Lower Duwamish Waterway Group

Port of Seattle / City of Seattle / King County / The Boeing Company

TASK 5: IDENTIFICATION OF CANDIDATE SITES FOR EARLY ACTIONS – TECHNICAL MEMORANDUM:

DESCRIPTION OF CANDIDATE SITE SELECTION CRITERIA

Prepared for

The U.S. Environmental Protection Agency
Region 10
Seattle, WA

The Washington State Department of Ecology
Northwest Regional Office
Bellevue, WA

FINAL

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Table of Contents

1.0 Introduction

One of the goals of the Phase I Lower Duwamish Waterway Remedial Investigation (LDW RI) is to identify potential sites that may be candidates for early remedial actions. Given the availability of a large environmental data set for the LDW, particularly sediment data, there is general acknowledgement that sufficient information currently exists to identify some sites that may require remediation. The process of identifying candidate early action sites is being undertaken during Phase I in the anticipation that expediting the initiation of remediation at sites with significant risks will reduce those risks on an accelerated schedule. Any candidate sites proposed for early action will be selected in a process that is consistent with the National Contingency Plan (NCP), Washington's Model Toxic Control Act (MTCA), and EPA guidance for non-time critical removal actions. Early remedial action at these sites could be potentially implemented on accelerated schedules well before completion of the Feasibility Study and Record of Decision for the Superfund site.

Identification of candidate sites for early actions is a two-step process (Figure 1). In the first step, existing environmental data for the LDW are used to identify those sites within the study area that can be classified as high priority sites. Site prioritization will be based on the results of the scoping-phase risk assessments, which will be presented as part of the LDW RI report. The risk-based framework proposed for site prioritization is consistent with EPA's principles for managing risks from contaminated sediments (EPA 2002).

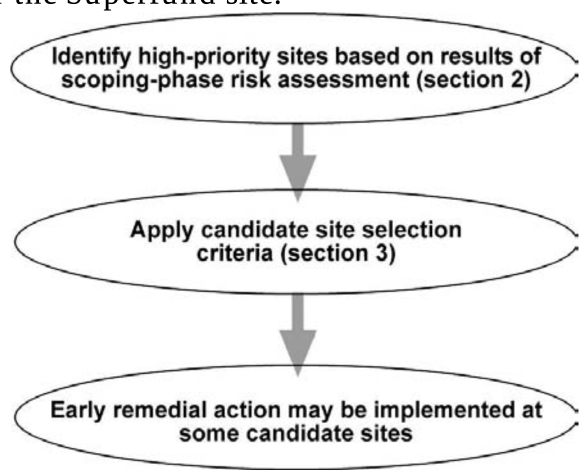


Figure 1.
Candidate site selection process overview

The site prioritization methods are described in Section 2 of this memorandum. These methods were previously described in a separate draft memorandum (Windward Environmental 2001), but they are incorporated into this document to more completely describe the identification process for candidate early action sites.

The second step in the identification process will be to determine which of the high priority sites will be suitable candidate sites for undertaking early remedial actions using management-based criteria. Selection criteria for the second step are described in Section 3. Following agency approval of the methods described in Sections 2 and 3, an additional technical memorandum will be prepared that will identify the candidate sites based on methods outlined in this memorandum. This memorandum, called the Technical Memorandum on Data Analysis and Identification of Candidate Sites

("Candidate Sites Memorandum"), is the second and final deliverable under Statement of Work (SOW) Task 5 (Identification of candidate sites for early remedial action), and will be submitted to EPA and Ecology following completion of the draft RI report.

EPA and Ecology will use the recommendations in the Candidate Sites Memorandum to determine which sites will undergo early cleanup actions. One or more LDWG member(s) may propose to enter into an agreement with EPA or Ecology to undertake one or more of the early remedial actions. For sites LDWG members do not volunteer to undertake, EPA and Ecology will identify appropriate parties to undertake these actions using EPA's potentially responsible party search.

The agencies will determine which non-LDWG candidate sites ultimately move forward based on their ability to find viable potentially responsible parties to undertake the action and to negotiate a regulatory agreement or order.

Decisions on whether candidate sites for early action will be remediated on an accelerated schedule will be made after the completion of the LDW Phase I RI. The LDW Phase II RI will include a baseline risk assessment that will evaluate risks for two exposure regimes: 1) baseline sediment conditions as they exist at the time the RI is completed, and 2) residual sediment conditions expected to exist after completion of early action projects sponsored by individual LDWG members or others. Implementing early remedial action at high priority sites is expected to substantially reduce risks associated with some of the more contaminated sites within the LDW by moving those sites into an accelerated remediation process.

2.0 Site Prioritization Methods

This section describes the proposed risk-based methods that will be used to accomplish the first step in the site identification process: identifying high priority sites within the LDW study area. High priority sites will be identified using a framework that relies on the:

- large amount of available sediment chemistry data for the LDW (data from over 1,200 surface sediment chemistry samples that provide coverage for all sections of the LDW study area)
- results of the scoping-phase human health and ecological risk assessments that are currently being conducted for the site.

