WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Responsiveness Summary Appendices

Sediment Management Standards
1993 Annual Review
1995 Triennial Review
1996 Annual Review

Draft Final
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Part VII. Appendices

Appendix A - Formal Comment Letters

I) **1993 Annual Review**

- Konrad Liegel, Preston, Thorgrimson, Shidler, Gates & Ellis
- Lincoln Loehr, Heller, Ehrman, White & McAulliffe
- Teresa Michelsen, Ecology
- Naki Stevens, People for Puget Sound
- Kevin Godbout, Weyerhaeuser
- Kris Holm, Northwest Pulp and Paper Association
- Peter Rude, Landau Associates
- Pat Hartigan, Ecology

II) **1995 Triennial Review**

- Lincoln Loehr, Heller, Ehrman, White & McAulliffe
- George Perry, Metro
- Ted DeWitt, Battelle, Marine Sciences Laboratory
- William L. Pugh, City Of Tacoma
- Kevin Godbout, Weyerhaeuser
- John Andersen, Georgia-Pacific Corporation
- Hannah Kimball, The Boeing Company
- David Aggerholm, Douglas Hotchkiss, Thomas Newlon, Port of Seattle

III) **1996 Annual Review**

- Douglas Hotchkiss, Thomas Newlon, Port of Seattle
  Eric Johnson, Washington Public Ports Association
- Michael Salazar, Applied Biomonitoring
- Spyros Pavlou, Ogden Environmental and Energy Services
- Revised SMS Rule Language: Douglas Hotchkiss, Thomas Newlon, Port of Seattle and Konrad Liegel, Preston, Gates and Ellis
- Tom Newlon, Port of Seattle
- Mike Johns, EVS Consultants

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July 15, 1992

Brett Betts
Sediment Management Unit
Department of Ecology
Mail Stop PV-11
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Re: Comments on Cleanup Study Plan Requirements

Dear Brett:

You have asked me to clarify my suggestion that Ecology reexamine its cleanup study plan requirements, including sampling and testing plan requirements, to make sure they are consistent with and comparable to those required for RI/FSs under the MTCA regulations.

It is unclear in the Sediment Management Standards (SMS) or the Sediment Cleanup Standards User Manual whether a party undertaking a MTCA sediment cleanup should follow the SMS for guidance on preparing cleanup study plans and sampling plans, should follow the MTCA regulations for guidance on preparing RI/FSs and sampling and analysis plans, or should follow some combination of the two. If the party undertaking the MTCA sediment cleanup should follow only MTCA regulatory guidance, the SMS or SMS guidance should be clarified accordingly. On the other hand, if the party undertaking the MTCA sediment cleanup should follow both sets of regulatory guidance, the regulations should be made consistent and comparable. Presently, the SMS and the MTCA regulations use different terminology and require different contents for cleanup study plans and sampling and analysis plans. Compare WAC 173-204-560 (cleanup study plan) with WAC 173-340-350 (RI/FS) and WAC 173-204-600 (sampling plan) with WAC 173-340-820 (sampling and analysis plan) (attached).

I hope you have found this explanation helpful. Please give me a call if you have any additional questions regarding my comment.

Very truly yours,

PRESTON THORGRIMSON SHIDLER
GATES & ELLIS

By
Konrad J. Liegel

Attachment
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August 18, 1993

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Mr. Brett Betts
Department of Ecology
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P.O. Box 47600
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Re: Comments re sediment management standards annual review, and human health sediment standards development

Dear Mr. Betts:

Thank you for the opportunity to provide comments for the annual review of the sediment management standards and for the development of human health sediment standards. My comments are attached. Please let me know if you have any questions concerning these comments.

Very truly yours,

HELLER, EHRMAN, WHITE & McAULIFFE

Lincoln C. Loehr
Environmental Analyst

COMMENTS FOR THE ANNUAL REVIEW OF THE SEDIMENT MANAGEMENT STANDARDS

1. The standards may be overly stringent due to toxic effects that are artifacts from the bioassay methods.

Discussion: EPA's Science Advisory Board, when commenting on the AET method, specifically raised the issue of possible toxic effects from disturbing the sediments[1]. The concern is that the bioassays with disturbed sediments indicate a toxicity that may not actually exist in ambient conditions if the sediments are not disturbed. The numbers are driven by the bioassays. To override the numbers, one must go back and use the same type of bioassays (i.e., with disturbed sediments). The rule did not address this concern, even though the SAB had raised it.

The triennial review needs to examine the significance of this issue and perhaps different numbers, or different confirmatory biological test protocols are needed for disturbed and non-disturbed sediments. This could also mean that PSDDA criteria are overly stringent. If toxicity, as determined by bioassays, is a short term phenomenon, and not an ongoing one, then the standards are too stringent because the short term acute effects of smothering associated with dredged material disposal greatly overshadow this.

Supporting information:

Word, J.Q., B.W. Claiborne, J.A. Ward and C. Chapin. 1991. "The Effect of Test Sediment Stabilization and Disturbance on Acute Toxicity to the Amphipod *Rhepoxynius abronius*." in Puget Sound Research ' 91 Proceedings Vol 2, pp 441-448.

EPA Science Advisory Board. July 1989. Evaluation of the Apparent Effects Threshold (AET) Approach for Assessing Sediment Quality, Report of the Sediment Criteria Subcommittee. SAB-EETFC-89-027.

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[1] In discussing uncertainties in the AET, the SAB specifically mentioned "bioassays conducted with homogenized sediments or with supernatants derived from agitated sediments as opposed to undisturbed sediments."

Puget Sound Estuary Program (PSEP). 1986 (as amended). Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound. Prepared by Tetra-Tech, Inc. for the Puget Sound Estuary Program.

(Note that the Oyster Larvae protocol was recently changed to allow some settling time before adding the larvae.)

2. The standards for metals need to better address the issue of bioavailability.

Discussion: This issue was also raised by the SAB. The issue of bioavailability may also have been a factor in those cases where DOE chose to exclude anomalous data in SEDQUAL from the derivation of the standards.

3. The triennial review needs to evaluate the changes to the "no adverse effects levels" and the "minor adverse effects levels" that result from the change in the oyster larvae test protocols.

Discussion: Oyster larvae results often set the sediment quality standard (the no effects level) or the minimum cleanup standard (the minor adverse effects level). As additional data is collected but tests other than oyster larvae are used, the standards, set by the old protocol, will not be adjusted because people will be using other tests instead. The department therefore needs to conduct studies to evaluate the magnitude of this difference, and even to correct the standard, or delete the old oyster larvae data from the data base altogether and recompute the standards. The original protocol was changed to correct a fault, yet we are left with the legacy of the old protocol in our numerical standards.

4. Because the bioassays have the potential to create toxic effects as artifacts of the test methods, the benthic population data should, in some situations, be able to override both the chemistry and the bioassays.

Discussion: The department will be considering requiring more detailed benthic population analyses, so the department should also be willing to provide greater weight to the results of such analyses.

5. The department needs to provide an analysis of the data that they chose to exclude from the SEDQUAL data set when developing the standards, and to determine the significance of excluded data in the sediment management program.

> Discussion: This is not saying that all data should be included. Rather, it is saying that the reasons behind excluding some data may also have significance to the implementation of the standards elsewhere.

6. The department needs to develop a methodology for applying site specific modifications to their sediment criteria. There should be means of adjusting the criteria to reflect sensitivity of species at the site, site specific toxicity testing, and bioavailability.

> Discussion: EPA is considering such an approach for sediments. EPA also allows for site specific modifications to their surface water criteria.

COMMENTS FOR THE DEVELOPMENT OF HUMAN HEALTH SEDIMENT CRITERIA

1. It is important to protect consumers by using a realistic bases for the consumption of fish that carry a significant body burden of chemicals. Fish consumption rates need to be site-specific adjusted to represent spatially explicit exposures.

> Discussion: Only a small percentage of total fish consumption is likely to have sufficient exposure to contaminated sediments (either direct exposure, or through the food chain) to be considered. Because of that, the department must recognize that not all fish are the same (some move a lot, some a little, and shellfish not at all). The department must also recognize that the exposures for the fish depend on what the fish eat, where the fish eat, where the fish live (on the bottom or higher up in the water column) and where the human consumer gets their fish from. This results in a complicated analysis that cannot be ignored. If sediment contamination is very wide spread, then a low concentration could be a significant risk, and if sediment contamination is over a very small area (relative to where the fish live and are harvested from), then a much higher concentration would still be an insignificant risk. However a number is established, the fish consumption must reflect only that amount of fish that has had a sufficient exposure to develop a body burden of concern.

2. Anything that overstates the true risk could result in greater risk to the public.

> Discussion: If a risk of eating fish is exaggerated, people will switch to eating something else. This could have greater impacts on their personal health and longevity than if they ate the fish, in which case the criteria would have done more harm than good (to humans).

3. Because human health risk numbers should be derived based on fish consumption of affected fish, and because the percentage of fish consumed that are affected will vary with the area and location of contamination, single numbers are inappropriate. Rather, a range of numbers as a function of area and location should be used.

> Discussion: It would be appropriate to recognize that the smaller the area, the higher the potential number could be. This does not automatically allow high contamination in a small area because the AET based criteria would prevent that.

Another alternative would be to have a range of numbers based on various consumption rates. In implementation, for any given site, a number would have to be selected that was proportionate to the actual consumption rate of affected fish.

4. The biota-sediment accumulation factor for arsenic must be for the accumulation of inorganic arsenic in fish tissue.

Discussion. Most arsenic in fish is in the organic form, and this is not a concern. The fish is not selectively concentrating organic arsenic from the water or the sediments. Rather, the fish is taking up inorganic arsenic and converting it to the organic form. The Food and Drug Administration does not view organic arsenic as a concern. Consequently, if the department uses total arsenic in fish tissue, they will implement overly stringent standards.

References:

Food and Drug Administration Center for Food Safety and Applied Nutrition Guidance Document for Arsenic in Shellfish. January 1993.

Oladimeji. 1979. Ecotoxicology and Environmental Safety. Vol. 3, pp 393-400.

5. The department should not treat all carcinogenic PAHs as being equally carcinogenic.

Discussion: It is possible to evaluate carcinogenic PAHs using a Benzo(a)Pyrene equivalents approach. This allows for a more realistic total carcinogenic PAH evaluation.

References:

ICF-Clement Associates. 1988. "Comparative Potency Approach for Estimating the Cancer Risk Associated with Exposure to Mixtures of Polycyclic Aromatic Hydrocarbons", Interim Final Report prepared for EPA under Contract No. 68-02-4403.

Quantitative Risk Assessment Committee. August 9, 1990. Report of the Quantitative Risk Assessment Committee on the Estimation of Risk Associated with Consumption of Oil-Contaminated Fish and Shellfish by Alaskan Subsistence Fishermen Using a Benzo(a)pyrene Equivalency Approach. Center for Food Safety and Applied Nutrition, Food and Drug Administration.

6. The department should recognize that there are serious scientific concerns with the validity of the cancer potency numbers themselves. The paradigm is in a state of change. It is recognized that the present method overstates the risk. Therefore, a risk level of 10^{-6} would be overly stringent, and 10^{-4} or 10^{-5} would still be highly protective, perhaps even to the extent of being no risk whatsoever.

Discussion: The use of maximum tolerable dose and ½ maximum tolerable dose is recognized to cause large scale cell deaths, and increase the chance for mutations as the body repairs the damage. This response is not because of an inherent carcinogenicity to the chemical in question. Rather, it is an artifact of the test methodology itself. There are additional problems with the assumptions behind the derivation of the cancer potency factors including the no threshold assumption, the choice of the linear multi-stage model, the deletion of data points when the data do not fit the model, the failure to consider all of the relevant data, the direct one for one extrapolation to humans of cancer incidence in lab animals, the assumption that the metabolism of "the most sensitive species" is representative of that of humans, and the use of a 95% confidence limit.

References: Editorials and responses to comments on editorials in the following issues of Science.

14 December 1990. "Incorporation of New Science into Risk Assessment". - Philip Abelson.

26 July 1991. "Excessive Fear of PCBs". Philip Abelson.

30 August 1991. "Toxic Chemicals and Toxic Laws". Daniel Koshland, Jr.

10 January 1992. "Diet and Cancer in Humans and Rodents". Philip Abelson.

19 June 1992. "Exaggerated Carcinogenicity of Chemicals". Philip Abelson.

4 September 1992. Response by Philip Abelson to comments concerning the 19 June 1992 editorial.

8 January 1993. "Regulatory Costs". Philip Abelson.

26 February 1993. "Pesticides and Food". Philip Abelson.

9 April 1993. "Science and Society". Daniel Koshland, Jr.

4 June 1993. Response by Philip Abelson to comments concerning the 26 February 1993 editorial.

25 June 1993. "Pathological Growth of Regulations". Philip Abelson.

23 July 1993. "Toxic Terror; Phantom Risks". Philip Abelson.

SEDIMENT MANAGEMENT STANDARDS
ANNUAL REVIEW COMMENTS

Teresa Michelsen
August 25, 1993

WAC 173-204-200. A definition of "sediment" is needed to avoid situations such as occurred with the South Terminal project and to differentiate between sediments and wastes that have been dumped in the aquatic environment. How about something like: "Naturally occurring deposits of mineral and organic matter, containing less than 50% material of anthropogenic origin (e.g., wood debris, bark, sandblast grit, slag)."

WAC 173-204-310. I would like a new subsection (4) in this section entitled "Reporting Requirements", which requires a person collecting sediment data to report the data to the SMU within a set period of time. Alternatively, they could be required to report it only if they exceed the SQS. This would avoid the problem we had with Weyerhaueser when they refused to provide us data until a number of other companies had the opportunity to review it. We could also put in this section that data will be reported in a format consistent with the TIM we developed.

WAC 173-204-315(1)(a)(i). We should consider adding *Ampelisca abdita* for use in marine areas with fine-grained sediments.

WAC 173-204-320(1)(b),(c). We should consider extending the Puget Sound marine sediment standards to other marine areas of the state, based on the recent work that's been done by EPA. Also applies to WAC 173-240-420(1)(b) and WAC 173-204-520(1)(b). Even if the chemical standards could not be extended, we should consider extending the biological standards.

WAC 173-204-320(3)(c). The benthic endpoint should be revised per the benthic workshop to eliminate this criterion and substitute a more workable one (or more). I have had problems trying to use this endpoint at sites. Realistically, if it can't be decided in time for this rule revision, perhaps we could put in a sentence that says "or other endpoint(s) as determined by the Department". This would give us a little more flexibility in interpreting this endpoint, particularly because we would be able to use guidance as soon as it appears rather than waiting for another rule revision. Also applies to WAC 173-204-420(3)(c)(iii) and WAC 173-204-520(3)(d)(iii).

WAC 173-204-320(5). In practice, I've been using the bioassay tests and biological criteria for other deleterious substances not represented in the chemical criteria. Would it be worth identifying in this section that the biological tests can be used for these contaminants? Also applies to WAC 173-204-420(5) and WAC 173-204-520(5).

WAC 173-204-330 and 340. Even though we don't have chemical criteria, I would like to recognize EILS and PSDDA work, and start listing some biological tests for these sections. For example, both amphipod and Microtox work in these situations. *Eohaustorius estuarius* could be used for estuarine and *Hyalella azteca* for freshwater. Because the endpoints that correspond to SQS and CSL are primarily policy-based, we could use the same endpoints we use for marine sediments. This is the approach that was recommended in SCUM1, and basically, we're using it, so it would be nice if it were promulgated and we didn't have to fall back on the BPJ arguments every time. Jim Cubbage has a suggestion for a third freshwater test - but I can't remember what it is, you'll have to ask him. Also applies to WAC 173-204-420(1)(c),(d) and WAC 173-204-520(1)(c),(d).

WAC 173-204-510(2). The first sentence says "A station cluster is defined as any number of stations from the inventory..." This sentence should be revised to indicate a minimum of three stations.

WAC 173-204-530(2). Again, to ensure timely response to requests for information, I would add a time requirement to this as follows: "Onsite dischargers, lessees, landowners, and adjacent dischargers shall submit, *within 30 days of* the department's request..."

WAC 173-204-540(6)(a). A subsection (iii) should be added to this section because there is a third way that a site could be delisted - if it has naturally recovered since it was put on the list. I am beginning to think that this may happen quite often. All then a person would have to do to get it delisted would be to submit site characterization data showing that the site no longer exceeds CSLs.

WAC 173-204-550(3). This section needs major revision, as we all know. I think the best way would be to modify the current "incidental" and "partial" language, and replace it with language that is consistent with the two policies that we are near finishing on 401 certifications/cleanups and the waterfront policy, both of which contain language addressing partial characterizations and cleanups. We may want to replace "incidental" with a category related to dredging and/or construction and discuss the three types of permit requirements that may be added for these activities in contaminated sites. Similarly, under the partial cleanup section, we may want to acknowledge the few cases we've come up with where partial characterization may be OK. Also under partial cleanup, we have listed in the new waterfront policy a variety of reasons why partial cleanup may be appropriate, and only one of these reasons is currently listed in the rule. In both cases, we may want to reference the appropriate policies for more detail, and emphasize that the department will exercise its judgment in these cases.

Finally, with respect to "department-initiated" and "voluntary" - the MTCA group has been finding that there really is something in between these two that's sort of "semi-voluntary". These situations may be addressed with a pre-pay position or somehow have increased oversight by the agencies. Perhaps we want to replace these terms with ones that more accurately reflect the enforcement vehicle that's being used. In other words, you could differentiate between three or four levels of oversight: 1) those projects under an agreed order, consent decree, or unilateral order (e.g., Texaco, Unocal, ARCO), 2) those projects with a prepayment agreement or which have otherwise arranged for a high level of discussion and oversight (e.g., Terminal 3, Port of Seattle), 3) those projects being conducted primarily because they want a 401 certification (e.g., Port of Everett South Terminal, DOT ferry terminal), and 4) those projects that are being conducted entirely voluntarily (e.g., Weyerhaueser Mill E). Eventually, we will hopefully also have cleanups that are being conducted in accordance with a bay-wide or port-wide plan. These cleanups may use some other vehicle (e.g., interagency memorandum of agreement) to effect cleanup. We may want to add a subsection encouraging entities with jurisdiction over multiple sites to develop such management plans in each area.

I think we also need a section that allows for interim actions to address imminent threats or when final cleanup cannot be completed (for example, if it is believed that recontamination may occur). This would be different from partial cleanup in that, similar to MTCA, it could allow for interim actions to be conducted without a full alternatives analysis when the action is obvious and sensible and will not foreclose future cleanup options or when the threat is great enough that time is critical. I can think of two cases already where this would be a big help.

WAC 173-204-560(4). This section also needs some work, as many people have found it confusing. The main problem is that it doesn't differentiate clearly between what is needed in the cleanup study *plan* and what is needed in the cleanup study *report*. Everything is listed under the cleanup study plan; some of this information could not actually be provided until after the cleanup study is conducted (e.g., the locations where SQS and CSLs are exceeded, evaluation of cleanup alternatives). I would suggest moving the contents that apply only to the cleanup study report into subsection (7) for clarity; this was done in SCUM2 but would be helpful also to do in the rule.

I would particularly suggest moving subsection (4)(b)(ii) into the cleanup study report, and clarifying that we're looking for contour maps here showing the results of the investigation. These contours are different from the rest of the site conditions map, which should be provided in the cleanup study plan. We should reference the TIM on recommendations for reporting sediment data.

We also should recognize somewhere in this section that many of these cleanups are associated with upland MTCA or CERCLA sites. In these cases, certain modifications should be allowed. In particular, information on site history and existing conditions, weather, geology, etc. already provided in the upland work plan need not be repeated in the sediments work plan, which is often an attachment or addendum to the upland work plan. Second, our cleanup study report is written as if it would include the contents of both an RI and an FS, but these reports are usually separate under MTCA or CERCLA. For larger sites it is often easier to separate the two evaluations.

Assistance. If you need assistance, I would be willing to work on developing more direct language for the rule, particularly relating to the two comments above regarding the types of cleanup and the contents of the cleanup plan and report. SCUM2 also needs updating, to revise our description of the clustering routine, add the new policies, and reflect any changes made to the rule. We may want to consider integrating some of the newer policies into their appropriate chapters, instead of appending them. At the least, we should add references in the main text to the new appendices. There are also some minor changes I would like to make to the site ID worksheets - I don't know how easy it will be without PTI graphics.

August 27, 1993

Brett Betts
Washington Department of Ecology
Sediment Management Unit
P.O. Box 47703
Olympia, WA 98504-7703

Dear Mr. Betts: Brett

PEOPLE for PUGET SOUND

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Thank you for the opportunity to comment on the Sediment Management Standards. We appreciate the efforts Ecology is making to improve and strengthen these standards. We would like to offer several general comments on how the standards could be modified to better achieve the stated goals of "no adverse effect to biological resources" and no "significant impact on human health"

Sediment Quality Standards

We are concerned that the current chemical and biological criteria used in the sediment quality standards may not be adequate to prevent sublethal effects on marine organisms, unacceptable levels of bioaccumulation, and adverse effects on human health. It is our understanding that the criteria were established on the basis of toxicity tests that look only for mortality and do not consider sublethal effects, such as impairment of growth, reproduction and immune systems. Aquatic toxicologists increasingly recognize the importance of such sublethal effects on the survival of populations and natural communities. Sublethal effects are a significant economic problem when species such as salmon are affected and the fishery resource is impaired.

The process of setting criteria must also fully consider the effects of bioaccumulation on the ecosystem. It is not sufficient to consider merely the effects of a pollutant on a single species used in bioassays. Effective tests must be used to predict bioaccumulation in predator species. The effects on predators must then be taken into account in setting criteria.

We urge Ecology to set sediment criteria using tests that examine sublethal effects and account for bioaccumulation. The ongoing work at the Seattle laboratories of the Environmental Conservation Division (ECD) of the National Marine Fisheries Service can provide current, local, scientific knowledge that should be useful in revising the chemical and biological criteria. It is our understanding that the ECD and other laboratories use more sophisticated bioassays than are currently used in developing the SMS. Use of these more sensitive tests would make the SMS criteria both more defensible *and* more protective of our natural resources.

The chemical criteria for the marine sediment quality standards (Table I of WAC 173-204-320) do not include a number of fairly common industrial chemicals, such as those associated with pulp mill effluents (e.g., organotin compounds, tetrachlorophenol, trichlorophenol, polychlorinated dibenzodioxins, and polychlorinated dibenzofurans). These compounds should be evaluated and included in the chemical criteria.

Sediment Impact Zones

Sediment impact zones, like mixing zones for effluent, permit a discharger to adversely affect biological resources within the zone of impact. We strongly urge the elimination of both mixing zones and sediment impact zones as incompatible with the goal of no impact on biological resources. Eliminating mixing zones would, of course, go a long way toward eliminating the perceived need for sediment impact zones. A strong pollution prevention program is a prerequisite to eliminating mixing zones and sediment impact zones, both of which are end-of-pipe management rather than true source control. Genuine source control would include sediment quality standards that must be met at the outfall in all permits.

If Ecology were to make a good faith effort to avoid locating sediment impact zones in all the "areas of special importance" described in the standards, it would be next to impossible ever to authorize one. With the whole of Puget Sound classified as an estuary on national significance, the existence of any sediment impact zones precludes the intent of truly protecting areas of special importance. The regulations should clearly specify that sediments in pristine areas will not be degraded in any way.

We understand that there are no sediment impact zones currently authorized in permits, and that very few permits even require the baseline sediment studies needed to determine whether or not a zone is necessary. It is also our understanding that it is up to permit writers to determine whether or not these baseline studies are written into permits. Therefore, eliminating sediment impact zones altogether would not significantly change current practices. Monitoring of sediment quality should be a requirement of every NPDES permit. Sediment tests should be done more frequently than once per permit cycle.

Use of sediment impact zones as even a temporary measure is hazardous, as temporary measures have a way of becoming long-lived, if not permanent. If sediment impact zones are to be tolerated as a temporary measure, the regulations must clearly require that the size of the zone be decreased with each successive permit cycle. Such ratcheting down would be the only way to "reduce and ultimately eliminate adverse effects ... from surface sediment contamination" (WAC 173-204-100(2)).

Without a specific requirement for ratcheting down, dischargers could actually increase the size of the zone if they are using best management practices and applying all known available reasonable methods of prevention, control, and treatment. Furthermore, if the discharger can show that technical feasibility and cost are prohibitive to meeting sediment quality, they can be exempted from meeting the standards. This is neither source control nor environmental protection.

In addition, the regulations must require notification of the public when a sediment impact zone is under consideration. The regulations currently require only a "reasonable effort to identify and notify" landowners, adjacent landowners and lessees affected by the proposed sediment impact zone. This does not allow for adequate input from everyone affected by the impact zone. Contaminated sediments can easily affect the general public, as well as landowners and adjacent landowners.

Thank you for considering our comments.

Very truly yours,

Naki

Naki Stevens
Policy Director

Weyerhaeuser

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August 30, 1993

Mr. Brett Betts
Sediment Management Unit
P.O. Box 47703
Olympia, WA 98504-7703

Dear Mr. Betts:

Enclosed are Weyerhaeuser Company's comments in response to the Department of Ecology's (Ecology) annual review of the Sediment Management Standards (SMS) Chapter 173-204-130 (6)-(8) WAC.

The purpose of these comments are to provide suggested improvements to the rule and promote consistent and efficient implementation. In most cases are comments are general in nature. On behalf of Weyerhaeuser, the Northwest Pulp and Paper Association (NWPPA) will provide technical comments on the SMS.

To assist you in reviewing our comments, we have organized them in the following manner. First, comments are grouped by common management topics. Comments on specific SMS activities then follow.

Four common management topics were identified by Weyerhaeuser. These topics center around our goals to:

- Conform the SMS as closely as possible to federal requirements. Where federal requirements do not exist, Ecology should seek formal written concurrence from federal agencies prior to rule/policy development. EPA should also be consulted during early implementation of the SMS to ensure consistent application.

- Promote consistent rule development within Ecology programs, and with other state agencies like the Department of Health (DOH), when developing rules or policies based upon the science of human health and/or ecological based risk assessment.

- As a matter of public policy and consistent rule development, Ecology should codify all mandatory requirements. The application of discretionary, i.e. non-administrative rule based material as contained in Ecology's Permit Writers Manual, in TIMs and/or Focus Sheets should be limited to non-enforceable technical guidance.

- Prior to developing new rules Ecology should adequately staff, budget and implement existing regulations.

Are comments are herein enclosed for your review.

Please accept these comments in the cooperative manner in which they are intended. Should you or your staff wish to discuss the issues raised, please contact me at (206) 924-3878.

Sincerely,

Kevin Godbout
Associate Area Environmental Manager

cc: Kris Holm, NWPPA
Ken Johnson, CH1L28
Keith Phillips, Ecology (w/o attachment)

1. *Conform the SMS as closely as possible to federal requirements, where federal requirements do not exist Ecology should seek and receive written federal concurrence prior to rule/policy development. Oversight by EPA during early implementation of the SMS is necessary to ensure Federal/State consistency.*

   - Ecology has now begun the process to draft sediment standards for freshwater and for protection of human health in Puget Sound. Similar efforts are also being undertaken by EPA. Because of these seemingly parallel efforts we believe that close coordination between the Agencies is necessary to ensure consistency, reduce the regulatory burden placed the business community, and provide future opportunities to manage sediment in a manner that is protective, cost effective and efficient.

   - Future Federal and State coordination is necessary to ensure consistent technical application. For instance, EPA appears to be at least six months away from implementing any final sediment criteria, yet the first sediment management standards to be adopted by a State occurred in Washington during 1991. Washington's criteria are based in part on the Acceptable Exceedence Threshold (AET) approach used by EPA headquarters in the development of Sediment Cleanup Objectives (SCO) for the Commencement Bay Superfund site. Yet differences in the analytical procedures are present, i.e. the requirement to TOC normalize data per the SMS. We recommend that EPA and Ecology conform future sediment regulations to avoid inconsistent technical application.

   - The application of state applicable or relevant and appropriate standards (ARARs) on Federal "Superfund" sites should be restricted to those state standards that were promulgated under a state environmental law at the time the Record of Decision (ROD) was signed for a specific superfund site. We recommend that Ecology now focus its efforts on implementing the SMS (as a ARAR) on those Superfund sites that contain newly signed RODs.

2. *Promote consistent rule development within Ecology programs and with other state agencies when developing rules or policies based upon the science of human health and ecological based risk assessment.*

   - We are encouraged by the efforts of Ecology to include the Department of Health (DOH) in the development of a technical approach to criteria setting for the human health sediment criteria development. We encourage Ecology to obtain scientific peer review of the proposed bioaccumulation values developed by DOH from the Sediment Scientific Review Board (SSRB) and EPAs National Research Council Sediment Board.

- We encourage all Ecology Programs to adopt the use of "distributional analysis" in risk based rule making. The use of a Monte Carlo Analysis in the development of human health sediment criteria is acknowledged by independent experts as a state of the art approach. Adoption of this approach by the Sediment Management Unit will however present cross media policy implications to other Ecology Programs involved in setting human health risk based criteria. Resolution is necessary because existing human health criteria contained in the Model Toxics Control Act (Method B cleanup levels) and Water Quality Criteria (Fish Consumption concentrations) use a different technical process.

3. *As a matter of public policy and consistent rule development Ecology should codify all mandatory requirements. The application of discretionary, i.e. non-administrative rule based material as contained in Ecology's Permit Writers Manual, in TIMs and/or Focus Sheets should be limited to non-enforceable technical guidance-only.*

- Ecology has recently incorporated the Sediment Source Control Standards User Manual as guidance into the final permit writers manual. (Section 3.4.1 Technical Evaluation Procedures for Discharges to Freshwater Environment provides guidance to permit writers on alternative procedures for evaluating the potential for sediment impacts in freshwater envorinments) The manual appears to provide recommended bioassay tests and test interpretation criteria which a permit writer must use to determine whether a sediment impact has been exhibited. We would encourage Ecology to promulgate freshwater sediment criteria through the administrative rule making process rather than seek implementation on a case-by-case basis via individual permit writers.

4. *Prior to developing new rules, Ecology should adequately staff, budget and implement comprehensive regulations. Weakening one initiative to emphasize another is short sighted and will cause long term management problems for both regulators and the regulated community.*

- Implementation of the SMS will require significant funding, codification of administrative rules, development of new policy and guidance and a complementary technical and support staff well versed in the science of risk assessment. We are concerned that given the tight state budget, Ecology may not have the resources to meet these obligations. It has been our experience (with many of the State of Washington only regulatory initiatives), that resources are either "cannibalized" from current programs to meet the new requirements or the new initiative is not staffed or funded. Either way the result is inefficient application and accountability.

- Although Ecology has made significant progress towards implementing the "cleanup" portion of the SMS, through development of ecological based numeric criteria, the lack of companion Human Health Criteria now limits the ability of a potentially liable party from conducting a onetime comprehensive sediment cleanup. In order to avoid future liability, it is essential that the regulated community be subject to comprehensive standards which must be met in applicable waterbodies. We would encourage Ecology to defer sediment site cleanups per MTCA or NPDES authority until the Human Health Criteria are developed.

NORTHWEST
PULP&PAPER

August 30, 1993

Brett Betts
Department of Ecology
Sediment Management Unit
P. O. Box 47703
Olympia, WA 98504-7703

Dear Brett:

Thank you for the opportunity to participate in Ecology's annual review of the Sediment Management Standards. As a member of the previous Sediment Management Standards Advisory Committee and the existing Sediment Management Standards Implementation Advisory Committee representing NWPPA members, I have always endorsed the need for public involvement in the ongoing development and implementation of the rule. The annual review under section 130 of the rule is an essential element of that process.

Although you are primarily requesting comment on the rule itself, many of the issues of concern for NWPPA deal with implementation and liability issues. The themes of reliability, equity and efficiency in rule implementation for point source control and clean up programs are detailed in the attached January 18, 1993 letter to Mr. Sorlie on NWPPA recommendations for addressing stormwater and sediment liability. These issues are of continuing concern and should be addressed in the upcoming rule revision process.

Concerns regarding the interim implementation of the freshwater "narrative" criteria and the development of numeric freshwater standards were detailed in my May 28, 1993 letter to Keith Phillips on the Sediment Source Control Users Manual for 1993 (enclosed). The proper application of the "narrative" criteria for freshwater or other effects should also be addressed in the rule revision.

The rule should also clarify how existing and future federal regulations relating to sediment criteria and/or cleanup requirements will relate to those adopted and implemented under this state rule. A mechanism for ensuring federal involvement and concurrence with state rulemaking and implementation is essential to the rule's success. This is also important in light of EPA's new policy of performing consultations under the Endangered Species Act when it approves state water quality rules. A copy of the MOU between EPA, the National Marine Fisheries Service and U. S. Fish & Wildlife on this issue is enclosed.

The application of the sediment management standards under MTCA and under federal cleanups as ARAR's is frequently confusing. Since cleanup agreements and implementation may take several years, the application of developing state standards to meet human health and fresh water environmental concerns in these ongoing projects should be clarified as much as possible in the rule itself. A clarification will help prevent additional delays in cleanups.

The development by the state of human health-based standards for sediments is the first in the country. The rule must ensure that the risk management approach proposed is consistent with other risk management approaches developed by the state. This is especially important for the human health-based water quality criteria being developed by Ecology in the next triennial review. The state's view of risk must be consistent and consistently applied in order to ensure a rational basis for regulation and enforcement. NWPPA continues to endorse the use of scientific review boards to assist Ecology and other state agencies in this effort.

And finally, any new efforts to manage sediments must consider the ability of the state to adequately staff and implement the program. The regulated community, especially small businesses, will need technical assistance to ensure compliance with discharge related and cleanup requirements.

Thank you again for this opportunity to comment. I look forward to my continuing involvement in the sediment rule process.

Sincerely,

Kristine Holm

kh

LANDAU
ASSOCIATES,
INC.
Environmental and Geotechnical Services

August 31, 1993

Mr. Brett Betts
Washington Department of Ecology
Sediment Management Unit
P.O. Box 47703
Olympia, WA 98504-7703

RE: **1993 ANNUAL REVIEW OF SEDIMENT MANAGEMENT STANDARDS COMMENT SUBMITTAL**

Dear Mr. Betts:

Landau Associates is actively involved in several projects in which contaminated sediments are being evaluated within the context of the State Sediment Management Standards (SMS). Given our involvement in sediment related projects, and our commitment to development of technically sound and practicable environmental regulations, we are pleased to have this opportunity to provide input to the further development of the SMS. This submittal is in response to your letter requesting comments and recommendations for revisions to the State Sediment Standards (Chapter 173-204 WAC) as part of the annual review of the SMS.

Our comment and related recommendation relate to the general issue of the application of TOC normalization to sediment data on nonionic organic constituents, which is incorporated in WAC 173-204-320(2) and 520(2) and is discussed in Appendix G of the Sediment Cleanup Standards Users Manual (Ecology 1992). Specifically, we are concerned about how Ecology might regulate the way TOC normalization of nonionic organic constituents is performed in the presence of organic matter such as coarse wood debris.

We generally agree that the concentration of nonionic organic constituents normalized to the organic fraction of sediment is a better basis on which to develop biological effects relationships than concentrations based on dry weight. We also generally agree that the contribution of any coarse wood debris to the TOC content of a given sediment should be subtracted before normalization and comparison to criteria takes place. Nevertheless, we recommend that caution is exercised when methodologies or regulations are developed for determining the contribution of coarse wood debris to the TOC content of marine sediment.

During discussions with Ecology's Sediment Management Unit (Ecology 1993), the use of sieves to separate coarse wood debris from the bulk sediment was identified as a potentially

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useful method for correction of the effect of coarse wood debris. Briefly, the bulk sediment would be passed through a sieve (on the order of a few millimeters in mesh size) and the TOC content of the material that passes the sieve would be determined. With a volume correction for the removal of the wood debris and the assumption that the wood debris is inert with respect to the constituents of concern, a more accurate TOC value by which to normalize nonionic organic constituents can be obtained.

We have made a preliminary evaluation of the effectiveness of this approach using sediment samples from the Puget Sound region that contain abundant wood debris. Our preliminary results indicate that sieving is effective in separating the coarse wood debris fraction from the bulk sediment. It appears, however, that subsampling techniques employed in typical laboratory procedures for measuring TOC are inherently biased toward reducing the impact of coarse wood debris on the TOC actually measured on bulk samples. This phenomenon was encountered during comparison of the TOC contents of unsieved (bulk) samples and samples from which wood debris had been removed by sieving. The results showed little difference in the TOC content of the two differently treated samples even when independent measurements indicated that the TOC content of the bulk sample should be approximately double that of the sieved sample.

The cause of this bias is apparently twofold. First of all, because of the small sample size required for the actual TOC measurement (on the order of milligrams), a small aliquot of the bulk sample was subsampled by the laboratory and homogenized, which inherently lead to selective analysis of sediment free of coarse wood debris. In addition, the subsampler is required to completely grind the subsample to pass a fine sieve (typically to the fine sand particle size). This would tend to bias the lab technician to select finer material and leave behind in the bulk sample any coarse debris such as gravel or coarse wood debris during the subsampling. It appears, based on this limited data set, that the TOC measurement techniques typically employed by area labs already involve at least a partial removal of or bias against wood debris during subsampling (albeit arbitrarily) and before the TOC content is determined.

In summary, we recommend that any further guidance related to the issue of TOC normalization and wood debris should acknowledge this potential bias and therefore not automatically preclude use of previously collected site specific TOC data that is greater than an arbitrarily determined amount.

We again thank you for this opportunity to take part in the review of the SMS. If you have any questions or would like to discuss these issues further, please call me at (206) 778-0907.

LANDAU ASSOCIATES, INC.

By: Peter D Rude

Peter D. Rude, Ph.D.
Senior Staff Geochemist

PDR/sms
No. 7.300

REFERENCES

Ecology. 1992. *Technical Information Memorandum Organic Carbon Normalization of Sediment Data (Appendix G).* Included in the Sediment Standard Users Manual (Ecology 1991).

Ecology, March 1993. Personal communication (telephone conversation by Peter D. Rude, Landau Associates, Edmonds, Washington, regarding organic carbon normalization of sediment data), Teresa C. Michelsen, Washington State Department of Ecology, Sediment Management Unit.

DEPARTMENT OF ECOLOGY

September 2, 1993

TO: Brett Betts, Sediment Management Unit

FROM: Pat Hartigan Pat Hartigan

THROUGH: Peter Birch Peter Birch

SUBJECT: Sediments and Stormwater

This is in response to your request for comments on sediment quality standards. The comments actually better reflect some concerns we have identified with SSCUM but we feel any SSCUM-related concerns may eventually be reflected in the standards themselves. I must also note that I have not had the opportunity to review the latest SSCUM so some of these comments may be out-of-date. As I understand it, SSCUM has now struck from the text requirements for assessing stormwater discharges by stating something like "this manual does not apply to municipal stormwater discharges." This only postpones the problem, so I think my concerns are still valid. In places where I reference pages in SSCUM I am referring to the January, 1993 draft and not the final SSCUM (which I do not have a copy of).

The major concern the Urban Nonpoint Unit has is that the criteria in the Sediment Source Control Users Manual (SSCUM) is not feasible for stormwater discharges.

A second concern is that it appears possible (likely?) that Municipal Stormwater NPDES permits for Seattle and Tacoma may require TMDLs due to violation of sediment quality standards. Is it Ecology's intent to require TMDLs for these permits, if not, what is Ecology's strategy for addressing contaminated sediments using NPDES permits? This may be more appropriately answered by the Water Quality Program since the responsibility for issuing NPDES permits lies there. Nonetheless, the Sediment Management Unit should be aware of this issue if they are not already.

ISSUE 1 - "SSCUM" Criteria for determining eligibility for an SIZ for stormwater discharges is not feasible at this time.

I attempted to apply the procedures and criteria in the Sediment Source Control Users Manual (SSCUM) to the Municipal Stormwater NPDES permit program, for both marine sediments and freshwater sediments, and found the manual infeasible for such purposes. Three problems which I feel must be resolved before SSCUM can be used for evaluating stormwater discharges are:

1. SIZ Eligibility determination procedure - how to apply to municipal storm water NPDES permits.
2. AKART/BMPs for stormwater is not defined in Ecology's Permit Writers' Manual
3. Application of BMPs may increase concentration of contaminants in sediment even though the mass of contaminants is greatly reduced.

SIZ Eligibility Determination Procedure

A key step for determining whether a stormwater discharge is eligible for a sediment impact zone (SIZ) is a "Screening-Level Evaluation of the Potential for Sediment Impacts. SSCUM anticipates that this evaluation will be conducted by Water Quality Program staff and not by the discharger. I do not believe this step is feasible when applied to the stormwater NPDES permits. First, it is important to note that the permits will cover a large geographic area that will typically contain hundreds, if not thousands of individual outfalls. The Water Quality Program may not have sufficient resources to evaluate such a large number of outfalls. I can foresee a screening evaluation being conducted based on categories of outfalls, specifically the type of land uses in the watershed draining to outfalls. For example, criteria could be developed for outfalls depending on whether the contributing drainage area is composed of residential, commercial, or industrial land uses, or some combination. I recommend that Ecology develop these criteria and, further, that it be the responsibility of the discharger (i.e., the municipality) to conduct the evaluation instead of Water Quality Program staff.

AKART/BMPs Not Defined

A second problem is that SIZ eligibility is contingent upon whether AKART is met and/or BMPs are in place. SSCUM directs the user to Ecology's *Draft Permit Writers' Manual* to make the AKART/BMP determination but this is currently not possible. The manual does not provide criteria and guidance for stormwater discharges and it is, thus, impossible to make the AKART/BMP determination. The manual must be updated before it can be referenced by SSCUM.

Application of BMPs May Increase Sediment Contamination

The third problem is one that is may not be realized by many people is that *the application of BMPs may actually increase the concentration of contaminants in sediment, even though the total mass of contaminants in the sediment may be greatly reduced*. The screening level analysis in SSCUM relies on an equation (page 3-25) that estimates the sediment contaminant concentration by taking the ratio of the contaminant of concern to the total suspended solids (TSS) concentration. Treatment BMPs are typically more efficient at removing TSS than metals because metals are associated with finer particulate material, or are in the dissolved phase. This results in an increase in contaminant concentrations in sediments, even though the total mass of contaminants is greatly reduced. The final result will depend upon site specific "bioturbation" or mixing of the sediment column but the screening level analysis does not take this into account. A possible outcome is that the screening level analysis may actually discourage the use of treatment BMPs, even though their application (or meeting AKART) is a condition of eligibility for an SIZ. The question then may be whether protecting sediments is more important than protecting water quality.

Summary of Issue 1

The obvious conclusion is that the SSCUM process is not feasible at this time for stormwater, in particular the Municipal Stormwater NPDES permit program. The key step in SSCUM, "Screening-Level Evaluation of the Potential for Sediment Impacts," must be revised before the manual becomes implemented.

ISSUE 2 - Violations of sediment quality standards (SQS) may trigger the TMDL Process for stormwater NPDES permits, beginning with Seattle and Tacoma.

An opinion written by an EPA attorney asserts that sites which violate marine sediment standards constitutes a violation of state surface water quality standards and, therefore, such sites should be considered candidates for a water quality-limited listing. Since stormwater has been implicated, rightfully or wrongfully, for contributing or causing violations of sediment standards will Ecology be implementing TMDLs for municipal stormwater permits. Currently both Seattle and Tacoma have contaminated sediment sites that are receiving stormwater discharges; these discharges may be contributing to the violation of sediment standards.

Ecology's current stormwater strategy is to first implement technology-based controls but, if a TMDL is required, this strategy is obviously not correct. Ecology could phase in the TMDL process through the stormwater NPDES permits but is this legal and/or proper? What is Ecology's strategy on this issue?

Conclusions

I hope these comments are of some value to you. We will continue to work on sediment and stormwater issues as time allows. Please contact me if you have any questions or comments. My number is 493-9454.

Sincerely,

Patrick Hartigan
Environmental Engineer

PH:PB/ml
Enclosure

cc: Dick Wallace
Peter Birch
Ann Wessel
Ed O'Brien
Steve Butkus
Gary Bailey

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Triennial Review

Sediment Management Standards (SMS) Rule
Chapter 173-204 WAC

Action: Need to evaluate the effects of apparent toxicity resulting from artifacts of the bioassay methods. Are these tests, and the standards that are based on these tests, really representative of toxicity under ambient conditions?

Subject: Validity of bioassay protocols and the historical bioassay data as representing toxicity of sediments in Puget Sound.

Author: Lincoln Loehr, Heller, Ehrman, White & McAuliffe

Date: April 27, 1995

INTRODUCTION

The sediment management standards were developed based on Apparent Effects Thresholds determined by use of sediment bioassays that subjected organisms to exposures of disturbed sediments under static conditions. Organisms in the real world live in a flow through environment, not a static one, and many sediments are not disturbed. The great majority of the sediment quality standards and the minimum cleanup levels were set by sediment bioassay results, not by benthic population assessment.

If some of the apparent toxic effects are associated with artifacts of the test methods, and not the real world conditions, then the standards themselves are overly protective. If this is the case, then we may have defined a problem for ourselves, at least in some instances, where no problem exists.

Presumably the sediment management standards provide a way out, in that if the sediment chemistry exceeds the standards, the discharger may override the results with the use of sediment bioassays. Unfortunately, these are the same bioassay protocols used to develop the standards, with the same problem of being static tests with disturbed sediments. Hence, the potential flaw remains.

The potential effect of artifact toxicity needs to be evaluated to see if the standards are overly conservative and to allow for correcting the standards or to allow for confirmatory testing that is more representative of ambient conditions.

PROBLEM IDENTIFICATION

In developing the sediment management standards, DOE requested a review by EPA's Science Advisory Board (SAB) of the AET methodology. The SAB raised a number of concerns, and DOE failed to address some of these concerns in developing, adopting and implementing sediment standards. Specifically, the SAB noted the following:

> "The Puget Sound study concentrated on the chemical and biological data and used little or no physical data (currents, salinity, turbulence, and sediment characteristics) in the development of AET. **Until the effect of physical factors on AET is adequately studied, the present AET values could contain significant errors and the AET cannot be applied generically with confidence.** (emphasis added)."

SAB (1988) at 11.

Physical factors that I do not believe have been adequately evaluated in the development of the Sediment Management Standards include 1) the effects of running bioassays on disturbed sediment samples, 2) the effects of running bioassays under static conditions, and 3) the possible impact on the sediment quality standards associated with lower pore water salinities when no pore water salinity measurement was made.

<u>The effects of running bioassays on disturbed sediment samples</u>

Sediment bioassays run on disturbed sediment samples may not really represent toxicity in the ambient waters if the ambient sediments are not disturbed.

The SAB report includes examples of factors that may give rise to biased relationships between the exposure and response variables. One of these factors was:

> **"Bioassays conducted with homogenized sediments or with supernatants derived from agitated sediments as opposed to undisturbed sediments."**

SAB (1988) at 13.

In January 1991, shortly before the sediment management standards were adopted, research results by Word, Claiborne, Ward and Chapin (1991) were presented at the Puget Sound Research '91 conference on "The Effect of Test Sediment Stabilization and Disturbance on Acute Toxicity to the Amphipod *Rhepoxynius abronius*." This presentation showed an example where test sediments that showed toxicity under the required test protocols were allowed to stabilize for a period of several weeks before commencing the tests. The toxic effects went away. If those same sediments were redisturbed, the toxic effects returned.

