As required by
Washington State Administrative Procedures Act
Chapter 34.05 RCW

CONCISE EXPLANATORY STATEMENT

AND

RESPONSIVENESS SUMMARY

FOR THE AMENDMENT OF

Chapter 173-340 WAC, *Model Toxics Control Act Cleanup Regulation*

Prepared by
Washington State Department of Ecology
Toxics Cleanup Program

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ACRONYMS AND ABBREVIATIONS

Ah	aryl hydrocarbon hydroxylase
APA	Administrative Procedures Act
ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
Cal-EPA	California EPA
CBA	cost-benefit analysis
CDC	Centers for Disease Control
CLARC	Cleanup Levels and Risk Calculation
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	cleanup screening level
DLC	dioxin-like compound
DMPP	Dredge Material Management Program
EPA	Environmental Protection Agency
GI	gastrointestinal
HCA	healthcare authority
LBA	least burdensome alternative
MCL	maximum containment limit
MCUL	minimum cleanup level
MRC	minimal risk allowance
MTCA	Model Toxics Control Act
ng	nanogram
NTR	National Toxics Rule
PAC	Model Toxics Control Act Policy Advisory Committee
PAH	polycyclic aromatic hydrocarbons
PBT	persistent bioaccumulative toxin
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
PCP	pentachlorophenol
PEF	potency equivalency factor
pg	picogram
PLP	potentially liable party
POG	Total Petroleum Hydrocarbons Policy Oversight Group

ppt	parts per trillion
PQL	practical quantitation limit
QA/QC	quality assurance/quality control
QRA	quantitative risk assessment
RCW	Revised Code of Washington
RME	reasonable maximum exposure
RPF	relative potency factor
SBEIS	Small Business Economic Impact Statement
SIC	standard industry classification
SMS	sediment management standard
SQS	sediment quality standard
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCP	Toxics Cleanup Program
TEE	terrestrial ecological evaluation
TEF	toxic equivalency factor
TEQ	total toxicity equivalence
TMDL	total maximum daily load
TPH	total petroleum hydrocarbon
VSL	value of statistical life
WAC	Washington Administrative Code
WHO	World Health Organization

Chapter 1: Introduction

1.1 Purpose of the Document

This document is the concise explanatory statement for the proposed amendments to the Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 WAC). The Washington Administrative Procedures Act (APA) requires that an agency prepare a concise explanatory statement that:

- Identifies the agencies reasons for adopting the rule;
- Describes the differences between the text of the proposed rule and the text of the rule as adopted, other than editing changes, stating the reasons for differences; and
- Summarizes all comments received about the proposed rule and provides responses to the comments by category or subject matter. It shows how the final rule reflects agency consideration of the comments, or why it fails to do so. (RCW 34.05.325(6)(a))

The concise explanatory statement must be prepared before final rule adoption and must be provided to any person on request or from whom the agency received comment (RCW 34.05.325(6)(a) and (b).

1.2 Background Information

The Model Toxics Control Act (MTCA) was passed by Washington voters in November 1988. The law sets up the basic authorities and requirements for cleaning up contaminated sites. The Department of Ecology (Ecology) originally adopted cleanup standards in February 1991. Ecology completed significant changes to the cleanup standards in February 2001.

The 2001 rule amendments stated that people undertaking a cleanup action may use the Environmental Protection Agency's (EPA) toxicity equivalency factor (TEF) values and methodology when assessing dioxin and furan mixtures. Ecology also provided a choice for people to use similar TEF-based methodology to assess mixtures of polycyclic aromatic hydrocarbons (PAHs). In November 2001, Ecology published a guidance document, the Cleanup Levels and Risk Calculations (CLARC) guidance, that explains how to use the TEF methodology when establishing cleanup levels.

In November 2005, the Rayonier Corporation filed a lawsuit challenging Ecology's use of the CLARC guidance at the Port Angeles mill site. Rayonier argued the MTCA rule requires Ecology to establish cleanup levels for each dioxin congener using a cancer risk level of one-in-one million (or 10^{-6}). This approach differs from the CLARC guidance which states that cleanup levels must be established for the whole mixture using the 10^{-6} risk level.

In April 2006, Ecology settled the lawsuit and agreed that Rayonier's approach was also a possible interpretation of the current MTCA rule. Ecology agreed to settle the lawsuit since neither the current MTCA rule nor the federal guidance referenced in the MTCA rule clearly required the procedures in the CLARC guidance to be used.

As settlement discussions were occurring, several environmental groups presented a rulemaking petition to Ecology in March 2006. These groups requested that Ecology amend the rule to clarify that policies and procedures in the Ecology CLARC guidance be used when establishing cleanup levels for dioxins/furans and other similar mixtures.

Ecology reviewed the rulemaking petition and decided to begin a focused rulemaking process to address the issues raised in the lawsuit and rulemaking petition. Specifically, Ecology decided to define in the rule how the EPA methodology should be used within the MTCA regulatory framework. Further, Ecology decided that amending the MTCA rule to explicitly define key policy choices is preferable to repeatedly resolving those policies on a site-specific basis.

1.3 The Regulatory Dilemma

In this rulemaking process, Ecology must decide what methods and policies should be used to establish cleanup standards for mixtures of dioxins and furans, PAHs, and polychlorinated biphenyls (PCBs). These chemicals are widely recognized as hazardous substances that pose threats to human health. There is also widespread agreement, by scientists, policy makers, and the public, that human exposure should be reduced and avoided. The dilemma facing Ecology revolves around the scientific uncertainty and debate about exactly how these types of chemicals cause adverse health effects at low levels of exposure. Given the costs involved, legitimate debate exists over the degree to which these chemicals must be removed as contaminants from the environment.

Ecology has previously addressed questions about setting public policy when faced with scientific uncertainty. Scientific understanding continues to evolve, and while this advancing frontier expands our knowledge base, it also reveals the unknown. By its very nature, science looks into that void, and in the process illuminates the workings of nature. Nowhere is this more striking than in the field of cancer research, where recent increases in fundamental understanding have lead directly to treatments that save lives.

It's increasingly clear that environmental exposures to carcinogens play a role in cancer rates, and regulatory agencies have a role to play in reducing exposure. In 1991, while establishing cleanup standards for the various environmental media, Ecology made reasoned determinations of acceptable exposure levels for hazardous substances generally, even given uncertainty about exact exposure risks. The reasoning used by Ecology then is equally applicable today.

This type of regulatory dilemma is neither new nor unique to the Department of Ecology. Indeed, Ecology and other regulatory agencies face the same difficulties that public officials have faced in the past. Dr. Richard Bates (former Science Director for the Food and Drug Administration) described those similarities in his written comments on the Occupational Safety and Health Administration's cancer policy. He stated:

> *A classic episode in the history of disease prevention took place in London in 1854. An epidemic of cholera occurred in the neighborhood around Broad Street. John Snow, the hero of the story, studied the habits of the victims and found that almost all obtained their water from the well on Broad Street. Swift action was taken; the pump was closed down and the epidemic rapidly subsided. This disease was caused by exposure to the bacterium Vibrio cholerae. One can imagine the reaction that might occur today if it were proposed to close down the pump on the basis of evidence of the kind obtained by John Snow. Many scientists would point out that it had not been conclusively demonstrated that the water was the cause of the disease. They would be troubled because of the lack of satisfactory theoretical knowledge to explain how the water could have caused the disease. Furthermore, other habits of those who had become ill had not been adequately investigated, so it would not be possible to rule out other causes of the disease. The scientists would have been correct. Others would have pointed out that some members of the community who drank from the Broad Street well had not succumbed to cholera. Thus, even if there were something wrong with the water, there must be other factors involved and if we could control these we would not have to be concerned about the water. The conclusions are also correct.*

Some who consumed water from the Broad Street well would have objected to closing it because the taste of water from other wells was not as agreeable. Finally, if the pump had been owned by an individual who sold the water, he would certainly have protested against closing down his business on the basis of inconclusive evidence of hazard. (Bates, 1978, pp. 1-2.)

Dr. Bates concluded that this story highlights several key concepts that should be kept in mind by government agencies charged with the responsibility of regulating hazardous substances:

- If human disease is to be prevented, it is often necessary to control exposure for which there is some evidence of hazard before that evidence has reached the point that scientists would universally regard as conclusive;

- Development of a disease in any individual is the result of complex interactions of a variety of factors including genetic susceptibility, exposure to other environmental pollutants, age, nutrition, etc.; and

- The incidence of disease in a population can be reduced by reducing exposure to hazardous substances or by measures designed to reduce the susceptibility of individuals.

Ecology continues to find this advice relevant to the cleanup of hazardous waste sites. Ecology is required by law to set cleanup levels and carry out cleanup actions to protect human health and the environment. Science properly guides every step of the decision making process, from site identification to establishing cleanup levels. However, scientific information is only one of several factors that must be considered when developing regulatory strategies for hazardous substances. In that sense, the rulemaking is essentially focused on answering the following question:

What methods and policies should Ecology use to set MTCA cleanup standards for mixtures of dioxins and furans, carcinogenic PAHs and PCBs given:

- *Current statutory and regulatory framework for setting MTCA cleanup standards. MTCA directs Ecology to "…[p]ublish and periodically update minimum cleanup standards for remedial actions at least as stringent as the cleanup standards under section 121 of the federal cleanup law, 42 U.S.C. Sec. 9621, and at least as stringent as all applicable state and federal laws, including health-based standards under state and federal law…."*

- *Current understanding of the potential threats to human health and the environment posed by these chemical mixtures and the uncertainties surrounding those threats. There is a large body of scientific information that indicates these chemical mixtures pose threats to human health and environment. However, there are numerous scientific uncertainties about the exact relationship between adverse health effects and exposure levels likely to occur at concentrations present in the Washington environment.*

- *Variability in exposures and susceptibility among individuals. No two individuals are exactly alike. There are wide ranges in exposure and susceptibility to these types of hazardous substances. These variations complicate the task of identifying cleanup levels that reflect the MTCA statutory principle that "each person has a fundamental and unalienable right to a healthful environment…."*

- *Background concentrations and exposures. These chemicals are widely distributed in the Washington and global environments. Consequently, Washington residents are exposed to multiple sources of exposures – many of which are independent of specific cleanup sites. This*

underlying background exposure complicates efforts to characterize site-specific health risks and develop cleanup strategies for individual sites.

- *Potential costs of cleanup measures and the uncertainties surrounding those costs. The costs of cleanup measures are inversely proportional to the cleanup levels for these mixtures. As cleanup levels are lowered, cleanup costs are expected to increase. As with health risks, there are uncertainties surrounding cost estimates. The Washington Administrative Procedures Act (APA) requires agencies to demonstrate that the benefits of new rules exceed the costs of complying with those rules.*

- *Methods and policies used by other agencies and programs. Cleanup standards must comply with all applicable laws and regulations. Consequently, it is important to consider how the proposed standards relate to other regulatory requirements.*

In the face of uncertainty and variability, public health and environmental agencies properly and prudently establish policies that protect people and the environment. The questions become twofold: where to set cleanup levels, and how to justify where these levels are set.

1.4 Ecology's Rulemaking Objectives

Ecology considered and balanced several issues and concerns during the rule development process. Ecology's efforts to amend this rule were guided by five broad objectives:

- Protection of Human Health and the Environment. The rule should promote efforts to protect human health and environment.

- Scientific Foundation. The rule should promote decisions that are based on current scientific information. However, the lack of full scientific consensus should not be used as justification for delaying reasonable measures to prevent harm to human health and the environment.

- Efficient Decision-making Approach. The rule should promote timely and rationale decisions using processes that minimize transaction costs.

- Balancing Predictability and Flexibility. The rule should include well-defined criteria and processes that enable interested parties to understand Ecology actions, timelines and opportunities to provide input to Ecology decisions. However, the rule should also provide the flexibility to address new information and circumstances.

- Integration with Other Requirements. The rule amendments should be compatible with other parts of the MTCA rule and other Washington regulatory programs.

1.5 Overview of the Rule Amendments

Ecology proposed to revise and update the policies and procedures for setting cleanup levels for certain types of chemical mixtures. Key elements of the proposed rule amendments include the following:

- Risk Policies Applicable to Dioxins/Furans, PAHs and PCBs. Ecology proposed to amend WAC 173-340-708(8) to revise and update the risk policies for mixtures of dioxins/furans, carcinogenic PAHs and PCBs. Specifically, Ecology proposed to:

- Require that cleanup levels for mixtures of dioxins and furans be based on a cancer risk of one-in-a-million (10^{-6}).

- Require that cleanup levels for mixtures of carcinogenic PAHs be based on a cancer risk of one-in-a-million (10^{-6}).

- Require that cleanup levels for PCB mixtures continue to be based on a cancer risk of one-in-a-million (10^{-6}).

- TEF Used to Characterize Mixtures. Ecology proposed to amend the rule to require people to use the most current TEF values. These include:

  - TEFs for dioxins/furans and PCBs recommended by the World Health Organization (Van den Berg, et al. 2006). (Note that using the TEF methodology for PCB is optional.)

  - Updated potency equivalency factors (PEFs)[1] for carcinogenic PAHs adopted by the California Environmental Protection Agency. (California EPA, 2005).

- Default Parameters Used to Calculate Cleanup Levels. Ecology proposed to modify the gastrointestinal (GI) absorption fraction specified in WAC 173-340-740 and -745 used to set soil cleanup levels for dioxin and furan mixtures. Specifically, Ecology proposed to change the default value from 1.0 (100%) to 0.6 (60%).

- Evaluating Cross-Media Impacts. Ecology proposed to amend WAC 173-340-708(8) to require cleanup proponents to consider the physical-chemical properties of individual PAH compounds, PCB compounds, or dioxin/furan mixtures when evaluating cross-media impacts.

1.6 Public Involvement during the Rule Development Process

Ecology began the formal rulemaking process on June 7, 2006. This process began with filing the CR-101 with the Office of the Code Reviser. Later that month, Ecology prepared draft rule language and distributed it to interested parties for review and comment. Ecology held several meetings to discuss the draft rule language and key rulemaking issues. Ecology received many comments on the draft rule language. Ecology also held four meetings with the MTCA Science Advisory Board (SAB) to discuss key rulemaking issues.

Ecology changed the June draft rule language based on the comments received from the public, the Department of Health, EPA and the MTCA SAB. Ecology published the proposed rule for public comment on April 4, 2007. The proposed rule was published in the April 18th State Register. The deadline for public comments was May 25, 2007. Three public hearings were held at the following locations:

- May 10, 2007, Seattle

- May 14, 2007, Port Angeles

- May 17, 2007, Spokane

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[1] Cal-EPA's term "Potency Equivalency Factor" is synonymous in concept to "Toxicity Equivalency Factor" and the two terms may be used interchangeably. This document will use "TEF" for the remainder to be consistent with discussion of other chemicals.

Ecology published printed notice of the public hearings in the Peninsula Daily News, the Columbian, the Seattle Times, the Yakima Herald-Republic and the Olympian. Email announcing the hearings was sent to people interested in the topic. The hearings were also announced in Ecology's Site Register, which gets distributed to over 1,500 individuals by mail or email. In total, 42 people attended the three hearings.

1.7 Changes to the Proposed Rule Amendments Made in Response to Public Comments

Ecology made the following changes to the proposed rule:

A technical correction was made to WAC 173-340-900, Table 708. The correct CAS number for 1,2,3,4,7,8 Hexachloro dibenzo-p-dioxin is 39227-28-6. Appendix A contains the final text of the rule amendments adopted by Ecology and filed with the CR 103. Appendix B provides a list of persons who commented on the proposed rule, organized by name and by issue.

1.8 Organization and Format of the Concise Explanatory Statement

This Concise Explanatory Statement is organized into nine chapters with a tenth chapter providing a list of references cited by Ecology in responding to particular issues:

Chapter 2: General Rulemaking Issues
Chapter 3: Dioxins
Chapter 4: Polycyclic Aromatic Hydrocarbons (PAHs)
Chapter 5: Polychlorinated Biphenyls (PCBs)
Chapter 6: Other Issues Not Within Scope of Current Rulemaking
Chapter 7: Cost-Benefit Analysis
Chapter 8: State Environmental Policy Act
Chapter 9: Small Business Impacts
Chapter 10: References

The Concise Explanatory Statement responds to comments received on the proposed rule. Comments were received in writing and transcribed from oral testimony provided at public hearings.

The Concise Explanatory Statement responds to the identified comments in a question and answer format. Ecology reviewed the public comments and grouped them into a series of questions (the "issues"). Each of the questions reflects a particular issue or set of issues raised by one or more individuals or organizations. The following format is used for each question:

- Ecology's Proposal: This subsection includes a brief summary of the issue and relevant provisions in the April 2007 proposal, if applicable.

- Public Comments and Concerns: This subsection provides a summary of the public comments and concerns raised on the issue during the May 2007 comment period. Where multiple comments were received on a particular issue, Ecology summarized the major concerns and provided examples of individual comments.

- Ecology's Review and Response to Public Comments: This subsection provides Ecology response to each issue.

Quotes from written and oral comments are shown in italic text blocks. References to comments are shown in bold and designated by the name of the individual providing the comment [e.g., **(John Smith, p. 2)**]. References to public testimony provided at one of the public hearings include the persons name and the hearing date, [e.g., **(John Smith, testimony at May 10th Public Hearing)**]. A comprehensive

list of persons who submitted comments and a summary of the comments by specific issues are provided as appendices to this document.

This document includes the following appendices:

- Appendix A – Final Rule Amendments

  Appendix A is physically attached at the end of this document.

- Appendix B – Comments on Proposed Amendments.

  Appendix B is available separately. Refer to Publication No. 07-09-108B.

Chapter 2: General Rulemaking Issues

2.1 Overview

Ecology received written and oral comments that addressed a wide range of issues associated with cleanup levels for mixtures of dioxin/furans, carcinogenic PAHs and PCBs. Most people identified issues and concerns and expressed opposition to the proposal and/or specific elements of the proposal. Comments on specific issues are addressed in Sections 3 through 10 of this document.

However, Ecology also received many comments that apply to the whole rule – not specific provisions. Ecology has reviewed all of the comments on the proposed rule and believes that these comments raise important rulemaking concerns and issues. Based on that review, Ecology also believes that several of the comments reflect some misunderstanding over certain key terms or concepts and the overall MTCA decision-making framework. Ecology believes it is important to provide some clarification on these terms and concepts before addressing specific comments on the proposed rule.

This chapter is divided into two main sections. Section 2.2 provides background information and clarifications on the following three terms or concepts:

- Regulatory Baseline;
- Role of Cleanup Levels in Identifying Contaminated Sites; and
- Role of Scientific Information in Regulatory Decision-Making.

Section 2.3 summarizes the comments and provides Ecology responses on the following general rulemaking issues:

Issue 2-1: Why isn't Ecology addressing these issues as part of the broader five-year rule review process?

Issue 2-2: Are the proposed rule revisions confusing and difficult to understand?

Issue 2-3: Are the proposed rule revisions consistent with current scientific information on the health risks posed by dioxins/furans, PAHs & PCBs?

Issue 2-4: Do the proposed rule revisions foreclose the ability to consider new scientific information?

Issue 2-5: Do the proposed rule revisions result in cleanup levels that are overly conservative?

Issue 2-6: Why isn't Ecology applying a similar approach to other types of chemical mixtures?

Issue 2-7: Are the proposed rule revisions consistent with other state and federal laws and regulations?

Issue 2-8: Do the proposed rule revisions identify an appropriate approach for evaluating the cross-media transfer of these types of mixtures?

Issue 2-9: How will the proposed rule revisions be applied to sediment cleanup actions conducted under the Sediment Management Standards?

Issue 2-10: How will the proposed rule revisions be applied to ongoing or completed cleanup actions?

Issue 2-11: Do the proposed rule revisions reflect current policy being implemented by Ecology?

Issue 2-12: Has Ecology demonstrated that the proposed rule amendments meet the Administrative Procedures Act requirements for significant legislative rules?

Issue 2-13: Will the proposed rule revisions require changes to site characterization or requirements?

Issue 2-14: How will instances where a PQL is above the cleanup level for mixture of dioxins/furans, carcinogenic PAHs, or PCBs be addressed?

2.2 Key Terms and Concepts

Ecology received written and oral comments that addressed a wide range of issues associated with cleanup levels for chemical mixtures. Ecology believes that several of these comments reflect some misunderstanding over certain key terms or concepts and the overall MTCA decision-making framework.

Regulatory Baseline

Ecology considered the proposed rule revisions as compared to the "regulatory baseline." That is, the regulatory baseline is the Rayonier Corp. settlement interpretation of the current rule (referred to in this document as "the current rule"), which sets a 10^{-5} risk for mixtures of dioxins and furans. Ecology believes that the proposed rule revisions will result in changes to soil cleanup levels for mixtures of dioxins/furans and carcinogenic PAHs, bringing cleanup levels close to the levels under the original Ecology interpretation. However, public comments reflect a wide range of opinion on the magnitude of those changes. For example:

- Some individuals and organizations expressed concerns that the proposed rule would result in a cleanup level for dioxins and furans that is approximately six times lower than the cleanup level for non-industrial sites under the current rule. For example:

  Our greatest concern is the reduction of the soil cleanup action levels for mixtures of the dioxins and furans from the current 66.7 PPT to 11 PPT. ***(Don Madison, p. 1 of written comments.)***

- Some individuals and organizations expressed concerns that the proposed rule would result in a soil cleanup level for dioxins and furans that is 60% higher than the current cleanup levels for non-industrial sites. For example:

  Maintain the current value of 6.67 ppt and the 875 ppt for cleaning up dioxins from soils. ***(Darlene Schanfald, p. 3 of written comments.)***

Neither interpretation is correct. To paraphrase basketball coach John Calipari "reality lies somewhere in between."[2] Specifically, Ecology expects that the proposed rule revisions will result in Method B soil cleanup levels for dioxin/furan mixtures that are 30 to 50% lower (more stringent) than cleanup levels established under the current rule. Because no site has actually reached a cleanup decision under this

[2] When coaching the University of Massachusetts basketball, John Calipari offered the following comment after his teams suffered a 20 point loss that ended a 29 game winning streak: Things are rarely as good as they seem; things are never as bad as they seem – reality is somewhere in between."

interpretation of the current rule, Ecology conducted calculations to determine likely cleanup levels under this interpretation using available data from several sites. The result is a baseline cleanup level of 16 – 24 ppt. (See Table 1).

Two factors appeared to contribute to the range of opinions on this issue:

- Requirements for individual congeners. People who concluded that the proposed rule would result in a six-fold lowering of the cleanup levels did not appear to take into account cleanup level requirements for individual congeners. Ecology considered both the regulatory limits for individual congeners (10^{-6}) and the whole mixture (10^{-5}) when defining the regulatory baseline. After reviewing data from Washington cleanup sites, Ecology concluded that requirements for individual congeners will result in cleanup levels that are more stringent than simply applying a cleanup level of 67 ppt for the whole mixture; 67 ppt represents an order of magnitude difference between a target risk of 10^{-6} and 10^{-5}. Specifically, Ecology believes that dioxin/furan mixtures with TEQ values between 16 and 24 ppt will fail to meet the requirement that individual congener concentrations not exceed 6.7 ppt. This conclusion is based on data showing that one congener usually contributes 25-35% of the toxicity of the whole mixture.

- Rule vs guidance. People who concluded that Ecology was raising the Method B cleanup level appeared to be comparing the proposed rule to the CLARC guidance document. However, the regulatory baseline differs from the CLARC guidance. In April 2006, Ecology settled a lawsuit on this issue and agreed that applying the 10^{-6} risk level to each congener was a plausible interpretation of the current MTCA rule. Ecology agreed to settle the lawsuit since neither the current MTCA rule nor the federal guidance referenced in the MTCA rule clearly required the procedures in the CLARC guidance to be used. Therefore, Ecology views cleanup levels permitted under the settlement to be the regulatory baseline.

Table 1: Comparison of Soil Cleanup Levels for Dioxins/Furans

	Regulatory Baseline	Proposed Rule
Unrestricted – Human Health*		
2,3,7,8 TCDD	6.7 ppt	11 ppt
Dioxin/Furan Mixtures (TEQ)	16 – 24 ppt**	11 ppt
Industrial – Human Health*		
2,3,7,8 TCDD	875	1,460 ppt
Dioxin/Furan Mixtures (TEQ)	875	1,460 ppt
Ecological Screening		
Dioxins	2 – 5 ppt	2 – 5 ppt
Chlorinated Dibenzofurans	2 – 3 ppt	2 – 3 ppt

*Assumes direct contact via soil ingestion is the controlling exposure pathway and a GI absorption fraction of 0.6.
** Based on median cleanup level at dioxin/furan mixture contaminated sites in Washington State.

Role of Cleanup Levels in Identifying Contaminated Sites

Several individuals and organizations expressed concerns that the proposed rule revisions would increase the number of MTCA cleanup sites. In particular, people were concerned that Ecology would begin listing small sources (such as burn barrels, beach fires, etc.) as MTCA sites. Ecology believes these concerns reflect a misunderstanding on the factors that Ecology considers when identifying MTCA cleanup sites

The MTCA rule identifies several factors that Ecology must consider when evaluating whether a release of a hazardous substance requires action under MTCA. This determination is typically done during the

initial investigation and/or site hazard assessment stages of the MTCA process. In other words, exceeding a cleanup standard does not automatically trigger a site listing or a site cleanup determination.

Role of Scientific Information in Regulatory Decision-Making

There appeared to be some confusion about whether Ecology's regulatory choices were based on science, public policy, or a combination of both. This is not surprising since a number of choices or decisions must be made when evaluating health risks posed by hazardous substances. In some cases, scientific information alone provides enough data to make a reasonable decision. But in other situations, either the scientific data does not exist or it fails to provide a definitive basis for selecting from among several plausible approaches. In the face of this type of scientific uncertainty, the decision on which plausible approach to use is largely a choice that revolves around how "conservative" or "protective" to be both in estimating risk and protecting the public. This type of choice is largely a policy decision. Ecology recognizes that there is no natural "bright line" between scientific matters and policy considerations (Ecology, 1991, p. 14).

In reviewing the public comments on this issue, there appears to be general agreement that:

- Ecology's methods and procedures for establishing MTCA cleanup levels should be consistent with current scientific information;

- There are significant uncertainties associated with characterizing the adverse health threats associated with exposure to dioxins/furan mixtures, carcinogenic PAHs and PCBs; and

- Our level of understanding on the nature and extent of those threats will rarely, if ever, rise to point that scientists would uniformly regard as conclusive.

However, Ecology also believes that the public comments reflect some disagreement (or confusion) on the exact role that scientific information plays in the MTCA decision-making process. This is not surprising given that the approach used to establish MTCA cleanup standards (quantitative risk assessment) has been described by former EPA Administrator William Ruckelshaus as the product of "…a shotgun wedding between science and law." In particular, several organizations and individuals appear to believe that Ecology's decisions on cleanup levels are scientific decisions (as opposed to regulatory decisions that are informed by science).

Ecology believes it is misleading to characterize decisions on MTCA cleanup levels as purely scientific decisions. While scientific information plays an important role in establishing MTCA cleanup levels, the level of stringency is determined by policy choices on (1) what is an appropriate level of protection and (2) how to manage scientific uncertainty and variability. Over the last 20 years, many agencies and expert committees have highlighted the distinction between scientific information/evaluation and regulatory decision-making. For example:

> *Science does not drive EPA's policy and regulatory decisions, but rather, along with other relevant factors, informs and supports those decisions. Implementation costs and technological feasibility, local autonomy versus federal control, and justice and equity – all of which impact our quality of life and standard of living – are among the considerations that need to be factored into EPA decisions without compromising scientific integrity, the Agency's mission , or statutory mandates. The impacts or limitations of these non-science factors, as well as the current state of the art in science, will influence how scientific considerations are brought to bear on a particular environmental problem facing the Agency. (EPA, 2007, pp. 2-3.)*

It is important to emphasize that science is not a panacea for salmon recovery. Science can help provide direction and answer some key questions, but should not be expected to solve all problems. Science may simply not be able to answer some questions; in some cases suitable technologies may not exist, and in others, results from needed scientific investigations may take too long to be of help with current problems. Uncertainty will always be a part of natural resource management…. In the context of the strategy [best available science] means that the best scientific information available on a subject will be used to inform public policy decisions. (Governor's Salmon Recovery Office, 1999, p. 31.)

When a regulatory decision is incorrectly framed as a purely scientific matter, critics of the decision complain that it is based on "bad" or "unsound" science. Supporters argue that decisions are based on "good" or "sound" science. However, the true sources of disagreement are rarely about the quality of scientific evidence or interpretation. In most cases, disagreements on regulatory measures reflect competing political and social policy values.

Scientific methods in themselves lead only to new information and cannot convey "good or bad" values. Human judgments attribute positive or negative values, and the scientists using these phrases are expressing their judgments on regulatory polices rather than on scientific studies. Rowe uses the term "trans-science" to describe the area where judgments must be made but the science is limited: "The judgments involved are about science, but are not science in themselves"...Science can provide the scale, but doesn't draw the line. Most practitioners would agree with Victor Hugo's comment: "Science has the first word on everything, and the last word on nothing." (Tomboulian, P., 1989, pp. 1041 and 1045.)

Much of the uncertainty in the regulatory process is because of the misuse of science. Rather than admit that regulatory decisions necessarily reflect social values (as articulated in congressional statutes), many observers try to make science decide more than it can legitimately decide. They pretend that science can properly dictate regulatory outcomes. Any "wrong" outcome must therefore be based on shoddy science, goes the thinking, and any "right" outcome must be based on "good science". In either case, such regulatory observers are expressing a social policy judgment – but disguising it behind the veneer of scientific objectivity. (McGarity, et al. 2004, p.33.)

Ecology agrees that efforts to address environmental problems must have a sound scientific basis. However, we also believe that decision-makers must respect the limits of scientific knowledge when establishing cleanup levels. Inevitably, there is a natural tension that exists between the availability of scientific information and the need to respond to threats to human health and/or the environment. A shortage of scientific information may give rise to uncertainty, but it does not necessarily free agencies from the responsibility to implement legislative directives to prevent serious and irreversible health impacts.

Regulatory agencies live in a nether world between science, which prefers to defer judgment until sufficient evidence and testing have been completed, and governmental policy-making, which has an affirmative responsibility to take action against known dangers as rapidly as possible. No federal agency can ever fully resolve all of the scientific issues facing it, yet it still must decide what protections should be required. Regulatory policy is the tool used by agencies to bridge the inevitable factual gaps and take into account the social values embedded in congressional law. (McGarity, et al. 2004, p. 34.)

There is an inherent tension between the disciplinary norms of good science and good regulation. Unlike in pure scientific research, where the proper response to uncertainty is reservation of

judgment pending the development of adequate data and testable hypotheses, the risk assessment process cannot be suspended without significant social consequences… (Latin, Good Science, Bad Regulation, and Toxic Risk Assessment, as quoted by McGarity, et al. 2004, p. 47.)

2.3 Evaluation and Response to General Rulemaking Issues

Many individuals and organizations expressed general concerns about the proposed rule revisions. Ecology reviewed these comments and prepared responses to these general issues.

Issue 2-1: Why isn't Ecology addressing these issues as part of the broader five-year rule review process?

Ecology's Proposal

Several environmental groups presented a rulemaking petition to Ecology in March 2006. These groups requested that Ecology amend the rule to clarify the policies and procedures for establishing cleanup levels for dioxins/furans and other similar mixtures. They requested that Ecology amend the rule to incorporate the policies and methods identified in the CLARC guidance document.

Ecology reviewed the rulemaking petition and decided to begin a focused rulemaking process. Specifically, Ecology decided to define in the rule how the federal TEF methodology should be used within the MTCA regulatory framework. Ecology decided that amending the MTCA rule to explicitly define key policy choices would be preferable to repeatedly resolving those policies on a site-specific basis.

When announcing the focused rule process, Ecology explained that this rule revision was the first phase of a two-phase rulemaking process. In the second phase of the process, Ecology announced it would conduct the five-year review process specified in the MTCA rule[3]. Ecology plans to initiate the five-year rule review process in 2007 following the completion of this focused rulemaking.

Public Comments and Concerns

Ecology received comments from over three hundred Washington citizens who expressed support for Ecology's decision to proceed with the current rulemaking (See Appendix B). For example:

I support Ecology establishing a Model Toxics Control Act rule for soil cleanup levels of mixtures of dioxins, PAHs and PCBs using the strongest cancer risk level of 10-6 and the most current dioxin toxicity detection method developed by the World Health Organization and the California EPA. ***(Harley Oien, p. 1.)***

However, several organizations recommended that Ecology address these issues as part of the broader five-year review of the entire rule. They identified three main concerns:

- Lack of consistency with other rule provisions. Several organizations and individuals expressed the opinion that the proposed revisions and the policy choices underlying those revisions are not

[3] WAC 173-340-702 (11) states Ecology will review and, as appropriate, update WAC 173-340-700 through 173-340-760 at least once every five years.

consistent with other parts of the MTCA rule that are outside the scope of the current rulemaking. For example:

The proposed amendments contain a number of policy choices that do not necessarily mesh well with other portions of the rule that are not part of this amendment process. This makes it difficult to comment without considering the implications of the proposed changes in the context of the rule as a whole. The MTCA rule as a whole is scheduled for a 5-year review process. As part of the upcoming comprehensive review, it may be possible to consider some of the policy anomalies created by this proposal, but that is not certain. It would have been better to simply consider this proposal as part of the comprehensive review as the two are so close in time.

The proposed revisions are systematically biased toward overestimating the risk associated with Dioxins/furans in soil. This policy choice does not mesh well with WAC 173-340-708(10) and WAC 173-340-740(2) which are not part of the amendment, but probably should have been revised as well…. ***(Grant Nelson, Association of Washington Business, p. 2.)***

- Impacts on other rule provisions. Several organizations expressed the opinion that the proposed rule revisions will impact the workability of other parts of the rule that are outside the scope of the current rulemaking. For example:

  Some provisions in the existing, current rule language might not have been problematic in the context of existing methods to establish clean-up levels; however, they become problematic in the context of Ecology's proposal to adopt one of the most stringent clean-up rules in the country, driven in large part by overestimating risk. ***(Grant Nelson, Association of Washington Business, p. 2.)***

- Ability to Fully Evaluate Impacts. Several organizations stated that is was difficult to comment on the proposed rule revisions without considering the overall MTCA rule framework. For example:

  As in August 2006, Ecology asked for comment only on very specific issues. However, as was the case in 2006, we find it difficult to provide informed comment without considering the construct of the rule as a whole. ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 1.)***

Ecology's Response to Public Comment

Ecology continues to believe it is appropriate to complete the current rulemaking process prior to addressing a broader range of issues during the five-year rule review. These chemical mixtures are present at many sites where cleanup studies are currently being conducted. Consequently, Ecology believes it is important to complete this rulemaking in order to provide a uniform level of protection and avoid the additional transaction costs needed to address these issues on a site by site basis. Based on past experience, Ecology believes that combining this rulemaking process with the broader five-year review process would significantly delay final decisions.

Ecology agrees that it is important to evaluate how the proposed revisions mesh with the existing regulatory framework. In preparing the rule amendments, Ecology reviewed the entire rule in order to identify and revise potentially relevant rule provisions and mesh these changes with the other parts of the rule. We also considered how the proposed rule revisions would be implemented within the overall regulatory framework when preparing the economic and regulatory analyses required by the Washington APA. Based on a review of the public comments, Ecology believes that many organizations and individuals considered these issues when preparing comments on the proposed rule changes.

Ecology highlighted certain issues in background documents to help focus public comment. However, Ecology did not limit the public's opportunity to comment. Indeed, Ecology received numerous comments on issues not highlighted in the background documents.

Ecology reviewed the comments on all of the issues (independent of whether or not they were identified in the Ecology background documents). However, Ecology has limited the rule revisions to issues that fall within the rulemaking identified in the May 2006 CR 101 Statement:

> **Subject of possible rule making:** Ecology is initiating rulemaking to amend the Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 WAC). The purpose of the rulemaking is to clarify the policies and procedures for establishing cleanup levels for mixtures of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (dioxins/furans), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).

Ecology did receive comments on several issues that broadly apply to all hazardous substances – not just the three chemical mixtures identified in the CR 101. In those cases, Ecology decided to defer the issue to the five-year review process. Those issues include:

- Issues Associated with Early-Life Stage Exposure. In 2005, EPA published the *Supplementary Guidance for Assessing Susceptibility from Early Life Stage Exposure to Carcinogens*[4]. The guidance document identifies procedures for adjusting the cancer potency factors used in the risk assessment process. The EPA guidance is based on scientific studies that indicate that early-life exposure to some types of carcinogens makes a greater contribution to overall risk than comparable exposures occurring later in life. Ecology considered this information when evaluating whether to apply the 10^{-6} cancer risk level to individual PAH compounds or the whole PAH mixture. However, Ecology did not address the broader issue of whether and how to adjust the cancer potency factor. Ecology decided to defer this issue to the five-year rule review process because these types of adjustments are applicable to other hazardous substances found at MTCA cleanup sites. This issue is discussed later in this document (See Issue 4-3).

- Issues Associated With Concurrent Soil Exposure. The MTCA rule includes equations for calculating soil cleanup levels for unrestricted and industrial land uses. The standard equations for calculating MTCA Method B and C soil cleanup levels are based on incidental soil ingestion. Concurrent exposure resulting from dermal contact is only considered under modified Method B/C or for petroleum contamination. Several people recommended that Ecology always consider dermal contact and other soil-related exposure pathways when establishing soil cleanup levels. Ecology decided to defer this issue to the five-year rule review process because this change would broadly apply to all hazardous substances found at MTCA cleanup sites. This issue is discussed later in this document (See Issue 3-6).

- Issues Associated With Sediment Cleanup. The MTCA Cleanup Regulation, at WAC 173-340-760, states that "…[i]n addition to complying with the requirements in this chapter, sediment cleanup actions conducted under this chapter must comply with the requirements of chapter 173-

[4] Generally, cancer risks from childhood exposures to chemicals are evaluated based on methods that evaluate the chemical exposure to adults. This approach assumes chemicals are equally potent for inducing cancer risks from exposures in both early life and later life stages. For a selected group of chemicals with a mutagenic mode of action, available studies indicate higher cancer risks resulting from a given exposure occurring early in life when compared with the same amount of exposure during adulthood.

204 WAC…" Consequently the general risk policies and procedures specified in WAC 173-340-708 apply to sediment cleanup actions. Although Ecology did not propose to revise WAC 173-340-760, Ecology has received comments regarding how the proposed rule revisions may be applied to sediment cleanup actions. Ecology's responses to comments received regarding the Sediment Management Standards are in Issue 2-9.

Issue 2-2: Are the proposed rule revisions confusing and difficult to understand?

Public Comments and Concerns

A couple of organizations and individuals found the current MTCA rule and the proposed revisions to be confusing and difficult to understand. One individual recommended that Ecology extend the comment period to allow more informed review of the proposed changes. For example:

> *I think you should both give more exact information on the existing standards and also extend your comment period deadline, so average citizens can assess the value of such changes. By the way, I clicked on your links to the text of the documents, and it just gets much too complicated to dig out the information on my own.* ***(Glen Riley, p. 1.)***

> *…Ecology must more clearly inform the public regarding the fundamental change this rule would make regarding the cleanup levels for these mixtures to allow meaningful public review and comment.* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p.3 of attached comments.)***

> *In essence, the issue here is how to accurately calculate partitioning between different media to obtain steady-state concentrations. The primary factor is what model to use in this calculation. Unfortunately, the period allotted for this commenting activity precludes examination of this issue in any detail. However, regardless of what model is used it is universally true that chemical-specific information (e.g., chemical-specific pKows) should be used in these calculations when they are available.* ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 7.)***

Ecology's Response to Public Comment

Ecology believes that members of the public have had time and opportunity to review and provide comments on the proposed amendments. Because of the highly technical nature of this rule-making, Ecology provided a 51-day comment period (April 4, 2007 through May 25, 2007). This is almost twice as long as the 30 day public comment periods provided for many rules. It is also important to note that Ecology distributed a preliminary version of the proposed revisions in July 2006.

Ecology also took several steps to facilitate public review and comment. A background document provided explanations, information, and discussed the issues. Ecology also prepared a preliminary cost benefit analysis which includes an analysis of the potential compliance costs and benefits of the proposed rule. Ecology distributed both documents with the proposed rule. Both documents highlighted the changes in cleanup levels for dioxin/furan mixtures and carcinogenic PAHs as a result of the proposed rule amendments. Both of these documents were made available to the public through Ecology's web site and at the public meetings. Ecology also discussed these issues at public workshops held prior to the three public hearings.

Ecology will continue to work with members of the public to improve the ways Ecology provides this technical information to the broad range of groups and individuals who are interested in hazardous substances.

Issue 2-3: Are the proposed rule revisions consistent with current scientific information on the health risks posed by dioxins/furans, PAHs, & PCBs?

Ecology's Proposal

Ecology established five main objectives when it decided to move forward with this rulemaking. One of those objectives was that the rule revisions should be consistent with current scientific information. To meet that objective, Ecology reviewed a wide range of scientific studies and evaluations performed by expert scientific committees. Ecology discussed these studies and evaluations with representatives from the EPA and WA State Department of Health. Ecology also asked the MTCA Science Advisory Board (SAB) to review a series of scientific issues related to the proposed rule revisions. The MTCA SAB is created under 70.105D.030(4) to provide Ecology with scientific advice on cleanup standards. It is made up of five highly qualified academics and practitioners with a wide range of educational backgrounds and experience. Ecology considered the results of these other agencies' and the Board's review when preparing the proposed rule amendments.

Public Comments and Concerns

Several organizations and individuals expressed the opinion that the proposed rule revisions are consistent with current scientific information. For example:

> *In general, these rule revisions are well-founded in science and will benefit the public and wildlife in Washington State. I would like to especially note the proposals to use Toxicity Equivalency Factors for PAH mixtures….* ***(Wendy Steffensen, North Sound Baykeeper, p.1.)***
>
> *We appreciate that Ecology is using the most current scientific information to set cleanup standards. Lesser standards will not protect human health and the environment but protect the industry and insurers that bear the cleanup responsibility for these toxic chemicals.* ***(Heather Trim, p. 2.)***

However, several organizations expressed the opinion that the proposed changes are inconsistent with current scientific knowledge. For example:

> *[T]here is no scientific basis for the CLARC guidance that mandates this differential treatment for these three particular mixtures. Ecology has not provided any rationale for turning that unfounded guidance into a MTCA regulation.* ***(Dana B. Dolloff, Rayonier, p. 2 of attached comments.)***
>
> *… Ecology's rationale and basis for the proposed rule and cost-benefit analyses is inconsistent with current scientific evidence and opinions of nationally recognized, credible scientists throughout the world including the World Heath Organization (WHO), Agency for Toxic Substances and Disease Registry (ATSDR) and National Research Counsel (NRC)….****(Dana B. Dolloff, Rayonier, p. 2.)***
>
> *… regulating some individual chemicals differently- as this proposed rule would do with respect to dioxins/furans, PAHs and PCBs – from others that pose the same risk is mere fiat and not*

scientifically justified, undermines the foundations of MTCA as a science-based law and lacks a scientific, regulatory or rational basis. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 5.)***

Ecology's Response to Public Comment

Ecology has reviewed the public comments on this issue. Ecology's experience with other regulations indicates that many disagreements that are framed in terms of the scientific-basis for decisions are actually disagreements on the methods and policies for dealing with scientific uncertainty and variability (e.g., the degree of precaution). For more discussion of this topic see Section 2.2 (the Role of Scientific Information in Regulatory Decision-Making) and Issues 2-5 (Do the proposed rule revisions result in cleanup levels that are overly conservative?) and 3-5 (Should Ecology revise the default assumptions in the MTCA rule to take into account the relative bioavailability of soil-bound dioxins and furans?)