The process outlined in this section will be used to identify high priority sites after the risk characterization portions of the scoping-phase risk assessments are completed; the results of the site prioritization process will be presented as part of the scoping-phase risk assessment report.

The SOW for the LDW RI states:

> In identifying high priority sites, the respondents will review sediment site prioritization methodologies that have been used in other similar applications, and will develop a prioritization scheme that adequately represents the range of conditions associated with the potential current risks to human health and the environment. It is anticipated that the selected prioritization methodology will rely on existing environmental data and the results of the scoping-phase risk assessments. Models for prioritizing sediment sites to be evaluated include, among others, those developed by Ecology, EB/DRP, King County, and the Bellingham Bay Pilot Project. The respondents will summarize these approaches and may recommend alternative approaches.

2.1 EXISTING SITE PRIORITIZATION METHODS

LDWG conducted a review of the site prioritization methods cited in the SOW. The documents reviewed included those that provide programmatic guidelines for ranking sites under the state of Washington's Sediment Management Standards (PTI 1990; Ecology 1991), applications for a bay-wide assessment (Bellingham Bay; Anchor Environmental 1999), and site-specific assessments (Elliott Bay/Duwamish Restoration Program; King County 1994). While the objectives and purposes for developing site prioritization methods were different in each of the documents reviewed, all the methods relied on sediment chemistry data as an initial factor in defining site priorities. From there, the methods began to diverge with some of them incorporating risk-based narrative goals, while others applied non-risk-based factors into their analyses (e.g., entity willing to undertake a cleanup project, source control).

King County's Sediment Management Plan (King County 1999) provides an extensive discussion of the site prioritization methods cited in the SOW. A summary of these methods is presented in Table 1, which lists seven categories of goals and criteria that describe the characteristics of the site prioritization methods. The categories include factors that pertain to human and ecological health, habitat, and the status of source control, as well as factors that address site management and technical feasibility issues. Of these, only one category, human and ecological health, is directly relevant to a risk-based process for identifying high priority sites. The other categories are specific to potential remedial actions at the site (i.e., feasibility, resource management) and the site's societal context (e.g., social and cultural factors, economic factors). Such factors, while important, are more relevant to the selection of candidate sites within the LDW for early remedial action than they are for the initial identification of high priority sites. Many of these non-risk-based factors are discussed in detail in Section 3.

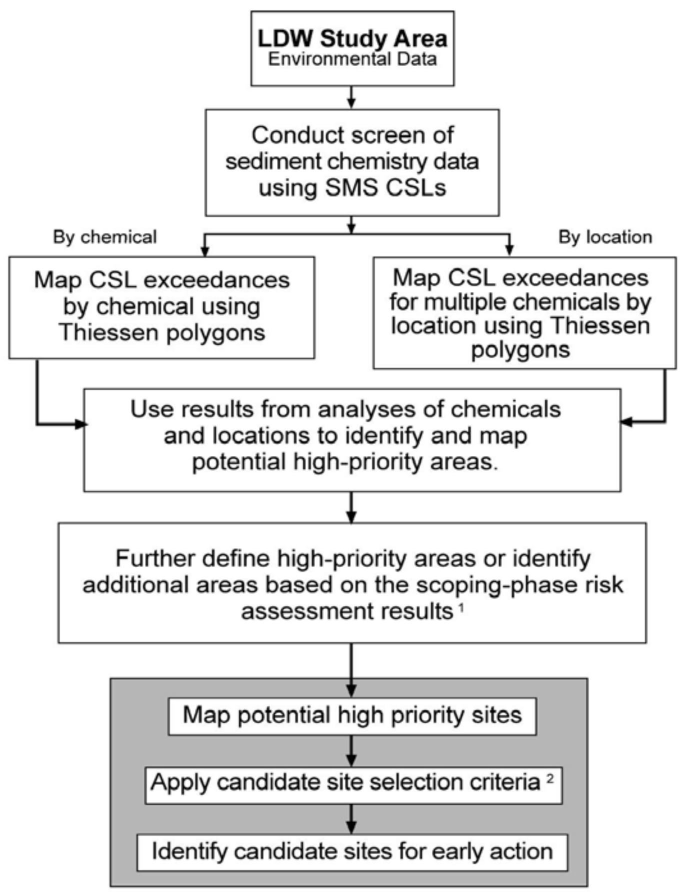
Table 1. Characteristics of existing site prioritization methods