The test results cast doubts on the validity of establishing sediment quality standards based on these tests for sediments that in nature may be undisturbed. The same issue is a concern with other sediment bioassay methods. The bivalve larval test and the Microtox test each used highly agitated mixtures of sediment and water, rather than stable sediments. Recently the bivalve larval test protocol was changed to try to avoid one artifact toxicity effect, by allowing a period of settling following agitation before inoculating with larvae. The studies with *Rhepoxynius abronius* and the necessity to change the bivalve larval test protocols illustrate the issues that the SAB expressed concern with.

The effects of running bioassays under static conditions

EPA's Office of Marine and Estuarine Protection (1990) noted:

> "The test system described by Swartz et al. (1985) for the phoxocephalid amphipod Rhepoxynius abronius is recommended for bioassays with this and other amphipod species. **Some amphipods do not survive well under static conditions and, therefore, should be tested using only a continuous flow or static renewal test design.**" (emphasis added)

and,

> "The use of flow-through exposure systems is preferred **to minimize the chances that stressful artifacts of experimental procedures will affect the results**; static renewal systems may be acceptable." (emphasis added)

Fredericka Ott (1985) observed higher mortalities in static bioassays than flow through bioassays.

The effect on the sediment quality standards of not measuring the pore water salinity

The sediment quality standards have reserved a section for standards for low salinity sediments. This is in recognition that when pore water salinities are less than 25 parts per thousand, the standards should not be based on bioassays with organisms that do not tolerate lower salinities.

Ramsdell, Strand and Cullinan (1989) reexamined sediment data from Sequim Bay and noted that earlier hits on the amphipod bioassay may have been related to,

> "....a relatively low interstitial salinity (24 o/oo)."

They further noted that,

> "Swartz et al. (1985) determined that R. abronius is sensitive to low salinity",

and they concluded that,

> "....a test sediment's interstitial salinity must be at least 25 o/oo before salinity effects on survival could be discounted."

Most of the SEDQUAL data base that was used to develop the Sediment Management Standards did not include measurements of pore water salinities. Perhaps it was simply assumed that they would be saline. Groundwater does flow into Puget Sound, and in places it will come through the sediments. Much of the SEDQUAL data based used to develop the Sediment Management Standards included samples from the Duwamish River. It is possible that some hits with amphipods might actually have been a result of low salinity that was not measured and therefore not considered.

DISCUSSION

Prior to the adoption of the sediment management standards, I asked that the DOE examine the effect of the Ward, Claiborne, Word and Chapin study on the standards. I asked that the effects of static versus flow through bioassays be evaluated. I also questioned whether the SEDQUAL data base used in the Puget Sound Sediment Standards development included routine measurements of pore water salinity. I do not believe that these evaluations were made. Now that the Department of Ecology is beginning a triennial review of its sediment management standards, it is appropriate that these issues be evaluated and resolved. The cost ramifications of potentially overly stringent standards demands that this analysis be performed.

PROPOSED ACTION

The triennial review of sediment management standards must evaluate the role of artifact toxicity in the present biomonitoring tests. Unless the evaluation determines that artifact toxicity is not significant, the Department of Ecology must develop alternate test protocols for confirmatory testing that reduce or eliminate artifact toxicity, and allow new data, with the new protocols to move the standards upward in a timely manner. If artifact toxicity is suspected to be a major problem, then it may be necessary to suspend the standard until it is resolved. In such case, it is still possible to assess the sediment quality through biological population assessment methods alone.

REFERENCES

EPA Office of Marine and Estuarine Protection, January 1990. Draft Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters (EPA-503-8-90/002)

EPA Science Advisory Board, July 1989. "Evaluation of the Apparent Effects Threshold (AET) Approach for Assessing Sediment Quality." SAB-EETFC-89-027.

Ott, Fredericka. 1986. Amphipod Sediment Bioassays: Effects on Response of Methodology, Grain Size, Organic Content, and Cadmium. Ph.D. Thesis, University of Washington. 285 pp.

Ramsdell, K. M., J.A. Strand and V. I. Cullinan, 1989. "Amphipod Bioassay of Selected Sediments from Sequim Bay, Washington". In, Proceedings of Oceans '89 Conference, Marine Technology Society.

Swartz, R.C., et al, 1985. "Phoxocephalid Amphipod Bioassay for Marine Sediment Toxicity." In: Aquatic Toxicology and Hazard Assessment: Seventh Symposium, ASTM STP 854, R.D. Cardwell, R. Purdy, and R.C. Bahner, Eds., American Society for Testing and Materials, Philadelphia, pp 284-307.

J.Q. Word, B.W. Claiborne, J.A. Ward and C. Chapin, 1991. "The Effect of Test Sediment Stabilization and Disturbance on Acute Toxicity to the Amphipod *Rhepoxynius abronius*." in, Puget Sound Research '91 Proceedings, Volume 2, pp 441-448.

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Triennial Review

Sediment Management Standards (SMS) Rule
Chapter 173-204 WAC

Action: Need to evaluate the effects of ammonia on sediment bioassay results, and whether ammonia toxicity should lead to a re-evaluation of our sediment standards.

Subject: Validity of bioassay protocols and the historical bioassay data as representing toxicity of sediments in Puget Sound when ammonia has not been considered.

Author: Lincoln Loehr, Heller, Ehrman, White & McAuliffe

Date: April 28, 1995

INTRODUCTION

Ammonia may naturally occur in sediments at toxic levels. This has not been evaluated or controlled for in the historical data. Perhaps some of our sediment standards, based on AETs, may have been influenced by ammonia toxicity. Also, does it make sense to clean up to non-toxic levels for one parameter when the natural toxicity from ammonia may be greater, and may re-establish itself after a cleanup anyway? There could also be related hydrogen sulfide issues.

PROBLEM IDENTIFICATION

Recently, EPA identified ammonia as an issue in Amphipod bioassays. Unfortunately, the information was not distributed rapidly to users with a real need to know. I have included a copy of EPA's letter to this issue paper, along with a discussion of toxicity of ammonia in aquatic sediments and its implications for sediment quality evaluation and management prepared by Anne Jones-Lee and G. Fred Lee.

PROPOSED ACTION

Both PSDDA and the triennial review of sediment management standards must evaluate the role of ammonia toxicity in the present biomonitoring tests. Unless the evaluation determines that ammonia toxicity is not significant, PSDDA and the Department of Ecology must develop alternate test protocols for confirmatory testing that reduce or eliminate the possible ammonia toxicity. Ecology must allow new data with the new protocols to move the standards upward in a timely manner. If ammonia toxicity is suspected to be a major problem, then it may be necessary to suspend the sediment standards until the ammonia issue is understood and resolved. In such case, it is still possible to assess the sediment quality through biological population assessment methods alone.

Perhaps hydrogen sulfide warrants similar scrutiny.

REFERENCES

EPA, December 21, 1993. Letter from Tudor Davies, David Davis and John Elmore to EPA Regional ocean Dumping Coordinators, EPA Regional Wetlands Coordinators and Corps of Engineers Regulatory and Civil Works Elements.

(Note: this letter explains how laboratories should reduce ammonia in sediment's interstitial water to below 20 mg/l before adding benthic test organisms. Tables in the letter also state that hydrogen sulfide is not likely to be a problem in these tests if adequate dissolved oxygen levels are maintained in the overlying water. That sounds quite a bit different than a static test protocol...)

Jones-Lee, A. and G. F. Lee. 1995. "Toxicity of Ammonia in Aquatic Sediments and its Implications for Sediment Quality Evaluation and Management." Submitted to Journal of Water Research, January 1995.

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METRO
Municipality of Metropolitan Seattle
Environmental Laboratory Division • 322 W. Ewing St. • Seattle, WA 98119-1507 • (206) 684-2300

9 May, 1995

Brett Betts
Washington Department of Ecology
Sediment Management Unit
PO Box 47703
Olympia, WA 98504-7703

Dear Brett :

I have enclosed comments regarding the summation guidelines for the triennial review process. This is a follow-up to the recently held annual sediment review meeting. I was not able to attend the meeting but hope these comments provide a useful perspective on the issue. Please call should you have any questions. My phone number is at the top of the comment page.

Thanks for your interest.

Sincerely,

George Perry

George Perry
Quality Assurance Officer

Document2

Comments for Triennial Review Chemical Summing 5/9/95
George Perry METRO Environmental Lab 206-684-2399

Analytical Considerations

The analyses of PCB and PAH's produce different kinds of results and different consideration should be given to each class of compounds for summing.

PCB's are mixtures of substances and the highest single Aroclor detection limit for a given sample quite likely represents the maximum possible concentration of total PCB in the sample.

PAH compounds are each unique and the present summing guidelines produce a conservative but I feel uesful piece of informatoin.

The difficulty that is being experienced with summing of PAH compounds is not so much a math problem but an indication that the methodology being employed does not sufficiently address the question at hand: what is the LPAH and HPAH concentration in the sample? Screening methods are available using HPLC (and probably other methodology) that directly address PAH concentration according to the number of rings present in the PAH compound. Similarly, for some sites the proportion of PAH compounds present as substituted or currently non-included compounds could be significant.

Note that the PSDDA motion to move to single isomer PCB analysis could produce similar issues to those listed above for the PAH compounds.

Summing procedures

The use of two or more techniques for the *summing* of PAH compounds at a given site could result in lack of consistency regarding site characterization.

For example, assume that LPAH data is summed using the following two sets of guidelines:

- completely non-detect sites are summed using the sum of all the detection limits
- a sum of all the positive results only is obtained for the sites containing some positive results

This approach could result in the clean sites exceeding the SMS and the contaminated sites being compliant.

The consequences of a single positive result is quite significant, from a compliance viewpoint, in this case. For example, the ability to obtain a very low detection limit for a single PAH compound could greatly alter the compliance of an entire site.

One issue seems to be that exceedances occur for clean samples or samples that are completely or nearly completely non-detect. Most of these exceedances are due to not only summing protocol but normalization protocol as well. Perhaps it is the *normalization and comparison to regulatory criteria* that need attention.

For example, compliance could be determined be exceeding *both* dry weight and normalized regulatory limits for any of the following options:

- sites that are completely non detect
- sites that have non detect for a majority of the compounds
- or sites that are below a particular TOC concentration could be required to exceed both dry weight and normalized limits to be non compliant

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May 18, 1995

Dave Kendall
Seattle District Corps of Engineers
PO Box 3755
Seattle, WA 98124-2255

Dear Dave:

Enclosed are my comments for the PSSDA and SMS annual review. They address issues related to the AETs, sediment toxicity tests, and benthic community (=abundance) responses. I hope they are helpful and I would be happy to discuss any of these points with any members of the PSSDA agencies. Thank you for the opportunity to provide these comments.

Sincerely,

Ted DeWitt
Senior Research Scientist
Marine Ecological Processes

THD:bb

enc

Comments for the PSSDA and SMS Annual Review

Theodore H. DeWitt
Senior Research Scientist
Marine Ecological Processes
Battelle/Marine Science Laboratory
Sequim, WA

May 18, 1995

Marine Sediment AET's

1. Why aren't "chemically anomalous" samples included in the AET, or at least included in tables so that the data can be evaluated by others? There is still information value to that data, and the reasons the chemistry data appear anomalous should be described for each sample - that information may help with the interpretation of data in future assessments.

2. The bases for rejecting over 50% (452 out of 824) of the amphipod bioassay samples should be reconsidered? This is a tremendous amount of data to omit. Presumably these studies provided data that were useful for sediment assessments; lack of a grain-size reference does not invalidate these data. The stated "lack of a matching reference sample" seems an arbitrary and unnecessary reason for rejection of most of these data. If grain-size reference sites are missing, you could also use the regression-based models (DeWitt et al.) to examine the extent to which grain-size would be expected to interfere with the results. Likewise, many of the other QA criteria listed in Table B-2 seem unnecessarily proscriptive, such as "statistically inconclusive" and "chemically anomalous" criteria. How does including these data (at least those rejected for lack of grain-size reference data) affect the AETs?

3. Re. the 25% rule for hits in amphipod mortality (pg. 17): 25% seems artificially high and perhaps under protective. How are AET values changed if this is dropped back to 20% or to "anything that is statistically different"? Why not just consider any statistically difference from the negative control to be ecologically significant? What is the ecological basis for deciding that a hit has to be 20-25% greater than some value? This threshold should be based on the population ecology of the test species, not on the *opinion* that some level of mortality is meaningful and another is not.

4. Were non-polar organic contaminant concentrations normalized to measured TOC values for the sample from which the contaminant was measured? Previously, I understand the TOC-normalization was based on an average TOC concentration for the region, which is inappropriate. I would very much like to have had the database to examine in order to evaluate the new AETs.

5. This new database would also be useful for re-examining the particle-size-mortality

regression for *Rhepoxynius* and *Eohaustorius* which I published in the late 80's.

6. A table showing which surveys & data came from before and after 1988 would be useful.

7. Studies are needed to ground truth the benthic abundance responses used in the AETs. A handful (5-10) species underlie the changes observed in most of the "impacted" communities in Puget Sound, but we do not know whether changes in their abundances is caused by chemical contaminants, increased TOC, or correlated factors. One way to approach this is to examine the sensitivities of these species to toxicants, TOC, grain-size, ammonia, and other correlated factors, and relate those responses to field concentrations of these factors which have been associated with changes in benthic abundance.

Freshwater Sediment AETs

1. Why haven't community structure data been incorporated into the AETs?

Amphipod Sediment Toxicity Tests

1. PSSDA should consider including the *Leptocheirus plumulosus* acute and chronic sediment toxicity tests in its suite of methods for sediment assessments. The advantages of these tests are: 1) wide tolerance to salinity (1-30‰) and grain-size (sand to very fine mud; it's native habitat is fine mud), 2) the amphipods can be cultured, thus providing year-round availability and uniform quality, 3) high sensitivity to contaminants (mortality comparable to *Eohaustorius* and *Ampelisca*, but reproductive sublethal endpoint of chronic test more sensitive than *Rhepoxynius* mortality), 4) availability of published protocols for both tests, including ASTM and EPA standard methods for the acute test (EPA standard method for chronic in development this summer), 5) availability of a true life-cycle test, and 6) interpretive guidance in the form of models that link toxicity test endpoints to population growth. These tests have been used to assess sediment contamination in several parts of the country, including Chesapeake Bay (Baltimore Harbor), San Francisco Bay (Lauritzen Canal), Massachusetts Bay (dredged spoil sites), Long Island Sound (dredged spoil sites), and Gulf of Mexico (EMAP sites).

2. Effects of interstitial water ammonia must be included in Puget Sound sediment toxicity test assessments. However, the procedures recommended by EPA and the Corps should be viewed with caution because their approach to reducing interstitial ammonia (ie, exchanging the overlying water in test chambers) may also result in removing contaminants present in the interstitial water; many studies have shown that the most readily-bioavailable fraction of

chemical contaminants is that which is dissolved in interstitial water. Thus, the "approved" procedure for reducing ammonia may also reduce the toxic fraction of sediment-associated contaminants.

3. The utility of grain-size reference sites should be evaluated. Appropriate sites are often located at a distance from study sites, and the addition of an extra sample is always costly. One approach would be to compare the reference site data with the DeWitt et al. grain-size effects model. If the model leads to the same conclusions as the reference site approach, then significant cost savings could be achieved by using the model.

Benthic Infaunal Responses

1. Same comments as in AET#6 above: need to evaluate experimentally the factors that the "sensitive" species are really responding to at "impacted" sites. Current methods (multivariate, etc.) are all correlative and suffer from lack of mechanistic underpinning.

Tacoma

City of Tacoma
Public Works Department

June 28, 1995

Mr. Brett Betts
Washington State Department of Ecology
Sediment Management Unit
P.O. Box 47703
Olympia, WA 98504-7703

Re: Triennial Review of State Sediment Management Standards

Dear Mr. Betts:

The City appreciates this opportunity to comment on several aspects of the Washington State Sediment Management Standards (SMS), ch. 173-204 WAC, as part of the Department of Ecology's triennial review of the rule. We have previously provided many of these comments to Ecology through our representatives on the various SMS work groups. We are reiterating several of our comments in this letter to ensure that Ecology gives them its careful consideration in any future rule revisions.

1. Part IV of the SMS must incorporate a stormwater source control strategy for public and private dischargers that sets clearly defined requirements for source control efforts, allows dischargers to plan and prioritize their efforts, and protects dischargers from Clean Water Act "compliance liability" when they fulfill source control expectations. Consistent with the current emphasis of Ecology's stormwater program, the rule should place an emphasis on head-of-the-pipe controls, such as use of best management practices (BMPs), and on accelerated source-control for high-priority problem discharges. The rule should give public and private dischargers who are fulfilling reasonable source control expectations reasonable compliance time-frames for meeting the sediment quality standards.

2. Part V of the SMS does not adequately recognize that many contaminated sedimentary sites are already the focus of remedial actions pursuant to the Federal CERCLA. This inadequacy in the current rule leaves the regulated community guessing as to what level of effort will provide finality to a remedial action. Further, the current rule establishes a redundant and wasteful procedure of sediment hazard assessment on sites where a Federal remedial effort has commenced or is scheduled to commence. We recognize, of course, the State's independent authority to supplement the Federal regulatory system in the field of environmental protection. At the same time, though, we must emphasize that many state citizens, corporations and public entities are expending millions of dollars to resolve Federal cleanup obligations. Some finality to these obligations is critical in order for these entities to secure adequate financing and resume economic vitality. In addition, some SMS sites are already ranked under the State MTCA, a separate process with differing standards.

Granted, the current rules establishing the criteria for site ranking under WAC 173-204-540(3) provide for the use of "best professional judgment and other information necessary on a case-by-case basis." Presumably this provision could recognize a site's remedial status under CERCLA as a criterion at the site ranking stage. However, the provision provides no assurance that such recognition will occur. Further, in the fortuitous event that such recognition does occur, Ecology will have wasted valuable resources in the station cluster screening, WAC 173-204-510, and the hazard assessment, WAC 173-240-530, stages by performing analysis which will, in large part, be duplicative of ongoing Federal remedial investigation.

The State and Federal governments should decide which regulatory process best provides for the protection of the environment and human health and administer that one process for final site remediation. Overlapping and inconsistent regulations have and continue to be the focus of regulatory efforts.

The following improvement to Part V of the SMS is strongly suggested: To provide some assurance of finality the rule should include a specific acknowledgment that remedial actions on a sediment site, undertaken pursuant to Federal regulations, will be taken into account under the SMS. To avoid redundant and wasteful effort, the rule should incorporate this criterion early in the sediment cleanup decision-making process, e.g., at the screening sediment station cluster stage, WAC 173-204-510. The delisting provision in WAC 173-204-540(6) should be modified in a similar fashion.

3. We appreciate Ecology's efforts to revise the SMS to reflect the latest scientific knowledge, but Ecology's current efforts do not go far enough. As part of any rule revision, Ecology should systematically recalculate the chemical criteria within the rule (e.g., WAC 173-204-320) to reflect the latest scientific knowledge. Doing so is consistent with SMS policies that call for the use of methods that accurately reflect the latest scientific knowledge consistent with the definitions of "minor adverse effects" and "no adverse effects." WAC 173-204-130.

4. Ecology should further address "independent" and "interim" cleanup actions in any revisions to the SMS. Ecology should consider issuing partial or conditional water quality certifications for such actions, or adopting a simplified procedure for their review and approval. "Independent" and "interim" actions should be encouraged to the greatest extent possible, such as provided for under MTCA, WAC 173-340-510 (5).

5. Ecology should reexamine its study plan requirements, including sampling and testing plan requirements, to be sure they are consistent with, and comparable to, those required for Remedial Investigations and Feasibility Studies (RI/FSs) under the MTCA regulations. Compare WAC 173-204-560 (cleanup study plan) with WAC 173-340-350 (RI/FS) and WAC 173-204-600 (sampling

plan) with WAC 173-340-820 (sampling and analysis plan). Revision of the rule to assure consistency between these two regulatory programs is consistent with the explicit requirements of the Regulatory Reform Act of 1995. 1995 Wash. Laws, ch. 403, §§ 201(1)(h), 201(4).

6. Ecology should reconsider extending the rule at this time to include human health criteria, as well as criteria for fresh and low-salinity waters. Human health sediment criteria do not yet appear to have sufficient technical justification for incorporation into the SMS. Any promulgation of human health criteria must be based on technically defensible bioaccumulation studies and be thoroughly reviewed and validated by the Sediment Scientific Review Board (SSRB). Human health sediment criteria also have the very real potential to limit the workability of an already over-complicated rule.

We thank you for your attention to the issues we have raised and look forward to an improved regulatory scheme to address contaminated sediments.

Sincerely,

for WILLIAM L. PUGH, P.E.
Director

WLP:das (5185D)

File: Utility Services

Weyerhaeuser

Corporate Headquarters
Tacoma, Washington 98477
Tel (206) 924 2345

June 28, 1995

Mr. Brett Betts
Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

Re: Triennial Review Sediment Management Standards Chapter 173-304

Dear Mr. Betts:

Enclosed are Weyerhaeuser Company's comments on the triennial review process for Sediment Management Standards Chapter 173-304. We appreciate the opportunity to comment.

A potentially far reaching revision to the rulemaking authority of Ecology will occur on July 23, 1995 when ESHB 1010 becomes effective. ESHB 1010 includes new rule adoption criteria for "Significant Legislative Rules" proposed by Ecology. We believe that many of the changes contemplated in the triennial review process meet the definition of "Significant Legislative Rules" and are therefor subject to the adoption criteria found in ESHB1010. As proposed--in this review process--Ecology has not yet applied the adoption criteria. We expect that prior to rulemaking Ecology will address those criteria and allow for adequate public comment.

The following comments are offered for your consideration.

Amphipod Bioassay

We support the proposal to expand the list of amphipod species to include *Amplelisca abdita* and *Eohaustorius estuaris*. This action will reduce false positives associated with salinity and grain size effects.

Juvenile Polychaete Bioassay

We support the proposal to change the bioassay protocol to reduce false positives by determining elevated ammonia and sulfides concentrations in test waters. However, this may increase the cost of testing. We are also concerned that insufficient data are now available to evaluate whether incorporating a growth rate as a bioassay endpoint will result in a change in the performance standard. We suggest that Ecology resolve address that later issue in some manner.

Larval Bioassay

We support the proposal to change the larval bioassay protocol to reduce false positives in ether test waters or due to the lack of viable test species. The addition of *Strongylocentrotus droebachiensis* should allow for testing to be performed during certain time periods without viability issues. We are however concerned that insufficient data are now available to evaluate whether sensitivity of this species in comparison to other test organisms.

Chemical Summing of LPAH, HPAH, Benzofluoranthenes and Total PCB's

The proposed modification will ensure consistency between SMS and PSDDA data sets. The modification will accurately address the use of non-detected data for regulatory purposes. We support the proposal.

Sediment Management Standards Detection Limits

In the past Ecology has used the proposed approach on a case-by-case basis to address problems with detection limits for the chlorinated organics (compounded in low total organic carbon [TOC] sediments) and subsequent comparison to the SMS chemical criteria. We support the proposal to broadly adopt this approach.

Bioassay Holding Times

This is a significant and important change which will reduce sampling and analysis costs. We support the change because it will allow for determination of chemical concentrations (and need for biological testing) prior to biological testing.

Development of Marine Finfish Rearing Facilities Sediment Criteria

Given that public comment is open for this new SMS rule, Ecology should consider reproposing it after it has been compared to the adoption criteria for "Significant Legislative Rules" per ESHB 1010.

Freshwater Sediment Criteria and Human Health Sediment Criteria Development

Ecology is now in the process of developing both these significant SMS rule changes. Because of the significance of these rules we strongly suggest that Ecology now begin to assess these significant legislative rules per the criteria found in ESHB1010.

We appreciate the opportunity to comment. Should you have any questions, please feel free to contact me at (206) 924-3878.

Sincerely,

Kevin Godbout

Kevin Godbout
Environmental Affairs Manager

cc: Ken Johnson, CH1L28
Kris Holme, NWPPA
Julia Porter, Olympia

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Telephone (206) 733-4410
Fax (206) 676-7217

June 30, 1995

Mr. Brett Betts
Washington Department of Ecology
Sediment Management Unit
P.O. Box 47703
Olympia, WA 98504-7703

Dear Mr. Betts:

We have reviewed the attached written comments, prepared by Hart Crowser, Inc. for the Sediment Management Standard Triennial Review, and concur with those comments.

Georgia-Pacific West, Inc. submits these comments for your review and supports the recommendations.

Sincerely,

John L. Andersen

John L. Andersen
Environmental Control Director

Attachment

HARTCROWSER

Earth and Environmental Technologies

Hart Crowser, Inc.
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Fax 206.328.5581
Tel 206.324.9530

June 29, 1995

Brett Betts
Washington State Department of Ecology
Sediment Management Unit
P.O. Box 47703
Olympia, Washington 98504-7703

Re: Written Comments
Sediment Management Standards Triennial Review

Dear Brett:

Hart Crowser, Inc., on the behalf of Georgia Pacific Corporation, appreciates the opportunity to provide written comments for the Sediment Management Standards (SMS) Triennial Review. Our comments are as follows:

Sediment Cleanup Decision Process

It is unclear what the difference is between the MTCA and SMS hazardous assessment, particularly since the WARM does not include a sediment module. Until such time Ecology develops SEDRANK, clarification is necessary on what constitutes a SMS hazardous assessment or how a MTCA WARM process can identify a sediment cleanup site. Further, Ecology must clarify regulatory authority at existing CERCLA sites. The identification of "potential clusters of concern" and other SMS cleanup actions is duplicative and unnecessary.

AET Recalculations

Hart Crowser, Inc. has previously provided review and comments on the Draft Progress Re-Evaluation of Puget Sound AETs dated March, 1995. We would like to reiterate our interest in participating in the Regulatory Work Group designed to evaluate the use of AETs in a regulatory context and provide the following comments.

- As the number of biological tests for which AETs exist, Ecology should re-consider the use of the LAET as the SQS and the 2LAET as the CSL/MCUL. The continued use of the LAET and 2LAET is inconsistent with the EIS prepared during the development of the SMS rule. Further, the use of the 2LAET results in a overly conservative cleanup levels.

- The data set used for these re-evaluations has been significantly expanded since the 1993. Any rule changes must consider the following important synoptic data sets include:

    1. Pre-Design Field and Data Report, West Harbor Operable Unit, Wyckoff/Eagle Harbor Superfund Sites. January 30, 1995.

    2. Supplemental Remedial Investigation Project, Harbor Island Sediment Operable Unit, Harbor Island Superfund Site. July, 1995.

    3. Shannon Point Seafoods Phase II Sampling and Analysis Program. June, 1995.

- Additional data sets (discussed above) which support higher AETs (and MCULs/CSLs) for mercury are not currently included in the database used to re-calculate AETs. The exclusion of these data sets may result overly conservative cleanup levels and sites which are held to different standards.

- The AET re-calculation should address *Ampelisca abdita* and *Neathes arenaceodentata*.

- The 1994 Amphipod (*Rhepoxinius abronius*) AET for tributyltin is > 180 ppb. The Harbor Island Sediment Operable Unit data set (discussed above) provides sufficient data to develop AETs for a number of biological tests. Consequently, the opportunity of the development of SMS and PSDDA chemical criteria for TBT should be evaluated.

Protocol Modifications

<u>*Bioassay Holding Times*</u>

We strongly support this protocol change to extend the SMS biological testing sediment holding time from 14 days to 57 days (at 2° C), consistent with PSDDA protocols. This change will allow the determination of chemical concentrations (and need for biological testing) prior to biological testing. This is technically sound and will reduce the potential for incurring significant re-sampling costs.

Chemical Summing of LPAH, HPAH, Benzofluoranthenes, and Total PCBs

We support the SMS rule modification to address the use of non-detected data (U). The SMS method was inconsistent with PSDDA and resulted in LPAH, HPAH, Benzofluoranthenes, and PCB "Total" exceedences based on U data.

Sediment Management Standards Detection Limits

We support the discussion of problems with detection limits for the chlorinated organics (compounded in low total organic carbon [TOC] sediments) and subsequent comparison with SMS chemical criteria. The proposed action of using dry weight data (and non-normalized SMS chemical criteria for sediment less that 0.5 percent TOC has been successfully used by Hart Crowser (allowed for by SMS on a case-by-case basis).

Amphipod Bioassay

We support the proposed SMS rule change to expand the list of amphipod species to include *Ampelisca abdita* (not sensitive to fine-grained sediments greater than 60 percent fines) and *Eohaustorius estuarius* (not sensitive to changes in salinity). We believe this issue will reduce "false positives" associated with salinity and grain size effects.

Juvenile Polychaete Bioassay

We support the Juvenile Polychaete bioassay protocol change and a SMS rule change. The identification of toxic responses resulting from elevated ammonia and sulfides (false positives) by determining concentrations in test waters is important. This additional testing may reflect an increase in testing costs, though our experience is that the three bioassay labs we work with most frequently already perform such testing.

The SMS rule change incorporates growth rate as a bioassay endpoint, a revision previously incorporated in the PSDDA program. However, it appears that biomass and growth rate test results would be the same number. Finally, if these results are different numbers, we suggest that Ecology consider the regulatory implication of having two data sets with different interpretations (i.e., what about control sediments that do not meet 0.72 mg/day growth criteria?).

Larval Bioassay

We support the following Larval bioassay protocol and SMS rule changes:

- Seawater Control Performance;

- Reference Performance;
- Test Performance;
- Laboratory Procedures;
- Non-Treatment Factors; and
- Bioassay Test Species.

Because these issues are the result of the PSDDA/SMS bioassay protocol workshop and are generally supported by the "scientific" community, we believe that these modifications are positive. For example, the Non-Treatment Factors issue is designed to identify toxic responses resulting from elevated ammonia and sulfides (false positives) by determining concentrations in test waters. The addition of *Strongylocentrotus droebachiensis* as a SMS confirmatory marine sediment biological test will reduce problems with viable (not stressed) larval species not being readily available from January to April, resulting in "false positives" and increased re-sampling costs.

WASP Modeling

The EPA model WASP is specifically identified by the SMS (and SCUM2) for the evaluation of sediment recontamination potential, sediment recovery zones (SRZs), and sediment impact zones (SIZs). We strongly support Ecology efforts to implement these management tools. However, based on our experience, the application of this model is complex and requires specific expertise (not provided in existing Ecology documentation). Further, the application of WASP to sediment remediation projects is costly and requires agencies to agree on modeling approaches upfront. Unfortunately, without identified agency WASP experts (and access), parties applying WASP are subject to inefficient, lengthy, and costly reviews. We recommend that:

- Ecology identify specific staff (WASP experts) to work upfront with consultants to clarify model application and approach issues;
- Ecology enter into an agreement with EPA to provide WASP support for CERCLA projects. This support must include technical working groups (to clarify model application and approach issues) and extend beyond a model results "review" capacity; and
- Ecology establish a WASP Technical Work Group to work through a specific application of WASP (Thea Foss and Wheeler-Osgood waterways, for example).

Natural Recovery as a Remedial Alternative

The SMS, consistent with EPA strategies, recognizes natural recovery as a remediation alternative. The Sediment Cleanup Users Manual (SCUM2) provides a brief description of natural recovery processes and discusses SEDCAM. However, we believe that

SEDCAM does not include the processes most likely to result in sediment concentration decreases. Other models (WASP or Officer and Lynch) are better suited to natural recovery evaluations. Further, the role of natural recovery in the protection on human health and the environment does not seem to be widely recognized (i.e. fish tissue concentrations decrease with surface sediment concentrations). We recommend that Ecology establish a Technical Work Group to discuss:

- The role of natural recovery in sediment remediation strategies;
- Sediment dynamics important to natural recovery processes;
- Methods for quantifying sediment processes;
- Methods for performing natural recovery evaluations (models); and
- The regulatory application of natural recovery.

Development of Marine Finfish Rearing Facilities Sediment Criteria

We are strongly opposed to Ecology developing sediment quality criteria to assess the impacts from marine finfish rearing facilities (net pens). The assessment of potential biological impacts due to the accumulation of organic material (food and fecal matter) below the pens relies on the benthic abundance biological test (and the ability to find an appropriate reference site). These proposed sediment criteria are not consistent with the existing SMS rule and their implementation will be problematic. Once this rule is in place, eventually areas with a natural accumulation of organic material that "fail" the criteria will be identified. Given that net pens represent a small fraction of the Puget Sound surface area, we believe that efforts should focus on "source control" and recovery rates (i.e. rotate net pens to different sites).

Human Health Sediment Criteria Development

We believe that Ecology should consider very carefully the development and implementation of human health sediment criteria. The application of the most restrictive criteria (protection of natural resources versus human health) to sediment source control and cleanup activities may be grossly conservative. Our primary concerns address predictive assumptions necessary to address sediment criteria protective of human health and include:

- Bioaccumulation factors;
- Consumption rates;
- Exposure routes (whole fish, fillets, etc.); and
- Selection of population appropriate to "protect".

Where a significant human health concern exists, monitoring of "edible" fish tissue will provide the necessary information to develop an appropriate response.

If I can provide any additional clarification, please do not hesitate to give me a call at (206) 324-9530.

Sincerely,

HART CROWSER, INC.

David W. Templeton

DAVID W. TEMPLETON
Associate

429901\tri-cmts.ltr

The Boeing Company
P.O. Box 3707
Seattle, WA 98124-2207

Mr. Keith Phillips
Washington Department of Ecology
Sediment Management Unit
PO Box 47600
Olympia, WA 98504-7600

BOEING

Dear Mr. Phillips:

Thank you for the opportunity to respond to the triennial review of the Washington State Sediments Management Standards, WAC 173-204. The Boeing Company is a waterfront property owner employing 95,000 people in Washington State for the construction of aircraft and aerospace products. Representatives of The Boeing Company have participated in the Department of Ecology's Sediment Implementation Team and on the Urban Sediment Task Force. Our comments are based on the needs identified during these meetings to create a workable sediment management strategy that protects the public health and environment while recognizing the extraordinary difficulty and costs involved in sediment management.

The sediment management program recognizes that benefit analysis must be a part of the process for "applying sediment standards as the basis for management····". There is Ecology advisory committee concensus that in most cases, mechanical cleanup methods present more of a hazard to the environment than leaving the sediments alone. Many cases have verified that limited "hot spot" cleanups would achieve most of the program's goals with minimal damage to the environment, and also reduce demand on agency and business resources. The benefit analysis concept should be incorporated in WAC 173-204-100 (2).

Increased emphasis on controlling the discharges from storm water, industrial sources and non-point sources needs to be the keystone to the sediment management program. While this is currently a component of the sediment management program, it is not given the priority status as the first action that needs to be taken. Only with diligent application of discharge controls can sediment recovery be effective. These discharge controls need to encompass all aspects of state and local permitting actions. The discharge control program should use a mix of baseline general permits and specific individual permits to address watersheds or drainage areas needing special attention.

BOEING

Itegral to the concept of discharge controls is the premise that natural recovery is the primary means of recovering a contaminated sediment site. Once effective discharge source control is in-place, a process of monitoring sediment recovery should be commenced. If it can be shown that the sediments will naturally recover to the "Cleanup Screening Level" and ultimately below the "Sediment Quality Standards" within a reasonable time frame (10/25 years respectively) then no mechanical cleanup action should be taken.

A minimalist approach should also be used when a mechanical clean-up is needed. The process should favor removal of the minimum amount of contaminated sediment (a hotspot) to the cleanup screening level (CSL). The subject site would then be re-evaluated using the multiple sampling techniques established for site identification. Those sites that have "cluster" values below CSL but above SQS would be placed into a monitoring condition to determine if natural recovery will suffice for management of the remaining contaminants. This approach can be incorporated into WAC 173-204 sections 550 through 590 dealing with clean-up evaluation, selection and impact zones.

No sediment removal actions should be required until an environmentally and economically satisfactory multi-user sediment disposal site has been constructed. This site should be part of a larger scheme for the management of contaminated sediment from channel dredging and cleanup actions. When available, Ecology should encourage the use of inland fill or shoreline development projects as the recipients for cleanup dredged material. This encouragement could take the form of relaxing selected regulatory requirements for the collection, monitoring, and liability associated with the final disposition of the sediment.

Baywide plans for habitat restoration, dredge disposal, sediment cleanup and agency cooperation /coordination should be established prior to any sediment cleanup action. These plans should focus on the means to meet sediment management goals with the least disruption of the environment and lowest resource requirements of the agencies, governments and property owners involved. Bay-wide plans should also address issues of natural resource trustees to ensure that their needs are blended into the overall effort. Also, baywide plans may be incorporated into watershed management plans when waste / storm water discharge parameters indicate a need to create a coordinated effort to manage sediment.

BOEING

Current efforts to establish a human health criteria should abandon the bioaccumulation factor approach currently being pursued. We recommend that the muscle tissue toxic level test be considered as a practical alternative to bioaccumulation factors. Muscle tissue levels are directly measurable indicators of exposure. Mr. Lincoln Lohr, representing Kaiser and ASARCO, provided several examples of the validity of the muscle tissue approach during the Ecology work group meetings. The Ecology contracted expert agreed that muscle tissue could be used with some additional studies.

Please contact Mel Oleson (393-4712) or myself with any questions.

Very truly yours,
BOEING SAFETY, HEALTH AND ENVIRONMENTAL AFFAIRS

E Berkitis for HFK

Hannah Kimball
Manger Environmental Operations
Phone: 206-393-4782, M/S 7E-EH

Port of Seattle

June 27,1995

Brett Betts
Department of Ecology
Environmental Review and Sediment Section
P.O. Box 47703
Olympia, Washington

Dear ~~Mr~~ Brett Betts

This letter documents our telephone conversations of June 22, 1995 that were the final resolution of previous discussions with you, Keith Phillips and Maria Peeler regarding the June 30, 1995 closing date for comments on the Sediment Management Standards Triennial Review. In that final conversation, you assured us that comments submitted by the end of July will be included in the record for the Triennial Review.

We appreciate this additional time as it will allow us time to meet with you and Pamela Sparks-McConkey, on the Benthic Infauna Assessments, and allow time for Conrad Leigel to return from overseas to help finalize our comments. This will help us submit comments that are more to the point and therefore more helpful for both the Port and Ecology.

Thank you again for the additional time. We look forward to working together with you in this process. If you have any questions, plese feel free to call me at 206-728-3192.

Sincerely,

Douglas A. Hotchkiss,
Environmental Management Specialist

3196V
DAH

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Port of Seattle

July 28,1995

Brett Betts
Department of Ecology
Environmental Review and Sediment Section
P.O. Box 47703
Olympia, Washington

Dear ~~Mr Betts~~ Brett

This letter documents our telephone conversations of July 26, 1995 in which we discussed some additional time to complete our comments on the Sediment Management Standards Triennial Review. In that conversation, you assured us that comments submitted by the middle to the end of August would be included in the record for the Triennial Review. Though, as you would be beginning your compilation of all comments in early August, the earlier you recieved comments of a major nature the easier it would be for your proccessing. .

We appreciate this additional time as it will allow us time to get together with our consultant team for a final review, revision period, after they return from personnel leaves and from overseas business. We intend to provide comments to you by August 15th.

Thank you again for the additional time. We look forward to working together with you in this process. If you have any questions, plese feel free to call me at 206-728-3192.

Sincerely,

Douglas A. Hotchkiss,
Environmental Management Specialist

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Received Aug 22, 1995

Port of Seattle

August 15, 1995

Brett Betts
Washington Department of Ecology
Sediment Management Unit
P.O. Box 47703
Olympia, WA 98504-7703

Re: Triennial Review of State Sediment Management Standards

Dear Mr. Betts:

On behalf of the Port of Seattle (Port), we appreciate this opportunity to comment on the Washington State Sediment Management Standards (SMS Rule), ch. 173-204 WAC, as part of the triennial review process of the Department of Ecology (Ecology). We also appreciate the extension you provided to us in making our comments, as it allowed us to review some relatively recent sediment data collected from Harbor Island and their implications for possible SMS Rule revisions.

The bulk of the comments that follow address our continuing concerns with certain aspects of the existing rule. We also address our concerns with the potential expansion of the rule in the area of specific human health criteria. Where possible, we have organized our comments to track the SMS Rule itself.

GENERAL COMMENT ON IMPORTANCE OF TRIENNIAL REVIEW PROCESS

We ask that you give the enclosed information and comments provided below your careful consideration. As the first state in the country to adopt a rule with specific pass/fail sediment criteria, Washington State must accept its continuing obligation to critically review the effectiveness of the SMS Rule and make any necessary modifications. As you will recall, at the time of adoption of the SMS Rule in 1991, Ecology explicitly recognized this need for continued review of the SMS Rule and committed itself to identifying the latest scientific knowledge and modifying the SMS Rule accordingly. WAC 173-204-130; see also Washington Department of Ecology Commitments for Rule Implementation and Review, dated April 12, 1991 (Enclosure No. 1). Key administrative commitments contained in the SMS Rule include:

- Modifying the rule using methods that reflect the latest scientific knowledge consistent with the sediment quality goals of the rule (WAC 173-204-130(1));

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- Modifying the rule so that the technical methods identified in the rule continue to accurately reflect the latest scientific knowledge as established through ongoing validation and refinement (WAC 173-204-130(3)); and

- Conducting an annual review of the rule and modifying its provisions every three years, or as necessary (WAC 173-204-130(6)).

Four years have now passed and, in spite of the problems that have plagued rule implementation since its adoption and the numerous recommendations for rule improvements that have been provided to Ecology during this time period, Ecology has failed to act.

It is time for Ecology to do more than simply discuss the issues and gather comments. It is time for Ecology to revise the SMS Rule. We sincerely believe that the comments and suggestions discussed below, if incorporated into revisions of the SMS Rule, would result in a rule that is more efficient, more workable and, in the end, more likely to provide real improvements to the environment of the State of Washington.

SPECIFIC COMMENTS ON SMS RULE

Part III -- Sediment Quality Standards

1. Reconceive sediment quality criteria as "screens" or "flags" instead of "pass-fail" evaluations. Our first comment concerning the existing sediment quality criteria speaks to the fundamental nature of the criteria. We recommend that Ecology reconceive the criteria in their entirety, abandoning the pass/fail model. Given the well-documented technical limitations on existing methods for assessing sediment contamination, numerical sediment criteria should not be used as "pass-fail" water-quality standards, cleanup triggers, or dredged-material disposal requirements.

Our proposal would be to amend the SMS Rule to expressly recharacterize the nature of the Rule's chemical criteria. The Rule should state that criteria based solely on sediment chemical concentrations are not regulatory limits. They are instead merely flags, or first pass screens, to be used in determining whether to pursue further review and possible regulatory action. Accordingly, under the Rule, sediments that exceed the sediment quality chemical criteria should not be presumed to have adverse effects. See WAC 173-204-310(1)(b). They should instead be noted for further review. Further review may include the single organism acute and chronic effects tests described by the current rule. Id. at 310(2)(a). It may also include benthic community testing (see comment 4 below).

Using the criteria in this way would provide useful information to the agency and the regulated community when dealing with site specific issues, yet would avoid unnecessarily binding either to rote regulatory responses. It would therefore allow for more flexible and focused responses than does the current pass/fail model. See EPA's Contaminated Sediment Management Strategy, 25-27 (Office of Water, August, 1994) (discussing the Scientific Advisory

Board's rejection of pass/fail sediment quality criteria). More flexible and focused responses are particularly needed in the Superfund context, where there is a tendency by EPA (and other agencies) to mechanistically apply Ecology's numerical sediment criteria as "applicable or relevant and appropriate requirements" (ARARs) without regard to the array of factors beyond chemical concentrations that affect actual toxicity and environmental impact. See Enclosure No. 2 (SMS/AET Analysis of Harbor Island Data Set).

2. Recalculate chemical criteria based upon new information. Our second comment concerns the sediment quality standards' chemical criteria. WAC 173-204-320. The comment applies equally, however, to the chemical concentration criteria set out in the source control and cleanup portions of the rule. WAC 173-204-420 (sediment impact zone maximum chemical criteria); id. at 204-520 (chemical criteria establishing cleanup screening levels and minimum cleanup levels). Consistent with Ecology's commitment to regularly revise the rule to reflect the latest scientific knowledge, id. at 204-130(3), (6)-(7), Ecology should systematically recalculate the chemical criteria. These criteria were set by rule over four years ago, and were established on the basis of a database that has since been greatly expanded and improved. This new data, which includes the enclosed sediment data from Harbor Island, reveals weaknesses in the original data set and calls into question its predictive ability. Enclosure No. 2 (SMS/AET Analysis of Harbor Island Data Set) provides a comparison of the Harbor Island Data Set and the existing SMS and 1994 Apparent Effect Thresholds (AETs) with respect to their predictive ability and illustrates quite clearly the need to move forward with recalculating the chemical criteria based upon the new sediment data. Accordingly, Ecology should now review the data set upon which the criteria are based, cull out bad data points, add in all new data, and recalculate the criteria. By doing so, Ecology will not only demonstrate compliance with its stated policy, it will also reassure those implementing the rule, and those affected by it, that actions taken in reliance on the rule are reasonable in light of the best available information.

In undertaking this task, Ecology should address and accept a fundamental policy issue, which is that recalculation of the criteria may well result in legitimate increases in the criteria for some chemicals. This potential was clearly understood during the rule development process. As you will recall, a concern of the regulated community at that time was that Ecology might back away from increasing the numerical criteria because of anti-backsliding policies and predilection. Ecology assured us then that it would stand firm behind its scientific and iterative approach to rule implementation and would revise the numbers upward if new data warranted doing so. In fact, given the difficulty of trying to isolate the ecological harm of a specific contaminant in sediments that contain multiple contaminants, it is more likely that the numerical criteria will increase as more data is analyzed than that they will decrease. Admitting that some criteria will rise as a result of recalculation should not, however, be considered a regulatory failure. It should instead be recognized as a needed improvement in the accuracy and value of the criteria, which were admittedly rough estimates when first adopted. Ecology should, therefore, be wary of resisting this trend by using methodologies that are biased toward lowering the criteria.

One example of a biased methodology is filtering out high data points based on the presumption that they are the result of quality control problems. If a data point or set is bad because of demonstrated quality control problems, it should be filtered out of the overall database (trying to keep as much of the data as is possible). It should not, however, be rejected merely because it is inconsistent with preconceived notions about what is and what is not toxic. Consideration should be given to why data is flagged for Quality Analysis/Quality Control (QA/QC). Often, it is for reasons that would not necessarily affect the validity of the sample, such as when there is high mortality in the reference samples but low mortality in the project samples. In such cases, the lowest acceptable mortality of the reference sample could be used to include the data in the AET data set. Currently, Ecology appears to be filtering out about half of the data being evaluated for inclusion in the AET data set. This has the effect of elevating the status of the original data set and its predictive capacity relative to incoming data sets and of ossifying existing numerical criteria at or near their current values. Ecology should strive for a data evaluation approach that is more accommodating of new data. Doing so will result in an evolving data set that more truly reflects sediment impacts in Puget Sound and therefore is more predictive of future impacts.

Another example of a biased methodology is the PSDDA agencies' proposed addition of another larval abnormality test (echinoderm) for calculating AETs for Puget Sound. If a new test is used in calculating AETs (even if the test is functionally equivalent and within the same sensitivity range), then logically, the AETs, and consequently the SMS chemical criteria, can only decrease. (This is easily proven statistically. We will be glad to provide this proof if needed.) The better and less biased methodology would be to pool the oyster and echinoderm data into one abnormality category. These tests have been judged functionally equivalent larval bioassays when they were allowed to be used as alternative bioassays in the protocols. There is no good justification for using them as separate AETs.

We are enclosing a large data set from the Sediment Unit of the Harbor Island Superfund Site (Enclosure No. 3 [Harbor Island Data Set]). This data set has the potential to be important in evaluating the insitu toxicity of some chemicals, and should be included in any recalculation of SMS Rule chemical criteria. Although we are still finalizing the QA/QC work, our preliminary review of the data indicates that including the data in the recalculation process will improve the reliability of the AETs, and should, in several instances, result in higher AETs and higher chemical criteria. We will continue to work with Ecology in preparing the final data set and analysis.