Ecology believes that most of the concerns expressed are primarily related to disagreements on policy issues – not questions about the underlying scientific information. Even if that is not the case, Ecology continues to believe that the proposed rule revisions are consistent with current scientific information. Specifically:

- The WHO-2005 TEF values for dioxin and furans are based on current scientific information. The WHO-2005 TEF values reflect the current scientific consensus on the relative toxicity of dioxin-like compounds. These values were developed after a rigorous scientific review performed by international experts. These values are consistent with earlier scientific reviews by the EPA Risk Assessment Forum (EPA, 2000), EPA's Science Advisory Board (EPA, 2001) and the National Research Council (NAS, 2003; NAS, 2006). The NAS panel (2006) specifically recommended that EPA consider the results of the WHO/International Programme on Chemical Safety review when revising the dioxin reassessment report. In addition, the MTCA SAB recently concluded:

  > *The Board stated that the 2005 TEF values for dioxin and furans recommended by WHO are consistent with current scientific information. As noted above, the Board stated that it was fortuitous that WHO had recently completed a review and evaluation of available scientific information which resulted in updated TEF values for dioxins and furans. (MTCA Science Advisory Board, 2007.)*

- The 2005 Cal-EPA TEF values are consistent with current scientific information. PAHs are a well defined group of chemicals consisting of three or more fused aromatic rings. PAHs are ubiquitous multi-media contaminants commonly found as complex environmental mixtures. The carcinogenicity of PAHs is due to the generation of biologically active metabolites which covalently bind to DNA and is considered a common mode of action for all carcinogenic PAHs (EPA, 1993; Naz, 1999). When preparing the 2001 rule amendments, Ecology concluded that Cal-EPA (1994) values had broader applicability than the EPA (1993) values[5]. The MTCA SAB

[5] EPA's TEFs are all based on dermal studies which is good for internal relative ranking but may not be good for applying to ingestion or inhalation exposures. In fact, EPA explicitly cautions against applying their TEFs to inhalation exposures. Instead, EPA proposes that their TEFs be applied only to ingestion exposure and is silent on the issue of dermal exposure (which is surprising, since their TEFs are based on mouse skin painting). In contrast, Cal-EPA TEFs are based on a variety of exposure routes, including a drinking water study for dibenzo(a,h)anthracene (Snell and Stewart, 1962), an intrapulmonary study for benzo(k)fluoranthene (Deutsch-Wenzel et al, 1983), and a skin painting study for chrysene (Wynder and Hoffman, 1959). In general, Cal-EPA TEFs were based on tumor data from relevant exposure routes (i.e., intrapulmonary and intratracheal administration, since

reviewed and endorsed Ecology's use of the original Cal-EPA values during the 2001 rulemaking process. Cal-EPA (2005) considered the most recent scientific information evaluating individual tumorigenic responses for 25 carcinogenic PAHs when updating the 1994 values. After reviewing Ecology's current rule proposal, the MTCA SAB concluded:

> *The Board stated that the 2005 PEF values for carcinogenic PAHs recommended by the California Environmental Protection Agency are consistent with current scientific information. As with dioxins and furans, the Board stated that it was fortuitous that the California EPA had recently completed a review and evaluation of available scientific information and published updated PEF values for carcinogenic PAHs. The Board noted that Cal-EPA considered a wide range of studies when establishing PEF values. The Board also observed that the California document describing the methodology provides information that is useful for Ecology as it proceeds with the MTCA rule update. (MTCA Science Advisory Board, 2007.)*

- The WHO 2005 TEF values for dioxin-like PCB congeners are consistent with current scientific information. The WHO-98 TEF values are based on a rigorous scientific review and professional consensus. More recent scientific reviews conducted by the EPA Risk Assessment Forum (EPA, 2000), EPA's Science Advisory Board (EPA, 1995; EPA, 2001), WHO (Van den Berg et. al., 1998) and the National Research Council (NRC) (NAS, 2003; NRC, 2001) have re-affirmed the scientific basis for these values. In addition, the MTCA SAB recently concluded:

  > *The Board stated that the 2005 TEF values for dioxin-like PCBs recommended by the WHO are consistent with current scientific information. (MTCA Science Advisory Board, 2007.)*

- Ecology's approach for characterizing the bioavailability of soil-bound dioxins and furans is consistent with the range of scientific studies and expert committee reviews. The National Academy of Sciences, WHO and the EPA have each concluded that soil-bound dioxins and furans are generally less bioavailable than dioxins and furans in food and water. WHO (Van den Berg et al., 2006) has also stated that the reduced bioavailability needs to be taken into account when applying TEF values to abiotic media such as soils. The MTCA SAB has also said that it is reasonable to conclude that soil-bound dioxins and furans are less bioavailable that dioxins and furans in foods and drinking water. Ecology compiled and reviewed studies performed to evaluate the bioavailability of soil-bound dioxins and furans. The vast majority of studies have evaluated the bioavailability of 2,3,7,8 TCDD. There is high degree of variability in study results that reflect differences in study designs, soil types and evaluation endpoints. The MTCA SAB concluded that a 50% absorption value for soil-bound dioxin and furans is consistent with current scientific information. However, the Board also noted that this value should not be interpreted to be an upper bound value and absorption fractions for sensitive population groups or individuals would likely be higher.

- Ecology's proposed approach for evaluating the cross-media transfer of dioxin-like congeners and PAHs is consistent with current scientific information. Ecology proposed to amend WAC 173-340-708(8) to require cleanup proponents to consider the physical-chemical properties of individual congeners and PAH compounds when evaluating cross-media impacts. This is

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Cal-EPA TEFs were targeted at air contaminants), tumor data from other exposure routes, genotoxicity data, and structure-activity relationships (SARs), in that order. Because Cal-EPA TEFs were based on a broader array of carcinogenic endpoints, these appear to have more general applicability (e.g., for route to route extrapolation) than EPA's approach based on a single endpoint. (Ecology SAB Briefing Memorandum, 1998)

consistent with the conclusions and recommendations of several expert scientific committees. For example, NAS has reviewed the application of the TEF methodology to dioxin/furan mixtures and concluded "…[a]lthough the TEF system is useful for determining toxicity in mixtures of DLC congeners, it cannot be used to simplify environmental fate and transport analyses of DLCs because individual congeners differ in their physical and chemical properties, an important consideration in fate modeling…." (NAS, 2003, p. 20.) The NRC (2001) reached similar conclusions in its review of PCB contamination.

Issue 2-4: Do the proposed rule revisions foreclose the ability to consider new scientific information?

Ecology's Proposal

Ecology proposed to amend the rule to require people to use the most current TEF values when establishing cleanup levels for mixtures of dioxins and furans, PAHs and PCBs. These include (1) TEFs for dioxins/furans and PCBs recommended by WHO (Van den Berg, et al. 2006) and (2) the updated potency equivalency factors (PEFs) for carcinogenic PAHs adopted by the Cal-EPA (California EPA, 2005).

The MTCA rule includes a series of equations that are used to establish cleanup levels. Each equation includes several parameters such as soil ingestion rate, fish consumption rate, etc. The rule provides limited flexibility to modify these parameters on a site-specific basis. Ecology proposed to modify the gastrointestinal (GI) absorption fraction specified in WAC 173-340-740 and -745 used to establish soil cleanup levels for dioxin and furan mixtures. Specifically, Ecology proposed to change the default value from 1.0 (100%) to 0.6 (60%). Ecology did not propose to make any other changes to the equations used to calculate cleanup levels.

Public Comments and Concerns

Several organizations expressed the opinion that the proposed rule amendments would prevent Ecology from considering new scientific information in the future. These organizations stated that this is particularly problematic because the scientific information relevant to many of the rulemaking issues is evolving very rapidly. For example:

> *The proposed rule changes undermine the MTCA statutory and regulatory objective of basing cleanup decisions on good science. The scientific methodologies these amendments would codify are evolving. Codifying specific science requirements as opposed to requiring appropriate currently acceptable science is bad regulation.* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, pp. 4-5.)***

> *Soil ingestion is in its own unique category and evolving science indicates that soil ingestion rates and gastro-intestinal absorption factors are likely overestimated in this proposal. This provision could lead to precluding better science from being considered. Soil ingestion rates are likely to vary by local and circumstances, for example, actual activities on-site and weather influence opportunities to be exposed to soil. Recommendation: Delete soil ingestion as a factor in WAC 173-340-708(10)(b).* ***(Grant Nelson, Association of Washington Business, p. 2-3.)***

Ecology's Response to Public Comment

Ecology acknowledges that the current rule language limits the ability to make changes to certain assumptions in the risk equations. This was a result of an intensive negotiated rule-making process that occurred in 1991. This was further reviewed in a process mandated by the state legislature that occurred in the mid-1990's, culminating in the 2001 rule revisions. The intent behind these limitations is to move cleanups forward quicker by limiting the ability to re-debate on a site-specific basis the policy choices made during the rule-making process. This includes the amount of soil ingestion assumed when calculating safe levels of contaminants in soil, since it is not possible to measure this value on a site specific basis at most sites or control factors such as weather that might change exposure. Adjustments to the soil ingestion rate are allowed when assessing the protectiveness of a remedy that uses engineering or institutional controls to limit exposure. (Ecology, 1991, 1996, 2001b.)

During the MTCA Policy Advisory Committee (PAC) discussion of these provisions limiting changes, it was recognized that the science continues to evolve and that the rule should provide a mechanism for considering new scientific information as it becomes available. WAC 173-340-702 of the existing rule was adopted in 2001 to allow the introduction of new scientific information if the burden of proof, quality of information criteria, and the public review process are met. The proposed rule revisions do change the ability to introduce new scientific information on a site-specific basis, should such changes be warranted.

Issue 2-5: Do the proposed rule revisions result in cleanup levels that are overly conservative?

Ecology's Proposal

Ecology proposed to revise the MTCA to require that Method B cleanup levels for three types of chemical mixtures must be based on a cancer risk of 10^{-6}. Under the proposed revisions, cleanup proponents would calculate environmental concentrations corresponding to this cancer risk by using the risk equations published in the MTCA rule. The revisions result in Method B soil cleanup levels that are 2-3 times lower than the cleanup levels established under the current MTCA rule.

Public Comments and Concerns

Several organizations and individuals expressed the opinion that a high degree of precaution or conservatism was needed when establishing requirements for dioxin/furan mixtures. For example:

> *As a result of scientific research over more than a decade, there is no doubt that dioxin and dioxin-like compounds act via a common mechanism of action. Now, clear guidance is required by the regulatory agencies to insure that risks from these highly toxic compounds are handled appropriately and with the conservatism necessary to protect human health. Where data are uncertain, the agencies need to be precautionary in their approach. However, there is a great deal of information regarding dioxin toxicity. The incredibly toxic nature of dioxins was recently reaffirmed by the National Academy of Sciences, which also endorsed the TEF methodology. This method is based on the fact that all dioxin congeners exert their toxicity through the same pathway and their effects are cumulative. The Department of Ecology is making the right decision in requiring the use of TEF methodology during the cleanup of contaminated sites in Washington.* ***(Peter L. deFur and Kyle T. Newman, p. 1.)***

> *…To protect human health and the environment on which human life depends, Ecology must adopt a "Precautionary Principle" approach….* ***(Darlene Schanfald, Olympic Environmental Council, p. 3.)***

Given the effort the State of Washington is placing on restoring Puget Sound and the information available in the Department of Ecology brochure "Reducing Toxic Threats" it seems incredulous to me that DOE would consider anything less that the MAXIMUM level of dioxin cleanup at polluted sites. Two statements in the Reducing Toxic Threats brochure point to why the maximum cleanup standards are required: "Children are exposed to toxins in ways that adults aren't" and "For all we know about toxic substances, there is a lot we don't know." Given what we do know about the toxicity of dioxin to humans, the last quote should send chills up and down the spine of everyone. ***(Robert Vreeland, p. 1.)***

Given the ever-rising cancer rates (among even younger people!) and the staggering increase in chronic illness, including chemical sensitivity, we should err on the side of human health. ***(Elaine Willey, p. 1.)***

I just want to come out and support the 11 parts per trillion. It seems like if you sit back over the last 30 or 40 years and look at standards we've set for most chemicals …the standards are becoming more stringent because we're learning more and we're learning that it kills people at lower levels than we thought it did. So if we're to err at all in this we certainly have to err on the more conservative. So I would like to support that 11 parts per trillion. ***(Bob Lynnette, Testimony at May 14, 2007 Public Hearing.)***

According to the EPA not only does there appear to be no safe level of exposure to dioxins but levels of dioxin and dioxin-like chemicals have been found in the general U.S. population that are at or near levels associated with adverse health effects…. So in conclusion, in the interest of human health, the Lands Council strongly urges Ecology to employ the precautionary principle and use the most nationally accepted dioxin soil cleanup levels of 6.67 parts per trillion at non-industrial sites and 875 parts per trillion at industrial sites. ***(Kat Hall, Lands Council, Testimony at May 17, 2007 Public Hearing.)***

However, several other organizations expressed the opinion that the proposed rule was overly conservative. They identified several issues and concerns:

… Ecology's rationale and basis for the proposed rule and cost-benefit analyses is inconsistent with current scientific evidence and opinions of nationally recognized, credible scientists throughout the world including the World Heath Organization (WHO), Agency for Toxic Substances and Disease Registry (ATSDR) and National Research Counsel (NRC). For example, ATSDR evaluated the residential dioxin data set EPA developed for Port Angeles in 1997 that included results exceeding 20 ppt in soil, and concluded that "Residents, including children, may be exposed to soil contaminants while gardening or playing…. None of the contaminates detected in…soil would be expected to produce adverse health effects in potentially exposed residents." ***(Dana B. Dolloff, Rayonier, p. 2.)***

Ecology is proposing a change to the current MTCA clean-up rules for mixtures of certain substances that, at least in the case of dioxin mixtures, is more than a thousand fold more stringent than EPA clean-up levels and recommendations of the Agency for Toxic Substances and Disease Registry (ATSDR). These federal recommendations are already designed to protect to well below any observed health effects and already include an extra measure of conservatism to account for scientific uncertainty. ***(Grant Nelson, Association of Washington Business, p. 1.)***

Ecology has proposed this overly stringent rule not based on some special factors that create a distinguishing need for Washington State. Rather, Ecology has created this result by consistently adopting conservative upper bound estimates of all exposure parameters. EPA guidance cautions

against over reliance on worst-case assumptions because this can lead to overstated risk and consequently to costly and unnecessary actions. EPA recommends instead, using a combination of upper bound and central tendency (mean values). ***(Grant Nelson, Association of Washington Business, p.1-2.)***

In addition, Ecology should reconsider the selection of parameters used in deriving soil cleanup level (SCL) to incorporate some parameters that are central tendency estimates in order to avoid the extreme conservatism that results when multiple upper-bound parameters and toxicity values are multiplied together. As has been discussed previously, there is already a very high level of conservatism inherent in the selection of the upper bound CSF for PCDD/Fs based on a linear dose response model. This, in combination with an overestimated upper-bound soil ingestion rate and the maximum possible exposure frequency, results in an SCL that is not likely to be representative of the potential risks for any individuals who may be exposed to those soils. EPA (1992b) recommends that high end risk estimates be comprised of a combination of upper bound and central tendency inputs in order to derive more reasonable estimates of potential risks. Ecology should follow this guidance in those cases where there is a reasonable body of data supporting calculation of a mean (or central tendency). ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 26 of attached technical comments.)***

WAC 173-340-708(1O)(c) states that if modification of a default value results in a modification to soil clean-up levels (SCL) that is significantly higher, then risk from other pathways will be taken into account. This is problematic for a number of reasons. This is vague as there is no method or criteria for deciding what constitutes significant. Given the large element of conservatism built into this rule, a 10-fold shift to a less stringent clean-up level might not be significant from a scientific or risk standpoint, but might create public perception issues. Ecology should develop some guidance on this and offer it for public comment. ***(Grant Nelson, Association of Washington Business, p. 3.)***

Ecology's Response to Public Comment

The comments on the proposed rule revisions reflect a wide range of opinions on the appropriate degree of conservatism or precaution built into the MTCA procedures for establishing cleanup levels. Many individuals and organizations expressed the opinion that the MTCA procedures are too conservative and significantly overstate the health risks posed by exposure to these types of mixtures. Other individuals and organizations were concerned that the MTCA procedures failed to protect highly exposed and/or highly susceptible population groups.

Ecology has reviewed the public comments and continues to believe that the rule reflects an appropriate level of conservatism for establishing cleanup standards for mixtures of dioxins and furans, PAHs, and PCBs. Ecology's mission is to protect human health and the environment from exposure to toxic waste. Achieving this mission is complicated by the limits of current scientific knowledge and the large variability in human exposure and susceptibility to hazardous substances. Given a body of evidence showing likely risks, Ecology believes it is appropriate to use conservative assumptions in interpreting data regarding carcinogens, and will risk erring on the side of protecting human health and the environment. As discussed below, this is an appropriate policy choice under MTCA and is consistent with MTCA's directive to assess and promulgate state standards that may exceed the human health protection afforded by federal standards. It's also consistent with the broad recognition that public health policy requires agencies to err on the side of caution in the face of imperfect data. In particular, conservatism is warranted when dealing with substances that can produce latent health effects. Ecology continues to believe this rule provides a reasonable level of conservatism or precaution considering the amount of scientific uncertainty and variability in exposure and susceptibility data for hazardous substances.

The following discussion expands on Ecology's rationale for the rule, and provides specific responses to comments expressing concern with this approach.

- Conservatism or precaution in the face of scientific uncertainty and variability is an appropriate public policy response under MTCA. MTCA states that "[e]ach person has a fundamental and unalienable right to a healthful environment…" To fulfill this mandate, Ecology believes it is necessary to establish methods and procedures that will result in cleanup levels that protect the whole population – including susceptible or high exposure population groups such as children, pregnant women, etc. Ecology believes that the use of conservative upper bound assumptions is consistent with this statutory directive. The use of average exposure values represents an alternate policy choice - one that may be at odds with the MTCA statutory directive. Indeed, one of the factors Ecology was directed by the MTCA Policy Advisory Committee, a statutorily mandated committee, when evaluating new information was to "…err on behalf of protection of human health and the environment." MTCA PAC, 1996. Moreover, Ecology believes that the lack of certainty or perfect evidence "…does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time..." (Hill, B.A. 1965)

  A few comments suggested that federal standards are adequate, and Ecology should simply rely on the federal standards. However, the Model Toxics Control Act directs Ecology to "…[p]ublish and periodically update minimum cleanup standards for remedial actions at least as stringent as the cleanup standards under section 121 of the federal cleanup law, 42 U.S.C. Sec. 9621, and at least as stringent as all applicable state and federal laws, including health-based standards under state and federal law." MTCA thus directs the agency to assess what level of protection to provide the public and then publish state standards that may differ (be more protective than) the federal cleanup standards. Ecology's determination here is that an added margin of safety is appropriate in calculating cleanup levels for certain mixtures of carcinogenic substances, based on all evidence reviewed.

- Conservatism or precaution in the face of scientific uncertainty and variability is consistent with how public health hazards should be regulated. Judgments on the quality of science need to take into account that most environmental laws and regulations are intended to prevent damage to environmental and human health. Precautionary concepts are embedded in many state and federal health, safety and environmental laws. In fact, the National Research Council's Committee on Environmental Epidemiology has concluded that "…public health policy requires that decisions be made despite incomplete evidence, with the aim of protecting public health in the future…" (National Research Council. 1991)

- Precaution in the face of uncertain risks is particularly important when dealing with irreversible risks with long latency periods: Some environmental risks have long latency periods. This was discussed by Weiner (2002)

  > *Moreover, some risks are especially latent: Their adverse impacts will only occur a long time (perhaps many years) after the event that set the risk in motion. For example, a highway accident typically causes fatality (if at all) within seconds or minutes after the accident; but if there are any brain tumors caused by cellphone use, it might take years after the exposure to the cellphone before the tumors become manifest. The longer the latency period between cause and effect, then the earlier (relative to the adverse outcome) measures must be taken if they are to be effective in preventing the outcome. If we wait to observe the latent outcome, it can become too late to take preventive measures. (Weiner, 2002, p. 1512)*

- The MTCA rule provides a reasonable level of conservatism or precaution in response to scientific uncertainty and variability in exposure/susceptibility to hazardous substances. Environmental agencies often need to select – from a range of values – a particular value to characterize exposure, toxicity, or risk. The selected value will always be subject to criticism because of scientific uncertainty and variability. Agencies often lump these two terms together. This is unfortunate because the nature of the errors that arise due to uncertainty are different than those that arise as a result of variability. Similarly, environmental agencies responses to uncertainty are inherently different than responses to variability.

  - Agency Response to Variability: With variability, agencies know that there is a range of actual values for the parameter in question. In these situations, agencies must simply decide which value to use to characterize the range of values.

    Cleanup levels established under the Model Toxics Control Act are based on estimates of the reasonable maximum exposure (RME). The RME is intended to correspond to roughly the 95th percentile of the range of potential exposure levels. Consequently, the RME is a summary measure selected to represent the upper end of the potential exposure range. In this case, choosing to characterize a variable quantity (exposure) by an estimate of the 95th percentile reflects the explicit (or implicit) choice that an error of underestimation (the five percent chance the actual value exceeds the summary estimator) is nineteen times as bad as an error of overestimation.[6]

    Ecology evaluated the variability in exposure estimates by performing a screening level Monte Carlo analysis using the Crystal Ball software tool. Crystal Ball is a commercially available risk analysis simulation and optimization package. Using this tool, Ecology replaced point estimates for several input parameters (e.g., soil ingestion rate) with probability distributions for those values. The analysis indicates that the point estimate developed using a GI absorption fraction of 0.6 falls at the upper end of the simulated exposure distribution when used in combination with other MTCA exposure parameters. Specifically, the average daily dose estimate (point estimate = 0.1 pg/kg/day) calculated using the MTCA exposure parameters and an AB1 value of 0.6 generally falls in between the 90th and 95th percentile values of the simulated exposure distributions.

  - Agency Response to Uncertainty. It's useful to distinguish between different types of uncertainty. Some uncertainty, for example, results from having insufficient data. Uncertainty also results from gaps in the scientific understanding of a particular problem.

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[6] Finkel (1989) noted that "...all summary estimators of an uncertain quantity are value laden. Summary measures are little more than ways to interpret facts in light of a subjective calculus of the costs of error..." (pp. 436-437). He described several other common statistical measures which he observed would strike a different balance between overestimating and underestimating a particular value:

- **Statistical mode** (most frequently measured value) which embodies the value judgment that one should minimize the probability of error, without regard to it's type (over- or under-estimation) or it's magnitude;
- **Statistical median** (the 50th percentile value) which embodies the value judgment that the costs of the two types of errors are exactly equivalent (as the probability of each error is fifty percent when the median is chosen).
- **Statistical mean** (the average of measured values) which embodies the value judgment that larger errors are more important than smaller errors independent of the direction of the error. When dealing with highly skewed distributions, the mean of the distribution will often (but not always) fall at the upper-end of the distribution and (in some cases) may approach the 95th percentile value or higher.

Uncertainties associated with insufficient data can sometimes be resolved with additional research or collecting more samples. Biological systems are enormously complex, however, and uncertainty associated with gaps in scientific knowledge may require years – or even decades – of research to obtain additional understanding.

Some gaps in scientific knowledge are created by lack of knowledge needed to validate a scientific theory; for example what are the appropriate assumptions for deriving toxicity or risk estimates, and which models most correctly evaluate the toxicity and risks of different chemicals. Many toxicity values used under MTCA for establishing cleanup levels explicitly acknowledge varying degrees of uncertainty. For example, the EPA uses an uncertainty factor approach to derive toxicity values. Also, the EPA IRIS database, when deriving cancer Slope Factors, describes both the technical quality of the data and extent of the information. Under MTCA, Ecology explicitly recognizes the IRIS database to obtain toxicity values to establish cleanup levels. Hence, Ecology recognizes and considers the uncertainties associated with this information when establishing cleanup levels under MTCA.

Furthermore, an important objective of the rule amendments is to increase the efficiency of site cleanup by clarifying the policies and procedures applied to the TEF methodology. The proposed rule amendments will reduce the amount of ambiguity in the current rule which serves to heighten uncertainty rather than predictability to cleanup sites in Washington State.

Ecology disagrees that the rule revisions result in cleanup levels that are overly conservative. Judge Skelly Wright of the D.C. Circuit Court of Appeals wrote "…[w]here a statute is precautionary in nature, the evidence is difficult to come by, uncertain, or conflicting because it is on the frontiers of scientific knowledge, the regulations designed to protect public health, and the decision that of an expert administrator, we will not demand vigorous step-by-step proof of cause and effect. Such proof may be impossible to obtain if the precautionary purpose of the statute is to be served…."

- Precaution in the face of uncertain risks is generally supported by the public. With respect to environmental problems, the public generally expresses the opinion that it is "better to be safe than sorry". For example, the Harvard Center for Risk Analysis surveyed public attitudes toward risk assessment and regulatory agencies' use of such assessments. People were asked whether they agree with the statement "When scientists are unsure about how harmful pollution is, environmental regulations should be designed to err on the side of safety, even if that makes regulations more expensive". Over three-quarters of those surveyed indicated they strongly agreed (20%) or agreed (56%) with the statement. (Graham, J.D. and S. Putnam, 2004.)

- Precaution in the face of uncertain risks has been recognized by several scientific review panels. The NRC's Committee on Environmental Epidemiology concluded that "…public health policy requires that decisions be made despite incomplete evidence, with the aim of protecting public health in the future…" (NRC, 1991.)

- Precaution in the face of uncertain risks is inherent in everyday life. In his review of the precautionary principle, Weiner (2002) made the following observations:

> *In the face of uncertainty about a risk, we often take precautionary measures, such as posting warning labels, driving safely, cooking foods to kill microbes, and saving money for future needs. Yet we never know for sure if these precautionary measures are effective (since, if they are successful, they result in the absence of an adverse outcome that might not have occurred anyway), nor do we know whether they are directed at the most important risks. At the same time, we rarely forego beneficial*

activities entirely just because they might be risky; we do not forego eating for fear of choking (but we do chew more carefully), no do we forego crossing the street even though there is an uncertain probability of death (but we do use crosswalks and look both ways). We choose prudent precautions that are proportionate to the expected risk, the cost of sacrifice, and the availability of alternatives. (Weiner, 2002, p. 1513.)

- Protection of Highly Exposed or Highly Susceptible Population Groups. The Model Toxics Control Act states that "[e]ach person has a fundamental and unalienable right to a healthful environment…" To fulfill this mandate, Ecology believes it is necessary to establish methods and procedures that will result in cleanup levels that protect the whole population – especially children. Ecology believes that the use of conservative upper bound assumptions is consistent with this statutory directive.

Issue 2-6: Why isn't Ecology applying a similar approach to other types of chemical mixtures?

Summary of Proposed Rule

Ecology proposed to revise and update the policies and procedures for establishing cleanup levels for three types of chemical mixtures (dioxins/furans, PAHs, and PCBs).

Ecology did not propose to revise the policies and procedures for other hazardous substances.

Public Comments and Concerns

Several organizations questioned why Ecology was proposing to regulate dioxin/furan, PAH, and PCB mixtures differently than other types of mixtures. For example:

The risk level change is not being proposed for all persistent, bioaccumulative toxins, nor for all commonly occurring carcinogenic contaminant mixtures. Nor is the change being proposed for all carcinogenic compounds. Rather the change is being proposed only for specific groups of compounds. This specificity exposes the agency to the arguments that the change is arbitrary unless there is a compelling scientific rationale for the specific change. Of the arguments presented in favor of the rule change, none are compelling when the question is asked "Why these mixtures and not other carcinogenic compound mixtures?" While it is true that the PAH compounds are commonly found together, and that they use a common mechanism of toxicity, it is not at all clear that these conditions require the proposed rule change. The common mechanism of toxicity means that the science of interactions between the chemicals is in fact better understood than for other contaminant mixtures. The potential for synergistic effects is therefore reduced and certainty of estimation improved. Likewise, the arguments for additional margins of safety are applicable to all contaminant mixtures and most carcinogens, and are not specific to PAH compounds. Arguments in favor of simplicity are appropriate, but only if the economic impact is insignificant, which is not the case here…. In contrast to the PAH mixtures, mixtures of other carcinogenic compounds will retain the prior MTCA-required risk-levels of 1 x 10-6 for individual compounds. For example, a mixture of seven chlorinated solvents that are carcinogenic would be allocated 1 x 10-6 risk levels for each solvent compound, provided that total site risks do not exceed 1 x 10-5. These compounds would be treated differently than a mixture of seven carcinogenic PAH under the proposed rule, because those PAH compounds would be collectively regulated as a mixture at the risk level of 1 x 10-6. The application of TEFs is appropriate, but the application of the individual compound risk-level to the mixture represents

an unsupported change in the MTCA regulations. ***(Mark Larsen, Anchor Environmental, p. 2, 1-2.)***

Ecology has provided no support for mandating a 1 x 10-6 cleanup level for these three types of mixtures while continuing to allow all other hazardous substance groups to be subject to a maximum cleanup level of 1 x 10-5. As a hypothetical to illustrate the effect of this proposed differential standard, consider a site that has a combination of the following pesticides: chlordane, DDE, DDT, DDD, dieldrin, lindane, heptachlor and heptachlorepoxide. All of these chemicals are carcinogens; many are from the same chemical class. However, Ecology's proposed rule would not change the current MTCA requirements for these substances…While there has been some discussion regarding the presumed common mode of biological action for that each compound in a dioxin/furan mixture, this does not adequately explain the need for a lower acceptable target risk level for mixtures of these substances. DDT, DDE, and DDD all have the same mode of action as well, as do other classes of related hazardous substances. However, Ecology is not proposing more stringent cleanup levels for these chemicals. In addition, regardless of the mode of action, EPA (1989) and Ecology (2001) assume that carcinogenic effects are additive and all carcinogens are summed together in risk assessments. Thus, even if these compounds had a common mode of action this does not justify assessing a site's total cancer risk differently under EPA methodology or under MTCA. The mode of action argument cannot justify why Ecology has arbitrarily established a lower target risk level for some carcinogens as opposed to others. ***(Dana B. Dolloff, Rayonier, p. 24-25 of attached comments.)***

The Background Document contains a disproportionate amount of discussion regarding the TEF approach that obscures the far more significant proposal made in this rulemaking: classification of mixtures of dioxins/furans, PAHs and PCBs as single hazardous substances that would be regulated differently and more stringently than other types of mixtures. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 3 of attached comments.)***

The Background Document (Ecology 2007b) explains that mixtures of dioxins/furans and CPAHs are different from other mixtures found at MTCA sites because they generally occur together and are believed to act through a common toxicological mechanism. The existing requirement to assign a cancer risk limit of 1 x 10-6 to individual carcinogens, regardless of type or chemical class, makes no provisions for co-occurrence, mechanism of action, or any other such factor (WAC 173-340-705(2)(c)(ii)). Ecology's proposed revisions would suggest that, in the future, if individual carcinogens are found to act through a common mechanism, Ecology's intent would be to treat them as a single hazardous substance when they occur together. If this is the case, then the rule revision should clearly state that, and be re-submitted for public review. ***(Jennie Goldberg, City of Seattle, p. 1.)***

In response to Ecology's request for comments on this issue, AWB offers that it makes no scientific sense to set one risk level for one set of chemicals and a different risk for another set What is important is overall risk. The current rule requires that the overall incremental risk associated with chemical contamination not exceed one-in-one-hundred thousand. If this threshold is not exceed by the sum of the collective risks associated with the different chemicals present, then it is not necessary to single out one or two particular types of chemical for a different threshold. ***(Grant Nelson, Association of Washington Business, p. 4.)***

Ecology's Response to Public Comment

Ecology recognizes there are other chemical groups where individual chemicals within the group appear to act through a common mode of action. However, Ecology disagrees with those who argued the agency should not establish policies for dioxins/furans, PAHs, and PCBs without first establishing similar policies for other types of chemical mixtures sharing similar chemical and toxicological characteristics.

Agencies are always faced with multiple demands on time and resources. In deciding how to respond to the rulemaking petition in May 2006, Ecology carefully considered the scope of the request, the number of sites potentially affected by the rulemaking, available staff resources and competing priorities for agency staff. When initiating the rulemaking process, Ecology consciously chose to limit the rulemaking to the three chemical mixtures identified in the May 2006 CR-101:

> ***Subject of possible rule making:*** *Ecology is initiating rulemaking to amend the Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 WAC). The purpose of the rulemaking is to clarify the policies and procedures for establishing cleanup levels for mixtures of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (dioxins/furans), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).*

Ecology continues to believe it appropriate to focus on the three mixtures identified in the rulemaking petition. These mixtures are frequently encountered at Washington sites at levels posing a threat to human health and the environment.

Ecology believes this choice is consistent with incremental approaches used by agencies to address other types of public policy issues. Indeed, the United States Supreme Court recently addressed this issue in a case on global climate change (Massachusetts v. Environmental Protection Agency):

> *…Agencies, like legislatures, do not generally solve massive problems in one fell regulatory swoop. See Williamson v. Lee Optical of Okla., Inc., 348 U.S. 483, 489 (1955) ("[A] reform may take one step at a time, addressing itself to the phase of the problem which seems most acute to the legislative mind"). They instead whittle away at them over time, refining their preferred approach as circumstances change and as they develop a more nuanced understanding of how best to proceed. Cf. SEC v. Chenery Corp., 332 U.S. 194, 202 (1947) ("Some principles must await their own development, while others must be adjusted to meet particular, unforeseeable situations").*

Ecology recognizes that there are other chemical groups where individual chemicals within the group appear to act through a common mode of action. Van den Berg et al. (2006) reviewed the scientific basis for expanding the TEF approach to other types of chemicals and reached the following conclusions:

> *Several groups of compounds were identified for possible future inclusion in the TEF/TEQ concept. Based on mechanistic considerations, PCB 37, PBDDs, PBDFs, PXCDDs, PXCDFs, PCNs, PBNs and PBBs undoubtedly belong in the TEF concept. However, for most, if not all, of these compounds there is a distinct lack of human exposure data. Therefore, preliminary exposure assessments should be done for humans with respect to TEQ dietary intake. In addition, HCB could be a possible candidate for inclusion in the TEF/TEQ concept but only if it is unequivocally shown that impurities have not been the cause of earlier dioxin-like effects observed in experimental models. With respect to PBDEs, it was concluded that there is no reason for their inclusion in the TEF/TEQ concept. (Van den Berg, et al. 2006, p. 237.)*

Ecology also discussed this issue with the MTCA SAB. Specifically, Ecology asked the Board "Is there sufficient scientific information currently available to establish toxic equivalency factors for other groups of hazardous substances?" The Board provided the following response:

SAB's Response: As noted above, the Board noted that other chemical groups may share a common mechanism of action or mode of action. However, the Board concluded that (with one possible exception) available scientific information does not support using a TEF approach for other chemical groups at this time. This is consistent with the conclusions reached by Van den Berg et al. (2006). The one exception may be organophosphate pesticides. However, the Board noted that this is not a major issue when establishing cleanup levels based on non-cancer effects. Specifically, the MTCA rule states that cleanup levels for individual substances (based on a hazard quotient of 1) must be adjusted downward to take into account concurrent exposures to multiple substances that act upon the same organ.

Ecology may consider applying the policies for dioxins, PAHs and PCBs to other types of chemical mixtures during future rulemakings. However, Ecology believes that decisions on whether to apply such policies to other mixtures must take into account several factors. These include: (1) the scientific information on common mode of action, (2) the scientific basis for TEF values, (3) the frequency that such mixtures are found at MTCA cleanup sites, (4) whether the components of each mixture are generally found together at MTCA cleanup sites, (5) the MTCA decision-making framework, and (6) approaches used by other environmental agencies and programs.

Issue 2-7: Are the proposed rule revisions consistent with other state and federal laws and regulations?

Ecology's Proposal

The Washington APA directs agencies to "…[c]oordinate the rule, to the maximum extent practicable, with other federal, state, and local laws applicable to the same activities or subject matter…"[7] When preparing the proposed amendments, Ecology reviewed other laws and regulations to insure the proposed revisions met this requirement.

Public Comments and Concerns

Several individuals and organizations questioned whether Ecology had adequately coordinated the proposed rule revisions with EPA regulations and other state regulations. For example:

This statutory criterion requires Ecology to coordinate the rule to the maximum extent practicable with other federal, state or local laws. It does not appear the rule docket includes information to support an evaluation and determination against this statutory criterion.…[W]e suggest Ecology has explicitly not attempted to coordinate the rule with EPA regulation and guidance, vis-à-vis soil cleanup determinations for chlorinated dioxin/furan and PAHs. ***(Ken Johnson, Weyerhaeuser, p. 10.)***

Several individuals and organizations also questioned whether the proposed revisions were consistent with laws and regulations developed by other environmental agencies. For example:

The Background Document (Ecology 2007b) states that other regulatory policies inside and outside the State of Washington usually consider mixtures of dioxins/furans, PCBs, and CPAHs as single hazardous substances (although it recognizes that there is regulatory variability on this issue for CPAHs). Unlike MTCA, however, none of the regulations listed in the Background

[7] RCW 34.05.328(1)(i).

Document identifies two separate cancer risk limits, a limit for individual carcinogens and a total limit for all carcinogens present at a site. MTCA's requirement to consider carcinogens individually imposes an additional degree of complexity not present in other regulations. Furthermore, some of the regulations listed allow cancer risk limits higher than the MTCA total limit of 1 x 10-5. The Background Document should recognize these important differences when considering consistency with other regulations. ***(Jennie Goldberg, City of Seattle, p. 1.)***

Ecology's Response to Public Comment

RCW 70.105D.030(2)(e) requires Ecology to publish "…cleanup standards for remedial actions at least as stringent as the cleanup standards under section 121 of the federal cleanup law, 42 U.S.C. Sec. 9621, and at least as stringent as all applicable state and federal laws, including health-based standards under state and federal law…." Consequently, Ecology routinely coordinates and integrates requirements under other state and federal laws and regulations with MTCA cleanup standards for individual sites.

During the current rulemaking process, Ecology met with EPA Region 10 staff and other offices to discuss EPA's approach for calculating the cancer risk posed by these chemical mixtures. Ecology reviewed method used by other states. (See Ecology responses to Issues 3-3 and 4-3 regarding target risk levels used by other states for establishing cleanup levels.) Ecology also reviewed other applicable laws and regulations to determine how to coordinate those requirements with the proposed MTCA rule revisions. Based on these reviews, Ecology reached the following conclusions:

- Coordination with federal laws applicable to the same activities or subject matter. Ecology routinely coordinates and integrates requirements under federal laws and regulations with MTCA cleanup standards for individual sites. Based on that experience, Ecology has evaluated how the rule revisions will affect the ongoing coordination with federal laws and regulations.

    - Under the revised rule, Ecology will continue to use the EPA cancer potency factors and reference doses when establishing cleanup levels. EPA uses these toxicity values to establish federal cleanup requirements.

    - Under the revised rule, Ecology will use the TEF values established by WHO for dioxin-like congeners. EPA uses these TEF values to establish federal cleanup requirements.

    - Under the revised rule, Ecology will continue to use the potency equivalency factors (PEFs) established by the California Environmental Protection Agency (2005) for PAH compounds. EPA uses relative potency factors (RPF) (EPA, 1993). Ecology has been implementing this requirement for the last six years. Coordination of the two approaches has not been a major issue at sites because the PEF and RPF values for individual PAH compounds are very similar. Consequently, the two approaches produce similar toxicity equivalency quotients for PAH mixtures.[8]

    - Under the revised rule, Ecology will continue to establish MTCA ground water and surface water cleanup standards using the requirements in applicable laws and regulations. EPA uses the same approach at federal cleanup sites.

    - Under the revised rule, Ecology will establish MTCA soil cleanup levels for dioxin, PAH, and PCB chemical mixtures using a target cancer risk level of 10^{-6}. The MTCA

[8] The EPA approach generally produces a slightly higher (more protective) TEQ value because the RPF value for dibenzo [a,h] anthracene is higher than the corresponding PEF value.

target cancer risk level falls at the more protective end of the risk range established in the National Contingency Plan[9]. EPA has also published several guidance materials identifying remediation goals and cleanup standards.

- Coordination with other state laws applicable to the same activities or subject matter. Ecology routinely integrates requirements under other state laws and regulations into cleanup standards for individual sites. Based on that experience, Ecology has evaluated how the proposed rule revisions will affect the ongoing coordination with other applicable state laws and regulations.

    - Under the revised rule, Ecology will continue to use the EPA cancer potency factors and reference doses when establishing cleanup levels. The Department of Health and other Ecology programs also use these toxicity values when evaluating human health concerns and/or establishing regulatory requirements.

    - Under the revised rule, Ecology will use the TEF values established by WHO for dioxin-like congeners. The Department of Health and other Ecology programs also use WHO values when evaluating human health concerns and/or establishing regulatory requirements.

    - Under the revised rule, Ecology will continue to use the PEFs established by the Cal-EPA (2005) for PAH compounds. Other state programs use the EPA RPFs (EPA, 1993). Ecology has been implementing this requirement for the last six years. Coordination of the two approaches has not been a major issue at sites because the PEF and RPF values for individual PAH compounds are very similar. Consequently, the two approaches produce similar toxicity equivalency quotients for PAH mixtures[10].

    - Under the revised rule, Ecology will continue to establish MTCA ground water and surface water cleanup standards using the requirements in applicable laws and regulations.

    - Ecology's Hazardous Waste and Toxic Reduction program uses the MTCA Cleanup Regulation to establish corrective action requirements at hazardous waste management facilities. This rule amendment will not change that coordination.

    - Ecology has established sediment cleanup requirements in the Sediment Management Standards (SMS) rule. Under that rule, the cancer risk policies in MTCA are applied to sediment cleanups. Ecology has identified several other issues related to the coordination of the current MTCA rule and the SMS rule. See Issue 2-9, for a further discussion of these issues.

- Coordination with local laws applicable to the same activities or subject matter. Local agencies have adopted a wide range of general requirements that are potentially applicable to MTCA cleanup sites (building and grading requirements and permits, erosion control requirements, storm water control requirements, solid waste landfill standards, etc). However, Ecology has not

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[9] The National Contingency Plan (NCP) establishes the federal requirements for cleanup actions conducted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The regulation establishes a cancer risk range (10^{-4} to 10^{-6}) that is used to establish site specific cleanup standards.

[10] The EPA approach generally produces a slightly higher (more protective) TEQ value because the RPF value for dibenzo [a,h] anthracene is higher than the corresponding PEF value.

identified any local laws or regulations with specific requirements for mixtures of dioxins/furans, PAHs, or PCBs.

Issue 2-8: Do the proposed rule revisions identify an appropriate approach for evaluating the cross-media transfer of these types of mixtures?

Ecology's Proposal

Ecology proposed to amend WAC 173-340-708(8) to require cleanup proponents to consider the physical-chemical properties of individual dioxin/furan congeners and PAH compounds when evaluating cross-media impacts. Ecology provided the following rationale for the proposed approach:

- Technical Basis. The fate and transport of individual dioxins/furans and PAH compounds are not necessarily related to their TEFs. A wide range of other physical and chemical characteristics influence the persistence, mobility and transport of contaminants in the environment.

- Scientific Review. NAS (2003) has reviewed the application of the TEF methodology to dioxin/furan mixtures and concluded "…[a]lthough the TEF system is useful for determining toxicity in mixtures of dioxins and dioxin-like compound (DLC) congeners, it cannot be used to simplify environmental fate and transport analyses of DLCs because individual congeners differ in their physical and chemical properties, an important consideration in fate modeling…" (p. 20).