	Bellingham Bay Goal Descriptors	SEDRANK Criteria	EB/DRP Criteria
Category 1: Human and ecological health			
	Enhance or maintain aquatic organism health, ecosystem diversity, productivity, stability, and biological function	Maximum concentration of individual chemicals	Presence of contaminated sediment (high toxicity)
	Protect human health and safety	Area of contaminated sediments	Potential for addressing injury to ecological receptors
	Protect water quality, including drinking water supplies		Potential for human health risk
	Cleanup contaminated sediment posing human or ecological health risk		
	Restore threatened and endangered fish and wildlife species		
Category 2: Source control			
	Control point and non-point sources	Historical versus ongoing sources	Control of combined sewer overflows, storm drains, industrial input and recontamination from adjacent sediment is adequate
Category 3: Habitat			
	Maintain or improve physical integrity of habitats, including shoreline erosion/accretion	Habitat complexity	Potential to incorporate extra habitat improvement
	Avoid/minimize loss of in-water habitats and compensatory mitigation		Proximity to other habitat projects or sediment remediation sites
Category 4: Social and cultural factors			
	Protect spiritual use and location	Proximity to special marine habitats and wildlife refuges	Potential for public education
	Protect/enhance ceremonial and subsistence resource use	Proximity to tribal and other commercial fisheries	
	Ensure compatibility with community goals and property uses	Proximity to recreational fisheries and public access	
	Enhance recreation, aesthetic values, public use and access		
Category 5: Efficiency and technical factors			
	Achieve technical feasibility and implementability	Water depth of contaminated sediments	Coordination with other projects
	Achieve timely completion and cost effectiveness	Net sedimentation rate	
	Integrate multiple land-use and environmental objectives and actions		
	Utilize efficient use of existing built-environment		

	Bellingham Bay Goal Descriptors	SEDRANK Criteria	EB/DRP Criteria
Category 6: Economic factors			
	Encourage water dependent commerce		
	Allow only water dependent discharges		
	Maintain/enhance navigation		
	Develop marine transportation facilities		
	Maintain/enhance commercial property use and redevelopment		
	Enhance economic vitality		
Category 7: Resource Management			
	Utilize renewable resources		
	Use dredged material beneficially		
	Conserve resources		

2.2 LDWG Site Prioritization Methods

Proposed site prioritization methods for the LDW are presented in Figure 2. The approach is based on the first category presented in Table 1, human and ecological health. As discussed previously, the other categories listed in Table 1 are examples of factors that could be included when identifying high priority sites that may become candidate sites for early remedial action (see Section 3).



[1] Additional details on this step are provided in Figure 3 and Section 2.2.2.
[2] Candidate site selection criteria are presented in Section 3.

Figure 2. Site prioritization method overview

The proposed approach for the LDW includes the following steps:

- Compare sediment chemistry data to Washington State Cleanup Screening Level (CSL) values to initially identify high priority areas (Section 2.2.1)
- Further define high priority areas or identify additional areas based on the scoping-phase risk assessment results (Section 2.2.2)
- Combine the CSL maps with the scoping-phase risk assessment results to identify high priority sites (Section 2.2.3)

Additional discussion on these steps is provided below.

2.2.1 Comparison of sediment chemistry data to SMS

The initial site prioritization step is to compare existing surface sediment chemistry data from the LDW to chemical criteria published in Ecology's Sediment Management Standards (SMS). Use of SMS chemical criteria to initially define areas of sediment contamination is consistent with the site-specific applications of site prioritization methods (e.g., Bellingham Bay and EB/DRP) that were described in Section 2.1. There are numeric chemical criteria for 47 individual chemicals or groups of chemicals in the SMS. If the chemical concentrations in a sediment sample are all below their respective sediment quality standard (SQS),[1] that sediment is assumed to cause no acute or chronic adverse effects to benthic invertebrates.[2] If, on the other hand, one or more chemicals are present in a sediment sample at concentrations above the cleanup screening level (CSL), that sediment sample may potentially be used to define a station cluster of potential concern for benthic invertebrates.[3] At chemical concentrations between the SQS and the CSL, sediment samples may contribute to station clusters of low concern.[4]

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[1] The SQS (WAC 173-204-320) and CSL (WAC 173-204-520) are part of the Washington State Sediment Management Standards (SMS) The SQS values represent concentrations below which adverse biological effects are considered to be unlikely. The CSL values represent concentrations above which adverse biological effects are considered to be significant. The SMS contains chemical and biological SQS and CSL standards; however, only the chemical standards are being used in the site-wide identification process because of the very limited biological data (10 surface sediment toxicity samples, 9 surface sediment samples characterized for benthic community) available for this site. The existing biological data may be used by potential early action sponsors outside the LDW RI for delineating the boundaries of a potential early action site.

[2] WAC 173-204-320(1)(a). This assumption, as stated in the SMS, is based on the expectation that potential adverse effects to benthic invertebrates are due primarily to the 47 chemicals with criteria. For the purposes of site prioritization, some of the chemicals without SMS criteria will be evaluated for receptors other than benthic invertebrates. The results of this evaluation will be included in site prioritization, as described in section 2.2.2.

[3] WAC 173-204-520(1)(a)

[4] ibid

Although exceedance of the SQS or CSL is only a predictor of effects (i.e., toxicity tests are necessary to confirm the prediction), comparison of sediment chemistry data to these criteria is one of the primary methods in the SMS for evaluating the potential need for sediment remediation. There is general acceptance that the likelihood of adverse effects to benthic invertebrates increases as either the CSL exceedance magnitude for a single chemical increases or the number of chemicals exceeding their respective CSL increases. Hence, it is reasonable to use comparisons with the CSL as an initial indicator of the potential need for sediment remediation.