3. <u>Recognize and institute procedures to minimize false positives resulting from interfering factors in bioassays</u>. The potential for false positives in the bioassays to confound regulatory decisions regarding sediments is well documented. Some of the common potential interferences which can cause significant mortality in test organisms include ammonia, sulfide, grainsize and salinity. As we stated in our comment letter to the PSDDA agencies (a copy of which was sent to you), the Port is seeking more open recognition of the potential problems and the institution of procedures for evaluating stations with potential interferences.

In an effort to address these interferences, the Port has contracted with Battelle to review existing data and recommend some immediate procedures and some potential future procedures.

The major recommendations and conclusions of the Battelle study are summarized briefly below. (Battelle's report, including a more detailed set of recommendations and conclusions, is included as Enclosure No. 4 [Battelle Report].)

- First, the end use of the data needs to be taken into account when determining the method appropriate for minimizing potential interferences. Some methods are more appropriate for determining the true toxicity insitu (e.g., using low salinity tolerant organisms for low salinity sediments), while other methods are more appropriate for determining the true toxicity once a sediment has been dredged and deposited at the open water disposal site (e.g., adjusting the salinity in the pore water, and testing at the higher salinity with the more common Repoxinius.).

- Second, a party sampling sediments under the SMS Rule should have the option of using procedures to minimize, track, and identify interferences leading to false positives. A brief outline of the additional protocols that should be available for consideration by parties and agencies is enclosed as Table 1 (the actual procedures used would be a site- and action- specific subset of the following list). These procedures should be discussed with and hopefully agreed upon by the agency and the party prior to the sampling. The agencies should be urged to take all concerns regarding false positive interferences seriously and work toward an up front understanding of appropriate additional protocols.

Ecology addressed the issue of false positives in its recent publication of Margaret Stinson's "Review of Sediment Management Standards Bioassay Protocols." Although we are glad to see Ecology beginning to recognize the problem of false positives, we believe that Stinson's paper failed to appreciate the need for revised procedures that would minimize the potential interfering factors that result in false positives. Our comments on Stinson's paper are included as Enclosure No. 5.

4. Provide greater emphasis on benthic community assessment data in determining whether sediments exceed regulatory limits. Benthic studies are especially valuable because they directly measure the abundance of the animals potentially impacted by contaminants. As such, they should potentially be given more weight than the bioassays under the SMS Rule in determining whether sediments exceed regulatory limits and need active remediation. Under the existing SMS Rule, sediments exceed regulatory limits if they fail more than one biological test. Thus, sediments can exceed regulatory limits even if they exhibit a healthy and diverse benthic community. Detailed benthic studies indicating a healthy and diverse benthic population should be allowed, under appropriate circumstances, to override both the chemistry and the bioassays as a third tier screen when considering large expensive active remediation projects.

Our proposal would be to revise the SMS Rule to allow the optional use of benthic community testing as a final determinant of sediment quality. In those situations where it is used, sediments with a healthy community would be treated as having no adverse effects even if the sediments had chemical levels above the criteria screening levels and had failed one or more of the bioassays. Allowing the use of benthic community testing in this manner would provide a mechanism for addressing the acknowledged problem of "false positive" bioassay results (see comment 3 above). It would also recognize that benthic community testing may, in appropriate instances, be a better indicator of actual sediment quality than either of the surrogate tests currently embodied in the rule. Finally, it would lessen the possibility of destroying healthy benthic communities through restoration projects that are, theoretically, intended to protect those very communities.

The type of benthic community testing envisioned here is more detailed than the current procedure allowed in the SMS. It addresses some of the issues Ecology is currently investigating, and some of the concerns we mentioned at the SMARM meeting in May and that Jack Word of Battelle discussed with Pamela Sparks-McConkly of your office last month. Briefly, our concerns include the following:

- Currently, the SMS benthic standards are controlled by the abundance of a few major taxa at less than 10 stations in Commencement Bay. The sediment at individual stations in this group has optimum total organic content (TOC) concentrations for those individual species that control each major taxa group. Lower densities of these taxa at other locations are being attributed to contamination. Differences in abundances, however, are often correlated with high TOC in urban bays. As such, the observed differences in abundance could very frequently be due to high TOC rather than contaminant toxicity.

- We support benthic studies in reference areas but we would like to see the reference areas expanded to include deeper stations to evaluate potential effects at sediment disposal sites.

- There are several Metro data sets from the early to mid 1980s that should be added to the SEDQUAL benthic data set.

- Interstitial water ammonia, salinity and, if possible, H2S measurements should be made during benthic studies, as there is a good possibility that some benthic effects may be due to the known interstitial toxicity of these interfering factors.

We feel that the best approach to assessing the benthic effects is in the infaunal trophic index. The Ecology recommended choice of the Swartz diversity index does not provide the level of information necessary to make the required detailed assessment of the benthic community. Though requiring a higher degree of expertise in identification, understanding the functional and ecological relevance of the community is necessary to determine true impacts.

The Battelle Report (Enclosure No. 4) includes the details of our benthic concerns. We ask that you consider carefully the comments provided in this technical report in making necessary revisions to the SMS Rule.

5. Incorporate Ecology proposed technical revisions to the SMS Rule. Ecology should incorporate the technical revisions to the SMS Rule proposed in its Public Notice regarding the SMS Triennial Review Process addressing the following rule requirements: amphipod bioassay test requirements; juvenile polychaete bioassay test requirements; larval bioassay test requirements; chemical summing for LPAH, HPAH, benzofluoranthenes and total PCBs groups; and bioassay holding times. Although we sympathize with Ecology's desire to approve these test modifications on a case-by-case basis consistent with the requirements of WAC 173-204-130(4) for approval of alternate technical methods, we do not believe that this alternate technical method approach should be a substitute for rule revision.

6. Do not extend the SMS Rule at this time to include human health criteria. Finally, we must comment on the proposed addition of human health criteria, as well as criteria for fresh and low salinity waters. While the concept behind promulgating such criteria may be laudable, we are convinced that doing so at this time would be a mistake, and would frustrate Ecology's implementation and further improvement of the existing rule.

As has been clearly demonstrated by the discussions in the various sediments work groups, the scientific issues surrounding implementation of the existing rule are fraught with uncertainty. This uncertainty, when combined with the overall complexity of the rule as it applies to real world sediments problems, poses real questions about whether or not the rule works on the most basic level. Problems of workability would only be exacerbated by promulgating additional criteria at this point, as each new set of criteria would, of necessity, further complicate the rule's application, and add to the already considerable uncertainty.

Ecology has recently issued the Department of Health's Tier I Report: *Development of Sediment Quality Criteria for the Protection of Human Health* (June 1995). This report describes the many uncertainties associated with human health sediment quality criteria. It also substantiates the potential effect of human health sediment quality criteria on implementation of the SMS Rule. Depending upon the assumptions ultimately used in deriving the human health sediment quality criteria values, the criteria have the potential to characterize large areas of Puget Sound as contaminated and to drive decision-making and regulatory activities with respect to contaminated sediments.

Given this potentially far-reaching impact, Ecology should take a step backward and assess whether the well-documented uncertainties associated with human health sediment quality criteria justify the promulgation and application of numerical criteria at this time. We believe that they do not.

However, should Ecology continue in its efforts to promulgate human health criteria at this time, Ecology must submit the criteria to the Sediment Scientific Review Board (SSRB) for thorough review and validation. At a minimum, Ecology should validate its human health sediment criteria through site-specific bioaccumulation studies and a full uncertainty analysis of the criteria. Promulgation of human health criteria without performing this kind of thorough analysis would be a disservice to the public and could generate unnecessary anxiety, especially if the rule suggested, as have some of the preliminary models, that background levels of substances like PAHs are "dirty" by several orders of magnitude.

Further, under the Regulatory Reform Act of 1995, adoption of human health criteria would constitute adoption of a "significant legislative rule." 1995 Wash. Laws, ch. 403, § 201(5)(c)(iii) (Engrossed Substitute House Bill 1010). As such, Ecology would be required to subject the proposed rule to the full review required by the Act. Id. at § 201(1)-(4). As part of this review, Ecology would have to confront an explicit policy of the Act, which is to discourage promulgation of state regulations that are more stringent than corresponding federal regulations. Id. at § 201(1)(g). This policy clearly applies here as there are no federal sediment management standards. The statute implements the policy by requiring Ecology to determine, before promulgating a more stringent state rule, that a state statute explicitly allows for such a rule, or that there is substantial evidence that the difference is necessary to achieve the goals of the statute the rule will implement. In this instance, none of the statutes being implemented appear to explicitly allow for more stringent human health sediment criteria. Accordingly, Ecology must determine that there is substantial evidence that more stringent rules are necessary. This burden is clearly more demanding than the one embodied in the arbitrary and capricious standard of review. Ecology should, therefore, defer to the policy of the legislature and decline to promulgate human health criteria until such time as they are clearly necessary and supported by the evidence.

Part IV -- Sediment Source Control Standards

7. Continue to make source control a top priority in the SMS Rule. With regard to the source control provisions of the SMS Rule, we believe that the rule's fundamental structure is sound in that it recognizes the critical role of pollution prevention in managing sediment contamination. Making prevention of further sediment contamination a top priority is a cost-effective policy. Further, when combined with the processes of natural recovery, pollution prevention will result in a significant overall improvement in environmental quality.

Part V -- Sediment Cleanup Standards

8. Focus active cleanup efforts on hotspots to accelerate cleanup at the worst sites. Our principal comment on the sediment cleanup standards concerns the prioritization of cleanup efforts. Rather than requiring all of each cleanup area to meet the current minimum cleanup levels, Ecology should instead focus our State's limited cleanup resources on cleaning up sediment hotspots. The remaining areas that exceed the Sediment Quality Standards should then be protected through source control, and allowed to recover naturally. See Sediment Cleanup Workgroup, Final Report, 8 (December 20, 1994).

From a technical standpoint, Ecology could achieve this in several ways. First, Ecology could rethink the "Regulatory Beauty" approach and raise the Cleanup Screening Level, WAC 173-204-520, so that it is higher than the existing regulatory limit. For example, a new cleanup screening level could be set at the "moderate adverse effects" level considered in the

Environmental Impact Statement for the Sediment Management Standards (1990, p. 2-21) or at a level that requires failure of both an acute bioassay test (such as the amphipod test) and a chronic bioassay test (such as the benthic community assessment test). Only sediments that exceed the new cleanup screening level would be identified as sediment cleanup sites requiring active remediation. Sediments that exceed the Sediment Quality Standards but not the new cleanup screening level would either recover naturally or be cleaned up incidental to project actions.

Alternatively, or in addition to the approach outlined in the previous paragraph, Ecology could modify WAC 173-240-570 to limit active cleanup only to those areas where the sediments would exceed the Minimum Cleanup Level after 10 years (MCUL10). WAC 173-204-570(3) and (4). Under the existing SMS Rule, a sediment area that exceeds the Sediment Quality Standards but not the Cleanup Screening Level (set at a level equal to the MCUL) is a station cluster of low concern and not a sediment cleanup site. WAC 173-204-510(2). On the other hand, any sediment area that exceeds the Sediment Quality Standards and includes a sediment area above the MCUL is a sediment cleanup site in its entirety, with the actual sediment cleanup standard for the site established on a site-specific basis in consideration of the net environmental effects, cost and engineering feasibility of different cleanup alternatives. WAC 173-204-530(4) and 570(4). But for the sediment area above the Minimum Cleanup Level, such areas would not be sediment cleanup sites and would be left to recover naturally. Under the SMS Rule modification proposed herein, such areas would be left to recover naturally by rule.

Providing language in the SMS Rule that focuses active cleanups on contaminated sediment hotspots has a number of salutary benefits. First, it makes the best use of the State's limited cleanup resources and sediment disposal sites. Second, by giving greater recognition to the process of natural recovery, as discussed below, it spares relatively healthy benthic communities the extreme disruption of the most common cleanup techniques. Third, it considerably lessens the liability concerns of aquatic landowners, and their lenders, resulting from historical and ongoing discharges. Finally, it avoids gridlock. Under the current regime, a large portion of the state's submerged lands are considered to be in need of cleanup. Ecology and the regulated community simply cannot accomplish the complicated process of weighing net environmental benefits, cost and engineering feasibility to determine site-specific cleanup standards for such a vast array of sites. As a result, many sites are never addressed. Of the sites that are addressed, many are merely targets of opportunity, or sites where ongoing projects otherwise require regulatory approval. Using this method to select sites that will receive attention is inequitable in that the target of opportunity sites are disproportionately required to meet the full burden of the cleanup standards. It is also questionable policy in that sites are prioritized for cleanup not on the basis of risk, but on the basis of happenstance. For all of the above reasons, Ecology should revise the SMS Rule to more sharply focus active cleanup efforts on selected hotspots.

9. Give greater recognition to the process of natural recovery. Consistent with limiting active cleanups to selected hotspots, Ecology should give greater recognition to the process of natural recovery. The lack of toxicity in the most recent data set from the Sediment Unit of the Harbor Island Superfund Site (Enclosure No. 3) indicates that natural recovery can

and will occur in many sediment areas once source control is achieved. Where natural recovery will occur within a reasonable period of time, it has distinct advantages over active cleanup, not the least of which is that benthic communities are spared the extreme disruption of the most common cleanup techniques, dredging and capping. One specific way in which Ecology could recognize the process of natural recovery is by including it amongst the ways in which a site could be "de-listed." As Teresa Michelsen of Ecology has noted in her 1993 SMS Annual Review Comments, natural recovery of sites previously listed "may happen quite often." Annual Review Comments, August 25, 1993, at 2. Accordingly, Ecology should add a section to WAC 173-204-540(6) which recognizes natural recovery and provides for delisting when natural recovery is adequately demonstrated.

10. Reduce barriers and provide incentives for voluntary cleanups. Ecology should seek to encourage voluntary cleanups wherever feasible. Ecology has stated this as one of its cleanup policies. WAC 173-204-550(3)(b). Others, including the Sediment Cleanup Workgroup, have noted the importance of a regulatory regime that encourages voluntary cleanup. See Sediment Cleanup Workgroup, Final Report, 8 (December 20, 1994). In practice, however, there are process and regulatory barriers that frustrate voluntary cleanups. One example is the water quality certification process. Absent Ecology's willingness to issue conditional or partial certifications, it becomes nearly impossible to obtain the federal permits necessary for undertaking the activities typically involved in a voluntary cleanup. Ecology should, therefore, review the Sediment Management Standards with an eye toward facilitating voluntary cleanups wherever practicable.

11. Simplify and clarify cleanup study plan and report requirements. Our final comment is process related. It concerns the cleanup study plan and report requirements. WAC 173-204-560. As currently drafted, this section is both confusing and inefficient. It is confusing in that the differentiation between what is required in a cleanup study plan and a cleanup study report is poor. According to Teresa Michelsen of Ecology (Annual Review Comments, August 25, 1993), some of the information currently required in a plan is not available until after the study has actually been completed. We therefore recommend that the rule be revised to clearly differentiate between what must be included in a cleanup plan, and what must be included in a cleanup report.

The current study plan requirements are, however, not only confusing, they are also inefficient. The inefficiency arises because the cleanup study plan requirements of the Sediment Management Standards are not consistent with the study requirements of the Model Toxics Control Act Rules. When both the Standards and MTCA are implicated for a specific cleanup, the provisions of these two regulatory authorities should be consistent in order to facilitate moving the cleanup through the regulatory process. Ecology should therefore engage in a thorough review and revision of WAC 173-204-560 and, at a minimum, ensure its consistency with the parallel provisions of the MTCA Rules. Compare WAC 173-204-560 (SMS cleanup study plan) with WAC 173-340-350 (MTCA RI/FS) and WAC 173-204-600 (SMS sampling plan) with WAC 173-340-820 (MTCA sampling and analysis plan). In the alternative, Ecology should consider adopting an exception to the cleanup study plan requirement in those situations where a similar plan has been developed under MTCA. Both options are strongly supported by the newly enacted Regulatory Reform Act of 1995. See ESHB 1010, §§ 201(1)(h), 201(4).

CONCLUSION

For four years, Ecology has heard from the public about the problems associated with the Sediment Management Standards Rule and its implementation. This year's triennial review of the SMS Rule will serve no useful purpose unless the Department of Ecology finally acts to propose solutions to these problems and initiate revisions to the rule. We are prepared to work with Ecology in this endeavor, and flesh out our suggestions into specific rule language for your consideration, if Ecology will commit itself to exercising real leadership and seeing the process through to its conclusion.

We thank you for the opportunity to comment on the SMS Rule and suggest how it may be improved.

Port of Seattle

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TABLE 1

Recommended Additional Protocols To Minimize False Positives Resulting From Interfering Factors in Bioassays

	For Solid Phase Tests (Amphipod)	For Larval Toxicity / Abnormality Tests
For Salinity	•Measure the interstitial salinity. •Use low salinity tolerant species. •Compare to the established does/response curve, and only consider toxicity not accounted for by the salinity. •Use species not exposed to interstitial water.	Not an issue.
For Ammonia	•For all tests, the ammonia, pH, temperature and salinity need to be measured on the sample as it is being taken in the field. and also prior to and during the tests on interstitial or overlying waters. •Temperature increases in samples during sampling, transport,storage and testing must be carefully avoided. •Ammonia reference toxicant tests should be performed on same populatiions at the same time as testing. Compairison of dose/response curves to test doses and responses for appropriate time period. Consider the toxicity that exceeds the ref.tox dose/response only.	
	•Manipulate the levels of ammonia in the interstitial water by waiting untill NOEC is attained by natural bacterial activity. •Manipulate the levels of ammonia in the interstitial water by EPA approved protocol (2 exchanges of water per day untill NOEC is attained). • Use organisms that are less intimately associated with the interstitial water. •Avoid any protocols requiring sediment sterialization.	• Allow additional time for natural bacterial reduction of ammonia to NOEC in the overlying water prior to test initiation. •Use species more tolerant of ammonia.
For Grainsize	•Use a range of reference sediments that encompass the range of expected sample tests, and compair to reference •Use more tolerant species. •Compare to the established dose/response curve. Only consider mortality that exceeds that relationship.	•.Use a complete range of reference sediments and compair to reference. •Use more tolerant species. •Further increase the settling time to decrease the effects of suspended sediment.
For Hydrogen Sulfide	•For all tests, analytical difficulties confound separating the effects of hydrogen sulfide from anoxia. Project proponents should be encouraged to develop and propose procedures to measure hydrogen sulfide, and its potential effects, in interstitial and overlying waters. •The proposed sediment and water manipulation procedures for ammonia may provide us a starting place in developing procedures for hydrogen sulfide as they are both bacterially regulated processes.	
For Storage Interferences	•For all tests, it is important to minimize storage times to reduce the potential for introduction of sediment changes that will influence test organism survival. • Test samples at setup time for water quality parameters of concern.	

Port of Seattle

May 22, 1996

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Re: Eighth Annual Sediment Management Annual Review Meeting (SMARM) – Follow-up Comments

Dear Mr. Applebury and Ms. Patin:

On behalf of the Port of Seattle and the Washington Public Ports Association (WPPA), we would like to take this opportunity follow up on some of the key issues raised during the eighth annual Sediment Management Annual Review Meeting (SMARM).

As an initial matter, we appreciate the opportunity that you have provided, through the SMARM process, for public ports and the regulated community to engage in spirited discussion with participating agencies about PSDDA/SMS evaluation issues. The meeting itself, in addition to the dialogue that should follow, exemplifies how the process for assessing current evaluation procedures and developing new evaluation procedures should work. The process allows affected parties to identify issues requiring attention, and then fosters discussion of the most appropriate resolution of those issues.

By continuing to follow a fair and open process like the SMARM process, the agencies will increase the likelihood that the resulting regulatory regime is reasonable, sound, and efficient. By working with all affected parties, the agencies should be able to develop evaluation procedures that are environmentally sound yet do not impose unreasonable burdens on the regulated community. Further, by addressing issues on a programmatic basis, rather than on a project-by-project basis, the SMARM process should yield the kind of consistency and predictability that PSDDA was designed to accomplish. We therefore strongly encourage the PSDDA and SMS agencies to stand by the SMARM process, use it to its fullest advantage, and resist the temptation to engage in ad hoc, project-by-project decision making on what should be programmatic regulatory issues.

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With these thoughts in mind, what follow are our comments on the specific issues before the PSDDA/SMS agencies after the May 8, 1995 meeting.

ISSUES AFFECTING BOTH PSDDA AND SMS

AET Recalculation

The Port of Seattle and WPPA appreciate the PSDDA and SMS agencies' commitment to reviewing AETs in light of new information. AETs are at the very heart of the existing sediment evaluation process, whether in the context of PSDDA or SMS activities. Assuring that AETs are as accurate as possible is therefore critical to assuring fair and reasonable implementation of the PSDDA and SMS programs.

With this in mind, the Port of Seattle and WPPA urge the PSDDA and SMS agencies to seriously reconsider several aspects of the recent AET evaluation process. Specifically, the criteria used to screen new data should be revisited and revised. AETs are, by definition, the concentrations of various chemicals above which significant adverse biological effects always occur. As the name and the definition imply, these figures represent a threshold value, not a mean or clustered value. Further, because AET data is invariably derived from sediments with a multitude of contaminants, the AET values do not describe direct cause and effect relationships between a given contaminant and biological effects. Instead, the data is associational and, over time, provides more and more information about the apparent effects of individual contaminants. Given this understanding, it must be expected that, as more and more data is collected, AETs will rise. This is not a result of regulatory failure or backsliding, but rather an honest recognition of the meaning of AET data. In fact, Ecology specifically considered this regulatory aspect of AETs in its development of the SMS Rule and concluded it was not a problem in the implementation of the SMS Rule (see, e.g., that portion of Ecology's December 8, 1988 legal analysis for the draft sediment quality standards concluding that the statutory general prohibition against backsliding, found in 33 U.S.C. § 1342(o) did not prevent Ecology from modifying the final sediment quality standards for specific chemical parameters to less stringent standards based on new technical information). Accordingly, new AET data cannot and should not be reviewed with the intention of preventing AETs from rising or the presumption that any data resulting in higher AETs is automatically suspect or will lead to a less protective rule.

As detailed in the PSDDA/SMS Issue Paper by Johns, et al. ("Evaluation of Puget Sound Apparent Effects Thresholds [AETs]"), several of the criteria used to screen new AET data should be reconsidered because they have the effect of excluding valid, high quality data from the AET calculations. One of these, the "chemically anomalous" screen, is particularly troublesome because it specifically excludes valid data that should be included unless some atypical mechanism for a lack of toxicity is demonstrable, such as the chemical being bound in a slag matrix that would not generally be present in Puget Sound. Excluding a data point solely because it is higher than others presumes that a cause and effect relationship exists between the current AET value and toxicity in the environment. However, Ecology has, from the inception of their use, recognized that AETs are not cause and effect figures.

A good example of the problems associated with the "chemically anomalous" screening tool is the antimony data mentioned at the SMARM. The data point that was rejected would have raised the AET value considerably. Seven "hit" data points were present between this value and the next lower concentration associated with no effects. This kind of distribution should not be surprising when using a statistical method wherein any one of over 50 chemical substances could be a toxicity driver. Additionally, the "hit" stations could also have shown effects due to factors such as ammonia toxicity, salinity differences, or any one of the other difficulties with testing that we are only now beginning to appreciate. Given all of these potential drivers for the toxicity seen in the seven intervening stations, it would be surprising if antimony toxicity was the driver at any of them.

The myriad of potential toxicity sources is precisely why Ecology abandoned a cause and effect approach for deriving standards and instead went to an associational AET approach. The numbers that we have now for antimony probably reflect an uneven distribution of an uncommon low-toxicity element. A "reality check" on toxicity and chemical activity within the sediments for antimony is arsenic, which has approximately the same type of mobility and chemical activity in sediment systems (Chuck Boatman, personal communication). The relative toxicity is shown by the marine chronic criteria in which antimony is 500 ppb whereas arsenic is 36 ppb. This would lead one to assume that a similarly protective sediment criterion should be over one order of magnitude higher for antimony than that for arsenic. Instead the current AET-based sediment value for antimony is approximately one and one half orders of magnitude <u>lower</u> than arsenic's. In other words, in comparison to arsenic, the AET calculation initially produced an antimony value approximately 500 times lower than what one might expect if one regarded the AETs as generating cause and effect values. Given this, an increase of considerably more than one order of magnitude in a second round calculation should not be surprising or cause regulatory concern. Instead, an increase of well less than an order of magnitude has been rejected as "chemically anomalous" even though the data point was validly derived and there is no indication that the site is unique.

Excluding data simply because it looks too high to a reviewer is a rational approach only if one assumes a cause and effect relationship exists between the current standards and toxicity, <u>i.e.</u>, that the current standard is a threshold value whose exceedence by more than a small amount will result in toxicity. However, the AET values are expressly understood to <u>not</u> be thresholds of this type, and Ecology's insistence on treating them as if they were is inconsistent with the fundamental premises of the AET approach. The Port of Seattle and WPPA agree that there should be a process for screening new data. That process cannot be an arbitrary one, though, and should not be designed in such a way that it is inherently prejudiced against data suggesting higher AETs.

Given the importance of accurate AETs to the PSDDA and SMS regulatory programs, the Port of Seattle and WPPA urge the agencies to carefully consider and address the comments raised in this Issue Paper (and in the other PSDDA/SMS issue papers addressing AETs submitted by Johns, et. al., and Word, et al.), and to recalculate the AETs in 1996-97 using all available data that meets appropriate quality controls and is not from a unique environment such as a smelter slag disposal site. The Port of Seattle would be pleased to work with the Regulatory Work Group tasked with recommending how new AETs should be used in the PSDDA and SMS programs. The Port of Seattle will be submitting specific comments on the April 1996 Draft Report "Progress Re-Evaluating Some Puget Sound Apparent Effects Thresholds" by the July 1, 1996 deadline for comments.

TBT

As was apparent from discussion at the SMARM, establishing appropriate and reasonable TBT evaluation procedures is a challenging task. It is also a critical task. Given the number of areas around Puget Sound where TBT is detected, there are very real costs associated with any decisions made regarding TBT evaluation procedures and resulting regulatory activity. The Port of Seattle and WPPA therefore appreciate the PSDDA and SMS agencies' commitment to reassess the recommendations made by Michelsen, et al. in their Draft PSDDA Issue Paper ("Testing, Reporting, and Evaluation of Tributyltin Data in PSDDA and SMS Programs").

As Seeley et al. discuss in their Issue Paper ("Critique of PSDDA Draft Issue Paper on Testing, Reporting, and Evaluation of Tributyltin Data in PSDDA and SMS Programs"), much of the impetus for Michelsen's recommendations appears to be the Meador et al. study, which has serious methodological problems,[1] and for which the underlying data has not yet been made available for review. These problems aside, the study is still not an appropriate one on which to base significant regulatory changes. Specifically, the study does not support the conclusions that bioassays are not an effective means of evaluating TBT contaminated sediments, or that the organisms currently used in bioassays are insufficiently sensitive to TBT. Further, existing data does not support the recommended upper regulatory limit of 0.7 ug TBT/L in porewater, and adoption of such a limit is not consistent with the general PSDDA philosophy regarding the relationship between screening levels and upper regulatory limits.

[1] These include use of an acetone carrier to spike sediments with TBT, but failure to rinse the solvent/TBT mixture from the interstitial water prior to testing resulting in excess TBT in porewater beyond what would be present from partitioning out of the sediment, as well as potential acetone toxicity problems.

Accordingly, the PSDDA and SMS agencies should continue using the current bioassay evaluation procedure until appropriately designed and controlled studies can be conducted to assess these unresolved issues, such as those provided in Bergquist et al. ("Sensitivity of Amphipod Species to TBT in Sediment and Porewater"). Further, where interstitial water analyses are required, the agencies should initially allow testing of interstitial water for total organotin to reduce the costs associated with such testing. Finally, the agencies should not establish a numerical upper regulatory limit until adequate confirmatory tests are conducted on the effects of TBT and its toxicity using appropriate protocols. Following this course of action would not result in needless delay. It would instead recognize that much of the TBT data under evaluation is from a wide variety of tests using varying protocols and is complicated by variations in sediment physical and chemical characteristics, TBT availability, and the presence of other contaminants. Given these complicating factors, and given the impact of potential changes in the regulatory regime, it is critical that any such changes be based upon appropriately designed studies that have been subject to full peer and public review.

Neanthes 20-Day Growth Bioassay (PSDDA/SMS Clarification Paper)

This clarification paper proposes that the PSDDA and SMS programs may consider Neanthes 20-day growth bioassay tests initiated with worms smaller than 0.25 mg (dry weight) as a QA/QC failure. The technical justification in the paper for this cutoff is based on an evaluation of three years of PSDDA/SMS program data regarding initial starting size that suggests that there is much more variability in the control and reference growth exhibited over the 20-day exposure period when average initial worm sizes are less than 0.25 mg (dry weight). This variability in the control and reference growth is apparently due to the practical considerations of handling the smaller size animals rather than any technical differences in their growth at somewhat lighter weights (D. Michael Johns, EVS, personal communication). As such, Neanthes tests which are initiated with worms smaller than 0.25 mg (dry weight) should not automatically be considered a failure, but should be judged on the overall quality and technical validity of the test using best professional judgment, similar to the approach used to evaluate reference QA/QC failure problems common in the amphipod test.

Statistical Evaluation of Bioassay Results
(PSDDA Clarification Paper/SMS Technical Information Memorandum)

We have attached a memo from Lorraine Read of EVS Consultants addressing potential problems associated with some of the clarifications and modifications proposed by this paper. Specifically, transformations should not be applied to the data unless there is clear evidence that the untransformed data do not meet the assumptions of the statistical test. Further, since the t-test is more robust than the hypothesis testing suggested in the paper, use of the hypothesis testing for screening is inappropriate. Accepting the hypothesis testing as a screening tool may result in increased use of a nonparametric test and potentially greater likelihood of Type II errors.

SMS ISSUES

Triennial Review

The Port of Seattle and WPPA appreciate Ecology's acknowledgment that the SMS triennial review process is still ongoing, and that the December, 1995 marine finfish rule does not satisfy the SMS triennial review requirement. Consistent with Ecology's commitment to undertake thorough triennial review of the rule, the Port of Seattle is enclosing by separate letter to Dave Bradley of Ecology proposed SMS Rule revisions. The rationale for these revisions is detailed in the Port of Seattle's August 15, 1995 letter to Ecology regarding triennial review. The Port of Seattle and WPPA urge Ecology to seriously consider and adopt these revisions in order to create a more efficient, more workable rule, and one that is, in the end, more likely to provide real improvements to Washington's environment.

Human Health Criteria

The Port of Seattle, WPPA and Ecology have been engaged in discussion for some time over the potential development of SMS human health criteria. The Port of Seattle and WPPA recognize the importance of protecting human health through regulatory programs such as SMS. However, we have grave concerns about some of Ecology's past recommendations regarding the nature of proposed SMS human health criteria. Given these concerns, many of which were expressed in the Port of Seattle's August 15, 1995 letter to Ecology regarding triennial review of the SMS Rule, the Port of Seattle and WPPA greatly appreciate Ecology's realization of the value of pausing to reconsider the basic approach to human health criteria before adopting what would be a major new rule with far reaching regulatory impacts. The Port of Seattle and WPPA also appreciate Ecology's recognition of the value of first considering how human health considerations are being addressed in site-specific sediment cleanup projects, in other MTCA cleanup programs, and in the Cooperative Sediment Management Program sponsored Demonstration Pilot Project.

One of our primary concerns regarding Ecology's development of a human health SMS rule is Ecology's apparent preference for a rule based on biota-sediment accumulation factors (BSAFs) for Puget Sound. Any such rule, especially if it is based upon the June 1995 Department of Health's (DOH) 1995 Tier I Report ("Development of Sediment Quality Criteria for the Protection of Human Health"), would be so pervaded with assumptions and uncertainties as to be almost meaningless from a human health perspective. For example, reported BSAFs for individual chemicals vary as much as five orders of magnitude (i.e., the highest values are roughly

100,000 times higher than the lowest values). BSAFs also vary widely between even individual species of a given genus and at different life stages of the same species. Any BSAF-based approach introduces such a tremendous amount of variability into the standard-setting process as to call into question the validity of any standards that result. This is evidenced by the preliminary standards derived using a BSAF-based approach for the DOH Tier I Report, which would indicate that vast areas of Puget Sound are grossly contaminated, and that even completely unaffected areas such as the San Juan Islands have levels of certain contaminants that are many times higher than an acceptable level. This conclusion simply does not make sense. Instead, it serves to highlight the net effect of using BSAFs to derive standards, especially when BSAFs are combined with multiple conservative assumptions.

Rather than establish a BSAF-based human health rule, Ecology should further pursue ways to use fish tissue data. A much simpler and more effective approach would be to define fish tissue levels that would serve as triggers for concern, and only move forward with site-specific inquiries on the need for sediment cleanup in those areas where fish tissue monitoring defines a valid concern for human health. Both the Sediment Scientific Review Board and the EPA's Science Advisory Board have endorsed the use of fish tissue data as an important component of human health criteria. Ecology should seriously consider these recommendations before proceeding further with adoption of SMS human health criteria. Ecology should also consider the work of the MTCA Policy Committee to ensure that a consistent approach to human health risks is implemented across its cleanup programs. Finally, Ecology sediment management should provide direction to its regional offices indicating that the June 1995 DOH Tier I Report is not a valid basis for making regulatory determinations in exercising best professional judgment (BPJ) in regulatory case-by-case decision making.

SMS Guidance for Sampling and Analysis Plans

The Port of Seattle and WPPA appreciate Ecology's efforts to develop guidance for preparing sampling and analysis plans under the SMS Rule. As we understand it, this guidance will be attached as appendices to the current Sediment Source Control User Manual (SCUM 1) and Sediment Cleanup Standards User Manual (SCUM 2). Before this guidance is finalized, however, we believe that it should be reviewed by the SMS Implementation Committee. This Committee had the opportunity to review SCUM 1 and SCUM 2 before they were finalized and the Committee's comments made for more readable and usable documents than otherwise would have been the case.

CONCLUSION

Thank you for the opportunity to comment. Call us if you have any questions about this letter or the PSDDA/SMS issue papers submitted on behalf of the Port of Seattle and WPPA, or if you wish to arrange a meeting to further discuss the issues and how they may be resolved before the 1997 SMARM.

Port of Seattle

Thomas A. Newlon

Douglas A. Hotchkiss
Thomas A. Newlon

Washington Public Ports Association

FOR

Eric Johnson

cc: David Bradley, Washington Department of Ecology
Ann Essko, Department of Natural Resources
David Kendall, U.S. Army Corps of Engineers
John Malek, Environmental Protection Agency
Konrad Liegel, Preston Gates & Ellis

h: files/envirn/policy/sed/smarmltr.doc

EVS CONSULTANTS
MEMORANDUM

to: Doug Hotchkiss
from: Lorraine Read
re: Review of PSDDA Clarification Paper, "Statistical Evaluation of Bioassay Results", Michelsen and Shaw, 2/465-03.1
date: May 21, 1996

Michelsen and Shaw's paper is intended to clarify several issues surrounding the determination of statistical significance of bioassay data under the Puget Sound Dredged Disposal Analysis (PSDDA) program and Washington Sediment Management Standards (SMS). My comments address the appropriateness of specific recommendations made.

Data Transformations

It is recommended that an "arcsine-square root transformation should be performed to stabilize the variances and improve the normality of data sets expressed in percent."

- I disagree that transformations should automatically be made on data without consideration of their untransformed distribution. The appropriateness of the arcsine-square root transformation is based on theory, and may well be justified for large data sets. However, Zar (1996) states that this transformation is unwarranted for an ANOVA (or t-test) *unless the largest sample size is more than 5 times greater than the smaller sample size, and that the smaller variance is associated with smaller sample.* In the case of bioassay results, the sample sizes are generally equal, and therefore eliminates the necessity of this transformation.
- If one concludes that the original data do not meet the assumptions of the t-test (see below), then the transformations suggested may be used to resolve the problems with the data (i.e., non-normality or different variances).
- It should also be noted that the arcsine-square root transformation is only appropriate for percentages bounded by 0 and 100 (e.g., mortality or abnormality; it would not apply to percent change as these values could be greater than 100%).

Tests for Normality and Homogeneity of Variances

Checking the assumptions on which statistical tests are based is important in order that the results from these tests be properly interpreted. However, many studies have been done on the performance of the t-test under varying conditions of non-normality and non-homogenous variances. The conclusions are that the t-test is quite robust[1] to deviations from both assumptions, particularly when sample sizes are equal (as is generally the case in bioassay

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[1]A robust test is one in which the true type I and type II error rates remain relatively constant under varying conditions.

results) and only becomes important when there are severe deviations from these assumptions, and especially when extreme values are present. The recommendation to test these assumptions before proceeding with the t-test is cautious, but is difficult due to the small sample sizes (n=5 for most bioassay results).

- In most cases, the hypothesis tests for normality and homogeneity of variances are less robust to deviations from their assumptions than is the t-test. The Shapiro-Wilks test (W) for normality is adversely affected by tied data (common in bioassay results). The F-test for equal variances is strongly affected by deviations from normality (much more so than the t-test). (Zar, 1996.)
- Rather than running the data through statistical tests which have limited power because of small sample size, it would be more desirable to assess the basic symmetry of the distributions and check for extreme values using graphical measures, such as boxplots or Quantile-Quantile (QQ) plots. If extreme values are present, then a nonparametric test would be a better choice than the t-test. Highly skewed data (clearly visible from boxplots and QQ plots) can affect the results of a one-tail t-test. The subjectiveness of this type of screening leaves some room for debate; however, in my opinion it is more desirable than applying hypothesis tests (e.g., H_0: $\sigma_1=\sigma_2$) with low power.
- If small differences in variance are suspected, a modified t-test using separate variance estimates rather than a pooled-variance estimate could be used, and the test statistic compared to Student's t with modified degrees of freedom (this is presented in most statistics books following the standard pooled variance t-test). When sample sizes are equal the two tests are identical.

Summary

- Transformations should not be applied to the data unless there is clear evidence that the untransformed data do not meet the assumptions of the statistical test (i.e., t-test).
- The assumptions of the t-test should be assessed for severe deviations from the assumptions (looking for highly skewed data or extreme values) using graphical measures, such as box plots, or Q-Q plots, rather than the hypothesis tests suggested in Michelsen and Shaw.

References:

Zar, Jerrold H. 1996. Biostatistical Analysis, Third Edition. Simon & Schuster, Upper Saddle River, NJ.

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Have Mussels, Will Travel

22 May 1996

Mr. Brian Applebury
Chief, Operations Division
Seattle District Corps of Engineers

Dear Mr. Applebury,

I want to thank you for the opportunity to offer written comments to the SMARM Meeting held on 8 May 1996. It is my opinion that this open dialog can only lead to a better exchange of information, cross-fertilization of ideas and a peer-review process with constantly improving approaches to evaluation and management of contaminated sediment. Unfortunately, I do not have time to compliment you on the progress you have made over the years and offer positive comments on everything you did to improve the approach and manage those contaminated sediments in a responsible way. The net result is that most of my comments will be negative. They should be reviewed in the spirit in which they were given; i.e., constructive criticism. I thought the document prepared by the PSDDA agencies was clear, concise, and extremely well organized. It also contained graphics that were appropriate in terms of necessity and volume. Likewise, I thought the meeting was well done although somewhat long. Probably long out of necessity however in that everyone was provided ample opportunity to comment. You are to be commended for your approach to this technically challenging and politically charged issue of contaminated sediments. The following are my comments on various technical issues.

Adjustments to Site Monitoring. Perhaps the issue of most concern presented at the meeting was the proposal to consider adjustments to disposal site monitoring. In his presentation, Ted Benson of DNR implied that there would be a reduction in the frequency and magnitude of monitoring at disposal sites. Given the uncertainty in standard PSDDA approaches to evaluating chemicals like TBT, this is alarming. My belief is that chemical analysis of sediments, standard laboratory bioassays, and evaluation of benthic community structure is inadequate to properly evaluate chemicals like TBT. It also appears that the traditional tiered approach of sediment chemistry followed by laboratory bioassays and assessments of bioaccumulation potential is backwards. PSDDA has recognized the importance of biological testing and provided an approach for using the results of laboratory bioassays to override sediment chemistry results. The problem is that if sediment chemistry levels are low enough, these other tiers will never be used in the evaluation. In the original 1977 "Green Book," Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters, the assessment of bioaccumulation potential was a requirement. There are some interesting corollaries here with TBT. In some of our early studies with TBT-contaminated sediments in the most contaminated yacht basins, we found no toxicity in short-term acute bioassays but we did find significant accumulation of TBT in clam tissues (*Macoma nasuta*) after a 20-day exposure period (Salazar & Salazar, 1985). Treatment clams accumulated TBT to a concentration an order of magnitude above control clams and a factor of four above treatment sediment. This is interesting because these sediments reportedly had large amounts of paint chips and paint dust amd were collected immediately adjacent to a ship repair facility in Commercial Basin, San Diego Bay. Others have suggested that much of this TBT is tightly bound and would not be biologically available. Our laboratory bioassays with 20-day exposures of *Macoma nasuta* suggest that some of this TBT could be biologically available and exhibit the potential for bioaccumulation in the absence of toxicity in short-term acute bioassays.

These observations are important for other reasons. The PSDDA agencies have been criticized for a "rush to judgment" on the TBT issue and I have been one of the critics. One criticism has been that the agencies "expected" toxicity in short-term acute tests with standard species and assumed that the species must be inappropriately sensitive if no acute toxicity was measured. Personally, I believe that the PSDDA agencies made the right decision to seek alternative assessment procedures although the reasons for this decision are not adequately justified in the document. Meador's recent work (Meador et al., 19965; Meador, 1996) suggests that it takes 45 days for these amphipods to reach equilibrium. This is consistent with other work but documentation is not provided by the PSDDA agencies. Our work (Salazar & Salazar, 1996) and the work of Moore (Moore et al., 1991) suggest that on a tissue-residue basis, growth and reproduction in bivalves and *Neanathes arenaceodentata* in longer exposure periods (60 to 80 days) are about an order of magnitude more sensitive than the amphipod mortality endpoint with either *Rhepoxynius* or *Eohaustorius*. This is another possible explanation for the apparent lack of sensitivity in amphipods but this kind of supporting information is not provided by the PSDDA agencies. Langston & Burt (Langston & Burt, 1991) predicted chemical equilibrium in about 40 days in a deposit feeding bivalve. This is also consistent with Meador's work but is not mentioned in the document.

Another aspect of the "rush to judgment" is that the PSDDA agencies and the industries have been too eager to embrace the pore water exposure pathway as the most important route of exposure. Meador and his colleagues have also chosen to support the importance of pore water as the primary pathway of exposure to the exclusion of all others. I believe that this conclusion is also premature. Langston and Burt (Langston & Burt, 1991) concluded that the particulate component was the primary pathway of TBT exposure in the deposit-feeding clam *Scrobicularia plana*. There is also strong circumstantial evidence in the TBT literature supporting a particulate pathway for TBT accumulation. A critical evaluation of the work by Waldock & Thain (Waldock & Thain, 1983; Waldock, 1986) strongly suggests that suspended sediment is an important pathway for TBT exposure and enhancing the effects on shell thickening in oysters. When their original paper appeared in 1983, it should be remembered that there was uncertainty in suggesting whether suspended sediment or TBT was the causative agent. This uncertainty was the basis of their title: "Shell thickening in *Crassostrea gigas*: organotin fouling or sediment induced?" Their laboratory work and field observations strongly suggest that suspended sediment enhances the shell-thickening effects of TBT. We have made similar observations during a field evaluation of a portable microcosm system (Salazar et al., 1987). We suspended extra oysters and mussels at the seawater intake during this flow-through experiment and observed significant shell thickening in these oysters at TBT concentrations below 10 ng/L. This was surprising since the seawater TBT concentrations were so low. Since this area had strong currents and high suspended sediment loads, I now believe that this pathway was a significant route of exposure for the caged oysters. It also demonstrates that water and sediment concentrations may not provide an accurate estimate of actual exposure. Bioaccumulation provides a method for normalizing the dose from several potential pathways of exposure. Other evidence for TBT accumulation from food and particulates are provided in Salazar, 1986; Laughlin et al., 1986; and Henderson, 1985. There is also a compelling list of evidence for bioaccumulation of other hydrophobic compounds like TBT: MacFarland, 1995; Ekelund et al, 1987; Hermsen et al., 1994; Bruner et al., 1994; Meador et al., 1995; Boese et al., 1990.

I believe that PSDDA should re-evaluate the questions to be answered and confirm that traditional approaches will allow the conclusion that the disposal sites have not been impacted with any degree of confidence. Three questions that need answering are the following: 1) Is a 10-day exposure with amphipods using the mortality endpoint appropriately sensitive to detect potential effects?; 2) What are the significant pathways of exposure and are they being evaluated with the species now being used?; and 3) What is the relationship between apparent sensitivity, exposure duration, and endpoints being measured?.

The preponderance of evidence suggests that 10-day exposures of amphipods to TBT-contaminated sediment using mortality as an endpoint is not appropriately sensitive but the document does not provide the evidence for this conclusion. There is also substantial evidence to suggest that particulates may be a significant pathway for exposure to bivalves via sediment ingestion or filter feeding. There is a large body of evidence suggesting that molluscs may be particularly sensitive to TBT. Given this weight of evidence, I would recommend the following approach for testing TBT-contaminated sediment and evaluating conditions at the disposal site to confirm that there have been no significant adverse effects: 1) Conduct 60-day laboratory exposures with *Neanthes arenaceodentata* using growth and reproduction as endpoints; 2) Utilize 20-day laboratory exposures with *Macoma nasuta* to assess the potential for bioaccumulation and use tissue and shell growth as an effects endpoint (tissue mass should also be used to confirm that the animals are in reasonable health throughout the experiment); 3) Use bioaccumulation in field-collected samples (either natural populations or caged experiments) to establish relationships between tissue residues and effects levels in laboratory experiments and natural populations.

Since the PSDDA document states that "Environmental monitoring is the primary tool in the management of the non-dispersive disposal sites," it is imperative that the agencies believe that their monitoring tools will be effective in detecting significant differences should they occur.

Given the uncertainties associated with AET's discussed at the meeting, the uncertainty associated with detecting possible TBT effects, and the lack of a good correlation between sediment chemistry, laboratory bioassays and benthic community structure, the agencies should carefully evaluate the traditional approaches that are currently being used to make decisions regarding adverse effects at the disposal sites. The PSDDA agencies should also consider the possibility that there may be other chemicals (PCBs and DDTs for example) that will not show toxicity in short-term acute tests. The answer for these chemicals may also be longer exposures with sublethal endpoints such as those suggested previously for TBT. Here again, one link between the laboratory tests and evaluations of benthic community structure is the assessment of bioaccumulation potential. If these types of chemicals are recognized to be present, there should not be a bioaccumulation "trigger," bioaccumulation should be required as part of the evaluation. The reason for this is that toxicity will probably not be manifested in short-term acute bioassays. It seems as though the tiered testing is backwards in that bioaccumulation testing should be conducted first and used as a guide for additional testing. The rationale for using laboratory toxicity tests and assessments of bioaccumulation potential in the old 1977 "Green Book" was that all of the chemicals may not be clearly identified so the biological approach was used for the evaluation. No chemical analysis of the sediments was even required. Perhaps the PSDDA agencies should consider a greater emphasis on biological effects and bioaccumulation potential in future evaluations.

