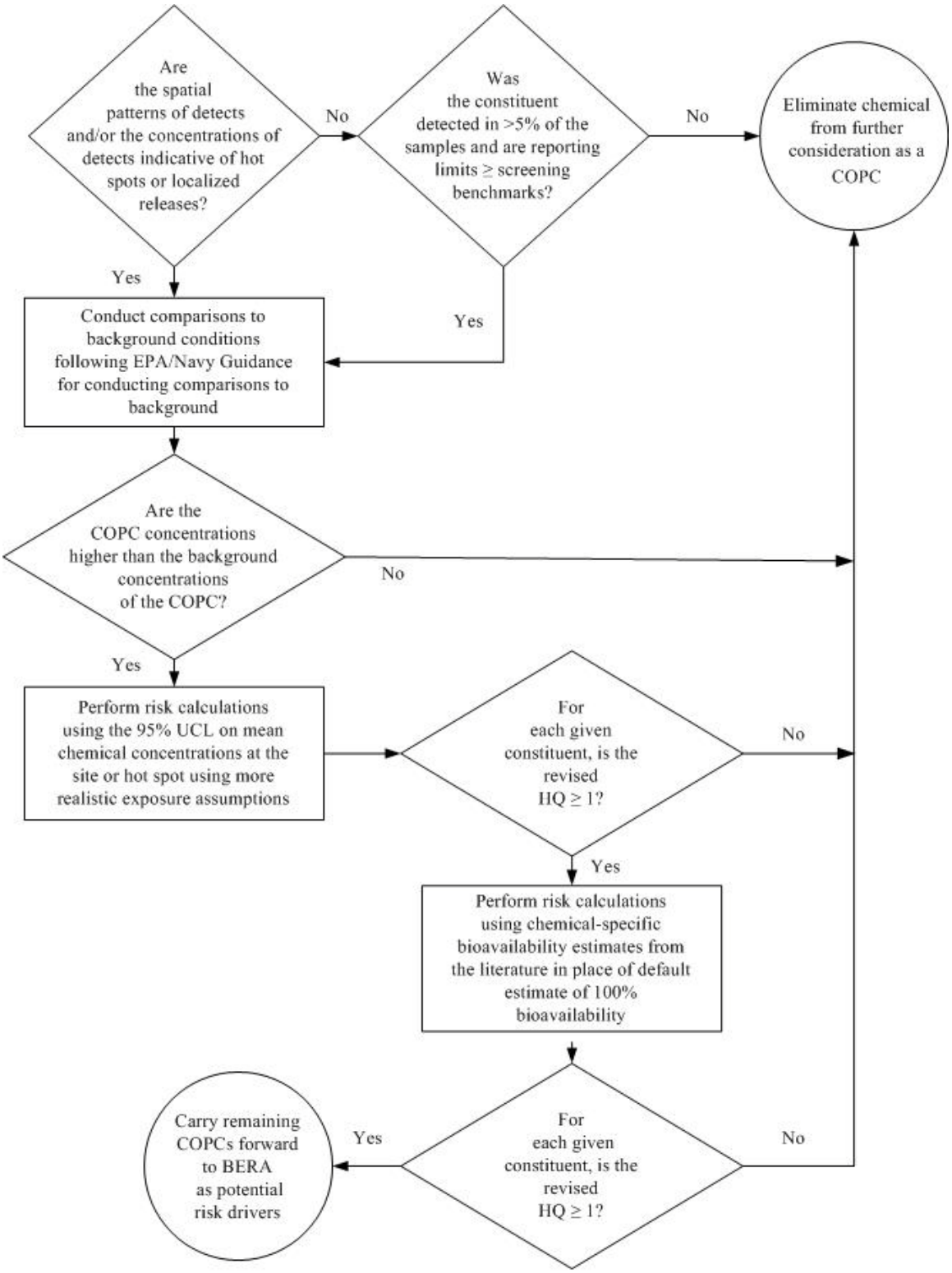

Figure 3. COPC Refinement and Focusing Decision Flow Diagram

Use of Spatial Distribution to Further Focus the Site COPCs. The first COPC refinement method involves examining the spatial distribution and frequency of detects for each individual COPC carried forward from Step 2. Human health risk assessments use a rule that if the constituent is detected in less than 5% of the samples, it can be eliminated from further consideration. The support for this approach is provided in Section 5.9.3 of Part A of the Risk Assessment Guidance for Superfund (RAGS) (EPA 1989). However, it is not adequate to look solely at the frequency of detects as a means of eliminating constituents from further evaluation. The spatial distribution of detects and the concentration of detects must also be taken into consideration. In order to remove COPCs based upon low frequency of detect from an ecological risk assessment, all of the following conditions must be met:

1. The COPC must have been detected in less than 5% of the samples. If fewer than 20 samples have been taken, this refinement activity cannot be used.
2. The total number of detects **plus** the total number of laboratory reported detection limits exceeding the screening value must be less than 5% of the total samples. For example, if the COPC was detected in 3% of the samples, but reporting limits exceeded the screening value in an additional 4% of the samples, the COPC should be retained, because potentially 7% of the samples could exceed screening values.
3. The detected constituent concentrations and spatial distribution must not be indicative of a potential "hotspot" or localized release, e.g. data/findings are confirmed by other adjacent data/findings.