One of the objectives for the LDW Phase I RI is to identify those portions of the LDW that clearly represent areas with higher chemical concentrations that may pose unacceptable risks to human health or the environment. The first step in site prioritization is to compare the available sediment chemistry data with the CSL. Consideration will be given both to the magnitude of the exceedance of the CSL for individual chemicals and the number of chemicals exceeding their respective CSL.

Maps of CSL exceedances will provide an overview of the general distribution of chemical-specific contamination with the LDW. The spatial distribution of the surface sediment chemistry data will be plotted both by chemical and by location using Thiessen polygons. Thiessen polygons associate each point in a plane with the closest neighbor for which a measurement is available. This algorithm assumes that the concentration at any point where measurements have not been made is the same as the concentration in the sample closest to that point. Additional GIS data analysis methods, such as Inverse Distance Weighting and Natural Neighbor, may also be used in future spatial analyses. LDWG will meet with EPA and Ecology to discuss the usefulness of these additional techniques for identifying high priority sites.

A series of GIS maps will be produced that depict those areas in which the sediment concentration for an individual chemical is above the respective CSL. These maps will include the exceedance ratio (i.e., concentration divided by CSL) as well. No specific boundaries will be drawn around the high priority sites in the candidate site identification document.

The SMS rule describes a process by which station clusters of potential concern are identified. A cluster of potential concern is defined as several stations that exhibit a similar pattern of chemical contamination. LDWG is adopting a similar convention using Thiessen polygons. A high priority site will be defined as three or more contiguous Thiessen polygons with concentrations in excess of the CSL. Areas with three or more Thiessen polygons with CSL exceedances in close proximity to one another will also be considered. Individual stations with a high risk potential that are otherwise surrounded by much lower risk stations will be further evaluated, potentially including confirmatory sampling and analyses, in the Phase II RI.

Individually, the maps may display patterns of contamination for each chemical, but they do not represent the potential impact that might be associated with having multiple chemicals exceeding their respective CSLs within an area. To address the issue of co-occurrence, GIS maps of multiple chemicals by location will be created using a variety of methods, potentially including: 1) the number of chemicals with CSL exceedances in a given sediment sample, 2) the sum of the CSL exceedance ratios for individual chemicals (i.e., the CSL exceedance ratio for an individual chemical is the concentration of that chemical in a given sediment sample divided by its CSL), and 3) the average[5] CSL exceedance ratio for a given sediment sample. These three methods for addressing multiple chemicals are given as examples. LDWG, EPA, and Ecology will meet prior to completion of the second Task 5 memorandum (candidate site identification) to discuss specific mapping techniques.

Each example mapping method provides a different evaluation of the potential impact that the presence of multiple chemicals may have on identifying high priority sites. The number of chemicals with CSL exceedances will provide useful information concerning the general levels of contamination at a sampling location. The sum of the CSL exceedance ratios and the average CSL exceedance ratio provide an indication of the potential risk posed by sediments that exceed the CSL (i.e., magnitude of CSL exceedance). The single-chemical and multiple-chemical maps will be distilled into a single map displaying initial high priority sites. More complicated analytical methods involving differential weighting of chemicals or locations may also be developed. If such methods are considered, LDWG will submit an addendum to this Technical Memorandum describing the proposed methods and the rationale for their application.

2.2.2 Use of scoping-phase risk assessment results for site prioritization

The comparisons described in Section 2.2.1 focus only on SMS, which are relevant to the health of benthic invertebrate species with limited home ranges. To incorporate potential human health risks or risks to other ecological receptors of concern (ROCs), specific exposure scenarios and pathways will be evaluated on a receptor-specific basis. The applicability of each human health risk exposure scenario or ecological receptor pathway to verifying high priority sites or identifying additional sites depends largely on the site specificity of the activity and the home range or migratory behavior of the organisms involved.

Table 2 classifies each potential human health risk exposure scenario and ecological receptor pathway based on their perceived ability to identify high priority sites. For site prioritization purposes, exposure scenarios and ecological receptor pathways are

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[5] The average and sum of exceedance ratios will be calculated for all chemicals whose concentrations exceeded their respective CSLs; chemicals without exceedances will not be included in the calculations.

classified as representing either direct or indirect exposure. Pathways with direct sediment exposure by the targeted receptor include dermal contact and incidental ingestion during human beach play. Pathways for which indirect exposure to sediment through diet represents the majority of the chemical-specific exposure will also be used for site prioritization, but there is an uncertain relationship between mobile prey items (the primary exposure source) and chemical contamination at a specific location.