It also appears that the requirement for a $\geq$ 50% statistically significant decrease in any of the major taxa is not a very sensitive monitoring tool. Even more interesting is the observation that molluscan taxa did show a significant decrease at the station further most from the site. Are the PSDDA agencies confident that their tools are appropriately sensitive to detect significant adverse effects at the disposal site where none were found. Conversely, what is causing the shift in molluscan taxa at the far field sites? It seems too coincidental to conclude that there are no effects at the site where effects might be expected and yet to detect effects at sites removed from the site. Several recent studies have suggested that bivalves may actually be more sensitive than crustaceans (Burgess et al., 1991; McKinney et al., 1996; Salazar & Salazar, 1996). All of the above issues raise serious questions about the PSDDA proposal to "reduce the frequency and scope of monitoring based on past documented compliance with site management objectives". The site management objectives may have been appropriate but the monitoring tools used to evaluate those objectives may have been inappropriate.

Sediment Bioaccumulation Testing. There should be a "growth" or "tissue maintenance" requirement for the bioaccumulation testing with deposit/suspension feeding bivalves and deposit-feeding polychaetes for the same reason that there is a growth requirement in the *Neanthes* test. There are at least three reasons for measuring growth: 1) as an effects endpoint; 2) as a way to calibrate bioaccumulation; and 3) to standardize test results. The effects endpoint in the bioaccumulation test could supplement the growth endpoints for *Neanthes*. Alternatively, if sufficient tissue were available, *Neanthes* could be used for evaluating both bioaccumulation and bioeffects. This approach may be more plausible with 60-day exposures for TBT assessments if more worms are used and more tissue is available. In our work with a number of bivalves, we have found that measuring tissue concentrations alone can be misleading if the rate of accumulation differs from the rate of growth. Rapid growth could lead to growth dilution of bioavailable contaminants and an underestimation of bioaccumulation potential. Tissue loss could lead to de-growth magnification and an overestimation of bioaccumulation potential. The latter is a distinct possibility in laboratory exposures because bivalves in particular do not grow well under most laboratory exposures. If there are estimates of initial tissues weights however, this potentially confounding effect can be assessed and chemicals of concern can be expressed as a concentration (ug chemical/g tissue) or a content (ug chemical/animal). These two different endpoints allow more flexibility in interpreting bioaccumulation data.

Neanthes 20-day Growth Bioassay. Don Reish still believes that days post-emergence is more important than absolute weight on conducting these tests. Mike Johns confirms that the weights that are now being used as criteria were developed on correlations with days post-emergence. If days post-emergence is really the critical parameter, perhaps it should be used as the criterion. The PSDDA agencies have moved in the right direction by providing more flexibility in terms of absolute starting weights and absolute growth requirements, but it seems counterproductive to consider eliminating data because absolute growth requirements are not met. Perhaps these requirements should continue to be re-evaluated as more data are available.

Demonstration Pilot Project. It has been proposed to "Develop a 'place-based' project where agencies enter into partnerships with local interests and provide grant funding and/or administrative discretion to participants". This would be an excellent opportunity to test supplementary monitoring tools and evaluate the sensitivity of existing tools. For example, the demonstration pilot project could be used to evaluate the relative sensitivity of a 10-day amphipod test with the mortality endpoint versus the 60-day *Neanthes* test with growth and reproduction as endpoints if a TBT-contaminated site was selected. The demonstration pilot project could also be used to evaluate the relationship between bioaccumulation and growth in laboratory assessments of bioaccumulation potential versus field estimates using either resident or caged bivalves. Prudent selection of the demonstration pilot project should allow the flexibility to make a number of comparisons that could prove useful to the PSDDA agencies in evaluating their current approach. As examples, caged bivalves have already been used to evaluate contaminated sediment at Harbor Island (Salazar et al., 1995) the Puget Sound Naval Shipyard (URS, 1994) and the Hylebos Waterway (Salazar and Salazar, 1996). It has been suggested that if large vessels are a continuing source of TBT to sediments, it may be premature to promote remedial actions. Most people do not realize that TBT is still used on large vessels in many countries, including the U.S. Further, these large vessels have been identified as a continuing source of TBT contamination in shipping lanes and at oil terminals. Caged mussels have been used effectively to identify the sources of the TBT (Widdows et al., 1995a,b). It seems likely that large vessels are a continuing source of TBT to Puget Sound sediments.

Human Health-Based Sediment Criteria for Puget Sound. There a number of inherent problems in using chemical analysis of fish tissues to identify contaminated sediment sites. The most fundamental problem is an accurate estimate of exposure duration. Since fish are highly mobile animals it is difficult to quantify how long each has spent in the areas of concern. Representatives of the Department of Ecology and industry have been frustrated by the inability of fish tissue sampling to consistently detect the presence of dioxins in the Columbia River for example. Many samples have been taken and the majority have been analyzed as non-detects. Questions like these have led the Department of Ecology and the Department of Health to propose in their Tier I Report for the Development of Sediment Quality Criteria for the Protection of Human Health that caged fish or bivalves be used to develop site-specific biota-sediment accumulation factors. The two primary advantages of this approach are documenting the exposure period at a particular site and including all of the natural factors at each site that can influence the bioaccumulation of chemicals of concern. Unfortunately, although caging fish has been used in a variety of applications, there are many potential problems in caging fish at any site. One of the most important of these aspects is ensuring an adequate food supply and using species that are adaptable to caging. Bivalves do not have these disadvantages and have been used extensively to assess both exposure through estimates of bioaccumulation and effects through sublethal endpoints such as growth and reproduction. Using bivalves would also provide a link between human-health assessments and ecological assessments by utilizing species that were adaptable to both programs. There is also the additional link between consumption of bivalves and tissue residues measured in the field.

Re-evaluating AETs. I share concerns expressed by many industry representatives at the SMARM meeting about the increasingly larger number of data points that are being deleted from the data sets as being anomalous. While the justifications seem reasonable, one cannot help but wonder if there is a fatal flaw in the approach. As previously discussed, Salazar and Salazar have proposed the use of an exposure-dose-response triad that includes the evaluation of bioaccumulation potential to form the link between the characterization of exposure and a characterization of effects in the standard risk assessment format (Salazar & Salazar, 1995b; Salazar & Salazar, 1996). Rather than simply discarding these other sediment chemistry measurements as anomalous, perhaps the bioaccumulation endpoint could be used as a fourth tool in modifying the AET approach.

While bivalve larvae and echinoderm larvae are seldom tested in "side-by-side" assessments, those assessments and other data strongly suggest that the two endpoints are significantly different. Apparently the Department of Ecology has recognized this and have taken steps to calculate separate AETs using bivalve larvae and echinoderm larvae. There is also a fundamental question regarding the reasons for allowing the flexibility to substitute either species in sediment bioassays. Given that the bivalve test is significantly more difficult to conduct and may be significantly more sensitive under certain conditions perhaps the PSDDA agencies should reconsider the reasons for allowing this flexibility. The real reasons for allowing this flexibility appear to be related to inability to conduct echinoderm tests during all seasons of the year when the animals are not in spawning condition. Bivalves are attractive surrogates for other reasons as well since they are cultured extensively in Puget Sound. Nevertheless, the PSDDA agencies should re-evaluate the concept of allowing species substitution if they really believe that the test results are different. This issue goes beyond the question of re-calculating separate AETs.

Inconsistencies in Approach. If there are significant differences in the results of larval testing from different species, it is not clear why the Department of Ecology is requiring bivalve bioassays at pulp and paper mills in Puget Sound. Apparently there is some historical association between reported effects of pulp and paper mill effluents on resident or cultured bivalve populations. This is the link between effluent testing and sediment testing as part of the effluent evaluations. It appears then, that the pulp and paper industry is being held to a different standard than other industries. The bivalve larval test is significantly more difficult to conduct than the echinoderm larval test and the results are different. Equally anomalous is that sediment testing required by EPA in other parts of the Pacific Northwest which allow the flexibility for pulp and paper mills to substitute either the bivalve or echinoderm larval test. The argument could then be made that bivalve culture is more important in Puget Sound than in other parts of the Pacific Northwest. If this is the case why are there no special provisions for requiring bivalve larval testing only (without substitution) for sediments with TBT rather than allowing substitution?

There are other inconsistencies in approach, including those between PSDDA and Superfund. TBT is a good example. "EPA and the interagency work group selected 700 ng TBT/L as the basis for calculating a sediment cleanup that was conceptually similar to the SMS cleanup screening level (CSL) in that it was considered protective of many organisms from most acute and some chronic effects. This higher value represents the 23rd percentile for chronic toxicity values and the 77th percentile for acute values. Based on reported scientific research data, this higher value would protect a large number of adult organisms from diverse phyla (mollusks, crustaceans, polychaetes and fishes) as well as several sensitive life stages (larval or juvenile forms) of important aquatic resources including oysters, mussels, and salmonids. This higher value would not be considered protective of effects on certain life stages of more sensitive organisms (e.g., oyster spat, mussel larvae), including organisms considered salmonid prey species (e.g., mysid shrimp)." (Weston, 1996).

These statements are contradictory, misleading, and inconsistent with PSDDA. First, it should be pointed out that 700 ng TBT/L is more than two orders of magnitude higher than concentrations shown to cause chronic effects in more sensitive mollusks like dogwhelks. We have predicted a no-effect level for TBT on mussel growth at 25 ng TBT/L. 700 ng/L is 28 times that value. It should be pointed out that it is generally believed that oysters are more sensitive to TBT than mussels. Furthermore, it is not clear that all of the members of the interagency work group really agreed to the use of this number. Was the decision unanimous?

Do these data for acute and chronic effects then suggest that 77% of the species would be protected from acute effects and 23 % of the species would be protected from chronic effects? There are several problems with this approach: 1) Many of these tests were early (pre-1990) range-finding tests and were not intended for this purpose; 2) Chemical analyses of these water concentrations used different analytical techniques or may not have been measured at all; 3) Survival endpoints are mixed with sublethal endpoints in the chronic effects table; 4) Some species may not be appropriate for Puget Sound; 5) Adults under the stress of reproduction may be more sensitive than juvenile and larval stages and 5) No special consideration has been provided for cultured bivalves which appear to be particularly sensitive to TBT.

It is difficult to critically evaluate the data in the tables because no citations are provided in the tables. However, I am familiar with many of these studies and can offer an example of some specific problems. For example, six of the seven highest concentrations are associated with mortality endpoints. Although there are no good definitions of what constitutes a chronic test, it is generally assumed that the term "chronic" refers to a period of exposure that covers a significant portion of the life cycle in the test organism or a sublethal endpoint measured after exposure periods of more than one week. The 1-week cutoff is definitely arbitrary. Clearly, 30-day and 66 day-exposures of bivalves using mortality as endpoints do not meet the criteria of either sublethal endpoint or significant portion of the life cycle and should not be included in this table. Larval tests represent a different problem because it is generally believed that they are more sensitive than adults and it is possible to measure sublethal endpoints like growth and abnormality. In this particular example with mud crab larvae, the effects level is the highest concentration included in the summary of chronic effects. There are several issues that pertain here. First, this study with mud crab larvae was one of the early tests mentioned previously. It was intended as a range-finding test and it is not clear how sensitive the measurement techniques were in detecting adverse effects on growth. Second, mud crab larvae may not be particularly important in Puget Sound. Third, mud crab larvae may not adequately represent other crab larvae that are important in Puget Sound. Fourth, mud crab larvae may have the ability to depurate TBT. The same point regarding extreme values used in this table could be made at the other end of the spectrum since *Nucella lapillus* is not found in Puget Sound either. Nevertheless, there are other species of dogwhelks are found in the area and imposex has been demonstrated in *Nucella lima*. It should also be emphasized that recent evidence has shown that adults under the stress of reproduction may be more sensitive than juvenile or larval stages (Widdows & Donkin, 1992; Luoma , 1995; Ahtiainen et al., 1995). Much of this table suffers from similar inconsistencies which will be addressed in specific comments to EPA.

The point from the PSDDA perspective is that commercially important species like oysters, mussels, and salmon deserve special protection in Puget Sound and some programs within some agencies have taken steps to provide that protection. Whether they are technically correct in taking those steps is another matter but conceptually, special provisions have been made for these special species. There are several inconsistencies in the way these issues are being addressed by PSDDA and EPA. Even the lower screening level for TBT interstitial water concentrations (50 ng/L) is a factor of two above our predicted no-effect level for mussel growth and perhaps a factor of four above predicted growth effects in oysters. It is not clear why oyster and mussel farmers and Indian tribes are not concerned about this issue. Perhaps they do not realize that this is happening and that these criteria could have some impact on them.

Draft TBT Issue Paper. Unfortunately, this document suffers from many of the same problems as the EPA "Recommendations for a Screening Level for Tributyltin in Puget Sound Sediments" only to a greater degree. Since this is only a draft, these problems can be easily corrected. The main problems fall into three categories: 1) inadequate documentation; 2) over reliance on theory of pore water exposure pathways as the only pathway of exposure; and 3) misleading statements about effects levels on important species in Puget Sound. While it may be appropriate to cite the Beaverson et al. memorandum to the TBT workgroup as a way of expressing concerns from other agencies it is not very persuasive evidence of the significance of issues. It should be the responsibility of the Department of Ecology to properly cite each reference used in the memorandum and explain the quality of the data, the significance of the data, when the work was conducted, and how the measurements were made. Since this will be a significant issue paper to direct the course of future evaluations of TBT-contaminated sediments in Puget Sound, it needs to be a more credible document with appropriate citations and data screening.

It also appears that like all of the other data, recent papers from Meador et al. were taken at face value without careful scrutiny or evaluation of alternative explanations. As mentioned previously, I believe that Meador is probably correct in many of the principles he has demonstrated but that does not mean that everything should be taken at face value and incorporated into a position document without exploring alternative explanations. Meador's conclusions with regard to time for chemical equilibrium with TBT and amphipods after 45 days of exposure is consistent with other work. It also seems reasonable that on a tissue residue basis, there may not be any difference in the relative sensitivity of *Rhepoxynius* and *Eohaustorius*. Regardless of whether this sounds reasonable to me or the Department of Ecology or anyone else for that matter, the PSDDA agencies have a responsibility to explain why this is reasonable and provide supporting documentation. This is why many reviewers have made the comment with respect to a "rush to judgment" and an over-reliance on the Meador work.

On the other hand, I do not believe that pore water is the only important exposure pathway and have provided some documentation to support the theory that suspended particulates could be an important exposure pathway for species like filter feeding bivalves. It should be emphasized that the Meador work is based on theory and extrapolations made from 10-day exposures on what would happen after 45 days to reach equilibrium. This should be addressed in the PSDDA support document. Similarly, if you do not believe my "theory" based on our field data, observations reported by others, and literature supporting similar uptake pathways for similar chemicals, the document should identify why you do not believe this as a credible theory and provide supporting documentation.

As with the EPA document, the biggest problem with the PSDDA TBT document is misleading statements regarding the protection of commercially important species in such as oysters, mussels, and salmon in Puget Sound. Why was the particular study indicating effects at 730 ng TBT/L in oyster larvae selected as representative? There is also no citation listed with this study so that it could be critically evaluated. I have provided some documentation to suggest that bivalve larvae or spat may not be the most sensitive life stage of the species. The EPA chronic table includes effects on *Crassostrea gigas* spat at 10 ng/L. This effects level is 73 times lower than that reported in the other study cited by PSDDA. Furthermore, the EPA document specifies that although adult salmon may not be affected directly by TBT, it is possible that some of their food sources like mysids may be adversely affected. This issue is not addressed in the PSDDA document. To suggest that long-term effects in adult mussels and oysters only occur at concentrations between 94 and 2,500 ng TBT/L is inaccurate. As mentioned previously, we have reported no effects below 25 ng/L, possible effects between 25 and 100 ng/L and probable effects on juvenile mussel growth above 100 ng/L. Oyster growth may be affected by concentrations as low as 10 ng/L. As a matter of fact, probable effects on oyster growth at concentrations above 10 ng/L played a major role in EPA setting the draft proposed chronic water quality criterion at 10 ng/L. A similar number has been adopted by several states as well. The statement that the EPA chronic value is 360 ng TBT/L in the PSDDA document is inaccurate.

Michael H. Salazar

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SUBJECT: PROGRESSIVE APPROACHES IN SEDIMENT MANAGEMENT

Dear Rachel:

I enjoyed seeing you again at the PSDDA/SMS meeting and catching up on the State's sediment management efforts since my days on Ecology's Science Advisory Board and the NRC/Marine Board Briefing in Seattle in March 1994.

I returned to the Northwest in March of this year after 14 months in Florida on temporary assignment under contract to the South Florida Water Management District (SFWMD). I managed a project involving risk assessment audits on large land parcels purchased by the District to create artificial wetlands and buffer zones for reducing nutrient and contaminant migration into the protected areas of the Everglades and Florida Bay.

I left Foster Wheeler Environmental in mid January. After moving back to the Seattle area, I joined Ogden Environmental and Energy Services in early April. During the months of January and February, I was an independent consultant providing expert assistance to the Florida Power and Light Company, Office of Environmental Affairs, and working for the Florida Center for Environmental Studies to develop an inventory of risk assessment expertise in the Florida academic community.

Although my work for the SFWMD was both challenging and diverse, it did not diminish my primary focus on contaminated sediment management and risk-based environmental decision making. Therefore, I am providing you below with a quick update on my activities which I consider directly relevant to the Cooperative Sediment Management Program you are now coordinating through the Department of Ecology and possibly other Agency initiatives, e.g., the reform of the Model Toxics Control Act (MTCA).

NRC/Marine Board. As you know, I have been a member of the National Research Council (NRC)/Marine Board, Contaminated Marine Sediment Committee since 1993. My charge was to address how risks, costs and benefits can be incorporated in the decision making process regarding the management of contaminated sediments. I have accomplished this task successfully. The Committee has completed the concurrence draft report early last month. The report is currently undergoing peer review. The anticipated date for submittal to the US

Congress and Agencies is in September. The report includes specific recommendations for improving decision making, remediation technologies and project implementation. Specific items discussed in the report pertain to: regulatory constraints; outreach to stakeholders and consensus building; systems engineering; decision making approaches; engineering costs of clean-up; remediation technology options, R&D, testing and demonstration needs; improving long-term controls and technologies; source control responsibilities; site characterization needs and technologies; interim controls and; beneficial uses.

I believe the contents of this report are highly relevant to the issues I heard being discussed during the PSDDA/SMS meeting, particularly with respect to what the Interagency Group is now addressing in the Cooperative Sediment Management Program (CSMP).

Maritime Administration/US Department of Transportation. I serve as a technical advisor to the Maritime Administration (MARAD) regarding the application of decision analysis to dredged material management. In late 1994, I was awarded a contract by the Office of Environmental Activities to develop and apply a decision analytical methodology as a tool for streamlining the dredged material management process.

The study is being executed in three phases. Phase-I has been completed in October 1995. It consisted of the formulation of the DMM decision process and the development of the conceptual framework for the decision analytical methodology. Phase-II would entail the development of detailed decision models which would incorporate costs, risks and benefits and their associated uncertainties in selecting management alternatives for a specific test case project. Unfortunately, Phase II is on stand-by because the Agency's research allocations for FY '96 were eliminated due to federal budget cuts. Phase-III would be the application of the model to assist the decision maker and other stakeholders in resolving uncertainty and disagreement regarding the selection of the best set of dredging and dredged material disposal alternatives for the test case project. MARAD still considers this study as a top research priority and, pending their future appropriations, the Agency intends to complete the overall study.

Currently, the Agency is seeking a candidate project with active and/or planned dredging and dredged material management where contaminated sediments are an issue of concern. If a suitable case can be identified in Puget Sound that meets MARAD's evaluation criteria, I am confident that the agency would be highly interested in sharing costs with regional and local entities to test the methodology. The Demonstration Project may provide such an opportunity. I am attaching a short version of the Phase-I report. The complete document is also available.

Florida Ports. While in Florida last year, the Florida Ports Council (FPC) expressed interest in evaluating the potential application of the decision analytical methodology to the development of the 5-year dredged material management plans (DMMPs) that the Florida Ports are mandated to prepare under the "Clean Ports Bill" enacted by the Legislature. A draft guidance document is already in place by the Army Corps of Engineers which incorporates elements of risk assessment, uncertainty analysis and cost/benefit analysis in performing DMM studies. Just before I left Florida, in late February, the FPC was engaged in revising the Bill pertaining to the streamlining of the permitting process. Consideration of the decision methodology in the planning process was deferred until specific technical aspects on environmental compliance were to be addressed. I am communicating with the FPC and given the new direction in regulatory reform toward a risk-based rule making, I am convinced that decision analysis will find its way into the plan. Should such a progressive regulatory initiative be considered for implementation in this state, there are numerous technical and policy issues that are being addressed in the DMMPs, as implemented in the State of Florida, that would be of interest to the State of Washington as well.

US EPA/Office of Science and Technology. From June 1995 through March 1996, I served on a technical expert panel, assembled by the USEPA's Office of Science and Technology, Standards and Applied Science Division, to review and comment on the approach used by EPA to evaluate the National Sediment Inventory data and develop a classification scheme for ranking contaminated sediment sites nationwide. Classifications are determined using sediment chemistry, tissue and toxicity data. The ranking is according to the probability of adverse effects to aquatic life, from exposure of benthic organisms to contaminated sediments, and to human health, from the consumption of fish that bioaccumulate contaminants from sediments. This information will be published this summer in an USEPA report to be submitted to Congress under WRDA requirements.

The report includes a detailed evaluation of the various sediment quality assessment methods and their applicability to the sediment classification effort. I believe that both the PSDDA and Ecology's SMS programs, particularly the human health sediment criteria effort, would be highly benefited by the technical discussions on the methods evaluation included in the report and the way the data has been incorporated in the development of the classification scheme.

Risk-Based Rule Making. As you probably know, there is a considerable effort being placed at both the federal and state levels in the development of a decision making framework for risk reduction in the rule making process within the context of a risk/cost/benefit trade-off analysis. The driving force for this initiative is the regulatory reform being considered by the US Congress which, among other things, would require agencies to conduct risk assessments and cost-benefit analyses before issuing new rules.

In June 1995, the State of Florida passed risk assessment legislation under Laws of Florida, Chapter 95-295, and created the Risk-Based Priority Council to provide recommendations to the Governor, the Legislature and the Agencies in the State of Florida for conducting risk analyses and incorporating state-of-the-science methods in the formulation of environmental statutes.

In September 1995, the Florida Center for Environmental Studies (FCES) formed a technical steering committee to establish a forum for communicating current and emerging technologies in risk assessment and risk management to the Council in support of its deliberations to the Legislature and to initiate the process for developing an integrated technical bank of information and resources available in state agencies, industry, the professional services sector and academia.

My contribution to this effort was technical input to the development of guidelines in the use of risk analysis in regulatory rule-making and the development of an inventory of expertise in risk analysis within the Florida academic community. For the former, specific items included:

general principles for risk reduction; a decision making framework for risk reduction within the context of a risk/cost/benefit trade-off evaluation; a draft risk reduction plan; the use of risk assessment in cost-benefit analysis; critical factors in the performance of integrated exposure assessments and; methods for risk calculation. For the latter, I generated a report which is currently being finalized and will be submitted to the Risk-Based Priority Council, Legislature, Agencies and the general public in June.

Again, I believe these aspects would be directly applicable to Ecology's efforts in the development of integrated risk-based (human health/ecological) sediment criteria for Puget Sound, as part of the overall initiative for MTCA reform, and potentially in the adoption of risk-based rule making for the State of Washington.

All in all, Rachel, based on the above discussion, I am confident that I can provide the Interagency Group with useful technical input to the sediment management programmatic planning for the State of Washington. As a starting point, the Group may want to consider the establishment of a Science/Technical Advisory Board which would focus on technical issues that influence policy. I would be interested in chairing the Board. I would work with you and the other agency representatives to: (1) develop a problem-solving-oriented statement of task aimed to resolve key technical problems thus accelerating decision making and action taking by member agencies; (2) develop selection criteria for membership; (3) prepare a list of candidate (in-state and out-of-state) experts meeting these criteria and select members and alternates to serve on the Board; (4) establish a plan and agenda for the Board's activities and; (5) develop a liaison program with interest groups that focuses on effective communication of the technical issues and proposed resolution to obtain early input and buy-in for effective decision making and implementation of specific action alternatives.

I would welcome the opportunity to meet with you and other members of the Cooperative Sediment Management Program to expand on the aspects summarized above and discuss the most effective way to utilize my expertise. I am looking forward to your response and to the exciting prospect of supporting Ecology and the other member agencies in meeting current and future technical challenges in sediment management for the State of Washington

Sincerely,

Spyros P. Pavlou, PhD
Director, Risk-Based Environmental Management

Distribution:

B. Applebury	*J. Malek*	*T. Benson*	*B. Betts*
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THE USE OF RISK ANALYSIS AND DECISION ANALYSIS IN THE MANAGEMEMT OF CONTAMINATED SEDIMENTS

by

Spyros P. Pavlou[1] and J. Toll[2]
Foster Wheeler Environmental Corporation

Presented at the Risk Assessment Workshop, State of Practice of Risk Assessment in Human Health and Environmental Decision Making, Turnbull Conference Center, Tallahassee Florida, 13-14 December, 1995

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INTRODUCTION

Delays in dredging and inability to dredge the nation's harbors due to the presence of contaminated sediments and lack of environmentally acceptable disposal sites are interfering with shipping activities and increase in trade.

President Clinton's recent committment for continuing support of the port indusrtry's goals for enhancing economic growth while protecting, conserving and restoring coastal resources, has resulted in the articulation of a National Dredging Policy in the Action Plan for Improvement of the Dredging process in the United States. This national challenge calls for a systematic and consistent decision making approach to dredged material management and hence contaminated sediment management.

The discussion which follows presents a conceptual approach for contaminated sediment management through the use of risk analysis and decision analysis.

UNIQUE CHALLENGE

The unique challenge to the development of contaminated sediment management strategies arises when an attempt is made to quantify the costs associated with reducing risks to a level where the net benefits resulting from implementing the strategy are maximized. This process requires the evaluation of the trade-offs between risks, costs and benefits in choosing a specific course of action.

AVAILABLE METHODS FOR MEETING THE CHALLENGE

Meeting the unique challenge presented above can be accomplished through the use of risk assessment, risk management, cost-benefit analysis and decision analysis. Risk assessment can be used as a method for identifying the potential hazards of sediment contamination by establishing levels of acceptable risks for both human health and environmental protection and then comparing estimated actual risks to these benchmark values. Risk management integrates the risk assessment results with other information to make decisions about the need for, method of and extent of risk reduction. Cost benefit analysis relates costs to benefits of sediment contaminant removal, identifies the point of maximum net benefits, relates costs to a desired level of risk reduction and quantifies costs and benefits for different alternative courses of action.

As the complexity of the problem increases, the use of decision analysis may be appropriate. Decision analysis quantifies the outcome of selected management approaches and uses both factual and subjective information to evaluate the relative merits of specific alternative courses of action. In addition, decision analysis documents the decision making process, involves stakeholders and builds consensus, determines which factors drive decisions, accounts for uncertainty explicitly, provides better access to information for problem solving and, facilitates understanding and use of cost-benefit analysis.

THE DECISION ANALYSIS PROCESS

The decision analysis process involves the performance of four distinct activities: (1) problem formulation i.e., the development of a decision model; (2) running the decision model utilizing a minimum data set to rank potential management alternatives; (3) analysis of model results including identification of driving factors and sensitivity of various alternatives to uncertainties and disagreements and; (4) recommendations for selection of a preferred alternative. The process is iterative and accommodates the decision maker's request for additional analysis, as appropriate, to consider more factors (tangible or intangible) which could influence the ultimate decision or choice of the preferred alternative.

DECISION ANALYTICAL FRAMEWORK FOR DREDGED MATERIAL AND CONTAMINATED SEDIMENT MANAGEMENT

A preliminary study was conducted under support from the Maritime Administration (MARAD), Office for Environmental Activities, to determine the feasibility of using decision analysis in dredged material disposal planning and contaminated sediment management. The study responded to issues of interest to the port industry and, in particular, attempted to conceptualize a methodology which could improve decision making regarding: selection of environmentally sound and cost-effective management alternatives; expediting dredged material management and facilitating waterside access; identifying economic risks from delays in decision making; managing environmental risks while maximizing benefits of management alternatives and; reaching mutually acceptable solutions with stakeholders.

The driving forces to this study were: (1) the Action Plan for Improvement prepared by the Interagency Group on the Dredging Process which recommends that risk assessment and risk management methodologies be utilized to develop a comprehensive approach for evaluating dredged material and available disposal options; (2) the initiative by the National Academy of Sciences/National Research Council (NRC), Marine Board Committee on Contaminated Marine Sediments to assess how risks costs and benefits can be incorporated in the decision process for managing and remediating contaminated sediments and; (3) the implementation of guidance on the " National Harbors Program: Dredged Material Management Plans developed by the US Army Corps of Engineers (USACE).

The criteria for applying a decision analytical methodology to a dredged material management project included: the presence of sediment contamination; frequent maintenance dredging requirements; uncertain human health, environmental and economic risks; multiple stakeholders and agendas; limited disposal options; known remediation technologies.

The following sequential evaluation steps were recommended as the basic components of the dredged material management decision process: identification of important factors impeding timely maintenance dredging of ports; identification of key stakeholders in the decision making process; identification of cost/risk factors; selection of a specific project to demonstrate the utility of the methodology; selection of dredged material management alternatives to be analyzed; determination of criteria for selecting a preferred alternative;

development of a decision analytical prototype in a graphical computer modeling environment and; documentation of the analyses and results in a report.

To implement the decision analytical methodology, minimum data requirements were identified. These included: dredging and dredged material disposal costs; risk mitigation costs; compensation for resource damages; compliance and permitting costs; sampling and analysis costs; risk assessment costs; use and marketability of dredged material; economic benefits to the port; regional economic benefits (e.g., tax revenues); costs for implementing management alternatives.

SUMMARY

Risk analysis and decision analysis can be useful tools in balancing risks, costs and benefits for decision making regarding the selection of cost-effective and environmentally acceptable dredged material management alternatives. Decision analysis could assist in resolving uncertainties and disagreements among stakeholders in selecting the best alternative. Selection of a test case project would be highly desirable for demonstrating the applicability and effectiveness of this methodology in expediting the dredged material management decision process.

Port of Seattle

May 22, 1996

Mr. David Bradley
Washington Department of Ecology
MS PV-11
P. O. Box 47600
Olympia, WA 98504-7600

Re: Triennial Review of State Sediment Management Standards

Dear Dave:

As promised at this year's Sediment Management Annual Review Meeting (SMARM), we are enclosing specific suggestions for Sediment Management Standards (SMS) Rule revisions that we believe are appropriate to incorporate into the SMS Rule as part of the triennial review process. These suggested rule revisions are based upon our letter of August 15, 1995, the Interagency Sediment Cleanup Strategy (August 1995), and suggested rule revisions provided by other parties (including Ecology) during previous annual reviews of the SMS. Our suggested revisions are shown as black-line changes on the current SMS Rule (as revised in December 1995).

As discussed more fully in our follow-up letter to the SMARM proceedings, we ask that Ecology consider these recommended changes carefully as part of your triennial review of the SMS Rule. The rule revision language we have proposed (or similar language) would help ensure that the chemical criteria of the rule continue to accurately reflect the latest scientific knowledge, focus active cleanup efforts on hotspots to accelerate cleanup at the worst sites, reduce barriers and provide incentives for voluntary cleanups, and make the rule more compatible with the MTCA Rules.

We also ask that Ecology seriously consider moving the sediment cleanup standards portion of the SMS Rule into the MTCA Rules. Placing the sediment cleanup standards portion of the SMS Rule into the MTCA Rules would reduce existing inconsistencies and redundancies between the rules and generally serve the interests of regulatory reform. Doing so would also give recognition to the fact that the primary authority for dictating sediment cleanup processes and policies MTCA (and not the WPCA).

P.O. Box 1209
Seattle, WA 98111 U S A
(206) 728-3000
TELEX 703433
FAX (206) 728-3252

We thank you for the opportunity to suggest how the SMS Rule may be improved, and look forward to working with Ecology in seeing the triennial review process through to its conclusion. Call us if you have any questions about the enclosed suggested rule revisions or wish to arrange a meeting to discuss our proposed revisions.

Very truly yours,

Douglas A. Hotchkiss
Thomas A. Newlon

Enclosure
cc: Rachel Friedman-Thomas, Department of Ecology (w/enclosure)
Keith Phillips, Department of Ecology (w/enclosure)
Konrad Liegel, Preston Gates & Ellis (w/enclosure)
Eric Johnson, Washington Public Ports Association (w/enclosure)

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PRESTON GATES & ELLIS
ATTORNEYS

July 24, 1996

Mr. David Bradley
Washington Department of Ecology
MS PV-11
P. O. Box 47600
Olympia, WA 98504-7600

Re: Triennial Review of Sediments Rule

Dear Dave:

As I had promised at the last Sediment Implementation Committee meeting, I am enclosing a summary of the Port of Seattle's proposed revisions to the Sediment Management Standards Rule (ch. 173-204 WAC), together with a rule section-by-section discussion of the proposed revisions. As you can see from the summary, the Port of Seattle's proposed revisions are directed toward providing solutions to a handful of major concerns with the existing rule.

Please send the summary and rule section-by-section discussion to Sediment Implementation Committee members in advance of the August 6, 1996 meeting. I will see you then.

Very truly yours,

PRESTON GATES & ELLIS

By
Konrad J. Liegel

KJL:kjl
Enclosure
cc: Tom Newlon
Doug Hotchkiss
Eric Johnson

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Summary of Port of Seattle Triennial Review Proposed Rule Revisions (1993-1996)

Concern	Proposed Solution	Rule Revision (WAC 173-204)
1. Need for ongoing rule validation and refinement.	⇒Strengthen Ecology commitment to: a) rule review and revision b) use of alternate technical methods (e.g., for identifying false positives).	**Amend:** -130 (Administrative policies); -315 (Confirmatory marine sediment biological tests)
	⇒Recalculate chemical criteria based upon new information.	**Amend:** Tables I, II and III
	⇒Delete microtox test.	**Amend:** -315 (Confirmatory marine sediment biological tests); -320 (Marine sediment quality standards)
	⇒Revise sediment cleanup site list/ranking each time that the chemical concentration criteria of the rule are modified to reflect the latest scientific knowledge.	**Amend:** -500 (Sediment cleanup decision process and policies); -540 (Ranking, listing and deleting sites)
	⇒Reconceive sediment quality criteria as "screens" or "flags" instead of "pass-fail" evaluations.	

Summary of Port of Seattle Triennial Review Proposed Rule Revisions (1993-1996)

Concern	Proposed Solution	Rule Revision (WAC 173-204)
2. *Need for greater emphasis on benthic community assessment data in determining whether sediments exceed regulatory limits* (such studies are especially valuable because they directly measure the abundance of animals potentially impacted by contaminants).	⇒Allow the optional use of benthic community testing as a third tier determinant of sediment quality when evaluating cleanup strategies or undertaking cleanup actions under the rule.	**Amend:** -310 (Sediment quality standards designation procedures); -320 (Marine sediment quality standards)
3. *Need for "hotspot" focus in the rule.*	⇒Give policy recognition to "hotspot" focus.	**Amend:** -500 (Sediment cleanup decision process and policies)
	⇒Set cleanup screening levels criteria at the "moderate adverse effects" level.	**Amend:** -200 (Definitions); -510 (Identifying sediment station clusters of potential concern); -520 (Minimum cleanup levels criteria) **Add:** -525 (Cleanup screening levels criteria)
	⇒Revise procedures to identify sediment cleanup sites.	**Amend:** -530 (Hazard assessment and site identification)

Summary of Port of Seattle Triennial Review Proposed Rule Revisions (1993-1996)

Concern	Proposed Solution	Rule Revision (WAC 173-204)
4. Need for greater recognition to the process of natural recovery in "delisting" sites.	⇒Clarify that the cleanup decision process includes ranking, listing and delisting sediment cleanup sites.	**Amend:** -500 (Sediment cleanup decision process and policies)
	⇒Recognize the role of natural recovery and provide for delisting when natural recovery is adequately demonstrated.	**Amend:** -540 (Ranking, listing and deleting sites)
	⇒Clarify that a sediment cleanup site may be delisted on the basis of site specific information gathered during field investigations on the site.	**Amend:** -540 (Ranking, listing and deleting sites)
5. Need for reducing barriers and providing incentives in the rule for voluntary cleanup.	⇒Clarify that the cleanup decision process for managing contaminated sediments is under WPCA and MTCA.	**Amend:** -500 (Sediment cleanup decision process and policies); -540 (Ranking, listing and deleting sites); -550 (Types of cleanup and authority)
	⇒Allow for independent cleanups to take place without oversight or guidance from Ecology and incidental cleanups to proceed more independently that is currently allowable under the rule.	**Amend:** -550 (Types of cleanup and authority); -560 (Cleanup study)

Summary of Port of Seattle Triennial Review Proposed Rule Revisions (1993-1996)

Concern	Proposed Solution	Rule Revision (WAC 173-204)
6. Need for simplifying and clarifying cleamup study plan and report requirements (and their relationship to MTCA requirements).	⇒Provide an exception to the cleanup study plan requirements under the rule in those situations where a similar plan has been prepared under the MTCA Rules.	**Amend:** -500 (Sediment cleanup decision process and policies); -560 (Cleanup study)
	⇒Differentiate more clearly between what is required in a cleanup study plan and cleanup study report.	**Amend:** -560 (Cleanup study)
7. Need for making the rule more compatible with the MTCA Rules.	⇒Place sediment cleanup portion of the rule into the MTCA Rules.	
	⇒Provide an exception to the cleanup study plan requirements under the rule in those situations where a similar plan has been prepared under the MTCA Rules.	**Amend:** -500 (Sediment cleanup decision process and policies); -560 (Cleanup study)

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Proposed Revisions to
Sediment Management Standards (ch. 173-204 WAC)

As proposed in August 15, 1995 Port of Seattle letter to Department of Ecology

WAC 173-204-130 Administrative policies.

- Inserted a phrase in WAC 173-204-130(3) to clarify that chemical concentration criteria are among the provisions of the Sediment Management Standards that need to be modified regularly to ensure that they continue to accurately reflect the latest scientific knowledge as established through ongoing validation and refinement.

- Inserted additional protocols to minimize, track, and identify interferences that lead to false positives in bioassay tests as an example of an alternate technical method that can be proposed under WAC 173-204-130(4).

- Revised WAC 173-204-130(6) to clarify that Ecology will conduct an annual review of the Sediment Management Standards and, based upon its annual review, make any necessary revisions to the rule on at least a triennial basis to ensure that the rule continues to accurately reflect the latest scientific knowledge.

- Revised WAC 173-204-130(7) to clarify that Ecology will consider new or additional scientific information which is available concerning the efficacy of the existing regulations, including testing protocols, as one of the factors in evaluating the Sediment Management Standards for necessary revisions.

WAC 173-204-200 Definitions.

- Added a definition for "moderate adverse effects," the level above which station clusters of potential concern are defined as sediment cleanup sites under the rule.

WAC 173-204-310 Sediment quality standards designation procedures.

- Revised WAC 173-204-310(2)(b) to allow the optional use of benthic community testing as a third tier determinant of sediment quality when evaluating cleanup strategies or undertaking cleanup actions under the rule. In those situations where it is used, sediments with a healthy community would be treated as having no adverse effects even if the sediments had chemical levels above the criteria screening levels and had failed one or more of the bioassays. Ecology would approve the benthic community testing protocols to be used under its alternate technical method authority of WAC 173-204-130(4).

WAC 173-204-315 Confirmatory marine sediment biological tests.

- Inserted additional protocols to minimize, track, and identify interferences that lead to false positives in bioassay tests as an example in WAC 173-204-315(1) of a proposal for an alternate technical method.

- Deleted microtox test from WAC 173-204-315(1)(b)(iii) and WAC 173-204-315(2)(e) as an approved chronic effect test because of the great potential for false positives associated with this test.

WAC 173-204-320 Marine sediment quality standards.

- Table 1 to be revised based upon the results of the AET recalculation being performed.

- Inserted reference to optional third tier biological community testing in WAC 173-204-320(3).

- Deleted reference to microtox test in WAC 173-204-320(3)(e) because of the great potential for false positives associated with this test.

WAC 173-204-420 Sediment impact zone maximum criteria.

- Table II to be revised based upon the results of the AET recalculation being performed.

WAC 173-204-500 Sediment cleanup decision process and policies.

- Inserted phrase in WAC 173-204-500(1) to clarify that the cleanup decision process for managing contaminated sediments is under the authority of the state Water Pollution Control Act (ch. 90.48 RCW) and Model Toxics Control Act (ch. 70.105D RCW).

- Revised WAC 173-204-500(1)(c) to clarify that the cleanup decision process includes ranking, listing and delisting cleanup sites.

- Revised WAC 173-204-500(1) to require Ecology to reconduct its hazard assessment to identify sediment cleanup sites and its site ranking each time that the chemical concentration criteria of the rule are modified to reflect the latest scientific knowledge.

- Revised WAC 173-204-500(3) to provide an exception to the cleanup study plan requirements under the rule in those situations where a similar plan has been prepared under the Model Toxics Control Act.

- Added a policy in WAC 173-204-500(4) to require Ecology to focus sediment cleanup actions at the worst sites. Sites will include only those adjacent sediment stations that exceed the Sediment Management Standards regulatory trigger ("cleanup screening level" -- CSL).

WAC 173-204-510 Identifying sediment station clusters of potential concern.

- Revised section to reflect that the sediment station clusters of potential concern are identified based upon the minimum cleanup levels criteria rather than the cleanup screening levels criteria.

WAC 173-204-520 Minimum cleanup levels criteria.

- Revised section to reflect that the sediment station clusters of potential concern are identified based upon the minimum cleanup levels criteria rather than the cleanup screening levels criteria.

- Table III to be revised based upon the results of the AET recalculation being performed.

WAC 173-204-525 Cleanup screening levels criteria [new].

- Inserted new section to reflect that sediment cleanup sites are identified based upon a cleanup screening levels criteria set at the "moderate adverse effects" level rather than the "minor adverse effects" level.

- Table IV to be inserted based upon the "moderate adverse effects" level considered in the Environmental Impact Statement for the Sediment Management Standards (1990) as revised per the results of the AET recalculation being performed.

WAC 173-204-530 Hazard assessment and site identification.

- Revised the procedures in WAC 173-204-530(4) to identify cleanup sites. Sites will include only those adjacent sediment stations that exceed the Sediment Management Standards regulatory trigger ("cleanup screening level" – CSL). Those areas which are not defined as hotspot sites yet pose potential concern (i.e., exceed the sediment quality standards but not the CSL) will be tracked by Ecology for future monitoring and additional characterization.

WAC 173-204-540 Ranking, listing and deleting sites.

- Added a provision to WAC 173-204-540(3) to confirm that ranking considerations will be made on a consistent basis using the procedure described in *Sediment Ranking System ("SEDRANK"), January 1990*, and all additions and revisions thereto or other procedures approved by the department.

- Added a provision to WAC 173-204-540(5)(a)(ii) to clarify the types of cleanup authorized under the rule.

- Added a provision to WAC 173-204-540(6) to clarify that a site may be delisted on the basis of site specific information gathered during field investigations on the site.

- Added a provision to WAC 173-204-540(6) to recognize the role of natural recovery and providing for delisting when natural recovery is adequately demonstrated.

WAC 173-204-550 Types of cleanup and authority.

- Inserted phrases in section to clarify that cleanups of contaminated sediments can occur under the authority of the state Water Pollution Control Act (ch. 90.48 RCW) and Model Toxics Control Act (ch. 70.105D RCW) as appropriate to the source of contaminants requiring cleanup.

- Revised the types of cleanup actions described in WAC 173-204-550(3) to reduce barriers to independent and incidental cleanups and to make the types of cleanup actions described parallel to similar provisions in the MTCA Rules. As revised, these provisions allow for independent cleanups to take place without oversight or guidance from Ecology and incidental cleanups to proceed more independently than they have been able to do in the past.

- Revised the description of partial cleanup actions in WAC 173-204-550(3)(e) to clarify that such cleanups may occur as part of an incidental cleanup.

WAC 173-204-560 Cleanup study.

- Revised WAC 173-204-560(1) to provide an exception to the cleanup study plan requirements under the rule in those situations where a similar plan has been prepared under the Model Toxics Control Act.

- Revised WAC 173-204-560(1) to clarify that, although a cleanup study plan and report must be prepared by the person undertaking the cleanup, the department need only review and approve the cleanup study plan and report in the case of department or other person initiated cleanups.

- Revised WAC 173-204-560(2) through (7) to differentiate more clearly between what is required in a cleanup study plan and cleanup study report, to make the SMS Rule provisions more consistent with those in the Sediment Cleanup Standards Users Manual, and to make the SMS Rule provisions more consistent with similar provisions of the MTCA Rules.

SMS ISSUE PAPER

SMS TRIENNIAL REVIEW PROCESS

Prepared by Tom Newlon (206 / 728-3731) and Doug Hotchkiss (206 / 728-3192) (Port of Seattle) and Eric Johnson (Washington Public Ports Association, 360 / 943-0760)

INTRODUCTION

Ecology adopted Washington's Sediment Management Standards (SMS) in 1991. At the time of adoption, Ecology committed to review the SMS Rule on an annual basis and to make necessary revisions every three years. In conducting its annual review and triennial revision, Ecology committed to paying particular attention to new or additional scientific information.

Since 1991, many comments have been submitted regarding the need for significant revisions to the core Rule. Further, a substantial amount of new data regarding the effects of different contaminants has been collected and added to Ecology's sediment database. Despite Ecology's receipt of these comments and new data, Ecology has not adopted any significant revisions to the core Rule since 1991. Ecology has also declined to use the new data to recalculate the Rule's numeric criteria. Ecology's only notable change to the SMS Rule since 1991 is the addition, in 1995, of new sections dealing with fish farming (see Sparks 1996).

PROBLEM IDENTIFICATION

Ecology has failed to conduct a thorough triennial review and revision of the SMS Rule. Ecology has also failed to utilize substantial new scientific information to validate and refine the Rule by recalculating the Rule's many numeric criteria.

DISCUSSION

At the time Ecology adopted the SMS Rule in 1991, the agency explicitly recognized the need for continued review of the SMS Rule, committed itself to identifying the latest scientific knowledge, and committed itself to modifying the SMS Rule accordingly. WAC 173-204-130. One of the Rule's key goals is that it should be based upon methods that accurately reflect the latest scientific knowledge. The Rule seeks to accomplish this by directing Ecology to modify the Rule through ongoing validation and refinement. The Rule further directs Ecology to conduct an annual review of the Rule and to revise the Rule every three years, or as necessary. Finally, the Rule directs Ecology to provide meaningful opportunities for public comment during Rule review and revision.

In keeping with these provisions of the Rule, many interested parties have provided Ecology with proposed Rule revisions. The Port of Seattle, for example, recommended numerous Rule changes during the course of Ecology's purported triennial review of the Rule in 1995 (Aggerholm, et al., 1995). The Port's recommendations include, among others, the following:

- Recalculate the Rule's chemical criteria using newly obtained data;
- Recognize, and institute procedures to minimize, bioassay false positives that result from other interfering factors;
- Provide greater emphasis on benthic community assessment as a third tier for determining whether sediments exceed regulatory limits;
- Focus active cleanup efforts on "hotspots" to accelerate cleanups at the worst sites;
- Give greater emphasis to source control and natural recovery relative to active cleanup;
- Reduce barriers to, and provide incentives for, voluntary cleanups; and
- Simplify and clarify cleanup study plan and reporting requirements.