If the above conditions are met, the risk assessor should document the rationale for removing the COPCs from further consideration based upon low frequency of detects. If any of the above conditions are not met, the COPC should be retained for further evaluation. The number of samples necessary to adequately characterize any site will always be site specific, and in applying this focusing criterion, it is the responsibility of the risk assessor and the risk manager to demonstrate that the available data are adequate for this purpose.

Comparison to Site or Regional Background Conditions. Also considered in Step 3a COPC refinement is the comparison to site or regional background conditions. Regional background refers to a situation such as an up-gradient reference area that may be off-site of Navy property but has similar physical characteristics to the Navy site, and that reflects anthropogenic and non-anthropogenic background contributions to the site. This step is only possible if an adequate background data set can be identified for the site. The background data set should represent similar physical conditions as found at the site (e.g. similar grain size, TOC, pH, etc.). Agreement between the risk manager and the regulators should be obtained about the suitability of a background data set prior to any comparisons being conducted. There is some debate over the appropriate time to consider background conditions during the risk assessment process, but Navy policy for using background data states that the comparison to background should occur during Step 3a of the ecological risk assessment (Navy 2004). The Navy has also published guidance for conducting comparisons and determining the adequacy of the historical data for such comparisons to background during environmental investigations (Navy 1999b). The

Navy guidance advocates comparing the entire distribution of site data to the entire distribution of background data in lieu of defining ambient as a single point, and details appropriate statistical methods for conducting such comparisons. The adequacy of the background data set for conducting comparisons is determined by the assumptions of the statistical methodology used for the comparisons. The statistical tests recommended in the Navy Background Guidance all require that certain assumptions be met for the comparisons to be valid (for example, assumptions regarding data distributions, frequency of detects, data independence, and sample size). The data should be reviewed by a statistician to ensure that the required test assumptions are met to perform each statistical test. If the concentrations of a COPC at the site are not statistically different from the concentrations observed in background, the COPC can be eliminated from further evaluation in a baseline risk assessment, and should be discussed during risk characterization. If a background data set is available but is not adequate to conduct the statistical distribution tests set forth in the guidance, it is still important to consider the range of background concentrations in relation to the range of site concentrations and the ecological screening benchmarks. This qualitative information is important in overall risk management decisions, and is best considered in the Step 3a uncertainty discussion.

Use of 95% Upper Confidence Limit (UCL) of Mean Concentrations of COPCs. In this refinement activity, the risk calculations from Step 2 are revised using the 95% UCL of mean concentrations in media to compare to media-specific screening values and to calculate food chain doses to upper-trophic level receptors. Again, this activity is only appropriate if the available data are representative of the site. When calculating the 95% UCL, the distribution of the data must be taken into consideration. For instance, if the data fits a lognormal distribution instead of a normal distribution, then a different calculation of the 95% UCL may be appropriate. Also, the calculation of the 95% UCL should take into consideration if "hot spots" are present, since the potential effect of these "hot spots" could be diluted by calculating using a 95% UCL comparison. Hot spots should be evaluated to determine if the magnitude of the concentrations present warrant further action even if the spatial extent of the exceedances is small, but this must also be balanced against the ecological relevance of small “hot spots”. If the HQs from the revised calculations are less than 1, the risk assessor and risk manager should agree on which constituents can be removed, and document the rationale for removing these COPCs.

Use of More Realistic Exposure Parameters. This refinement applies particularly to screening-level food chain models commonly used to evaluate risks to upper-trophic level receptors. Screening-level food chain models in Step 2 generally use conservative estimates of organism body weight and ingestion rates, and also assume that the organism spends all of its time at the site (Site Use Factor = 1). In Step 3a, more realistic estimates of body weights and ingestion rates (i.e. mean or median values) can be substituted for the conservative parameters used in Step 2, and more realistic site use factors can be considered. When choosing more realistic exposure parameters for the models, it is important to consider the toxicological endpoints in relation to biology of the assessment endpoints. For example, if the toxicological endpoint is an adverse effect on reproduction such as low birth weight or spontaneous abortion, body weights and ingestion rates of

female organisms are more relevant than those of male organisms. Since many organisms are sexually dimorphic in size, use of an average across sexes is not appropriate if the effect manifests or is more pronounced in one sex than the other. This also holds true for site use factors, as some organisms have more restricted home ranges for one sex than the other, especially during breeding seasons.