Table 2. Use of each receptor of concern in site prioritization

Receptor	Exposure Route	Exposure Area of Individual Relative to Potential High Priority Sites	Use in Site Prioritization
Benthic invertebrates	Direct – diet and contact	smaller – individuals generally have a limited home range	Screening against CSL polygon by polygon
Juvenile chinook salmon	Indirect – diet	larger – individuals traverse entire study area	Evaluate locations where chemical of concern (COC) concentrations are highest
English sole	Indirect – diet; direct – incidental ingestion and contact	larger – particularly in winter, when individuals migrate outside LDW	Evaluate locations where COC concentrations are highest [a]
Bull trout	Indirect – diet	larger – individuals traverse entire study area	Evaluate locations where COC concentrations are highest
Great blue heron	Indirect – diet; direct – incidental ingestion and contact	larger – individuals forage mobile fish over a wide area	Evaluate locations where COC concentrations are highest [a]
Bald eagle	Indirect – diet	larger – individuals use LDW only occasionally and consume mobile prey	Evaluate locations where COC concentrations are highest
Spotted sandpiper	Indirect – diet; direct – incidental ingestion and contact	larger and smaller – individuals are migratory and forage sessile prey	Evaluate locations where COC concentrations are highest [a]
River otter	Indirect – diet; direct – incidental ingestion and contact	larger – individuals forage mobile prey over wide area	Evaluate locations where COC concentrations are highest [a]
Harbor seal	Indirect – diet; direct – incidental contact	larger – individuals use LDW only occasionally and consume mobile prey	Evaluate locations where COC concentrations are highest [a]
Emergent aquatic plants	Direct – root uptake	smaller – plants are rooted	Due to great uncertainty in effects data, this ROC will not be used in site prioritization
People eating fish	Indirect – diet	larger – some individual people may show high site fidelity, but target fish species may range much further	Evaluate locations where COC concentrations are highest
People netfishing	Direct – incidental ingestion and contact	smaller or larger – individual fishing behavior is quite variable	Thiessen polygons with concentrations in excess of risk threshold will be identified
People playing on beach	Direct – incidental ingestion and contact	smaller or larger – suitable beach play areas may be smaller than priority sites, but individuals may frequent multiple areas	Used in intertidal only; Thiessen polygons with concentrations in excess of risk threshold will be identified

[a] Receptors with both direct and indirect exposure to sediments will be treated the same, with respect to the identification of high priority sites, as receptors with only indirect exposure based on the assumption that the indirect pathway (i.e., diet) contributes more to overall exposure than does the direct pathway

Figure 3 provides additional details on the quantitative process that will be used to evaluate the direct and indirect pathways described in Table 2.

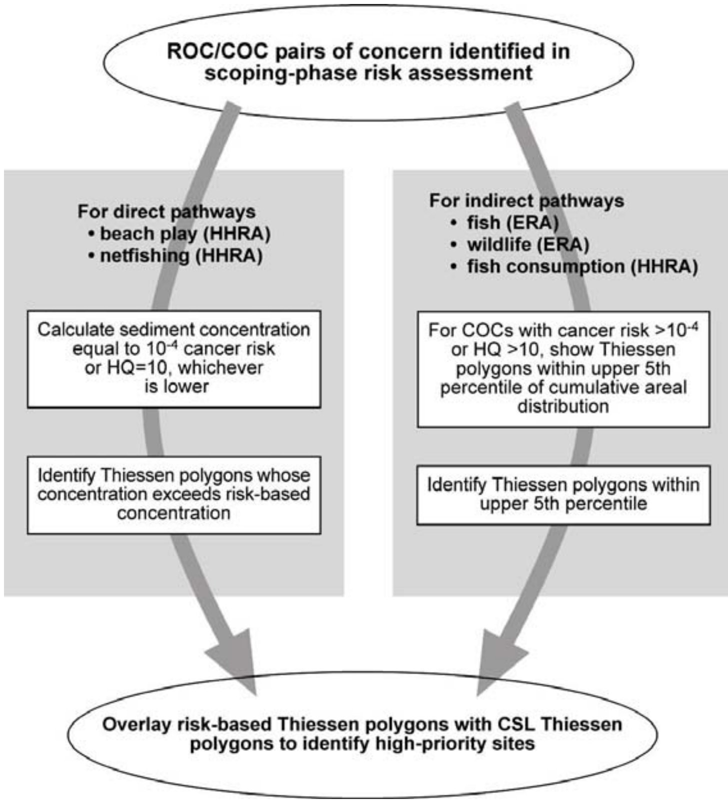

Figure 3.
Use of scoping-phase risk assessment results for site prioritization

2.2.2.1 Direct sediment exposure pathways

Site prioritization for direct sediment exposure pathways will be based on sediment chemistry data. Unlike the methods used to characterize potential effects to the benthic community, however, exposure for other receptors is typically over relatively large areas. As identified in Table 2, there are two direct sediment exposure pathways, other than the benthic community pathway, that will be used to identify high priority sites: exposure of humans to sediment through netfishing and beach play.