Overall, Ecology's response to these comments has been to acknowledge them, and then to take no further action. As noted above, Ecology's only notable Rule revision since 1991 is the 1995 addition of provisions specific to finfish farming (see Sparks 1996).

While some of the Port's proposed Rule revisions entail minor policy shifts, many are based on the Rule's unambiguous mandate that Ecology continually validate and refine the Rule to assure that it is based upon the latest scientific information. The clearest example of this is the Port's recommendation that Ecology recalculate the chemical criteria using newly obtained data. The Rule specifically requires Ecology to consider such data ("new or additional scientific information") when evaluating the Rule for possible revisions. WAC 173-204-130(7). In an area such as sediment management, where the scientific understanding of contamination and its related effects is evolving so rapidly, and where substantial new data is readily available, Ecology's first priority during rule revision should be recalculating the chemical criteria rather than continuing to rely on criteria that were established five years ago using an outdated data set of questionable predictive ability.

Ecology's failure to recalculate the chemical criteria during last year's purported triennial review, and its failure to address the many other issues raised during the review process, requires immediate attention. Ecology should therefore conduct a real triennial review over the coming year, and should commit to doing so every three years thereafter.

Finally, although the Rule does not mandate a specific process for conducting annual Rule review and triennial Rule revision, the Sediment Management Standards Annual Review Meeting (SMARM) process is an appropriate one which Ecology should follow and take full advantage of. SMARM provides a regular opportunity for raising and addressing Rule issues in need of review. It also provides a good mechanism for the public and for stakeholders to participate in Rule revision, and for all interested parties, including Ecology and other agencies, to present their views on the merits of various proposals. Accordingly, the Port of Seattle will be submitting proposed SMS Rule language during the SMARM comment period to follow-up on the proposed amendments to the SMS Rule identified in its August 1995 letter.

PROPOSED ACTION

- Ecology should commit to conducting a thorough review and revision of the SMS Rule over the next year and every three years thereafter. Ecology should also commit to using newly available data in its sediment database to recalculate the Rule's numeric criteria during this and future triennial reviews.

- Ecology should use the SMARM process as the mechanism for identifying areas of the Rule in need of revision and for obtaining public and peer review of proposed revisions to the Rule.

- Ecology should invite SMARM participants to submit proposed amendments to the SMS Rule, including proposed Rule language, during the SMARM comment period.

REFERENCES

Aggerholm, D., Hotchkiss, D., and Newlon, T., 1995. Letter to Brett Betts, Department of Ecology, regarding Triennial Review of State Sediment Management Standards.

Sparks-McConkey, P. (for Ecology), 1996. Status Paper -- Sediment Management Standards (SMS) Triennial Review.

PSDDA/SMS ISSUE PAPER

EVALUATION OF PUGET SOUND APPARENT EFFECTS THRESHOLDS (AETs)

Prepared by Mike Johns, Tim Hammermeister, Lorraine Read, and Kim Magruder (EVS Consultants, 206/217-9337) for the Port of Seattle.

INTRODUCTION

Apparent Effects Thresholds (AETs) are defined as concentrations of specific chemicals of concern in sediment above which significant adverse biological effects always occur. Dredging and disposal guidelines for Puget Sound and sediment management standards used in Washington State are based upon AETs. In 1994, a recalculation of the 1988 Puget Sound AETs was performed by the Washington Department of Ecology utilizing high quality synoptic data collected subsequent to the 1988 calculations. The purpose of this paper is to evaluate the methodology used to exclude data from the calculation of the new AET values.

It is important to use only high quality synoptic data in the calculation of AETs. It is equally important to base decisions on as much information as is available. Establishing relevant AETs is highly dependant on data, the more data the more likely the AET will be predictive of toxic conditions. Criteria established for the exclusion of data from the 1994 recalculation of AETs included, in order of application: 1) not synoptic; 2) failed chemical QA; 3) insufficient lab replicates; 4) negative control sample failure; 5) no reference or reference failure; 6) statistically inconclusive; and 7) chemically anomalous (Gries and Waldow, 1995). The following discussion examines the exclusion of potentially valid, high quality data from the AET calculations when using the last three criteria listed above.

PROBLEM IDENTIFICATION

Reference Station Performance

The emphasis placed on the reference station performance standards resulted in the exclusion of numerous data from the AET calculations that were otherwise of good quality. The present criteria for accepting data for AET calculation requires a negative control and at least one reference sample per bioassay batch. Positive control or reference toxicant bioassay data are no longer deemed necessary for inclusion in AET calculations. While both the negative control data and reference sample data are important in evaluating toxicity test responses, the performance of negative and positive controls are more critical in determining bioassay data quality. Negative control data provide an indication of test organism health during the exposure period, while the positive control data establish whether the test organisms are sensitive to toxicants. 96-hour LC50 values (48-hour LC50 and EC50 for larval bioassays) determined with reference toxicants are required for the QA2 data requirements, but were dismissed in the recalculation of AETs. There are no reference sediment performance standards specified in the QA2 data requirements (Corps, 1996).

Data should not be excluded from inclusion in the AET calculation because of poor reference station performance, rather a default group of reference samples based on historical reference data should be made available for use in those cases where the study-specific reference data do not meet minimum standards. Reference sample requirements and performance guidelines were the leading factors in rejecting data, resulting in the exclusion of 308 samples containing amphipod data (37% of total amphipod data) and 59 samples containing echinoderm data (19% of total echinoderm data).

Statistically Inconclusive Data

Gries & Waldow (1995) present a five phase process for determining whether significant effects exist between test and reference samples exhibiting high variability. The statistical methods employed to determine the significant effects between test and reference samples are not the most appropriate. As a result, data may be unnecessarily excluded from AET calculations as being statistically inconclusive. Sixteen amphipod (2% of total) and 11 echinoderm (3% of total) samples were excluded from AET calculations after being deemed statistically inconclusive.

Chemically Anomalous "No Hit" Samples

The 1994 re-evaluation of AETs defined a chemically anomalous "No Hit" sample as:

> a sample with a three-fold difference in chemical concentration between it and the next highest adjacent "No Hit" sample, when these samples were ranked according to chemical concentration.

Samples identified as anomalous for dry-weight and TOC normalized chemistry were excluded from AET calculations. Data that have passed all QA/QC guidelines should be considered valid and therefore appropriate for use in AET calculations. The definition of

AETs implies that the highest concentration with a "No Hit" sets the value. If data are to be excluded as being "anomalous," a more rigorous statistical method of determining outlier data should be employed. Eleven AET values were calculated for amphipod mortality based on samples that were not the highest "no hit' concentration. Seven AET values were calculated for echinoderm larvae abnormality based on samples that were not the highest "no-hit" concentration.

TECHNICAL BACKGROUND AND DISCUSSION

Quality Assurance/Quality Control Guidelines

Puget Sound Estuary Program (PSEP) guidelines were followed for the collection, handling, storage, and analysis of sediment samples used for calculating the AETs. Between 1988 and 1994, the Puget Sound Dredged Disposal Analysis (PSDDA) agencies adopted several modifications to the PSEP protocols, which were taken into consideration when selecting sediment data for the 1994 AET recalculations. Modifications to the PSEP protocols included:

- Extension of bioassay holding time from two weeks to six weeks
- Measurement of dissolved total ammonia and sulfides at the initiation and completion of each bioassay
- Monitoring dissolved oxygen (DO) and pH daily
- Aerating the overlying water if DO fell below 60% of saturation, or if high ammonia or total sulfides were present

Sediment data used for calculating the 1988 and 1994 AET values had undergone a rigorous quality assurance (QA) review process. This process is defined in the *Data Validation Guidance Manual for Selected Sediment Variables* (PTI, 1989), which is referred to as the QA2 document in this report. The QA2 data review process is relatively extensive in that it involves verifying the quality of the sample collection efforts as well as the laboratory performance. General QA guidance (based on PSEP protocols) for station positioning, sediment sample collection and storage, and sample handling and document control are provided in the QA2 document. The laboratory performance evaluation involves verifying all documentation provided by the laboratory (i.e., QA sample results and supporting information, original instrumentation printouts [when applicable], original laboratory benchsheets, etc.) for conventional variables, metals, organic compounds, and bioassay results. This documentation is reviewed with respect to the requirements set forth in the original statement of work for the laboratory, which is based on the data quality objectives for the project and PSEP protocol requirements.

Data that meets the QA/QC requirements as described above is considered to be of high quality and defensibly valid. The use of high quality data in the calculation of AETs is paramount to providing the best available knowledge on Puget Sound sediments.

Data excluded due to reference sediment performance

Subsequent to the QA/QC review of Puget Sound sediment data, additional criteria have been used to screen the usefulness of bioassay data in calculating AETs. A phased approach is utilized to determine significant adverse effects for each bioassay, based on reference and test sediment results.

The present reference sediment requirements for bioassay testing include:

- Testing at least one reference sediment per bioassay batch
- Reference sediment had to be collected from recognized reference areas (e.g. Carr Inlet), areas meeting the description in PSEP protocols, or areas identified by recent reference area studies
- Reference sediment performance met ≤20% mean amphipod mortality (≤18% Std. Dev.) and ≤35% mean effective mortality (≤22% Std. Dev.) for sediment larval testing

The assessment of adequate reference sediments for each batch of bioassay test samples is the first tier of significant effect determination. If the test with the reference sediment does not pass QA review, and no alternative reference option is available, then the test samples for those batches with rejected reference sediment results are excluded from the AET analysis. Most of the samples excluded from the 1994 amphipod mortality AET and the echinoderm abnormality AET were excluded because of inadequate reference sediment samples.

According to PSEP, samples are defined as a reference sediment "if it is in fact essentially free of contamination, can provide data that can be used to separate toxicant effects from unrelated effects such as those of sediment grain size." A pool of historical reference samples, stratified by sediment grain size and other factors affecting bioassay variability, should be made available. This historical pool could be used for comparison to test samples when adequate reference data are not available for a given bioassay batch.

A failed reference test does not necessarily indicate laboratory problems; those problems are evaluated by the negative and positive control samples. Operationally, performance of a reference sediment (good or poor) simply reflects the response of the test organisms to native Puget Sound sediment that is minimally contaminated. Providing that the reference sediment has been analyzed for contamination and for other factors (e.g., grain size, total organic carbon, and ammonia), it is possible to draw an alternative conclusion that the reference test response is due to anything other than a response to natural sediment characteristics. While this sediment should not be used to establish reference area mortality or abnormality, it should not result in throwing out the associated batch of test samples. Establishing a database of all historical reference sample bioassay results, stratified appropriately, is recommended to maximize the amount of data available for calculating AET values.

Data excluded as being statistically inconclusive

Choice of statistical tests

Phase III of the significant effect determination recommends using tests which may not be the most appropriate. The tests selected (t-tests for comparison of means and the F-test for equality of variances) assume that the data are normally distributed. While the t-test is quite robust to deviations from normality, the F-test is not; in both tests, the presence of extreme values can lead to erroneous conclusions. A more robust testing procedure would be one using a nonparametric test which is based on ranks -- this test is not adversely affected by extreme values, nor does it require distributional assumptions. In addition, it results in greater statistical power (i.e., the ability to detect differences when they really exist) under most circumstances. A review of some of the bioassay results and the implications of the proposed testing procedures with respect to increased probability of Type I errors (i.e., erroneously calling a station a "Hit") or Type II errors (i.e., erroneously calling a station a "No-Hit") is recommended.

Statistical power considerations

Phase IV of the evaluation of bioassay data screens test samples by comparing the variability among replicates to a trigger value which is based on a percentile of the observed test sample data set. The logic of screening the test samples for excessive variability is sound (i.e., when the variability of the data is high then there can be less confidence in the observed mean, and consequently less confidence in the observed difference between means). However, the selection of the screening value (the 80th percentile of the test sample data set) is subjective, and not very meaningful with respect to the statistical issues which it presumes to address. By the nature of percentiles, a given percentage of the samples evaluated would automatically be rejected because of high variability, regardless of statistical relevance.

If the intent of this screening is to limit the probability of Type II errors, then a probabilistic approach should be taken. The procedure should be designed to screen out test samples which have excessive variability, consequently resulting in decreased power to detect a biologically meaningful difference. This approach requires establishing a level of difference between reference and test samples that is biologically meaningful. The screening procedure would then be a power analysis to test whether variability is too high to result in an adequate assessment of significance at this predetermined level of difference.

The issue of statistical power is very important in the bioassay testing procedure and in the establishment of AET values. AET values are based on an observed relationship between the assessed chemical concentrations and significant biological effects. If there is error in either of these assessments, then the reliability of the AET values is seriously affected. Phase IV of the process to determine adverse biological effects advises a post-hoc power analysis which is well-intentioned. However, there has been some discussion in recent scientific literature indicating that a post-hoc power analysis is artificially bounded (ESA, 1995). A post-hoc power analysis using the original data (i.e., the observed difference of means and variance estimates) following a failure to reject the null hypothesis has an upper bound of 50%. Consequently, *any* post-hoc power analysis would result in an "Inconclusive" statistical evaluation by the rules outlined in the phased determination of significant adverse effects (Figure A-4; Gries and Waldow, 1995). *This type of screening will result in a final dataset that is much smaller than it should be based on accurate statistical considerations.* A post-hoc power analysis should be employed using an established "biological meaningful difference" rather than the observed difference of means.

The statistical evaluation procedure for the bioassay data requires some revisions to ensure statistical validity and appropriateness, and biological relevance. The risk of committing Type I and Type II errors may be increased beyond expectation when statistical tests are not applied appropriately. Because the setting of AET values hinges on the collection of "No-Hit" samples, the determination of biological significance should be as rigorous and robust as possible. To generate protective AETs (i.e., values sensitive to the potential for biological effects), we may prefer to err on the conservative side. Statistically, this means accepting a Type I error rate larger than alpha; practically, it means being more aggressive in determining what is called a "Hit." To generate reliable AETs (i.e., values which perform reasonably well at predicting both biological effects and non-effects), we should try to limit the Type II errors (i.e., maximize power). This can be accomplished by screening out highly variable samples which result in a low power test for the meaningful level of difference between reference and tests sediments.

Data excluded as being chemically anomalous

Data were determined to be chemically anomalous if a "No Hit" sample was one with a three-fold difference in chemical concentration between it and the highest adjacent "No-

Hit" sample, when these samples were ranked according to chemical concentration. The use of this methodology is in contrast to the definition of AET; in addition, it is not implemented as stated. For the recalculation of amphipod AETs, three chemicals of concern (2-methylphenol; 2,4-dimethylphenol, and silver) had two samples each regarded as anomalous, resulting in the *third* highest "No Hit" sample concentration setting the AET. The recalculated echinoderm AETS had two chemicals of concern, antimony and total PCBs, with multiple chemically anomalous samples. The echinoderm AET for antimony is based on the *fourth* highest "No Hit" concentration, due to three chemically anomalous samples (two samples were the same value), and the total PCBs AET based on the third highest "No Hit" concentration. In each of these examples of chemically anomalous data, the sample concentrations excluded differed by less than a factor of two from each other.

These samples were considered outliers because they exceed a subjective trigger value. The purpose of this trigger is to keep the AET value low, so that the predictive capacity of the established value is more sensitive. Therefore, the majority of the data with concentrations below the AET value will be "No Hit." However, a normal distribution of contaminant concentrations (and associated biological effects) should not be expected over the entire dataset. The distribution will be truncated at the analytical detection limit and have sporadic frequency at higher concentrations as data from chemically distinctive contaminated sites are collected. In statistical applications, a data point may be legitimately identified as anomalous (i.e. "outlier") for one of two reasons:

1) The accuracy of the data is in question, or there is clearly an error. In the case of the AET database, either the chemistry, the biology, or both may be in error. Consequently, the data points which are unreliable should be excluded from the database. However, the QA/QC guidelines and the laboratory control standards should detect any errors with respect to data quality.

2) The data associated with a particular station may be correct, but the data do not meet the assumptions of the current model. In the case of AETs, high concentrations of contaminants are expected, since most sites investigated are considered to be chemically degraded.

If a station has both very high chemistry and no apparent biological effects, then:

either

a)The biological responses used are insensitive to this level of contamination. In this case the regulations should require a bioassay or suite of bioassays which provide the acceptable level of sensitivity or a positive control (reference toxicant) bioassay that would indicate insensitivity of a particular test batch,

or

b)The contaminant in question is not toxic in the system being tested or readily bioavailable. This may be a result of the interference of toxicity associated with high concentrations of one compound due to high concentrations of another (antagonistic effects) or the composition of the contaminant.

The AET approach assumes a simplified model of positively correlated biological effects and chemical contamination. The example above describes the situation where a more complex toxicological model is required. If there is evidence that there is interference between certain chemical compounds (either synergistic or antagonistic), then the AET model should not be applied for those compounds. If there is no evidence for an alternative model, then the AET model can represent the null hypothesis and the AET values should be based on all available data which passes QA or laboratory control procedures. There is no reason to assume a valid datapoint with high chemistry and no apparent biological effect is any less accurate than a valid datapoint with moderate chemistry and no apparent biological effect.

An appropriate case for which data can truly be considered chemically anomalous would be when the substrate of a site (e.g., ASARCO slag) are not typical of Puget Sound substrates. Data are not comparable when the substrates are radically different, and therefore such samples should not be included in an AET calculation. However, excluding anomalous data due to non-typical substrate should be decided upon at the beginning of the process when potential datasets are identified, not after reviewing the analytical chemistry/bioassay results.

PROPOSED ACTIONS/MODIFICATIONS

Sediment management decisions should be made based on all of the high quality data (e.g., data that passes a QA2 review) that are available. Only data that have failed to meet QA/QC guidelines, and are therefore considered to be invalid, should be excluded from AET calculations. The following proposed modifications are designed to maximize the inclusion of quality data without compromising the overall integrity of the database and to speed the process by which AETs are recalculated.

The identification of high quality synoptic data sets for inclusion into the AET database should remain essentially the same. Synoptic datasets collected from sites with substrates typical of Puget Sound should undergo a QA/QC review at a QA2 level for chemistry and bioassays.

1) Inclusion of data with no reference or poor reference performance

As per the QA2 data requirements, assessment of bioassay performance should be based upon reference toxicants and problems that may have influenced data quality (i.e, negative control results). Upon meeting QA/QC requirements, test results are compared to reference data to determine whether the sample is a "Hit" or "No Hit". Presently, a "Hit" is determined when the test sample demonstrates a mean mortality that is 25% or greater than the mean mortality of one or more reference samples. The proposed modification is to identify a pool of historical reference samples, stratified by sediment grain size and other factors affecting bioassay variability, to create a default reference value. The default reference value could be used for comparison to test samples when an adequate reference is not available for a given bioassay batch.

2) Re-evaluate data previously deemed statistically inconclusive

The second proposed modification is to revise the analytical and statistical methods used to assess the significance of biological effects. The revision should include:

a) An evaluation of the appropriateness of the recommended parametric significance tests, and recommendations for alternative non-parametric tests.

b) Application of a probabilistic approach to screen the test samples for excessive variability among replicate observations.

c) Revision of the rule which requires a post-hoc power analysis to use a "biologically meaningful difference," rather than the observed difference of means.

3) Inclusion of data previously deemed chemically anomalous

The final proposed modification is to include all data in the AET database that meet required QA/QC guidelines. Data considered to be valid should be included regardless of how it affects an AET value or the predictive reliability of the resulting AET value. The AET database should contain data representative of all the information collected to date on Puget Sound sediments.

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Part VII. Appendices

Appendix B. - Sediment Management Standards, Chapter 173-204 WAC, Amended December 1995

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Sediment Management Standards

Chapter 173-204 WAC

Revised December 1995
Publication No. 96-252

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Revisions to
Sediment Management Standards
Chapter 173-204

As Finally Adopted on December 29, 1995

TABLE OF CONTENTS

1. Inserted new section: WAC 173-204-412 Marine finfish rearing facilities

WAC 173-204-100 AUTHORITY & PURPOSE

2. Inserted a statement to identify cleanup screening levels for identification of sediment cleanup sites, under **WAC 173-204-100 (7)**.

3. Updated the note section to identify Ecology's new mailing address under **WAC 173-204-100 (8)**.

WAC 173-204-130 ADMINISTRATIVE POLICIES

4. Corrected typographical errors (2) for number referencing the annual review process under WAC 173-204-130 (8); References to (7) corrected to (6).

WAC 173-204-200 Definitions

5. Inserted the following two species under the definition for "amphipod" in WAC 173-204-200 (2) *Ampelisca abdita* and *Eohaustorius estuarius.*

6. Inserted a definition for "Marine finfish rearing facilities" under WAC 173-204-200 (13).

7. Modified the definition for "Puget Sound Protocols:" Deleted term "updated in 1989" and replaced with "As amended."

WAC 173-204-315 CONFIRMATORY MARINE SEDIMENT BIOLOGICAL TESTS

8. Inserted *Ampelisca abdita* and *Eohaustorius estuarius* as examples of Amphipod

under WAC 173-204-315 (1)(a)(i).

9. For consistency with respect to current scientific taxonomic nomenclature, replaced *Mytilus edulis* with *Mytilus (edulis) galloprovincialis.*

10. Added *Strongylocentrotus droebachiensis,* i.e., Green sea urchin as a larval bioassay organism to be used in the sediment larval bioassay tests under WAC 173-204-315 (1)(a)(ii)(D).

11. For taxonomic clarification purposes inserted the classification terms Class, Class, and Phylum before Crustacea, Polychaeta, and Mollusca respectively under WAC 173-204-315 (1)(b)(i)..

12. Replaced the word "biomass" with "growth rate" to describe endpoint for Juvenile polychaete under WAC 173-204-315 (1)(b)(ii).

13. For consistency with respect to current scientific taxonomic nomenclature replaced *Photobacterium phosphoreum* with *Vibrio fisheri* under WAC 173-204-315(1)(b)(iii).

14. Replaced the first fifty and second fifty with thirty and seventy respectively for Larval seawater control performance under WAC 173-204-315 (2)(b).

15. Under WAC 173-204-315 (2)(d), included a Juvenile polychaete control growth performance standard of .72 mg/ind/day (i.e., mean individual growth) for acceptable control sediments. Additionally, replaced the term "biomass" with "individual growth rate." Restated the juvenile polychaete performance standard to clarify a range of mean individual growth rate.

WAC 173-204-320 Marine Sediment Quality Standards

16. Removed footnotes of Table 1, Marine Sediment Quality Standards--Chemical Criteria and placed them under subsection (2) of WAC 173-204-320.

17. In Table 1, deleted superfluous "chemical parameter" heading.

18. Restated the footnote 1 -- detection limit criteria for consistency with current scientific methods under WAC 173-204-320(2)(a).

19. Restated footnotes 3 and 4 LPAH and HPAH summing procedures respectively for clarity and consistency with current scientific methods under WAC 173-204-320(2)(b)(i) and (ii).

20. For taxonomic clarification purposes inserted the classification terms Class, Class, and Phylum before Crustacea, Polychaeta, and Mollusca respectively under WAC 173-204-320 (3)(c).

21. Replaced the first and second biomass terms with individual growth rate. Additionally, replaced the third and fourth biomass terms with mean individual growth rate under WAC 173-204-320 (3)((d).

WAC 173-204-400 General Considerations

22. Replaced WAC 173-201 with WAC 173-201A under WAC 173-204-400 (11).

WAC 173-204-410 Sediment quality goal and sediment impact zone applicability

23. Omitted the following sentence, "The sediment impact zone maximum criteria of WAC 173-204-420 shall not be applicable during the approved time schedule authorized by the department" under WAC 173-204-410 (6)(d)(i).

INSERTED NEW SECTION: WAC 173-204-412 Marine finfish rearing facilities.

24. Revised the applicability subsection to clarify that the 100 foot perimeter (line) is included within the sediment impact zone by rule under 173-204-412(2).

25. Revised the title of the table and headers to reflect scientific methods under 173-204-412(3)(b).

26. Replaced "antibiotics" with "antibacterials" for consistency with respect to scientific terminology and usage under 173-204-412(3)(d).

27. Restated the applicability of the sediment impact zone by rule to include the 100 foot perimeter and replaced "physical boundary of the rearing facility" with "outer edge of the marine finfish rearing facility structure" for clarity purposes under 173-204-412(4).

28. Clarified the requirement to use a reference benthic infaunal abundance sediment sample that is either a baseline sediment sample or reference sediment sample in compliance with WAC 173-204-200(21) under 173-204-412(4)(a)(i).

29. Inserted verb "be" for proper english usage under 173-204-412(4)(a)(ii).

WAC 173-204-415 Sediment impact zones

30. Corrected typographical error from 5 to 4 under WAC 173-204-415 (1)(f) to correctly reference the design requirements subsection of section 415.

31. Included "PLUMES" as a sediment modelling tool and eliminated the number 4 after WASP under WAC 173-204-415 (4).

32. Included "PLUMES" as a sediment modelling tool and eliminated the number 4 after WASP under WAC 173-204-415 (4)(a)(iii).

33. Included "PLUMES" as a sediment modelling tool and eliminated the number 4 after WASP under WAC 173-204-415 (4)(b).

34. Included "PLUMES" as a sediment modelling tool and eliminated the number 4 after WASP under WAC 173-204-415 (5)(c)(i).

WAC 173-204-420 Sediment impact zone maximum criteria

35. Removed footnotes of Table II, Puget Sound Marine Sediment Impact Zones Maximum Criteria and placed them under subsection (2) of this section.

36. In Table II, deleted superfluous chemical parameter header.

37. Restated the footnote 1 - detection limit criteria for consistency with current scientific methods under WAC 173-204-420(2)(a).

38. Restated footnotes 3 and 4 LPAH and HPAH summing procedures respectively, for clarity and consistency with current scientific methods under WAC 173-204-420(2)(b)(i) and (ii).

39. Restated the Amphipod performance standard to clarify the exceedance level between the test and reference sediments under WAC 173-204-420 (3)(c)(i).

40. For taxonomic clarification purposes inserted the classification terms Class, Class, and Phylum before Crustacea, Polychaeta, and Mollusca respectively under WAC 173-204-420 (3)(c)(iii).

41. Replaced the first and second biomass terms with individual growth rate. Additionally, replaced the third and fourth biomass terms with mean individual growth rate under WAC 173-204-420 (3)(c)(iv).

WAC 173-204-510 Screening sediment station clusters of potential concern

42. Replaced the term "contiguous" with "spatially and chemically similar" under WAC 173-204-510 (2).

WAC 173-204-520 Cleanup screening levels criteria

43. Removed footnotes in Table III, Puget Sound Marine Sediment Cleanup Screening Levels & Minimum Cleanup Levels -- Chemical Criteria and placed the footnotes under subsection (2) of this section.

44. In Table III deleted superfluous "chemical parameter" header.

45. Restated the footnote 1 -- detection limit criteria for consistency with respect to scientific methods under WAC 173-204-520(2)(a).

46. Restated footnotes 3 and 4 LPAH and HPAH summing procedures respectively, for clarity and consistency with current scientific methods under WAC 173-204-520(2)(b)(i) and (ii).

47. Restated the sentence to clarify the Amphipod performance standard between the test and reference test sediments under WAC 173-204-520 (3)(d)(i).

48. For taxonomic clarification purposes inserted the classification terms Class, Class, and Phylum before Crustacea, Polychaeta, and Mollusca respectively under WAC 173-204-520 (3)(d)(iii).

49. Replaced the first and second biomass terms with individual growth rate. Additionally, replaced the third and fourth biomass terms with mean individual growth rate for the Juvenile polychaete test under WAC 173-204-520 (3)(d)(iv).

WAC 173-204-530 Hazard assessment.

50. Inserted the phrase "and site identification" after assessment in the title, **WAC 173-204-530 Hazard assessment.**

51. Replaced "Identifying and characterizing" with "identify and characterize" under WAC 173-204-530 (2)(b).

52. Replaced "Identifying" with "identify" under WAC 173-204-530 (2)(c).

53. Replaced "Identifying" with "identify" under WAC 173-204-530 (2)(d).

54. Replaced "Providing" with "provide" under WAC 173-204-530 (2)(e).

WAC 173-204-560 Cleanup study.

55. Replaced "Properties" with "recontamination potential" under WAC 173-204-560 (4)(c)(i).

56. Inserted reference to use of Ecology's recommended sediment recovery zone computer models "CORMIX," "PLUMES," and/or "WASP," or an alternate sediment recovery zone model(s) approved by the department under WAC 173-204-560 (4)(f)(ii)(A).

WAC 173-204-590 Sediment recovery zones.

57. Inserted reference to use of Ecology's recommended sediment recovery zone computer models "CORMIX," "PLUMES," and/or "WASP," or an alternate sediment recovery zone model(s) approved by the department under WAC 173-204-590 (2)(a);

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Sediment Management Standards

Chapter 173-204

Amended December 1995

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Chapter 173-204 WAC

SEDIMENT MANAGEMENT STANDARDS

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PART I--GENERAL INFORMATION

WAC 173-204-100 Authority and purpose. (1) This chapter is promulgated under the authority of chapter 90.48 RCW, the Water Pollution Control Act; chapter 70.105D RCW, the Model Toxics Control Act; chapter 90.70 RCW, the Puget Sound Water Quality Authority Act; chapter 90.52 RCW, the Pollution Disclosure Act of 1971; chapter 90.54 RCW, the Water Resources Act of 1971; and chapter 43.21C RCW, the state Environmental Policy Act, to establish marine, low salinity and freshwater surface sediment management standards for the state of Washington.

(2) The purpose of this chapter is to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from surface sediment contamination by:

(a) Establishing standards for the quality of surface sediments;

(b) Applying these standards as the basis for management and reduction of pollutant discharges; and

(c) Providing a management and decision process for the cleanup of contaminated sediments.

(3) Part III, Sediment quality standards of this chapter provides chemical concentration criteria, biological effects criteria, human health criteria, and other toxic, radioactive, biological, or deleterious substances criteria which identify surface sediments that have no adverse effects, including no acute or chronic adverse effects on biological resources and no significant health risk to humans, as defined in this regulation. The sediment quality standards provide a regulatory and management goal for the quality of sediments throughout the state.

(4) The sediment criteria of WAC 173-204-320 through 173-204-340 shall constitute surface sediment quality standards and be used to establish an inventory of surface sediment sampling stations where the sediments samples taken from these stations are determined to pass or fail the applicable sediment quality standards.

(5) Part IV, Sediment source control standards of this chapter shall be used as a basis for controlling the effects of point and nonpoint source discharges to sediments through the National Pollutant Discharge Elimination System (NPDES) federal permit program, state water quality management permit programs, issuance of administrative orders or other means determined appropriate by the department. The source control standards establish discharge sediment monitoring requirements and criteria for establishment and maintenance of sediment impact zones.

(6) Part V, Sediment cleanup standards of this chapter establishes administrative procedural requirements and criteria to identify, screen, rank and prioritize, and cleanup contaminated surface sediment sites. The sediment cleanup standards of WAC 173-204-500 through 173-204-590 shall be used pursuant to authorities established under chapters 90.48 and 70.105D RCW.

(7) This chapter establishes and defines a goal of minor adverse effects as the maximum level of sediment contamination allowed in sediment impact zones under the provisions of Part IV, Sediment source control standards and as the cleanup screening levels for identification of sediment cleanup sites and as the minimum cleanup levels to be achieved in all cleanup actions under Part V, Sediment cleanup standards.

(8) Local ordinances establishing requirements for the designation and management of marine, low salinity and freshwater sediments shall not be less stringent than this chapter.

Note: All codes, standards, statutes, rules or regulations cited in this chapter are available for inspection at the Department of Ecology, P.O. Box 47703, Olympia, Washington 98504-7703.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-100, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-100, filed 3/27/91, effective 4/27/91.]

WAC 173-204-110 Applicability. (1) The sediment quality standards of WAC 173-204-300 through 173-204-315, and 173-204-350, and the sediment cleanup standards of WAC 173-204-500 through 173-204-580 shall apply to all surface sediments.

(2) The sediment quality standards of WAC 173-204-320, 173-204-330, and 173-204-340 shall apply to marine, low salinity and freshwater surface sediments, respectively.

(3) The source control standards of WAC 173-204-400 through 173-204-420 shall apply to each person's actions which exposes or resuspends surface sediments which exceed, or otherwise cause or potentially cause surface sediments to exceed, the applicable standards of WAC 173-204-320 through 173-204-340.

(4) The sediment recovery zone standards of WAC 173-204-590 shall apply to each person's cleanup action decision made pursuant to WAC 173-204-580 where the selected cleanup action leaves in place marine, low salinity, or freshwater sediments that exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(5) The sediment quality standards of WAC 173-204-320 through 173-204-340 shall not apply:

(a) Within a sediment impact zone as authorized by the department under WAC 173-204-415; or

(b) Within a sediment recovery zone as authorized by the department under WAC 173-204-590; or

(c) To particulates suspended in the water column; or

(d) To particulates suspended in a permitted effluent discharge.

(6) Nothing in this chapter shall constrain the department's authority to make appropriate sediment management decisions on a case-specific basis using best professional judgment and latest scientific knowledge for cases where the standards of this chapter are reserved or standards are not available.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-110, filed 3/27/91, effective 4/27/91.]

WAC 173-204-120 Antidegradation and designated use policies. (1) Antidegradation policy. The antidegradation policy of the state of Washington as generally guided by chapters 90.48 and 90.54 RCW, is applicable to any person's new or increased activity and shall apply to this chapter as follows:

(a) Existing beneficial uses shall be maintained and protected and no further degradation which would interfere with or become injurious to existing beneficial uses shall be allowed.

(b) No degradation of existing sediment quality shall be allowed of waters constituting an outstanding national resource, such as waters of national and state parks and scenic and recreation areas, wildlife refuges, and waters of exceptional recreational or ecological significance.

(c) Whenever surface sediments are of a higher quality (i.e., lower chemical concentrations or adverse biological response) than the criteria assigned to said sediments, the existing surface sediment quality shall be protected and waste and other materials and substances shall not be allowed to contaminate such sediments or reduce the existing sediment quality thereof, except in those instances where:

(i) It is clear, after satisfactory public participation and intergovernmental coordination, that overriding considerations of the public interest will be served;

(ii) All wastes and other materials and substances proposed for discharge that may contaminate such sediments are provided with all known, available and reasonable methods of prevention, control, and treatment and/or best management practices;

(iii) The reduction of existing surface sediment quality is authorized by the department; and

(iv) Existing beneficial uses are maintained and protected, and no degradation which would interfere with and/or become injurious to existing sediment beneficial uses and/or causes long-term, irreparable harm to the environment is allowed.

(2) Designated use policy. The policy of the department and the purpose of this chapter shall be to manage waste discharges and sediment quality so as to protect existing beneficial uses and move towards attainment of designated beneficial uses as specified in section 101 (a)(2) of the federal Clean Water Act (33 USC 1251, et seq.) and chapter 173-201 WAC, the Water quality standards for surface waters of the state of Washington. This policy is applicable to any person's existing or proposed actions which may affect surface sediment quality.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-120, filed 3/27/91, effective 4/27/91.]

WAC 173-204-130 Administrative policies. The department shall implement this chapter in accordance with the following policies:

(1) The department shall seek to implement, and as necessary modify this chapter to protect biological resources and human health consistent with WAC 173-204-100(2). To implement the intent of this subsection, the department shall use methods that accurately reflect the latest scientific knowledge consistent with the definitions contained in WAC 173-204-200 (14) and (15), as applicable.

(2) At the interface between surface sediments, ground water or surface water, the applicable standards shall depend on which beneficial use is or could be adversely affected, as determined by the department. If beneficial uses of more than one resource are affected, the most restrictive standards shall apply.

(3) It shall be the goal of the department to modify this chapter so that methods such as confirmatory biological tests, sediment impact zone models, use of contaminated sediment site ranking models, etc., continue to accurately reflect the latest scientific knowledge as established through ongoing validation and refinement.

(4) Any person or the department may propose an alternate technical method to replace or enhance the application of a specific technical method required under this chapter. Using best professional judgment, the department shall provide advance review and approval of any alternate technical method proposed prior to its application. Application and use of alternate technical methods shall be allowed when the department determines that the technical merit of the resulting decisions will improve the department's ability to implement and meet the intent of this chapter as described in WAC 173-204-100(2), and will remain consistent with the scientific intent of definitions contained in WAC 173-204-200 (14) and (15). The department shall maintain a record of the department's decisions concerning application for use of alternate technical methods pursuant to this subsection. The record shall be made available to the public on request.

(5) Intergovernmental coordination. The department shall ensure appropriate coordination and consultation with federally recognized Indian tribes and local, state, and federal agencies to provide information on and to implement this chapter.

(6) The department shall conduct an annual review of this chapter, and modify its provisions every three years, or as necessary. Revision to this chapter shall be made pursuant to the procedures established within chapter 34.05 RCW, the Administrative Procedure Act.

(7) Review of scientific information. When evaluating this chapter for necessary revisions, the factors the department shall consider include:

(a) New or additional scientific information which is available relating surface sediment chemical quality to acute or chronic adverse effects on biological resources as defined in WAC 173-204-200 (1) and (7);

(b) New or additional scientific information which is available relating human health risk to marine, low salinity, or freshwater surface sediment chemical contaminant levels;

(c) New or additional scientific information which is available relating levels of other toxic, radioactive, biological and deleterious substances in marine, low salinity, or freshwater sediments to acute or chronic adverse effects on biological resources, or to a significant health risk to humans;

(d) New state or federal laws which have established environmental or human health protection standards applicable to surface sediment; or

(e) Scientific information which has been identified for addition, modification or deletion by a scientific review process established by the department.

(8) Public involvement and education. The goal of the department shall be to provide timely information and meaningful opportunities for participation by the public in the annual review conducted by the department under subsection (6) of this section, and any modification of this chapter. To meet the intent of this subsection the department shall:

(a) Provide public notice of the department's decision regarding the results of its annual review of this chapter, including:

(i) The department's findings for the annual review factors identified in subsection (7) of this section;

(ii) The department's decision regarding the need for modification of this chapter based on its annual review; and

(iii) Identification of a time period for public opportunity to comment on the department's findings and decisions pursuant to this subsection.

(b) Provide public notice by mail or by additional procedures determined necessary by the department which may include:

(i) Newspaper publication;

(ii) Other news media;

(iii) Press releases;

(iv) Fact sheets;

(v) Publications;

(vi) Any other method as determined by the department.

(c) Conduct public meetings as determined necessary by the department to educate and inform the public regarding the department's annual review determinations and decisions.

(d) Comply with the rule making and public participation requirements of chapter 34.05 RCW, the Administrative Procedure Act, for any revisions to this chapter.

(9) Test sediments evaluated for compliance with the sediment quality standards of WAC 173-204-320 through 173-204-340 and/or the sediment impact zone maximum criteria of WAC 173-204-420 and/or the cleanup screening levels criteria of WAC 173-204-520 shall be sampled and analyzed using the Puget Sound Protocols or other methods approved by the department. Determinations made pursuant to this chapter shall be based on sediment chemical and/or biological data that were developed using an appropriate quality assurance/quality control program, as determined by the department.

(10) The statutory authority for decisions under this chapter shall be clearly stated in the decision documents prepared pursuant to this chapter. The department shall undertake enforcement actions consistent with the stated authority under which the action is taken. The process for judicial review of these decisions shall be pursuant to the statutes under which the action is being taken.

(11) When the department identifies this chapter as an applicable, or relevant and appropriate requirement for a federal cleanup action under the Comprehensive Environmental Response, Compensation and Liability Act, the department shall identify the entire contents of this chapter as the appropriate state requirement.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-130, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-130, filed 3/27/91, effective 4/27/91.]

PART II--DEFINITIONS

WAC 173-204-200 Definitions. For the purpose of this chapter, the following definitions shall apply:

(1) "Acute" means measurements of biological effects using surface sediment bioassays conducted for time periods that are relatively short in comparison to the life cycle of the test organism. Acute effects may include mortality, larval abnormality, or other endpoints determined appropriate by the department.

(2) "Amphipod" means crustacean of the Class Amphipoda, e.g., Rhepoxynius abronius, Ampelisca abdita, or Eohaustorius estuarius.

(3) "Appropriate biological tests" means only tests designed to measure directly, or through established predictive capability, biologically significant adverse effects to the established or potential benthic or aquatic resources at a given location, as determined by rule by the department.

(4) "Beneficial uses" means uses of waters of the state which include but are not limited to use for domestic, stock watering, industrial, commercial, agricultural, irrigation, mining, fish and wildlife maintenance and enhancement, recreation, generation of electric power, and preservation of environmental and aesthetic values, and all other uses compatible with the enjoyment of the public waters of the state.

(5) "Best management practices" or "BMPs" means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of surface sediments of the state. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or water disposal, or drainage from raw material storage.

(6) "Bioassay" means a test procedure that measures the response of living plants, animals, or tissues to a sediment sample.

(7) "Chronic" means measurements of biological effects using sediment bioassays conducted for, or simulating, prolonged exposure periods of not less than one complete life cycle, evaluations of indigenous field organisms for long-term effects, assessment of biological effects resulting from bioaccumulation and biomagnification, and/or extrapolated values or methods for simulating effects from prolonged exposure periods. Chronic effects may include mortality, reduced growth, impaired reproduction, histopathological abnormalities, adverse effects to birds and mammals, or other endpoints determined appropriate by the department.

(8) "Contaminated sediment" means surface sediments designated under the procedures of WAC 173-204-310 as exceeding the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(9) "Control sediment sample" means a surface sediment sample which is relatively free of contamination and is physically and chemically characteristic of the area from which bioassay test animals are collected. Control sediment sample bioassays provide information concerning a test animal's tolerance for stress due to transportation, laboratory handling, and bioassay procedures. Control sediment samples cannot exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(10) "Department" means the department of ecology.

(11) "Freshwater sediments" means surface sediments in which the sediment pore water contains less than or equal to 0.5 parts per thousand salinity.

(12) "Low salinity sediments" means surface sediments in which the sediment pore water contains greater than 0.5 parts per

thousand salinity and less than 25 parts per thousand salinity.

(13) "Marine finfish rearing facilities" shall mean those private and public facilities located within state waters where finfish are fed, nurtured, held, maintained, or reared to reach the size of release or for market sale.

(14) "Marine sediments" means surface sediments in which the sediment pore water contains 25 parts per thousand salinity or greater.

(15) "Minor adverse effects" means a level of effects that:

(a) Has been determined by rule by the department, except in cases subject to WAC 173-204-110(6); and

(b) Meets the following criteria:

(i) An acute or chronic adverse effect to biological resources as measured by a statistically and biologically significant response relative to reference in no more than one appropriate biological test as defined in WAC 173-204-200(3); or

(ii) A statistically and biologically significant response that is significantly elevated relative to reference in any appropriate biological test as defined in WAC 173-204-200(3); or

(iii) Biological effects per (b)(i) or (ii) of this subsection as predicted by exceedance of an appropriate chemical or other deleterious substance standard, except where the prediction is overridden by direct biological testing evidence pursuant to (b)(i) and (ii) of this subsection; and

(c) Does not result in significant human health risk as predicted by exceedance of an appropriate chemical, biological, or other deleterious substance standard.

(16) "No adverse effects" means a level of effects that:

(a) Has been determined by rule by the department, except in cases subject to WAC 173-204-110(6); and

(b) Meets the following biological criteria:

(i) No acute or chronic adverse effects to biological resources as measured by a statistically and biologically significant response relative to reference in any appropriate biological test as defined in WAC 173-204-200(3); and

(ii) No acute or chronic adverse biological effect per (b)(i) of this subsection as predicted by exceedance of an appropriate chemical or other deleterious substance standard, except where the prediction is overridden by direct biological testing evidence pursuant to (b)(i) of this subsection; and

(iii) Does not result in significant human health risk as predicted by exceedance of an appropriate chemical, biological, or other deleterious substance standard.

(17) "Other toxic, radioactive, biological, or deleterious substances" means contaminants which are not specifically identified in the sediment quality standards chemical criteria of WAC 173-204-320 through 173-204-340 (e.g., organic debris, tributyltin, DDT, etc.).

(18) "Person" means an individual, firm, corporation, association, partnership, consortium, joint venture, commercial entity, industry, private corporation, port district, special purpose district, irrigation district, unit of local government, state government agency, federal government agency, Indian tribe, or any other entity whatsoever.

(19) "Practicable" means able to be completed in consideration of environmental effects, technical feasibility and cost.

(20) "Puget Sound basin" or "Puget Sound" means:

(a) Puget Sound south of Admiralty Inlet, including Hood Canal and Saratoga Passage;

(b) The waters north to the Canadian border, including portions of the Strait of Georgia;

(c) The Strait of Juan de Fuca south of the Canadian border; and

(d) All the lands draining into these waters as mapped in water resources inventory areas numbers 1 through 19, set forth in water resources management program established pursuant to the Water Resources Act of 1971, chapter 173-500 WAC.

(21) "Puget Sound protocols" means *Puget Sound Estuary Program. 1986. As amended. Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, U.S. Environmental Protection Agency, Region 10, Seattle, WA (looseleaf).*

(22) "Reference sediment sample" means a surface sediment sample which serves as a laboratory indicator of a test animal's tolerance to important natural physical and chemical characteristics of the sediment, e.g., grain size, organic content. Reference sediment samples represent the nonanthropogenically affected background surface sediment quality of the sediment sample. Reference sediment samples cannot exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(23) "Sediment impact zone" means an area where the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 are exceeded due to ongoing permitted or otherwise authorized wastewater, storm water, or nonpoint source discharges and authorized by the department within a federal or state wastewater or storm water discharge permit, or other formal department authorization.

(24) "Sediment recovery zone" means an area where the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 are exceeded as a result of historical discharge activities, and authorized by the department as a result of a cleanup decision made pursuant to WAC 173-204-580, Cleanup action decision.

(25) "Site units" means discrete subdivisions of an individual contaminated sediment site that are being evaluated for the purpose of establishing cleanup standards. Site units are based on consideration of unique locational, environmental, spatial, or other conditions determined appropriate by the department, e.g., cleanup under piers, cleanup in eelgrass beds, cleanup in navigational lanes.

(26) "Surface sediments" or "sediment(s)" means settled particulate matter located in the predominant biologically active aquatic zone, or exposed to the water column. Sediment(s) also includes settled particulate matter exposed by human activity (e.g., dredging) to the biologically active aquatic zone or to the water column.

(27) "Test sediment" means a sediment sample that is evaluated for compliance with the sediment quality standards of WAC 173-204-320 through 173-204-340 and/or the sediment impact zone maximum criteria of WAC 173-240-420 and/or the cleanup screening levels criteria of WAC 173-204-520.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-200, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-200, filed 3/27/91, effective 4/27/91.]

PART III--SEDIMENT QUALITY STANDARDS

WAC 173-204-300 Purpose. The sediment quality standards of WAC 173-204-320 through 173-204-340 include chemical concentration criteria, biological effects criteria, human health criteria, other toxic, radioactive, biological, or deleterious substances criteria, and nonanthropogenically affected sediment quality criteria which are used to identify sediments that have no adverse effects on biological resources, and correspond to no significant health risk to humans. Designation determinations using the sediment quality standards of WAC 173-204-320 through 173-204-340 shall be conducted as stipulated in WAC 173-204-310, Sediment quality standards designation procedures.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-300, filed 3/27/91, effective 4/27/91.]