- Approaches Used By Other Agencies. EPA Region V has developed a Total Equivalency Approach that is designed to allow variations in bioaccumulation potential to be considered when establishing water quality criteria for dioxin/furan mixtures. This approach involves multiplying each TEF value for each congener by a corresponding bioconcentration equivalency factor (BEFs) to calculate a Total Equivalency for the mixture. This approach is being used by the water quality programs in New York and several other Great Lakes states. The Oregon DEQ is considering adopting a similar approach.

- Practical Considerations. Congener-specific information is available for the physical and chemical characteristics that influence the environmental fate and transport of dioxins and furans. Site-specific evaluations of fate and transport can be streamlined through the use of spreadsheet models.

Public Comments and Concerns

Several organizations offered comments supporting Ecology's proposal to consider congener-specific physical-chemical properties when evaluating cross-media transfer of these types of mixtures. For example:

> *In essence, the issue here is how to accurately calculate partitioning between different media to obtain steady-state concentrations. The primary factor is what model to use in this calculation. Unfortunately, the period allotted for this commenting activity precludes examination of this issue in any detail. However, regardless of what model is used it is universally true that chemical-specific information (e.g., chemical-specific pKows) should be used in these calculations when they are available.* ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 7.)***
>
> *The proposed rule revisions and background document circulated by Ecology equate each of the dioxin and furan congeners to an index chemical (2,3,7,8-TCDD) using Toxicity Equivalency*

Factors (TEFs). Because these factors only account for variability in toxicity, using these factors to equate a mixture of chemicals to a single chemical prior to calculating exposure results in pervasive errors in the exposure estimation because the toxicity of each of the chemicals is not an estimate of, nor proportional to, other chemical properties that directly affect exposure (e.g., lipohilicity, vapor pressure, practical vapor partition, octanol water partition coefficient, photolysis rate, water solubility). ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 2 of attached comments.)***

Ecology's Response to Public Comment

Ecology believes that the time period allotted for public review and response allowed sufficient time for interested persons to evaluate and respond to the issues raised. Ecology does acknowledge the complexities associated with partition modeling calculations, and appreciates the stated support for use of chemical-specific information when evaluating cross-media transfer of the chemical mixtures addressed in the proposed rule.

Toxicity equivalency factors (TEFs) are used to evaluate the toxicity and assess the risks of selected complex environmental mixtures. TEFs are not used as input parameters for fate and transport models intended to evaluate the fate and transport of complex environmental mixtures. The TEF methodology does facilitate site-specific assessments that account for changes in congener composition due to differential environmental partitioning and transformation (ATSDR, 1998).

Issue 2-9: How will the proposed rule revisions be applied to sediment cleanup actions conducted under the Sediment Management Standards?

Ecology's Proposal

The MTCA Cleanup Regulation, at WAC 173-340-760, states that "…[i]n addition to complying with the requirements in this chapter, sediment cleanup actions conducted under this chapter must comply with the requirements of chapter 173-204 WAC…" Consequently the general risk policies and procedures specified in WAC 173-340-708 apply to sediment cleanup actions.

Ecology did not propose to revise WAC 173-340-760.

Concurrent with the current MTCA rulemaking process, the multi-agency Dredge Material Management Program (DMMP) began a process to evaluate similar issues related to dioxin-contaminated sediments. Ecology discussed the relationship between the two projects in the Background Document distributed with the proposed MTCA rule:

> Ecology uses the general policies and procedures in the MTCA rule, specifically WAC 173-340-700 through -710, cleanup levels when establishing site-specific requirements for contaminated sediment sites. It is not clear how the proposed revisions would actually impact sediment cleanup standards and cleanup actions. However, Ecology believes that the issue of how to establish MTCA sediment cleanup standards must be addressed as part of a larger set of regulatory questions on the relationships between requirements in the Sediment Management Standards (SMS) rule and the MTCA rule. Ecology is currently working with other sediment management agencies (EPA, Corp of Engineers, Department of Natural Resources, etc.) and interested parties to review a number of issues associated with dioxin-contaminated sediments in Puget Sound. Ecology has decided to wait until that process is

completed before developing rule amendments (if any) to address sediment cleanup requirements. (Ecology, 2007, p. 17.)

Public Comments and Concerns

Several organizations expressed concerns about how the proposed rule revisions would influence and affect application of the SMS rule. For example:

> *MTCA cleanup levels apply directly to sediments when those are addressed under MTCA itself. MTCA cleanup levels also apply by reference to the broader range of sediment response actions conducted under the state sediment management standards at WAC Chapter 173-204 and to any sediment actions conducted under the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Ecology's failure to identify and evaluate the potential costs of this rule on sediment response actions is a fundamental gap. Ecology has stated that the proposed rule change is not intended to affect the cleanup of sediments contaminated with mixtures of dioxins/furans, cPAHs and PCBs and this issue instead will be addressed during the 5-year review of the Sediment Management Standards (SMS). This response is insufficient and inaccurate because Ecology cannot adequately evaluate the costs and benefits of a proposed rule "assuming" future rulemaking outcomes. More fundamentally, this proposed rule will impact sediment cleanups independent of and well before the next SMS 5-year review process. Routes of human exposure to chemicals present in soil and sediment are similar and risks from exposure to soil and sediment must be evaluated using the same acceptable cancer risk level that applies under MTCA. See WAC 173-204-580(2). Thus the MTCA cleanup levels directly impact sediment cleanups conducted both within and outside the MTCA program. Since MTCA cleanup levels apply directly to MTCA actions that include sediments, and are applied by reference to other sediment sites being addressed under the SMS sediment management standards at WAC Chapter 173-204, Ecology must take into account the potential costs of this proposed rule to all sediment cleanup actions. The evaluation of the costs likely to be associated with this proposed rule will change significantly if sediment sites are added due to the much higher unit costs for investigating and remediating them compared to the costs at upland sites…There are a significant number of sites in Washington where sediments affected by mixtures of dioxin, cPAHs, and/or PCBs are a concern and where these substances could drive remedial requirements. Of the 3,207 sites listed on Ecology's confirmed and suspected contaminated sites list as of May 8, 2007, 417 (or 13 percent) of the sites listed sediment as an affected medium. In addition, of those 417 sites, 182 sites had dioxin, cPAHs, and/or PCBs as confirmed or suspected sediment contaminants. Despite this information, the PEAA concluded that this rule would not affect any sediment site…Further, it cannot ignore sediment sites based on its claim that dioxins/furans, cPAHs and PCBs are never the cleanup drivers at these sites. Ecology has provided no support for that claim.* ***(Dana B. Dolloff, Rayonier, p. 14-15 of attached comments.)***

> *The Background Document (Ecology 2007b) states that Ecology believes the proposed rule revisions will not have significant impacts on sediment cleanups because risk-based sediment cleanup levels are often superseded by background concentrations, and the sediment cleanup screening levels under the Sediment Management Standards are comparable to Method C cleanup levels under MTCA. We feel that this assumption is inaccurate: many sediment sites are likely to be impacted by the proposed rule change. Although MTCA refers to the Sediment Management Standards for establishing sediment cleanup levels, Ecology often requires responsible parties to consider risks associated with ingestion of fish exposed to sediments, and this pathway can dominate the derivation of cleanup levels. From Ecology's discussion during the public hearing in Seattle, it seems likely that Ecology will expect mixtures of dioxins/furans, CPAHs, and PCBs to each be treated as single hazardous substances for the fish ingestion*

pathway as a result of the proposed MTCA revisions. Potential impacts to sediment sites are real and should be considered in the Cost Benefit Analysis. ***(Jennie Goldberg, City of Seattle, p. 3-4.)***

Ecology's Response to Public Comment

Sediment cleanup actions conducted under MTCA must comply with MTCA risk policies (WAC 173-340-700 through -710). Ecology implements this requirement within the Sediment Management Standards (SMS) framework for establishing sediment cleanup standards.

The sediments management standard (SMS) rule governs the identification and cleanup of contaminated sediment sites. It establishes two sets of numerical chemical criteria for evaluating surface sediment concentrations. The Sediment Quality Standard (SQS) provides a regulatory goal by identifying surface sediments that have no adverse effects on biological resources and no significant health risk to humans. The Cleanup Screening Level (CSL) represents the regulatory level that defines minor adverse effects on biological resources and no significant health risk to humans. Under the SMS rule, sites with three or more sediment stations exceeding the chemical, biological, or human health criteria corresponding to the CSL require cleanup.

Under the sediments management standard rule, the SQS is the cleanup objective. Ecology establishes site-specific sediment cleanup standards that are as close as practicable to the SQS. When establishing site-specific sediment cleanup standards, Ecology also considers net environmental effects, technical feasibility, and cost. Furthermore, when the area background level exceeds the cleanup screening level, the background concentration becomes the driver for establishing cleanup levels.

Ecology has reviewed the current SMS framework and concluded that the revised MTCA risk policies will not result in any significant changes to the sediment cleanup requirements. The rationale for this conclusion is as follows.

- The SQS is equivalent to a Method B cleanup level. The human health risk-based SQS under the sediment management standard is equivalent to the Method B cleanup level under MTCA. Under the current MTCA rule, SQS and Method B cleanup levels can be established for individual carcinogen or for each chemical compound group having the same mode of action, (dioxins/furans, cPAHs, dioxin-like PCBs, and Total PCB as the sum of Aroclors) using a target cancer risk level of one-in-one million (10^{-6}) for the individual exposure pathway. The total site risk (taking into account all hazardous substances and all exposure pathways) cannot exceed a cancer risk level of one-in-a-hundred thousand (10^{-5}).

- The revised rule will not result in changes to the criteria and procedures for identifying sediment cleanup sites. Ecology uses cleanup screening level (CSL) values to identify sediment cleanup sites. For protection of human health, the upper bound of the sediment CSL is the same upper risk level allowed under MTCA. The revised rule does not alter the requirements for human health cleanup levels because the maximum cancer risk level for each compound congener group (10^{-5}) is the same as the target cancer risk for total site risk.

The revised rule will not significantly change the criteria and procedures for establishing site specific dioxin sediment cleanup levels. Ecology believes that risk-based dioxin/furan cleanup levels will continue to be driven by site-specific factors such as background concentrations.

- Risk-based concentrations corresponding to the CSL are generally below reference area concentrations. That is, background concentrations are generally much higher than risk-based

cleanup levels established using a target cancer risk of one-in-one million (10^{-6}) (See Table 3). Consequently, Ecology believes that site-specific cleanup standards for dioxins and furans will continue to be established by background concentrations.

- The SMS rule includes a number of other factors[11] that influence site-specific determinations on sediment cleanup standards. Where site specific information regarding exposure parameters is available, these generally result in lower exposure than the Reasonable Maximum Exposure scenario. The rule revisions will not modify the SMS policies applicable to the upper limit on site-specific cleanup levels,

Table 2 shows background concentrations, (area reference concentrations), of dioxins and furans for two non-contaminated sites in Puget Sound.[12] These sites are well characterized with respect to dioxin/furan contamination and provide estimates for typical background concentrations.

Table 2. Dioxin/Furan Background Levels, ng TEQ/kg dry weight

	N	Median	Mean	Std Dev.	90th	4 x 50th
Dungeness Bay	11	0.239	0.365	0.299	0.787	0.956
Freshwater Bay	11	0.106	0.115	0.028	0.142	0.424
Combined	22	0.127	0.240	0.244	0.471	0.508

Table 3 shows the sediment cleanup screening level corresponding to a 10^{-6} cancer risk. Ecology computed CSLs assuming various fish consumption rates. In all cases, cleanup screening levels are below background levels.

Table 3 Risk-Based Sediment Cleanup Screening Levels: Dioxins/Furans

Comparing screening levels calculated for various fish consumption rates				
Option	Fish Consumption Rate (g/day) (Fish Diet Fraction)	CSL Corresponding to 10^{-6} Risk Level (ng/kg dry weight) (BSAF = 2.2)	Ratio of Background Level (0.471 ng/kg) to Risk-Based Level	Incremental Cancer Risk at 0.09 ng/kg DW
MTCA Default (Recreational Exposure)	54 (FDF = 0.5)	0.0061	77	7.7E-05
MTCA Tribal (EPA National Fish Consumption Rate)	142 (FDF = 1)	0.0005	950	9.5E-04

[11] These factors include: biota sediment accumulation factors, fish and shell consumption rates, exposure potential, net environmental protection, costs, and technical feasibility.
[12] Reference areas in Puget Sound are sites without human-caused contamination.

MTCA Tribal (Tulalip) - w/o salmon	100 (FDF = 1)	0.00083	570	5.7E-04
MTCA Tribal (Suquamish) w/o salmon	600 (FDF = 1)	0.00013	3500	3.5E-03
Oregon Department of Environmental Quality (Subsistence)	142 (FDF = 1)	0.0012	410	4.1E-04

The Revised Rule Revisions do Not Significantly Impact the Requirements for PCB-Contaminated Sediment Sites. Ecology believes the rule revisions will not significantly impact requirements for PCB-contaminated sediment sites.

- The revised rule does not modify the current requirements for establishing risk-based PCB cleanup levels under the MTCA and SMS rules. PCBs are currently regulated as a single hazardous substance when establishing Method B and C cleanup levels. Compliance with risk-based standards is evaluated using measurements of total PCBs (e.g., the sum of all Aroclors). The revised rule provides the option for using congener-specific information to establish PCB cleanup levels that is comparable to the current rule requirements.

- The revised rule will not significantly change the criteria and procedures for establishing site specific PCB sediment cleanup levels. Ecology believes that risk-based PCB cleanup levels will continue to be driven by other site-specific factors such as background concentrations.

  For PCBs, risk-based concentrations corresponding to the sediment quality standard (and sometimes the minimum cleanup level) are generally below reference area concentrations (See Table 4). For example, for the reference area, concentration of total PCBs in Puget Sound is 1.2 mg/kg organic carbon. This is much higher than the risk-based cleanup level established using a target cancer risk of one-in-one million (10^{-6}). (Tables 5 and 6) Consequently, Ecology believes that site-specific cleanup standards for PCBs will continue to be established by background concentrations.

  The rule revisions will not modify the policies applicable to sediment quality standards which are established at a target cancer risk level of one-in-one million (10^{-6}) for individual carcinogens or each chemical compound group with the same mode of action by single exposure pathway. The total site risk (taking into account all carcinogens and all exposure pathways) cannot exceed a cancer risk level of one-in-a-hundred thousand (10^{-5}).

Ecology analyzed data for both dioxin-like PCBs and total PCBs. Table 4 shows background concentrations of dioxin-like PCBs for non-contaminated sites in Puget Sound. Table 5 compares CSLs for dioxin-like PCBs at various fish consumption rates. Table 7 compares CSLs for total PCB concentration at various fish consumption rates. [13]

[13] PCB total background data is from: Developing Health-Based Sediment Quality Criteria for Cleanup Sites: A Case Study Report, Ecology 1997 (publication number 97-114)

- **Table 4. Background Levels for Dioxin-like PCBs - ng TEQ/kg dry weight**

	N	Median	Mean	Std Dev.	90th	4 x 50th
Dungeness Bay	11	0.040	0.051	0.035	0.100	0.160
Freshwater Bay	11	0.030	0.031	0.010	0.044	0.120
Combined	22	0.035	0.041	0.027	0.090	0.138

Table 5 Risk-Based Sediment Cleanup Screening Levels: Dioxin-like PCBs

Comparing dioxin-like PCB SCLs calculated at various fish consumption rates				
Option	Fish Consumption Rate (g/day) (Fish Diet Fraction)	CSL Corresponding to 10^{-6} Risk Level (ng/kg dry weight) (BSAF = 4)	Ratio of Background Level (0.09 ng/kg) to Risk-Based Level	Incremental Cancer Risk at 0.09 ng/kg DW
MTCA Default (Recreational Exposure)	54 (FDF = 0.5)	0.0034	27	2.7E-05
MTCA Tribal (EPA National Fish Consumption Rate)	142 (FDF = 1)	0.00027	330	3.3E-04
MTCA Tribal (Tulalip) - w/o salmon	100 (FDF = 1)	0.00045	200	2.0E-04
MTCA Tribal (Suquamish) w/o salmon	600 (FDF = 1)	0.000073	1200	1.2E-03
Oregon Department of Environmental Quality (Subsistence)	142 (FDF = 1)	0.00064	140	1.4E-04

Table 6 Risk-Based Sediment Cleanup Screening Levels: Total PCBs

Comparing total dioxin CSLs calculated at various fish consumption rates

Option	Fish Consumption Rate (g/day)	CSL Corresponding to 10^{-6} Risk Level, mg/kg organic carbon (BSAF = 2.6)	Ratio of Puget Sound Reference (1.2 mg/kg organic carbon) to Risk-Based Level	Incremental Cancer Risk at 1.2 mg/kg organic carbon
MTCA Default (Recreational Exposure)	54 (FDF = 0.5)	0.039	31	3.1E-05
Tribal (EPA National Fish Consumption Rate)	142 (FDF = 1)	0.0032	380	3.8E-04
Tribal (Tulalip) - w/o salmon	100 (FDF = 1)	0.0052	230	2.3E-04
Tribal (Suquamish) w/o salmon	600 (FDF = 1)	0.00084	1400	1.4E-03
Oregon Department of Environmental Quality (Subsistence)	142 (FDF = 1)	0.0074	160	1.6E-04

The revised rule will not significant change the criteria and procedures for establishing site specific cPAHs sediment cleanup levels. Ecology believes that cPAHs risk-based cleanup levels will continue to be driven by background concentrations.

Ecology considered sediment concentrations of carcinogenic PAHs. Table 7 shows background levels for a non-contaminated site in Puget Sound. Table 8 compares this sediment background level to the CSL assuming various fish consumption rates.

- Risk-based concentrations corresponding to the CSLs are below reference area concentrations. For example, the cPAHs TEQs in Holmes Harbor and Carr Inlet are shown in Tables 5 and 6. These concentrations are generally much higher than risk-based cleanup levels established using a target cancer risk of one-in-one million (10^{-6}) (See Table 6.) Consequently, Ecology believes that site-specific cleanup standards for cPAHs will continue to be established by background.

- The rule revisions will not modify the policies applicable to sediment quality standards which are established. at target cancer risk level of one-in-one million (10^{-6}) for individual carcinogen or each chemical compound group with the same mode of action by single exposure pathway. The total site risk (taking into account all carcinogens and all exposure pathways) cannot exceed a cancer risk level of one-in-a-hundred thousand (10^{-5}).

Table 7 cPAH Background Levels - ug TEQ/kg dry weight

	N	Median	Mean	Std Dev	90th	4 x 50th
Holmes Harbor & Carr Inlet	8	7.27	8.30	4.34	14.57	29.09

Table 8 Risk-Based Sediment Cleanup Screening Levels: carcinogenic PAHs

Comparing CSLs calculated at various fish consumption rates				
Option	Fish Consumption Rate (g/day) (Fish Diet Fraction)	CSL Corresponding to 10^{-6} Risk Level, ug/kg dry weight (BSAF = 0.38)	Ratio of Background Level (14.57 ug/kg dry weight) to Risk-Based Level	Incremental Cancer Risk at 14.57 ug/kg dry weight
MTCA Default (Recreational Exposure)	54 (FDF = 0.5)	0.36	40	4.0E-05
MTCA Tribal (EPA National Fish Consumption Rate)	142 (FDF = 1)	0.059	250	2.5E-04
MTCA Tribal (Tulalip) - w/o salmon	100 (FDF = 1)	0.098	150	1.5E-04
MTCA Tribal (Suquamish) w/o salmon	600 (FDF = 1)	0.016	920	9.2E-04
Oregon Department of Environmental Quality (Subsistence)	142 (FDF = 1)	0.14	110	1.1E-04

Conclusion

Ecology's analysis compared background level concentrations for dioxins/furans, PCBs, and carcinogenic PAH to sediment cleanup screening levels calculated based on a cancer risk of 10^{-6}.[14] As shown by the

[14] Fu-Shin Lee, Toxics Cleanup Program, Aquatic Lands Cleanup Unit, Washington Department of Ecology. Email to Craig McCormack and Dave Bradley, October 3, 2007.

ratio of the background levels to the risk-based levels, background levels are seen to be higher than the risk-based screening levels. Therefore background levels, not risk-based levels, are used to set cleanup levels. Ecology believes that the rule revisions will not result affect sediment cleanup for dioxins/furans, PCBs, or carcinogenic PAH because cleanup standards for these contaminants are driven by background concentrations.

Issue 2-10: How will the proposed rule revisions be applied to ongoing or completed cleanup actions?

Public Comments and Concerns

Comments were provided that questioned how the proposed rule revisions would be applied to sites where cleanup was already ongoing or had been completed, and whether additional clarification should be provided regarding the impact of changes to cleanup standards to interim cleanup actions:

> *It is likely that several sites with PAH or PCB contamination have been previously remediated, with attainment of cleanup levels evaluated on an individual constituent basis rather than the PAH or PCB mixture having been considered as a single hazardous substance. The rule should be revised to state that the amended rule provisions will not require re-evaluation or additional cleanup of sites previously remediated in accordance with the regulation in effect at the time. In addition, at many complex cleanup sites (such as the Hanford site) cleanup is pursued in a phased manner using interim actions for groupings of waste sites rather than attempting to select a final remedy for all waste sites at the facility. In these situations, waste sites addressed in accordance with the interim actions should also be grandfathered, and no additional cleanup required as a consequence of these rule changes.* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 4 of attached comments.)***

Ecology's Response to Public Comment

WAC 173-340-702(12) was added to the MTCA regulation in 2001 to address the implications of changes to cleanup standards for on-going cleanups. The proposed rule amendments do not modify this provision. WAC 173-340-702(12) defines when newly promulgated cleanup levels will apply to completed or ongoing cleanups:

> *(12) Applicability of new cleanup levels.*
>
> *(a) For cleanup actions conducted by the department, or under an order or decree, the department shall determine the cleanup level that applies to a release based on the rules in effect under the chapter at the time the department issues a final cleanup action plan for that release.*
>
> *(b) In reviewing the adequacy of independent remedial actions, the department shall determine the cleanup level that applies to a release based on the rules in effect at the time the final cleanup action for that release began or in effect when the department reviews the cleanup action, whichever is less stringent.*
>
> *(c) A release cleaned up under the cleanup levels determined in (a) and (b) of this subsection shall not be subject to further cleanup action due solely to the subsequent amendments to the provisions in this chapter on cleanup levels, unless the department determines, on a case-by-case basis, that the previous cleanup action is no longer sufficiently protective of human health and the environment.*

(d) Nothing in this subsection constitutes a settlement or release of liability under the Model Toxics Control Act. (WAC 173-340-702(12))

According to this provision, in order to apply newly adopted standards to a previously cleaned up site Ecology must determine, on a case-by-case basis, that the prior cleanup is no longer sufficiently protective. It does not mean that Ecology will or must require more cleanup at all sites where the new standards might apply. Whether additional work will be necessary depends on the facts in any given case. For example, a prior cleanup may have resulted in contaminated soil being contained on site. If the new, more stringent cleanup standard is for protection of the direct contact pathway, Ecology may determine that the containment remedy is still protective of that pathway, even if the new cleanup standard is applied. Therefore Ecology would not require any additional cleanup at that site. These same types of considerations would apply to review of whether additional actions are necessary following interim actions, to meet new cleanup standards. However, it is important to note why the existing rule applies to final cleanups and not interim actions.

Ecology does not think it is appropriate to authorize acceptance of interim actions based on cleanup standards applicable at the time they are performed. Many years can pass between early interim actions taken at a site and the selection and implementation of final cleanup. Ecology must ensure that human health and the environment are protected based on current standards. Ecology is also concerned there would be less incentive to expedite the final cleanup action at any given site, if the applicable standards were fixed at the time an early interim action is taken.

Issue 2-11: Do the proposed rule revisions reflect current policy being implemented by Ecology?

Ecology's Proposal

Current Ecology guidance in the CLARC guidance and practice has been to use TEFs to reduce these chemical mixtures to an equivalent concentration of an index chemical (2,3,7,8 TCDD for dioxins/furans or benzo(a)pyrene for carcinogenic PAHs) and compare this toxic equivalent concentration to the cleanup level for the index chemical. The rule would codify this practice.

Public Comments and Concerns

One commenter questioned whether Ecology was simply codifying existing practice or in fact establishing new cleanup requirements through the proposed rule revisions. For example:

> *The proposed language changes appear to do more than clarify policies and procedures. Does Ecology intend to amend the rule to establish new regulatory requirements for affected cleanups, or is Ecology using the rulemaking process to codify procedures that reflect Ecology policy regarding cleanup expectations? Would the rulemaking simply clarify Ecology understanding of the intent of the referenced methodologies or is Ecology seeking to convert procedures from the methodologies into requirements?* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 1 of attached comments.)***

Ecology's Response to Public Comment

The proposed rule revisions generally reflect Ecology's previously published CLARC policies and procedures for calculating cleanup levels for these chemical mixtures. As noted above, Ecology initiated the rule revision process because neither the current MTCA rule nor the federal guidance referenced in the MTCA rule clearly describe the procedure for using TEFs. The revised procedures are consistent with

the federal TEF methodology (See Issue 3-2). However, Ecology is proposing to use that methodology within the MTCA rule framework and that framework reflects policies that differ from the federal cleanup program (See Issue 3-3).

Issue 2-12: Has Ecology demonstrated that the proposed rule amendments meet the Administrative Procedures Act requirements for significant legislative rules?

Public Comments and Concerns

Several organizations stated that they believe Ecology had not adequately considered the rulemaking criteria in the APA. For example:

> *RCW 34.05.328 identifies more than ten substantive statutory criteria state agencies must consider, make determinations against, and present supporting information on before adopting new, or enacting significant amendments to, a policy or regulatory program. As will be demonstrated in the following comments, there are important and significant deficiencies in Ecology's response to RCW 34.05.328. Taken together, our view is that the Department has not met and will not be able to meet its burden under the statute to support adoption of the proposed rule.* ***(Ken Johnson, Weyerhaeuser, p. 1.)***

> *…all three sections of the PEAA are deeply and fundamentally flawed. The cost-benefit analysis fails to provide meaningful detail from which Ecology or an informed public can assess either the benefits or the costs of the proposed rule; Ecology has not prepared a small business impact statement because of its flawed conclusion that the rule would affect only very few sites; and Ecology's least burdensome alternative analysis is meaningless since it has not adequately gauged the burden of the proposed rule.* ***(Dana Dollof, Rayonier Properties, LLC, pp. 1-2 of attached comments.)***

Ecology's Response to Public Comment

The Washington APA requires agencies to demonstrate that proposed rules meet several criteria before adopting final rule language. Agencies must provide "…documentation of sufficient quantity and quality so as to persuade a reasonable person that the determinations are justified…." RCW 34.05.328(2)

Ecology believes that the proposed rule revisions meet the APA rulemaking criteria. Ecology prepared several preliminary evaluations to support Ecology's review of the APA rulemaking criteria. These evaluations were included in the following two documents:

- *Model Toxics Control Act (MTCA) Cleanup Regulations. Preliminary Economic Analysis for Amendments to Chapter 173-340 WAC. Prepared for Ecology's Toxics Cleanup Program. March 2007. Publication No. 07-09-045.*

- Background Document For the Proposed Amendments to the Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC. April 2007. Publication No. 07-09-050.

Ecology distributed these documents for public review and comment.

The following paragraphs summarize Ecology's description of the MTCA statutory goals and its determinations on each rulemaking criterion.

- RCW 34.05.328(1)(a) requires agencies to "…[c]learly state in detail the general goals and specific objectives of the statute that the rule implements. MTCA directs Ecology to "…[p]ublish and periodically update minimum cleanup standards for remedial actions at least as stringent as the cleanup standards under section 121 of the federal cleanup law, 42 U.S.C. Sec. 9621, and at least as stringent as all applicable state and federal laws, including health-based standards under state and federal law." There are several statutory provisions that provide guidance on implementing this directive:

    - Relationship to Federal Standards. Given the language in the voter's pamphlet and public advertisements prepared by initiative supporters, Ecology believes it is clear that the authors of the initiative intended for the state to assess what level of protection is appropriate for Washington State, rather than just deferring to existing federal standards. MTCA makes clear that Ecology has the authority to adopt cleanup standards more protective than the federal cleanup standards.

    - Protection of Highly Exposed or Highly Susceptible Population Groups. The MTCA states that "[e]ach person has a fundamental and unalienable right to a healthful environment…." To fulfill this mandate, Ecology believes it is necessary to establish methods and procedures that will result in cleanup levels that protect the whole population – including susceptible or high exposure population groups such as children, pregnant women, etc.

    - Responses to Threats or Potential Threats to Human Health or the Environment. MTCA directs Ecology to "…[c]onduct, provide for conducting, or require potentially liable persons to conduct remedial actions … to remedy releases or threatened releases of hazardous substances." The law defines "remedial actions" as "…any action or expenditure consistent with the purposes of this chapter to identify, eliminate, or minimize any threat or potential threat posed by hazardous substances to human health or the environment…" Ecology believes that the choice of the words "threat" and 'potential threat" reflects the drafter's intent that the lack of certainty or perfect evidence "…does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time." (Hill, B.A. 1965) Ecology feels it is appropriate to use conservative assumptions in interpreting data with regard to carcinogens, and to risk error on the side of overprotection rather than underprotection.

    - Use of Current Scientific Information. RCW 70.105D.030(4) directs Ecology to establish a science advisory board to provide advice on cleanup standards and other topics.

- RCW 34.05.328(1)(b) requires agencies to "[d]etermine that the rule is needed to achieve the general goals and specific objectives stated under (a) of this subsection, and analyze alternatives to rule making and the consequences of not adopting the rule." Ecology has analyzed several rule-making alternatives (include the alternative of not adopting the proposed rule amendments). Based on that review, Ecology believes that the proposed amendments are needed to achieve the MTCA goals and objectives.

    - Protection of Human Health. Ecology believes the revisions to the cancer risk policies are necessary to adequately protect human health. Specifically, the revised cancer risk policies will provide a margin of safety with respect to the health risks associated with other soil-related exposure pathways, non-cancer health effects and other PAH compounds not routinely measured during site investigations. For additional explanation, see the Background Document (pages 29-30) and responses to Issues 3-3, 4-3, and 5-2.

- Current Scientific Information. The revised rule incorporates new scientific information on the relative toxicity of dioxin-like congeners, the bioavailability of soil-bound dioxins, and the relative toxicity of PAH compounds. Ecology's decisions on new scientific information are consistent with the determinations and recommendations of the MTCA SAB.

Ecology also considered alternatives to rulemaking (in the form of guidance) and determined that the general goals and specific objectives of the statute could not be accomplished under these alternatives. As explained in Section 1.2, the problem is that the current rule does not specifically state how to use the TEF methodology and is therefore subject to different interpretations. Those different interpretations can result in different cleanup levels. Therefore, the solution to the problem is not to publish guidance, but to amend the rule itself.

- RCW 34.05.328(1)(c) requires agencies to "…[p]rovide notification in the notice of proposed rule making under RCW 34.05.320 that a preliminary cost-benefit analysis is available. The preliminary cost-benefit analysis must fulfill the requirements of the cost-benefit analysis under (d) of this subsection. If the agency files a supplemental notice under RCW 34.05.340, the supplemental notice shall include notification that a revised preliminary cost-benefit analysis is available. A final cost-benefit analysis shall be available when the rule is adopted under RCW 34.05.360…." Ecology completed a preliminary cost-benefit analysis in March 2007. This document was distributed for public review and comment. Ecology has reviewed the public comments on the preliminary analysis. The public comments and Ecology's responses to those comments are provided in Chapter 7 of this document.
- RCW 34.05.328(1)(d) requires agencies to "…[d]etermine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the statute being implemented." Ecology has prepared a final cost benefit analysis which take into account the comments on the preliminary document. Based on that evaluation, Ecology has determined that the probable benefits of the rule revisions are likely to be greater than the probable costs of complying with the rule revisions. The final cost-benefit analysis is available on Ecology's web site and in the rule making file.
- RCW 34.05.328(1)(e) requires agencies to "…[d]etermine, after considering alternative versions of the rule and the analysis required under (b), (c), and (d) of this subsection, that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated under (a) of this subsection." The proposed rule amendment is the least burdensome alternative that will achieve the general goals and objectives of MTCA. In reaching this conclusion, Ecology evaluated several rulemaking alternatives (including the no action alternative). Based on that evaluation, Ecology concluded that other rulemaking alternatives did not effectively achieve the MTCA goals and objectives and/or were more burdensome than the proposed rule amendments. Ecology's evaluation and conclusions are provided in Chapter 8 of the final cost-benefit analysis.
- RCW 34.05.328(1)(f) requires agencies to "…[d]etermine that the rule does not require those to whom it applies to take an action that violates requirements of another federal or state law." Both the state statute and the implementing regulation require compliance with applicable state and federal laws. In particular, MTCA provides that "[Ecology] shall adopt, and thereafter enforce, …minimum cleanup standards for remedial actions at least as stringent as the cleanup standards under section 121 of the federal cleanup law, 42 U.S.C. Sec. 9621, and at least as stringent as all applicable state and federal laws, including health-based standards under state and federal law[.]" RCW 70.105D.030(2)(e). The MTCA Cleanup Regulation also requires that all cleanup actions "[c]omply with applicable state and federal laws" and specifically emphasizes that "the term

'applicable state and federal laws' shall include legally applicable requirements and those requirements that the department determines…are relevant and appropriate requirements." WAC 173-340-360(2)(a)(iii) and 173-340-710(1). Selected application of specific applicable state and federal laws to cleanup actions, including water discharge requirements, air emission requirements, solid waste landfill closure requirements, and sediment management requirements, are specifically listed in the regulation. WAC 173-340-710(7). The regulation also requires consideration of new applicable state and federal requirements as part of the periodic review of cleanup actions. WAC 173-340-710(6).

Under both the state statute and the implementing regulation, a person conducting a remedial action under an order or decree, and Ecology when it conducts a remedial action, are exempt from the procedural requirements of several other state laws and the procedural requirements of any laws requiring or authorizing local government permits or approvals for the remedial action. RCW 70.105D.090(1) and WAC 173-340-710(9). However, remedial actions exempt from procedural requirements must still comply with the substantive requirements of these laws. RCW 70.105D.090(1) and WAC 173-340-710(9)(c). Ecology must also ensure compliance with substantive requirements and provide for an opportunity for comment by the public and by the state agencies and local governments that would otherwise implement these laws. RCW 70.105D.090(1) and WAC 173-340-710(9)(d).

Consequently, Ecology routinely coordinates and integrates requirements under other federal, state and local laws with the MTCA cleanup standards for individual sites. Based on that experience, Ecology has not identified any situations where compliance with the MTCA rule would require an individual to violate another federal or state law.

- RCW 34.05.328(1)(g) requires agencies to "…[d]etermine that the rule does not impose more stringent performance requirements on private entities than on public entities unless required to do so by federal or state law." The MTCA cleanup standard provisions apply to both public and private entities. Consequently, the rule does not impose different or more stringent performance requirements on private entities than public entities unless such distinctions are made in other applicable federal or state laws.

- RCW 34.05.328(1)(h) requires agencies to "…[d]etermine if the rule differs from any federal regulation or statute applicable to the same activity or subject matter and, if so, determine that the difference is justified by the following: (i) A state statute that explicitly allows the agency to differ from federal standards; or (ii) Substantial evidence that the difference is necessary to achieve the general goals and specific objectives stated under (a) of this subsection." RCW 70.105D.030(2)(e) requires Ecology to publish "…cleanup standards for remedial actions at least as stringent as the cleanup standards under section 121 of the federal cleanup law, 42 U.S.C. Sec. 9621, and at least as stringent as all applicable state and federal laws, including health-based standards under state and federal law…." MTCA thus explicitly allows Ecology to publish regulations that differ from federal standards.

- RCW 34.05.328(1)(i) requires agencies to "…[c]oordinate the rule, to the maximum extent practicable, with other federal, state, and local laws applicable to the same activities or subject matter." Ecology has reviewed the proposed rule revisions and they will not adversely affect the ongoing coordination with other federal, state and local laws applicable to MTCA cleanup actions. (See Issue 2-7) As noted above, Ecology routinely evaluates and integrates requirements from other state and federal laws and regulations in revisions to the MTCA cleanup standards. Ecology consulted with EPA and Washington State Department of Health in preparing this rule. In addition, the MTCA regulation requires that cleanups comply with other laws that are legally applicable or determined by the agency to be relevant and appropriate to the cleanup. WAC 173-340-710.

Issue 2-13: Will the proposed rule revisions require changes to site characterization or requirements?

Summary of Proposed Rule

Under WAC 173-340-350, remedial investigations must conduct sufficient field investigations to characterize the types and distribution of hazardous substances present at a site. No changes are proposed to these provisions.

Public Comments and Concerns

One organization requested that Ecology include rule language that states that additional environmental sampling is not required:

> *In the process of finalizing this rule, Ecology should clarify that the rule is not intended to impose additional sampling requirements at cleanup sites; i.e., no additional sampling for dioxins/furans, PCBs, or PAHs is required by this rule for the sole purpose of addressing all the constituents listed in Tables 708-1 and 708-2 at sites where these constituents have not been identified as contaminants of concern.* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 4 of attached comments.)***

Ecology's Response to Public Comment

Ecology agrees that these rule amendments are not intended to impose additional sampling requirements at cleanup sites. Under WAC 173-340-350, remedial investigations must conduct sufficient field investigations to characterize the types and distribution of hazardous substances present at a site. As part of this study, a sampling and analysis plan must be prepared under WAC 173-340-820 identifying what samples will be analyzed for. Determining what to analyze samples for is discussed in various EPA guidance documents and other published references that we do not believe would be appropriate to repeat in the MTCA rule. It depends on many factors including:

- products found at the site;
- results of previous investigations at the site or on nearby sites;
- historic uses of the site and contaminants potentially present as a result of these uses;
- potential nearby sources of contaminants;
- naturally occurring substances common for the area; and
- degradation by-products potentially present.

Issue 2-14: How will instances where a PQL is above the cleanup level for mixture of dioxins/furans, carcinogenic PAHs, or PCBs be addressed?

Ecology's Proposal

The issue of how to set cleanup levels for substances below the practical quantitation limit (PQL) is addressed in existing rule language in WAC 173-340-707. In essence, this Section, as well as other provisions in the rule indicate cleanup levels do not need to be set more stringent than the PQL for a substance, within certain limitations specified in Section 707.

No changes were proposed to this and similar language in other parts of MTCA in the proposed rule revisions.

Public Comments and Concerns

One organization questioned the feasibility of the proposed rule revisions with respect to its application to chemical mixtures, the ability of existing analytical methods to detect concentrations of chemicals at the levels defined by the risk limit, and the likelihood that any mixture of multiple chemicals will be able to achieve this standard:

> *The proposed requirement to sum the risk from individual constituents (e.g., individual PAH constituents) within a mixture, with the resultant total compared to the Method B 1 x 10-6 cancer risk, raises a concern with regard to situations where the PQL for a constituent is above the 1 x 10-6 risk level. In such instances, using the PQL as the concentration would obviously cause the total to exceed the 1 x 10-6 risk limit for the mixture. Using the risk-based cleanup level as the contaminant concentration for risk summation calculations (as suggested by Ecology's Implementation Memo No. 3) is also problematic: any other constituent present in the mixture could cause the 1 x 10-6 risk limit to be exceeded. For example, consider benzo(a)pyrene. Table I, Part II of Ecology's Implementation Memo No. 3 shows a groundwater PQL of 0.2 ug/L when using SW-846 Method 8310, a concentration that exceeds the 0.012 ug/L cleanup level. If an analysis indicates the presence of a benzo(a)pyrene below the PQL and an assumption is made (consistent with the implementation memo) that the constituent is present at 0.012 ug/L (representing the 1 x 10-6 risk limit), then the presence of any other PAH listed in Table 708-2 of the draft rule will ensure that the risk limit is exceeded. A similar example can be made for soil cleanup of benzo(a)pyrene contamination using SW-846 Method 8270. In order to address this situation, the rule should state that if the PQL for an individual dioxin/furan, PCB, or PAH constituent is above the risk-based cleanup level, then the concentration of that constituent should not be included in the summation of constituents for purposes of comparing to the Method B 1 x 10-6 risk limit…Use of estimated values for comparison to risk limits: The issue identified in the previous comment raises another issue relating to analytical results: What approach should be taken when an analysis results in an estimated value for an individual constituent (a "J-qualified" data point) that is below the PQL, but above the Method B 1 x 10-6 risk limit? WAC 173-340-707 indicates that (subject to meeting certain criteria) the cleanup level will be assumed to have been met if the PQL is not exceeded. However, if the estimated result is used in calculating a risk for a "family" of constituents (e.g., the dioxin/furan family of contaminants), the single estimated result above the 1 x 10-6 risk level will ensure that the entire "family" of constituents exceeds the standard. In order to address this situation, it is recommended that the rule state that estimated values below the PQL should not be included in the summation of*

constituents for purposes of comparing to the 1 x 10-6 Method B risk limit…. The addition of more PAH compounds to an additive parameter such as total PAH increases the detection limit as a function of the TEF. Inclusion of all Cal EPA cPAHs would essentially guarantee a site owner would be unable to demonstrate compliance…. The additivity of detection limits can be a problem. The current Benzo(a)pyrene detection limit using a routine analytical method (SW-846, Method 8310) is typically around 15ug/kg in soil. Other PAHs exhibit various different detection limits. Nevertheless, for simplicity, if we assume all PAHs are detectable at that level, using the TEF Method, the "Total PAH" detection limit for the seven EPA PAHs would be 1.51 times higher or 23ug/kg. This number is derived from the sum of all individual PAH detection limit times their respective TEF/PEF. This is not a severe impact, (the CLARC Method B soil criterion is 137ug/kg) and would not be expected to impact an actual field cleanup activity. However, if all 25 Cal EPA cPAHs were considered, the resulting Total PAH detection limit could be raised to 700ug/L, a significant increase and substantially higher than the Method B criterion! This could clearly and negatively affect a cleanup action, requiring the application of resources to clean sites, simply because the detection limit is above MTCA action levels. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 4-5, 7, 9-10 of attached comments.)***

Assays of undetected congeners should be set equal to zero. The revised rule should clearly state that if a congener of dioxins/furans, PAHs or PCBs is undetected in all assays the value used in the risk calculation shall be set equal to zero. Ecology commonly uses one-half the PQL as the assay for contaminants of concern that are undetected. If this methodology were to be used in the risk calculation it would be virtually impossible to meet a 1 x 10-6 risk level for dioxins/furans, PAHs and PCBs. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 5 of attached comments.)***

Ecology's Response to Public Comment

Ecology agrees that the treatment of undetected congeners, PCBs, and carcinogenic PAHs can affect the outcome of risk assessments and compliance evaluations. MTCA already has language addressing handling of samples with "undetected concentrations." Because of the difficulty of applying the default approach to mixtures, actual practice at most dioxin/furan, PCB, and carcinogenic PAH contaminated sites is to use alternative procedures allowed by the rule. For example, under WAC 173-340-740(7)(f)(v), the following alternative statistical procedure is typically used for dioxin/furan congeners:

- For congeners that occur at the site but not in the sample of concern, assign one-half the detection limit for compliance calculations; and
- For congeners not detected in any samples at a site, assign a value of zero for compliance calculations (assuming Ecology approved detection limits were used).