For the purposes of identifying high priority sites for direct sediment exposure pathways, risk-based sediment concentrations will be calculated with the equations used to calculate human health risk for the netfishing and beach play scenarios. Combined exposure via the oral and dermal routes will be used for each scenario. For COCs identified in the scoping-phase risk assessment, risk-based sediment concentrations will be calculated for a cancer risk of 10^{-4} and/or a hazard quotient of 10 for non-carcinogenic effects. If cancer and non-cancer endpoints are both applicable for that COC, the lower of the two risk-based sediment concentrations will be used for mapping (Figure 3). The maps will indicate which Thiessen polygons have sediment concentrations exceeding risk-based concentrations. Only intertidal polygons will be evaluated for the beach play scenario. Both intertidal and subtidal polygons will be evaluated for the tribal net fisher scenario. Qualitative evaluation of combined cancer risks and hazard quotients for multiple substances in different regions of the river will be done to assist in ranking the priority of certain sites for early remedial action. The selected risk thresholds reflect the objectives of the site prioritization process, and are only meant to identify areas of concern for early cleanup actions, and not to identify the boundaries of these areas. The risk thresholds are unrelated to any risk-based decisions that may occur in the Phase II RI.

The revised risk-based sediment concentrations for each COC will be compared to concentrations associated with each Thiessen polygon. This comparison is quantitatively identical to the procedures used to construct the CSL maps, although the benchmark concentrations (CSL vs. risk-based sediment concentrations) are different. This information will be used to identify high priority sites using the methods described in Section 2.2.3.

2.2.2.2 Indirect sediment exposure pathways

Site prioritization for indirect exposure pathways will also be based on sediment chemistry data. Indirect exposures cannot be linked directly back to sediment concentrations because the exposures and risks are calculated from chemical concentrations in tissue, not from sediment concentrations. Calculation of a sediment concentration associated with a particular risk threshold is not possible for these pathways without modeling the transfer of chemicals between sediment and tissue. Modeling of this type is not being performed in the scoping-phase risk assessments, but will be performed in the baseline risk assessment during the Phase II RI. In addition, most of the indirect exposure pathways are not related to specific areas of the site, but instead are related to chemicals in sediment throughout the entire site.

Because the scoping phase risk assessments do not include modeling to directly link risks from indirect exposure pathways to sediment chemicals, the proposed site prioritization method for indirect pathways makes the general assumption that areas of higher sediment concentrations are associated with higher risks. Remediating areas with the highest concentrations will reduce potential risks. The proposed method will identify an upper percentile of the overall area with the greatest potential risk. Use of an upper percentile area rather than an upper percentile of concentration accounts for the variable sampling density throughout the LDW.[6] An upper percentile equivalent to 5% of the overall area is proposed as a cutoff for identification of high priority sites.

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[6] Percentile ranking of chemical concentrations without consideration of the area represented by each polygon would yield much higher concentrations compared to the proposed method that incorporates polygon area. For example, there are approximately 1,000 Thiessen polygons for total PCBs. The upper 5th percentile concentration calculated without consideration of polygon area is approximately four times higher than the concentration associated with the upper 5th percentile of the cumulative areal distribution.

COCs must exceed the indirect pathways risk thresholds shown in Figure 3 in order to be included in the area analysis. COCs for which the upper percentile area method is applicable will be identified by:

1. Computing the cancer risk and hazard quotient (HQ)[7] for indirect exposure pathways (e.g., fish consumption) using the existing concentration data (either the 95% UCL or the maximum concentration) and the exposure equations and parameter values contained within the scoping-phase risk assessment.
2. Comparing the HQ or cancer risk for a given chemical (or HQ and cancer risk if both are applicable) with threshold values of 10 and 10^{-4}, respectively.
3. Any COC with values exceeding either the HQ or cancer risk thresholds will undergo spatial analysis, as described below.

The proposed method for calculating the upper 5th percentile area associated with each COC is as follows:

1. For each COC identified in the scoping-phase risk assessment, Thiessen polygons will be constructed around each sampling location. The area of each polygon will be calculated in the GIS.
2. Polygons will be ranked from high to low, based on COC concentrations.
3. Starting with the polygons with the highest concentration and proceeding to locations with successively lower concentrations, a cumulative sum of polygon areas will be calculated, until that sum reaches the specified percentile of the total area for all polygons.

Several sets of polygons will be produced using this method. This information will be used to identify high priority sites using the methods described in Section 2.2.3.

2.2.3 Combining CSL maps with other scoping-phase risk assessment results

The maps generated using the procedures described in Sections 2.2.1 and 2.2.2 will all have the same format (i.e., Thiessen polygons) although the definition of polygon categories differs among the three approaches (benthic CSL, other direct sediment pathways, and indirect sediment pathways). Consequently, all the information from the three different approaches can be mapped simultaneously.[8] Although a single map

[7] A single HQ is calculated for each chemical in the scoping-phase human health risk assessment. Two HQs, one based on a no-effect level and one based on a lowest-effect level, are calculated for each COC in the scoping-phase ecological risk assessment. For indirect pathways leading to ecological receptors, the low-effect level HQ will be used to identify COCs to be considered in identifying high priority sites.

[8] Thiessen polygons generated for different chemicals may have different shapes because not all sediment samples were analyzed for all chemicals. Hence, comparison of polygon distributions across chemicals may have to be done qualitatively in some cases.

may be created that shows priority sites identified for any ROC/COC pair, it is likely that multiple maps will be necessary to fully describe the differences between the benthic CSL maps and the maps described in Section 2.2.2. Each map will assign labels to high priority sites. High priority sites will be identified by three or more contiguous polygons identified by any of the methods described above: 1) CSL exceedance, 2) exceedance of risk-based sediment concentration for direct pathways, or 3) within the upper 5th percentile of the cumulative areal distribution for an indirect pathway COC. Areas with three or more polygons in close proximity will also be considered.