WAC 173-204-310 Sediment quality standards designation procedures. Any person may use these procedures to determine a sediment's designation using the applicable sediment quality standards of WAC 173-204-320 through 173-204-340. Any person who designates test sediments using the procedures of this section shall meet the sampling and testing plan requirements of WAC 173-204-600 and records management requirements of WAC 173-204-610. Test sediments designated using the procedures of this section shall be sampled and analyzed using the Puget Sound protocols or other methods approved by the department, and shall use an appropriate quality assurance/quality control program, as determined by the department. A sediment sample that passes the initial designation procedures is designated as complying with the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, until such time as any person or the department confirms the sediment designation as failing the applicable sediment quality standards of WAC 173-204-320 through 173-204-340. A sediment sample that fails the initial designation procedures is designated as not complying with the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, until such time as any person or the department confirms the sediment designation as passing the applicable sediment quality standards of WAC 173-204-320 through 173-204-340. A sediment sample that passes or fails the confirmatory designation procedures is designated as such under the procedures of WAC 173-204-310. Sediments shall be designated with the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 as follows:

(1) Initial designation. Sediments that have been chemically analyzed for the applicable chemical concentration criteria of WAC 173-204-320 through 173-204-340 shall be designated as follows:

(a) Sediments with chemical concentrations equal to or less than all the applicable chemical and human health criteria are designated as having no adverse effects on biological resources, and not posing a significant health threat to humans, and pass the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(b) Sediments with chemical concentrations which exceed any one applicable chemical or human health criterion in WAC 173-204-320 through 173-204-340 are designated as having adverse effects on biological resources or posing significant human health threats, and fail the sediment quality standards of WAC 173-204-320 through 173-204-340, pending confirmatory designation.

(2) Confirmatory designation. Any person or the department may confirm the designation of sediments which have either passed or failed initial designation procedures listed in subsection (1) of this section using the applicable biological testing of WAC 173-204-315, as required below. Sediment samples that pass all the required confirmatory biological tests are designated as passing the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, notwithstanding the sediment's previous initial designation under subsection (1) of this section. Any sediment sample which fails any one of the required confirmatory biological tests shall be designated as failing the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, notwithstanding the sediment's previous initial designation under subsection (1) of this section. The confirmatory biological test standards are described below.

(a) To confirm the designation of a sediment which either passed or failed any applicable chemical concentration criterion

established in WAC 173-204-320 through 173-204-340, the sediment shall be tested for:

(i) Two of the acute effects biological tests described in the applicable standards of WAC 173-204-315; and

(ii) One of the chronic effects biological tests described in the applicable standards of WAC 173-204-315.

(b) Sediments with chemical concentrations which either passed or failed any applicable human health criterion of WAC 173-204-320 through 173-204-340 shall be eligible for confirmatory designation as follows: Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(3) Initial and confirmatory designation of sediments which contain other toxic, radioactive, biological, or deleterious substances. Sediments which contain other toxic, radioactive, biological, or deleterious substances, as defined in WAC 173-204-200(16), shall be designated by the department using the following procedures.

(a) The department shall:

(i) Identify individual contaminants of concern;

(ii) Identify appropriate and practicable sampling and analysis methodologies;

(iii) Identify test interpretation standards for initial and confirmatory designation; and

(iv) Identify acceptable levels of sediment contamination for sediments which contain other toxic, radioactive, biological, or deleterious substances.

(b) Where sediment containing other toxic, radioactive, biological or deleterious substances may also be contaminated by chemicals identified in WAC 173-204-320 through 173-204-340, the department shall require application of the appropriate tests and standards of WAC 173-204-320 through 173-204-340, as determined by the department, in addition to any requirements developed pursuant to (a) of this subsection.

(c) The department may use all or some of the sediment biological tests of WAC 173-204-320 through 173-204-340 to designate sediments with other toxic, radioactive, biological or deleterious substances in cases where those tests are technically appropriate, as determined by the department.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-310, filed 3/27/91, effective 4/27/91.]

WAC 173-204-315 Confirmatory marine sediment biological tests. (1) The following five acute and chronic effects biological tests shall be used to confirm designation of Puget Sound marine sediments using the procedures described in WAC 173-204-310(2). Use of alternate biological tests shall be subject to the review and approval of the department using the procedures of WAC 173-204-130(4).

(a) Acute effects tests.

(i) Amphipod: Ten-day mortality sediment bioassay for the Amphipod, i.e., Rhepoxynius abronius, Ampelisca abdita, or Eohaustorius estuarius.

(ii) Larval: Any one of the following mortality/abnormality sediment bioassays:

(A) Crassostrea gigas, i.e., Pacific oyster;

(B) Mytilus (edulis) galloprovincialis, i.e., Blue mussel;

(C) Strongylocentrotus purpuratus, i.e., Purple sea urchin;

(D) Strongylocentrotus droebachiensis, i.e., Green sea urchin; or

(E) Dendraster excentricus, i.e., Sand dollar.

(b) Chronic effects tests.

(i) Benthic infaunal abundance: Abundance of the following major taxa: Class Crustacea, Class Polychaeta, and Phylum Mollusca.

(ii) Juvenile polychaete: Twenty-day growth rate of the juvenile polychaete Neanthes arenaceodentata; or

(iii) Microtox saline extract: Decreased luminescence from the bacteria Vibrio fisheri after a fifteen minute exposure.

(2) Performance standards for control and reference sediment biological test results. The biological tests of this section shall not be considered valid unless test results for the appropriate control and reference sediments meet the performance standards of (a) through (e) of this subsection. The department may reject the results of a reference sediment biological test based on unacceptably high variability.

(a) Amphipod: The control sediment shall have less than ten percent mortality over the test period. The reference sediment shall have less than twenty-five percent mortality.

(b) Larval: The seawater control sample shall have less than thirty percent combined abnormality and mortality (i.e., a seventy percent normal survivorship at time-final).

(c) Benthic abundance: The reference benthic macroinvertebrate assemblage shall be representative of areas of Puget Sound removed from significant sources of contaminants, and to the extent possible shall have the following characteristics:

(i) The taxonomic richness of benthic macroinvertebrates and the abundances of higher taxonomic groups shall reflect seasonality and natural physical-chemical conditions (e.g., grain size composition and salinity of sediments, water depth) in a reference area, and not be obviously depressed as a result of chemical toxicity;

(ii) Normally abundant species that are known to be sensitive to chemical contaminants shall be present;

(iii) Normally rare species that are known to become abundant only under chemically disturbed conditions shall be rare or absent; and

(iv) The abundances of normally rare species that control community structure through physical modification of the sediment shall be similar to those observed at the test sediment site.

(d) Juvenile polychaete: The control sediment shall have less than ten percent mortality and mean individual growth of $\geq$ 0.72 mg/ind/day per dry weight basis. The reference sediment shall have a mean individual growth rate which is at least eighty percent of the mean individual growth rate found in the control sediment. Control

sediments exhibiting growth below 0.72 mg/ind/day may be approved by the department on a case-by-case basis.

(e) Microtox: Reserved: The department shall determine performance standards on a case-by-case basis as necessary to meet the intent of this chapter.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-315, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-315, filed 3/27/91, effective 4/27/91.]

WAC 173-204-320 Marine sediment quality standards. (1) Goal and applicability.

(a) The sediment quality standards of this section shall correspond to a sediment quality that will result in no adverse effects, including no acute or chronic adverse effects on biological resources and no significant health risk to humans.

(b) The marine sediment quality standards of this section shall apply to marine sediments located within Puget Sound as defined in WAC 173-204-200(19).

(c) Non-Puget Sound marine sediment quality standards. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(2) Chemical concentration criteria. The chemical concentrations in Table I establish the marine sediment quality standards chemical criteria for designation of sediments.

(a) Where laboratory analysis indicates a chemical is not detected in a sediment sample, the detection limit shall be reported and shall be at or below the Marine Sediment Quality Standards chemical criteria value set in this table.

(b) Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied:

(i) Where chemical analyses identify an undetected value for every individual compound/isomer then the single highest detection limit shall represent the sum of the respective compounds/isomers; and

(ii) Where chemical analyses detect one or more individual compound/isomers, only the detected concentrations will be added to represent the group sum.

(c) The listed chemical parameter criteria represent concentrations in parts per million, "normalized," or expressed, on a total organic carbon basis. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.

(d) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, and Anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds as listed.

(e) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Total Benzofluoranthenes, Benzo(a)pyrene, Indeno(1,2,3,-c,d)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.

(f) The TOTAL BENZOFLUORANTHENES criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.

Table I

Marine Sediment Quality Standards --Chemical Criteria

CHEMICAL PARAMETER	MG/KG DRY WEIGHT (PARTS PER MILLION (PPM) DRY)
ARSENIC	57
CADMIUM	5.1
CHROMIUM	260
COPPER	390
LEAD	450
MERCURY	0.41
SILVER	6.1
ZINC	410

CHEMICAL PARAMETER	MG/KG ORGANIC CARBON (PPM CARBON)
LPAH	370
NAPHTHALENE	99
ACENAPHTHYLENE	66
ACENAPHTHENE	16
FLUORENE	23
PHENANTHRENE	100
ANTHRACENE	220
2-METHYLNAPHTHALENE	38
HPAH	960
FLUORANTHENE	160
PYRENE	1000
BENZ(A)ANTHRACENE	110
CHRYSENE	110
TOTAL BENZOFLUORANTHENES	230
BENZO(A)PYRENE	99
INDENO (1,2,3,-C,D) PYRENE	34
DIBENZO (A,H) ANTHRACENE	12
BENZO(G,H,I)PERYLENE	31
1,2-DICHLOROBENZENE	2.3
1,4-DICHLOROBENZENE	3.1
1,2,4-TRICHLOROBENZENE	0.81
HEXACHLOROBENZENE	0.38
DIMETHYL PHTHALATE	53
DIETHYL PHTHALATE	61
DI-N-BUTYL PHTHALATE	220
BUTYL BENZYL PHTHALATE	4.9
BIS (2-ETHYLHEXYL) PHTHALATE	47
DI-N-OCTYL PHTHALATE	58
DIBENZOFURAN	15
HEXACHLOROBUTADIENE	3.9
N-NITROSODIPHENYLAMINE	11
TOTAL PCB'S	12

CHEMICAL PARAMETER	UG/KG DRY WEIGHT (PARTS PER BILLION (PPB) DRY)
PHENOL	420
2-METHYLPHENOL	63
4-METHYLPHENOL	670
2,4-DIMETHYL PHENOL	29
PENTACHLOROPHENOL	360
BENZYL ALCOHOL	57
BENZOIC ACID	650

(3) Biological effects criteria. For designation of sediments pursuant to WAC 173-204-310(2), sediments are determined to have adverse effects on biological resources when any one of the confirmatory marine sediment biological tests of WAC 173-204-315(1) demonstrate the following results:

(a) Amphipod: The test sediment has a higher (statistically significant, t test, $p \leq 0.05$) mean mortality than the reference sediment and the test sediment mean mortality exceeds twenty-five percent, on an absolute basis.

(b) Larval: The test sediment has a mean survivorship of normal larvae that is less (statistically significant, t test, $p \leq 0.05$) than the mean normal survivorship in the reference sediment and the test sediment mean normal survivorship is less than eighty-five percent of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than fifteen percent relative to time-final in the reference sediment).

(c) Benthic abundance: The test sediment has less than fifty percent of the reference sediment mean abundance of any one of the following major taxa: Class Crustacea, Phylum Mollusca or Class Polychaeta, and the test sediment abundance is statistically different (t test, $p \leq 0.05$) from the reference sediment abundance.

(d) Juvenile polychaete: The test sediment has a mean individual growth rate of less than seventy percent of the reference sediment mean individual growth rate and the test sediment mean individual growth rate is statistically different (t test, $p \leq 0.05$) from the reference sediment mean individual growth rate.

(e) Microtox: The mean light output of the highest concentration of the test sediment is less than eighty percent of the mean light output of the reference sediment, and the two means are statistically different from each other (t test, $p \leq 0.05$).

(4) Marine sediment human health criteria. Reserved: The department may determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(5) Marine sediment other toxic, radioactive, biological, or deleterious substances criteria. Other toxic, radioactive, biological or deleterious substances in, or on, sediments shall be at or below levels which cause no adverse effects in marine biological resources, and below levels which correspond to a significant health risk to humans, as determined by the department. The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter pursuant to WAC 173-204-310(3).

(6) Nonanthropogenically affected sediment quality criteria. Whenever the nonanthropogenically affected sediment quality is of a lower quality (i.e., higher chemical concentrations, higher levels of adverse biological response, or posing a greater health threat to humans) than the applicable sediment quality standards assigned for said sediments by this chapter, the existing sediment chemical and biological quality shall be identified on an area-wide basis as determined by the department, and used in place of the sediment quality standards of WAC 173-204-320.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-320, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-320, filed 3/27/91, effective 4/27/91.]

WAC 173-204-330 Low salinity sediment quality standards. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-330, filed 3/27/91, effective 4/27/91.]

WAC 173-204-340 Freshwater sediment quality standards. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-340, filed 3/27/91, effective 4/27/91.]

WAC 173-204-350 Sediment quality standards inventory. (1) The department shall gather available data on sediments and produce an inventory of sediment sampling stations which pass or fail the applicable sediment quality standards of WAC 173-204-320 through 173-204-340. Sediment sampling stations which are evaluated for compliance with the sediment quality standards of WAC 173-204-320 through 173-204-340 and placed on the inventory shall be sampled and analyzed using the Puget Sound Protocols or other methods approved by the department, and shall use an appropriate quality assurance/ quality control program, as determined by the department. The sediment quality standards inventory produced per this section shall be used by the department, and made available upon request to the public and other federal, state, and local agencies for the following uses:

(a) To identify and target necessary source control activities, such as discharger monitoring, to eliminate adverse effects on biological resources and significant health threats to humans from sediment contamination;

(b) To identify contaminated sediment cleanup sites per the procedures in WAC 173-204-500 through 173-204-590;

(c) To establish sediment quality ambient monitoring program status and trends analyses and reports;

(d) To identify the sediment quality of areas proposed for dredging, in-water construction, and other actions requiring federal, state, and/or local permits; and

(e) To complete other uses consistent with the intent of this chapter, as determined by the department.

(2) Sources of data. Sediment biological and chemical data shall be gathered by the department for review to produce and update the sediment quality inventory on a biennial basis. Data sources include, but are not limited to:

(a) Sediment data collected by the department for the Puget Sound ambient monitoring program, compliance monitoring of permitted discharges, and special environmental investigations.

(b) Sediment data submitted to the U.S. Army Corps of Engineers in support of dredging permit applications.

(c) Sediment data collected to identify problem areas and needed source controls in Puget Sound as defined in WAC 173-204-200(19), other marine waters, and all low salinity and freshwater areas in Washington state.

(d) Sediment data used or collected in compliance with chapter 70.105D RCW, and the Model Toxics Control Act cleanup regulation, chapter 173-340 WAC.

(e) Sediment data used or collected in compliance with the federal Comprehensive Environmental Response, Compensation and Liability Act.

(f) Sediment data collected as a requirement of a National Pollutant Discharge Elimination System or state discharge permit.

(g) Sediment data derived from other studies including:

(i) Federally sponsored monitoring studies.

(ii) Special monitoring studies conducted by local and municipal governments, or private industry.

(iii) Data derived through Washington state department of natural resources administration of use authorizations.

(3) The inventory shall be updated and made available to the public on a biennial basis.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-350, filed 3/27/91, effective 4/27/91.]

PART IV--SEDIMENT SOURCE CONTROL

WAC 173-204-400 General considerations. (1) The standards of WAC 173-204-400 through 173-204-420 specify a process for managing sources of sediment contamination. These procedures include:

(a) Evaluating the potential for a waste discharge to create a sediment impact;

(b) Requiring application for a sediment impact zone authorization;

(c) Verifying whether a discharge has received all known, available and reasonable methods of prevention, control, and treatment prior to discharge, and/or application of best management practices;

(d) Analysis and verification of the potential sediment impact;

(e) Determining whether the sediment impact zone would meet maximum allowable contamination requirements;

(f) Evaluating the proposed sediment impact zone in consideration of locational criteria;

(g) Design and/or constrain the sediment impact zone to be as small, and with the least contamination, as practicable;

(h) Public review of the proposed sediment impact zone authorization;

(i) Issuance of the sediment impact zone authorization with provisions for maintenance and closure; and

(j) Reducing and eventually eliminating the sediment impact zone via renewals and modifications of a sediment impact zone authorization.

(2) Permits and other authorizations of wastewater, storm water, and nonpoint source discharges to surface waters of the state of Washington under authority of chapter 90.48 RCW shall be conditioned so that the discharge receives all known, available and reasonable methods of prevention, control, and treatment, and best management practices prior to discharge, as required by chapters 90.48, 90.52, and 90.54 RCW. The department shall provide consistent guidance on the collection, analysis and evaluation of wastewater, receiving-water, and sediment samples to meet the intent of this section using consideration of pertinent sections of the *Department of Ecology Permit Writers' Manual,* as amended, and other guidance approved by the department.

(3) As determined necessary, the department shall require any person who proposes a new discharge to evaluate the potential for the proposed discharge to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(4) As determined necessary, the department shall require existing permitted discharges to evaluate the potential for the permitted discharge to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(5) Within permits authorizing existing discharges to surface waters of the state of Washington, the department may specify appropriate locations and methodologies for the collection and analysis of representative samples of wastewater, receiving-water, and sediments to evaluate the potential for the discharge to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(6) In establishing the need for, and the appropriate, individual permit monitoring conditions, the department shall consider multiple factors relating to the potential for a discharge to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 including but not limited to:

(a) Discharge particulate characteristics;

(b) Discharge contaminant concentrations, flow, and loading rate;

(c) Sediment chemical concentration and biological effects levels;

(d) Receiving water characteristics;

(e) The geomorphology of sediments;

(f) Cost mitigating factors such as the available resources of the discharger; and

(g) Other factors determined necessary by the department.

(7) As determined necessary to ensure the wastewater discharge does not cause a violation of the applicable standards of WAC 173-204-320 through 173-204-340, except as authorized by the department under WAC 173-204-415, Sediment impact zones, the department shall stipulate permit terms and conditions which include wastewater discharge average and maximum mass loading per unit time, and wastewater discharge average and maximum chemical concentrations within new and existing facility permits authorizing wastewater discharges to surface waters of the state of Washington.

(8) As determined necessary, the department shall modify wastewater discharge permits whenever it appears the discharge causes a violation, or creates a substantial potential to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, as authorized by RCW 90.48.520.

(9) To meet the intent of this section, the sediment quality standards of WAC 173-204-320 through 173-204-340 and the sediment impact zone standards of WAC 173-204-415 through 173-204-420 are not considered to be federal discharge permit effluent limits subject to antibacksliding requirements of the federal Clean Water Act. Discharge permit sediment monitoring and sediment impact zone compliance requirements may be used to establish effluent limits sufficient to meet the standards of this chapter.

(10) As determined necessary, the department shall use issuance of administrative actions under authority of chapters 90.48 or 70.105D RCW to implement this chapter.

(11) Wastewater dilution zones. Water quality mixing zones authorized by the department pursuant to chapter 173-201A WAC, Water quality standards for surface waters of the state of Washington, do not satisfy the standards of WAC 173-204-415, Sediment impact zones.

(12) For the sediment source control standards of WAC 173-204-400 through 173-204-420, any and all references to violation of, potential to violate, exceedance of, or potential to exceed the applicable standards of WAC 173-204-320 through 173-204-340 shall also apply to the antidegradation and designated use policies of WAC 173-204-120. Any exceedances or potential exceedances of the antidegradation or designated use policies of WAC 173-204-120 shall meet the applicable requirements of WAC 173-204-400 through 173-204-420.

(13) Under no circumstances shall the provisions of sediment source control standards WAC 173-204-400 through 173-204-420 be construed as providing for the relaxation of discharge permit requirements under other authorities including, but not limited to, chapter 90.48 RCW, the Water Pollution Control Act, chapter 90.54 RCW, the Water Resources Act of 1971, and the Federal Water Pollution Control Act of 1972 and amendments.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-400, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-400, filed 3/27/91, effective 4/27/91.]

WAC 173-204-410 Sediment quality goal and sediment impact zone applicability. (1) Goal and policies.

(a) It is the established goal of the department to manage source control activities to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from sediment contamination.

(b) The stated policy of the department shall be to only authorize sediment impact zones so as to minimize the number, size, and adverse effects of all zones, with the intent to eliminate the existence of all such zones whenever practicable. The department shall consider the relationship between environmental effects, technical feasibility and cost in determining whether it is practicable to minimize and/or eliminate sediment impact zones.

(c) The department shall implement the standards of WAC 173-204-400 through 173-204-420 so as to prevent the creation of new contaminated sediment cleanup sites identified under WAC 173-204-530(4).

(2) A sediment impact zone authorization issued by the department under the authority of chapter 90.48 RCW does not constitute authorization to trespass on lands not owned by the applicant. These standards do not address and in no way alter the legal rights, responsibilities, or liabilities of the permittee or landowner of the sediment impact zone for any applicable requirements of proprietary, real estate, tort, and/or other laws not directly expressed as a requirement of this chapter.

(3) Except as identified in subsection (6)(d) of this section, any person may apply for a sediment impact zone under the following conditions:

(a) The person's discharge is provided with all known, available and reasonable methods of prevention, control, and treatment, and meets best management practices as stipulated by the department; and

(b) The person's discharge activity exposes or resuspends sediments which exceed, or otherwise cause or potentially cause sediments to exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, or the antidegradation policy standards of WAC 173-204-120 (1)(a) and (c) within a period of ten years from the later date of either the department's formal approval of the application for a sediment impact zone authorization or the starting date of the discharge.

(4) The department shall only authorize sediment impact zones for permitted wastewater and storm water discharges, and other discharges authorized by the department. The department shall authorize all sediment impact zones via discharge permits or other formal administrative actions.

(5) The department shall not limit the application, establishment, maintenance, or closure of an authorized sediment impact zone via consideration of sediment contamination determined by the department to be the result of unknown, unpermitted or historic discharge sources.

(6) As determined necessary by the department, any person with a permitted discharge shall be required to meet the standards of WAC 173-204-400 through 173-204-420, as follows:

(a) Any person with a new or existing permitted wastewater discharge shall be required to meet the standards of WAC 173-204-400 through 173-204-420;

(b) Any person with a new or existing permitted industrial storm water discharge, regulated as process wastewater in National Pollutant Discharge Elimination System or state discharge permits, shall be required to meet the standards of WAC 173-204-400 through 173-204-420;

(c) Any person with a new or existing permitted storm water or nonpoint source discharge, which fully uses all

known, available and reasonable methods of prevention, control, and treatment, and best management practices as stipulated by the department at the time of the person's application for a sediment impact zone, shall be required to meet the standards of WAC 173-204-400 through 173-204-420;

(d) Any person with a storm water discharge, existing prior to the adoption of this chapter, and determined by the department to not be fully using best management practices stipulated by the department at the time of the person's application for a permit from the department, shall be eligible for a sediment impact zone as follows:

(i) The department shall issue sediment impact zone authorizations with requirements for application of best management practices stipulated by the department on an approved time schedule.

(ii) Sediment impact zones authorized by the department for permitted storm water discharges under the applicability provisions of subsection (6)(d) of this section shall be subject to cleanup action determinations made by the department pursuant to WAC 173-204-500 through 173-204-590 when the sediment impact zone maximum criteria of WAC 173-204-420 are exceeded within the authorized sediment impact zone.

(iii) The department shall identify and include best management practices required to meet the sediment impact zone design standards of WAC 173-204-415(4) as soon as practicable within sediment impact zone authorizations established for storm water discharges per WAC 173-204-410 (6)(d).

(7) Dredged material and fill discharge activities subject to authorization under Section 401 of the federal Clean Water Act via chapter 90.48 RCW and chapter 173-225 WAC, establishment of implementation procedures of application for certification, are not subject to the standards of WAC 173-204-415 but are subject to the standards of WAC 173-204-400 through 173-204-410 and 173-204-420 as follows:

(a) Requirements for dredging activities and disposal sites shall be established by the department using best available dredged material management guidelines and applicable federal and state rules. These guidelines shall include the Puget Sound dredged disposal analysis (PSDDA) dredged material testing and disposal requirements cited in:

(i) *Management Plan Report - Unconfined Open-Water Disposal Of Dredged Material, Phase I, (Central Puget Sound), June 1988, or as amended;*

(ii) *Management Plan Report - Unconfined Open-Water Disposal Of Dredged Material, Phase II, (North And South Puget Sound), September 1989, or as amended;* and

(iii) *Users Manual For Dredged Material Management In Puget Sound, November 1990, or as amended.*

(b) In coordination with other applicable federal and state and local dredged material management programs, the department may issue administrative orders to establish approved disposal sites, to specify disposal site use conditions, and to specify disposal site monitoring requirements.

(c) The department may authorize sediment impact zones for dredged material disposal via federal Clean Water Act Section 401 certification actions.

(d) As determined necessary by the department, the department may authorize sediment impact zones for dredged material disposal via administrative orders issued under authority of chapter 90.48 RCW. The department shall authorize sediment impact zones for all Puget Sound dredged disposal analysis disposal sites via administrative orders issued under authority of chapter 90.48 RCW.

(e) Administrative orders and certifications establishing sediment impact

zones for dredged material disposal sites shall describe establishment, maintenance, and closure requirements for the authorized site, consistent with the requirements described in (a) of this subsection.

(8) The source control standards of WAC 173-204-400 through 173-204-420 are applicable in cases where the sediment quality standards of WAC 173-204-320 through 173-204-340 are reserved.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-410, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-410, filed 3/27/91, effective 4/27/91.]

WAC 173-204-412 Marine finfish rearing facilities. (1) Purpose. This section sets forth the applicability of this chapter to marine finfish rearing facilities only. This section also identifies marine finfish rearing facility siting, operation, closure and monitoring requirements to meet the intent of this chapter, as applicable.

(2) Applicability. Marine finfish rearing facilities and their associated discharges are not subject to the authority and purpose standards of WAC 173-204-100 (3) and (7), and the marine sediment quality standards of WAC 173-204-320 and the sediment impact zone maximum criteria of WAC 173-204-420, within and including the distance of one hundred feet from the outer edge of the marine finfish rearing facility structure. Marine finfish rearing facilities are not subject to the sediment impact zone standards of WAC 173-204-415.

(3) Sediment monitoring. Sediment quality compliance and monitoring requirements for marine finfish rearing facilities shall be addressed through National Pollutant Discharge Elimination System or other permits issued by the department for facility operation. Marine finfish rearing facilities shall meet the following sediment quality monitoring requirements:

(a) Any person with a new facility shall identify a baseline sediment quality prior to facility operation for benthic infaunal abundance, total organic carbon and grain size in the location of the proposed operation and downcurrent areas that may be potentially impacted by the facility discharge;

(b) Any person with an existing operating facility shall monitor sediment quality for total organic carbon levels and identify the location of any sediments in the area of the facility statistically different (t test, $p \leq 0.05$) from the total organic carbon levels identified as facility baseline levels or statistically different from the applicable total organic carbon levels as identified in Table 1:

TABLE 1 - Puget Sound Reference Total Organic Carbon Values

Silt-Clay Particles (percent Dry Weight)	Total Organic Carbon (percent Dry Weight)
0-20	0.5
20-50	1.7
50-80	3.2
80-100	2.6

(c) The locations and frequency of monitoring fpr total organic carbon, benthic infaunal abundance and other parameters shall be determined by the department and identified in the applicable National Pollutant Discharge Elimination System permit;

(d) Antibacterials. Reserved: The department shall determine on a case-by-case basis the methods, procedure, locations, and frequency for monitoring antibacterials associated with the discharge from a marine finfish rearing facility;

(e) Closure. All permitted marine finfish rearing facilities shall monitor sediments impacted during facility operation to document recovery of sediment quality to background levels. The department shall determine on a case-by-case basis the methods, procedure, locations, and frequency for monitoring sediments after facility closure.

(4) Sediment impact zones. Marine finfish rearing facilities and their associated discharges that are permitted under a National Pollutant Discharge Elimination System permit are hereby provided a sediment impact zone by rule for any sediment quality impacts and biological effects within and including the distance of one hundred feet from the outer edge of the marine finfish rearing facility structure.

(a) The department may authorize an individual marine finfish rearing facility sediment impact zone for any sediments beyond a distance of one hundred feet from the facility perimeter via National Pollutant Discharge Elimination System permits or administrative actions. The authorized sediment impact zone shall meet the benthic infaunal abundance requirements of the sediment impact zone maximum criteria, WAC 173-204-420 (3)(c)(iii). Marine finfish rearing facilities that exceed the sediment quality conditions of subsection (3)(b) of this section beyond a distance of one hundred feet from the facility perimeter shall:

(i) Begin an enhanced sediment quality monitoring program to include benthic infaunal abundance consistent with the requirements of the National Pollutant Discharge Elimination System permit. The sediment quality monitoring program shall include a benthic infaunal abundance reference sediment sample as required in subsection (3)(a) of this section or a benthic infaunal abundance reference sediment sample in compliance with WAC 173-204-200(21); and

(ii) Be consistent with the sediment source control general considerations of WAC 173-204-400 and the sediment quality goal and sediment impact zone applicability requirements of WAC 173-204-410, apply for a sediment impact zone as determined necessary by the department.

(b) Administrative orders or permits establishing sediment impact zones for marine finfish rearing facilities shall describe establishment, maintenance, and closure requirements as determined necessary by the department.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-412, filed 12/29/95, effective 1/29/96.]

WAC 173-204-415 Sediment impact zones. The purpose of this section is to set forth the standards for establishment, maintenance, and closure of sediment impact zones to meet the intent of sediment quality dilution zones authorized pursuant to RCW 90.48.520, except for sediment impact zones authorized under WAC 173-204-410(7). The department shall authorize all sediment impact zones via discharge permits or other formal administrative actions.

(1) General requirements. Authorization, modification and renewal of a sediment impact zone by the department shall require compliance with the following general requirements:

(a) Permits authorizing wastewater discharges to surface waters of the state of Washington under authority of chapter 90.48 RCW shall be conditioned so that the discharge receives:

(i) All known, available and reasonable methods of prevention, control, and treatment prior to discharge, as required by chapters 90.48, 90.52, and 90.54 RCW; and

(ii) Best management practices as stipulated by the department.

(b) The maximum area, and maximum chemical contaminant concentration and/or allowable maximum biological effect level within sediments assigned to a sediment impact zone shall be as authorized by the department, in accordance with the standards of this section.

(c) The department shall determine that the person's activity generating effluent discharges which require authorization of a sediment impact zone is in the public interest.

(d) The department shall determine that any person's activity generating effluent discharges which require authorization of a sediment impact zone has adequately addressed alternative waste reduction, recycling, and disposal options through application of all known, available and reasonable methods of prevention, control, and treatment to minimize as best practicable the volume and concentration of waste contaminants in the discharge.

(e) The area boundaries of the sediment impact zone established by the department shall include the minimum practicable surface area, not to exceed the surface area allowed under subsection (4) of this section.

(f) Adverse effects to biological resources within an authorized sediment impact zone shall be maintained at the minimum chemical contamination and biological effects levels practicable at all times. The department shall consider the relationship between environmental effects, technical feasibility and cost in determining the minimum practicable chemical contamination and biological effects levels. Adverse effects to biological resources within an authorized sediment impact zone shall not exceed a minor adverse effects level as a result of the discharge, as determined by the procedures of subsection (4) of this section.

(g) The operational terms and conditions for the sediment impact zone shall be maintained at all times.

(h) Final closure of the sediment impact zone shall be conducted in strict accordance with the department's sediment impact zone authorization.

(i) Documents authorizing a sediment impact zone shall require that the permitted discharge not result in a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, outside the area limits of the established zone.

(j) All applications to the department for sediment impact zone authorizations shall be subject to public notice, comment and hearing procedures defined but not limited to the applicable discharge permit or other formal administrative action requirements of chapter 43.21C RCW, the State

Environmental Policy Act, chapter 197-11 WAC, SEPA rules, chapter 90.48 RCW, chapter 163-216 WAC, the State waste discharge permit program, and chapter 173-220 WAC, National Pollutant Discharge Elimination System Permit Program prior to issuance of the authorization. In determining the need for, location, and/or design of any sediment impact zone authorization, the department shall give consideration to all comments received during public review of the proposed sediment impact zone application.

(2) Application requirements.

(a) Whenever, in the opinion of the department, as a result of an ongoing or proposed effluent discharge, a person violates, shall violate, or creates a substantial potential to violate the sediment quality standards of WAC 173-204-320 through 173-204-340 as applicable within a period of ten years from the later date of either the department's evaluation of the ongoing discharge or the starting date of the proposed discharge, the department may require application for a sediment impact zone authorization under authority of chapter 90.48 RCW.

(b) Any person with a proposed or permitted effluent discharge shall apply to the department for authorization of a sediment impact zone when:

(i) The department requires the sediment impact zone application by written notification; or

(ii) The person independently identifies that the ongoing or proposed effluent discharge violates, shall violate, or creates a substantial potential to violate the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 within a period of ten years from the later date of the person's evaluation of the ongoing discharge or the starting date of the proposed discharge, using the procedures of this section.

(c) As necessary, the department may require any person to submit a sediment impact zone application in multiple steps concurrent with its ongoing review and determination concerning the adequacy of the application. The application shall provide the sediment impact zone design information required in subsection (4) of this section and other such information the department determines necessary. The application shall also provide the legal location and landowner(s) of property proposed for use as, or potentially affected by, a sediment impact zone, and shall be accompanied by such other relevant information as the department may require. The department shall issue a written approval of the complete sediment impact zone application prior to or concurrent with authorizing a sediment impact zone.

(d) Submittal of an application to the department for authorization of a sediment impact zone under the terms and conditions of this section shall establish the applicant's interim compliance with requirements of chapter 90.48 RCW and this chapter, as determined by the department. The department may authorize an interim compliance period within a valid discharge permit or administrative order to ensure ultimate compliance with chapter 90.48 RCW and this chapter. The interim compliance period shall not continue beyond the date of issuance of a sediment impact zone authorization within a valid discharge permit issued by the department.

(e) Prior to authorization, the department shall make a reasonable effort to identify and notify all landowners, adjacent landowners, and lessees affected by the proposed sediment impact zone. The department shall issue a sediment impact zone notification letter to any person it believes to be a potentially affected landowner and other parties determined appropriate by the department. The notification letter shall be sent by certified

mail, return receipt requested, or by personal service. The notification letter shall provide:

(i) The name of the person the department believes to be the affected landowner;

(ii) The names and addresses of other affected landowners to whom the department has sent a proposed sediment impact zone notification letter;

(iii) The name and address of the sediment impact zone applicant;

(iv) A general description of the location, size, and contamination level proposed for the sediment impact zone;

(v) The intention of the department to release all specific sediment impact zone application information to the public upon written request to the department;

(vi) The determination of the department concerning whether the proposed sediment impact zone application meets the standards of this section;

(vii) The intention of the department whether to authorize the proposed sediment impact zone; and

(viii) Notification that the affected landowners, adjacent landowners, and lessees may comment on the proposed sediment impact zone. Any comments on the proposed sediment impact zone authorization shall be submitted in writing to the department within thirty days from the date of receipt of the notification letter, unless the department provides an extension.

(f) Prior to authorization, the department shall issue a sediment impact zone notification letter to affected port districts, the Washington state department of natural resources marine lands division, the U.S. Army Corps of Engineers, and other parties determined appropriate by the department. The notification letter shall be sent by certified mail, return receipt requested, or by personal service. The notification letter shall provide the information required under (e) of this subsection.

(3) Locational considerations. The department shall require any person applying for a sediment impact zone to submit information concerning potential location considerations of the zone. The location of an authorized sediment impact zone shall avoid whenever possible and minimize adverse impacts to areas of special importance. Prior to authorization of a sediment impact zone, the department shall consider all pertinent information from the applicant, all affected parties, local, state and federal agencies, federally recognized Indian tribes, and the public concerning locational considerations, including but not limited to:

(a) Spawning areas;

(b) Nursery areas;

(c) Waterfowl feeding areas;

(d) Shellfish harvest areas;

(e) Areas used by species of economic importance;

(f) Tribal areas of significance;

(g) Areas determined to be ecologically unique;

(h) Water supply intake areas;

(i) Areas used for primary contact public recreation;

(j) High quality waters that constitute an outstanding national resource; and

(k) Areas where sediment quality is substantially better than levels necessary for protection of biological resources and human health.

(4) Design requirements. The location, areal limitations, and degree of effects allowed within an authorized sediment impact zone shall be determined by application of the department's sediment impact zone computer models "CORMIX," "PLUMES," and/or "WASP," or an alternate sediment impact zone model(s) approved by the department under WAC 173-204-130(4), as limited by the standards of this section and the department's best professional judgment. The models shall be used by the department or by the discharger as required by the department, to estimate the impact of

any person's wastewater or storm water discharge on the receiving water and sediment quality for a period of ten years from the later date of either the department's formal approval of the application for a sediment impact zone authorization or the starting date of the discharge.

(a) Data requirements. The discharger shall submit the following information to determine requirements for establishment and authorization of a sediment impact zone, as required by the department:

(i) Data reports and analyses results for all samples of wastewater or storm water, receiving water, and sediments collected by the discharger or other parties relating to evaluation of the potential effects of the permitted discharge, as required by WAC 173-204-400.

(ii) Data reports and analyses results determined necessary to:

(A) Apply discharge modeling to the permitted discharge; and

(B) To identify and evaluate potential alternative chemical and biological effects of the discharge on the receiving water and sediments; and

(C) To identify and evaluate potential alternatives to define the areal size and location of a sediment impact zone needed by the discharge.

(iii) Data reports and analyses results from the discharger's application of the "CORMIX," "PLUMES," and/or "WASP" or an alternate sediment impact zone model(s) approved by the department under WAC 173-204-130(4), to the permitted discharge to identify and evaluate:

(A) Potential alternative chemical and biological effects of the discharge on the receiving water and sediments; and

(B) Potential alternatives for the areal distribution and location of a potential sediment impact zone required by the discharge.

(iv) Preferred alternative for closure of the potential sediment impact zone by active removal and/or natural recovery, and identified costs of the preferred closure method.

(b) Overlapping sediment impact zones. Overlapping sediment impact zones, as predicted by the "CORMIX," "PLUMES," and/or "WASP" models or an alternate sediment impact zone model(s) approved by the department under WAC 173-204-130(4), and the department's best professional judgment, shall be authorized only as follows:

(i) The applicable sediment impact zone maximum criteria of WAC 173-204-420 shall not be exceeded as a result of the multiple discharge sediment impact zones overlap; and

(ii) If the department determines that the applicable chemical contaminant concentration and biological effects restrictions of WAC 173-204-420 would be exceeded as a result of the overlap of multiple discharge sediment impact zones, the department may authorize the sediment impact zones after:

(A) Application of a waste load allocation process to the individual permitted discharges to identify individual permit effluent limitations necessary to meet:

(I) The applicable chemical contaminant concentration and biological effects restrictions for sediment impact zones required by this section; and/or

(II) Storm water best management practices required by the department; and

(B) Establishment of individual permit compliance schedules for the multiple permitted discharges to ensure compliance with:

(I) The permit effluent limitations established by the department using the waste load allocation process and best professional judgment; and

(II) The standards of WAC 173-204-400 through 173-204-420.

(5) Maintenance requirements.

(a) The department shall review sediment impact zone monitoring conducted by the discharger to evaluate compliance with the department's sediment impact zone authorization and the standards of WAC 173-204-400 through 173-204-420. The department may require additional sediment impact zone monitoring when the department determines that any sediment sampling station within an authorized sediment impact zone exceeds the sediment impact zone maximum criteria of WAC 173-204-420 or violates the sediment impact zone authorization as a result of the discharge.

(b) Whenever the department can clearly demonstrate that, as a result of an effluent discharge, a discharger violates, shall violate, or creates a substantial potential to violate the department's sediment impact zone authorization, or the sediment impact zone maximum criteria of WAC 173-204-420, the department shall:

(i) Provide written notification and supporting documentation of the department's clear demonstration determination to the affected discharger;

(ii) Establish a reasonable time frame for the affected discharger to either submit a written statement and supporting documentation rebutting the department's clear demonstration determination, or accept the department's determination. The discharger may use the clear demonstration methods identified in (c) of this subsection for rebuttal of the department's clear demonstration; and

(iii) Provide written notification of the department's determination concerning approval or denial of the submitted clear demonstration rebuttal to the discharger.

(c) For the purpose of this section, a clear demonstration shall consist of:

(i) Use of the sediment impact zone model(s) "CORMIX," "PLUMES," and/or "WASP" or other model(s) to demonstrate a discharge(s) is the source of the violation or potential violation; and

(ii) Use of one or more of the following methods to demonstrate a violation of the sediment impact zone authorization or the sediment impact zone maximum criteria of WAC 173-204-420:

(A) Direct sediment sampling. A violation of the sediment impact zone authorization and/or the sediment impact zone maximum criteria of WAC 173-204-420 is demonstrated when:

(I) The average chemical concentration for three stations within the sediment impact zone exceeds the sediment impact zone maximum criteria of WAC 173-204-420 due to the discharge source. This concentration average shall not include stations for which complete biological testing information shows that the biological effects requirements of WAC 173-204-420, or the authorized sediment impact zone if applicable, are met; or

(II) The biological effects at each of any three stations within the sediment impact zone exceed the sediment impact zone maximum biological effects criteria of WAC 173-204-420 or the authorized sediment impact zone as applicable, due to the discharge source; or

(B) Monitoring data which demonstrates a chemical contaminant concentration gradient toward the discharge source exists in sediments which violates the sediment impact zone authorization or the standards of WAC 173-204-420; or

(C) A trend analysis of the effluent chemical discharge quality and inplace sediment monitoring data which statistically demonstrates an ongoing violation or substantial potential to violate the sediment impact zone authorization or the standards of WAC 173-204-420; or

(D) Field depositional (e.g., sediment traps) and/or effluent particulate (e.g., centrifuge analysis) data which demonstrate an ongoing violation or substantial potential

to violate the sediment impact zone authorization or the standards of WAC 173-204-420; or

(E) Mathematical or computer modeling which demonstrates an ongoing violation or substantial potential to violate the sediment impact zone authorization or the standards of WAC 173-204-420.

(d) The department's response to a clear demonstration of a violation or potential violation shall be to require maintenance activities in the following order:

(i) Require reanalysis of whether the discharger's effluent treatment complies with all known, available and reasonable methods of prevention, control, and treatment and best management practices based on the data used to establish the clear demonstration;

(ii) Alter the authorized sediment impact zone size and/or degree of effects consistent with the standards of this section and the results of direct sediment sampling;

(iii) Reduce impacts of the existing or potential violation by requiring additional discharge controls or additional sediment impact zone maintenance activities which can include, but are not limited to:

(A) Dredging and removal of sediments, solely for sediment impact zone maintenance needs or coordinated with maintenance dredging of commercially important areas, e.g., navigational lanes or ship berthing areas;

(B) Dredging, treatment, and replacement of sediments within the sediment impact zone; and/or

(C) Capping of sediments within the sediment impact zone;

(iv) Limit the quantity and/or quality of the existing permitted discharge; and/or

(v) Withdraw the department's sediment impact zone authorization and require final closure of the zone.

(e) All sediment impact zone maintenance actions conducted under this chapter shall provide for landowner review of the maintenance action plans prior to implementation of the action. In cases where the discharger is not able to secure access to lands subject to the sediment impact zone maintenance actions of this subsection, the department may facilitate negotiations or other proceedings to secure access to the lands. Requests for department facilitation of land access shall be submitted to the department in writing by the responsible discharger.

(6) Closure planning and requirements.

(a) The discharger shall select and identify a preferred method for closure of a sediment impact zone in the application required by WAC 173-204-415(2). Closure methods can include either active cleanup and/or natural recovery and monitoring. The department shall incorporate the discharger's identified closure method in the sediment impact zone authorization.

(b) The department may require closure of authorized sediment impact zones when the department determines that:

(i) The discharger has violated the sediment impact zone maintenance standards of subsection (5) of this section; or

(ii) The department determines that:

(A) The wastewater or storm water discharge quality will not violate the applicable sediment quality standards of WAC 173-204-320 through 173-204-340; or

(B) A sediment impact zone is no longer needed or eligible under the standards of WAC 173-204-410 through 173-204-415.

(7) Modification of sediment impact zones. The department may modify sediment impact zone authorization requirements where the nature of a person's activity which generates, transports, disposes, prevents, controls, or treats effluent discharges has substantially changed and been demonstrated to the department's satisfaction. The modification may occur after consideration of the following:

(a) Reduction of effects. Assessment of the discharge activities and treatment

methods shall be conducted by the discharger to demonstrate to the satisfaction of the department that:

(i) Elimination of the sediment impact zone is not practicable; and

(ii) Further reduction in any existing or proposed sediment impact zone area size and/or level of contamination or effects is not practicable in consideration of discharge requirements for all known, available and reasonable methods of prevention, control, and treatment, best management practices, and applicable waste reduction and recycling provisions.

(b) Alterations. There are substantial alterations or additions to the person's activity generating effluent discharges which require authorization of a sediment impact zone which occur after permit issuance and justify application of permit conditions different from, or absent in, the existing permit.

(c) New information. Sediment impact zones may be modified when new information is received by the department that was not available at the time of permit issuance that would have justified the application of different sediment impact zone authorization conditions.

(d) New regulations. The standards or regulations on which the permit was based have changed by amended standards, criteria, or by judicial decision after the permit was issued.

(e) Changes in technology. Advances in waste control technology that qualify as "all known, available and reasonable methods of prevention, control, and treatment" and "best management practices" shall be adopted as permit requirements, as appropriate, in all permits reissued by the department.

(8) Renewal of previously authorized sediment impact zones. Renewal of sediment impact zones previously authorized under the standards of WAC 173-204-410 and this section shall be allowed under the following conditions:

(a) The department determines the discharge activities and treatment methods meet all known, available and reasonable methods of prevention, control, and treatment and best management practices as stipulated by the department; and

(b) The discharger demonstrates to the department's satisfaction that the discharge activities comply with the standards of WAC 173-204-400 through 173-204-420 and with the existing sediment impact zone authorization; and

(c) Reduction of effects. The discharger conducts an assessment of the permitted discharge activities and treatment methods and demonstrates to the department's satisfaction that:

(i) Elimination of the sediment impact zone is not practicable; and

(ii) A further reduction in any existing or proposed sediment impact zone area size and/or level of contamination is not practicable in consideration of discharge requirements for all known, available and reasonable methods of prevention, control, and treatment, best management practices, and applicable waste reduction and recycling provisions.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-415, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-415, filed 3/27/91, effective 4/27/91.]

WAC 173-204-420 Sediment impact zone maximum criteria. This section establishes minor adverse effects as the maximum chemical contaminant concentration, maximum health risk to humans, maximum biological effects level, maximum other toxic, radioactive, biological, or deleterious substance level, and maximum nonanthropogenically affected sediment quality level allowed within authorized sediment impact zones due to an existing or proposed discharge. If the department determines that the standards of this section are or will be exceeded as a result of an existing or proposed discharge(s), the department shall authorize a sediment impact zone or modify a sediment impact zone authorization consistent with the standards of WAC 173-204-400 through 173-204-420 such that individual permit effluent limitations, requirements, and compliance time periods are sufficient to meet the standards of this section as applicable.

(1) Applicability.

(a) The marine sediment impact zone maximum chemical criteria, and the marine sediment biological effects criteria, and the marine sediment human health criteria, and the marine sediment other toxic, radioactive, biological or deleterious substance criteria and the marine sediment nonanthropogenically affected sediment criteria of this section shall apply to marine sediments within Puget Sound.

(b) Non-Puget Sound marine sediment impact zone maximum criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(c) Low salinity sediment impact zone maximum criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(d) Freshwater sediment impact zone maximum criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(2) Puget Sound marine sediment impact zone maximum chemical criteria. The maximum chemical concentration levels that may be allowed within an authorized sediment impact zone due to a permitted or otherwise authorized discharge shall be at or below the chemical levels stipulated in Table II, Sediment Impact Zone Maximum Chemical Criteria, except as provided for by the marine sediment biological effects restrictions of subsection (3) of this section, and any compliance time periods established under WAC 173-204-410 (6)(d) and 173-204-415.