Use of Literature Derived Estimates of Bioavailability. The screening calculations in Step 2 assumed that the concentrations of constituents in the media of concern are 100% bioavailable to ecological receptors. This is generally not the case for chemical constituents in soil and sediment, with some portion of the chemicals being bound to the sediment/soil matrix and unavailable for uptake or not totally absorbed by the risk target. Adjustments can be made in Step 3a to account for that portion of COPCs that are unavailable under typical site conditions. The Navy has published guidance for incorporating bioavailability adjustments into human health and ecological risk assessments (Navy 2000), and has published an issue paper discussing issues associated with metals bioavailability and the use of bioavailability adjustments in ecological risk assessment (available via the Navy Environmental Restoration and BRAC website Risk Assessment page). To date the Navy guidance only addresses bioavailability of metals, although bioavailability adjustments for various organic COPCs may be available from other literature sources. To account for bioavailability, the risk calculations from Step 2 are revised using only the presumed bioavailable fraction of the chemical concentration to arrive at a HQ. Agreement with the regulatory agencies on presumed bioavailable fraction of the constituent concentration and the methodology used to determine that fraction should be obtained prior to performing the revised HQ calculations. If the HQs from the revised calculations are less than 1, the risk assessor and risk manager should agree on which constituents can be removed, and document the reason for removing them.

Step 3a COPC Uncertainty Discussion

The uncertainty discussion of Step 3a should discuss uncertainties associated with all of the refinement tools used during this step. These may include uncertainties associated with data variability and representativeness, uncertainties associated with literature derived estimates of bioavailability, and uncertainties associated with the background data set and the comparisons of site data to background data. The potential impacts of these uncertainties on the COPC refinement process should also be discussed. Again, it is crucial to present a balanced presentation of uncertainties describing how the use of realistic but conservative exposure assumptions, and other factors, address the uncertainties observed.

Step 3a Scientific Management Decision Point (SMDP)

At the end of Step 3a, COPCs eliminated during the refinement process and the reasons for removing them should be documented and agreement should be reached with the site decision makers on the final list of COPCs to be carried forward to the rest of the BERA. If no COPCs remain after Step 3a, further evaluation under the auspices of a BERA are unnecessary, and a No Action ERA ROD should be proposed for the site. This SMDP finding needs to be made formal among the decision-making parties before continuing to

a "No Action" record of decision or BERA. Agreement on specific criteria of the SMDP must be negotiated and met prior to proceeding.

Point of Contact

For further information regarding this paper, contact your NAVFAC Risk Assessment Workgroup Member.

Acronyms

AWQC	Ambient Water Quality Criteria
BERA	Baseline Ecological Risk Assessment
COPC	Contaminants of Potential Concern
CSM	Conceptual Site Model
DOE	Department of Energy
EPA	Environmental Protection Agency
ERA	Ecological Risk Assessment
ER-L	Effects Range - Low
ERAGS	Ecological Risk Assessment Guidance for Superfund
HQ	Hazard Quotient
LANL	Los Alamos National Laboratory
LOAEL	Lowest Observed Adverse Effect Level
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
RAGS	Risk Assessment Guidance for Superfund
SMDP	Scientific Management Decision Point
TOC	Total Organic Carbon
UCL	Upper Confidence Limit

Glossary

Contaminants of Potential Concern (COPC) – potentially site-related chemical contaminant(s) occurring or suspected in water, soil, or sediment due to current or historical site operations.

Conceptual Site Model (CSM) – a series of working hypotheses about origin, distribution, and transport of site-related chemicals through the environment; routes and scenarios of exposure of ecological receptors to site chemicals; and how site chemicals may effect specific ecological components.

Hazard Quotient (HQ) – the ratio of an exposure level of a chemical to a selected screening benchmark. In the screening-level risk assessment, the HQ is generally the maximum observed concentration in a particular media divided by the screening benchmark for that media.

Lowest Observed Adverse Effect Level (LOAEL) – the lowest level of a stressor evaluated that has a statistically significant adverse effect on the exposed organisms compared to control or reference organisms.

No Observed Adverse Effect Level (NOAEL) – the highest level of a stressor evaluated that causes no statistically significant difference in effect compared to control or reference organisms.

Scientific Management Decision Point (SMDP) – A point during the risk assessment process when the risk assessor communicates the results of the assessment at that stage to the risk manager. At this point the risk manager determines whether the information is sufficient to arrive at a decision regarding risk management strategies and/or the need for additional information to move forward in the risk assessment process.

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