Tabular information about each high priority site will be presented so that reviewers can determine how each priority site was identified. The tabular information will include a qualitative description of habitat and human use characteristics. High priority sites will not be ranked or scored relative to one another in the candidate site selection process.

The identification of high priority sites and the subsequent selection of candidate sites for early action during the Phase I RI will not define the spatial area of each site potentially subject to remediation. Rather, the definition of such areas will be conducted as part of subsequent activities for each candidate site outside of the AOC. Those activities are likely to include additional sampling and analyses to more precisely identify the area (and volume) of sediments potentially subject to remediation. The identification of high priority sites is only intended to suggest, based on existing data, those general areas where significant risks occur and where early action may reduce those risks on an accelerated schedule.

The Candidate Sites Memorandum will emphasize that the results of the site prioritization process should not be used to draw any conclusions about whether or not human health or ecological risks are present at areas not identified through this process. There are many reasons why areas with contaminated sediments that pose a human health or ecological risk may not be identified, including:

- The scoping-phase risk assessment is based on limited chemical data, especially fish, shellfish, and benthic invertebrate tissue data.
- The site identification process does not take into account transfer of contaminants from sediments to biota, except through the assumption that identification of the upper 5th percentile areal distribution for some contaminants will address indirect pathway risks.
- A baseline risk assessment conducted as part of the Phase II LDW RI will consider different risk thresholds for identification of COCs and areas of concern and will consider cumulative risks for receptors exposed to contaminants via multiple pathways.

The purpose of the Phase II RI and baseline risk assessment is to reevaluate risks present at the site after gathering additional information and to identify additional areas that may require remediation.

The objective for defining high priority sites is to identify those sites that are sufficiently contaminated that early remediation, if feasible, represents a sound site management decision. Whether an identified high priority site is chosen as a candidate site for early remedial action will be dependent upon the outcome of the candidate site selection process (Section 3). If a high priority site is not selected as a candidate site, that site will be further assessed during the LDW Phase II RI.

3.0 LDWG Candidate Site Selection Criteria

The SOW for the LDW RI states that the candidate site selection criteria should include factors that relate to the relative risks posed by the site, and whether the site can be effectively remediated in such a way that recontamination is minimized. In addition, the SOW recognizes that impediments may exist to identifying a high priority site as a candidate site for early action, such as landowner constraints. Landowner constraints may arise because of a lack of any apparent connection between the identified high priority site and past or ongoing activities of any viable party, or lack of resources to undertake an early action at this time.

Several efforts to develop candidate site selection criteria have been undertaken within the last 10 years in Puget Sound (see Section 2.1). However, because these efforts were not developed specifically for Superfund sites, federal regulations [i.e., CERCLA (42USC§9601) and NCP (40CFR300)], associated federal guidance (e.g., USDOE 1995), and state regulations (MTCA, WAC 173-340) were also reviewed to determine if additional or alternative criteria should be included.

Based on this review, the process outlined in USDOE (1995) was deemed to be the most straightforward and regulatory-based approach available. The process outlined by USDOE is consistent with NCP, EPA, and State of Washington guidance on identifying sites that may be subject to non-time critical removal actions. Using this approach, three general criteria were selected for the proposed candidate site selection process (Figure 4). This flowchart captures the sequential and qualitative nature of the candidate site screen.