(a) Where laboratory analysis indicates a chemical is not detected in a sediment sample, the detection limit shall be reported and shall be at or below the Marine Sediment Quality Standards chemical criteria value set in WAC 173-204-320(2).

(b) Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied:

(i) Where chemical analyses identify an undetected value for every individual compound/isomer then the single highest detection limit shall represent the sum of the respective compounds/isomers; and

(ii) Where chemical analyses detect one or more individual compound/isomers, only the detected concentrations will be added to represent the group sum.

(c) The listed chemical parameter criteria represent concentrations in parts per million, "normalized," or expressed, on a total organic carbon basis. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.

(d) The LPAH criterion represents the sum of the following "low molecular weight

polynuclear aromatic hydrocarbon" compounds: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, and Anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds as listed.

(e) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Total Benzofluoranthenes, Benzo(a)pyrene, Indeno(1,2,3,-c,d)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.

(f) The TOTAL BENZOFLUORANTHENES criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.

Table II

Puget Sound Marine Sediment Impact Zones Maximum Chemical Criteria

CHEMICAL PARAMETER	MG/KG DRY WEIGHT (PARTS PER MILLION (PPM) DRY)
ARSENIC	93
CADMIUM	6.7
CHROMIUM	270
COPPER	390
LEAD	530
MERCURY	0.59
SILVER	6.1
ZINC	960

CHEMICAL PARAMETER	MG/KG ORGANIC CARBON (PPM CARBON)
LPAH	780
NAPHTHALENE	170
ACENAPHTHYLENE	66
ACENAPHTHENE	57
FLUORENE	79
PHENANTHRENE	480
ANTHRACENE	1200
2-METHYLNAPHTHALENE	64
HPAH	5300
FLUORANTHENE	1200
PYRENE	1400
BENZ(A)ANTHRACENE	270
CHRYSENE	460
TOTAL BENZOFLUORANTHENES	450
BENZO(A)PYRENE	210
INDENO (1,2,3,-C,D) PYRENE	88
DIBENZO (A,H) ANTHRACENE	33
BENZO(G,H,I)PERYLENE	78
1,2-DICHLOROBENZENE	2.3
1,4-DICHLOROBENZENE	9
1,2,4-TRICHLOROBENZENE	1.8
HEXACHLOROBENZENE	2.3
DIMETHYL PHTHALATE	53
DIETHYL PHTHALATE	110
DI-N-BUTYL PHTHALATE	1700
BUTYL BENZYL PHTHALATE	64
BIS (2-ETHYLHEXYL) PHTHALATE	78
DI-N-OCTYL PHTHALATE	4500
DIBENZOFURAN	58
HEXACHLOROBUTADIENE	6.2
N-NITROSODIPHENYLAMINE	11
TOTAL PCB'S	65

CHEMICAL PARAMETER	UG/KG DRY WEIGHT (PARTS PER BILLION (PPB) DRY)
PHENOL	1200
2-METHYLPHENOL	63
4-METHYLPHENOL	670
2,4-DIMETHYL PHENOL	29
PENTACHLOROPHENOL	690
BENZYL ALCOHOL	73
BENZOIC ACID	650

(3) Puget Sound marine sediment impact zone maximum biological effects criteria. The maximum biological effects level that may be allowed within an authorized sediment impact zone shall be at or below a minor adverse biological effects level. The acute and chronic effects biological tests of WAC 173-204-315(1) may be used to determine compliance with the minor adverse biological effects restriction within an authorized sediment impact zone as follows:

(a) When using biological testing to determine compliance with the maximum biological effects criteria within a sediment impact zone, a person shall select and conduct any two acute effects tests and any one chronic effects test.

(b) The biological tests shall not be considered valid unless test results for the appropriate control and reference sediment samples meet the performance standards described in WAC 173-204-315(2).

(c) The sediment impact zone maximum biological effects level is established as that level below which any two of the biological tests in any combination exceed the criteria of WAC 173-204-320(3), or one of the following biological test determinations is made:

(i) Amphipod: The test sediment has a higher (statistically significant, t test, $p \leq 0.05$) mean mortality than the reference sediment and the test sediment mean mortality is greater than a value represented by the reference sediment mean mortality plus thirty percent; or

(ii) Larval: The test sediment has a mean survivorship of normal larvae that is less (statistically significant, t test, $p \leq 0.05$) than the mean normal survivorship in the reference sediment sample and the test sediment mean normal survivorship is less than seventy percent of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than thirty percent relative to time-final in the reference sediment); or

(iii) Benthic abundance: The test sediment has less than fifty percent of the reference sediment mean abundance of any two of the following major taxa: Class Crustacea, Phylum Mollusca or Class Polychaeta and the test sediment abundances are statistically different (t test, $p \leq 0.05$) from the reference sediment abundances; or

(iv) Juvenile polychaete: The test sediment has a mean individual growth rate of less than fifty percent of the reference sediment mean individual growth rate and the test sediment mean individual growth rate is statistically different (t test, $p \leq 0.05$) from the reference sediment mean individual growth rate.

(4) Puget Sound marine sediment impact zone maximum human health criteria. Reserved: The department may determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(5) Puget Sound marine sediment impact zone maximum other toxic, radioactive, biological, or deleterious substances criteria. Other toxic, radioactive, biological or deleterious substances in, or on, sediments shall be below levels which cause minor adverse effects in marine biological resources, or which correspond to a significant health risk to humans, as determined by the department. The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(6) Puget Sound marine sediment impact zone maximum nonanthropogenically affected sediment criteria. Whenever the nonanthropogenically affected sediment quality is of a lower quality (i.e., higher chemical concentrations, higher levels of adverse biological response, or posing a higher threat to human health) than the applicable sediment impact zone maximum criteria established under this section, the

existing sediment chemical and biological quality shall be identified on an area-wide basis as determined by the department, and used in place of the standards of WAC 173-204-420.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-420, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-420, filed 3/27/91, effective 4/27/91.]

PART V--SEDIMENT CLEANUP STANDARDS

WAC 173-204-500 Sediment cleanup decision process and policies. (1) The standards of WAC 173-204-500 through 173-204-590 are procedures which specify a cleanup decision process for managing contaminated sediments. These procedures include:

(a) Screening sediment station clusters of potential concern;

(b) Conducting hazard assessments to identify cleanup sites;

(c) Ranking sites identified in (b) of this subsection;

(d) Determining the appropriate site cleanup authority;

(e) Conducting a site cleanup study;

(f) Determining the site-specific cleanup standard;

(g) Selecting a site cleanup action; and

(h) Where necessary, authorizing a cleanup site sediment recovery zone.

(2) Under this chapter, the department may require or take those actions necessary to implement the standards of WAC 173-204-500 through 173-204-580 for all contaminated sediment stations on the inventory identified in WAC 173-204-350.

(3) The cleanup process and procedures under this chapter and under other laws may be combined. The department may initiate a cleanup action under this chapter and may upon further analysis determine that another law is more appropriate, or vice versa.

(4) It is the policy of the department to manage sediment cleanup actions towards the goal of reducing and ultimately eliminating adverse effects on biological resources and significant health threats to humans from sediment contamination. To achieve this goal, the department will pursue sediment cleanup decisions and cleanup standards that are as close as practicable to the sediment quality standards of WAC 173-204-320 through 173-204-340, including the consideration of net environmental effects, cost and technical feasibility. The department shall only authorize sediment recovery zones so as to minimize the number, size and adverse effects of all zones, with the intent to eliminate the existence of all such zones whenever practicable.

(5) The department shall endeavor to make sediment cleanup decisions in an expeditious manner, as soon as all needed information is available, consistent with the availability of department resources and the priority of the cleanup site.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-500, filed 3/27/91, effective 4/27/91.]

WAC 173-204-510 Screening sediment station clusters of potential concern. (1) Using the sediment quality standards inventory of WAC 173-204-350, the department shall analyze the sediment sampling data to identify station clusters of potential concern and station clusters of low concern per the standards of this section. Station clusters of potential concern shall be further evaluated using the hazard assessment standards of WAC 173-204-530. Station clusters of low concern shall remain on the inventory and no further cleanup action determinations shall be taken by the department until the stations are reexamined per subsection (5) of this section.

(2) A station cluster is defined as any number of stations from the inventory of WAC 173-204-350 that are determined to be spatially and chemically similar. For the purpose of identifying a station cluster of potential concern per the procedures of this subsection, three stations with the highest contaminant concentration for any particular contaminant or the highest degree of biological effects as identified in WAC 173-204-520 are selected from a station cluster. This procedure may be repeated for multiple chemicals identified in WAC 173-204-520, recognizing that the three stations with the highest concentration for each particular contaminant may be different and the respective areas for all chemicals may overlap. The department shall review the inventory of WAC 173-204-350 to identify station clusters of potential concern via the following process:

(a) Identify if available, the three stations within a station cluster with the highest concentration of each chemical contaminant identified in WAC 173-204-520, Cleanup screening levels criteria; and

(b) For each contaminant identified in (a) of this subsection, determine the average concentration for the contaminant at the three stations identified in (a) of this subsection; and

(c) Identify if available, three stations within the station cluster with the highest level of biological effects for the biological tests identified in WAC 173-204-315(1); and

(d) If the average contaminant concentration for any three stations identified in (a) of this subsection, exceeds the applicable cleanup screening level in WAC 173-204-520, then the station cluster is defined as a station cluster of potential concern; and

(e) If the biological effects at each of the three stations from (c) of this subsection exceeds the cleanup screening level in WAC 173-204-520, then the station cluster is defined as a station cluster of potential concern; and

(f) If neither of the conditions of (d) or (e) of this subsection apply, then the station cluster is defined as a station cluster of low concern; and

(g) If the department determines that any three stations within a station cluster exceed the sediment cleanup screening levels human health criteria or the other toxic, radioactive, biological, or deleterious substances criteria or the nonanthropogenically affected criteria of WAC 173-204-520, then the station cluster is defined as a station cluster of potential concern.

(3) Notification. When a station cluster of potential concern has been identified, the department shall issue notification to the landowners, lessees, onsite dischargers, adjacent dischargers, and other persons determined appropriate by the department prior to the department's conducting a hazard assessment as defined in WAC 173-204-530.

(4) No further cleanup action determinations shall be taken with station clusters of low concern until the inventory of WAC 173-204-350 is updated and the stations reexamined per subsection (5) of this section. Station clusters of low concern shall receive no further consideration for

active cleanup, unless new information indicates an increase of chemical contamination at the stations in question. Station clusters of low concern shall be evaluated by the department for improved source control and/or monitoring requirements of this chapter.

(5) The department may at any time reexamine a station or group of stations to reevaluate and identify station clusters of potential concern following the procedures of subsection (2) of this section when new information demonstrates to the department's satisfaction that reexamination actions are necessary to fulfill the purposes of WAC 173-204-500 through 173-204-590.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-510, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-510, filed 3/27/91, effective 4/27/91.]

WAC 173-204-520 Cleanup screening levels criteria. (1) Applicability.

(a) The marine sediment cleanup screening levels chemical criteria, and the marine sediment biological effects criteria, and the marine sediment other toxic, radioactive, biological, or deleterious substance criteria, and the marine sediment nonanthropogenically affected criteria of this section shall apply to marine sediments within Puget Sound. The cleanup screening levels establish minor adverse effects as the level above which station clusters of potential concern are defined, and at or below which station clusters of low concern are defined, per the procedures identified in WAC 173-204-510(2). The cleanup screening levels also establish the levels above which station clusters of potential concern are defined as cleanup sites, per the procedures identified in WAC 173-204-530, Hazard assessment. The criteria in Table III and this section also establish minor adverse effects as the Puget Sound marine sediment minimum cleanup level to be used in evaluation of cleanup alternatives per the procedures of WAC 173-204-560, and selection of a site cleanup standard(s) per the procedures of WAC 173-204-570.

(b) Non-Puget Sound marine sediment cleanup screening levels and minimum cleanup levels criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(c) Low salinity sediment cleanup screening levels and minimum cleanup levels criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(d) Freshwater sediment cleanup screening levels and minimum cleanup levels criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(2) Puget Sound marine sediment cleanup screening levels and minimum cleanup levels chemical criteria. The chemical concentration criteria in Table III establish the Puget Sound marine sediment cleanup screening levels and minimum cleanup levels chemical criteria.

(a) Where laboratory analysis indicates a chemical is not detected in a sediment sample, the detection limit shall be reported and shall be at or below the Marine Sediment Quality Standards chemical criteria value set in WAC 173-204-320(2).

(b) Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied:

(i) Where chemical analyses identify an undetected value for every individual compound/isomer then the single highest detection limit shall represent the sum of the respective compounds/isomers; and

(ii) Where chemical analyses detect one or more individual compound/isomers, only the detected concentrations will be added to represent the group sum.

(c) The listed chemical parameter criteria represent concentrations in parts per million, "normalized," or expressed, on a total organic carbon basis. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.

(d) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, and Anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds as listed.

(e) The HPAH criterion represents the sum of the following "high molecular

weight polynuclear aromatic hydrocarbon" compounds: Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Total Benzofluoranthenes, Benzo(a)pyrene, Indeno(1,2,3,-c,d)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.

(f) The TOTAL BENZOFLUORANTHENES criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.

Table III
Puget Sound Marine Sediment Cleanup Screening Levels and Minimum Cleanup Levels--Chemical Criteria

CHEMICAL PARAMETER	MG/KG DRY WEIGHT (PARTS PER MILLION (PPM) DRY)
ARSENIC	93
CADMIUM	6.7
CHROMIUM	270
COPPER	390
LEAD	530
MERCURY	0.59
SILVER	6.1
ZINC	960

CHEMICAL PARAMETER	MG/KG ORGANIC CARBON (PPM CARBON)
LPAH	780
NAPHTHALENE	170
ACENAPHTHYLENE	66
ACENAPHTHENE	57
FLUORENE	79
PHENANTHRENE	480
ANTHRACENE	1200
2-METHYLNAPHTHALENE	64
HPAH	5300
FLUORANTHENE	1200
PYRENE	1400
BENZ(A)ANTHRACENE	270
CHRYSENE	460
TOTAL BENZOFLUORANTHENES	450
BENZO(A)PYRENE	210
INDENO (1,2,3,-C,D) PYRENE	88
DIBENZO (A,H) ANTHRACENE	33
BENZO(G,H,I)PERYLENE	78
1,2-DICHLOROBENZENE	2.3
1,4-DICHLOROBENZENE	9
1,2,4-TRICHLOROBENZENE	1.8
HEXACHLOROBENZENE	2.3
DIMETHYL PHTHALATE	53
DIETHYL PHTHALATE	110
DI-N-BUTYL PHTHALATE	1700
BUTYL BENZYL PHTHALATE	64
BIS (2-ETHYLHEXYL) PHTHALATE	78
DI-N-OCTYL PHTHALATE	4500
DIBENZOFURAN	58
HEXACHLOROBUTADIENE	6.2
N-NITROSODIPHENYLAMINE	11
TOTAL PCB'S	65

CHEMICAL PARAMETER	UG/KG DRY WEIGHT (PARTS PER BILLION (PPB) DRY)
PHENOL	1200
2-METHYLPHENOL	63
4-METHYLPHENOL	670
2,4-DIMETHYL PHENOL	29
PENTACHLOROPHENOL	690
BENZYL ALCOHOL	73
BENZOIC ACID	650

(3) Puget Sound marine sediment cleanup screening levels and minimum cleanup level biological criteria. The biological effects criteria of this subsection establish the Puget Sound marine sediment cleanup screening level, and the Puget Sound marine sediment minimum cleanup level criteria.

(a) The acute and chronic effects biological tests of WAC 173-204-315(1) shall be used to:

(i) Identify the Puget Sound marine sediment cleanup screening level for the purpose of screening sediment station clusters of potential concern using the procedures of WAC 173-204-510(2); and

(ii) Identify the Puget Sound marine sediment cleanup screening level for the purpose of identifying station clusters of low concern and/or cleanup sites using the hazard assessment procedures of WAC 173-204-530(4); and/or

(iii) Identify the Puget Sound marine sediment minimum cleanup level to confirm minimum cleanup level determinations using the procedures of WAC 173-204-570(3).

(b) When using biological testing to determine if station clusters exceed the cleanup screening level or to identify the minimum cleanup level for a contaminated site, test results from at least two acute effects tests and one chronic effects test shall be evaluated.

(c) The biological tests shall not be considered valid unless test results for the appropriate control and reference sediment samples meet the performance standards described in WAC 173-204-315(2).

(d) The cleanup screening level and minimum cleanup level is exceeded when any two of the biological tests exceed the criteria of WAC 173-204-320(3); or one of the following test determinations is made:

(i) Amphipod: The test sediment has a higher (statistically significant, t test, $p \leq 0.05$) mean mortality than the reference sediment and the test sediment mean mortality is greater than a value represented by the reference sediment mean mortality plus thirty percent.

(ii) Larval: The test sediment has a mean survivorship of normal larvae that is less (statistically significant, t test, $p \leq 0.05$) than the mean normal survivorship in the reference sediment and the test sediment mean normal survivorship is less than seventy percent of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than thirty percent relative to time-final in the reference sediment).

(iii) Benthic abundance: The test sediment has less than fifty percent of the reference sediment mean abundance of any two of the following major taxa: Class Crustacea, Phylum Mollusca or Class Polychaeta and the test sample abundances are statistically different (t test, $p \leq 0.05$) from the reference abundances.

(iv) Juvenile polychaete: The test sediment has a mean individual growth rate of less than fifty percent of the reference sediment mean individual growth rate and the test sediment mean individual growth rate is statistically different (t test, $p \leq 0.05$) from the reference sediment mean individual growth rate.

(4) Puget Sound marine sediment cleanup screening levels and minimum cleanup levels human health criteria. Reserved: The department may determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(5) Puget Sound marine sediment cleanup screening levels and minimum cleanup levels other toxic, radioactive, biological, or deleterious substances criteria. Other toxic, radioactive, biological, or deleterious substances in, or on, sediments shall be at or below levels which cause minor adverse effects in marine biological resources, or which correspond to a

significant health risk to humans, as determined by the department. The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(6) Puget Sound marine sediment cleanup screening levels and minimum cleanup levels nonanthropogenically affected sediment criteria. Whenever the nonanthropogenically affected sediment quality is of a lower quality (i.e., higher chemical concentrations, higher levels of adverse biological response, or posing a higher threat to human health) than the applicable cleanup screening levels or minimum cleanup levels criteria established under this section, the existing sediment chemical and biological quality shall be identified on an area-wide basis as determined by the department, and used in place of the standards of WAC 173-204-520.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-520, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-520, filed 3/27/91, effective 4/27/91.]

WAC 173-204-530 Hazard assessment and site identification. (1) Purpose. A hazard assessment shall be performed to gather existing and available information to further characterize each station cluster of potential concern identified per WAC 173-204-510.

(2) Hazard assessment requirements. Onsite dischargers, lessees, landowners, and adjacent dischargers shall submit, upon the department's request, all existing and available information that would enable the department to:

(a) Determine the concentration and/or areal extent and depth of sediment contamination at the station cluster of potential concern by:

(i) Identifying the contaminants exceeding the applicable sediment quality standards of WAC 173-204-320 through 173-204-340;

(ii) Identifying individual stations within the station cluster of potential concern which exceed the sediment cleanup screening levels criteria of WAC 173-204-520;

(iii) Identifying the level of toxicity to the applicable biological test organisms of WAC 173-204-320 through 173-204-340;

(iv) Determining where the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, for any given contaminant, is met;

(v) Determining if concentrations of chemicals exist that potentially present a significant threat to human health;

(vi) Defining the location where the minimum cleanup level as defined in WAC 173-204-570 is met.

(b) Identify and characterize the present and historic source or sources of the contamination.

(c) Identify the location of sediment impact zones authorized under WAC 173-204-415.

(d) Identify sensitive resources in the vicinity of the station cluster of potential concern.

(e) Provide other information as determined necessary by the department for ranking sites under WAC 173-204-540.

(3) The department shall also compile existing and available information from other federal, state, and local governments that pertain to the topics in subsection (2) of this section.

(4) To identify cleanup sites, the department shall use all available information of acceptable quality gathered from the hazard assessment to evaluate station clusters of potential concern identified pursuant to WAC 173-204-510(2). For the purpose of identifying a cleanup site per the procedures of this subsection, three stations with the highest contaminant concentration for any particular contaminant or the highest degree of biological effects as identified in WAC 173-204-520 are selected from a station cluster of potential concern. This procedure may be repeated for multiple chemicals identified in WAC 173-204-520, recognizing that the three stations with the highest concentration for each particular contaminant may be different and the respective areas for all chemicals may overlap. The department shall review the list of station clusters of potential concern to identify cleanup sites via the following process:

(a) Identify if available, three stations within the station cluster of potential concern with the highest level of biological effects for the biological tests identified in WAC 173-204-315(1).

(b) Station clusters of potential concern where the level of biological effects for any three stations within the station cluster of potential concern exceeds the cleanup screening levels of WAC 173-204-520(3) shall be defined as cleanup sites.

(c) Identify if available, the three stations within a station cluster of potential concern with the highest concentration of each chemical contaminant identified in WAC 173-204-520, Cleanup screening levels

criteria. For the purpose of identifying a cleanup site per the procedures of this subsection, stations that meet the biological standards of WAC 173-204-520(3) shall not be included in the evaluation of chemical contaminant concentrations.

(d) For each contaminant identified in (c) of this subsection, determine the average concentration for the contaminant at the three stations identified in (c) of this subsection.

(e) Station clusters of potential concern for which any average chemical concentration identified in (d) of this subsection exceeds the cleanup screening level chemical criteria of Table III shall be defined as cleanup sites.

(f) After completion of the hazard assessment, if neither of the conditions of (b) or (e) of this subsection apply, then the station cluster is defined as a station cluster of low concern.

(g) Station clusters of potential concern where the department determines that any three stations within the station cluster of potential concern exceed the sediment cleanup screening levels human health criteria or the other toxic, radioactive, biological, or deleterious substances criteria or the nonanthropogenically affected criteria of WAC 173-204-520, shall be defined as cleanup sites.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-530, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-530, filed 3/27/91, effective 4/27/91.]

WAC 173-204-540 Ranking and list of sites. (1) Purpose. The department shall prepare and maintain a list of contaminated sediment sites in the order of their relative hazard ranking. From this list, the department shall select sites where action shall be taken.

(2) Site ranking. The department shall evaluate each cleanup site identified by the procedures in WAC 173-204-530 on a consistent basis using the procedure described in *Sediment Ranking System ("SEDRANK"), January 1990,* and all additions and revisions thereto or other procedures approved by the department. The purpose of ranking is to estimate, based on technical information compiled during the hazard assessment procedures in WAC 173-204-530, the relative potential risk posed by the site to human health and the environment. Information obtained during hazard assessment, plus any additional data specified in "SEDRANK," shall be included in the site hazard ranking evaluation.

(3) Considerations in ranking. In conducting sediment site ranking, the department shall assess both human health hazard and ecological hazard, and consider chemical toxicity, affected resources, and site characteristics for both types of hazards. The department shall also use best professional judgment and other information as necessary on a case-by-case basis to conduct site ranking.

(4) Site reranking. The department may, at its discretion, rerank a site. To rerank a site, the department shall use any additional information within the scope of the hazard ranking evaluation criteria and best professional judgment to establish that a significant change in rank should result.

(5) List of ranked sites.

(a) Contaminated sediment sites that are ranked via "SEDRANK" shall be placed on a list in the order of their relative hazard ranking. The list shall describe the current status of cleanup action at each site and be updated on an annual basis. The department may change a site's status to reflect current conditions on a more frequent basis. The status for each site shall be identified as one or more of the following:

(i) Sites awaiting cleanup action;

(ii) Sites where voluntary, incidental, partial or department initiated cleanup actions, as defined in WAC 173-204-550, are in progress;

(iii) Sites where a cleanup action has been completed and confirmational monitoring is underway;

(iv) Sites with sediment recovery zones authorized under WAC 173-204-590; and/or

(v) Other categories established by the department.

(b) The department shall routinely publish and make the list available to be used in conjunction with a review of ongoing and proposed regulatory actions to determine where and when a cleanup action should be taken. The department shall also make the list available to landowners and dischargers at or near listed sites, and to the public.

(6) Site delisting.

(a) The department may remove a site from the list only after it has determined that:

(i) All cleanup actions except confirmational monitoring have been completed and compliance with the site cleanup study and report and cleanup standard(s) has been achieved; or

(ii) The listing of the site was erroneous.

(b) A site owner or operator may request that a site be removed from the list by submitting a petition to the department. The petition shall state the reason for the site delisting request, and as determined appropriate by the department, shall include thorough documentation of all investigations performed, all cleanup actions taken, and all compliance monitoring data and results to

demonstrate to the department's satisfaction that the site cleanup standards have been achieved. The department may require payment of costs incurred, including an advance deposit, for review and verification of the work performed. The department shall review such petitions, however the timing of the review shall be at its discretion and as resources may allow.

(c) The department shall maintain a record of sites that have been removed from the list under (a) of this subsection. This record shall be made available to the public on request.

(7) Relisting of sites. The department may relist a site which has previously been removed if it determines that the site requires further cleanup action.

(8) Delisting notice. The department shall provide public notice and an opportunity to comment when the department proposes to remove a site from the list.

(9) Relationship to hazardous sites list. The department may additionally evaluate cleanup sites on the site list developed under subsection (5) of this section for possible inclusion on the hazardous sites list published under WAC 173-340-330.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-540, filed 3/27/91, effective 4/27/91.]

WAC 173-204-550 Types of cleanup and authority. (1) Purpose. The department acknowledges that cleanups of contaminated sediment sites can occur under the authority of chapter 90.48 or 70.105D RCW. Sediment cleanups may also be initiated by the federal government pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This section describes the department's role in department initiated and other cleanup actions.

(2) The department shall use best professional judgment and other information as necessary on a case-by-case basis to determine the appropriate administrative authority for conducting, or requiring contaminated sediment cleanup actions based on, but not limited to, the following considerations:

(a) Source of contaminants requiring cleanup including spills, dredging actions, and wastewater and/or storm water discharges;

(b) Significance of contamination threat to human health and the environment including the degree of contamination and types and number of contaminants;

(c) Public perception concerning the contaminant threat to human health and the environment;

(d) Personal or corporate financial status of the landowner(s) and/or discharger(s);

(e) Enforcement compliance history of the landowner(s) and/or discharger(s);

(f) Status of existing or pending federal, state, or local legal orders or administrative actions; and

(g) Size of cleanup action proposed or determined necessary.

(3) The types of cleanup actions below establish scenarios recognized by the department which may occur to effect cleanup of contaminated sediment sites. All of these types of cleanup actions shall be subject to administrative review and approval of the department under chapters 90.48 and/or 70.105D RCW.

(a) Department initiated cleanup. Department initiated cleanup actions occur when the department uses its authority under chapter 90.48 and/or 70.105D RCW to conduct or require and/or otherwise effect cleanup to meet the intent of this chapter.

(b) Voluntary cleanup. Voluntary cleanup actions are initiated by parties other than the department. The department shall encourage voluntary cleanup actions whenever possible, and as early as possible, to meet the intent of this chapter.

(c) Incidental cleanup. Incidental cleanup actions are conducted when other state or federally permitted activities are ongoing in and/or around the contaminated sediment site. Early coordination of incidental cleanup actions with the department is encouraged to meet the intent of this chapter, chapter 70.105D RCW, and chapter 90.48 RCW, as appropriate.

(d) Partial cleanup. Partial cleanup actions may be conducted when completion of cleanup study requirements under WAC 173-204-560 has identified and proposed discrete site units and cleanup standards, the department has approved the selection of the partial cleanup alternative per the standards of WAC 173-204-580, and the department has determined that awaiting action or decision on conducting a complete site cleanup would have a net detrimental effect on the environment or human health.

(e) CERCLA cleanup. Pursuant to the federal Comprehensive Environmental Response, Compensation and Liability Act, the department may identify chapter 173-204 WAC as an applicable state requirement for cleanup actions conducted by the federal government.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-550, filed 3/27/91, effective 4/27/91.]

WAC 173-204-560 Cleanup study. (1) Purpose. This section describes cleanup study plan and report standards which meet the intent of cleanup actions required under authority of chapter 90.48 and/or 70.105D RCW, and/or this chapter. Cleanup actions required under authority of chapter 70.105D RCW shall also meet all standards of chapter 173-340 WAC, the Model Toxics Control Act cleanup regulation. The cleanup study plan and report standards in this chapter include activities to collect, develop, and evaluate sufficient information to enable consideration of cleanup alternatives and selection of a site-specific sediment cleanup standard prior to making a cleanup decision. Each person performing a cleanup action to meet the intent of this chapter shall submit a cleanup study plan and cleanup study report to the department for review and written approval prior to implementation of the cleanup action. The department may approve the cleanup study plan as submitted, may approve the cleanup study plan with appropriate changes or additions, or may require preparation of a new cleanup study plan.

(2) Scope of cleanup study plan. The scope of a cleanup study plan shall depend on the specific site informational needs, the site hazard, the type of cleanup action proposed, and the authority cited by the department to require cleanup. In establishing the necessary scope of the cleanup study plan, the department may consider cost mitigation factors, such as the financial resources of the person(s) responsible for the cleanup action. In all cases sufficient information must be collected, developed, and evaluated to enable the appropriate selection of a cleanup standard under WAC 173-204-570 and a cleanup action decision under WAC 173-204-580. The sediment cleanup study plan shall address:

(a) Public information/education;

(b) Site investigation and cleanup alternatives evaluation;

(c) Sampling plan and recordkeeping; and

(d) Site safety.

(3) Cleanup study plan public information/education requirements. The cleanup study plan shall encourage coordinated and effective public involvement commensurate with the nature of the proposed cleanup action, the level of public concern, and the existence of, or potential for adverse effects on biological resources and/or a threat to human health. The cleanup study plan shall address proposed activities for the following subjects:

(a) When public notice will occur, the length of the comment periods accompanying each notice, the potentially affected vicinity, and any other areas to be provided notice;

(b) Where public information repositories will be located to provide site information to the public;

(c) Methods for identifying the public's concerns, e.g., interviews, questionnaires, community group meetings, etc.;

(d) Methods for providing information to the public, e.g., press releases, public meetings, fact sheets, etc.;

(e) Coordination of public participation requirements mandated by other federal, state, or local laws;

(f) Amendments to the planned public involvement activities; and

(g) Any other elements that the department determines to be appropriate for inclusion in the cleanup study plan.

(4) Cleanup study plan site investigation and cleanup alternatives evaluation requirements. The content of the cleanup study plan for the site investigation and cleanup alternatives evaluation is determined by the type of cleanup action selected as defined under WAC 173-204-550. As determined by the department, the

cleanup study plan shall address the following subjects:

(a) General site information. General information, including: Project title; name, address, and phone number of project coordinator; legal description of the cleanup site; area and volume dimensions of the site; present owners and operators of contaminant source discharges to site; chronological listing of past owners and operators of contaminant source discharges to the site and their respective operational history; and other pertinent information determined by the department.

(b) Site conditions map. An existing site conditions map which illustrates site features as follows:

(i) Property boundaries.

(ii) The site boundary defined by the individual contaminants exceeding the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 at the point where the concentration of the contaminant would meet the:

(A) Cleanup objective; and

(B) Minimum cleanup level; and

(C) Recommended cleanup standards.

(iii) Surface and subsurface topography.

(iv) Surface and subsurface structures.

(v) Utility lines.

(vi) Navigation lanes.

(vii) Current and ongoing sediment sources.

(viii) Other pertinent information determined by the department.

(c) Site investigation. Sufficient investigation to characterize the distribution of sediment contamination present at the site, and the threat or potential threat to human health and the environment. Where applicable to the site, these investigations shall address the following:

(i) Surface water and sediments. Investigations of surface water hydrodynamics and sediment transport mechanisms to characterize significant hydrologic features such as: Site surface water drainage patterns, quantities and flow rates, areas of sediment erosion and deposition including estimates of sedimentation rates, and actual or potential contaminant migration routes to and from the site and within the site. Sufficient surface water and sediment sampling shall be performed to adequately characterize the areal and vertical distribution and concentrations of contaminants. Recontamination potential of sediments which are likely to influence the type and rate of contaminant migration, or are likely to affect the ability to implement alternative cleanup actions shall be characterized;

(ii) Geology and ground water system characteristics. Investigations of site geology and hydrogeology to adequately characterize the physical properties and distribution of sediment types, and the characteristics of ground water flow rate, ground water gradient, ground water discharge areas, and ground water quality data which may affect site cleanup alternatives evaluations;

(iii) Climate. Information regarding local and regional climatological characteristics which are likely to affect surface water hydrodynamics, ground water flow characteristics, and migration of sediment contaminants such as: Seasonal patterns of rainfall; the magnitude and frequency of significant storm events; prevailing wind direction and velocity;

(iv) Land use. Information characterizing human populations exposed or potentially exposed to sediment contaminants released from the site and present and proposed uses and zoning for shoreline areas contiguous with the site; and

(v) Natural resources and ecology. Information to determine the impact or potential impact of sediment contaminants from the site on natural resources and ecology of the area such as: Sensitive environment, local and regional habitat, plant

and animal species, and other environmental receptors.

(d) Sediment contaminant sources. A description of the location, quantity, areal and vertical extent, concentration and sources of active and inactive waste disposal and other sediment contaminant discharge sources which affect or potentially affect the site. Where determined relevant by the department, the following information shall be obtained by the department from the responsible discharger:

(i) The physical and chemical characteristics, and the biological effects of site sediment contaminant sources;

(ii) The status of source control actions for permitted and unpermitted site sediment contaminant sources; and

(iii) A recommended compliance time frame for known permitted and unpermitted site sediment contaminant sources which affect or potentially affect implementation of the timing and scope of the site cleanup action alternatives.

(e) Human health risk assessment. The current and potential threats to human health that may be posed by sediment site contamination shall be evaluated using a risk assessment procedure approved by the department.

(f) Cleanup action alternatives. Each cleanup study plan shall include an evaluation of alternative cleanup actions that protect human health and the environment by eliminating, reducing, or otherwise controlling risks posed through each exposure pathway and migration route. The number and types of alternatives to be evaluated shall take into account the characteristics and complexity of the site.

(i) The proposed site cleanup alternatives may include establishment of site units, as defined in WAC 173-204-200(24), with individual cleanup standards within the range required by WAC 173-204-570, based on site physical characteristics and complexity, and cleanup standard alternatives established on consideration of cost, technical feasibility, and net environmental impact.

(ii) The proposed site cleanup alternatives may include establishment of a sediment recovery zone as authorized under WAC 173-204-590, Sediment recovery zones. Establishment or expansion of a sediment recovery zone shall not be used as a substitute for active cleanup actions, when such actions are practicable and meet the standards of WAC 173-204-580. The cleanup study plan shall include the following information for evaluation of sediment recovery zone alternatives:

(A) The time period during which a sediment recovery zone is projected to be necessary based on source loading and net environmental recovery processes determined by application of the department's sediment recovery zone computer models "CORMIX," "PLUMES," and/or "WASP," or an alternate sediment recovery zone model(s) approved by the department under WAC 173-204-130(4) as limited by the standards of this section and the department's best professional judgment;

(B) The legal location and landowner(s) of property proposed as a sediment recovery zone;

(C) Operational terms and conditions including, but not limited to proposed confirmational monitoring actions for discharge effluent and/or receiving water column and/or sediment chemical monitoring studies and/or bioassays to evaluate ongoing water quality, sediment quality, and biological conditions within and adjacent to the proposed or authorized sediment recovery zone to confirm source loading and recovery rates in the proposed sediment recovery zone.

(D) Potential risks posed by the proposed sediment recovery zone to human health and the environment;

(E) The technical practicability of elimination or reduction of the size and/or

degree of chemical contamination and/or level of biological effects within the proposed sediment recovery zone; and

(F) Current and potential use of the sediment recovery zone, surrounding areas, and associated resources that are, or may be, affected by releases from the zone.

(G) The need for institutional controls or other site use restrictions to reduce site contamination risks to human health.

(iii) A phased approach for evaluation of alternatives may be required for certain sites, including an initial screening of alternatives to reduce the number of potential remedies for the final detailed evaluation. The final evaluation of cleanup action alternatives that pass the initial screening shall consider the following factors:

(A) Overall protection of human health and the environment, time required to attain the cleanup standard(s), and on-site and off-site environmental impacts and risks to human health resulting from implementing the cleanup alternatives;

(B) Attainment of the cleanup standard(s) and compliance with applicable federal, state, and local laws;

(C) Short-term effectiveness, including protection of human health and the environment during construction and implementation of the alternative; and

(D) Long-term effectiveness, including degree of certainty that the alternative will be successful, long-term reliability, magnitude of residual, biological and human health risk, and effectiveness of controls for ongoing discharges and/or controls required to manage treatment residues or remaining wastes cleanup and/or disposal site risks;

(g) Ability to be implemented. The ability to be implemented including the potential for landowner cooperation, consideration of technical feasibility, availability of needed off-site facilities, services and materials, administrative and regulatory requirements, scheduling, monitoring requirements, access for construction, operations and monitoring, and integration with existing facility operations and other current or potential cleanup actions;

(h) Cost, including consideration of present and future direct and indirect capital, operation, and maintenance costs and other foreseeable costs;

(i) The degree to which community concerns are addressed;

(j) The degree to which recycling, reuse, and waste minimization are employed; and

(k) Environmental impact. Sufficient information shall be provided to fulfill the requirements of chapter 43.21C RCW, the State Environmental Policy Act. Discussions of significant short-term and long-term environmental impacts, significant irrevocable commitments of natural resources, significant alternatives including mitigation measures, and significant environmental impacts which cannot be mitigated shall be included.

(5) Cleanup study plan -- sampling plan and recordkeeping requirements. The cleanup study plan shall address proposed sampling and recordkeeping activities to meet the standards of WAC 173-204-600, Sampling and testing plan standards, and WAC 173-204-610, Records management, and the standards of this section.

(6) Cleanup study plan site safety requirements. The cleanup study plan shall address proposed activities to meet the requirements of the Occupational Safety and Health Act of 1970 (29 U.S.C. Sec. 651 et seq.) and the Washington Industrial Safety and Health Act (chapter 49.17 RCW), and regulations promulgated pursuant thereto. These requirements are subject to enforcement by the designated federal and state agencies. Actions taken by the department under this chapter do not constitute an exercise of statutory authority

within the meaning of section (4)(b)(1) of the Occupational Safety and Health Act.

(7) Cleanup study report. Each person performing a cleanup action to meet the intent of this chapter shall submit a cleanup study report to the department for review and written approval of a cleanup decision prior to implementation of the cleanup action. The sediment cleanup study report shall include the results of cleanup study site investigations conducted pursuant to subsection (4) of this section, and preferred and alternate cleanup action proposals based on the results of the approved cleanup study plan.

(8) Sampling access. In cases where the person(s) responsible for cleanup is not able to secure access to sample sediments on lands subject to a cleanup study plan approved by the department, the department may facilitate negotiations or other proceedings to secure access to the lands. Requests for department facilitation of land access for sampling shall be submitted to the department in writing by the person(s) responsible for the cleanup action study plan.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-560, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-560, filed 3/27/91, effective 4/27/91.]

WAC 173-204-570 Sediment cleanup standards. (1) Applicability and purpose. This section establishes the sediment cleanup standards requirements for cleanup actions required under authority of chapter 90.48 and/or 70.105D RCW, and/or this chapter, and describes the process to determine site-specific cleanup standards.

(2) Cleanup objective. The sediment cleanup objective shall be to eliminate adverse effects on biological resources and significant health threats to humans from sediment contamination. The sediment cleanup objective for all cleanup actions shall be the sediment quality standards as defined in WAC 173-204-320 through 173-204-340, as applicable. The sediment cleanup objective identifies sediments that have no acute or chronic adverse effects on biological resources, and which correspond to no significant health risk to humans, as defined in this chapter.

(3) Minimum cleanup level. The minimum cleanup level is the maximum allowed chemical concentration and level of biological effects permissible at the cleanup site to be achieved by year ten after completion of the active cleanup action.

(a) The minimum cleanup levels criteria of WAC 173-204-520 shall be used in evaluation of cleanup alternatives per the procedures of WAC 173-204-560, and selection of a site cleanup standard(s) per the procedures of this section.

(b) The Puget Sound marine sediment minimum cleanup level is established by the following:

(i) Sediments with chemical concentrations at or below the chemical criteria of Table III shall be determined to meet the minimum cleanup level, except as provided in (b)(iv) of this subsection; and

(ii) Sediments with chemical concentrations that are higher than the chemical criteria of Table III shall be determined to exceed the minimum cleanup level, except as provided in (b)(iii) of this subsection; and

(iii) Sediments with biological effects that do not exceed the levels of WAC 173-204-520(3) shall be determined to meet the minimum cleanup level; and

(iv) Sediments with biological effects that exceed the levels of WAC 173-204-520(3) shall be determined to exceed the minimum cleanup level; and

(v) Sediments which exceed the sediment minimum cleanup level human health criteria or the other toxic, radioactive, biological, or deleterious substances criteria or the nonanthropogenically affected criteria of WAC 173-204-520 as determined by the department, shall be determined to exceed the minimum cleanup level.

(4) Sediment cleanup standard. The sediment cleanup standards are established on a site-specific basis within an allowable range of contamination. The lower end of the range is the sediment cleanup objective as defined in subsection (2) of this section. The upper end of the range is the minimum cleanup level as defined in subsection (3) of this section. The site specific cleanup standards shall be as close as practicable to the cleanup objective but in no case shall exceed the minimum cleanup level. For any given cleanup action, either a site-specific sediment cleanup standard shall be defined, or multiple site unit sediment cleanup standards shall be defined. In all cases, the cleanup standards shall be defined in consideration of the net environmental effects (including the potential for natural recovery of the sediments over time), cost and engineering feasibility of different cleanup alternatives, as determined through the cleanup study plan and report standards of WAC 173-204-560.

(5) All cleanup standards must ensure protection of human health and the environment, and must meet all legally applicable federal, state, and local requirements.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-570, filed 3/27/91, effective 4/27/91.]

WAC 173-204-580 Cleanup action decision. (1) Each person performing a cleanup action to meet the intent of this chapter shall comply with the standards of WAC 173-204-560(7), Cleanup study report. Except for cleanups conducted under chapter 70.105D RCW, the department shall review each cleanup study report and issue a written approval of one or more of the cleanup action alternatives described in the cleanup study report, or issue a written disapproval of all alternatives described in the cleanup study report. The department's approval of one or more cleanup study report cleanup action alternatives shall constitute the cleanup decision and shall be referenced in one or more permit or administrative authorities established under chapter 90.48 or 70.105D RCW, Section 401 of the federal Clean Water Act, chapter 173-225 WAC, establishment of implementation procedures of application for certification, or other administrative authorities available to the department. The department may approve the cleanup alternative recommended in the cleanup study report, may approve a different alternative discussed in the report, or may approve an alternative(s) with appropriate conditions. The department's disapproval of all cleanup study report cleanup action alternatives shall be issued by certified mail, return receipt requested, to the cleanup action proponent(s). The procedures for department review of the cleanup study report and selection of a cleanup action under chapter 70.105D RCW shall be in accordance with the procedures of chapter 173-340 WAC.

(2) All cleanup actions conducted under this chapter shall meet the following requirements:

(a) Receive department review and written approval of the preferred and/or alternate cleanup actions and necessary sediment recovery zones proposed in the cleanup study report prior to implementing a cleanup action(s);

(b) Achieve a degree of cleanup that is protective of human health and the environment;

(c) Achieve compliance with applicable state, federal, and local laws;

(d) Achieve compliance with site cleanup standards;

(e) Achieve compliance with sediment source control requirements pursuant to WAC 173-204-400 through 173-204-420, if necessary;

(f) Provide for landowner review of the cleanup study plan and report, and consider public concerns raised during review of the draft cleanup report; and

(g) Provide adequate monitoring to ensure the effectiveness of the cleanup action.

(3) Cleanup time frame.

(a) The cleanup action selected shall provide for a reasonable time frame for completion of the cleanup action, based on consideration of the following factors:

(i) Potential risks posed by the site to biological resources and human health;

(ii) Practicability of achieving the site cleanup standards in less than a ten-year period;

(iii) Current use of the site, surrounding areas, and associated resources that are, or may be, affected by the site contamination;

(iv) Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by the site contamination;

(v) Likely effectiveness and reliability of institutional controls;

(vi) Degree of, and ability to control and monitor, migration of contamination from the site; and

(vii) Natural recovery processes which are expected to occur at the site that will reduce concentrations of contaminants.

(b) The department may authorize cleanup time frames that exceed the ten-year period used in deriving the site cleanup

standards of WAC 173-204-570(4) where cleanup actions are not practicable to accomplish within a ten-year period.

(4) In evaluating cleanup action alternatives, the department shall consider:

(a) The net environmental effects of the alternatives, including consideration of residual effects, recovery rates, and any adverse effects of cleanup construction or disposal activities;

(b) The relative cost-effectiveness of the alternatives in achieving the approved site cleanup standards; and

(c) The technical effectiveness and reliability of the alternatives.

(5) Public participation. The department shall provide opportunity for public review and comment on all cleanup action study plans, reports, and decisions reviewed and approved by the department, for cleanup actions conducted under this chapter.

(6) Land access. In cases where the person(s) responsible for cleanup is not able to secure access to lands subject to a cleanup action decision made pursuant to this section, the department may facilitate negotiations or other proceedings to secure access to the lands. Requests for department facilitation of land access shall be submitted to the department in writing by the person(s) named in the cleanup action approval.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-580, filed 3/27/91, effective 4/27/91.]

WAC 173-204-590 Sediment recovery zones. (1) The purpose of this section is to set forth the requirements for establishment and monitoring of sediment recovery zones to meet the intent of sediment quality dilution zones authorized pursuant to RCW 90.48.520. The standards of this section are applicable to cleanup action decisions made pursuant to WAC 173-204-580 where selected actions leave in place marine, low salinity, or freshwater sediments that exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(2) General requirements. Authorization of a sediment recovery zone by the department shall require compliance with the following general requirements:

(a) The sediment recovery zone shall be determined by application of the department's sediment recovery zone computer models "CORMIX," "PLUMES," and/or "WASP," or an alternate sediment recovery zone model(s) approved by the department under WAC 173-204-130(4) as limited by the standards of this section and the department's best professional judgment.

(b) The department shall provide specific authorization for a sediment recovery zone within the written approval of the cleanup study report and cleanup decision required under WAC 173-204-580.

(c) The time period during which a sediment recovery zone is authorized by the department shall be so stated in the department's written approval of the cleanup study report and cleanup decision.

(d) The department's written sediment recovery zone authorization shall identify the legal location and landowners of property proposed as a sediment recovery zone.

(e) Operational terms and conditions for the authorized sediment recovery zone pursuant to subsection (5) of this section shall be maintained at all times.

(f) Where cleanup is not practicable pursuant to the analysis under WAC 173-204-570(4), sediment recovery zones may be authorized for periods in excess of ten years.

(3) A sediment recovery zone authorization issued by the department under the authority of chapter 90.48 or 70.105D RCW, or other administrative means available to the department, does not constitute authorization to trespass on lands not owned by the applicant. These requirements do not address, and in no way alter, the legal rights, responsibilities, or liabilities of the permittee or landowner of the sediment recovery zone for any applicable requirements of proprietary, real estate, tort, and/or other laws not directly expressed as a requirement of this chapter.