Ecology expects the above described practice to continue under the adopted rule. The primary concern of automatically zeroing out all values that are undetected is that this creates an incentive to use higher detection limits, so congeners are not detected and the site risk is underestimated. Similarly, using the detection limit to represent undetected congeners may overstate the risk at a site. Ecology believes that using one-half the detection limit creates an incentive to use more sensitive analytical techniques with lower detection limits while not over or understating the risk at a site. Ecology's experience with TEQ calculations for samples with low levels of dioxins is that using one-half the detection limit does not result in samples exceeding the cleanup level provided reasonable detection limits are used. Furthermore, assigning zero to undetected congeners can result in a larger coefficient of variation in the data set. This increases, rather than decreases, the chance that a site (or portion of a site) would be found to exceed the cleanup level when statistics are used to determine compliance.

Chapter 3: Dioxins

3.1 Introduction

Dioxins and furans are generally present in the environment as complex mixtures of chemical "congeners" that differ in terms of the number and location of chlorine atoms. In order to evaluate the risks associated with the whole mixture, scientists have developed the TEF methodology. In this method, each congener is assigned a TEF value. The TEF is the ratio of the estimated toxicity for a particular congener to the toxicity demonstrated by 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD). TCDD is the most studied congener and considered to be the most toxic. The total toxicity equivalency (TEQ) of a mixture is the sum of the products of the concentration of each congener in a contaminated medium and the TEF value for that congener.

The method for assessing dioxin/furan risk has evolved over the last 20 years as the result of scientific reviews and evaluations conducted by several organizations. EPA first adopted the TEF methodology for dioxin/furan mixtures in 1987. EPA has periodically updated their guidance on TEF values based on an international consensus regarding the interpretation of relevant toxicological information.

In April 2007, Ecology proposed to revise the methods and policies used to establish cleanup levels for mixtures of dioxins and furans.

- Ecology proposed to amend WAC 173-340-708(8) to require that Method B cleanup levels for mixtures of dioxins and furans be based on a cancer risk of 10^{-6} for mixture as a whole. The proposed changes would modify the current MTCA rule. According to the current rule, Method B cleanup levels can be established for individual congeners based on a cancer risk of 10^{-6}, and total site risk (taking into account all 17 dioxin and furan congeners with non-zero TEF values) cannot exceed one-in-a hundred thousand (10^{-5}).

- Ecology proposed to amend the rule to require people to use the most current TEF values to evaluate mixtures of dioxins/furans. The most current values were published by WHO (Van den Berg, et al. 2006). Ecology also added new rule language to explain how people should use the TEF methodology when establishing and evaluating compliance with cleanup levels.

- Ecology proposed to modify the gastrointestinal (GI) absorption fraction specified in WAC 173-340-740 and -745 used to establish soil cleanup levels for dioxin and furan mixtures. Specifically, Ecology proposed to change the default value from 1.0 (100%) to 0.6 (60%).

- Ecology proposed to amend WAC 173-340-708(8) to require cleanup proponents to consider the physical-chemical properties of individual PAH compounds, PCB compounds, or dioxin-congeners when evaluating cross-media impacts.

A considerable number of individuals and organizations provided comments on the proposed revisions. The principal issues raised during the public comment period were the following:

Issue 3-1: Should Ecology revise the MTCA rule to require people to use the toxic equivalency factors (TEFs) developed by WHO when evaluating the human health risks of dioxin/furan mixtures?

Issue 3-2: Is Ecology's proposal for using the TEF methodology for dioxin/furan mixtures consistent with EPA's procedures for application of this methodology?

Issue 3-3: Should Ecology revise the MTCA rule to require that Method B cleanup levels for dioxin/furan mixtures be based on a cancer risk of 10-6?

Issue 3-4: Do the proposed cleanup standards adequately consider noncancer health effects?

Issue 3-5: Should Ecology revise the default assumptions in the MTCA rule to take into account the relative bioavailability of soil-bound dioxins and furans?

Issue 3-6: Should Ecology consider multiple exposure pathways when establishing soil cleanup levels for mixtures of dioxins and furans?

Issue 3-7: Should the rule be amended to clarify how undetected congeners are considered when calculating risk for mixtures of dioxins and furans?

Issue 3-8: Will the proposed rule revisions result in cleanup levels that are below background concentrations commonly found in Washington?

3.2 Ecology's Review and Response to Public Comment

Issue 3-1: Should Ecology revise the MTCA rule to require people to use the toxic equivalency factors (TEFs) developed by WHO when evaluating the human health risks of dioxin/furan mixtures?

Ecology's Proposal

The MTCA rule currently requires cleanup proponents to use the EPA 1989 TEF values to characterize dioxin and furan mixtures. However, WHO published an updated set of TEF values in 2005 (WHO-2005 TEF). These values have been endorsed by the National Academy of Sciences and the MTCA SAB. Ecology proposed to revise WAC 173-340-708(8) to require that people use the WHO-2005 TEF values be when evaluating the human health risks of mixtures of dioxins and furans.

Public Comments and Concerns

Many organizations and individuals expressed support for Ecology's proposal to use the WHO-2005 TEFs to evaluate the human health risks of dioxin/furan mixtures. For example:

> *We…support Ecology's proposal to amend the rule to incorporate the most recent toxicity equivalency factors (TEFs) for dioxins/furans… as recommended by the World Health Organization.* ***(Stephen Lester, Center for Health, Environment, and Justice, p. 1.)***
>
> *Despite the considerable uncertainties associated with TEF methodology, it is the only tool available for assessing the potential cancer risk posed to humans by dioxin/furan congeners other than 2,3,7,8 TCDD…The revised WHO TEFs represent the most updated values and thus should be used in place of previous TEFs.* ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 4.)***
>
> *In general, these rule revisions, are well-founded in science and will benefit the public and wildlife of Washington State…I would like to especially note that the proposals to use the Toxic Equivalency Factor for dioxins and furans…are solid proposals.* ***(Wendy Steffensen, North Sound Baykeeper, p. 1.)***

Ecology also received comments from over three hundred Washington citizens who expressed support for Ecology's proposal to based cleanup levels on the most current TEF values developed by WHO.

Ecology's Response to Public Comment

Ecology has reviewed the comments on this issue and appreciates the support for the proposed rule language. Ecology's decision to incorporate the WHO 2005 TEFs is based on the following rationale:

- The TEF methodology has a strong biological basis. The TEF methodology is a relative potency approach that is grounded in the concept that dioxin/furan mixtures act through a common mode of action that involves binding to the aryl hydrocarbon hydroxylase (Ah) receptor. The methodology is based on the assumption that the total dose can be represented by the sum of the doses for individual chemicals in the whole mixture. This assumption (dose additivity) has been evaluated for a number of toxic endpoints. Of particular relevance to the current rulemaking process, Walker et al. (2005) evaluated the dose-additive carcinogenicity of a mixture of dioxin-like compounds and reached the following conclusions: (1) the dose-response for the mixture could be predicted from a combination of the potency-adjusted doses of the individual congeners, (2) the WHO-98 TEF values adequately predicted the increased incidence of liver tumors associated with exposure to a mixture of dioxin-like compounds, and (3) the shapes of the dose-response curves were the same in the studies of three individual congeners and the mixture.

- The WHO-2005 TEF values are based on current scientific information. The WHO-2005 TEF values reflect the current scientific consensus on the relative toxicity of dioxin-like compounds. These values were developed after a rigorous scientific review performed by international experts. These values are consistent with earlier scientific reviews by the EPA Risk Assessment Forum (EPA, 2000), EPA's Science Advisory Board (EPA, 2001) and the NRC (NAS, 2003; NAS, 2006). The NAS panel (2006) specifically recommended that EPA consider the results of the WHO/International Programme on Chemical Safety review when revising the dioxin reassessment report. In addition, the MTCA SAB recently concluded:

  > *The Board stated that the 2005 TEF values for dioxin and furans recommended by the WHO are consistent with current scientific information…., the Board stated that it was fortuitous that the WHO had recently completed a review and evaluation of available scientific information which resulted in updated TEF values for dioxins and furans (MTCA SAB, 2007).*

- The WHO expert panel considered the scientific uncertainties associated with current information when revising the TEF values. Ecology recognizes that there are uncertainties in the TEF values and the application of this approach to predict health risks and calculate cleanup levels. However, a scientific panel convened by EPA and the Department of Interior concluded that "...the uncertainties associated with using … TEFs are not thought to be larger than other sources of uncertainty within the risk assessment process (e.g., dose-response assessment, exposure assessment and risk characterization)..." (EPA, 2001b). The EPA Science Advisory Board also noted that five of the 29 dioxin-like compounds (17 polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans [PCDDs/PCDFs] and 12 dioxin-like PCB congeners) are considered by EPA account for over 70% of the TEQ in the human diet. The Board noted that the variability in relative potency factors for these five congeners is much lower than the variability in TEFs for congeners that are minor contributors to human exposure (EPA, 2001a). Haws et al. (2006) reached similar conclusions.

- Ecology's proposal to use the WHO-2005 TEF values is consistent with approaches being used by Ecology and other environmental agencies. Ecology believes that the use of the most current TEF values published by the WHO is consistent with the current MTCA rule and reflects a logical update based on more recent scientific information. Numerous agencies have been using the WHO-98 TEF values (since 2005 values were not yet available) when evaluating the health risks associated with dioxin and furan mixtures. For example:

    - The Water Quality Program used the WHO-98 TEFs when establishing the Total Maximum Daily Load (TMDL) for Lake Chelan (Ecology, 2005).

    - The Environmental Assessment Program used the WHO-98 TEFs to prepare the 2004 303(d) list of impaired bodies of water (Ecology, 2004).

    - The State of Washington Solid Waste and Financial Assistance Program used the WHO-98 TEFs when preparing the initial list of persistent, bioaccumulative toxins (PBTs).

    - EPA used the WHO-98 TEF values when preparing the 2003 dioxin reassessment report.

    - The EPA Superfund program recommends that the WHO-98 TEF values be used when evaluating the health risks posed by dioxin/furan mixtures. EPA Region 10 staff have since recommended the 2005 WHO TEF values be used in place of the 1998 TEF values.

    - EPA used the WHO-98 TEF values when establishing reporting requirements for dioxin and dioxin-like compounds under Section 313 of the federal Emergency Planning and Community Right-to-Know Act.

    - ATSDR used the WHO-98 TEF values to establish a Minimal Risk Level (MRL) for dioxin-like compounds (ATSDR, 1998).

    - Most state health and environmental agencies currently use the WHO-98 TEF values to evaluate dioxin and furan mixtures.

- Ecology does not believe that the use of the WHO-2005 TEF values will significantly increase or decrease the stringency of cleanup requirements established under MTCA. As indicated in Table 9, the two approaches include identical TEF values for 12 of the 17 dioxin and furan congeners. Of the remaining five congeners, the WHO-2005 TEF values are lower than the 1989 EPA TEF values for four congeners (1,2,3,7,8-PeCDF, 2,3,4,7,8-PeCDF, OCDD and OCDF); the WHO-2005 TEF value for PeCDF is higher. While these differences may affect conclusions on individual samples, Ecology does not believe that the use of the WHO-98 TEF or the WHO-2005 values will significantly alter cleanup requirements on a statewide basis (relative to the current rule language).

Table 9: Toxicity Equivalency Factors (TEFs) For Chlorinated Dioxins and Furans

Congener	CAS number	EPA 1989 (Current MTCA Rule)	WHO 1998	WHO 2005
TEFs for chlorinated dibenzo-p-dioxins				
2,3,7,8 tetrachloro dibenzo-p-dioxin	1746-01-6	1	1	1
1, 2,3,7,8 pentachloro dibenzo-p-dioxin	40321-76-4	0.5	1	1
1,2,3,4,7,8 hexachloro dibenzo-p-dioxin	39227-28-6	0.1	0.1	0.1
1,2,3,6,7,8 hexachloro dibenzo-p-dioxin	57653-85-7	0.1	0.1	0.1
1,2,3,7,8,9 hexachloro dibenzo-p-dioxin	19408-74-3	0.1	0.1	0.1
1,2,3,4,6,7,8 heptachloro dibenzo-p-dioxin	35822-46-9	0.01	0.01	0.01
1,2,3,4,6,7,8,9 octachloro dibenzo-p-dioxin	3268-87-9	0.001	0.0001	0.0003
TEFs for chlorinated dibenzofurans				
2,3,7,8 tetrachloro dibenzofuran	51207-31-9	0.1	0.1	0.1
1,2,3,7,8 pentachloro dibenzofuran	57117-41-6	0.05	0.05	0.03
2,3,4,7,8 pentachloro dibenzofuran	57117-31-4	0.5	0.5	0.3
1,2,3,4,7,8 hexachloro dibenzofuran	70648-26-9	0.1	0.1	0.1
1,2,3,6,7,8 hexachloro dibenzofuran	57117-44-9	0.1	0.1	0.1
1,2,3,7,8,9 hexachloro dibenzofuran	72918-21-9	0.1	0.1	0.1
2,3,4,6,7,8 hexachloro dibenzofuran	60851-34-5	0.1	0.1	0.1
1,2,3,4,6,7,8 heptachloro dibenzofuran	67562-39-4	0.01	0.01	0.01
1,2,3,4,7,8,9 heptachloro dibenzofuran	55673-89-7	0.01	0.01	0.01
1,2,3,4,6,7,8,9 octachloro dibenzofuran	39001-02-0	0.001	0.0001	0.0003

Issue 3-2: Is Ecology's proposal for using the TEF methodology for dioxin/furan mixtures consistent with EPA's procedures for application of this methodology?

Ecology's Proposal

Ecology proposed to revise WAC 173-340-708(8) to define the procedures for using the TEF methodology when establishing and evaluating compliance with cleanup levels and remediation levels. The proposed rule included the following provisions:

> *(ii)* ***Establishing cleanup levels and remediation levels.*** *The cleanup levels and remediation levels established for 2,3,7,8-TCDD shall be used, respectively, as the cleanup levels and remediation levels for mixtures of dioxins and/or furans.*
>
> *(iii)* ***Determining compliance with cleanup levels and remediation levels.*** *When determining compliance with the cleanup levels and remediation levels established for mixtures of dioxins and/or furans, the following procedures shall be used:*
>
> *(A) Calculate the total toxic equivalent concentration of 2,3,7,8-TCDD for each sample of the mixture. The total toxic equivalent concentration shall be calculated using the following method, unless the department determines that there is clear and convincing scientific data which demonstrates that the use of this method is inappropriate:*
>
> *(I) Analyze samples from the medium of concern to determine the concentration of each dioxin and furan congener listed in Table 708-1;*
>
> *(II) For each sample analyzed, multiply the measured concentration of each congener in the sample by its corresponding TEF in Table 708-1 to obtain the toxic equivalent concentration of 2,3,7,8-TCDD for that congener; and*

(III) For each sample analyzed, add together the toxic equivalent concentrations of all the congeners within the sample to obtain the total toxic equivalent concentration of 2,3,7,8-TCDD for that sample.

(B) After calculating the total toxic equivalent concentration of each sample of the mixture, use the applicable compliance monitoring requirements in WAC 173-340-720 through 173-340-760 to determine whether the total toxic equivalent concentrations of the samples comply with the cleanup level or remediation level for the mixture at the applicable point of compliance.

Public Comments and Concerns

Several organizations and individuals questioned whether Ecology's proposal was consistent with EPA procedures for using the TEF methodology. These organizations were concerned that Ecology's proposal would lead to outcomes more stringent than the outcomes intended by EPA. For example:

> *Do the proposed amendments for mixtures of dioxins/furans simply incorporate as procedures certain details that reflect the USEPA interpretation regarding application of Toxicity Equivalency Factors (TEFs), or do these amendments establish an Ecology interpretation for application of the methodology that is possibly more stringent than or inconsistent with the USEPA intent for application of the methodology?* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 1 of attached comments.)***

Ecology's Response to Public Comment

Ecology's technical approach for applying the TEF methodology is the same technical approach used by the EPA Superfund and Resource Conservation and Recovery Act (RCRA) programs. Both programs use the following procedures to estimate the toxicity of mixtures of dioxins, furans and dioxin-like PCBs. This procedure is described in Volume II (Chapter 9) of the EPA Dioxin Reassessment Report (EPA, 2003b). The approach includes the following steps:

- Measure the concentrations of each dioxin and furan congener in the environmental sample[15].
- Multiple the concentration of each dioxin and furan congener in the environmental sample by the TEF value for that congener.
- Sum the products to calculate the total TEQ of the mixture which serves as an estimate of the total toxicity of the mixture.

The Washington Department of Ecology Total Petroleum Hydrocarbons Policy Oversight Group (POG) discussed the TEF approach when they reviewed the Method A carcinogenic PAH cleanup levels during the 2001 rule-making process. The POG (in which EPA Region 10 scientists participated) indicated that this was the appropriate way to use TEFs.

Ecology and EPA also discussed this issue when Ecology was considering the issues raised by Rayonier Properties LLC. EPA scientists in Region 10 and EPA Headquarters confirmed that Ecology was using the TEF methodology in a manner that is consistent with EPA procedures. For example, Dr. Michael DeVito (one the EPA experts on the toxicology of dioxins and furans) stated:

[15] Ecology considers dioxin and furan congeners separately from dioxin-like PCBs when making initial MTCA cleanup level determinations. EPA considers dioxins, furans and dioxin-like PCB congeners when characterizing the toxicity of mixtures.

EPA assesses the total risk including all dioxin-like congeners as listed in the draft dioxin reassessment. Our concern is with the total risk. It is not scientifically invalid to apply the method for single chemicals and evaluate the potential risk from a single congener. Once again it is unclear why this would be of value to a risk assessor except for source apportionment. (Dr. Michael DeVito, personal correspondence with Dr. Craig McCormack, March 13, 2006.)

EPA and other federal environmental agencies have established a wide range of regulatory requirements for dioxins and furans. Ecology recognizes that these requirements reflect a wide range of policy choices on acceptable cancer or non-cancer risks, many of which differ from the policy choices reflected in the MTCA rule. However, EPA and other federal agencies have generally established requirements for the whole mixture – not individual congeners. For example:

- EPA (1998) published a guidance memo for cleanup of dioxin-contaminated properties. The guidance specifies that compliance should be evaluated reducing the dioxin/furan congener mixture to an equivalent concentration of 2,3,7,8 TCDD and comparing this equivalent concentration to the 1 ppb removal action level specified in that guidance.

- EPA has published human health water quality criteria for 2,3,7,8-TCDD in the National Toxics Rule (NTR) (EPA, 1992) and the California Toxics Rule (EPA, 2000). In promulgating the California Toxics Rule, EPA stated that water quality-based effluent limits for dioxin or dioxin-like compounds should be expressed using a TEQ approach (65 FR 31682 at 31695).

- EPA established emission limits for medical waste incinerators that include limitations expressed in terms of either (1) allowable levels of total chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans or (2) allowable TEQs. The proposed rule for primary manganese refining facilities also includes emission limits for dioxin/furan mixtures expressed in terms of nanograms (ng) of toxic equivalents (TEQ) per dry standard cubic meter.

- ATSDR (1998) established a MRL for dioxin and dioxin-like compounds at a concentration of 1 picogram (pg) TEQ/kg-day.

- The Food and Drug Administration uses the TEF methodology and TEQs to monitor food and animal feed with the goal of reducing dietary exposure to dioxin-like compounds (FDA, 2005).

In conclusion, Ecology's proposal for applying the TEF methodology is the same technical approach used by the EPA Superfund and RCRA programs. However, Ecology and EPA use different risk management frameworks for establishing cleanup standards. Under the EPA Superfund program, EPA establishes cleanup levels for dioxin-like compounds using a target risk level between one-in-one million and one-in-ten thousand. Ecology is proposing to establish MTCA cleanup levels for mixtures of dioxins and furans using a target risk level of 10^{-6}. This issue is discussed in the next section.

Issue 3-3: Should Ecology revise the MTCA rule to require that Method B cleanup levels for dioxin/furan mixtures be based on a cancer risk of 10^{-6}?

Ecology's Proposal

Ecology proposed to revise WAC 173-340-708(8) to state that dioxin and furan mixtures will be considered a single hazardous substance for assessing carcinogenic risk under MTCA. Under this approach, Method B cleanup levels for mixtures of dioxins and furans must be based on a cancer risk of one-in-one million (10^{-6}).

The proposed changes would modify the current policies and procedures for establishing Method B cleanup levels for dioxin and furan mixtures. Under the current rule, Method B cleanup levels can be established for individual congeners based on a cancer risk of one-in-million (10^{-6}), and the total site risk (taking into account all 17 dioxin and furan congeners with non-zero TEF values) cannot exceed one-in-a hundred thousand (10^{-5}).

Public Comments and Concerns

Ecology received comments from over three hundred Washington citizens who expressed support for Ecology's proposal to base cleanup levels for dioxin and furan mixtures on a cancer risk level of 10^{-6}. For example:

> *I support Ecology establishing a Model Toxics Control Act rule for soil cleanup levels of mixtures of dioxins, PAHs and PCBs using the strongest cancer risk level of 10^{-6} and the most current dioxin toxicity detection method developed by the World Health Organization and the California EPA.* ***(Harley Oien, p. 1.)***
>
> *Ecology is establishing a Model Toxics Control Act rule for soil cleanup levels of mixtures of dioxins, PAHs and PCBs using the strongest cancer risk level of 10^{-6} and the most current dioxin toxicity detection method developed by the World Health Organization and the California EPA. That is necessary and appropriate according to currently available technical data. Ecology, however, must also use the most nationally accepted dioxin soil cleanup level of 6.67 ppt at non-industrial sites and 875 ppt at industrial sites and nothing higher. This establishes a stronger human health protection standard and affords much better coverage for vulnerable populations at risk--infants, children, pregnant women, elderly and those with impaired health.* ***(Susan Svitak, p. 1.)***
>
> *When a community is told not to eat shellfish caught within its harbor because of the very high levels of toxins that far exceed safe levels for human consumption, the time has come to strengthen and clarify regulations relative to toxic discharges and cleanups.* ***(R.M. Cockrill, p. 1.)***
>
> *I am writing to register my strong support for the Department of Ecology establishing a Model Toxics Control Act rule for soil cleanup levels of mixtures of dioxins, PAHs and PCBs using the strongest cancer risk level of 10^{-6} and the most current dioxin toxicity detection method developed by the World Health Organization and EPA.* ***(G Donahue, p. 1.)***

Many local, state and national organizations also expressed support for Ecology's proposal to establish Method B cleanup levels for mixtures of dioxins and furans using a cancer risk of one-in-one million (10^{-6}). For example:

> *We appreciate Ecology's efforts in establishing the Model Toxics Control Act rule for soil cleanup levels and mixtures of dioxins…. using the strongest cancer risk level of 1 in a million….* ***(Kat Hall, Lands Council, Testimony at May 17, 2007 Public Hearing.)***
>
> *In general, these rule revisions, are well-founded in science and will benefit the public and wildlife of Washington State. For that, Ecology is to be commended. I would like to especially note that the proposals to…revise the clean up levels for mixtures of dioxins/furans to 1x 10^{-6} are solid proposals.* ***(Wendy Steffensen, North Sound Baykeeper, p. 1.)***
>
> *We appreciate that Ecology is using the most current scientific information to set cleanup standards. Lesser standards will not protect human health and the environment but protect the*

industry and insurers that bear cleanup responsibility for these toxic chemicals. ***(Heather Trim, People for Puget Sound, p. 2.)***

CHEJ supports the Washington State Department of Ecology Toxics Cleanup Program's (Ecology) proposal to require that cleanup levels for mixtures of dioxins and furans, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) be based on a cancer risk value of one-in-one million. ***(Stephen Lester, Center for Health, Environment, and Justice, p. 1.)***

We support The Department of Ecology's (DOE) proposal to establish cleanup levels for mixtures of dioxins, PAHs and PCBs using the cancer risk level of 1 in 1 million for non industrial sites. DOE should use the highest standards for dioxin soil cleanup levels that are consistent with reasonable economic constraints - but in no event should the levels exceed 11 ppt for non-industrial sites, as proposed by DOE. We also support the strongest reasonable cleanup standards for industrial sites. The revised rule should be applied to the cleanup of the former Rayonier Mill site in Port Angeles…Additionally,…strong toxic cleanup standards will support Governor Gregoire's initiative now in place to clean up Puget Sound and the Strait of Juan de Fuca. ***(Sue Chickman, Olympic Peninsula Audubon Society, p. 1.)***

However, one organization urged Ecology to adopt cleanup standards for mixtures of dioxins and furans using a cancer risk level of one-in-ten million (10^{-7}):

*The OEC strongly supports the rule making action…. This is not to say, however, that WA State should not strengthen the latter as has the State of Wisconsin, using a cancer risk rate of one in ten million. This would be appropriate given the widespread environmental sources bombarding human and wildlife health, directly or indirectly causing cancer, and the fact that WA State is one of the nation's leaders in cancer.****(Darlene Schanfald, Olympic Environmental Council, p. 1.)***

Several organizations and individuals expressed the opinion that it was inappropriate to establish cleanup levels for mixtures of dioxins and furans using a cancer risk level of 10^{-6}. For example:

Ecology should not revise the MTCA rule to require that Method B cleanup levels for dioxin/furan mixtures or PAH mixtures to be based on one-in-a-million risk. ***(Grant Nelson, Association of Washington Business, p. 3.)***

… Ecology is charged with general responsibility for protecting human health and the environment and with specific responsibility under the MTCA statute for issuing MTCA rules that set cleanup requirements at protective levels. Ecology's agreement that the maximum 1 x 1 0^{-5} cleanup level for dioxin/furan mixtures (and by implication, Rayonier submits, for the other compound groups covered by this rule) is consistent with the MTCA rules thus means that it meets MTCA requirements for protecting human health and the environment. Ecology has provided no new facts, no analysis, no discussion and no rationale in the rulemaking materials explaining what has changed. ***(Dana B. Dolloff, Rayonier, p. 22 of attached comments****)*

While the agency explains the shift in the risk level is to "clarify" and "reduce uncertainty in how cleanup levels should be calculated," it is in fact a fundamental policy choice which makes the Method B cleanup protocol more stringent. The WDOE's stated purposes for this rulemaking; i.e., to add clarity or to achieve "Ecology's goal of stricter cleanup levels," is an inadequate response to the directive in the statute. ***(Ken Johnson, Weyerhaeuser, p. 2)***

In the background document provided by Ecology (WDOE 2007), the potential impact of changing the underlying assumptions used in the derivation of SCLs (e.g., changing the default numerical values of the resulting SCLs and, in one instance, the number of sites that would exceed these new SCLs. Neither of these metrics is relevant if the goal of the MTCA rule is to protect human health. ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 3-4)***

The proposed language for WAC 173-340-708(d) through (f) states that mixtures of dioxins/furans, CPAHs, and PCBs each shall be treated as a single hazardous substance. Treating mixtures as single hazardous substances is inconsistent with MTCA's requirement to assign 1 x 10-6 cancer risk to individual carcinogens. Ecology's evaluation of this approach for consistency with other regulatory policies, as described in the Background Document, is complicated by MTCA's unique requirement to assign two cancer risk limits: one for individual carcinogens, and a total risk limit for all carcinogens present at a site combined.…For clarity in defining acceptable risks when chemical mixtures are present, and for consistency with other regulations in the context of MTCA's specific requirements, we believe that the MTCA Method B language on target risks should not be changed as proposed. Instead, the language should accept the treatment of individual constituents of these mixtures as individual substances. This approach will ensure consistency in allowable target risks among sites, while providing a high level of health protection. ***(Jennie Goldberg, City of Seattle, p. 1-2)***

The 11 parts per trillion that Ecology has proposed is the second lowest cleanup standard in the country...,it's a pretty low number and as you may have understood today, almost impossible to understand or quantify the benefits…There is a data set for Port Angeles that a lot of other communities don't have. This data was collected by EPA back in 1997…ATSDR looked at this data set. And quoting their report "residents, including children, may be exposed to soil contaminants while gardening or playing. None of the contaminants detected in off-site soil would be expected to produce adverse health affects in potentially exposed residents."…. to bring about a further reduction without extremely strong justification does seem inappropriate. ***(Dana Dolloff, Rayonier, Testimony at May 14, 2007 Public Hearing)***

[T]he proposed rule would alter the acceptable dioxin intake for a child receptor from the currently allowed exposure of 0.3 pg/kg/day to 0.083 pg/kg/day. Both of these levels are significantly below the ATSDR comparison level of 1 pg/kg/day and the WHO TDI of 1 - 4 pg/kg/day. Thus both the existing and proposed more stringent cleanup level that would be mandated here are substantially below the potential screening thresholds established by ATSDR and WHO. This is further evidence that Ecology has not demonstrated the public health benefits claimed for this proposed rule…. ***(Dana B. Dolloff, Rayonier, p.10, 23 of attached comments)***

Although setting an acceptable level of risk is purely a policy decision, there is no scientific basis for apportioning tolerable risk among different chemicals that might be present at any given site. The current rule limits overall incremental risk associated with chemical contaminants at one in one hundred thousand. As long as this threshold is not exceeded by the sum of the risks posed by multiple chemicals found at a site, it is not necessary to limit incremental risk associated with dioxins/furans to one in one million. Overall, the use of TEF methodology to assess incremental cancer risk associated with dioxin/furan mixtures is generally consistent with the scientific consensus, but promulgation of a dioxin/furan-specific risk threshold below that allowed for total site specific risk is neither sensible nor scientifically justified. ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 4-5)***

Current scientific evidence indicates that the cancer risk associated with lower dioxin TEQ doses in the extrapolated low risk range (e.g., associated with a 10^{-4} risk and lower) is likely negligible. Evidence cited by NAS (2006) as supporting a lower risk at low doses or even a practical threshold of risk from dioxins includes the mechanism of action, lack of direct genotoxicity, and results from animal bioassay studies. The mechanism of toxic action at high doses leading to cancer is likely not applicable at low doses. ***(Mark E. Madsen, City of Port Angeles, p. 5-6 of attached technical memorandum)***

EPA has never published a Cancer Slope Factor (CSF) or Reference Dose (RfD) for PCDD/Fs in its Integrated Risk Information Service (IRIS) database. In deriving its Method B SCL for PCDD/Fs, Ecology has used a CSF of 156,000 (mg/kg-day)-1, which is the CSF for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) that was derived by EPA in the mid-1980's and presented in its Health Effects Assessment Summary Tables (EPA, 1997a). This CSF was derived using a non-threshold, linearized multistage model to extrapolate human toxicity based on the rat bioassay data reported by Kociba et al. (1978). More recent information indicates that the nonlinear extrapolation approach used to derive this CSF is not likely to be representative of the mechanism of carcinogenic action of TCDD…The carcinogenic dose response for TCDD is highly controversial and is an ongoing matter of scientific debate…At present, there is no consensus within the scientific community as to the appropriate CSF for TCDD. As a result, there is enormous uncertainty associated with assuming any value. However, it is likely that once the Reassessment has been completed, the CSF upon which the proposed value is based will be substantially lower than the CSF that is currently used in that derivation. Consideration of these factors highlights that the proposed approach to calculating Method B SCLs results in substantial towards overestimating cancer risks. ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 7-8, 13-14 of attached technical comments)***

Ecology's first stated purpose for this rulemaking is to make the MTCA rules consistent with Ecology's Cleanup Levels And Risk Calculations (CLARC) guidance, specifically the CLARC directive that mixtures of dioxin/furan congeners are to be classified as a single hazardous substance and thus subject as a group to the 1 x 10^{-6} cleanup level that the MTCA rules specify for "individual" hazardous substances. However, Ecology has not articulated any scientific support for that CLARC directive. Since Ecology has not demonstrated any scientific basis for that CLARC directive, by the same token Ecology has not provided any rationale for elevating it to a MTCA regulation. ***(Dana B. Dolloff, Rayonier, p. 23 of attached comments)***

Ecology's Response to Public Comment

The comments on this issue fell into six main categories (considered below following the general background discussion). Ecology has carefully reviewed the comments and continues to believe that it is appropriate to establish Method B cleanup levels for dioxin mixtures using a cancer risk level of one-in-one million. Specifically, Ecology believes this approach is an appropriate policy choice for regulating dioxins and furans within the overall MTCA decision-making framework. Ecology provided the following rationale for this choice in the Background Document distributed with the proposed rule:

- Dioxin/furan mixtures differ from the majority of mixtures found at MTCA sites. Most MTCA sites include mixtures of hazardous substances. However, the mixtures addressed in this rulemaking differ from most other types of mixtures in that (1) the congeners in the dioxin/furan mixture always occur together and (2) scientists have concluded that the 17 dioxin/furan

congeners identified in the rule act through common biological mechanisms and essentially behave like one chemical in the human body.[16]

- The revised approach provides a margin of safety that minimizes the potential for health risks from exposure pathways that are not explicitly addressed in the MTCA rule. Ecology made a number of simplifying assumptions regarding exposure pathways when developing the MTCA rule. For example, soil cleanup levels are based on an evaluation of the direct contact pathway (e.g., soil ingestion and dermal contact) and migration from soil to ground water. For the majority of hazardous substances, this approach addresses the main human exposure pathway. However, dioxins and furans differ from many other hazardous substances because they are able to bioaccumulate in the terrestrial and aquatic food chains (e.g., soil>plants>animals>humans). EPA (2003) has estimated that soil-related food chain exposure may equal or exceed exposures resulting from soil ingestion. These exposure pathways are typically not considered when setting cleanup levels under the MTCA rule.

- The revised approach provides a margin of safety that minimizes the potential that soil cleanup levels based on carcinogenic risks will result in unacceptable non-cancer health risks. Exposures to dioxins/furans have been shown to increase the risks of developing a wide range of non-cancer health problems including hepatic, immunological, dermal, endocrine effects, neurological effects and reproductive and development effects. The MTCA rule includes procedures for establishing cleanup levels based on non-cancer health effects. However, dioxins and furans differ from other hazardous substances because (1) EPA has not officially established a reference dose and (2) EPA has concluded that a reference dose for non-cancer effects may be below current background levels of exposure. Consequently, the proposed approach provides a margin of safety to address the data gaps for non-cancer health effects. [See Issue 3-4].

- The revised approach is consistent with the policy choices underlying cleanup levels for PCB mixtures. The National Research Council has concluded that chlorinated dioxins and furans mixtures and PCB mixtures share many similar exposure and toxicity characteristics. The revised approach for dioxins and furans is consistent with the policy choices underlying cleanup levels for PCB mixtures in the current MTCA rule. For example, the Method A soil cleanup levels for PCB mixtures in the current MTCA rule were established for the whole mixture using a cancer risk level of one-in-one million. [See Issue 5-3]

- The revised approach is consistent with approaches used by other Ecology programs. The proposed approach is consistent with approaches used by other Ecology programs when evaluating the health risks associated with dioxin and furan mixtures. These requirements are often applicable, relevant and appropriate requirements (ARARs) that establish minimum cleanup standards under MTCA. For example:

    - The Water Quality Program used the WHO-98 TEFs when establishing the TMDL for Lake Chelan. In that evaluation, Ecology used congener-specific data to calculate TEQs which were compared with the National Toxics Rule (NTR) criterion for TCDD.[17]

    - The Environmental Assessment Program identified impaired water bodies by comparing the TEQs for dioxins/furans to the NTR criteria for TCDD (Ecology, 2004).

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[16] The TEF approach is based on the concept that the various congeners of dioxin/furan essentially act as one chemical, affecting the Ah receptor (aryl hydrocarbon hydroxylase receptor).

[17] The NTR criterion for TCDD is based on a 10^{-6} cancer risk level.

- The Hazardous Waste & Toxics Reduction Program specifies that fertilizers must contain no more than eight parts per trillion of dioxin, measured as toxic equivalent (TEQ).

- The Air Quality Program uses the TEF methodology to calculate TEQs for potential emissions from proposed new sources of dioxins/furans. The TEQ values are compared to a screening level for dioxin/furans that is expressed in terms of TCDD. The screening level is based on an incremental cancer risk of one-in-one million (WAC 173-460-060).

- The cleanup levels established using this policy result in cleanup levels similar to those required by many other states: The Association of State and Territorial Solid Waste Management Officials (ASTSWMO) recently completed a survey of state screening levels and action levels (ASTSWMO, 2006). They found that "...[t]he cancer risk basis of the standards and guidelines reported by States ranged from a stringent one-in-ten million (10^{-7}) to one-in-ten thousand (10^{-4}). The majority of standards utilize the more typical one-in-one million (10^{-6}) risk level criteria...." Ecology reviewed the approaches being used by other environmental agencies to establish soil cleanup levels for dioxins and furan mixtures. Based on that review, it appears that many states establish soil cleanup levels for TCDD (not the whole mixture). However, Ecology's cleanup standards are comparable to cleanup levels and/or screening levels used in several other states.

- The revised approach will simplify the procedures for establishing MTCA cleanup levels. The MTCA Cleanup Regulation specifies that Method B cleanup levels established for individual hazardous substances based on a particular pathway (e.g., soil ingestion) must be adjusted downward to take into account exposure to multiple hazardous substances and/or multiple exposure pathways in situations where total excess cancer risk would exceed 10^{-5}. Treating dioxin and furan mixtures as a single hazardous substance minimizes the need to make such adjustments. This simplifies the process for establishing cleanup levels.

- The revised rule reflects public concerns about exposure to toxic chemicals. Public concerns about health threats posed by toxic chemicals have grown over the last decade as new information on toxicity and body burdens have become available. Ecology has undertaken several initiatives to reduce and cleanup sources of toxic chemicals in Puget Sound and other parts of the state. The revised rule reflects risk policy choices that are consistent with public concerns and the high priority assigned to these initiatives.

Table 10: Comparison of Approaches Used By Other State Environmental Agencies When Evaluating Dioxin/Furan Mixtures (based on 2,3,7,8 TCDD)

State	mg/kg	ppt (ng/kg)	TEQ, ppt	State Target Risk
Wisconsin	4.3E-07	0.43	1.29	1.00E-07
Wisconsin	6.4E-08[18]	0.064	0.129	1.00E-07
Oregon	3.90E-06	3.9	11.7	1.00E-06
Idaho	3.90E-06	3.9	11.7	1.00E-06
Wyoming	3.90E-06	3.9	11.7	1.00E-06
W. Virginia	4.10E-06	4.1	12.3	1.00E-06
Mississippi	4.26E-06	4.26	12.78	1.00E-06
Virginia	4.30E-06	4.3	12.9	1.00E-06

[18] Wisconsin 6.4E-08 mg/kg Residual Contaminant Level for TCDD based on slope factor of 1,000,000 $(mg/kg\text{-}d)^{-1}$

Delaware	4.30E-06	4.3	12.9	1.00E-06
California	4.60E-06	4.6	13.8	1.00E-06
Massachusetts	5.70E-06	5.7	5.7	1.00E-06
Florida	7.00E-06	7	21	1.00E-06
Washington	1.10E-05	11	11	1.00E-06
Iowa	1.90E-05	19	57	5.00E-06
Minnesota	2.00E-05	20	60	1.00E-05
Ohio	3.58E-05	35.8	107.4	n/a
Arizona	3.80E-05	38	114	1.00E-06
Kansas	6.00E-05	60	180	1.00E-05
Michigan	9.00E-05	90	270	1.00E-05
Pennsylvania	1.20E-04	120	360	1.00E-05
Alabama	1.00E-03	n/a	1000	1.00E-06
New York	1.00E-03	n/a	1000	1.00E-06
Texas	1.00E-03	n/a	1000	1.00E-05
EPA				
EPA - Region 3	4.30E-06	4.3	12.9	1.00E-06
EPA - Region 6	3.90E-06	3.9	11.7	1.00E-06
EPA - Region 9	3.90E-06	3.9	11.7	1.00E-06
EPA - 1998 OSWER Directive 9200.4-26	1.00E-03	n/a	1000	Policy Not Risk Based
ATSDR				
1998 Policy Guideline for Dioxin and DLCs	1.00E-03	n/a	1000	Policy Not Risk Based
2006 Update of 1998 Policy Guideline[19]	5.00E-05	n/a	50	Policy Not Risk Based

Ecology has reviewed the comments on the issue of whether Method B cleanup levels for dioxin/furan mixtures should be based on a cancer risk of 10^{-6} and believes they raise a number of important issues. Ecology has organized is review and response into six main parts that correspond to the issue categories.

- General Support for the Proposed Rule: Many individuals and organizations expressed support for Ecology's proposed approach.

- Need for Additional Protection: One organization urged Ecology to adopt cleanup standards for mixtures of dioxins and furans using a cancer risk level of one-in-ten million. Ecology has reviewed this recommendation and continues to believe that it is appropriate to establish Method B cleanup levels using a one-in-one million cancer risk level. Ecology does not believe that the use of a more

[19] ATSDR revision of 1998 Policy Guideline for Dioxins and Dioxin-Like Compounds in Residential Soil are 1.) Deletion of the 1 ppb action level as the criteria for taking specific public health actions and 2.) Retention of the 0.05 ppb screening level. (71 FRN 78441, December 29, 2006)

stringent cancer risk limit would have any practical benefits given current analytical capabilities, background concentrations, and the overall MTCA rule framework. As noted above, Ecology's approach is consistent with the approaches used by a number of other states and EPA Regions.

- Consistency with MTCA Policies and Goals: Several people expressed the opinion that the proposed revisions are not consistent with current MTCA policies and procedures. In particular, several people stated that the proposed rule was inconsistent with the general policy of applying a target cancer risk of one-in-one million to individual hazardous substances. In developing the proposed rule, Ecology recognized that the underlying policy for dioxin mixtures differs from the policy applied to the majority of other hazardous substances. However, dioxin mixtures differ from the majority of mixtures found at MTCA sites (see above discussion). Given these differences, Ecology concluded that the proposed rule represents an appropriate methodology for dioxin mixtures. Ecology believes it is important to recognize that the MTCA rule contains similar policies for PCB mixtures. Specifically:

    - Ecology uses a similar approach to establish Method B cleanup levels for PCB mixtures. Ecology believes that dioxin mixtures are similar to PCB mixtures in that they are persistent and bioaccumulate in terrestrial and aquatic food chains.

    - Ecology used a similar approach to establish the Method A cleanup levels for PAH and PCB mixtures.

    - Cleanup standards must be at least as stringent as requirements in other applicable laws and regulations. Water quality standards are applicable requirements; the standards for dioxins and PCB mixtures are based on a cancer risk of one-in-one million.

- Lack of significant health effects: Several people questioned whether the proposed rule revision was needed in light of the lack of evidence of health effects under the current rule provisions. They noted that ATSDR had reviewed available soil data and concluded that off-site soil concentrations did not pose a threat to nearby residents. Ecology has reviewed the ATSDR Public Health Assessment for Rayonier Incorporated, Port Angeles Mill (also called Rayonier Mill), May 13, 2004. In addition, Ecology has consulted with Washington Department of Health (DOH) staff regarding this assessment. Although the assessment was conducted in Washington State, DOH had no direct involvement in the development of this assessment because ATSDR was petitioned by Port Angeles community members to conduct a public health assessment of the Rayonier site. Ecology and DOH disagree with the ATSDR Public Health Assessment conclusion. The conclusion says: "None of the contaminants detected in off-site soil would be expected to produce adverse health effects in potentially exposed residents." Ecology and DOH have concerns regarding the conclusions and basis for the conclusions of the ATSDR public health assessment for the Rayonier site. Some of these concerns are:

    Inadequate characterization of the nature and extent of contamination from the Rayonier Mill site. Ecology and DOH have concerns about how the sampling was conducted, the locations of the sampling events, and insufficient sampling data.

    Inadequate accounting for the health concerns, treaty reserved rights, Native American culture, and fish consumption rates of the Lower Elwha Klallam Tribe.

    Failure to account for future land uses of the Rayonier site that may increase the potential for future exposures to contaminated properties, sediments, and contaminated fish and shellfish.