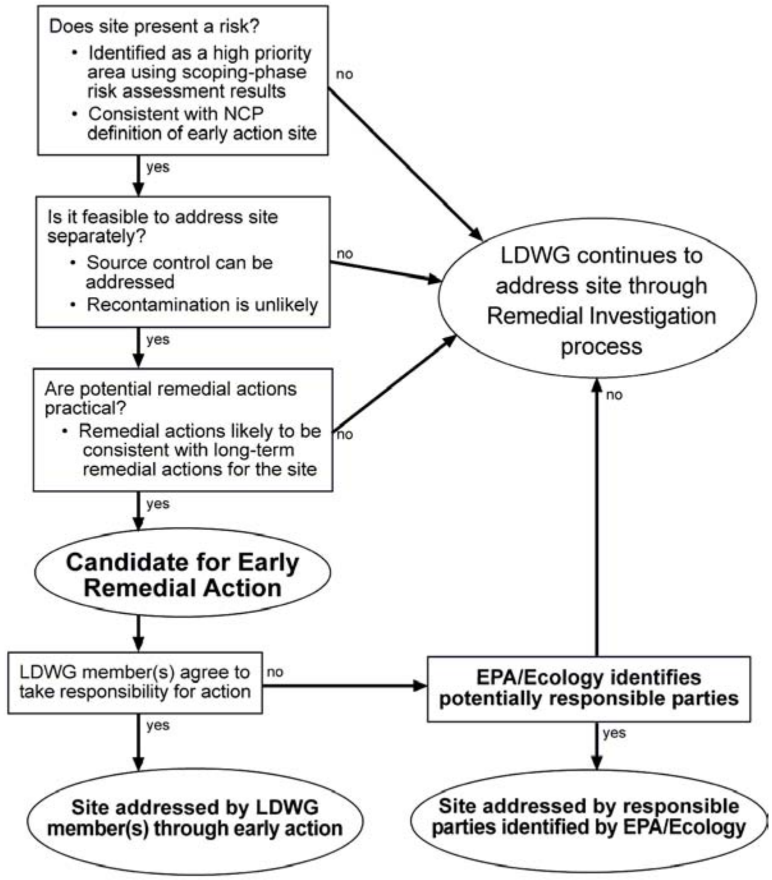

Figure 4. Proposed candidate site selection methods

Each high priority site identified using the risk-based methods described in Section 2.2 will be sequentially evaluated using the candidate site selection criteria described below. If a high priority site does not meet all these criteria, then the site will not be identified as a candidate site for early remedial action. LDWG will meet with EPA and Ecology prior to completing the Candidate Sites Memorandum. LDWG will provide draft data and maps developed according to the methods described in Section 2.2, as well as other maps requested by the agencies, to EPA and Ecology for their review prior to the meeting. At the meeting, the maps and data will be reviewed to determine whether areas meeting the screening criteria for high priority sites warrant designation as proposed candidate sites for early action.

- **Risk-based Site Prioritization**: The first step in determining candidate sites for early remedial action is to identify sites associated with elevated risk to the environment and human health. The risk-based approach for identifying high priority sites is outlined in Section 2.2. Each identified high priority site will, in turn, be further evaluated to assure that its identification as a high priority site is consistent with the NCP and MTCA before it is identified as a candidate site for early remedial action. The NCP requires that decisions on removal actions be based on threats to human or animal populations, sensitive ecosystems, or other significant factors affecting the health or welfare of the public, or the environment (40 CFR §300.415).

- **Ability to Isolate Site**: The next step in identifying candidate sites is to assess the probability of recontamination to a level that would constitute an unacceptable risk to human health or the environment. Candidate sites will be selected for early remedial action only if they have a low probability of recontamination because: 1) the site is currently contaminated as the result of historical inputs with little or no expectation of current sources, or 2) current sources, if present, can be meaningfully addressed as part of the early action process or under other regulatory programs, even if all source control actions have not been undertaken or completed. Readily available documents will be reviewed for information on historical site use, as well as ongoing or planned source control activities. This information will be used to evaluate the likelihood that source control measures, if required at an early action site, would be successful. The benefits of an interim action and the ability of other source control programs under development to address potential future recontamination will also be considered. The potential for recontamination from upstream sources, including other high priority sites, will also be qualitatively assessed, relying primarily on analyses from other studies. The source control analysis to be conducted as part of the candidate site selection process will be qualitative in nature. No specific criteria for characterizing source control will be developed during this process. If the qualitative information reviewed suggests additional source control analysis should be conducted for a particular site, it will be conducted outside the AOC for the LDW Phase I RI. EPA and Ecology will ultimately make determinations of whether and when source control is adequately addressed at a specific site.
- **Consistency with Long-Term Actions**: In addition, the high priority sites will be evaluated for the likelihood that the remedial actions taken will be consistent with the preferred remedial actions identified for the LDW. The NCP requires that, to the extent practicable, all early remedial actions should contribute to the efficient performance of any anticipated long-term remedial action for the site (40 CFR §300.415). A brief qualitative assessment of potential remedial alternatives will be conducted by LDWG for each high priority site to determine whether remediation is possible utilizing remedial alternatives commonly used at sediment remediation sites. The assessment will include an evaluation of the likely technical feasibility of remedial and disposal alternatives, the reliability of the remedial alternatives technology, and the long-term effectiveness and permanence of the alternatives (EPA 1988). For the

purposes of this assessment, it is assumed that the primary remedial alternatives will be removal and capping, or some combination of these two alternatives. Natural recovery would also be considered as part of any remedial action plan. A more detailed analysis of this topic will be conducted outside the AOC/SOW by the parties responsible for the site.

Once a site has been determined to be of high priority and low recontamination potential, and the potential remediation alternatives have been shown to be consistent with long-term actions, willing sponsor(s) are needed to further assess the site for early remedial action and to undertake any identified remedial action. Individual LDWG members may propose to take responsibility for specific candidate sites. Early remedial action at these candidate sites may then proceed on an accelerated schedule outside the AOC/SOW, in coordination with EPA and Ecology. Potential candidate sites without a LDWG sponsor will be referred to EPA and Ecology. EPA and Ecology will identify whether there are appropriate parties to undertake those cleanup actions through the Potentially Responsible Party search currently being conducted by EPA. EPA and Ecology will negotiate an Administrative Order on Consent or other regulatory agreement with the appropriate parties to further study and clean up each candidate site. Candidate sites without LDWG or other sponsors will continue to be addressed through the RI/FS process.

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