(4) Prior to authorization, the department shall make a reasonable effort to identify and notify all landowners affected by the proposed sediment recovery zone. The department shall issue a sediment recovery zone notification letter to any person it believes to be a potentially affected landowner and other parties determined appropriate by the department. The notification letter shall be sent by certified mail, return receipt requested, or by personal service. The notification letter shall provide:

(a) The name of the person the department believes to be the affected landowner; and

(b) The names of other affected landowners to whom the department has sent a proposed sediment recovery zone notification letter; and

(c) The name of the sediment recovery zone applicant; and

(d) A general description of the proposed sediment recovery zone including the chemical(s) of concern by name and concentration, and the area of affected sediment; and

(e) The determination of the department concerning whether the proposed sediment recovery zone application meets the standards of this section; and

(f) The intention of the department whether to authorize the proposed sediment recovery zone; and

(g) Notification that the affected landowner may comment on the proposed sediment recovery zone. Any landowner comments shall be submitted in writing to the department within thirty days from the date of receipt of the notification letter, unless the department provides an extension.

(5) As determined necessary by the department, operational terms and conditions for the sediment recovery zone may include completion and submittal to the department of discharge effluent and/or receiving water column and/or sediment chemical monitoring studies and/or bioassays to evaluate ongoing water quality, sediment quality, and biological conditions within and adjacent to the proposed or authorized sediment recovery zone.

(6) The department shall review all data or studies conducted in accordance with a sediment recovery zone authorization to ensure compliance with the terms and conditions of the authorization and the standards of this section. Whenever, in the opinion of the department, the operational terms and conditions of a sediment recovery zone or the standards of this section are violated or there is a potential to violate the sediment recovery zone authorization or the standards of this section, or new information or a reexamination of existing information indicates the sediment recovery zone is no longer appropriate, the department may at its discretion:

(a) Require additional chemical or biological monitoring as necessary;

(b) Revise the sediment recovery zone authorization as necessary to meet the standards of this section;

(c) Require active contaminated sediment maintenance actions including additional cleanup in accordance with the standards of WAC 173-204-500 through 173-204-580; and/or

(d) Withdraw the department's authorization of the sediment recovery zone.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-590, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-590, filed 3/27/91, effective 4/27/91.]

PART VI--SAMPLING AND TESTING PLANS/RECORDKEEPING

WAC 173-204-600 Sampling and testing plan standards. (1) Applicability. These standards apply to:

(a) Any person who samples sediments to determine compliance with this chapter;

(b) Any person who makes application to the department for authorization of a sediment impact zone under the standards of WAC 173-204-400 through 173-204-420; and

(c) Any person who samples sediments consistent with cleanup action plans approved and cleanup actions conducted under this chapter.

(2) All applicable persons shall at a minimum, develop, keep, and abide by a sediment sampling and testing plan. The sampling and testing plan shall be available for inspection at the request of the department. Sediment sampling and testing plans shall identify sampling dates, sample types, sample depths, sample composites, sample locations, sample positioning methods, sampling personnel, sampling equipment and methods, a description of methods of chemical analysis and biological testing, and quality assurance/quality control procedures.

(3) Sediment sampling locations and procedures and testing protocols and interpretations shall be those included in the Puget Sound protocols as amended and/or other methods approved by the department.

(4) The department reserves the right to revise these sampling and testing protocols when:

(a) The Puget Sound protocols are modified or updated per the approval of the department; or

(b) The department determines the Puget Sound protocols are not applicable to, or appropriate for analysis of sediment chemical contamination in any given case.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-600, filed 3/27/91, effective 4/27/91.]

WAC 173-204-610 Records management. (1) Applicability. These standards apply to:

(a) Any person who samples sediments to determine compliance with this chapter;

(b) Any person who makes application to the department for authorization of a sediment impact zone under the standards of WAC 173-204-400 through 173-204-420.

(2) All applicable persons shall keep sediment sampling and testing records as follows:

(a) Sediment sampling and testing plans which identify sampling dates, sample types, sample composites, sample locations, sample depths, sample positioning method, sampling personnel, sampling equipment and methods, quality assurance/quality control plans, and sampling procedures.

(b) Sediment removal records which identify removal dates, dredging contractor/equipment, volume of sediment removed, analytical data generated during the sediment removal process, and sediment disposal location(s).

(c) Records and results of sediment analyses conducted in accordance with this chapter, or as required under activities authorized under chapter 173-225 WAC, establishment of implementation procedures of application for certification.

(d) Records and results of inspections conducted as required under chapter 173-225 WAC, establishment of implementation procedures of application for certification.

(e) Sediment treatment records.

(f) Sediment onsite capping records.

(g) Sediment disposal records which identify sediment disposal location(s), onsite operating records, sediment volumes, disposal site property owner(s), and the chemical/biological nature of effluent discharges from the disposal location including the name, location, and quality of the receiving water.

(3) All sediment records as required under subsection (2) of this section must be furnished upon request, and made available at all reasonable times for inspection, by any officer, employee, or representative of the department who is designated by the director.

(4) All sediment records as required in this section shall be maintained for a period not less than ten years after the issuance, modification, or renewal of the applicable permit, or administrative order, or certification, or cleanup site delisting under WAC 173-204-540(6), whichever is greater.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-610, filed 3/27/91, effective 4/27/91.]

WAC 173-204-620 Severability. If any provision of this chapter or its application to any person or circumstance is held invalid, the remainder of this chapter or the application of the provision to other persons or circumstances shall not be affected.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-620, filed 3/27/91, effective 4/27/91.]

Washington Department of Ecology
Commitments for Rule Implementation and Review

for the
Sediment Management Standards
Chapter 173-204 WAC

April 12, 1991

Rule Policies

Section 130 (1), Administrative policies, of the proposed Sediment Management Standards (SMS) commits the Washington Department of Ecology (Ecology) to implement and modify the SMS using methods that reflect the latest scientific knowledge which are consistent with the sediment quality goals in the rule.

Section 130 (6), (7) and (8) identify a requirement for annual review of the rule. The rule establishes scientific factors to be considered during this annual review and requires a public information and education process to provide increased opportunity for public involvement in the review and identification of necessary changes to the SMS.

To implement the SMS, identify the latest scientific knowledge, and modify the SMS accordingly, Ecology has agreed to conduct the implementation, technical development, and rule review process activities below.

Implementation Committee and Sediment Scientific Review Board

Ecology will establish an "Implementation Committee" shortly after adoption of the rule via an Ecology Director policy action. Committee members will represent a balanced group of interests from earlier workgroup members. The Committee will assist Ecology in developing rule implementation guidance that is consistent with the intent of the rule development process. The Committee will also be asked to identify, discuss and recommend technical and policy changes to the SMS to improve rule implementation and effectiveness.

Ecology will establish a Sediment Scientific Review Board to recommend additions, modifications or deletions of scientific information contained in the SMS. This Board will be established by Ecology policy action shortly after rule adoption. The Board will be initially charged with providing advice to Ecology on the appropriate methods for addressing the technical issues and commitments identified below. The Board will then be asked to provide recommendations to Ecology on aspects of the rule that merit the initiation of technical development for future rule improvements. The Board will also be asked to evaluate the results of technical development studies and any proposed changes to the technical features of the rule, relative to ensuring the application of the latest scientific knowledge. In determining what technical development activities are needed for the rule and in deciding what rule changes are appropriate, Ecology shall consider the recommendations of the Sediment Scientific Review Board.

Ecology will develop and present "issue papers" to both the Implementation Committee and Sediment Scientific Review Board to introduce key issues for their consideration and recommendations. Ecology will support the need for close coordination with the two groups to:

- Develop a clear understanding of the need for technical and policy changes and improvements to the SMS;
- Identify the implications of recommended changes to the SMS on meeting stated goals for the protection of the environment and human health; and
- Identify economic and legal considerations of recommended changes to the SMS on Ecology and the public.

Rule Review Process

Ecology will establish a rule review and modification process which incorporates a review of new scientific information, identifies policy changes for consideration, and provides for public education and involvement in annual review of, and any modifications to, the SMS. The annual review process will primarily be based on technical and policy issue papers and background materials prepared for the Implementation Committee and Sediment Scientific Review Board. Their recommended modifications to the SMS will be incorporated as key annual review issues. Additionally, public comments and recommendations for modifications to the SMS will be considered during the annual review public involvement process. Ecology will also fulfill public involvement requirements per the Administrative Procedure Act for rulemaking to complete modifications of the SMS recommended during the annual review process.

Because technical issues and their implementation must often be considered together, Ecology's identification, development and decisionmaking regarding potential modifications to the SMS will often involve both the Implementation Committee and Sediment Scientific Review Board.

Ecology Rule Activities

A list and description of key SMS technical and policy issue areas to be developed by Ecology for the first annual review is provided below. In general, the Implementation Committee will be asked to review overall rule plans and guidance documents, and not site-specific permit or cleanup actions. The same general approach will be used with the Sediment Scientific Review Board. The degree of involvement of the Committee and Board in each of the specific following issue areas will be determined by Ecology after consultation with each group.

Policy and Implementation Issues

<u>Technical Studies Plan</u> - Ecology will describe ongoing and planned technical studies for model verification and other technical work to address key issues for implementation and

future modification of the SMS. (Target date: May 1991)

Training Plan - Ecology will develop an internal training program for permit managers and cleanup site managers. As requested, Ecology will also develop training for the regulated community. Training will address development, interpretation and implementation of the SMS in source control, cleanup and other affected Ecology programs. (Target date: May 1991)

Public Information and Education Plan - Ecology will identify ongoing and planned efforts to implement a public information and education program that fulfills the requirements of element S-9 of the Puget Sound Water Quality Management Plan and the public involvement and education requirements in the SMS for the annual review process. (Target date: May 1991)

Rule Responsiveness Summary Commitments - Ecology will assemble an outline of Rule Responsiveness commitments for technical and policy issue development, and training activities to support implementation and future modification of the SMS. (Target date: May 1991)

Policy Issue Paper for Annual Review - Ecology will assemble a list and description of key policy issues that directly affect successful implementation of the SMS and recommended alternatives to be considered during the annual review process. (Target date: January 1992)

Comprehensive Liability Management Plan - Ecology will present to the Implementation Committee the Department of Natural Resource/Ecology Memorandum of Understanding concerning managing liability to the state of Washington. Key issue areas and recommended alternatives to be considered during the annual review process will be identified. (Target date: June 1991)

Antidegradation - Ecology will conduct a coordinated water quality and sediment quality standards workgroup process to address the federal Clean Water Act goal statement for improving the quality of sediments and water. This effort will include options for naming "pristine" sediment/water quality areas, methods to manage the quality of all sediment and water toward improvement (including enforcement), and procedures for issuance or restrictions of dilution zones. (Target date: start July 1991)

Sediment Impact Zones - Ecology will provide an inventory and characterization of authorized sediment impact zones, assess problems identified during implementation and recommend modifications to the rule as needed. (Target date: first triennial review of the SMS)

Technical Issues

Human Health Criteria - Ecology will conduct a public scoping meeting with the state Department of Health to identify current scientific methods to establish human health sediment criteria, outstanding technical and policy issues and a workplan for development of criteria and inclusion in the SMS. (Target date: start May 1991)

Chronic Effects - Ecology will conduct multiple activities to identify methods to assess chronic effects to biological resources which will be considered for possible inclusion in the SMS. Primary activities include:

1. Assessment of effects to benthic populations.

   a) Participation in a Puget Sound regional benthic experts workshop. Ecology will participate in a regional benthic experts workshop to identify current scientific methods for assessment and interpretation of benthic population impacts, key technical issues and leading scientists. (Target date: July 1991?)

   b) Development of an issue paper. Ecology will use the information from the regional workshop and a literature review to develop an issue paper on assessment of benthic effects. (Target date: October 1991)

   c) Ecology will convene an experts workshop based on issues raised in the Ecology issue paper and incorporating the agenda, objectives and participant recommendations of the Washington Environmental Council, the Sediment Scientific Review Board, and the regional benthic experts workshop. (Target date: January 1992)

2. Assessment of bioaccumulation and biomagnification effects to biological resources and threats to human health. - Ecology will develop an issue paper discussing the current scientific methods to identify and evaluate the impacts of bioaccumulation and biomagnification on biological resources and human health, and to identify key chemicals of concern and technical issues which should be considered for possible incorporation into the SMS. Ecology will coordinate activities in this effort with the state Departments of Fisheries and Wildlife, and other appropriate resource agencies. (Target date: October 1991)

3. Chronic effects biological tests - Ecology will review the recently completed research study results by Region 10, U.S. Environmental Protection Agency on the juvenile polychaete biomass test. The study addressed contaminated sediment quality impacts to the life cycle and juvenile growth patterns for the polychaete *Neanthes arenaceodentata* and may result in Ecology recommending modifications to this test or its interpretation currently included in the SMS. Additionally, Ecology will utilize the Puget Sound sediment quality database to develop and evaluate chemical criteria based on the juvenile polychaete biomass test. (Target date: January 1992)

Chemical Criteria - Ecology will develop individual issue papers on sediment chemical criteria and a review of new chemicals of concern, addressing the following topics:

1. Proposed and future sediment criteria development efforts planned by the U.S. Environmental Protection Agency (EPA). The EPA has indicated they will propose 6 organic contaminant sediment criteria in 1991. (Target date: December 1991)

2. Current state and federal activities to regulate dioxin and furans will be examined for potential environmental and/or human health criteria development. (Target date: December 1991)

3. Recent national research efforts supported by the EPA on normalization of metals contaminant sediment values will be examined for application/revision of current metals sediment criteria in the SMS. (Target date: December 1991)

4. Other prevalent chemicals of concern, such as tributyltin associated with shipbuilding and marinas and pesticides associated with agricultural runoff, will be reexamined for potential criteria development using the Puget Sound database or proposed federal criteria (see number 1 above). (Target date: December 1991)

5. Review of the current SMS language on other toxic, radioactive, biological, or deleterious substances criteria. Ecology will focus on improvement of the narrative language to provide improved guidance for implementation. (Target date: December 1991)

6. Interim management of dioxin. As for other deleterious substances, Ecology will require a case-specific evaluation of dioxin contamination in sediments when making a sediment management or regulatory decision in the vicinity of a known source. As done with the Puget Sound Dredged Disposal Analysis, sediment evaluation will be necessary when activities are in the vicinity of a pulp and paper mill known to discharge chlorinated dioxins and furans. Per previous commitment to PSDDA, Ecology will be conducting modeling to assist in defining "in the vicinity of a pulp and paper mill" for known Puget Sound sources. (Target date: May 1991)

7. Freshwater sediment criteria. Ecology will continue development work of freshwater sediment criteria during the coming state biennium. (Target date: adopt by 1994)

Summary of Target Dates

Adopt Sediment Management Standards	March 91
Convene Implementation Committee (IC)	May 91
Convene Sediment Scientific Review Board	May 91
Human Health Public Scoping Mtg.	May 91
Benthic Assessment Issue Paper	June 91
Antidegradation Development Begins	July 91
Bioaccum./Biomag. Issue Paper	October 91
Chemical Criteria Issue Paper	December 91
Benthic Experts Workshop	January 92
SMS Modification Public Scoping Mtg.	February 92
Annual Review of SMS	March - June 92
Rulemaking Decision Public Notice	July 92
First Rule Amendments adopted	NLT June 93

Part VII. Appendices

Appendix D. - Washington Department of Ecology
Sediment Management Unit
Bibliography of Sediment Management
Reports/Documents

Washington Department of Ecology
Sediment Management Unit

Bibliography of Sediment Management Documents

April 1997

The following documents support Ecology's development and implementation of the Sediment Management Standards, Chapter 173-204 WAC, development of the Dredged Material Management Standards rule (not adopted to-date) and other Ecology activities that involve management of contaminated sediments. The bibliography is grouped as follows:

- Sediment Management Standards (SMS)
  - Background
  - Benthos/Bioassay
  - Marine Finfish Rearing Facilities (Net Pens)
  - Modeling
  - Sediment Source Control
  - Sediment Cleanup
- Criteria Development
  - Apparent Effects Threshold (AET)
  - Freshwater
  - Human Health
- Dredged Material Management
- Multiuser Disposal Sites

To order or for more information

1. Documents are mailed via the U.S. mail at the 3rd class bookrate.
2. Expect a 4 - 6 week turnaround from request to receipt of document.
3. There is no charge for the following documents, except:
   - Sediment Source Control Standards Users Manual (SCUM1) - $16.00
   - Sediment Cleanup Standards Users Manual (SCUM2) - $9.90

These documents will be sent after Ecology's Sediment Management Unit is notified of receipt of payment.

Questions, comments, and requests should be sent to:

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Phone: 360-407-6914
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US Mail: Washington Department of Ecology
Sediment Management Unit
P.O. Box 47703
Olympia, WA 98504-7703

SEDIMENT MANAGEMENT STANDARDS (SMS)	STATUS	DATE
Background		
Interim Performance Standards for Puget Sound Reference Areas	Final	Ecology - 6/89
Data Quality Evaluation for Proposed Dredged Material Disposal Projects (QA-1)	Final	Ecology - 6/89
Data Validation Guidance Manual for Selected Sediment Variables (QA-2)	Edited Draft	Ecology - 6/89
Sediment Ranking System	Final	Ecology - 1/90
Final Environmental Impact Statement for the SMS	Final	Ecology - 10/90
Final Economic Impact Statement for the SMS	Final	Ecology - 12/90
Responsiveness Summary for Adoption of Chapter 173-204 WAC Sediment Management Standards	Final	Ecology - 12/90
SEDRANK Guidance Document	Final	Ecology - 6/91
Washington Ranking Method (WARM) Appendix - Sediment Scoring Route	Updated	Ecology - 6/91
Reference Area Performance Standards for Puget Sound	Final	PSEP - 9/91
Sediment Management Standards Rule Chapter 173-204 WAC	Final	Ecology - 12/95

SEDIMENT MANAGEMENT STANDARDS (SMS)	STATUS	DATE
Benthos/Bioassay		
Protocol for Juvenile Neanthes Sediment Bioassay	Final	Ecology - 6/90
Recommendations for Assessing Adverse Benthic Effects in Puget Sound	Final	Ecology - 5/93

Review of Sediment Management Standards Bioassay Protocols	Final	Ecology - 4/95
Evaluation and Recommendation of Revised SMS Benthic Infaunal Sediment Standards	Final	Ecology - 12/95
Sediment Management Standards Marine Bioassays: Recommended Quality Assurance and Quality Control Deliverables	Final	Ecology - 1996

SEDIMENT MANAGEMENT STANDARDS (SMS)	STATUS	DATE
Marine Finfish Rearing Facilities (Net Pens)		
Evaluation of Benthic Data from the Paradise Bay (Port Townsend) and Stolt Sea Farm (Port Angeles) Net Pens	Final	Ecology - 1995
Development of a Marine Finfish Sediment Quality Standard	Final	Ecology - 1995

SEDIMENT MANAGEMENT STANDARDS (SMS)	STATUS	DATE
Modeling		
Puget Sound Contaminated Sediment Impact and Recovery Zone Workshop Summary	Final	Ecology - 10/89
Recommended Sediment Impact and Recovery Zone Models and Case Study Analysis	Final	Ecology - 2/91
Sediment Modeling Variables in Puget Sound Workshop Summary	Final	Ecology - 6/91
WASP Sensitivity Analysis	Final	Ecology - 11/92
WASP Implementation and Model Modifications Manual	Final	Ecology - 6/93
WASP Application Guidance Manual	Final	Ecology - 12/93

SEDIMENT MANAGEMENT STANDARDS (SMS)	STATUS	DATE
Sediment Source Control		
Sediment Source Control Standards Users Manual (SCUM 1)	Final	Ecology - 6/93 $16.00 Cost

Sediment Sampling and Analysis Plan Appendix (SAPA): Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC)	Draft	Ecology - 12/95 Microsoft Word Doc

SEDIMENT MANAGEMENT STANDARDS (SMS)	STATUS	DATE
Sediment Cleanup		
Sediment Cleanup Standards Users Manual (SCUM 2)	Final	Ecology - 12/91 $9.90 Cost
SMS Contaminated Sediment Site List	Final	Ecology - 5/96

CRITERIA DEVELOPMENT	STATUS	DATE
Apparent Effects Threshold (AET)		
1988 Update and Evaluation of Puget Sound AET -- Sediment Quality Values Refinement: Vol. 1 and Vol. 1 Data Appendices	Final	PSEP - 9/88
The Apparent Effects Threshold Approach: Briefing Report to the EPA Science Advisory Board	Final	PSEP - 9/88
Contaminated Sediments Criteria Report	Final	Ecology - 4/89
Application of Equilibrium Partitioning Sediment Quality Criteria to Puget Sound	Final	Ecology - 6/89
Evaluation of the AET Approach for Assessing Sediment Quality (EPA Science Advisory Board, Sediment Criteria Subcommittee)	Final	EPA - 7/89
Progress Re-evaluating Puget Sound Apparent Effects Thresholds (AETs), Vol. 1: 1994 Amphipod and Echinoderm Larval AETs	Draft	PSDDA - 4/96

CRITERIA DEVELOPMENT	STATUS	DATE
Freshwater		
Effects of Polycyclic Aromatic Hydrocarbons (PAHs) in Sediments from Lake Washington on Freshwater Bioassay Organisms and Benthic Macroinvertebrates	Final	Ecology - 6/91
A Review of Interpretation Methods for Freshwater Benthic Invertebrate Survey Data Used by Selected State and Federal Agencies	Final	Ecology - 10/91

Evaluation of Bioassay Organisms for Freshwater Sediment Toxicity Testing	Final	Ecology - 2/92
Copper in Sediments from Steilacoom Lake, Pierce County, Washington	Final	Ecology - 4/92
Review and Evaluation of Microtox Test for Freshwater Sediments	Final	Ecology -11/92
Creation of Freshwater Sediment Quality Database and Preliminary Analysis of Freshwater Apparent Effects Thresholds	Draft	Ecology - 6/94
Summary of Guidelines for Contaminated Freshwater Sediments (FSEDCRIT)	Final	Ecology - 3/95
Creation and Evaluation of Freshwater Sediment Quality Values in Washington State	Draft Final	Ecology - 4/97

CRITERIA DEVELOPMENT	STATUS	DATE
Human Health		
Concept Paper: Regulatory Policy and Structure For Development of Human Health Sediment Criteria	Final	Ecology - 6/92
Development of Human Health Sediment Criteria Using A Distributional Analysis	Final	Ecology - 1/94
Regulatory Options: Use of Fish Tissue Criteria	Final	Ecology - 9/94
Tier 1 Report: Development of Sediment Quality Criteria For The Protection of Human Health	Final	DOH - 6/95
Technical Review of Distributional Analysis Approaches for Cancer Potency Factors	Final	Ecology - 7/95
Bioaccumulation Factor Approach Analysis for Metals and Polar Organic Compounds	Final	Ecology - 10/95
Displays of Chemicals of Concern for Human Health-Based Sediment Quality Criteria	Final	Ecology - 10/95
Analysis of BSAF Values for Nonpolar Organic Compounds in Finfish and Shellfish	Final	Ecology - 11/95
Tier II Report: Development of Sediment Quality Criteria For The Protection of Human Health	Final	DOH - 5/96
Evaluation of Biota-Sediment Accumulation Factors for Selected Species and Chemicals in Puget Sound	Draft Final	Ecology - 11/96

DREDGED MATERIAL MANAGEMENT	STATUS	DATE

Confined Disposal of Contaminated Sediments: Documentation of Standards Development -- Appendices	Final	Ecology - 11/89
Confined Disposal of Contaminated Sediments: Development Documentation	Final	Ecology - 1/90
Standards for Confined Disposal of Contaminated Sediments	Final	Ecology - 1/90
The Effects-Based Design Process	Final	Ecology - 6/90

MULTIUSER DISPOSAL SITES	**STATUS**	**DATE**
Multiuser Confined Disposal Sites Program Study	Final	Ecology - 12/90
Multiuser Sites for the Confined Disposal of Contaminated Sediments from Puget Sound	Final	Ecology - 10/91

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Part VII. Appendices

Appendix E. Technical Information Memorandum: Organic Carbon Normalization of Sediment Data

TECHNICAL INFORMATION MEMORANDUM

ORGANIC CARBON NORMALIZATION OF SEDIMENT DATA

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1. INTRODUCTION

All sediment data collected in Washington State are evaluated using the Sediment Management Standards (SMS), Chapter 173-204 WAC. Under the SMS rule, the numerical sediment standards for most organic chemicals are organic carbon normalized. Consequently, all sediment samples that are analyzed for organic chemicals must also be analyzed for organic carbon to facilitate comparisons with the numerical standards.

This technical information memorandum describes why some sediment data are organic carbon normalized, how organic carbon data are collected and analyzed, provides an equation for organic carbon normalizing data, and explains how to evaluate historical data for which organic carbon data are not available. Finally, guidelines are presented for determining when it may not be appropriate to organic carbon normalize data.

For questions on the enclosed information or for further information, please contact the Sediment Management Unit at (SCAN 585)206/459-6824, or contact the NWRO or SWRO Sediment Technical Specialist.

2. WHY SEDIMENT DATA ARE ORGANIC-CARBON NORMALIZED

Concentrations of organic contaminants (particularly nonpolar, nonionizable chemicals) and the toxicity of these contaminants in sediments have been observed to correlate well with the organic carbon content of sediments (DiToro et al., 1991; Lyman, 1982; Roy and Griffin, 1985). Nonpolar contaminants in sediments or water preferentially partition into the organic material in sediments because of the similar chemical nature of the organic material to the nonpolar organic contaminants. Contaminants that form ions, such as acids, bases, phenols, and metals, do not partition as strongly into the organic fraction in sediments.

DiToro et al. (1991) and others have reported that the toxicity of nonionic organic chemicals in sediments appears to be correlated to the concentration of those chemicals in the organic carbon fraction of sediments, but is not well-correlated with the overall (dry weight) concentration of the chemicals in sediments. Therefore, the concentrations of contaminants in the organic fraction of sediments may be more relevant than dry weight concentrations for setting standards that are intended to prevent adverse biological effects.

In addition, because nonpolar organic contaminants are primarily associated with the organic matter in sediments, these contaminants move in the environment along with the organic fraction in sediments and may also move along with suspended organic matter in water. Therefore, gradients of chemical concentration associated with a source may be more easily observed when the data are OC-normalized than when they are presented in dry weight.

The Sediment Management Standards criteria for nonionizable organic chemicals have been set on an OC-normalized basis. Because the bioavailability of acids, bases, other ionizable organic chemicals, and metals are generally not controlled by organic matter in sediments, standards for these contaminants are set on a dry weight basis.

3. COLLECTING AND ANALYZING ORGANIC CARBON DATA

The organic carbon content of sediments is measured and referred to as *total organic carbon* (TOC). TOC refers to the total amount of organic carbon in the sediment, and does not include mineralized carbon present as carbonates or bicarbonates. These inorganic forms of carbon do not substantially affect the partitioning of organic chemicals, and are removed from the sample by the laboratory.

TOC samples may be collected in glass or plastic containers. A minimum sample size of 25 grams (wet weight) is recommended. Because a special bottle is not required, sediments for TOC analysis may be combined with sediments for other analyses that will be performed at the same laboratory. Samples should be stored frozen and can be held for up to six months if frozen.

Detailed methods for analyzing TOC samples may be found in the 18th Edition of *Standard Methods for the Examination of Water and Wastewater* (Franson, 1992). Method 5310B is recommended, slightly modified for sediment samples. A description of the method is attached as an addendum (*Clarification: Recommended Methods for Measuring TOC in Sediments*, K. Bragdon-Cook). The laboratory calculates the amount of carbon that was present in the sample from the amount of CO_2 released during combustion. TOC values are reported as percentage of the dry weight sample.

Nearly any full-service laboratory is equipped to perform this analysis, which costs approximately $60 per sample.

4. ORGANIC CARBON NORMALIZATION OF DRY WEIGHT DATA

As discussed in Section 5, organic carbon (OC) normalization is performed on a sample-by-sample basis, because TOC values vary from station to station. Because some site-specific evaluation is required (see Section 7), OC normalization should be performed by the project manager or consultant who receives data from the laboratory. Laboratories are generally not expected to perform the normalization.

To convert chemical concentration data expressed as mg/kg dry weight to mg/kg OC, divide the dry weight concentration by the percent TOC (expressed as a decimal), as shown in the following equation:

$$\text{mg/kg OC} = \frac{\text{mg/kg dry weight}}{\text{kg TOC/kg dry weight}}$$

where: mg/kg OC = milligrams of the chemical per kilogram of organic carbon

mg/kg dry weight = milligrams of the chemical per kilogram of dry weight sample

kg TOC/kg dry weight = percent total organic carbon in dry weight sample (expressed as a decimal; for example, 1% TOC = 0.01)

Although data are typically reported in mg/kg, data reported in ug/kg, ppb, or ppm can also be used in the above equation. For example:

$$\frac{\text{2 ug phenanthrene/kg dry sediment}}{\text{0.01 kg TOC/kg dry sediment}}$$

= 200 ug phenanthrene/kg TOC
= 200 ppb phenanthrene, OC-normalized.

Because this conversion is tedious to do by hand for large data sets, the data may either be entered into a spreadsheet or database that can be used to perform the conversion. **Contractors providing sediment data for permit applicants, cleanup proponents, or for Ecology should perform the normalization (for nonionic organic chemicals) and report the data for these chemicals both as dry weight and as OC-normalized data.**

5. TYPICAL TOC VALUES FOR SEDIMENTS

TOC values vary widely in the natural environment. A range of 0.5-3 percent is typical for Puget Sound marine sediments, particularly those in the main basin and in the central portions of urban bays. For example, the Puget Sound Ambient Monitoring Program reports a mean TOC value of 1 percent (PSAMP, 1990). TOC values less than 0.5 percent are commonly found in sandy or gravelly areas, erosional areas, or areas with fast-flowing currents (including rivers). In addition, the percent organic carbon in subsurface sediments usually decreases with depth, to as little as 0.01 percent.

Natural TOC values greater than 3 percent are common in nearshore environments. On occasion, natural TOC values of up to 12-15 percent have been observed in Puget Sound and other areas, particularly in depositional and/or quiescent areas where organic matter may collect. Natural TOC values may be much higher in marshy areas or other wetlands environments.

TOC values may also be artificially elevated in sediments that are heavily contaminated with organic substances (sewage, petroleum hydrocarbons, wood chips). Sewage and organic chemicals will typically raise TOC values by at most a few percent; in a majority of the cases, the effect will be negligible. However, organic debris such as wood chips can raise the TOC value by anywhere from several percent to 50 percent or more.

Because TOC values may vary widely within a single site, organic carbon normalization is preformed on a station-by-station basis. **Therefore, each sample that is analyzed for nonionizable organic contaminants must also be analyzed for TOC.**

6. EVALUATION OF HISTORICAL DATA SETS

Collection of TOC data is currently required for all sediment sampling to allow comparison to numerical sediment standards. However, many historical data sets are not OC-normalized and may not contain station-by-station TOC data. If any TOC data are available for the data set, it is recommended that a conservative value be chosen from the data available that represents the lowest percent TOC observed at the site. If different areas of the site appear to have widely varying levels of TOC, a different value may be chosen for each area that represents the lower end of the range of TOC values for that area. The professional judgment of the site/permit manager should be used to select an appropriate value in each case.

If TOC data were not included in the data set, data may be available from other studies in the same area. The SEDQUAL database may be consulted to determine whether TOC values are available for the area of interest. Again, a value should be chosen that represents the lower end of TOC values for the area, to insure that the OC-normalized concentrations calculated using the general TOC value are protective. If no TOC data are available for the area of interest, the Sediment Management Unit or a regional sediment technical specialist should be consulted to determine an appropriate TOC value to use for the comparison.

7. WHEN ORGANIC-CARBON NORMALIZATION MAY NOT BE APPROPRIATE

There are several situations, including those described below, in which it may not be appropriate to OC normalize sediment data. For additional information or guidance on data evaluation and presentation for these situations, contact the Sediment Management Unit or a regional technical specialist. **Because of the variety of uses to which sediment data are put, sediment data for nonionic organic chemicals should be reported both as dry weight and as OC-normalized data.**

In areas where the TOC is very low or very high, biological testing or use of dry weight concentrations should be considered along with OC-normalized concentrations in evaluating the extent of contamination and potential biological effects.

For example, if TOC values are very low (e.g., 0.1-0.2), it is even possible for background concentrations of organic chemicals to exceed the Sediment Quality Standards when OC-normalized. In this situation, it may be appropriate, on a site-specific basis, to use Apparent Effects Thresholds (AETs) expressed as dry weight (see PSEP, 1988) to evaluate sediment toxicity. Please contact the Sediment Management Unit for assistance in evaluating such data.

Conversely, if TOC concentrations in sediments have been increased above normal concentrations by organic contamination (such as wood chips, sewage, or petroleum), the OC-normalized values may be inappropriately low. In these cases, although the OC-normalized chemical criteria would not be exceeded, the sediments may still cause adverse biological effects and may therefore exceed the narrative standards or biological criteria. To address this concern, if the organic chemicals or substances that are the primary contributors to the elevated TOC levels are known, the contribution of the organic contaminants to the percent TOC may be determined through analytical methods and subtracted from the TOC value before OC normalizing. Alternatively, as described above, biological testing or dry weight AETs may be used to evaluate sediment toxicity.

Bulk sediment concentrations expressed as dry weight are used to make decisions regarding treatment and disposal of sediments. Currently, the Puget Sound

Dredged Disposal Analysis (PSDDA) program uses dry weight data to determine whether sediments can be disposed of in open-water disposal areas. In addition, upland disposal options require evaluation of whether the sediment exceeds land disposal restrictions and dangerous/hazardous waste thresholds, based on dry weight concentrations. For treatment alternatives, the average dry weight concentrations of chemicals in sediment may be used to predict the effectiveness of processes such as bioremediation or chemical stabilization/solidification.

8. REFERENCES

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CLARIFICATION

RECOMMENDED METHODS FOR MEASURING TOC IN SEDIMENTS

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INTRODUCTION

Current PSEP protocols for measuring total organic carbon (TOC) in sediment call for drying a sediment sample at 70 degrees C in order to minimize the loss of volatile organic compounds. HCl is then added to the dried sample to remove inorganic carbon and dried again at 70 degrees C. The sample is then combusted using cupric oxide fines as a catalyst at 950 degrees C. A preweighed, ascarite-filled tube is used to capture the resulting CO_2 upon combustion. The tube is then weighed once more to determine the concentration of CO_2 which is used to calculate the TOC in percent dry weight based on total solids in the sample.

Ecology's Technical Information Memorandum, "Organic Carbon Normalization of Sediment Data", recommends Methods 5310A-D, slightly modified, from the 18th Edition of Standard Methods for the Examination of Water and Wastewater (Franson, 1992). These include a wet chemical oxidation method (5310D) and a combustion method (5310B), both using infrared detection (IR). The Department of Ecology Manchester Environmental Laboratory recommends Method 5310B for measuring TOC in wastewater or, with some modification, in sediments. Test Methods for Evaluating Solid Waste (EPA 1986) SW-846 Method 9060 also references Standard Methods for the Examination of Water and Wastewater for measuring TOC levels of solid and hazardous waste.

These methods require some modification for measuring TOC in sediment. Standard Method 5310B calls for the sample to be treated with HCl to convert inorganic carbon to CO_2 which is then purged using purified gas. The sample is homogenized and diluted as necessary. A portion is injected with a blunt-tipped syringe into a heated reaction chamber (packed with a catalyst) of a carbon analyzer using infrared detection. Needle size is selected to be consistent with particle size. Some accredited laboratories have adapted this technique to sediment by drying the sample at 70 degrees C and using an instrument attachment to the carbon analyzer designed specifically for sediment samples (Dohrman sludge/sediment boat sampler attachment, Model 183, for use with the Dohrman DC-80 TOC analyzer). The sample is then combusted and organic carbon in the sediment converted to CO_2 and transported in carrier gas streams to be measured by an infrared detector.

Method 5310D describes the wet-oxidation method where the sample is acidified and purged as above and oxidized with persulfate in an autoclave from 116 to 130 degrees C. Again, the resultant CO_2 is measured by infrared spectrometry. Adaptation of this method to sediments may be problematic. Reagents and analytical techniques may be adjusted by the laboratory, however, to increase oxidation of organic carbon in sediments.

The carbon analyzer/infrared detection used in these methods identifies characteristic spectral fingerprints as light in the infrared spectrum passes through various molecules. This instrument offers greater sensitivity than the ascarite-filled tube collector for measuring low levels of CO_2.

PROBLEM IDENTIFICATION

The combustion method dries the sediment sample at 70 degrees C to minimize the loss of organic compounds, but 70 degrees C is not enough to drive off all of the moisture in the sample. A minimum temperature of 104 degrees C is needed to ensure a truly dry sample for total solids calculations. At 104 degrees C, however, a significant loss of volatile organics occurs.

In addition, the ascarite-filled tube used to detect CO_2 in the PSEP method is less sensitive than the infrared detector of the standard methods, limiting accurate detection of low TOC concentrations. Comparative data between the two methods are not yet available.

PSDDA Reports, Development of Sediment Quality Values for Puget Sound, lists the 50%, 75%, and 90% TOC percentile concentrations for Puget Sound at 1.31%, 2.30%, and 4.50% respectively. TOC levels for individual test sites, however, vary greatly with some concentrations well below these averages. Low level detection of TOC in these areas is less accurate using the PSEP method.

Because the Ecology sediment clean up program and PSDDA program may overlap on projects, the need exists for consistency in the method used to measure TOC in sediments.

PROPOSED ACTION/MODIFICATION

Standard Method 5310B and SW-846 Method 9060 provide for more sensitive measurement of TOC concentrations in sediment. SW-846 Method 9060 (as modified by Laucks Laboratories for example) can detect TOC in sediments below 0.1%. Analytical precision for the PSEP method is not given in the protocols. For these reasons, utilization of Method 5310B or SW-846 Method 9060 using infrared detection is strongly recommended. Under conditions described below the PSEP method is acceptable.

Based on the lack of analytical error data for the PSEP method and greater instrument sensitivity of the combustion/IR method, the following guideline is given.

Prior to method selection, consideration should be given to the condition of the test site regarding probable TOC levels. When possible, historical data of particular sites should be reviewed to identify probable TOC concentration ranges.

When TOC concentrations are above 2% either method described could be used. Standard Method 5310B or SW-846 Method 9060 should be used for areas where TOC levels below 2% are likely. PSDDA applicants should state in their sampling and analysis plan which method for measuring TOC in sediment is proposed and provide detailed justification.

To correct for true dry weight with either method, the corresponding total solids analysis should be run twice, once at 70 degrees C and once at 104 degrees C, and the TOC calculation based on dry weight at 104 degrees C.

This document serves as an addendum to Ecology's Technical Information Memorandum noted above. An errata sheet to replace page 3 is included.

REFERENCES

Franson, M.H., ed. 1992. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, American Water Works Assn., and Water Environment Federation, Washington D.C. 18th Edition. pp 5-10 - 5-15.

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Part VII. Appendices

Appendix F. Recommended Sample Preparation Methods, Cleanup Methods, Analytical Methods, and Detection Limits For The Sediment Management Standards, Chapter 173-204 WAC.

TABLE 5. RECOMMENDED SAMPLE PREPARATION METHODS, CLEANUP METHODS, ANALYTICAL METHODS, AND DETECTION LIMITS FOR SEDIMENTS

Chemical	Recommended Sample Preparation Methods[a]	Recommended Sample Cleanup Methods[b]	Recommended Analytical Methods[c]	Recommended Maximum Detection Limits[d, i] (μg/kg dry weight)
Metals				
Antimony	PSEP	--	6010/7041	50,000
Arsenic	PSEP	--	6010/7061	19,000
Cadmium	PSEP	--	6010/7131	1,700
Chromium	PSEP	--	6010/7191	87,000
Copper	PSEP	--	6010	130,000
Lead	PSEP	--	6010/7421	150,000
Mercury	--[e]	--	7471	140
Nickel	PSEP		6010	47,000
Silver	PSEP	--	6010	2,000
Zinc	PSEP	--	6010	137,000
Nonionizable Organic Compounds				
LPAH Compounds				
Naphthalene	3540/3550	3640/3660	8270/1625C	700
Acenaphthylene	3540/3550	3640/3660	8270/1625C	433
Acenaphthene	3540/3550	3640/3660	8270/1625C	167
Fluorene	3540/3550	3640/3660	8270/1625C	180
Phenanthrene	3540/3550	3640/3660	8270/1625C	500
Anthracene	3540/3550	3640/3660	8270/1625C	320
2-Methylnaphthalene	3540/3550	3640/3660	8270/1625C	223
HPAH Compounds				
Fluoranthene	3540/3550	3640/3660	8270/1625C	567
Pyrene	3540/3550	3640/3660	8270/1625C	867
Benz[a]anthracene	3540/3550	3640/3660	8270/1625C	433
Chrysene	3540/3550	3640/3660	8270/1625C	467
Total benzofluoranthenes[f]	3540/3550	3640/3660	8270/1625C	1067
Benzo[a]pyrene	3540/3550	3640/3660	8270/1625C	533
Indeno[1,2,3-cd]pyrene	3540/3550	3640/3660	8270/1625C	200
Dibenz[a,h]anthracene	3540/3550	3640/3660	8270/1625C	77
Benzo[ghi]perylene	3540/3550	3640/3660	8270/1625C	223
Chlorinated Benzenes				
1,2-Dichlorobenzene	3540/3550	3640/3660	8270/1625C/8240	35
1,3-Dichlorobenzene	3540/3550	3640/3660	8270/1625C/8240	57
1,4-Dichlorobenzene	3540/3550	3640/3660	8270/1625C/8240	37
1,2,4-Trichlorobenzene	3540/3550	3640/3660	8270/1625C/8240	31
Hexachlorobenzene	3540/3550	3640/3660	8270/1625C	22
Phthalate Esters				
Dimethyl phthalate	3540/3550	3640/3660	8270/1625C	24
Diethyl phthalate	3540/3550	3640/3660	8270/1625C	67
Di-n-butyl phthalate	3540/3550	3640/3660	8270/1625C	467
Butyl benzyl phthalate	3540/3550	3640/3660	8270/1625C	21
Bis[2-ethylhexyl]phthalate	3540/3550	3640/3660	8270/1625C	433
Di-n-octyl phthalate	3540/3550	3640/3660	8270/1625C	2067

TABLE 5. (cont.)

Chemical	Recommended Sample Preparation Methods[a]	Recommended Sample Cleanup Methods[b]	Recommended Analytical Methods[c]	Recommended Maximum Detection Limits[d, i] (µg/kg dry weight)
Miscellaneous Extractable Compounds				
Dibenzofuran	3540/3550	3640/3660	8270/1625C	180
Hexachlorobutadiene	3540/3550	3640/3660	8270/1625C	11
Hexachloroethane	3540/3550	3640/3660	8270/1625C	47
N-nitrosodiphenylamine	3540/3550	3640/3660	8270/1625C	28
PCBs				
PCB Aroclors®	3540/3550	3620/3640/3660	8080	6
Chlorinated Pesticides				
DDD	3540/3550	3620/3640/3660	8080	3.3
DDE	3540/3550	3620/3640/3660	8080	2.3
DDT	3540/3550	3620/3640/3660	8080	6.7
Aldrin	3540/3550	3620/3640/3660	8080	1.7
Chlordane	3540/3550	3620/3640/3660	8080	1.7
Dieldrin	3540/3550	3620/3640/3660	8080	2.3
Heptachlor	3540/3550	3620/3640/3660	8080	1.7
Lindane	3540/3550	3620/3640/3660	8080	1.7
Volatile Organic Compounds				
Ethylbenzene	--[g]	--	8240/1624C	3.2
Tetrachloroethene	--[g]	--	8240/1624C	3.2
Total xylene	--[g]	--	8240/1624C	3.2
Trichloroethene	--[g]	--	8240/1624C	3.2
Ionizable Organic Compounds				
Phenol	3540/3550	3640/3660	8270/1625C	140
2-Methylphenol	3540/3550	3640/3660	8270/1625C	63
4-Methylphenol	3540/3550	3640/3660	8270/1625C	223
2,4-Dimethylphenol	3540/3550	3640/3660	8270/1625C	29
Pentachlorophenol	3540/3550	3640/3660	8270/1625C	120
Benzyl alcohol	3540/3550	3640/3660	8270/1625C	57
Benzoic acid	3540/3550	3640/3660	8270/1625C	217
Conventional Sediment Variables				
Ammonia	--[h]	--	Plumb (1981)	100
Grain size	--[h]	--	Plumb (1981)	1%
Total solids	--[h]	--	PSEP	0.1% (wet wt)
Total organic carbon (TOC)	--[h]	--	9060	0.1%
Total sulfides	--[h]	--	Plumb (1981)/9030	100

Note:
EPA - U.S. Environmental Protection Agency
GPC - gel permeation chromatography
HPAH - high molecular weight polycyclic aromatic hydrocarbon
LPAH - low molecular weight polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PSEP - Puget Sound Estuary Program
TOC - total organic carbon

(Footnotes continued on next page)

TABLE 5. (cont.)

[a] Recommended sample preparation methods are:

PSEP (1989a)

Method 3500 series - sample preparation methods from SW-846 (U.S. EPA 1986) and updates.

[b] Recommended sample cleanup methods are:

All sample extracts should be subjected to GPC cleanup in accordance with procedures specified by EPA SW-846 Method 3640. Special care should be used during GPC to minimize loss of analytes.

If sulfur is present in the samples (as is common in most marine sediments), cleanup procedures specified by EPA SW-846 Method 3660 should be used.

All PCB extracts should be subjected to florisil column cleanup as specified by EPA SW-846 Method 3620.

Additional cleanup procedures may be necessary on a sample-by-sample basis. Alternative cleanup procedures are described in PSEP (1989a) and U.S. EPA (1986).

[c] Recommended analytical methods are:

Method 6000, 7000, 8000, and 9000 series - analytical methods from SW-846 (U.S. EPA 1986) and updates

Method 1624C/1625C - isotope dilution method (U.S. EPA 1989)

Plumb (1981) - U.S. EPA/U.S. Army Corps of Engineers Technical Report EPA/CE-81-1

PSEP (1986a)

Acid volatile sulfide method for sediment (U.S. EPA 1991).

[d] To achieve the recommended detection limits for organic compounds, it may be necessary to use a larger sample size (approximately 100 g), a smaller extract volume for gas chromatography/mass spectrometry analyses (0.5 mL), and one of the recommended sample cleanup methods, as necessary, to reduce interference. Detection limits are on a dry-weight basis unless otherwise indicated. For sediment samples with low TOC, it may be necessary to achieve even lower detection limits for certain analytes in order to compare the TOC-normalized concentrations with applicable numerical criteria (see Table 1).

[e] The sample digestion method for mercury is described in the analytical method (Method 7471, SW-846 [U.S. EPA 1986] and updates).

[f] Total benzofluoranthenes represent the sum of the b, j, and k isomers.

[g] Sample preparation methods for volatile organic compound analyses are described in the analytical methods.

[h] Sample preparation methods for sediment conventional analyses are described in the analytical methods.

[i] The recommended maximum detection limits are based on a value equal to one third of the 1988 dry weight lowest apparent effects threshold value (LAET, Barrick et al 1988) except for the following chemicals: 1,2-dichlorobenzene, 1,2,4-trichlorobenzene, hexachlorobenzene, hexachlorobutadiene, n-nitrosodiphenylamine, 2-methylphenol, 2,4-dimethylphenol, and benzyl alcohol, for which the recommended maximum detection limit is equal to the full value of the 1988 dry weight LAET.