  Ecology and DOH do not believe that any conclusions can be made regarding potential health impacts from exposures to contaminated soils (particularly for off-site soils), shell fish, and sediments

from the small amount of data collected at the time of the ATSDR assessment. Ecology and DOH believe it would be imprudent to establish cleanup standards at levels where health effects would be expected to occur given the lack of fish tissue data and the high probability that land use will change.

- Level of Conservatism: Several people expressed the opinion that Ecology's use of the current EPA cancer slope factor and exposure parameters results in biased estimates of cancer risk. They recommended that Ecology take this into account when deciding what cancer risk level to use to establish MTCA cleanup levels. Under MTCA, the risk-based policies, toxicity values, exposure parameters, cleanup decisions and cleanup standards reflect a balance between central tendency estimates, high end estimates, and a policy choice regarding an appropriate level of conservatism or protection. This balance, achieved under MTCA with corresponding levels of protection, is consistent with WAC 173-340-702 general policies. As stated in the goals for cleanups WAC 173-340-702 (3): "The Model Toxics Control Act contains policies that state, in part, each person has a fundamental and inalienable right to a healthful environment and it is essential that sites be cleaned up well. Consistent with these policies, cleanup standards and cleanup actions selected under this chapter shall be established that provide conservative estimates of human health and environmental risks that protect susceptible individuals as well as the general population." Ecology believes that the policy decision to assign a target cancer risk level of 10^{-6} to (a) individual hazardous substances and (b) to the total toxicity equivalent concentration for selected environmental mixtures where the TEF methodology is applied reflects a level of conservatism consistent with the statutory requirements in RCW 70.105D.030. In making that policy choice, Ecology has considered the scientific issues associated with the cancer slope factor and the level of conservatism reflected in the exposure assumptions. Specifically:

  Cancer Slope Factor. Ecology uses cancer slope factors developed by the Environmental Protection Agency to establish risk-based cleanup levels. Ecology recognizes that there are currently several scientific and policy issues surrounding the cancer slope factor for dioxin mixtures. In light of those issues, Ecology has not used the new cancer slope factor developed as part of the EPA Dioxin Reassessment. EPA is currently reviewing the National Research Council (NRC 2006) report and recommendations on the cancer slope factor. If EPA finalizes a new cancer slope factor, Ecology will use that value to establish MTCA soil cleanup levels. If EPA develops a lower slope factor, this will translate into higher cleanup levels.

  Exposure Assumptions: In determining the appropriate level of protection, Ecology considered the relationship between the exposure assumptions and policy choices. The MTCA exposure parameters and assumptions are focused on young children ingesting soil. That is, unrestricted (residential) soil cleanup is required to a level that protects young children from exposure due to ingestion of soil. EPA and other states typically consider both children and adult exposures when characterizing health risks and establishing soil cleanup levels. EPA and other states also consider other exposure pathways (e.g., dermal contact, inhalation of windblown dust, eating home grown vegetables) when establishing soil cleanup levels, whereas Washington does not. Ecology believes it is appropriate to use a more protective risk policy given the existing MTCA methods and assumptions used to establish soil cleanup levels.

The U.S. Environmental Protection Agency, Region 10, recommends the use of EPA-Region 6 human health medium-specific screening levels and the use technical background information from EPA-Regions 6 and 9 (EPA R-10 2007 Memorandum) for CERCLA and RCRA sites. Similar to MTCA, the risk based levels recommended by EPA-Region 6 uses a target cancer risk of 10^{-6} and a cancer slope factor of 150,000 $(mg/kg\text{-}day)^{-1}$ to establish

residential soil levels for 2,3,7,8-TCDD of 3.9 ppt. The level derived from EPA-Region 6 web site, as recommended by EPA-Region 10, is within a comparable level of protection as proposed under the MTCA rule revision.

- Scientific foundation of the MTCA rule revisions: Several people expressed the opinion that the proposed revisions did not have a sufficient scientific foundation. For example: "Ecology has provided no new facts, no analysis, no discussion and no rationale in the rulemaking materials explaining what has changed." (comment by Dana B. Dolloff, Rayonier) Ecology disagrees with this characterization and believes that sufficient scientific rationale has been provided to support the proposed rule revisions. Ecology has presented new technical information, technical analysis and scientific rationale for the proposed rule revisions to the public, the MTCA Science Advisory Board, U.S. Environmental Protection Agency – Region 10, Washington Department of Health, Ecology's regional staff, and has consulted with other state environmental and health agencies. Explanation of the proposed rule revisions, the technical information, and rationale in support of the proposed rule revisions were provided to the above people and organizations. This included:

  Information about Ecology's choice and use of toxicity equivalency factors (TEFs) and potency equivalency factors (PEFs) to evaluate the toxicity and assess the risks for selected environmental mixtures. Ecology explained the proposed rule revision's incorporation of the most recent toxicity equivalency factors for dioxins/furans and PCBs recommended by World Health Organization. Ecology explained the proposed update to use the potency equivalency factors (PEFs) for carcinogenic PAHs adopted by the California Environmental Protection Agency.

  Ecology's rationale for revising the default Gastrointestinal Absorption Fraction to account for the relative bioavailability of soil-bound dioxins/furans when establishing soil cleanup levels for mixtures of dioxins/furans.

  Information clarifying Ecology's proposed rule revisions for risk-based policies, explaining that:

  - Cleanup levels for dioxin and furan mixtures are based on a cancer risk of one-in-one million.
  - Cleanup levels for c-PAH mixtures are based on a cancer risk of one-in-one million.
  - Cleanup levels for dioxin-like PCB mixtures are based on a cancer risk of one-in-one million.

  This information can be found in this publication and the supporting materials in the rule administrative record.

Issue 3-4: Do the proposed cleanup standards adequately consider noncancer health effects?

Proposed Rule

Ecology proposed to revise the procedures used to establish cleanup levels for mixtures of dioxins and furans. The proposed rule revisions apply to the procedures for establishing cleanup levels based on cancer risks.

Ecology did not propose any changes to the procedures for establishing cleanup levels based on non-cancer health effects.

Public Comments and Concerns

Several organizations and individuals noted that exposure to dioxin and furan mixtures is associated with a wide range of noncancer health effects. These organizations and individuals urged Ecology to establish cleanup standards that account for non-cancer health effects. For example:

> *Standards for dioxins/furans, PAHs, and PCBs have traditionally been assessed based on cancer risks. Recent scientific research has exposed the need to focus on more than cancer risks for persistent bioaccumulative toxic chemicals. Non-cancer effects such as nerve and endocrine damage, reproductive problems and birth defects, Parkinson's, diabetes, etc. related to these toxic chemicals must also be considered. The standards proposed need to be protective beyond the cancer evidence.* ***(Heather Trim, People for Puget Sound, p. 1.)***

Ecology's Response to Public Comment

The MTCA Cleanup Regulations establishes policies and procedures for establishing cleanup levels based on noncancer health effects. However, EPA has not published a reference dose for dioxin and furan mixtures. Consequently, Ecology establishes cleanup levels dioxin and furan mixtures based on carcinogenic risks. Implicit in this approach is the assumption that cleanup levels based on cancer risk will also prevent unacceptable noncancer health risks. In most cases, this is a reasonable assumption. As shown in Table 11 below, cleanup levels based on cancer risk are more stringent than non-cancer cleanup levels calculated using the ATSDR MRL and WHO Acceptable Daily Intake values. However, calculations based on more recent scientific analyses result in cleanup levels that are similar to cleanup levels based on cancer risk.

- Range of Non-Cancer Health Effects. Exposure to dioxins/furans have been shown to increase the risks of developing a wide range of non-cancer health problems including hepatic, immunological, dermal, endocrine effects, neurological effects and reproductive and development effects.

- Range of Toxicity Measures. As noted above, EPA has not published a reference dose for dioxin and furan mixtures. The ATSDR (2004a) has established a MRL[20] for 2,3,7,8 TCDD (chronic MRL = 1 pg/kg/day). Paustenbach et al. (2006) found that reference doses (or equivalent non-cancer toxicity measures) developed by federal and international organizations ranged from 0.013 to 100 pg/kg/day.

  EPA (2003) evaluated available studies and calculated benchmark doses that range over several orders of magnitude. EPA (2003) decided not to establish a reference dose for dioxin because they concluded that any reference dose calculated using current data and methods would be 2-3 orders of magnitude below current background intakes and body burdens. Schecter and Gasiewicz (2003) have summarized the key EPA conclusions:

  > *For the characterization of noncancer effects, USEPA generally calculates a reference dose (RfD/RfC) value that represents an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a*

[20] When calculating MRLs, ATSDR uses methods similar to the EPA methods for calculating reference doses.

lifetime. The current estimated average dose to the U.S. population (about 1 pg TEQ/kg per day) is greater than RfD/RfC dose values that might be calculated given the data reviewed in this characterization, and therefore RfD/RfC values would be uninformative for safety assessment. EPA has chosen rather to characterize the margins of exposure (MOEs) for noncancer endpoints in order to inform risk management decisions. MOE is the ratio of the human body burden to the effect level in the comparison species (ED01 or low effect level), animal or human. For the most sensitive endpoints identified, MOEs range from, for example, less than 1 for enzyme induction in mice, through 2.6 to 15 for enzyme induction in rats, less than 3 for developmental effects, and 5 for endometriosis in nonhuman primates. In evaluating MOEs, consideration should be given to uncertainties in distinguishing between adaptive biochemical changes and adverse effects, on both an individual level and as these changes affect the entire population. Children's risks from dioxin and related compounds may be greater than for adults, but more data are needed to address this issue. (Schecter, A. and T.A. Gasiewicz, 2003, p. 182.)

The NRC (2006) concluded that it was more appropriate to use body burden rather than daily intake as a dose metric for extrapolating results from animal studies to human populations. This may have important implications for characterizing non-cancer risks. For example, ATSDR calculated the current MRL value using daily intake dose metric. If ATSDR had calculated the MRL value using a body-burden dose metric, the resulting MRL would be 0.07 pg/kg/day (assuming all other factors were the same). This is more than ten times lower than the current MRL.

- Implications for MTCA cleanup levels. The MTCA Cleanup Regulation includes policies and procedures for establishing cleanup levels based on non-cancer health effects. Those procedures are based on estimating potential site exposures and comparing those exposure estimates to the appropriate reference dose. Cleanup levels are established at concentrations where the ratio (exposure/reference dose) or "hazard quotient" is equal to one. Ecology calculated soil cleanup levels using the range of available toxicity measures (See Table 11). Based on those calculations, soil cleanup levels based on non-cancer toxicity measures established by ATSDR and WHO are higher than cleanup levels based on cancer risks. In other words, the cleanup level based on cancer risk is protective for non-cancer risks. However, calculations based on more recent scientific analyses result in cleanup levels that are similar to cleanup levels based on cancer risk.

  If the body burden approach recommended by NRC is adopted by EPA, this would result in a Method B soil cleanup level based on non cancer risk that is comparable to or somewhat more stringent than that derived based on a 10^{-6} cancer risk. If EPA takes this approach, the MTCA rule provides the flexibility in cleanup level calculations to adopt new toxicity values that account for background body burdens.

Table 11: Soil Cleanup Levels Calculated Using Different Noncancer Toxicity Measures

Source	Toxicity Measure (pg TEQ/kg/day)	Soil Cleanup Level (ng/kg)
World Health Organization	1 to 4	80-320
ATSDR - MRL (dose metric = daily intake)	1	80
ATSDR - MRL (dose metric = daily intake) + Relative Source Contribution = 0.2	1	16
ATSDR – MRL (dose metric = body burden)	0.07	5.6

Issue 3-5: Should Ecology revise the default assumptions in the MTCA rule to take into account the relative bioavailability of soil-bound dioxins and furans?

Summary of Proposed Rule

The MTCA Cleanup Regulation defines methods for establishing soil cleanup levels. The GI absorption fraction (the amount of the soil contaminant absorbed in the gut once ingested) is one of several factors considered when establishing these levels.

The MTCA rule establishes a default GI absorption factor of 1.0 (100%). The default value is based on the assumption that soil-bound contaminants are absorbed to the same extent as the contaminants administered in the animal studies used to establish the cancer potency factor and/or reference dose.

Ecology reviewed the available scientific literature on the bioavailability of soil-bound dioxins and furans. Based on that review, Ecology proposed to amend WAC 173-340-740 and -745 to change the default GI absorption fraction for dioxin/furan mixtures from 1.0 to 0.6. Under this proposal, the Method B soil cleanup level for 2,3,7,8-TCDD would be 11 ppt (instead of 6.7 ppt under the current rule). The industrial soil cleanup level would increase from 875 to 1,460 ppt.

Public Comments and Concerns

Ecology received a wide range of comments from individuals and organizations about the proposed rule revision to change the default assumptions in MTCA to take into account the relative bioavailability of soil-bound dioxins and furans, and these comments covered a variety of technical issues related to this proposal. All comments received fell into one of three categories, and will be summarized and addressed according to these categories:

<u>Public Comment Category #1 – Comments in Opposition to Reducing the GI Absorption Factor</u>
The first category of public comments opposed any reduction in the assumed bioavailability; some of the comments in this category also expressed concern that other exposure factors used in calculating cleanup levels are not sufficiently conservative to offset uncertainty in protectiveness that may be introduced through use of a reduced GI absorption factor. The factors that were cited in this first category of comments that opposed reduction in the GI absorption factor included:

- Insufficient scientific evidence and consensus to support a revised absorption factor;

- Failure to account for factors such as range of potential soil conditions, range of concentrations of dioxin/furan mixtures, and duration of contact between dioxin/furans and the soil when establishing the newly proposed absorption factor; and,

- The need to consider the variability in absorption and bioavailability from one individual to another.

Example comments in this first comment category include:

> *CHEJ believes that there is insufficient scientific evidence and consensus to define a generic absorption factor for mixtures of soil-bound dioxins and furans that would be appropriate for all sites. Ecology should continue to use a Gastrointestinal (GI) Absorption Fraction default factor of 1.0 (indicating 100% absorption)…. [W]ithout site specific soil bioavailability measurements, data are insufficient to make default bioavailability adjustments for dioxins in soil…. Although each of these factors - the range of soil conditions at different sites, the range of concentrations of mixtures of dioxins and furans, and the duration of contact between dioxin/furans and the soil - influence the absorption and bioavailability of soil-bound dioxins and furans, Ecology did not included them in its analysis of the studies cited to justify the selection of a GI Absorption Fraction of less than 1.0…. Another critical element that Ecology has not considered is the variability in absorption and bioavailability from one individual to another, and from the young to older people. Absorption, uptake, distribution and excretion can vary substantially among different people and among people of different ages.* ***(Stephen Lester, Center for Health, Environment, and Justice, p.2-3.)***
>
> *…[W]e believe there is far too much uncertainty regarding the factors influencing the rate of dioxin uptake within the gastrointestinal tract to come to reasonably conclude that absorption is always reduced. There is simply not enough evidence to support the addition of the rule regarding gastrointestinal absorption, given the known variability among people, the high level of uncertainty in the data set, the difficulties that this rule change would present to other cleanups in the state, and the precedent that it would set at the national level.* ***(Peter L. deFur and Kyle T. Newman, p. 2-3.)***
>
> *Please do not relax your current cleanup standard. Please keep the current 100% bioavailability safety standard….* ***(Wendy Sampson, p. 1.)***
>
> *Ecology…must use the most nationally accepted dioxin soil cleanup level of 6.67 ppt at non-industrial sites and 875 ppt at industrial sites and nothing higher. This is a stronger human health protection standard and affords much better coverage for vulnerable populations at risk -- infants, children, pregnant women, elderly and those with impaired health….* ***(Harley Oien, p. 1)***
>
> *Please keep the 6 67ppt and 875ppt standard It affords much better coverage for vulnerable populations at risk -- infants, children, pregnant women, elderly and those with impaired health -- on those two specific points of soil clean up.* ***(Sally Lovell, p. 1.)***
>
> *EPA's current bioavailability standard, a standard of how much dioxin laden soil is inhaled, ingested or absorbed by dermal contact and retained in the body is 100 percent. We believe that this standard protects vulnerable populations such as infants, children, pregnant women, those in poor health and the elderly.* ***(Kat Hall, Lands Council, Testimony at May 17, 2007 Public Hearing.)***

The absorption rate of ingested dioxin congeners that is used to calculate human risk from dioxin ingestion should be set at 1 (100%). The toxic nature of these compounds and the uncertainty in the scientific literature regarding factors influencing their absorption mandates the most protective standards possible be established in MTCA. ***(Beckett Stanley, Sierra Club Cascade Chapter, p. 1.)***

We feel that the absorption rate of 60% should be reconsidered. …[T]here are a number of variables that effect absorption rate including soil chemistry and other medium characteristics, total body burdens of dioxins, individual physiology, and fat content within the gut. These factors alone warrant the need for a precautionary approach ***(Heather Trim, People for Puget Sound, p. 2.)***

We're very concerned about the health situation. You know Clallam County is 9th highest in the state for woman's breast cancer, and we have a lot of children that have brain cancer here…We want a cleanup to the most stringent levels. …We're not pleased with the 11 parts per trillion - we want that lower. ***(Darlene Schanfald, Testimony at May 14, 2007 Public Hearing.)***

Public Comment Category #2 – Comments in Support of Reducing the GI Absorption Factor

The second category of public comments on reducing the GI absorption factor supported the proposed change, and in some cases recommended that Ecology reduce the default assumption for relatively bioavailability to a lower value than the 60% value proposed in the rule revisions. For example:

…the MTCA rule has historically used upper bound estimates for every exposure parameter. Ecology should now adopt the average value (0.34) as the default for AB1. In addition, theory predicts that gastrointestinal absorption (bioavailability) for the more highly chlorinated congeners will be less than that observed for 2,3,7,8-TCDD, and there are some data in the literature showing this. Ecology should acknowledge this…. In estimating bioavailability based on liver content, Ecology has used results …not representative of the availability pf PCDD/Fs in aged soil… In addition, some of the studies identified by Ecology used enzyme induction as a measure of bioavailability of TCDD. However, enzyme induction does not provide a sound basis for the measurement of bioavailability…. Ecology has adjusted its bioavailability by a factor of 0.8 to account for differences in absorption between the bioavailability study and the study upon which the cancer slope factor (CSF) for TCDD is based. Making this adjustment gives an average of 34%.... [T]here are clearly sufficient data to identify 0.34 (34%) as the most reliable measure of dioxin bioavailability, so Ecology should adopt this as the default gastrointestinal absorption factor (AB1) in lieu of the 60% proposed. ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 5-6 of letter, p. 2, 4-7 of attached technical comments.)***

In the background document, Ecology reports on many of the documents and studies it relies upon. However, there are a number of flaws in Ecology's literature review and scientific analysis of these references.. In sum, some of these studies should not have been considered relevant due to deficiencies in the studies themselves, particularly a number of studies cited from the 1980s. Also, important newer studies were omitted. Lastly, Ecology reports results of these studies that appear to differ from results reported in the original studies. ***(Grant Nelson, Association of Washington Business, p. 2.)***

Public Comment Category #3 – Comments in Support of Developing Congener-Specific GI Absorption Factors

A third category of comments recommended that instead of the proposed rule revision, Ecology should develop congener-specific bioavailability factors for dioxins and furans. For example:

> *Although the proposed revision is an improvement over the current standard, it still provides only a relatively high default factor for all congeners and does not provide for the differences among congeners. …[A]dding all TEQ concentrations without correction for differences in bioavailability is scientifically inaccurate because it assumes equal exposure to all congeners despite their great differences in bioavailability and actual absorbed dose in the body. For this reason, the WHO expert panel (van den Berg et al. 2006) recommendations indicate that the use of separate risk assessment equations for each congener would be appropriate. Although the WHO toxicity equivalence factor (TEF) methodology has yet to incorporate these aspects of dioxin mixture toxicity, at a minimum, the clear differences in absorption and exposure of compounds should be considered…. [T]he rule should have explicit flexibility to accommodate advancements in the science in this area.* ***(Mark E. Madsen, City of Port Angeles, p. 2-3 of attached technical memorandum.)***

> *Ecology should… allow use of homolog specific bioavailability values as reliable congener-specific data become available….* ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 5-6 of letter, p. 2, 4-7 of attached technical comments.)***

Ecology's Response to Public Comment

As noted above, comments on this proposal to reduce the default GI absorption fraction from 1.0 to 0.6 for establishing soil cleanup levels for dioxin/furan mixtures fell into three general categories. Ecology has reviewed the comments, and decided that there is sufficient scientific basis for the proposal. The rationale for this decision is provided in three parts to specifically address each of the comment categories.

Response to Public Comment Category #1 – Comments in Opposition to Reducing the GI Absorption Factor

Comments were received that expressed opposition to reduction of the GI absorption factor based on insufficient scientific evidence, failure to account for specific conditions (soil, range of contaminant concentration, duration of contact, etc.) that may exist between sites, and the need to consider individual variability in chemical absorption.

Ecology believes that the proposed approach has both a strong, underlying scientific basis, and accounts for the remaining uncertainties in the data. The following responds to comments on the proposed reduction in the default GI absorption fraction.

- Scientific evidence in support of a reduced GI absorption factor. Ecology recognizes the available studies to evaluate the bioavailability / absorption of soil bound dioxins/furans have limitations reflecting a high degree of uncertainty, variability, and a large range in results. To address these issues, Ecology consulted with the MTCA Science Advisory Board (SAB) between September 2006 and March 2007. Ecology presented to the SAB issue papers that explored different options, provided copies of technical literature, and engaged in a broad range of discussions regarding the bioavailability/ absorption of dioxins/furans from soil. Study limitations were noted and discussed. The limitations discussed included:

- Lack of a well defined or validated animal model;
- Lack of appropriate endpoints to measure for absorption/bioavailability;
- Limited number of soil samples from a limited number of sites;
- Lack of soil characterization;
- Unknown if soils tested are representative of Washington State; and
- Lack of a validated protocol for absorption/bioavailability.

However, in light of these study limitations, the NAS, WHO and EPA have each concluded that soil-bound dioxins and furans are generally less bioavailable than dioxins and furans in food and water. WHO (Van den Berg et al. 2006) has also stated that the reduced bioavailability needs to be taken into account when applying TEF values to abiotic media such as soils.

Based on the properties of soils and dioxins/furans, it is reasonable to assume that, in general, release and absorption of dioxins/furans from ingested soils is less than 100%, and data from the studies support this assumption.

After review of the information and discussion, the SAB concluded that a 0.5 absorption value for soil-bound dioxin and furans is consistent with current scientific information and represents a central tendency value. However, the SAB also noted that this value should not be interpreted to be an upper bound value and absorption fractions for sensitive population groups or individuals would likely be higher. It should be noted that when the 0.5 absorption value is adjusted for the absorption in the studies on which the cancer potency factor for dioxin is based (which is 0.8), the result is a GI absorption fraction of 0.6.

- Variation in specific conditions. Several studies (Umbreit et. al., 1986 & 1988; Van den Berg, 1994) suggest that different soils characteristics, type of soil, and the residence time of the dioxins/furans in the soil (weathering) may influence the bioavailability of soil bound dioxins/furans. Unfortunately, the limited numbers of studies evaluating soil bioavailability do not provide sufficient information to take into account how site-specific soil characteristics and residence time influence bioavailability. Ecology acknowledges that no published studies have evaluated the bioavailability/absorption of soil bound dioxin/furans using soil from Washington State, and the characteristics of soil used in studies has not been well documented. However, in choosing a generic GI absorption factor that is at the upper end of published values (60%), Ecology believes that human health will be protected as required by MTCA. Additionally, on a site-specific basis, if there is sufficient evidence to indicate the need to evaluate soil chemistry related to the bioavailability of soil-bound dioxins/furans (for example, if the composition of soil or length of time the contaminants had been in contact with soil were thought to be an important factor) the MTCA Cleanup Regulation provides a process for conducting a site specific study (WAC 173-340-702 & -708). Ecology believes that site-specific bioavailability data in conjunction with other site-specific information will improve the ability to evaluate the toxicity and assess the health risks from soil bound dioxins/furans. Any site-specific evaluation of the relative bioavailability of soil bound dioxins/furans will require development of a validated protocol, soil sample characterization, and selection of an appropriate animal model to estimate the site-specific bioavailability of soil bound dioxins/furans.

- Accounting for individual variability and overall protectiveness. Exposure factors used to establish cleanup levels under MTCA are a combination of upper bound and central tendency

estimates. These exposure estimates in combination with the target risks established under MTCA (10^{-6} for a single hazardous substance for unrestricted, residential land use) provide a sufficient margin of safety in consideration of the variability in response between individuals and the uncertainties associated with estimating exposures to contaminants.

Response to Public Comment Category #2 – Comments in Support of Reducing the GI Absorption Factor and Recommending Further Reduction

- Biased Analysis Results in the 60% Estimate: When changes are made to exposure parameters, MTCA requires that they result in cleanup levels that are protective of human health. If the goal was to protect an individual from exposure to an average soil, then the mean or median of the results from the various studies might be an appropriate value, assuming that the data were reliable and the range and distribution of the sample of values from the studies was shown to reliably represent the range and distribution of values found in nature. However, Ecology believes that using a central tendency estimate for bioavailability is appropriate since under MTCA default exposure values and measures of toxicity are a combination of upper bound and central tendency estimates. As previously noted, the MTCA SAB noted that this bioavailability estimate should not be interpreted as an upper bound estimate because: (1) the MTCA requirement for protectiveness (2) the small number of soils that have been evaluated to determine bioavailability, and (3) various technical questions regarding the reliability of the results from the available studies.

  Two studies (Shu et al., 1988 and McConnell et al., 1984) suggest that bioavailability of dioxins from some soils can be relatively high. In combination with other exposure factors and toxicity values used to establish cleanup levels under MTCA that are central tendency and upper bound estimates, Ecology believes the proposed default bioavailability value is reasonably protective. Ecology, in consultation with the MTCA SAB, believes that the 60% bioavailability estimate is based on a central tendency estimate (50%) given a very wide range, uncertainty, and variability of the available estimates and represents a reasonable and scientifically defensible estimate. The 60% estimate is derived based on an adjustment to account for differences between the administered and absorbed doses between the bioavailability studies and the feeding study used to derive the cancer potency factor for 2,3,7,8-TCDD (0.5/0.8 = ~0.6).

  The bioavailability estimate proposed in public comments (0.34) received from AMEC is based on an *arithmetic average* from selected results from selected studies. During extensive deliberations by Ecology and the MTCA SAB, Ecology proposed an estimate of bioavailability based on an arithmetic average. The SAB rejection of Ecology's proposed arithmetic average as percent estimate of bioavailability was based on concerns that: (1) it does not account for differences in study design or results, and (2) an average numerical estimate assumes there is uniformity across study design, study results, soil characteristics, and measures of bioavailability that does not exist.

  Based on these discussions, Ecology has considered the entire data base available, accounted for the limitations, uncertainty, variability, and has made a reasonable scientifically defensible estimate based on extensive consultation and deliberations with the MTCA SAB, EPA Region 10, and Washington Department of Health.

- Potential flaws in the literature review conducted by Ecology**.** Comment had been made that some of the studies reviewed by Ecology should not be considered relevant, because the authors acknowledged that they were not reliable studies. Ecology responds that although all the published studies were evaluated, the bioavailability value selected was based only on liver

absorption results and not enzyme induction or mortality data. It was further suggested in comment that enzyme induction is not a measure of bioavailability of 2,3,7,8-TCDD. Ecology believes that enzyme induction could be a useful indicator of bioavailability under certain circumstances. However, limitations in the existing studies (mostly the presence of other chemicals in the soil that bind to the Ah receptor and induce enzymes) make it difficult to use the results to assess bioavailability. As noted previously, Ecology chose a default bioavailability value based on liver absorption, not enzyme induction.

Response to Public Comment Category # 3 – Comments in Support of Developing Congener-Specific GI Absorption Factors

- Congener differences. Ecology previously presented to the MTCA SAB congener-specific per cent bioavailability estimates for soil bound dioxins/furans. Ecology's proposed congener-specific estimates of bioavailability (the lower degree of chlorination being more bioavailable than the higher degree of chlorination for the dioxin/furan congeners) was rejected by the MTCA SAB and questioned by EPA Region 10 and Washington's Department of Health based on the following:

  1. The range, variability, and uncertainty of the results from studies that tried to evaluate congener specific patterns of bioavailability for the soil bound dioxins/furans; and
  2. The unknown composition of the soils in the absorption/bioavailability studies and the lack of comparability to soils found in Washington state.

  Two studies (Wendling et. al., 1989; and Wittsiepe et. al., 2007) evaluated congener-specific patterns of bioavailability using guinea pigs and minipigs showing a range of bioavailability estimate of < 1% to > 20% from Times Beach, MO, Newark, NJ, soils and sludge contaminated soils from Hamburg, Germany. In support of Ecology's evaluations of the absorption of soil bound dioxins/furans, the Washington Department of Health reviewed how the degree of chlorination affects oral absorption of soil bound dioxins/furans. The Department of Health found no simple or predictable pattern of absorption based on the degree of chlorination for the congeners of dioxins/furans bound to soils. The Department of Health's conclusions were based on the following studies related to congener-specific patterns of absorption:

  - Two studies suggest that more chlorines leads to lower absorption [(Wendling et. al., 1989) with five congeners; (Birnbaum and Couture, 1988) with OCDD only]

  - Two studies found no pattern, with 2,3,7,8-TCDD often more poorly absorbed than congeners with five, six, seven, or eight chlorines (Wittsiepe et. al., 2007) with 17 congeners; (Van den Berg et. al., 1987) with nine congeners.

  - One study found no pattern based on in vitro bioaccessibility, with 2,3,7,8-TCDD often less bioaccessible than congeners with more than four chlorines (Ruby et. al., 2002) with 17 congeners.

Issue 3-6: Should Ecology consider multiple exposure pathways when establishing soil cleanup levels for mixtures of dioxins and furans?

Summary of Proposed Rule

Current MTCA rule language addresses when additive risk should be considered in circumstances where multiple exposure pathways are present at a site. Specifically, WAC 173-340-708(6)(b) states that adjustments to cleanup levels for multiple exposure pathways only need to be made "…if exposure through multiple pathways is likely to occur at a site and, with the adjustment, the hazard index would exceed one (1) or the total excess cancer risk would exceed one in one hundred thousand ($1X10^{-5}$)."

WAC 173-34-740(3)(c)(iii) states that the dermal exposure pathway must be considered for non-petroleum substances only when site-specific adjustments to the default exposure assumptions would result in a significantly higher soil cleanup level than would be normally calculated without these adjustments.

Ecology did not propose to revise these rule provisions.

Public Comments and Concerns

Several organizations and individuals recommended that Ecology consider other soil-related pathways when establishing soil cleanup levels for mixtures of dioxins and furans. For example:

> *The dermal adsorption pathway of dioxin conagers* [*sic*] *should also be considered in establishing the MTCA standard for maximum sediment concentration for dioxin cleanup at contaminated sites. Again, the risks to human and environmental health from dermal exposure to these contaminants demand a high level of protection to the public from exposure.* ***(Beckett Stanley, Sierra Club Cascade Chapter, p. 1.)***

> *In addition, other exposures routes should be numerically factored in including dermal exposure (which may be more important than ingestion), food ingestion, and inhalation of dust blown off of soil areas.* ***(Heather Trim, People for Puget Sound, p. 2.)***

However, other organizations and individuals expressed the opinion that it made no sense to consider additional pathways because of the large amount of conservatism built into the rule. For example:

> *WAC 173-340-708(10)(c) states that if modification of a default value results in a modification to soil clean-up levels (SCL) that is significantly higher, then risk from other pathways will be taken into account…. This is vague as there is no method or criteria for deciding what constitutes significant. Given the large element of conservatism built into this rule, a 10-fold shift to a less stringent clean-up level might not be significant from a scientific or risk standpoint, but might create public perception issues. Ecology should develop some guidance on this and offer it for public comment. Also, if good science shows the criteria for deciding soil clean-up levels should be higher in a particular situation, then that determination would have considered acceptable risk. It makes no sense to pile on other pathways in this one situation..*
>
> *<u>Recommendation</u>: WAC 173-340-708(10)© should be deleted or not applied to dioxins/furans mixtures as Ecology is adding even more conservative assumptions than it uses for other chemical mixtures.* ***(Grant Nelson, Association of Washington Business, p. 3.)***

One person expressed concerns about how the revised procedures would be implemented in situations where a site-specific risk assessment was prepared to support site-specific decisions:

On a broader level, the provisions relating to how dioxins/furans are evaluated for soil under Method B are also likely to be applied to multi-pathway site-specific risk assessments conducted under MTCA. This would impact assessments involving direct contact with sediment, and consumption of fish, shellfish, fruits, vegetables, game, livestock, or milk, among other pathways. (Locke 2007). ***(Mark E. Madsen, City of Port Angeles, p. 4 of attached technical memorandum.)***

Ecology's Response to Public Comment

The current MTCA rule language reflects recommendations made by the MTCA PAC in 1996. No changes were proposed to these rule provisions.

The issue of additive risk for multiple exposure pathways was considered during the 2001 rule amendment process. The reasoning behind the current rule language is discussed under issue 9.7.4 on pages 144-146 of the 2001 rule amendments concise explanatory statement (Ecology, 2001). Ecology believes the current rule language sufficiently addresses this issue.

Similarly, the issue of concurrent dermal exposure and soil ingestion was extensively considered during the 2001 rule amendment process, culminating in the current rule language. A discussion of the dermal exposure pathway can be found under issue 12.2 on pages 216 to 220 of the 2001 rule amendments concise explanatory statement (Ecology, 2001b) and on pages 37 and 38 of the final EIS for those amendments (Ecology, 2001c).

Specifically for dioxin/furan mixtures, inclusion of the dermal exposure pathway would result in about a 10% reduction (from 11 ppt to 10 ppt) in the proposed Method B soil direct contact cleanup level using typical exposure assumptions. Ecology does not believe this is sufficiently significant to warrant routinely including this exposure pathway. However, when less soil ingestion is assumed in risk calculations, this results in less intake through the soil ingestion pathway, and the dermal exposure pathway becomes potentially more important. While Ecology does not see a need for any changes to the approach in the rule at this time for dioxin/furan mixtures, we do expect the broader issue of concurrent soil ingestion and dermal exposure to be a topic for review under the five-year review process.

Issue 3-7: Should the rule be amended to clarify how undetected congeners are considered when calculating risk for mixtures of dioxins and furans?

Ecology's Proposal

The MTCA rule currently has language addressing what to do when determining compliance with cleanup levels at sites with samples with "undetected" concentrations. For example, WAC 173-340-740(7)(f) provides the following guidance for evaluating compliance with soil cleanup levels:

> ***(f)*** *When using statistical methods to demonstrate compliance with soil cleanup levels, the following procedures shall be used for measurements below the practical quantitation limit:*
>
> > ***(i)*** *Measurements below the method detection limit shall be assigned a value equal to one-half the method detection limit when not more than fifteen percent of the measurements are below the practical quantitation limit.*

(ii) *Measurements above the method detection limit but below the practical quantitation limit shall be assigned a value equal to the method detection limit when not more than fifteen percent of the measurements are below the practical quantitation limit.*
(iii) *When between fifteen and fifty percent of the measurements are below the practical quantitation limit and the data are assumed to be lognormally or normally distributed, Cohen's method shall be used to calculate a corrected mean and standard deviation for use in calculating an upper confidence limit on the true mean soil concentration.*
(iv) *If more than fifty percent of the measurements are below the practical quantitation limit, the largest value in the data set shall be used in place of an upper confidence limit on the true mean soil concentration.*
(v) *The department may approve alternate statistical procedures for handling nondetected values or values below the practical quantitation limit.*
(vi) *If a hazardous substance or petroleum fraction has never been detected in any sample at a site and these substances are not suspected of being present at the site based on site history and other knowledge, that hazardous substance or petroleum fraction may be excluded from the statistical analysis.*

Ecology did not propose to revise this provision or similar language in other parts of MTCA rule.

Public Comments and Concern

One organization recommended that undetected congeners not be included in the TEQ calculation:

> *Because of the large number of congeners, the treatment of undetected congeners (e.g., as one-half the detection limit, the detection limit, or zero) can affect the outcome of the risk assessment., the assumption is that Ecology would likely require that undetected congeners be included in the TEQ calculation using one-half their detection limit. Although increases in TEQ concentrations resulting from inclusion of undetected congeners and changes in TEF methods are relatively small, these changes can result in exceeding the low cleanup level that would result from the proposed rule amendment.* ***(Mark E. Madsen, City of Port Angeles, p.4, 5 of attached technical memorandum.)***

Ecology's Response to Public Comment

Ecology agrees that the treatment of undetected congeners can affect the outcome of risk assessments and compliance evaluations. As described above, MTCA already has language addressing handling of samples with "undetected concentrations." Because of the limited number of samples with full dioxin/furan congener analysis and the difficulty of applying the default approach to mixtures, actual practice at most dioxin/furan contaminated sites is to use the following alternative statistical procedure under WAC 173-340-740(7)(f)(v):

- For congeners that occur at the site but not in the sample of concern, assign one-half the detection limit for compliance calculations; and

- For congeners not detected in any samples at a site, assign a value of zero for compliance calculations (assuming Ecology approved detection limits were used).

Ecology expects the above described practice to continue under the adopted rule. The primary concern of automatically zeroing out all values that are undetected is that this creates an incentive to use higher detection limits, so congeners are not detected and the site risk is underestimated. Similarly, using the detection limit to represent undetected congeners may overstate the risk at a site. Ecology believes that

using one-half the detection limit creates an incentive to use more sensitive analytical techniques with lower detection limits while not over or understating the risk at a site. Ecology's experience with TEQ calculations for samples with low levels of dioxins is that using one-half the detection limit does not result in samples exceeding the cleanup level provided reasonable detection limits are used. Furthermore, assigning zero to undetected congeners can result in a larger coefficient of variation in the data set. This increases, rather than decreases, the chance that a site (or portion of a site) would be found to exceed the cleanup level when statistics are used to determine compliance.

Issue 3-8: Will the proposed rule revisions result in cleanup levels that are below background concentrations commonly found in Washington?

Ecology's Proposal

The MTCA Cleanup Regulation establishes policies and procedures for considering background concentrations of hazardous substances when setting cleanup standards and selecting cleanup actions.

- **Natural background** is defined as "…the concentration of hazardous substance consistently present in the environment that has not been influenced by localized human activities…." Under the existing MTCA rule, the cleanup standard cannot be more stringent than natural background concentrations (see WAC 173-340-705(6)). WAC 173-340-709 states that a minimum oftensamples must be analyzed to define natural background. For regulatory purposes, natural background concentration is defined using the higher end of the background distribution (typically the 90th percentile value). Ecology uses an upper percentile value to reduce the possibility of erroneously concluding that human activities have caused site concentrations to exceed risk-based standards. If a risk based cleanup standard is lower than the natural background concentration, the standard is adjusted upward to natural background. Cleanup of contamination below natural background concentrations is not required.

- **Area background** is defined as "…the concentrations of hazardous substances that are consistently present in the environment in the vicinity of the site which are the result of human activities unrelated to releases from that site…." Under the existing rule, area background may be factored into the remedy selection process if this is an issue at a site. Essentially, sites may delay cleanup of contaminant concentrations below area background if the site will be recontaminated by the other sources of contamination in the area (see WAC 173-340-360). WAC 173-340-709 states that a minimum of 20 samples must be analyzed to define area background concentrations. For regulatory purposes, area background is defined using the higher end of the range of reported results (typically the 90th percentile value). Ecology uses an upper percentile value to reduce the possibility of erroneously concluding that site-related releases have caused site concentrations to exceed risk-based standards when those exceedances are due to other human activities that are not related to that particular site.

Ecology did not propose to revise these provisions.

Public Comments and Concerns

Several organizations expressed concerns that proposed rule revisions will result in cleanup levels below background levels. For example:

> *I do think in a lot of cases you're going to end up with PAH, and even in some cases dioxin cleanup levels, that are 2 to 7 times lower than an area background. Area background in this*

case is being defined by samples of the surface soil that are collected from people's yards outside of any known influence from an industrial activity or even a plume. ***(Clay Patmont, Testimony at May 10, 2007 Public Hearing.)***

Particularly in developed areas, background dioxin/furan concentrations from individual samples-and in some cases even the mean of all samples, will often be likely to exceed the Method B cleanup level, unnecessarily triggering further action. The TEQ cleanup level should explicitly account for the fact that background concentrations in developed areas can reach 22 ng/kg and above, and that site-specific action is unnecessary at these concentrations…. Ecology concluded that the "proposed rule establishes a cleanup level that is on the high end of the range of background concentrations found in Washington State" and therefore this " ...should minimize investigative costs" (Ecology 2007b). However, the available background data indicate that if Ecology adopts the proposed 11 ng/kg TEQ cleanup level, it is likely that a number of samples from developed areas in the state will have dioxin concentrations exceeding this level. Thus, the proposed rule would more likely result in increased costs associated with investigating sites where dioxin/furan concentrations are consistent with background. If soil from nearby communities is sampled as a part of site actions, these areas may be found to exceed the cleanup level because of background levels, thereby generating fear of cancer and other health risk in the community and potentially resulting in stigma, loss of property values, and difficulty obtaining mortgages. Common nonpoint sources of dioxins in soils include deposition of emissions or ashes from wood and trash burning, as well as vehicle emissions. Without adequate characterization of background levels and clear guidance about how background will be addressed for dioxins/furans, it is difficult if not impossible to perform a cost-benefit analysis (i.e., assess the negative and positive impacts) of this proposed rule revision. ***(Mark E. Madsen, City of Port Angeles, p. 1-2 of attached technical memorandum.)***

Ecology has found that background levels of dioxin mixtures in soil around the state range from 0.0078 to 19.5 parts per trillion (ppt) of dioxin TEQ. In British Colombia, 53 background soil samples resulted in a range of less than 1 ppt TEQ to over 50 ppt TEQ….

… Ecology needs to somehow account for background in a manner that makes sense. The rule, when viewed in its entirety, lacks this feature. Again it needs to be pointed out that had Ecology conducted the MTCA amendment process as part of the comprehensive review, this proposal could have been integrated in a much more logical manner.

<u>Recommendation</u>: It may make sense to consider background levels as part of a screening level analysis as this gives some insight to total risk; however background should be considered before making any final remediation decisions ***(Grant Nelson, Association of Washington Business, p. 4.)***

It may be that the proposed Method B cleanup levels are overly stringent and may be comparable to background soil levels. In the 1998 report "Preliminary Screening Survey for Metals and Dioxin in Fertilizers, Soil Amendments, and Soils in Washington State," Ecology documents chlorinated dioxin/furan concentrations that approach or even exceed the proposed cleanup level of 11 ppt TEQ (Fourteen samples of urban soils from public parks with a range of 0.13 to 19 ppt TEQ; eight samples of forest soils with a range of 0.033 to 5.2 ppt TEQ.) EPA's 2003 report titled "Levels of CDD, CDF and PCB congeners in Environmental Media and Food" presents much concurring information. At this point the number of samples collected by Ecology to characterize chlorinated dioxin/furan (or c-PAHs) soils in Washington is below the 20 or more samples that WAC 173-340-709 requires for defining background concentrations. ***(Ken Johnson, Weyerhaeuser, p. 4.)***

As noted above, if a risk based cleanup standard is lower than the natural background concentration, the standard is adjusted upward to natural background. Cleanup of contamination below natural background concentrations is not required.

In 1998, the Department of Ecology sampled soils in numerous locations throughout Washington State to define typical concentrations of dioxin in soils throughout the state.[21] This data is summarized in Table 12.

Table 12: Typical Concentrations of Dioxin and Furan Mixtures in Surficial Soils in Washington State and MTCA Background

Land Use	Number of Samples	Range of TEQ (ppt)	Mean TEQ (ppt)	Median TEQ (ppt)	Background TEQ (ppt)*
Forested Land	8	0.033 – 5.16	2.3	2.2	4.8
Open Areas	8	0.04 – 4.59	1.0	0.2	1.0
Urban Areas	14	0.133 – 19.5	4.1	1.7	7.7
Forested & Open	16	0.033 – 5.16	1.7	0.8	2.2
All Combined	30	0.033 – 19.5	2.8	1.2	3.9

*Upper 90% or 4X50%, whichever is less (WAC 173-340-709(3)(c)

Based on the above sampling, the natural background TEQ for dioxin/furan mixtures in Washington soils is estimated at 2.2 ppt. This is the calculated background TEQ for sampling data combined from forested and open areas, areas unlikely to be influenced by localized human activity. The number of samples in this data set (16) meets the minimum requirements for establishing natural background under the MTCA rule. The proposed Method B soil cleanup level of 11 ppt TEQ is well in excess of this concentration. Thus, extra expenses are not anticipated to distinguish site impacts from natural concentrations at most sites.

Area background is a site specific determination, so Ecology's dioxin study cannot be used to establish a generic urban area background concentration. However, based on information in this report, it appears the proposed Method B soil cleanup level is higher than typical urban background TEQ found in Washington State (7.7 ppt). Thus, the Method B soil cleanup level for dioxins appears to be sufficiently different from urban area background concentrations that extra expenses are not anticipated to distinguish site impacts from area background concentrations at most sites.

[21] Screening Survey for Metals and Dioxins in Fertilizers, Soil Amendments, and Soils in Washington State, Ecology Publication #98-331, 1998.

Chapter 4: Polycyclic Aromatic Hydrocarbons (PAHs)

4.1 Introduction

Polycyclic Aromatic Hydrocarbons, PAHs, are a group of chemicals formed during the incomplete burning of organic materials such as wood, garbage, oil, coal, gas, and tobacco. There are more than 100 different PAHs.

EPA (1993) published provisional guidance in 1993 (EPA, 1993) for evaluating the carcinogenic risks associated with PAH mixtures using a relative potency factor (RPF) approach. The EPA (1993) approach uses benzo(a)pyrene as the index chemical (i.e., having a relative potency of 1.0) and includes relative potency factor (RPF) values for seven carcinogenic PAHs.

Cal-EPA (1994) expanded upon the EPA approach when it developed TEFs for use in evaluating PAH mixtures. As with the EPA approach, the total toxicity equivalent concentration of the mixture is represented by the sum of the products of the TEF and the respective carcinogenic PAH compound concentrations.

In February 2001, Ecology revised WAC 173-340-708(8) by adding new provisions applicable to PAH mixtures. Specifically, the rule states that cleanup proponents may use the TEF methodology developed by the Cal-EPA when assessing the potential carcinogenic risk of mixtures of carcinogenic PAHs.

In April 2007, Ecology proposed to revise the methods and policies used to establish cleanup levels for PAH mixtures.

- Ecology proposed to amend WAC 173-340-708(8) to require that cleanup levels for PAH mixtures of be based on a cancer risk of 10^{-6}. The revisions modify how the current rule establishes Method B cleanup levels for carcinogenic PAH mixtures. Using the current rule, Method B cleanup levels can be established for individual PAH compounds are based on a cancer risk of 10^{-6}, and the total site risk (taking into account all seven PAH compounds) cannot exceed 10^{-5}.

- Ecology proposed to amend the rule to require people to use the most current TEF values to evaluate PAH mixtures. The most current values were published by the Cal-EPA (2005). Ecology also added new rule language to explain how people should use the TEF methodology when establishing and evaluating compliance with cleanup levels.

- Ecology proposed to amend WAC 173-340-708(8) to require cleanup proponents to consider the physical-chemical properties of individual PAH compounds, PCB compounds, or dioxin-congeners when evaluating cross-media impacts.

A considerable number of individuals and organizations provided comments on the proposed revisions. The principal issues raised during the public comment period were the following:

Issue 4-1: Should Ecology reconsider the use of the TEF approach for evaluating risk and calculating cleanup levels for PAHs in the MTCA Cleanup Regulations?

Issue 4-2: Should Ecology revise the MTCA rule to require use of the latest PEFs developed by the Cal-EPA when evaluating the human health risks of PAH mixtures?

Issue 4-3: Should Ecology revise the MTCA rule to require that Method B cleanup levels for carcinogenic PAH mixtures be based on a cancer risk of 10-6?

Issue 4-4: Should Ecology retain the current rule language that provides the discretion to require evaluation of additional PAH compounds at individual sites?

Issue 4-5: Will the proposed rule revisions result in cleanup levels that are below PAH concentrations commonly found in Washington?

Issue 4-6: Will the proposed rule revisions limit options for sediment cleanups with PAH contamination?

Issue 4-7: Are analytical methods available for the additional carcinogenic PAHs?

Issue 4-8: Should Ecology establish an exemption for asphalt used in construction projects?

4.2 Ecology's Review and Response to Public Comment

Issue 4-1: Should Ecology reconsider the use of the TEF approach for evaluating risk and calculating cleanup levels for PAHs in the MTCA Cleanup Regulations?

Ecology's Proposal

In February 2001, Ecology revised WAC 173-340-708(8) by adding new provisions applicable to PAH mixtures. Specifically, the rule states that cleanup proponents may use the TEF methodology developed by the Cal-EPA when assessing the potential carcinogenic risk of mixtures of carcinogenic PAHs.

In April 2007, Ecology proposed to continue to use the Cal-EPA methodology to evaluate the carcinogenic risks of PAH mixtures.

Public Comments and Concerns

Many organizations questioned Ecology's proposal to use the Cal-EPA methodology to assess the potential carcinogenic risks of PAHs (See issue 4-2). However, one organization also appeared to question the continued use of the TEF approach for PAH mixtures:

> *The vast majority of federal and state environmental programs do not advocate the use of the TEF approach for PAH…. …Ecology adopted the Cal EPA approach years ago by reference in the MTCA regulations and perhaps feels the need to continue, but the lack of general acceptance of the approach, even after many years of evaluation and review, argues to the contrary….The TEF approach for dioxins and furans is based on a large base of technical experimental data, reviewed extensively by many individuals and bodies in the international community. Even the dioxin-like PCB data rests, arguably, on a fairly deep technical basis. In contrast, the PAH data is sparse.* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 10, 8-9 of attached comments.)***

Ecology's Response to Public Comment

Ecology has reviewed the use of the TEF for evaluating the health risks associated with exposure to PAH mixtures. Based on that review, Ecology continues to believe that it is appropriate to use this methodology to establish and evaluate compliance with cleanup levels. In reaching this conclusion, Ecology considered the following factors:

- The TEF methodology has a strong scientific and biological basis. PAHs are a well defined group of chemicals consisting of three or more fused aromatic rings. The carcinogenicity of PAHs is due to the generation of biologically active metabolites which covalently bind to DNA. This is considered a common mode of action for all carcinogenic PAHs (EPA, 1993; Naz, 1999).

- The MTCA SAB reviewed and endorsed Ecology's use of the TEF approach for characterizing PAH mixtures during the 2001 rulemaking process.

- EPA and most other state environmental agencies use some type of relative potency approach to characterize PAH mixtures.

Ecology's response to Issue 4-2 provides additional information on this issue.

Issue 4-2: Should Ecology revise the MTCA rule to require use of the latest PEFs developed by Cal-EPA when evaluating the human health risks of PAH mixtures?

Ecology's Proposal

In February 2001, Ecology revised WAC 173-340-708(8) by adding new provisions applicable to PAH mixtures. Specifically, the rule was amended to state that cleanup proponents may use the PEF methodology developed by the Cal-EPA in 1994 when assessing the potential carcinogenic risk of mixtures of carcinogenic PAHs or assume the entire carcinogenic PAH mixture is equally potent to benzo(a)pyrene.

In April 2007, Ecology proposed to continue to use the California methodology to evaluate the carcinogenic risks of PAH mixtures. However, Ecology proposed to revise the rule to require people to use the most current PEF values developed by Cal-EPA in 2005. Ecology also proposed to eliminate the option for people to treat the entire mixture as equally potent as benzo(a)pyrene.

Public Comments and Concerns

Several organizations expressed support for Ecology's proposal to revise the MTCA rule to require use of the Cal-EPA TEF values for PAH mixtures. For example:

> *In general, these rule revisions are well-founded in science and will benefit the public and wildlife in Washington State. I would like to especially note the proposals to use Toxicity Equivalency Factors for PAH mixtures….* ***(Wendy Steffensen, North Sound Baykeeper, p. 1.)***
>
> *We appreciate that Ecology is using the most current scientific information to set cleanup standards….* ***(Heather Trim, p. 2.)***

Ecology also received comments from over three hundred Washington citizens who expressed support for Ecology's proposal to based cleanup levels on the most current PEF values developed by Cal-EPA (See Appendix B).

However, other organizations questioned the basis for using the Cal-EPA PEF values rather than the 1993 EPA values. Several organizations recommended that Ecology use the 1993 EPA values. For example:

> *Ecology should drop the use of the Cal EPA OEHHA approach for PAH evaluation and adopt the more universally-accepted USEPA approach, as an optional alternative to individual component evaluation.* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 6 of attached comments.)***

> *In 1993, EPA stated in its provisional guidance that there was limited data for benzo(a)pyrene (BaP), the most widely studied PAH compound, but that there were even less for the other PAHs. In 2005, this fact remains, as Cal EPA notes, "OEHHA staff concluded that while the studies available for carcinogenic risk assessment of BaP are not ideal for risk assessment, those for practically all other individual PAHs are less complete for risk assessment…" (OEHHA, 1993). Although this reference was made in 1993, the 2005 update does not state that this data paucity has been corrected…Ecology argued in 2001 that the Cal evaluations were superior to the USEPA evaluation because it includes one drinking water study for one compound, one interpulmonary study for another, and one skin-painting study for a third. Why this makes the evaluation stronger, or a comparison more viable than the USEPA approach is unclear. The Cal EPA evaluations are based, for many compounds, on only one or two studies.* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, pp. 7, 8 of attached comments.)***

Ecology's Response to Public Comment

Ecology has reviewed the comments on this issue and continues to believe the California EPA potency equivalency factors provide a sound basis for establishing MTCA cleanup levels for mixtures of carcinogenic PAHs. The rationale for this decision includes:

- The Cal-EPA methodology has a strong scientific and biological basis. PAHs are a well defined group of chemicals consisting of three or more fused aromatic rings. PAHs are ubiquitous multi-media contaminants commonly found as complex environmental mixtures. The carcinogenicity of PAHs is due to the generation of biologically active metabolites which covalently bind to DNA and is considered a common mode of action for all carcinogenic PAHs (EPA, 1993; Naz, 1999). When preparing the 2001 rule amendments, Ecology concluded that Cal-EPA (1994) values had broader applicability than the EPA (1993) values:

  > *EPA's TEFs are all based on dermal studies which is good for internal relative ranking but may not be good for applying to ingestion or inhalation exposures. In fact, EPA explicitly cautions against applying their TEFs to inhalation exposures. Instead, EPA proposes that their TEFs be applied only to ingestion exposure and is silent on the issue of dermal exposure (which is surprising, since their TEFs are based on mouse skin painting). In contrast, Cal-EPA TEFs are based on a variety of exposure routes, including a drinking water study for dibenzo(a,h)anthracene (Snell and Stewart, 1962), an intrapulmonary study for benzo(k)fluoranthene (Deutsch-Wenzel et al, 1983), and a skin painting study for chrysene (Wynder and Hoffman, 1959). In general, Cal-EPA TEFs were based on tumor data from relevant exposure routes (i.e., intrapulmonary and intratracheal administration, since Cal-EPA TEFs were targeted at air contaminants), tumor data from other exposure routes, genotoxicity data, and structure-activity relationships (SARs), in that order. Because Cal-EPA TEFs were based on a broader array of carcinogenic endpoints, these appear to have more general applicability (e.g., for route to route extrapolation) than EPA's approach based on a single endpoint. (Ecology SAB Briefing Memorandum, 1998)*

- The Cal-EPA methodology and values are based on current scientific information. Cal-EPA (2005) considered the most recent scientific information evaluating individual tumorigenic responses for 25 carcinogenic PAHs when updating the 1994 values. Scientists at EPA Region 10 agree that the current Cal-EPA's TEFs provide a scientifically valid way to evaluate the health risks of PAH mixtures

- The MTCA SAB has concluded that the Cal-EPA methodology and values are consistent with current scientific information. The MTCA SAB reviewed and endorsed Ecology's use of the original Cal-EPA values during the 2001 rulemaking process. Ecology believes that the use of the updated Cal-EPA values is a logical extension of the initial decision to use the original Cal-EPA values. After reviewing Ecology's current rule proposal, the MTCA SAB concluded:

  > *The Board stated that the 2005 PEF values for carcinogenic PAHs recommended by the California Environmental Protection Agency are consistent with current scientific information. As with dioxins and furans, the Board stated that it was fortuitous that the California EPA had recently completed a review and evaluation of available scientific information and published updated PEF values for carcinogenic PAHs. The Board noted that Cal-EPA considered a wide range of studies when establishing PEF values. The Board also observed that the California document describing the methodology provides information that is useful for Ecology as it proceeds with the MTCA rule update. (MTCA Science Advisory Board, 2007)*

- The 2005 TEF values are similar to the TEF values specified in the current MTCA rule. The updated Cal-EPA values are similar to TEF values in 1994 Cal-EPA guidance materials. As indicated in Table 13, the 1994 and 2005 Cal-EPA approaches include identical TEF values for six of the seven carcinogenic PAHs typically assessed at cleanup sites. The exception is dibenzo(a,h)anthacene which has a lower value in the updated guidance. While this difference may impact conclusions on individual samples, Ecology does not believe that the use of the more current TEF values will significantly alter the stringency of cleanup requirements on a statewide basis.

- The 2005 TEF values are consistent with values used by EPA and other state agencies to characterize PAH mixtures. EPA and most other state environmental agencies use some type of relative potency approach to characterize PAH mixtures. Ecology recognizes that EPA and most states use the methodology and values specified in an EPA guidance document (EPA 1993). However, the Cal-EPA approach is conceptually similar to the EPA approach. It is also important to recognize that the two approaches establish identical TEF values for four of the seven PAH compounds on the EPA list.

Table 13: Comparison of Relative Potency Factors (RPFs) and Toxicity Equivalency Factors (TEFs) for Polycyclic Aromatic Hydrocarbons

Polycyclic Aromatic Hydrocarbon	Relative Potency Factors (RPF) (EPA, 1993[22])	Toxicity Equivalency Factors (TEF) (Cal-EPA, 1994[23]) (Current MTCA)	Toxicity Equivalency Factors (TEFs) (Cal-EPA, 2005[24]) (Planned Revisions)
Benzo(a)pyrene	1.0	1.0	1.0
Benz(a)anthracene	0.1	0.1	0.1
Benz(b)fluoranthene	0.1	0.1	0.1
Benz(j)fluoranthene	---	0.1	0.1
Benz(k)fluoranthene	0.01	0.1	0.1
Dibenz(a,j)acridine	---	0.1	0.1
Dibenz(a,h)acridine	---	0.1	0.1
7H-dibenzo(c,g)carbazole	---	1.0	1.0
Dibenzo(a,e)pyrene	---	1.0	1.0
Dibenzo(a,h)pyrene	---	10.0	10.0
Dibenzo(a,i)pyrene	---	10.0	10.0
Dibenzo(a,l)pyrene	---	10.0	10.0
Indeno(1,2,3-cd)pyrene	0.1	0.1	0.1
5-methylchrysene	---	1.0	1.0
1-nitropyrene	---	0.1	0.1
4-nitropyrene	---	0.1	0.1
1,6-dinotropyrene	---	10.0	10.0
1,8-dinotropyrene	---	1.0	1.0
6-nitrochrysene	---	10.0	10.0
2-nitrofluorene	---	0.01	0.01
Chrysene	0.001	0.01	0.01
Dibenz(a,h)anthracene	1.0	0.4	0.1
7,12-dimethylbenzanthracene	---	---	10.0
3-methylcholanthrene	---	---	1.0
5-nitroacenaphthene	---	---	0.01

Issue 4-3: Should Ecology revise the MTCA rule to require that Method B cleanup levels for carcinogenic PAH mixtures be based on a cancer risk of 10^{-6}?

Summary of Proposed Rule

Ecology proposed to revise WAC 173-340-708(8) to state that carcinogenic PAH mixtures will be considered a single hazardous substance for assessing carcinogenic risk under MTCA. Under this

[22] U.S. EPA, 1993. Provisional Guidance for Quantitative risk Assessment of Polycyclic Aromatic Hydrocarbons. July 1993. EPA/600/R-93/089.
[23] Cal-EPA, 1994. Benzo(a)pyrene as a toxic air contaminant. Part B: Health Assessment, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Berkeley, California
[24] Cal-EPA, 2005. Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II Technical Support Document for Describing Available Cancer Potency Factors. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. May 2005. Pages B-77 to B-97.

approach, Method B cleanup levels for mixtures of carcinogenic PAHs must be based on a cancer risk of 10^{-6}.

The revisions modify how the current rule establishes Method B cleanup levels for carcinogenic PAH mixtures. Using the current rule, Method B cleanup levels can be established for individual PAH compounds are based on a cancer risk of 10^{-6}, and the total site risk (taking into account all seven PAH compounds) cannot exceed 10^{-5}.

Public Comments and Concerns

Ecology received comments from over three hundred Washington citizens who expressed support for Ecology's proposal to based cleanup levels for PAHs on a cancer risk level of 10^{-6}.

Several local, statewide and national organizations also expressed support for Ecology's proposal to establish Method B cleanup levels for carcinogenic PAH mixtures using a cancer risk of 10^{-6}. For example:

> *We appreciate Ecology's efforts in establishing the Model Toxics Control Act rule for soil cleanup levels and mixtures of , PAH's using the strongest cancer risk level of 1 in a million or 10 to 6 .* ***(Kat Hall, Lands Council, Testimony at May 17, 2007 Public Hearing.)***
>
> *In general, these rule revisions, are well-founded in science and will benefit the public and wildlife of Washington State. For that, Ecology is to be commended. I would like to especially note that the proposals to revise the clean up levels for mixtures of PAH's with similar mechanisms to 1x 10-6 are solid proposals.* ***(Wendy Steffensen, North Sound Baykeeper, p. 1.)***
>
> *CHEJ supports the Washington State Department of Ecology Toxics Cleanup Program's (Ecology) proposal to require that cleanup levels for mixtures of dioxins and furans, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) be based on a cancer risk value of one-in-one million.* ***(Stephen Lester, Center for Health, Environment & Justice, p. 1.)***

However, several other organizations and individuals expressed the opinion that it was inappropriate to establish cleanup levels for carcinogenic PAH mixtures using a cancer risk level of one-in-a-million. They recommended that Ecology retain the current rule language and establish cleanup levels for individual carcinogenic PAH compounds using a cancer risk level of 10^{-6}. These organizations and individuals presented several lines of reasoning to support their recommendations:

> *Ecology has provided no support for mandating a 1 x 10-6 cleanup level for these three types of mixtures while continuing to allow all other hazardous substance groups to be subject to a maximum cleanup level of 1 x 10-5.* ***(Dana Dolloff, Rayonier Properties LLC, p. 24 of attached comments.)***
>
> *In response to Ecology's request for comments on this issue, AWB offers that it makes no scientific sense to set one risk level for one set of chemicals and a different risk for another set. What is important is overall risk.* ***(Grant Nelson, Association of Washington Business, p. 4.)***
>
> *Under the proposed rule change, PAH mixtures will be treated differently than other mixtures. This difference I think exposes the agency to the argument of being arbitrary, when I don't think that is clearly the intent. So I think parity under the rule for different compounds is important unless there is a compelling scientific for a different approach.* ***(Mark Larsen, Testimony at May 10, 2007 Public Hearing.)***

It has not been made clear why this risk reduction is justified for PAHs. The fact that the EPA has adapted the methodology of using Toxic Equivalency Factors for PAHs as well as dioxin/furans and PCBs in no way suggests the PAHs are as dangerous in the environment as dioxin/furans and PCBs. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 4 of attached comments.)***

Treating mixtures as single hazardous substances is inconsistent with MTCA's requirement to assign 1 x 10-6 cancer to individual carcinogens. MTCA's requirements to consider carcinogens individually imposes an additional degree of complexity not present in other regulations. Furthermore, some of the regulations listed allow cancer risk limits higher than the MTCA total limit of 1x10-5. ***(Jennie Goldberg, Seattle City Light/Seattle Public Utilities, pp. 1 & 2.)***

The proposed rule changes undermine the MTCA statutory and regulatory objective of basing cleanup decisions on good science. …Regulating some individual chemicals differently- as this proposed rule would do with respect to dioxins/furans, PAHs and PCBs – from others that pose the same risk is mere fiat and not scientifically justified, undermines the foundations of MTCA as a science-based law and lacks a scientific, regulatory or rational basis. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, pp. 4-5.)***

The proposed rule changes provide no practicable benefit with respect to risk reduction. The actual effect of lowering the MTCA risk limits for some individual carcinogenic compounds, but not others will result in significantly more cleanup effort, time and cost but will not reduce the risk posed by most of the sites where the rule changes are applicable. This is because the various individual carcinogenic compounds proposed for treatment as single compounds are usually found together at sites along with other carcinogenic compounds not addressed by these rule changes. Given that MTCA regulates total site risk from carcinogens at a 1 x 10-5 level, no net risk reduction is likely to result at most sites cleaned up under this proposed amendment. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 4.)***

Ecology's Response to Public Comment

Ecology has reviewed the comments on this issue and continues to believes that it is reasonable to establish Method B cleanup levels for carcinogenic PAH mixtures using a cancer risk of 10^{-6}. The rationale for this decision includes:

- <u>The proposed approach reflects public concerns about exposure to toxic chemicals</u>. Public concerns about health threats posed toxic chemicals have grown over the last decade as new information on toxicity and body burdens have become available. Ecology has undertaken several initiatives to reduce and cleanup sources of bioaccumulative chemicals in Puget Sound and other parts of the state.

- <u>Ecology believes that the proposed approach provides a margin of safety that minimizes the potential for health risks from PAH compounds that are not routinely considered when establishing cleanup levels for PAH mixtures.</u> WAC 173-340-708(8)(e) specifies that, at a minimum, seven carcinogenic PAH compounds [benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd) pyrene] must be evaluated when using the TEF approach to characterize carcinogenic PAH mixtures. However, scientific and regulatory agencies have identified a number of other PAH compounds as known or potential human carcinogens. For example, the National Toxicology Program (NTP, 2005) has identified 15 PAH compounds as "reasonably anticipated to be a human carcinogen". Cal-EPA has established potency equivalency factors for twenty-five

carcinogenic PAHs (2005). Under the proposed approach, the seven PAHs identified in the MTCA rule serve as surrogates or indicators for the broader suite of carcinogenic PAHs until analytical methods are developed for the other carcinogenic PAHs.

- Ecology believes that the proposed approach provides a margin of safety that minimizes the potential health risks resulting from early-life exposures to carcinogenic PAHs. Recent studies indicate that exposure to carcinogens during childhood can increase the risk of developing cancer later in life. In March 2005, EPA published the *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (EPA, 2005b) that describes approaches for using this information when assessing health risks. In that document, EPA identified benzo(a)pyrene, dimethylbenz(a)anthracene and dibenzo(a,h)anthracene as chemicals that have a mutagenic mode of action for carcinogenicity. In June 2006, EPA published guidance for implementing the Supplemental Guidance. EPA (2006) recommended that risk assessors use the age-dependent adjustment factors in the Supplemental Guidance when using the cancer potency factors for these compounds. The use of these factors is a broader issue that Ecology plans to consider during the five-year process.

- The proposed approach simplifies the approach for establishing MTCA cleanup levels. The MTCA Cleanup Regulation specifies that Method B and C cleanup levels established for individual hazardous substances based on a particular pathway (e.g., soil ingestion) must be adjusted downward to take into account exposure to multiple hazardous substances and/or multiple exposure pathways in situation where total excess cancer risk would exceed 10^{-5}. Treating PAH mixtures as a single hazardous substance minimizes the need to make such adjustments. This simplifies the process for establishing cleanup levels.

- The proposed approach is consistent with the policies and procedures used to establish the Method A cleanup levels in the current MTCA rule. This proposed approach was extensively discussed with the TPH POG during the 2001 MTCA rule making and developed based on those discussions. It is also consistent with the policies and procedures underlying the Method A soil cleanup levels.[25]

- The proposed approach is consistent with the policies and procedures used by several other Ecology programs. Several other Ecology programs have adopted approaches that are similar to this proposed approach. For example, The Air Quality Program treats PAH mixtures as a single toxic air pollutant when evaluating potential emissions from proposed new sources. Under this regulation, PAH emissions are compared to screening levels for mixtures of PAHs that are expressed in terms of benzo(a)pyrene.[26] The screening levels are based on an incremental cancer risk of one-in-one million (WAC 173-460-060). The Water Quality Program has established a ground water criterion for both PAHs and benzo(a)pyrene (Chapter 173-200 WAC). However, Ecology recognizes that not all programs use the same approach to evaluate/ regulate PAH mixtures. For example, the National Toxics Rule establishes surface water standards based on protection of human health and includes individual criteria for seven PAH compounds. Compliance is evaluated separately for each PAH compound.

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[25] When developing the Method A values, carcinogenic PAH mixtures were treated as a single hazardous substance and the Method A soil cleanup level was calculated using a target cancer risk of 10^{-06}

[26] For mixtures of PAHs, WAC 173-460-050 states "The owner or operator of a source that may emit a mixture of polyaromatic hydrocarbon emissions shall quantify the following PAHs and shall consider them together as one TAP equivalent in potency to benzo(a)pyrene: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h,)anthracene, indenol(1,2,3-cd)pyrene, benzo(a)pyrene." [WAC 173-460-050 (4) (iii) (c)].

- The proposed approach is consistent with approaches used by some EPA programs. There is also a great deal of variability in the approaches used by federal programs to evaluate/ regulate PAH mixtures. EPA has established a maximum contaminant level (MCL) for benzo(a)pyrene and compliance is evaluated based on benzo(a)pyrene measurements in drinking water. However, several federal programs implement approaches that are similar to the proposed approach. For example:

    - The EPA Superfund program continues to use the methods and procedures described in EPA (1993) and has reaffirmed the use of TEF methodology for carcinogenic PAHs considered as a single hazardous substance for the whole mixture by summing the carcinogenic potential of individual PAHs relative to an index compound (e.g., benzo(a)pyrene).[27]

    - EPA established emission limits for polycyclic organic matter, PAHs, as part of its list of 189 hazardous air pollutants using TEF methodology to evaluate the potential health risks from exposures to airborne particulate mater contaminated with PAHs.

- The proposed approach falls within the range of approaches use by other state environmental agencies. The Association of State and Territorial Solid Waste Management Officials (ASTSWMO) recently completed a survey of state screening levels and action levels (ASTSWMO, 2006). They found that "...[t]he cancer risk basis of the standards and guidelines reported by States ranged from a stringent one-in-ten million (1E-07) to one-in-ten thousand (1E-04). The majority of standards utilize the more typical one-in-one million (1E-06) risk level criteria...." Ecology reviewed the approaches being used by other environmental agencies to establish soil cleanup levels for dioxins and furan mixtures. Based on that review, it appears that most states establish soil cleanup levels for benzo(a)pyrene (not the whole mixture). However, Ecology's cleanup standards fall in the middle of the range of cleanup levels/screening levels used by other states. As shown in Table 14, several states establish cleanup levels that are significantly below the MTCA cleanup standards. In most cases, those states have adopted procedures for adjusting the cancer potency factor based on recent EPA guidance (*Supplementary Guidance for Assessing Susceptibility from Early Life Stage Exposure to Carcinogens.*[28]) As noted above, Ecology considered this information when evaluating whether to apply the 10^{-6} cancer risk level to individual PAH compounds or the whole PAH mixture. However, Ecology did not address the broader issue of whether and how to adjust the cancer potency factor. Ecology decided to defer this issue to the five-year rule review process because these types of adjustments are applicable to other hazardous substances found at MTCA cleanup sites.

- PAH mixtures differ from the majority of mixtures found at MTCA sites. Most MTCA sites include mixtures of hazardous substances. However, the mixtures addressed in this rulemaking differ from most other types of mixtures in that (1) the different PAH compounds generally occur together, and (2) scientists have concluded that the PAH compounds identified in the rule act

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[27] Lynn Flowers, Abstract:Toxicology of Polycyclic Aromatic Hydrocarbon (PAH) Mixtures. IRIS Staff, US Environmental Protection Agency. Presentation from Spring 2005 Society of Toxicology Meeting.

[28] Generally, cancer risks from childhood exposures to chemicals are evaluated based on methods that evaluate the chemical exposure to adults. This approach assumes chemicals are equally potent for inducing cancer risks from exposures in both early life and later life stages. For a selected group of chemicals with a mutagenic mode of action, available studies indicate higher cancer risks resulting from a given exposure occurring early in life when compared with the same amount of exposure during adulthood.

through common biological mechanisms and essentially behave like one chemical in the human body.[29]

Table 14: Approaches Used By Other Agencies When Evaluating PAH Mixtures

Agency	Benzo(a)pyrene ppb (ug/kg)	TEQ ppb (ug/kg)	State Target Risk
State Environmental Agencies			
Wisconsin	8.8		10^{-7}
Oregon	15		10^{-6}
Virginia	22		10^{-6}
California	38		10^{-6}
Idaho	42		10^{-6}
New York	61		10^{-6}
Wyoming	62		10^{-6}
Alabama	62		10^{-6}
Washington		140	10^{-6}
Delaware	87		10^{-6}
Mississippi	87.5		10^{-6}
W. Virginia	88		10^{-6}
Illinois	90		10^{-6}
Florida	100		10^{-6}
Iowa	310		10^{-6}
Maryland	330		10^{-6}
Indiana	500		10^{-6}
Ohio	512		n/a
Texas	560		10^{-5}
Arizona	610		10^{-6}
Missouri	620		10^{-5}
New Mexico	621		10^{-5}
Massachusetts	750		10^{-6}
Connecticut	1000		10^{-6}
Kansas	1200		10^{-5}
Minnesota	2000		10^{-5}
Michigan	2000		10^{-5}
Pennsylvania	2500		10^{-5}
Environmental Protection Agency			
EPA - Region 3	22		10^{-6}
EPA - Region 6	15		10^{-6}

[29] Polycyclic aromatic hydrocarbons are a well defined group of chemicals consisting of three or more fused aromatic rings. The carcinogenicity of PAHs is due to the generation of biologically active metabolites which covalently bind to DNA and is considered a common mode of actions for all carcinogenic PAHs (EPA, 1993; Naz, 1999). The TEF methodology is based on carcinogenic PAHs collectively producing a similar biological response – essentially acting as one chemical through a common mode of action.

EPA - Region 9	62		10^{-6}
EPA - Region 10	15		10^{-6}

Issue 4-4: Should Ecology retain the current rule language that provides the discretion to require evaluation of additional PAH compounds at individual sites?

Ecology's Proposal

Under the current rule, cleanup levels are generally based on the seven PAH compounds identified in the definition of "PAH (carcinogenic)." The current rule also states:

> *…[T]he department may require additional compounds from the Cal-EPA list to be included in the methodology should site testing data or information from other comparable sites or waste types indicate the additional compounds are potentially present at the site….*

Ecology proposed to continue to provide an option for the Department to consider other PAH compounds from the Cal-EPA list on a site-specific basis.

Public Comments and Concerns

Many organizations supported Ecology's proposal to continue to focus chemical testing and TEF calculations on the seven PAH compounds identified in the current rule:

> *We support Ecology's proposal to retain the focus on the seven CPAHs listed as "minimum required."* ***(Jennie Goldberg, City of Seattle, p. 4.)***

However, several organizations and individuals recommended that Ecology remove the provision related to evaluating additional PAH compounds. They expressed the opinion that this provision was unnecessary and unreasonable. For example:

> *Fluor believes Ecology should not expand its treatment of PAHs under MTCA, and should consider reducing the PEF approach to PAHs to guidance….* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 10, 8-9 of attached comments.)***

Fluor Hanford presented several lines of reasoning to support this recommendation:

> *Unlike the application of TEFs to dioxins and furans, the development and application of the PEF for PAHs is neither based on large amounts of data nor on technical review and acceptance by a wide variety of national and international scientists and regulators. …[I]ncorporation into regulation is not consistent with Ecology's requirements to apply sound and demonstrated science.* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 10, 8-9 of attached comments.)***

> *The vast majority of federal and state environmental programs do not advocate the use of the TEF approach for PAHs. The two programs that Ecology found that even mention the [TEF] approach as an option in guidance documents, use the seven USEPA PAH compounds to evaluate PAH mixtures. Ecology could find NO environmental program, outside of Washington, that requires the Cal EPA approach – even the California Department of Toxics*

Control does not…. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, pp. 6 of attached comments.)***

Regardless of the strength or weakness of the scientific basis or community acceptance, Ecology has no need to expand the universe of potential PAHs for regulation beyond the 7 for which there is broad consensus. Ecology has not required any cPAH other than the 7 USEPA-defined PAH compounds to be evaluated at any site. Fifteen of these appeared within a MTCA reference and have apparently been available to Ecology for application since 2001. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 10 of attached comments.)***

The proposed changes to the list of carcinogenic polycyclic aromatic hydrocarbons cPAH) adds an additional 18 compounds to the list of compounds used to characterize cPAH mixtures. Where it is true that these compounds may not be required, there is also the option that they may be. These additional compounds are not typically analyzed and so laboratories will have to do method development to determine the best means of detecting these additional compounds and optimizing the performance to ensure the lowest concentrations by which these additional compounds can be reliable reported.. In addition once the method is developed then it must be implemented. Currently the MTCA has seven cPAH that are used to characterize cPAH mixtures, so these additional compounds are quite a substantial increase. ***(Jennifer L. Holmes, Ph.D., p. 1.)***

The addition of more PAH compounds to an additive parameter such as total PAH increases the detection limit as a function of the TEF. Inclusion of all Cal EPA cPAHs would essentially guarantee a site owner would be unable to demonstrate compliance. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 9 of attached comments.)***

It opens the door to arbitrary field decisions that could waste precious resources, including chemical analytical method development, with no concomitant environmental benefit. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 10 of attached comments.)***

Ecology's Response to Public Comment

Ecology has reviewed the comments on this issue and continues to believe that it is reasonable to retain the current rule language on evaluating additional PAH compounds. Under this approach, Ecology will continue to focus on the seven PAH compounds classified as A (known human) or B (probable human) carcinogens[30] when establishing cleanup levels and cleanup action requirements. This is consistent with the approaches currently used by most regulatory agencies[31]. However, Ecology will also retain the discretion to consider additional PAH compounds when this is warranted by site-specific circumstances.

[30] On March 29, 2005, EPA issued "Guidelines for Carcinogen Risk Assessment" which replaced the 1986 cancer risk guidelines. The 2005 guidelines include a new set of weight of evidence descriptors that replace the previous system (A, B1, B2, C and D). To date, EPA has not updated the IRIS entry for the various PAH compounds to reflect the new classification system.

[31] Ecology reviewed the methods and procedures used by other environmental programs to characterize PAH mixtures. Several Ecology programs consider more than the seven PAH compounds identified in EPA (1993) when evaluating PAH mixtures. However, it appears that most state and federal environmental agencies focus on the seven PAH compounds when evaluating carcinogenic risks. For example, EPA's Superfund Program generally uses the methods and procedures described in EPA (1993) when evaluating health risks associated with carcinogenic

Scientific and regulatory agencies have also identified a number of other PAH compounds as known or potential human carcinogens. The International Agency for Research on Cancer (1987, 1989) classified a wide range of PAH compounds, mixtures and derivatives as carcinogens (Group 1, Group 2A and Group 2B). The National Toxicology Program (NTP, 2005) has identified 15 PAH compounds as "reasonably anticipated to be a human carcinogen". The California EPA reviewed the most recent scientific information evaluating individual tumorigenic responses for 25 PAHs when updating the TEF values for carcinogenic PAHs (Cal-EPA, 2005).

Based on these scientific reviews, Ecology believes it is reasonable to maintain the flexibility to consider other PAH compounds when establishing cleanup levels or cleanup requirements for particular sites. However, Ecology agrees there are a number of practical considerations that need to be considered when exercising that discretion. Consequently, Ecology has not required cleanup proponents to evaluate other carcinogenic PAH compounds when performing remedial investigations.

For example, Ecology recognizes that standard analytical methods are not available and/or routinely used for many of the carcinogenic PAH compounds included on the Cal-EPA list. Ecology does not plan to implement this provision until analytical methods are adequately developed. The Minnesota Department of Environmental Protection has identified analytical methods for many of the additional PAHs on the Cal-EPA list. Minnesota DEP is currently using those methods to measure the concentrations of these compounds at Minnesota sites. Ecology will review this information before requiring a Potentially Liable Party (PLP) to evaluate additional compounds.

Issue 4-5: Will the proposed rule revisions result in cleanup levels that are below PAH concentrations commonly found in Washington?

Ecology's Proposal

The MTCA Cleanup Regulation establishes policies and procedures for considering background concentrations of hazardous substances when setting cleanup standards and selecting cleanup actions.

- **Natural background** is defined as "…the concentration of hazardous substance consistently present in the environment that has not been influenced by localized human activities…." Under the existing MTCA rule, the cleanup standard cannot be more stringent than natural background concentrations (see WAC 173-340-705(6)). WAC 173-340-709 states that a minimum oftensamples must be analyzed to define natural background. For regulatory purposes, natural background concentration is defined using the higher end of the background distribution (typically the 90th percentile value). Ecology uses an upper percentile value to reduce the possibility of erroneously concluding that human activities have caused site concentrations to exceed risk-based standards. If a risk based cleanup standard is lower than the natural background concentration, the standard is adjusted upward to natural background. Cleanup of contamination below natural background concentrations is not required.

- **Area background** is defined as "…the concentrations of hazardous substances that are consistently present in the environment in the vicinity of the site which are the result of human activities unrelated to releases from that site…." Under the existing rule, area background may be factored into the remedy selection process if this is an issue at a site. Essentially, sites may delay cleanup of contaminant concentrations below area background if the site will be recontaminated

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PAH mixtures. Most states appear to be using the EPA (1993) methodology and focus their evaluation on the seven carcinogenic PAHs identified in the EPA document.

by the other sources of contamination in the area (see WAC 173-340-360). WAC 173-340-709 states that a minimum of 20 samples must be analyzed to define area background concentrations. For regulatory purposes, area background is defined using the higher end of the range of reported results (typically the 90th percentile value). Ecology uses an upper percentile value to reduce the possibility of erroneously concluding that site-related releases have caused site concentrations to exceed risk-based standards when those exceedances are due to other human activities that are not related to that particular site

Ecology did not propose to revise these provisions.

Public Comments and Concerns

Several organizations expressed concerns the proposed rule revisions will result in cleanup levels that are below background levels. For example:

> *I do think in a lot of cases you're going to end up with PAH, and even in some cases dioxin cleanup levels, that are 2 to 7 times lower than an area background. Area background in this case is being defined by samples of the surface soil that are collected from people's yards outside of any known influence from an industrial activity or even a plume.* ***(Clay Patmont, Testimony at May 10, 2007 Public Hearing.)***
>
> *I think by getting so close to area background you're going to kick in a significant increase in the transaction costs. One only has to look at what's happening in the lower Duwamish waterway and places like that and how much effort it takes to define area background in the context of the cleanup.* ***(Clay Patmont, Testimony at May 10, 2007 Public Hearing.)***
>
> *Where typical residential background concentrations have been studied, they have typically ranged between 0.1 and 1 mg/kg carcinogenic PAH (prior to application of the TEF methods). The proposed rule change operates within this concentration range and will likely create a substantial increase in affected soil volumes. The background information provided with the proposed rule did not include consideration of residential and urban background PAH concentrations and their effect on the economic impacts of the proposed rule change.* ***(Mark Larsen, p. 3.)***
>
> *…At this point the number of samples collected by Ecology to characterize chlorinated dioxin/furan (or c-PAHs) soils in Washington is below the 20 or more samples that WAC 173-340-709 requires for defining background concentrations.* ***(Ken Johnson, Weyerhaeuser, p. 4.)***
>
> *…[G]iven the endemic nature of C-PAHs in the region, the proposed amendment to the process for establishing C-PAH cleanup levels will likely adversely impact many Brownfields redevelopment projects. Given that new PAH cleanup levels may approach natural background concentrations in many areas, the proposed amendment could unintentionally discourage redevelopment in areas that may greatly benefit from redevelopment efforts, such as shoreline areas, former upland dredge disposal sites, and other areas where relatively high concentrations of C-PAHs unrelated to industrial activities are present.* ***(Carlotta Cellucci, Tetra Tech, p. 1.)***

Ecology's Response to Public Comment

As noted above, if a risk based cleanup standard is lower than the natural background concentration, the standard is adjusted upward to natural background. Cleanup of contamination below natural background

concentrations is not required. Area background may be factored into the remedy selection process if this is an issue at a site.

Ecology identified and reviewed four studies that include information on the levels of carcinogenic PAH compounds in typical urban soils. Ecology recognizes that these studies were not designed to evaluate questions in the context of the MTCA Cleanup Regulations. However, Ecology believes the results provide some insights into the stringency of the proposed carcinogenic PAH soil cleanup levels relative to typical soil concentration.

- Everett Smelter –imported topsoil. Ecology measured the concentrations of hazardous substances in topsoil when performing soil cleanup actions at the Everett Smelter site. In that evaluation, Ecology found that one source of topsoil had carcinogenic PAH concentrations that exceed the proposed carcinogenic PAH cleanup levels. However, this topsoil consisted of soil manufactured from waste products. The concentrations of carcinogenic PAH in topsoil from other sources did not exceed the proposed Method B soil cleanup level.

- Port Gamble – sediment. Ecology is currently working with several other organizations to complete cleanup actions in the Port Gamble area. Carcinogenic PAH concentrations have been measured in the nearshore sediments. Ecology has reviewed the study results and concluded that the proposed rule revisions will not significantly increase the number of sample results that exceed the Method B soil cleanup levels. Specifically:

- Of the 30 samples taken, only one would fail under the proposed rule but pass under the current MTCA rule requirements. This sample is in an area of the site separated from the other samples.

- Four other samples would fail under both approaches. All of these are clustered in a different, more contaminated area of the site.

- The remaining 24 would pass both approaches.

Ecology identified two other studies that include information on carcinogenic PAH concentrations in Washington soils.

- United States Geological Service (USGS) Soil Background Study (USGS, 1997). The USGS conducted a study of metals concentrations in Washington background soils in the 1990's. As part of that study, the USGS analyzed the levels of carcinogenic PAHs in several soil samples from Clark County. None of these samples contained detectable levels of carcinogenic PAHs using a detection limit approximating the Method B soil cleanup level.

- University of Washington study. A fourth data set consisting of soil samples taken at Green Lake Park in Seattle Washington were also examined. These samples also found very low concentrations well below the Method B soil cleanup level.

Based on this information, while it is possible urban background concentrations could complicate some cleanups, when looked at together, these studies indicate the final rule for carcinogenic PAHs should not result in a significant increase in the affected soil volumes or adversely affect Brownfields redevelopment.

Issue 4-6: Will the proposed rule revisions limit options for sediment cleanups with PAH contamination?

Ecology's Proposal

The current MTCA rule states the following with regard to sediment cleanup standards:

> ***WAC 173-340-760 Sediment cleanup standards.*** *In addition to complying with the requirements in this chapter, sediment cleanup actions conducted under this chapter must comply with the requirements of chapter 173-204 WAC.*

Ecology did not propose to revise this provision.

Public Comments and Concerns

One individual stated that the proposed rule revisions to carcinogenic PAH cleanup levels will increase the costs of sediment cleanup actions because the changes will limit the use of lower cost remedial options.

> *…[O]ur company has done a lot of work, actually some of the projects with Ecology, to remove wood wastes from old saw mills. Every one of these sites would pass under the current regulations in terms of unrestricted use, and every one of these sites would fail under the proposed changes.* ***(Clay Patmont, Testimony at May 10, 2007 Public Hearing.)***

Ecology's Response to Public Comment

Ecology reviewed the data set referred to in this comment, which is from the Port Gamble site. Based on this review, the following observations of sediment data were made:

- Of the 30 samples taken, only one would fail under the revised MTCA rule but pass under the current MTCA rule. This sample is in an area of the site separated from the other samples.
- Four other samples would fail under both approaches. All of these are clustered in a different, more contaminated area of the site.
- The remaining 24 would pass both approaches.

Based on this review, while is it possible the change in the Method B carcinogenic PAH soil cleanup level could constraint the reuse of wood waste in some circumstances, this does not appear to be supported by the Port Gardner data, as asserted at the Seattle rule hearing.

Issue 4-7: Are analytical methods available for the additional carcinogenic PAHs?

Summary of Proposed Rule

WAC 173-340-708(8)(e) requires analysis for the seven most common carcinogenic PAHs. Ecology also has the authority to require analysis of additional carcinogenic PAHs from the Cal-EPA list should site testing data or information from other comparable sites or wastes types indicate the additional compounds are potentially present at the site.

Ecology did not propose any substantive changes to this rule language.

Public Comments and Concerns

Ecology received comments from two organizations expressing concern that analytical methods are not currently available that can achieve the chemical detection limits required for carcinogenic PAHs:

> *…Standard analytical methods are not available for the 18 additional PAHs…. The application of any of these compounds would necessitate major analytical chemistry method development or modification, with the associated method validation and documentation. This would presumably be borne by the regulated community in order to prove what's not there is really not there. At the very least, prior to imposing the requirement to gather data on these compounds, Ecology should fund the development of appropriate analytical techniques.* ***(Jennifer Nuzum, Flour Hanford Environmental Protection, p. 7, 10 of attached comments.)***

One person expressed the opinion that adding 18 PAH compounds to the list of PAHs used to characterize PAH mixtures would double or triple analytical costs:

> *The proposed changes to the list of carcinogenic polycyclic aromatic hydrocarbons (cPAH) adds an additional 18 compounds to the list of compounds used to characterize cPAH mixtures. Where it is true that these compounds may not be required, there is also the option that they may be. These additional compounds are not typically analyzed and so laboratories will have to do method development to determine the best means of detecting these additional compounds and optimizing the performance to ensure the lowest concentrations by which these additional compounds can be reliable reported. This takes time, both on the instrument and manpower and hours. In addition once the method is developed then it must be implemented. Currently the MTCA has seven cPAH that are used to characterize cPAH mixtures, so these additional compounds are quite a substantial increase. Simply purchasing the standards necessary lo support the analyses will more than double with these additional cPAH. Also the amount of time it takes to optimize the instrument and perform the analyses will increase. This will result in increased costs to perform the analyses. I would estimate the amount of increase in costs simply for the analysis to more than double and most likely it would more than triple. This is not the "unchanged" cost that your forecasts project.* ***(Jennifer L. Holmes,Ph.D. STL Seattle, p. 2.)***

Ecology's Response to Public Comment

The authorization to require additional carcinogenic PAHs to be analyzed for is existing rule language that is not being proposed to be changed (except for minor editing). Since there is no change in the current rule language, there is no cost impact.

Ecology acknowledges analytical methods are not currently available for several of the additional carcinogenic PAHs on the Cal-EPA list. However, the rule authorizes Ecology to add these compounds only if the compounds are potentially present based on previous testing at the site, or information from other comparable sites or wastes types indicates these compounds are potentially present. To meet this standard, analytical methods would have to be available. Ecology does intend to develop analytical methods and look for these compounds at sites in the state using state funds. Ecology will not require responsible parties to expend funds testing for these compounds until the analytical methods have been developed and sufficient information is available to indicate testing for these compounds is necessary to protect human health and the environment.

Issue 4-8: Should Ecology establish an exemption for asphalt used in construction projects?

Ecology's Proposal

WAC 173-340-110(1) states that "…[t]his chapter shall apply to all facilities where there has been a release or threatened release of a hazardous substance that may pose a threat to human health or the environment…."

Ecology did not propose to revise this provision.

Public Comments and Concerns

One individual recommended that Ecology establish an exemption for asphalt used in construction projects:

> *The revised rule should exempt asphalt used or formerly used in roadways, parking lots, roofing, and other construction activities from regulation as PAHs. The toxicity limits of PAHs are based on ingestion of PAHs used as wood preservatives, not upon the occurrence of PAHs in asphalt.* ***(Jennifer Nuzum, Fluor Hanford, p. 4.)***

Ecology's Response to Public Comment

Ecology has reviewed this issue and decided that an exemption for asphalt used in construction projects is not necessary or appropriate. The MTCA rule requires soil compliance testing on 2 mm sized particles and smaller. This is because, in part, smaller particles are more likely to be ingested by small children. carcinogenic PAHs are particularly toxic to humans and to fish and other aquatic organisms. However, carcinogenic PAHs contained in asphalt pavement or roofing materials are typically locked in a matrix of material much larger than 2 mm in size. As such, these materials would not be subject to cleanup under MTCA and Ecology believes a special exemption for these materials is unnecessary. However, should these materials break up into 2 mm or smaller particles, these small particles could, under some circumstances, pose a potential threat to human health or the environment and be subject to cleanup under MTCA. An exemption for these materials could constrain Ecology's ability to respond in these situations and would be inappropriate.

Chapter 5: Polychlorinated Biphenyls (PCBs)

5.1 Introduction

PCBs are a group of synthetic organic chemicals that include 209 chlorinated biphenyl compounds (known as congeners). Commercial mixtures of PCBs were manufactured in the United States from 1930 to 1977 under the trademark "Aroclor" followed by a four digit number.[32] PCBs were used as coolants and lubricants in electrical equipment, such as capacitors and transformers, because of their inflammability, chemical stability, and insulating properties. There are no known natural sources of PCBs.

There are two general approaches for evaluating the health risks associated with environmental concentrations of PCBs:

- Total PCB concentrations. Under the MTCA Cleanup Regulation, excess cancer risks, cleanup levels and remediation levels for PCB mixtures are currently calculated using the cancer potency factor for PCBs published in the Integrated Risk Information System (IRIS) database. Compliance is evaluated using measurements of total PCB concentrations in environmental media using standard methods (e.g., EPA Methods 8080 and 8081) that involve the use of gas chromatography/electron capture detection systems. Specifically, total PCB concentrations are estimated by comparing the chromatographic pattern of peaks in the environmental sample with the pattern or number of peaks in a commercial Arochlor sample.

- Congener-specific analyses. PCB mixtures may include up to 209 individual congeners which differ in terms of the number and location of chlorine atoms. Over the last 30 years, the standard approach for estimating PCB environmental concentrations has begun to shift from the analysis of commercial mixtures (Aroclors) to congener-based analyses. WHO established TEF values for nine PCB congeners in 1998, and updated these values in 2005. Dioxins and furans are generally present in the environment as complex mixtures of chemical "congeners" that differ in terms of the number and location of chlorine atoms. In order to evaluate the risks associated with the whole mixture, scientists have developed the TEF methodology. In this method, each congener is assigned a TEF value. The TEF is the ratio of the estimated toxicity for a particular congener to the toxicity demonstrated by 2,3,7,8-TCDD. 2,3,7,8-TCDD is the most studied congener and considered to be the most toxic. The total TEQ of a mixture is the sum of the products of the concentration of each congener in a contaminated medium and the TEF value for that congener.

In April 2007, Ecology proposed to revise the methods and policies used to establish cleanup levels for mixtures of PCBs.

- Ecology proposed to amend WAC 173-340-708(8) to require that cleanup levels for mixtures of polychlorinated biphenyls (PCBs) be based on a cancer risk of 10^{-6}.

- Ecology proposed to amend the rule to provide the option for people to establish PCB cleanup levels using information on PCB congeners. Under the proposed revisions, people must use the most current TEF values to evaluate PCB mixtures. The most current values were published by WHO (Van den Berg, et al. 2006). Ecology also added new rule language to explain how people

[32] The first two digits usually indicate the parent biphenyl molecule and the last two digits indicate the percent chlorine by weight. For example, Aroclor 1260 contains 12 carbon atoms (parent biphenyl molecule) and approximately 60 percent chlorine by weight. Aroclor 1016 is an exception to this nomenclature scheme, as it contains 12 carbon atoms and contains over 41 percent chlorine by weight.

should use the TEF methodology when establishing and evaluating compliance with cleanup levels.

- Ecology proposed to amend WAC 173-340-708(8) to require cleanup proponents to consider the physical-chemical properties of individual PAH compounds, PCB compounds, or dioxin-congeners when evaluating cross-media impacts.

A considerable number of individuals and organizations provided comments on the proposed revisions. The principal issues raised during the public comment period were the following:

Issue 5-1: Should Ecology revise the MTCA rule to explicitly allow or require people to use the TEF values and methodology developed by WHO when assessing the human health risks of PCB mixtures?

Issue 5-2: Should Ecology continue to require that Method B cleanup levels for PCB mixtures be based on a cancer risk of 10-6?

Issue 5-3: How should Ecology take into account non-dioxin-like health effects when using the TEF methodology to assess the potential carcinogenic risk of PCB mixtures under MTCA?

Issue 5-4: Are the proposed rule revisions applicable to sites with PCB contamination that are regulated under the Toxic Substances Control Act (TSCA)?

Issue 5-5: Will a new Washington State waste category be created through identification of "dioxin-like" contaminants in environmental media?

Issue 5-6: Is Ecology proposing to distinguish between PCBs and PCB mixtures?

Issue 5-7: Are analytical methods available to support the use of the TEF methodology for PCB mixtures?

5.2 Ecology's Review and Response to Public Comment

Issue 5-1: Should Ecology revise the MTCA rule to explicitly allow or require people to use the TEF values and methodology developed by WHO when assessing the human health risks of PCB mixtures?

Ecology's Proposal

Ecology proposed to revise WAC 173-340-708(8) to provide the option for Ecology and others to use the WHO 2005 TEF values and methodology when calculating excess cancer risk, cleanup levels and remediation levels for PCB mixtures.

Public Comments and Concerns

Ecology received comments from over three hundred Washington citizens who expressed support for Ecology's proposal to provide the option to establish PCB cleanup levels using the most current TEF values developed by WHO.

Ecology received comments from one organization supporting the proposed rule revision to explicitly allow or require use of TEF values and methodology developed by WHO when assessing the human health risks of PCB mixtures:

> *We also support Ecology's proposal to amend the rule to incorporate the most recent toxicity equivalency factors (TEFs) for PCBs as recommended by the World Health Organization.* ***(Stephen Lester, Center for Health, Environment, and Justice, p. 2.)***

However, several organizations expressed concerns that Ecology's proposal would eliminate the current approach that is based on the application of the cancer potency factor for PCBs published in the EPA Integrated Risk Information System (IRIS). For example:

> *...In the draft rule revision, Ecology proposes to add a new subsection at WAC 173-340-807(8)(f)* [*sic*] *specific to PCB mixtures. It appears that this change, coupled with the proposed change to -807(h)* [*sic*] *would completely change the current approach for cleanup of PCBs. Specifically, it appears that, instead of establishing a CPF for PCBs based on availability in specified EPA sources or consultation with EPA and other qualified parties, it would require use of TEFs. If this is accurate, please explain the rationale for the proposed use of TEFs.* ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p.1-2, 2 of attached comments.)***

Several organizations recommended that Ecology not provide an option for using this methodology to evaluate health risks of PCB mixtures. For example:

> *[C]onsiderable scientific uncertainties are associated with application of TEF methodology to dioxin/furans even though the index chemical is a dioxin (2,3,7,8-TCDD). These uncertainties are compounded by attempting to extrapolate the methodology to PCBs (Section 4.9 of attachment). In addition, unlike dioxins and furans, reliable toxicological data are available for mixtures of PCBs, making use of TEF methodology unnecessary. In fact, EPA (USEPA 1996) has developed CPFs specific to mixtures of PCBs having differing degrees of chlorination. For all these reasons, Ecology should most certainly not require, and we suggest should not allow, application of TEF methodology for estimating risks to human health resulting from exposure to PCBs…The inclusion of selected PCBs in the TEQ approach is not advisable because there is enormous uncertainty associated with the application of this approach to these compounds.* ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 6 of letter, p. 22-23, 25 of attached technical comments.)***

> *The Cost-Benefit Analysis (Ecology, 2007a) states that there will be no impacts on PCB sites because the new alternative involving congener data is optional. It is reasonable to expect, however, that on sites with both PCBs and dioxins/furans, Ecology will want the dioxin-like PCBs to be combined with the dioxins/furans in analyses of cancer risks. Also, if congener-specific PCB data are available, it seems likely that Ecology will require the second alternative. If the second alternative is retained, the impacts of using it should be evaluated in the Cost-Benefit Analysis. As stated previously, however, we strongly recommend that the second alternative be deleted from the proposed rule language.* ***(Jennifer Goldberg, Seattle City Light/Seattle Public Utilities, p. 3.)***

Ecology's Response to Public Comment

Ecology has reviewed the comments on this issue and believes that the proposed rule revision is well supported by the current understanding of PCB toxicity. The rationale for this decision includes:

- Application of the TEF methodology to coplanar PCBs has a sound biological basis. The TEF approach for dioxin-like PCBs is based on the scientific basis that the various congeners of dioxin-like PCBs essentially act as one chemical, affecting the Ah receptor.

- The TEF values for dioxin-like PCB congeners have a sound scientific basis. The WHO-98 TEF values are based on a rigorous scientific review and professional consensus. More recent scientific reviews conducted by the EPA Risk Assessment Forum (EPA, 2000), EPA's SAB (EPA, 1995; EPA, 2001), WHO (Van den Berg et. al., 1998) and the National Research Council (NAS, 2003; NRC, 2001) have re-affirmed the scientific basis for these values. In addition, the MTCA SAB recently concluded:

  The Board stated that the 2005 TEF values for dioxin-like PCBs recommended by the WHO are consistent with current scientific information. As noted above, the Board stated that it was fortuitous that the WHO had recently completed a review and evaluation of available scientific information which resulted in updated TEF values for dioxins and furans.

- The TEF methodology is an effective tool for assessing environmental risks. The TEF methodology is a tool that allows the assessor to evaluate the toxicity of a complex environmental mixture in the absence of complete knowledge of the toxicity for all of the components of the mixture. EPA has used the TEF methodology to evaluate the risks of PCB contamination in and around the Hudson River, the Housatonic River, and in the EPA's Great Lakes Initiative. The NRC (2001) concluded that congener-specific analyses often provide a better basis for assessing environmental risks because:

  - After release into the environment, PCB mixtures change through partitioning, transformation, and bioaccumulation, differing considerably from commercial mixtures.

  - There is a selective retention of persistent PCB congeners through the food chain (enrichment) that confers greater exposure and potential risks.

  - Persistent congeners can retain biological activity long after exposure stops.

  - Half-life estimates for a PCB mixture can underestimate its long – term persistence, because half-lives of its components differ widely.

- Environmental PCBs occur as mixtures; there are no cancer studies of PCB mixtures found in the environment. Studies are available for some commercial Aroclor mixtures, though similarity to an environmental mixture can be uncertain. This uncertainty results because mixtures are partitioned, transformed, and bioaccumulated in the environment. Testing an Aroclor mixture in the laboratory may not be a valid surrogate for assessing an Aroclor mixture that has been in the environment.

- Ecology and other environmental agencies are currently using congener-specific analyses to evaluate the health risks of PCB mixtures. Ecology has reviewed the methods and procedures used by other environmental programs to characterize PCB mixtures. Several agencies currently use the WHO-98 TEF values and methodology to evaluate health risks and establish regulatory requirements for PCB mixtures. For example:

  - When preparing the 303(d) list of impaired water bodies, the Environmental Assessment Program calculated TEQs for dioxins/furans and PCBs in fish tissue and surface water in freshwater environments using the WHO-98 TEF values. The Water Quality Program used this evaluation to identify impaired waterbodies by comparing the total TEQs for

dioxins/furans and PCBs relative to the water quality criterion for 2, 3, 7, 8-TCDD (Ecology, 2004).

- EPA's Superfund Program uses the methods and procedures described in IRIS for evaluating mixtures of PCBs. The EPA Superfund program also recommends that the risk of dioxin-like compounds be considered (using WHO-98 values) when evaluating the health risks posed by PCB mixtures (EPA 2000 and 2003b).

- Several environmental agencies in other states currently use the WHO-98 TEF values for dioxin-like PCBs when evaluating excess cancer risks and establishing regulatory requirements. States using the WHO-98 TEF values for dioxin-like PCBs include California[33], Louisiana[34], Massachusetts[35], Minnesota[36], Oregon[37] and Texas.[38]

- There are several practical considerations that may limit the use of congener-specific analyses at individual sites. Ecology believes that congener-specific analysis provides a sound approach for evaluating PCB mixtures. However, there are several practical considerations that may limit the use of this approach at individual sites. Consequently, Ecology decided to revise the rule to provide the flexibility for cleanup proponents to continue using the current rule provisions. These considerations include:

  - **Analytical Costs**. Congener-specific analyses are more expensive than total PCB analyses and, consequently, may not be appropriate for smaller cleanup sites.

  - **Applicable Requirements**. MTCA cleanup levels must be at least as stringent as requirements in other applicable laws and regulations. Several existing regulatory requirements are based on total PCB measurements. Consequently, cleanup proponents may be required to measure total PCB concentrations.

  - **Uncertainties on the Completeness of Assessment**. PCB toxicity includes both dioxin-like and non-dioxin-like modes of action that contribute to the overall toxicity of PCB mixtures. Dioxin equivalence evaluates the toxicity of only the dioxin-like (those linked to cancer health effects) PCB portion of the PCB mixtures. Non-dioxin-like toxicity, in turn, includes both cancer and non-cancer effects due to different modes of action.

Issue 5-2: Should Ecology continue to require that Method B cleanup levels for PCB mixtures be based on a cancer risk of 10^{-6}?

Ecology's Proposal

Ecology proposed to revise WAC 173-340-708(8) to clarify that PCB mixtures will continue to be considered a single hazardous substance for assessing carcinogenic risk under MTCA. Under this approach, Method B cleanup levels for PCB mixtures would continue to be based on a cancer risk of 10^{-6}.

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[33] California EPA, 2005
[34] ATSDR Health Consultation, Review of 2002 Eunice City Lake Fish Investigation Eunice, Louisiana. July 27, 2005
[35] Housatonic Superfund Site Risk Assessment
[36] Minnesota Department of Health. Risk Assessment Rules/Guidance. Polycyclic Aromatic Hydrocarbons: Methods for Estimating Health Risks from Carcinogenic PAHs.
[37] Oregon Department of Environmental Quality. E-Mail From M. Poulsen (OR DEQ) to Dr. M. Bailey (EPA, Region 10) March 30, 2006.
[38] Texas Administrative Code, Title 30, Part 1, Chapter 350 subchapter D, Rule 350.76, (e)(1)(A)

Public Comments and Concerns

Ecology received comments from over three hundred Washington citizens who expressed support for Ecology's proposal to continue to establish cleanup levels for PCBs using a cancer risk level of 10^{-6}.

Several local, statewide and national organizations also expressed support for Ecology's proposal to continue to establish Method B cleanup levels for dioxin/furans, PAH and PCB mixtures using a cancer risk of 10^{-6}. For example:

> *CHEJ supports the Washington State Department of Ecology Toxics Cleanup Program's (Ecology) proposal to require that cleanup levels for mixtures of dioxins and furans, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) be based on a cancer risk value of one-in-one million.* ***(Stephen Lester, Center for Health, Environment & Justice, p. 1.)***

Additional comments are summarized in Sections 3-3 and 4-3 of this document.

Several organizations and individuals expressed the opinion that it was inappropriate to require use of a cancer risk of 10^{-6} for setting Method B cleanup levels for these types of chemical mixtures. For example:

> *For clarity in defining acceptable risks when chemical mixtures are present, and for consistency with other regulations in the context of MTCA's specific requirements, we believe that the MTCA Method B language on target risks should not be changed as proposed. Instead, the language should accept the treatment of individual constituents of these mixtures as individual hazardous substances. This approach will ensure consistency in allowable target risks among sites, while providing a high level of health protection.* ***(Jennie Goldberg, Seattle City Light/Seattle Public Utilities, p. 2.)***

Most organizations and individuals provided specific comments on dioxins and furans or PAH mixtures (See Issues 3-3 and 4-3). After reviewing those comments, Ecology believes that these organizations were implicitly raising the same concerns and arguments for PCB mixtures. However, several organizations and individuals made a point of raising those concerns in the context of Ecology's proposal for PCB mixtures. For example:

> *Although setting an acceptable level of risk is purely a policy decision, there is no scientific basis for apportioning tolerable risk among different chemicals that might be present at any given site. The current rule limits overall incremental risk associated with chemical contaminants at one in one hundred thousand. As long as this threshold is not exceeded by the sum of the risks posed by multiple chemicals found at a site, it is not necessary to limit incremental risk associated with PCBs to one in one million. If site-specific estimated risk exceeds one in one hundred thousand the rule should provide for flexibility in reducing this risk by allowing remediation of any or all chemicals found at the site; i.e., there is no scientific justification for requiring that risk be reduced by remediation of one chemical vs. another.* ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 7.)***

Ecology's Response to Public Comment

Ecology has reviewed the comments on this issue, and believes that the proposed rule language is based on current scientific understanding of the risk posed by PCBs, and reflects the goals and objectives of MTCA. The rationale for this decision includes:

- The proposed approach is consistent with the current MTCA rule requirements for PCB mixtures. The proposed rule revisions are consistent with the approach used for PCB mixtures in the current MTCA rule. PCB mixtures have been historically treated as a single hazardous substance when developing Method B and C cleanup levels or determining compliance with the Method A cleanup levels.

- The proposed approach is consistent with requirements established by other Ecology programs that are ARARs for MTCA sites. MTCA cleanup levels must be at least as stringent as ARARs established under other state and federal environmental laws. This approach is consistent with approaches used by other Ecology programs to develop requirements that are applicable to MTCA cleanup sites. For example:

    - The Water Quality Program uses surface water human health criterion for marine and freshwaters identified in the National Toxics Rule for PCBs as a single numeric criterion for all PCBs. The EPA's National Recommended Water Quality Criteria for 2002 reaffirms the consideration of PCBs as a single hazardous substance stating: "The polychlorinated biphenyl (PCB) numeric criterion for the protection of human health applies to total PCBs which is the sum of all homolog, all isomer, all congener, or all Aroclor analyses. Consequently, this option is consistent with the minimum cleanup standard for surface waters in Washington."

    - The Environmental Assessment Program calculated TEQs for PCBs in fish tissue and surface water in freshwater environments using the WHO-98 TEF values. Ecology identified impaired waterbodies by comparing the total TEQs for PCBs relative to the NTR criterion for total PCBs (64 FRN 61195) with a designated 10^{-6} risk level (Ecology, 2004).

    - The Air Quality Program specifies risk-based acceptable source impact levels for Class A toxic air pollutants using unit risk factors published in EPA's IRIS. When performing these evaluations, PCB mixtures are treated as a single hazardous substance in the same way as other toxic air pollutants such as arsenic or trichloroethylene.

- The proposed approach simplifies the procedures for establishing MTCA cleanup levels. The MTCA Cleanup Regulation specifies that Method B and C cleanup levels established for individual hazardous substances based on a particular pathway (e.g., soil ingestion) must be adjusted downward to take into account exposure to multiple hazardous substances and/or multiple exposure pathways in situation where total excess cancer risk would exceed 10^{-5}. Treating PCB mixtures as a single hazardous substance minimizes the need for such adjustments. This simplifies the process for establishing cleanup levels.

- The proposed approach is consistent with approaches being used by other environmental programs. Ecology has reviewed the methods and procedures used by other environmental programs to characterize PCB mixtures. These programs differ in terms of analytical parameters (e.g., total PCB analysis vs dioxin-like PCB congener analysis), regulatory focus (e.g., site cleanup, water quality, etc.) and risk policies. However, the vast majority of programs reviewed by Ecology treat PCB mixtures as a single hazardous substance when establishing regulatory requirements. For example:

    - EPA has established a maximum contaminant level for PCBs under the Safe Drinking Water Act. The MCL establishes a single numeric standard (0.0005 mg/L) for total PCBs.

The Washington Board of Health has adopted an identical drinking water standard for PCBs (WAC 246-290-310).

- The EPA Superfund Program uses the methods and procedures described in IRIS for evaluating mixtures of PCBs. PCB mixtures are treated as a single hazardous substance.

- The ATSDR uses the TEF methodology to evaluate the toxicity and assess the risks of PCB mixtures. For example, ATSDR evaluated the health risks associated with eating PCB contaminated fish in Eunice City Lake in Louisiana. In that evaluation, ATSDR calculated TEQs using the WHO-98 TEFs for the 12 dioxin-like PCB congeners. The TEQs for each fish species were then compared to the EPA Region III risk-based concentration (RBC) for TCDD levels in fish tissue. The Region III RBC for TCDD in fish tissue is based on an excess cancer risk of 10^{-6}.

- The Food & Drug Administration uses the TEF methodology and toxicity equivalent factors to monitor food and animal feed with the goal of reducing dietary exposure to dioxin-like compounds (FDA, 2005).

- Ecology reviewed the methods and procedures used by several other state environmental programs. Most states have established cleanup levels for total PCBs that treat the mixture as a single hazardous substance. Several states also use the WHO-98 TEF values and methodology to evaluate dioxin-like PCBs. Many of these states treat mixtures of dioxin-like PCBs as if the mixture (characterized by the TEQ) was a single hazardous substance. Some states (e.g., Texas) calculate TEQs that reflect the sum of dioxins, furans and dioxin-like PCBs.

- The proposed approach is consistent with Ecology's initiatives on toxic chemicals. Public concerns about health threats posed toxic chemicals have grown over the last decade as new information on toxicity and body burdens have become available. Ecology has undertaken several initiatives to reduce and cleanup sources of bioaccumulative chemicals in Puget Sound and other parts of the state. Selection of a different approach that relaxes cleanup requirements for PCB mixtures would be inconsistent with these Ecology initiatives.

Issue 5-3: How should Ecology take into account non-dioxin-like health effects when using the TEF methodology to assess the potential carcinogenic risk of PCB mixtures under MTCA?

Summary of Proposed Rule

Ecology proposed to revise WAC 173-340-708(8) to state that Ecology may require that the health effects posed by non-dioxin-like PCB congeners be considered when using the TEF methodology to establish PCB cleanup levels. Specifically, Ecology identified the TEF approach as one option for establishing cleanup levels and remediation levels and specified:

> *Use the toxicity equivalency factors for the dioxin-like PCBs congeners in Table 706-4 and procedures approved by the department. When using the toxicity equivalency factors, the department may require that the health effects posed by dioxin-like PCB congeners and nondioxin-like PCB congeners be considered in the evaluation. (WAC 173-340-708(8)(f)(ii)(B))*

Public Comments and Concerns

Several organizations expressed the opinion that using the PCB potency factor to characterize the health risks associated with non-dioxin-like PCB congeners would significantly overstate such risks. One organization recommended that Ecology clearly state that the PCB potency factor should not be applied to non-dioxin-like congeners:

> *… [T]here are important scientific uncertainties regarding the evaluation of risks associated with exposure to non-dioxin-like PCB congeners not recognized by the proposed rule change. The PCB cancer slope factors, were developed for PCB mixtures which included both dioxin-like and non-dioxin-like congeners. The values derived for the PCB slope factors were influenced by the presence of the dioxin-like congeners. It is inappropriate to use these slope factors to estimate risks associated with only the non-dioxin-like PCB congeners. Ecology should revise the language to state that the EPA's PCB cancer slope factors should not be applied to non-dioxin-like PCB congeners individually, or to mixtures of non-dioxin-like congeners.* ***(Jennie Goldberg, City of Seattle, p. 3.)***

Other organizations expressed the opinion that it was not possible to distinguish between dioxin and non-dioxin like health effects associated with PCB mixtures. As noted above (Issue 5-1), these organizations recommended that Ecology not apply the TEF methodology to PCB mixtures. For example:

> *There appears to be no way to tease out the carcinogenic potential of "non-dioxin-like" PCB congeners based on current toxicologial information, and EPA (USEPA 1996) has developed CPFs for PCB mixtures including both "dioxin-like" and "non-dioxin-like" congeners. Consequently, use of the appropriate PCB CPF (based on the degree of chlorination of the site-specific mixture) would account for both "dioxin-like" and "nondioxin-like" health effects. Ecology should avoid the uncertainties associated with attempting to apply the TEF methodology to PCBs and, instead, utilize EPA's CPFs.* ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 7.)***

Ecology's Response to Public Comment

Ecology believes that there will be a need on some sites to conduct an integrated evaluation of dioxin-like and non-dioxin like health effects when using TEFs to evaluate dioxin-like PCBs, and that information on these health effects is sufficient to support the need for these evaluations and support this work. Ecology provides the following rationale for the proposed rule revision:

- PCB toxicity includes both dioxin-like and non-dioxin-like modes of action that contribute to the overall toxicity of PCB mixtures. The TEF methodology considers the toxicity of only the dioxin-like PCB portion of the PCB mixtures. Non-dioxin-like toxicity includes both cancer and non-cancer effects due to different modes of action that are not taken into account in the TEF methodology.

- An integrated evaluation is consistent with current EPA Guidance. An integrated evaluation of dioxin-like and non-dioxin-like health effects for PCBs would follow the general guidance provided by EPA's IRIS:

  > *When congener concentrations are available, the slope-factor approach can be supplemented by analysis of dioxin TEQs to evaluate dioxin-like toxicity. Cancer risks from dioxin-like congeners (evaluated using dioxin TEQs) would be added to risks from the rest of the mixture (evaluated using slope factors applied to total PCBs reduced by the amount of dioxin-like congeners). Non-cancer risks would be evaluated using available reference doses. (EPA, 2007, Integrated Risk Information System.)*

- Specific procedures for performing an integrated evaluation for dioxin-like and non-dioxin-like PCBs are still evolving.

  The rule revisions provide site managers with the option**,** on a site-specific basis**,** to use the World Health Organization (WHO) TEF values and methodology to evaluate the toxicity and assess the risks for dioxin-like PCBs. The application of the TEF methodology requires a congener-specific analysis. That is, identifying concentrations of the dioxin-like co–planar PCBs. (The WHO publishes TEF values for 12 dioxin-like PCB congeners: 4 non-ortho and 8 mono-ortho chlorine substituted PCBs.) A total PCB (Aroclor) analysis is still an option. No specific methodology is provided in the rule to evaluate the risks for non-dioxin like PCBs, on a site-specific basis, because Ecology believes the methodology is still evolving, both on a national level and for Washington State. Upon adoption of the rule amendments Ecology plans to clarify the methodology to be used under MTCA to evaluate the risks associated with non-dioxin like PCBs. According to the EPA regarding the methodology for evaluating the risks of dioxin-like and non-dioxin like PCBs:

  > "The contribution of dioxin-like PCB congeners is important in the evaluation of risks associated with releases of PCBs, and in the development of PCB cleanup levels, as the evaluation of Aroclors or total PCBs alone may result in a mischaracterization of the mixture. As described on the IRIS web site for PCBs, risks from dioxin-like congeners can be evaluated separately from the rest of the mixture. Analyses of dioxin-like PCB congeners from at least a portion of media samples are strongly recommended by this office as the default procedure for estimating baseline risks and for developing and demonstrating compliance with cleanup levels." EPA Region 10 Guidance Memo (dated 4/17/07- Recommendations for Human Health Risk-based Chemical Screening and Related Issues at EPA Region 10 CERCLA and RCRA Sites)
  >
  > "Although PCB exposures are often characterized in terms of Aroclors, this can be both imprecise and inappropriate. Total PCBs or congener or isomer analyses are recommended. When congener concentrations are available, the slope-factor approach can be supplemented by analysis of dioxin TEQs to evaluate dioxin-like toxicity. Risks from dioxin-like congeners (evaluated using dioxin TEQs) would be added to risks from the rest of the mixture (evaluated using slope factors applied to total PCBs reduced by the amount of dioxin-like congeners)." EPA IRIS Database) (http://www.epa.gov/iris/subst/0294.htm)

Issue 5-4: Are the proposed rule revisions applicable to sites with PCB contamination that are regulated under the TCSA?

Public Comment and Concerns

One organization questioned whether the proposed revisions applied to PCB releases regulated under the Toxics Substances Control Act.

> *According to a past evaluation by the Washington Attorney General Office, Ecology authority for regulation of federally-regulated PCBs is limited or perhaps even precluded by RCW 70.105.030. WAC 173-303-071(3)(k) provides an exclusion for management of federally-regulated PCBs. Does this exclusion have any meaning under MTCA? Has Ecology performed or contracted any analysis regarding the scope of its authority for regulation of federally-regulated PCBs under the*

MTCA? Do the current rules apply to all PCBs, or only to PCBs that are unregulated by EPA?...Currently, WAC 173-340-900, Table 740-1, defers to PCB remediation waste cleanup standards of 40 CFR 761.61 for PCB cleanup. Federal programs have established PCB cleanup levels of 1 part per million in soil to be generally protective of human health and the environment. Furthermore, federal EPA studies show that PCBs are less hazardous than previously believed. Does Ecology anticipate that this proposal will have any effect on the existing cleanup standards for PCBs in soil? If so, what effect does Ecology anticipate, and what is the basis any resulting changes in cleanup requirements or perceived cleanup requirements for PCBs in soil? ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 1, 2 of attached comments.)***

Ecology's Response to Public Comment

The specific exemption referred to in WAC 173-303-071(3)(k) has since been revised. WAC 173-303-071(3) now specifically provides that the PCB deferral to TSCA does not apply to Ecology's cleanup authority under WAC 173-303-050, WAC 173-303-145 regulating spills and releases of PCBs to the environment, and actions necessary to prevent an imminent and substantial endangerment to health or the environment under WAC 173-303-960.

In response to the effect of the use of TEFs on cleanup levels, based on preliminary calculations using available PCB congener-specific analyses, the use of TEFs did not result in cleanup levels that were much different from those using the traditional cancer potency factor approach.

Issue 5-5: Will a new Washington State waste category be created through identification of "dioxin-like" contaminants in environmental media?

Public Comment and Concerns

Comment was submitted by one organization questioning whether a new waste stream (dioxin-like waste in environmental media) would be classified as a result of the proposed rule revisions:

Is Ecology going to now allow treatment/disposal of "dioxin" like waste that will be newly classified as such by this rule making? (Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 5 of attached comments)

Ecology's Response to Public Comment

No changes are proposed that would affect MTCA rule requirements pertaining to the treatment or disposal of dioxin contaminated cleanup waste. Constraints in other statutes or regulations on the treatment or disposal of dioxin contaminated waste materials are not altered by the proposed rule amendment.

Issue 5-6: Is Ecology proposing to distinguish between PCBs and PCB mixtures?

Ecology's Proposal

WAC 173-340-200 includes the following definition:

"Polychlorinated biphenyls" or "PCB mixtures" means those aromatic compounds containing two benzene nuclei with two or more substituted chlorine atoms. For the purposes of this chapter, PCB includes those congeners which are identified using the appropriate analytical methods as specified in WAC 173-340-830.

Ecology did not propose to revise this provision.

Public Comment and Concerns

Comment was submitted by one organization questioning whether Ecology was proposing a distinction between PCB and PCB mixtures:

Currently, WAC 173-340 defines PCBs and PCB mixtures to mean the same thing. The proposed rule does not include a proposed modification to this definition. Is Ecology proposing a distinction between PCBs and PCB mixtures, and if so, what is the proposed distinction? ***(Jennifer Nuzum, Fluor Hanford, p. 2.)***

Ecology's Response to Public Comment

No, under the final rule, there is no distinction between PCBs and PCB mixtures.

Issue 5-7: Are analytical methods available to support the use of the TEF methodology for PCB mixtures?

Ecology's Proposal

WAC 173-340-830 specifies analytical procedures to be used at contaminated sites.

Ecology did not propose to revise this section of the rule.

Public Comments and Concerns

One organization expressed concern that EPA approved analytical methods are currently not available to measure PCB congeners at concentrations corresponding to a 10^{-6} risk limit for chemical mixtures. For example:

Proposed use of TEF for PCBs at proposed low levels will need to be done with an EPA method that is stalled in the promulgation process. It is also only a method for water and being proposed here for other media. What is Ecology's rationalization for using this unofficial approach? ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 5 of attached comments.)***

One organization stated that congener-specific PCB analyses would be significantly higher than measuring total PCB concentrations:

…There is also a significant impact in the methodology for Polychlorinated Biphenyl (PCB) mixtures. Currently PCB mixtures are characterized by examining the Aroclor or Aroclors and reporting the concentration as a total. The costs associated with these analyses can vary based on the clean up necessary to the sample matrix and turn around time desired however they typically range from $75 - $125. The proposed rule change, although optional, could change this methodology in a significant manner in that rather than the Aroclor being measured it is proposed to measure 17 individual congeners, however as many as 209 congeners could be required. This again would require many laboratories that do not currently perform this type of

analyses to perform costly method development. The analysis time will increase and the costs are substantial. The recent Northwest Regional Sediment Evaluation Framework Interim Final Report suggests applying this approach to tissue. It estimates costs involved for these analyses will be over well over $300 dollars. Laboratories that currently provide analyses of all 209 congeners typically charge over $1000 per sample for such analyses as it is required to be done by high resolution mass spectrometry. It therefore seems unreasonable for the DOE to forecast that the cost associated with sampling and analysis for site characterization to be unchanged. Clearly the costs of analysis alone will more than triple and most likely go up by a factor of 5 or more ***(Jennifer L. Holmes, STL Seattle, Ph.D., p. 2.)***

Ecology's Response to Public Comment

EPA does have an approved method for PCB congener analyses (EPA Method 1668A, EPA Publication number EPA 821 R 00 002, December 1999). Furthermore, any proposal to do a congener specific analysis would require preparation of a site-specific sampling and analysis plan that would be subject to approval by Ecology.

Chapter 6: Other Issues Not Within Scope of Current Rulemaking

6.1 Introduction

Issue 6-1: Should Ecology revise the rule to allow a probabilistic risk assessment approach to be used to calculate soil cleanup levels?

Issue 6-2: Should Ecology revise the procedures for establishing cleanup levels to include the Precautionary Principle?

Issue 6-3: Should Ecology revise the default soil ingestion rate used in the MTCA Cleanup Regulation to assess risk and establish cleanup levels?

Issue 6-4: Should Ecology revise the default exposure parameters used in the MTCA Cleanup Regulation to reflect a different balance between upper bound and central tendency values?

Issue 6-5: Should the CLARC tool continue to be used for calculating cleanup levels under the MTCA Cleanup Regulation?

Issue 6-6: Is more Washington State health data and evaluation of this data needed to support the proposed rule revisions or additional amendments to the MTCA Cleanup Regulations?

Issue 6-1: Should Ecology revise the rule to allow a probabilistic risk assessment approach to be used to calculate soil cleanup levels?

Ecology's Proposal

WAC 173-340-708(11) allows the use of probabilistic risk assessment methods only on an informational basis for evaluating alternative remedies.

Ecology did not propose to revise this provision.

Public Comments and Concerns

One organization recommended that Ecology revise the MTCA rule to allow people to use a probabilistic risk assessment approach to calculate cleanup levels for individual sites:

> *Many peer-reviewed scientific papers discussing the relative merits of probabilistic vs. deterministic models for assessing risk have been published over the last decade or so (e.g., Burmaster and Harris 1993; Cullen 1994; Finley and Paustenbach 1994; Paustenbach et al. 2006). One of the primary factors driving the use of probabilistic models is that some measure of variability and uncertainty is associated with every estimate of risk. This is because the inputs to these models are data distributions, not point estimates. Thus, the whole body of relevant data is utilized. Although this approach still requires parsing of the scientific data in order to develop appropriate distributions for each relevant parameter (e.g., a gastrointestinal absorption factor), it would obviate the need to settle on a single numerical input and mitigate the tendency to adopt worst-case estimates. In addition, the output from a probabilistic model is a probability distribution, which inherently provides a much more realistic characterization of risk than the*

single value outputs obtained from deterministic models. Although the mechanics of the regulatory paradigm might still drive adoption of a single threshold (screening) value (e.g., an SCL), this approach would at least provide a clearer indication of the degree of conservatism (or certainty) associated with this single value. Paustenbach et al. (2006) recently reviewed the cancer risks to human health associated with dioxin/furans in soils. As part of this effort the authors reviewed all relevant data1 and used the resulting distributions to perform a probabilistic assessment of risk. The outcome was the statement that "95% of the population has a cancer risk below 1 per 100,000 at 540 ppt TEQ." Although we believe the outcome of this analysis gives a defensible SCL, the primary point is that the output from this kind of modeling carries with it explicit statements concerning the statistical certainty of resulting cleanup goals. Ultimately, Ecology should shift to the use of a probabilistic model for calculating soil cleanup levels and/or risks because this approach makes fuller use of the available data and inherently provides a more informative and useful statement of risk. ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 3.)***

Ecology's Response to Public Comment

The MTCA Policy Advisory Committee (PAC) discussed the use of probabilistic risk assessment during the legislatively mandated review process that occurred in the mid-1990s. As the PAC worked through this issue, it became readily apparent that these types of risk assessments are very complicated and difficult to correctly apply and understand, not only by the general public, but also by persons who work in the remediation field. In addition, it also became apparent that the outcome of these types of risk assessments is heavily dependent on assumptions made in the calculations and that many of variables in the calculations have insufficient data to describe a distribution. The PAC recommended that Ecology not allow probabilistic risk assessments to be used to establish cleanup standards and remediation levels. The rule language reflects this recommendation and revisions to this language are beyond the scope of this rule revision.

Issue 6-2: Should Ecology revise the procedures for establishing cleanup levels to include the Precautionary Principle?

Public Comments and Concerns

Several organizations and individuals expressed the opinion that a high degree of precaution or conservatism was needed when establishing requirements for dioxin/furan mixtures. Several organizations and individuals recommended that Ecology use the Precautionary Principle to guide efforts to reduce and prevent exposure to dioxin-like chemicals. For example:

As a result of scientific research over more than a decade, there is no doubt that dioxin and dioxin-like compounds act via a common mechanism of action. Now, clear guidance is required by the regulatory agencies to insure that risks from these highly toxic compounds are handled appropriately and with the conservatism necessary to protect human health. Where data are uncertain, the agencies need to be precautionary in their approach…. ***(Peter L. deFur and Kyle T. Newman, p. 1.)***

*…To protect human health and the environment on which human life depends, Ecology must adopt a "Precautionary Principle" approach….****(Darlene Schanfald, Olympic Environmental Council, p. 3.)***

Given the effort the State of Washington is placing on restoring Puget Sound and the information available in the Department of Ecology brochure "Reducing Toxic Threats" it seems incredulous to me that DOE would consider anything less that the MAXIMUM level of dioxin cleanup at polluted sites. Two statements in the Reducing Toxic Threats brochure point to why the maximum cleanup standards are required: "Children are exposed to toxins in ways that adults aren't" and "For all we know about toxic substances, there is a lot we don't know." Given what we do know about the toxicity of dioxin to humans, the last quote should send chills up and down the spine of everyone. ***(Robert Vreeland, p. 1.)***

According to the EPA not only does there appear to be no safe level of exposure to dioxins but levels of dioxin and dioxin-like chemicals have been found in the general U.S. population that are at or near levels associated with adverse health effects…. So in conclusion, in the interest of human health, the Lands Council strongly urges Ecology to employ the precautionary principle and use the most nationally accepted dioxin soil cleanup levels of 6.67 parts per trillion at non-industrial sites and 875 parts per trillion at industrial sites. ***(Kat Hall, Lands Council, Testimony at May 17, 2007 Public Hearing.)***

Ecology's Response to Public Comment

Ecology's mission is to protect human health and the environment. Achieving this mission is complicated by the limits of current scientific knowledge and the large variability in human exposure and susceptibility to hazardous substances. As discussed earlier in this document, Ecology believes that "conservatism" or "precaution" in the face of scientific uncertainty and variability is an appropriate public policy response under MTCA. This approach is consistent with other environmental laws and regulations as well as society's responses to other types of health hazards. Ecology also believes the MTCA rule provides a reasonable level of conservatism or precaution in response to scientific uncertainty and variability in exposure/susceptibility to hazardous substances.

Ecology recognizes that judgments on the appropriate level of precaution are often subjective. Ecology is interested in exploring whether the precautionary principle might help to make such judgments more transparent and predictable. However, Ecology believes this issue is broadly applicable to all hazardous substances found at MTCA cleanup sites. Consequently, Ecology does not believe it is appropriate to consider this type of rule revision without broader public dialogue. In addition:

- There are at least nineteen versions of the precautionary principle that have been adopted by state, federal and international agencies. It's unclear what version of the precautionary principle people are urging Ecology to use to support implementation of the MTCA rule.

- Most of the comments on this issue were provided in the context of Ecology's proposal to modify the gastrointestinal absorption fraction. Specifically, people argued that lowering the default value was inconsistent with the precautionary principle. However, Ecology is unclear what (if any) additional measures are being recommended based on the implementation of the precautionary principle.

- Current versions of the precautionary principle do not provide explicit guidance on how the principle might be used to guide different types of site cleanup decisions. Consequently, there are numerous issues that require public dialogue. For example, should the principle be applied to decisions on cleanup standards and cleanup actions? Should the same level of precaution be applied to the risks created by cleanup measures?

Issue 6-3: Should Ecology revise the default soil ingestion rate used in the MTCA Cleanup Regulation to assess risk and establish cleanup levels?

Ecology's Proposal

WAC 173-340-740 specifies how to develop soil cleanup levels that are protective of children that come into direct contact with the soil. This includes default assumptions on the amount of soil inadvertently ingested by children playing in the soil or otherwise coming into contact with it.

Ecology did not propose to modify the default soil ingestion rate.

Public Comment and Concerns

Several organizations recommended that Ecology review recent studies on soil ingestion by children and evaluate potential changes to the default soil ingestion rate specified in the WAC 173-340-740. These organizations also recommended that Ecology consider use of some central-tendency estimates in parameter values to avoid excessive conservatism in calculated cleanup values:

> *The soil ingestion rate (SIR) for young children, which is used to derive the Method B SCL, while consistent with the default soil ingestion rates for young children reported in EPA's Exposure Factors Handbook (EFH) (EPA, 1997b), does not reflect the best available information on this topic. Improved and more recent studies of soil ingestion by children have been published in the peer-reviewed literature, and these indicate that the former daily rates were biased high. Because of improvements in study methodologies, the results of these more recent studies are more representative of potential exposures to these individuals. Specifically, two recent studies published by the authors of the studies upon which EPA based its earlier estimate provide the most objective information for use in deriving estimates of daily soil intake. EPA originally recommended a SIR of 200 mg/day as the upper bound for 1 to 6 year old children in its Risk Assessment Guidance for Superfund (EPA, 1989a) and reiterated that recommendation in its EFH (EPA, 1997b) as a "conservative estimate of the mean." The latter recommendation was based primarily on tracer studies in children (ages 1 through 5) that were undertaken by Calabrese and his coworkers (Calabrese et al. 1989; Stanek and Calabrese, 1995a; 1995b). However, updated studies by these same authors, conducted using improved methodologies and published since that guidance was released, indicate that these previous recommendations were overestimates. The results of the most recent study in children were published by Stanek et al. (1999) and Stanek and Calabrese (2000). As described by Stanek and Calabrese (2000), this study implemented several improvements in study design and analytical procedures relative to their earlier work, and this led to improved estimates of soil ingestion for this age group. The soil ingestion rates reported by Stanek and Calabrese (2000) for these children were:*
>
> - *A 95th percentile rate of 106 mg/day (when evaluated over a 365-day period);*
> - *An arithmetic mean ingestion rate of 31 mg/day; and*
> - *A median (50th percentile) ingestion rate of 17 mg/day…*
>
> *In a presentation to EPA Region 1 in May 2002, Dr. Calabrese explained these points and recommended, based on this more recent study, that the upper bound estimate of soil ingestion rates for young children should be 100 mg/day, and the central tendency estimate should be 20*

mg/day (based on the median in this study). Dr. Calabrese reiterated these recommendations in a subsequent letter to the General Electric Company, a copy of which is attached as Exhibit 1. Given this new information, if the SCLs are based on six years of soil ingestion by young children, the upper bound soil ingestion rate should be 100 mg/day and the central tendency should be 20 mg/d. ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 2-4 of attached technical comments.)***

Ecology's Response to Public Comment

As noted above, the proposed rule revisions do not include any changes to the default soil ingestion rate. Changes to this rate are a major policy issue that is beyond the scope of this rule-making. This issue will be considered as part of the five-year review process that is anticipated to begin after completion of this rule amendment.

Issue 6-4: Should Ecology revise the default exposure parameters used in the MTCA Cleanup Regulation to reflect a different balance between upper bound and central tendency values?

Ecology's Proposal

WAC 173-340-740 specifies how to develop soil cleanup levels that are protective of children that come into direct contact with the soil. This includes several default assumptions including for example, the amount of soil ingested, the weight of the child and how many years the exposure occurs. WAC 173-340-745 contains assumptions for adults in direct contact with contaminated soil. Other rule chapters include default assumptions addressing exposures to contaminated ground water, surface water and air.

Ecology did not propose to change the default assumptions used to establish cleanup levels for ground water, surface water and air. No changes are proposed to these provisions.

Public Comment and Concerns

Several organizations expressed the opinion that the current procedures for establishing cleanup levels are problematic because of over-reliance on worst-case assumptions. They recommended that Ecology consider using some central-tendency values for some exposure parameter values in order to avoid excessive conservatism in calculated cleanup values:

Ecology is proposing a change to the current MTCA clean-up rules for mixtures of certain substances that, at least in the case of dioxin mixtures, is more than a thousand fold more stringent than EPA clean-up levels and recommendations of the Agency for Toxic Substances and Disease Registry (ATSDR). …Ecology has created this result by consistently adopting conservative upper bound estimates of all exposure parameters. EPA guidance cautions against over reliance on worst-case assumptions because this can lead to overstated risk and consequently to costly and unnecessary actions. EPA recommends instead, using a combination of upper bound and central tendency (mean values). ***(Grant Nelson, Association of Washington Business, p. 1-2, 3.)***

In addition, Ecology should reconsider the selection of parameters used in deriving SCL to incorporate some parameters that are central tendency estimates in order to avoid the extreme conservatism that results when multiple upper-bound parameters and toxicity values are multiplied together. …EPA (1992b) recommends that high end risk estimates be comprised of a

combination of upper bound and central tendency inputs in order to derive more reasonable estimates of potential risks. Ecology should follow this guidance in those cases where there is a reasonable body of data supporting calculation of a mean (or central tendency). ***(Dr. Jeff Louch, National Council for Air and Stream Improvement, p. 26 of attached technical comments.)***

Ecology's Response to Public Comment

As noted previously, the proposed rule revisions do not include any changes to the default exposure assumptions used to calculate cleanup levels. Changes to these assumptions involve major policy issues that are beyond the scope of this rule-making. This issue will be considered as part of the five-year review process that is anticipated to begin after completion of this rule amendment.

Issue 6-5: Should the CLARC tool continue to be used for calculating cleanup levels under the MTCA Cleanup Regulation?

Public Comment and Concerns

Comment was submitted by one organization that the CLARC tool and supporting guidance contained errors and inconsistent/inaccurate information:

MTCA regulatory requirements should be applied to the specific chemical compound groups that use a TEF methodology. This would lead to numerous errors and uncertainties. The CLARC tool and its supporting guidance contain inaccuracies, inconsistencies and undocumented methods. ***(Jennifer Nuzum, Fluor Hanford Environmental Protection, p. 2-3 of attached comments)***

Ecology's Response to Public Comment

In late 2003 and throughout 2004 Ecology's Toxics Cleanup Program (TCP) was involved in the design, development, and a phased deployment of the CLARC Database. The CLARC web page with associated workbooks and guidance documents is a tool used for establishing cleanup levels and standards under the MTCA Cleanup Regulation. CLARC is used by agency staff (site managers, technical and policy staff in TCP, other agency programs and staff), the public (potentially liable persons, site owners, consultants, citizens), and other federal and state agencies (EPA and Oregon's and California's environmental regulatory agencies, Washington's Department of Health). For the past ten years CLARC has provided, and will continue to provide in the future, a critical and necessary resource for staff and the public to use when establishing cleanup levels under the MTCA Cleanup Regulation.

Prior to 2003 CLARC was in an Excel format and was primarily used as a calculating tool which was printed out and published. In recognition of the severe limitations associated with Excel as a management tool and the inefficient use of Program resources, CLARC was redeveloped for the web using relational database technology. Throughout the development of the CLARC web-based application, quality assurance/quality control (QA/QC) procedures were implemented to reduce human error in the transfer of data, maintain data integrity and quality, and to ensure the currency of information from other dynamic databases. The guidance used in the CLARC web page corresponds with the federal EPA and other programs within Ecology.

<u>Brief Overview of CLARC QA/QC Procedures</u>

To ensure the integrity and quality of the information in the CLARC database (also referred to as the CLARC Information System and the CLARC tool) QA/QC procedures were employed through the different phases of development.

During the initial phases of development for CLARC the QA/QC process was focused on, but not limited to, the following parameters for over 600 chemicals:

- Chemical names;
- Chemical abstract service numbers (CAS #'s);
- Methods B and C cleanup levels for soils, waters, and air;
- Default exposure parameters;
- Inhalation correction factor (INH) confirmed with physical-chemical data; and
- Measures of toxicity.

During the final phases of development for CLARC the QA/QC process focused on the following procedures and processes for over 600 chemicals:

- Ambient water quality criteria;
- State/federal drinking water standards;
- Support documentation and related technical/legal references reviewed and checked; and
- Physical-chemical parameters.

To maintain and sustain the data integrity over the long-term for CLARC, Ecology has dedicated resources for thorough data audits, review of dynamic databases and continuing consultation, collaboration, and coordination with EPA Region 10. All State and federal guidance, including the TEF/TEQ methodology guidance within CLARC, has been developed in close and continuing consultation, collaboration, and coordination with different programs within the Ecology, Washington's Department of Health, and EPA Region 10.

Sources used for CLARC are documented in that system and can be accessed by the user. Every effort is made to make sure the information is accurate and consistent with MTCA and other state and federal laws. Ecology intends to update this System to reflect the requirements in the new rule, upon adoption of the final rule.

Issue 6-6: Is more Washington State health data and evaluation of this data needed to support the proposed rule revisions or additional amendments to the MTCA Cleanup Regulations?

Public Comment and Concerns

One organization expressed concern over how current epidemiological data was being collected and evaluated, and requested collection of additional data to evaluate the effects of existing contamination:

We have found statistically significant excess death rates at the City, not County level prior to closure in 1997 of the dioxin producing Rayonier Mill which sits in the eastern part of Port Angeles (PA). Age adjusted excess deaths in PA for the years '95,'96 and '97 averaged 23.9 excess deaths/ year. The mortality rate in western PA was below state average, central PA was equivalent to and eastern PA was significantly higher than state average…. Five other Washington communities with chlorine bleach (dioxin producing) paper mills, showed elevated age-adjusted mortality rates from 1990-97. Four of these were elevated to a statistically significant degree. We are doubly challenged in Clallam County. Our County Health Officer portrays an "everything is fine on my watch" stance. This Health Officer warns the community to avoid eating local crabs only after current newspaper publicity though the contamination was known at least since 1999…. [A]vailable mortality statistics fail to reveal very real, but localized problems. Last year the latest available State Dept. of Health report was for 2003 statistics. It was disappointing to find that since1997 there is no age adjustment of mortality statistics at the city level, and mortality for fewer individual diseases reported for individual cities. The publication, Washington State Vital Statistics 2003, page 58, mortality by place of residence, shows Clallam County with a crude mortality rate of 12.4, age adjusted rate of 8 as compared to the State total crude rate 7.5 and age adjusted rate of 7.8. Port Angeles is reported as having a crude rate of 13.4. The need for age-adjusted health statistics and a plea to request same of WDOH was reported last March to the local citizens group advising County Board of Health, but to my knowledge and that of the secretary of this group as of today no action has been taken…. "Prenatal mortality" classification as used in the state's statistics identifies deaths of fetuses of 20 or more weeks gestation plus deaths of infants less than 7 days old. Perinatal mortality, by place of residence, page 114, shows Clallam County has a rate of 13.0 against the state rate of 9.1, but PA has a whopping rate of 22.6. Numbers of deaths in this category are small (there were 5 deaths in PA in this category. Below 5 deaths no rate is calculated, which was the situation in 2000, 2001 and 2002). We need more data but this is sufficient for a "heads up".... As an aside, rates for prenatal mortality in the state are rising: Year 2000-7.7; 2001--8.2; 2002---8.3; 2003-9.1…. ***(Eloise Kailin, M.D., Protect the Peninsula's Future, p.1-2.)***

Statewide, location information needs to be sharpened as to cause-of-death listings. We applied this for the Port Angeles (PA) problem by prediction of the path of a pollution plume and relating this to mortality in that path. But for timely identification of health problems your department needs to modernize, to develop much finer data for place of occurrence of specific illnesses /mortality. The emerging patterns then could suggest potential proximate causes to be followed up by community health surveys and, where appropriate, confirmed by blood profile studies for specific pollutants. It's time to ask for budget support. ***(Eloise Kailin, M.D., Protect the Peninsula's Future,p.2, p.2 of enclosure 1.)***

Ecology's Response to Public Comment

The request is beyond the scope of this rule-making. The Washington Department of Health, not Ecology, is responsible for compilation and analysis of mortality data. Ecology has forwarded these comments to the Washington Department of Health for their future consideration.

Chapter 7: Cost Benefit Analysis

7.1 Introduction

Issue 7-1: Has a complete presentation of the cost benefit analysis been provided and has the analysis been substantiated?

Issue 7-2: Does the proposed rule represent the “least burdensome alternative”?

Issue 7-3: Did Ecology provide a reasonable estimate of the number of sites impacted by the rule amendments when evaluating the incremental costs of complying with the proposed rule revisions?

Issue 7-4: Did Ecology adequately consider the potential impacts of the proposed rule revisions on the costs of sediment cleanup actions?

Issue 7-5: Did Ecology adequately consider the potential cost impacts of the proposed rule revisions on residential and commercial properties?

Issue 7-6: Will the proposed rule revisions limit the beneficial re-use of PAH-contaminated sediments?

Issue 7-7: Will the proposed rule revisions increase the costs of preparing periodic reviews at sites with institutional controls?

Issue 7-8: Did Ecology identify all of the potential benefits associated with the proposed rule revisions?

Issue 7-9: Did Ecology develop reasonable estimates of the increased sampling and analysis costs when evaluating the potential compliance costs associated with the proposed rule revisions?

Issue 7-10: Did Ecology develop reasonable estimates on the additional acreage that might be affected by the proposed revisions to the dioxin cleanup standards?

Issue 7-11: Did Ecology use an appropriate regulatory baseline when estimating the increased compliance costs associated with the proposed rule revisions?

Issue 7-12: Did Ecology use appropriate assumptions on remedial technologies and unit costs when evaluating the increase in soil remediation costs?

Issue 7-13: Did Ecology adequately evaluate the costs associated with evaluating background concentrations of dioxins, PAHs and PCBs?

Issue 7-14: Will the proposed rule revisions increase the level of effort necessary to consult/negotiate with Ecology Site Managers?

Issue 7-15: Will the proposed rule revisions increase the costs of complying with the ecological assessment provisions in the MTCA rule?

Issue 7-1: Has a complete presentation of the cost benefit analysis been provided and has the analysis been substantiated?

Ecology's Proposal

The Washington APA directs agencies to perform several evaluations and make several determinations before adopting final rules. Among other requirements, the APA specifies that agencies must "…[d]etermine that the probable benefits of the rule are greater than its probable costs taking into account both the qualitative and quantitative benefits and costs and the specific directives of the state law being implemented…."

Ecology evaluated the potential costs and benefits of the proposed rule revisions. As part of this evaluation, Ecology prepared quantitative estimates of the incremental compliance costs associated with the proposed rule revisions. However, Ecology did not prepared quantitative estimates for the benefits associated with reducing exposure to these types of mixtures. Ecology concluded that there are many sources of uncertainty and variability that prevent the Department from preparing meaningful quantitative estimates. These sources of uncertainty and variability were discussed in the preliminary cost benefit analysis.

Ecology concluded that the health benefits outweigh the quantifiable compliance costs associated with the proposed rule revisions.

Public Comments and Concerns

Several organizations expressed concerns that the cost-benefit analysis (CBA) was fundamentally flawed and incomplete. These organizations were particularly concerned about the qualitative evaluation of benefits. They argued that without some quantitative measure of benefits, Ecology was unable to conclude that benefits exceed compliance costs. For example:

> *Section 5.3 of the Economic Analysis includes extensive discussion on the benefits of a reduced human health and environmental exposure to chlorinated dioxin/furan; in support of a more stringent Method B soil cleanup level. It is, however, a largely qualitative evaluation which offers little insight into the tangible benefits of a TEQ quantification methodology and 10-5 excess cancer risk level (the baseline case) versus a 10-6 excess cancer risk level…. Ecology commentary on the benefits of the proposed rule is superficial and speculative. We note the exact same discussion could be offered to support a cleanup level reduction from the proposed 11 ppt TEQ to 5 ppt or 1 ppt or (why not) 0 ppt* ***(Ken Johnson, Weyerhaeuser, p. 7-8.)***
>
> *Ecology has failed to substantiate wither the asserted benefits or calculated costs of this proposed rule, making its cost benefit analysis and other economic evaluations fundamentally flawed and incomplete. …Similar to its cancer analysis, Ecology references various non-cancer pathologies associated with dioxin/furan exposures without giving any context as to the magnitude of the problem under the current rule or to what extent that problem would be reduced under the proposed rule. Ecology has not presented any information regarding the number of cases of diabetes, infertility, thyroid dysfunction, or developmental delay (all claimed as adverse health effects in the PEAA) that would be avoided by the proposed rules. The extent of Ecology's analysis is to hint at links between these problems and dioxin exposures and then assert that the total value of avoiding these problems is expected to be large. Again we would ask Ecology to identify the decrease in non-cancer health effects that will be achieved by the proposed rule. Even if Ecology does not monetize the non-cancer health benefits, it should specify the magnitude of*

the improvement if the cost-benefit analysis is to have any substance…The PEAA states that prepare meaningful quantitative estimates of the health benefits of this proposed rule cannot be done because there are many sources of uncertainty and variability. As demonstrated above, such a statement ignores a vast body of scientific, medical and economic literature that measures, quantifies, and reports information that is inherently uncertain and variable. Ecology improperly has made no attempt to use the available analytical tools to quantify or otherwise specify the benefits of this rulemaking. Further, Ecology's presentation of ranges of values as indicative of the uncertainty and variability is misleading. Ranges in data identify the high and the low values and do not provide information regarding the distribution of the data. A range can be large even though the majority of the data is tightly distributed around a mean. It would have been more useful had Ecology provided measures of central tendency (such as mean, median and mode) and the variance of the data…. Ecology has made no attempt to provide a quantitative assessment of the expected benefits of the proposed rule;' rather, it has presented a list of possible qualitative benefits without providing sufficient information as to how it weighed these possible qualitative benefits against the quantitative costs…. Absent documentation of its air dispersion modeling efforts, it is not possible to evaluate Ecology's proper and representative use of ISCST3, nor is it possible to validate the model's results…. Clearly, the three alternatives Ecology said that it considered would be more burdensome, but it has prepared no analysis to suggest that the proposed rule is the least burdensome alternative among the full range of potential options. ***(Dana Dolloff, Rayonier, page 2, 3, 5, 8-9, 10, 4, 21, 22.)***

Similar to its cancer analysis, Ecology references various non-cancer pathologies associated with dioxin/furan exposures without giving any context as to the magnitude of the problem under the current rule or to what extent that problem would be reduced under the proposed rule. Ecology has not presented any information regarding the number of cases of diabetes, infertility, thyroid dysfunction, or developmental delay (all claimed as adverse health effects in the PEAA) that would be avoided by the proposed rules. The extent of Ecology's analysis is to hint at links between these problems and dioxin exposures and then assert that the total value of avoiding these problems is expected to be large. Again we would ask Ecology to identify the decrease in non-cancer health effects that will be achieved by the proposed rule. ***(Dana B. Dolloff, Rayonier, p. 8-9 of attached comments.)***

There will be a significant economic burden on industry and private landowners if the dioxin and furans level change from 6.67 to 11 PPT. We do not believe that Ecology has fully studied the benefits vs. the economic costs. ***(Carol Johnson, North Olympic Timber Action Committee, p. 1.)***

Ecology's Response to Public Comment

Ecology disagrees that the draft CBA was fundamentally flawed. Ecology used the best information available to it at the time to prepare this document. Part of the purpose of providing the draft CBA for public review is to seek public comment on the document. In response to concerns regarding substantiation of the CBA, Ecology has revised the CBA to include quantitative estimates of benefits and refined cost estimates. Ecology also revised the CBA to include detailed information on the air-deposition modeling used in the analysis.

Revisions to the benefits section of the CBA include quantification of the range of avoided cancers resulting from the revisions made to the rule, further clarification of the difficulties associated with such quantification, and inclusion of additional benefits ranges reflecting these uncertainties.

However, because of the inability to quantify non-cancer benefits of the rule amendment, that portion of the CBA remains qualitative. A qualitative evaluation of benefits is allowed under RCW 34.05.328(d).

Revisions to the costs section of the CBA include revision of marginal values used in sampling and remediation estimates, revision and clarification of affected sites, real estate cost impacts, and a broader set of information regarding the air-deposition modeling.

For response to concerns regarding the Least Burdensome Alternative (LBA) Analysis, see Issue 7-2 of the Concise Explanatory Statement Responsiveness Summary, below.

See the Final CBA for changes. (The Final CBA is available from Ecology or can be downloaded from the Ecology web site, www.ecy.wa.gov.)

Issue 7-2: Does the proposed rule represent the "least burdensome alternative"?

Summary of Issue

The Washington APA directs agencies to make several determinations before adopting final rules. Among other requirements, the APA specifies that agencies must "…[d]etermine, after considering alternative versions of the rule and the analysis required under (b), (c), and (d) of this subsection, that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated under (a) of this subsection;"

In the course of rulemaking, Ecology considered several alternative approaches to achieving the goals of the rule-making. The alternatives considered included:

- Leaving the current MTCA rule as it is.
- Eliminating of use of TEQ factors for dioxin/furan and carcinogenic PAH mixtures.
- Using a different (higher or lower) relative bioavailability for dioxin mixtures.
- Using a single reference chemical (2,3,7,8 TCDD) for both dioxin/furan mixtures and PCBs.

Ecology prepared a preliminary analysis of these alternatives and concluded that some of these options would not have achieved the general goals of the rule-making and others were more burdensome than the proposed rule. Ecology further concluded that, of the options considered, only the proposed rule achieves the goals of the rulemaking and authorizing statutes, and is the least burdensome option for those who are required to comply with it.

Public Comments and Concerns

Several comments were received related to a LBA analysis. For example:

> *…A "least burdensome alternative analysis" is provided in the Ecology Analysis. Ecology erroneously concludes the proposed rule "imposes the least burden on those sites required to comply with it." This is simply not a defensible conclusion. The least burdensome analysis needs to be redone with more complete and relevant information, and in consideration of the statutory directive.* ***(Ken Johnson, Weyerhaeuser, p. 6-7, 8.)***

Ecology reframes the goals of the rule making to be, in part, to 1) clarify the interpretation of the existing rule and reduce uncertainty in the calculation of cleanup levels, and 2) enact regulations that protect human health and the environment in the face of scientific uncertainty. The reality is that the Rayonier Settlement resolved any ambiguity about the computation of cleanup levels, and that baseline interpretation achieves the "general goals and specific objectives" of the MTCA statute. Ecology has not provided a credible analysis in support of its discretionary choice to impose a more stringent cleanup standard; i.e., TEF methodology/one in one-million risk level…An obvious "less burdensome" outcome which explicitly achieves the general goals and specific objectives of the MTCA statute is the baseline interpretation. There is no reason for Ecology to reject this base case. The Economic Analysis has significant deficiencies and needs to be upgraded in order to support the needed regulatory determination. ***(Ken Johnson, Weyerhaeuser, p. 8.)***

Clearly, the three alternatives Ecology said that it considered would be more burdensome, but it has prepared no analysis to suggest that the proposed rule is the least burdensome alternative among the full range of potential options. ***(Dana Dolloff, Rayonier, page 2, 3, 5, 8-9, 10, 4, 21, 22.)***

Ecology's Response to Public Comment

The LBA analysis evaluates the least burdensome alternative of those possible rule amendments "that will achieve the general goals and specific objectives stated under (a) of this subsection" wherein (a) refers to "the general goals and specific objectives of the statute that the rule implements."

The policy assumptions and levels of protection are predicated on the authorizing statutes of the MTCA rule. MTCA provides Ecology with the authority to accomplish several specific statutory objectives. These objectives are specified in RCW 70.105D.030(1) and include the following:

(a) Investigate, provide for investigating, or require potentially liable persons to investigate any releases of hazardous substances, including but not limited to inspecting, sampling, or testing to determine the nature or extent of any release or threatened release…;
(b) Conduct, provide for conducting, or require potentially liable persons to conduct remedial actions (including investigations under (a) of this subsection) to remedy releases or threatened releases of hazardous substances…. In conducting, providing for, or requiring remedial action, the department shall give preference to permanent solutions to the maximum extent practicable and shall provide for or require adequate monitoring to ensure the effectiveness of the remedial action;
(d) Carry out all state programs authorized under the federal cleanup law and the federal resource, conservation, and recovery act, 42 U.S.C. Sec. 6901 et seq., as amended;
(e) Classify substances as hazardous substances…;
(f) Issue orders or enter into consent decrees or agreed orders that include deed restrictions where necessary to protect human health and the environment from a release or threatened release of a hazardous substance from a facility….;
(g) Enforce the application of permanent and effective institutional controls that are necessary for a remedial action to be protective of human health and the environment;
(h) Require holders to conduct remedial actions necessary to abate an imminent or substantial endangerment…;
(i) Provide informal advice and assistance to persons regarding the administrative and technical requirements of this chapter.… As part of providing this advice for independent

remedial actions, the department may prepare written opinions regarding whether the independent remedial actions or proposals for those actions meet the substantive requirements of this chapter or whether the department believes further remedial action is necessary at the facility….; and

(j) Take any other actions as necessary to carry out the provisions of this chapter, including the power to adopt rules under chapter 34.05 RCW.

The development of the amendments involved the consideration and balancing of a number of issues and interests. The proposed amendments were developed to satisfy the following six goals or objectives:

1. Remediation of contaminated sites to levels that are sufficiently protective of human health and the environment. Ecology's foremost goal was to develop standards that are protective of human health and the environment. Protection is defined to include both current and future generations and susceptible subgroups, such as small children, that are particularly sensitive to hazardous substances.

2. Scientifically and legally defensible cleanup standards. An important goal was to develop standards that are scientifically and legally defensible. Toward that end, Ecology reviewed the scientific literature and consulted with members of the SAB and other individuals experienced in the areas of risk assessment. Where conflicting opinions or recommendations exist, Ecology has attempted to balance the various positions to arrive at a scientifically defensible and workable approach.

3. Performance of cleanup actions in a manner that is consistent with existing state and federal regulatory programs. The MTCA requires that minimum cleanup standards be at least as stringent as applicable state and federal laws. In developing the proposed amendments, Ecology has attempted to rely on requirements established under these other authorities and avoid creating duplicate requirements. However, contaminated sites are frequently more complex than situations addressed by existing programs. Consequently, Ecology has attempted to provide an approach that supplements existing requirements to address situations where multi-media contamination and mixtures of hazardous substances are present.

4. Efficient cleanup of contaminated sites. An important objective of the proposed amendments is to increase the efficiency of site cleanup. In particular, the amendments reduce the flexibility of the present system. This particular flexibility created uncertainty rather than predictability. Ecology’s goal is a system which focuses available funds on site cleanup and minimizes cleanup standard negotiation and litigation.

5. Use of a consistent approach for assessing and managing health risks. As demonstrated by the recent Rayonier Corp. settlement, the current MTCA rule language can result in considerable variability in the methodologies used to develop cleanup levels and assess compliance with these levels. Through these amendments, Ecology hopes to ensure that consistent procedures are used to assess and manage health risks.

6. Provide some flexibility to address individual site characteristics. In developing the proposed amendments, Ecology has tried to balance the goals of regulatory consistency and efficiency with the need to provide some flexibility to address individual site characteristics.

The administrative procedures act (RCW 34.05.328) requires an agency engaged in rule-making to consider “alternative versions” of the rule. Ecology considered a wide range of alternatives, as discussed in the Background Document and the least burdensome analysis. (See the Final Cost Benefit Analysis.)

In response to the comments, Ecology has provided a more detailed discussion of the alternatives considered in the least burdensome analysis and an explanation of why Ecology has concluded the final rule is the least burdensome alternative for achieving the general goals and specific objectives of the statute.

The Rayonier lawsuit did not remove any ambiguity about the calculation of cleanup levels under the current rule. The settlement for that lawsuit only addressed the narrow issue of one plausible interpretation of the current rule regarding the level of risk to be applied to dioxin/furan mixtures at the Rayonier site when using TEFs. Under that settlement, dioxin/furan mixtures are permitted at levels above what Ecology had previously interpreted MTCA to permit, and greater than what Ecology believes is appropriate to protect human health. It did not address how this provision was to be applied at other sites. Also, in addition to clarifying the rule language pertaining to the level of risk to be applied to dioxin/furan mixtures, this rule-making addresses many other issues that were not addressed in that lawsuit. This includes: the level of risk to apply when using TEFs to calculate cleanup levels for carcinogenic PAH mixtures; the application of TEFs to PCB mixtures; updating the TEFs using the latest available science; addressing the bioavailability of dioxins and furans in contaminated soils; and, the appropriate physical properties to use when modeling the movement of mixtures consisting of multiple congeners.

Furthermore, Ecology disagrees that the baseline evaluated in the CBA achieves the general goals and specific objectives of the MTCA statute, and even it if did, would not be the least burdensome approach. (The baseline is the current rule.) This is discussed in more detail in the Background Document and Final Cost Benefit Analysis.

Issue 7-3: Did Ecology provide a reasonable estimate of the number of sites impacted by the rule amendments when evaluating the incremental costs of complying with the proposed rule revisions?

Summary of Issue

Ecology reviewed the numbers and types of Washington cleanup sites where dioxins/furans, PAHs, and/or PCBs are known or reasonably suspected to be present. As part of that review, Ecology considered the nature and extent of contamination present at these sites. Ecology concluded that the proposed rule revisions would not significantly increase the number of sites requiring cleanup in Washington state.

Public Comments and Concerns

Several individuals and organizations expressed the opinion that the proposed rule revisions would result in a significant increase in the number of contaminated sites. They stated that the draft CBA underestimates the increase in number of contaminated sites that would result from implementation of proposed rule revisions. For example:

> *The economic impact analysis associated with the rule change argues that the increasing stringency of the proposed rule will not create a significant change in the number of sites requiring cleanup or the ultimate cost of cleanup. I believe this analysis is flawed and dramatically underestimates the ubiquitous nature of low-level PAH concentrations in urban residential soils, and in many areas that are not currently subject to MTCA cleanup requirements. The proposed change would increase substantially the number of affected sites, the affected soil volumes and the associated economic impacts.* ***(Mark Larsen, Anchor Environmental, p. 2.)***

Ecology concluded that the proposed rule would affect only three pulp mill sites. In reaching this conclusion Ecology ignored entire categories of industrial, commercial and governmental facilities-including small business, hospital and agricultural operations-that could be affected…Sites where remedial action has been completed under MTCA or CERCLA are subject to ongoing review every 5 years to confirm that the remedy remains protective. Sites with remaining dioxins/furans, cPAHs and PCBs will be evaluated during their 5-year review under the more stringent cleanup levels proposed in this rulemaking if those become part of the MTCA regulations. The PEAA has not given any consideration to the additional costs this proposed rule could impose on sites that are subject to these 5-year reviews. ***(Dana B. Dolloff, Rayonier, p. 3 and 17 of attached comment.s)***

In Chapter 4 of the Economic Analysis, Ecology's assumptions about the universe of "common" sites potentially affected by the proposed amendments ignores several types of sites that could ultimately be impacted by this proposed rule. A more complete accounting of known sources of chlorinated dioxin/furan or c-PAHs, which informs on possibly contaminated sites, could significantly impact the cost impacts associated with this proposed rule…Overlooked in Ecology's analysis are:

- *wood treating sites with a history of pentachlorophenol or creosote use (note that chlorinated dioxins/furans are a common contaminant associated with the prevalent wood preservative pentachlorophenol, and PAHs are primary components of creosote wood preservatives),*
- *sawmills that historically used pentachlorophenol for sapstain control,*
- *former pentachlorophenol manufacturers or distributors,*
- *publicly- or privately-owned hospital incinerators that burn polyvinyl chloride medical waste, which can contribute both chlorinated dioxins/furans, as well as PAHs, to soil.*
- *municipal waste incinerators, operated by local governments or school districts,*
- *properties affected by air deposition from wood-fired or combination fuel-fired steam generating units, cement kilns, mortuaries, activated carbon regeneration, municipal treatment sludge incinerators, and other combustion sources.*
- *properties that have received land-applied municipal or industrial wastewater treatment solids, or ashes from wood or coal-fired combustion units,*
- *"urban areas" (in particular, public parks), state and federal forest ownership*

(Ken Johnson, Weyerhaeuser, p. 3-4.)

The cost projections ignore sites that are not currently listed as dioxin sites. There are many sites not listed but have a high potential, such as anybody that burned salt laden hog fuel, any mill that had bleaching, any wood treating plants, incinerators, medical waste incinerators, and railroad tracks. They all have potential to be pulled in under this rule. ***(Dana Dolloff, Rayonier, Testimony at May 14, 2007 Public Hearing.)***

Economic analysis should look beyond current MTCA sites. How will Ecology evaluate air borne contaminants coming from Asia or coming from sources that cannot be identified? How will they

parse that out between any major point source? Will the point source be responsible for cleaning to 11 part per trillion although they may have only contributed 1 part per trillion? ***(Paul Perlwitz, p. 1.)***

Ecology has ignored altogether the proposed rule's potential cost impacts on environmental media other than soils. Most importantly, Ecology has ignored its potential cost impacts on sediment cleanups…Ecology identifies almost four times as many dioxin/furan-related types of sites in its March 2007 Multiyear PBT Chemical Action Plan Schedule (PBTCAPS)" than it does in this proposed rule. Ecology stated the following in that document: Likely sources of dioxin and furan releases in Washington currently include:

- *Backyard burning of domestic trash*
- *Cement kilns*
- *Crematoria*
- *Forest, brush and grass fires*
- *Industrial wood combustion (via hogged-fuel boilers)*
- *Land-applied biosolids*
- *Pulp and paper mills*
- *Residential wood combustion*
- *Sewage sludge incineration*
- *Utility coal combustion*
- *Vehicle fuel combustion*

If the additional types of sites listed in the PBTCAPS are "likely sources of dioxin and furan releases in Washington," then it is reasonable to conclude that they are likely to be affected by the proposed rule and therefore must be addressed and evaluated in the PEAA. Ecology's cost-benefit analysis must provide a similar quantification or inventory of the air emissions-related sources that could be affected by this rule given the PBTCAPS and other state documents that identify dioxin/furan sites beyond those that Ecology has evaluated here…The PEAA states that there are currently 38 sites with dioxin soil contamination. This is only partially correct. While the 1998 Dioxin Source Assessment produced by Ecology identifies 38 "cleanup sites," Ecology's 2007 PBTCAPS document identifies 109 dioxin sites, 55 of which are MTCA sites. Ecology observes that: "There are potential cleanup opportunities for dioxins and furans given that there are 55 (combined) listings for dioxins and furans on the WQA list. Additionally, there are 54 MTCA sites where dioxins and furans exceed cleanup levels." It is not clear how Ecology concludes that a rulemaking lowering clean up levels for dioxins and furans will only impact three sites state-wide, when its own analysis shows there are at least 54 sites that exceed existing clean up levels… Insufficient air modeling information to review and comment on the accuracy of the modeling results regarding the additional soil remediation areas. The PEAA concludes that the proposed rule changes would result in only 1.65 additional acres of soil remediation, at a cost of $144,000, for each of three pulp and paper mills in the state. The entire foundation for this conclusion is its air dispersion modeling. Ecology does not provide sufficient information

regarding the input parameters it used in running the air dispersion model. The very little information Ecology does provide about the air model's input suggests a significant error regarding the hypothetical pulp mill's emissions impact...Ecology should have evaluated the possible inaccuracy of its linear exposure model as an uncertainty factor in the cost-benefit analysis. By not evaluating this uncertainty, the cancer reduction benefit is overstated. ***(Dana Dolloff, Rayonier, page p.3, 12, 14-15.)***

Ecology should also consider whether background levels on beaches might exceed the proposed dioxin cleanup level. As noted above, wood burning is a natural source of dioxin formation. Driftwood containing chlorides from seawater, when burned on beaches, could be an enhanced source of dioxins compared to firewood that is not saturated by seawater. Frequently used beaches and campgrounds near seashores could thus have much higher levels of dioxins than anticipated based on current sampling surveys, and should be considered in cost benefit analyses of the proposed rule revision. ***(Mark E. Madsen, City of Port Angeles, p. 3 of attached technical memorandum.)***

Ecology's Response to Public Comment

In response to comments received regarding the number and type of sites affected by the proposed rule, Ecology has revised the list of affected sites addressed in the Final CBA, and revised/added content to better reflect Ecology's decision-making process in determining which sites are likely to be affected by the rule.

Revisions to the list of sites Ecology expects to be affected by this rule change include inclusion of other sources of dioxin/furan air emissions. Ecology has included extensive discussion of various types of site associated with dioxin/furan contamination, the likelihood of this rule change impacting those sites, and explanation of which sites Ecology expects will be impacted and why.
See the Final CBA for changes.

Ecology has reviewed the information backing up the estimate of potentially impacted dioxin contaminated sites cited in the PBTCAPs report and discussed this with Ecology staff that prepared that report. Based on this review, we do not believe the CBA is inconsistent with the persistent Bioaccumulative toxin (PBT) analysis. The PBTCAPs report included in its "site" count any location where fish or surface water had exceeded dioxin food criteria (for fish) or water quality criteria (for surface water bodies). Neither of these constitutes a "site" under MTCA, as no facility has been identified to date that could be remediated. In addition, it appears a number of sites were counted twice in the PBTCAPs report as a result of multiple listings of the same site when multiple media are contaminated. At least one site was included in the PBTCAPs report that was not contaminated by the mixtures the subject of this rule-making. However, in light of this comment, Ecology again reviewed the list of dioxin contaminated sites and concluded the current contaminated sites list has 40 sites identified with suspected or confirmed dioxin contamination. This is slightly different from the 38 sites identified in the draft CBA. As described in detail in the CBA, only three of these sites are likely to be impacted by the rule amendments.

Ecology has also reviewed the wide variety of other potential sources of dioxins and carcinogenic PAHs identified in the above comments for whether they could result in the need for remedial action under MTCA. With regard to combustion sources, Ecology has concluded that only facilities that historically burned salty hog fuel before the advent of modern air pollution controls have the potential to be impacted by the rule amendments. This is an estimated total of nine additional facilities, located in western Washington. While literature information indicates that other combustion sources can generate dioxin, the concentrations or amounts of dioxin emitted are small enough that measurable site-specific impacts to soil

are unlikely. Rather, these other combustion sources can be viewed as contributing to the background levels seen in soils in Washington State.

Ecology agrees that pentachlorophenol manufacturers, wood treating sites, and sites that used pentachlorophenol for sap stain control are potential sources of dioxin contamination. However, contamination at these types of sites is typically a result of spillage and dripping from operational practices with the result being heavy soil and ground water contamination. In these cases, as explained in the CBA, the small difference in dioxin cleanup levels under this rule amendment vs. the baseline will not result in a change in the cost of remedial actions at these types of sites.

Lastly, while it is possible the land application of municipal and industrial wastewater treatment sludges and ashes from wood and coal combustion units could result in a site needing remediation under MTCA, Ecology believes this is unlikely for several reasons: these sources have not been previously identified as a major source of these contaminants in other studies; limited testing of these materials in Washington State to date indicates these are not likely to be highly contaminated with these chemical mixtures; these facilities are highly regulated by other programs; companies harvesting produce from these areas have an economic interest in their products not being contaminated and take efforts to prevent this; and, many land application sites are properties specifically dedicated for these purposes so that sale of the property, which typically triggers a review by lenders for compliance with MTCA, is unlikely.

Issue 7-4: Did Ecology adequately consider the potential impacts of the proposed rule revisions on the costs of sediment cleanup actions?

Summary of Issue

Ecology initiated the rulemaking process to address several issues associated with the policies and methods for establishing soil cleanup levels. Concurrent with the MTCA rulemaking process, the DMMP began a process to evaluate similar issues related to dioxin-contaminated sediments. Ecology discussed the relationship between the two projects in the Background Document distributed with the proposed MTCA rule:

> *Ecology uses the general policies and procedures in WAC 173-340-700 through -710 when establishing site-specific requirements for contaminated sediment sites. It is not clear how the proposed revisions would actually impact sediment cleanup standards and cleanup actions. However, Ecology believes that the issue of how to establish MTCA sediment cleanup standards must be addressed as part of a larger set of regulatory questions on the relationships between requirements in the Sediment Management Standards (SMS) rule and the MTCA rule. Ecology is currently working with other sediment management agencies (e.g. EPA, Corp of Engineers, Department of Natural Resources, etc.) and interested parties to review a number of issues associated with dioxin-contaminated sediments in Puget Sound. Ecology has decided to wait until that process is completed before developing rule amendments (if any) to address sediment cleanup requirements. (Ecology, 2007b, p. 17)*

Public Comments and Concerns

Several individuals and organizations expressed the opinion that Ecology failed to adequately consider the potential impacts of the proposed rule revisions on sediment cleanup actions. For example:

*Ecology has ignored altogether the proposed rule's potential cost impacts on environmental media other than soils. Most importantly, Ecology has ignored its potential cost impacts on sediment cleanups…. **(Dana Dolloff, Rayonier, p. 3 of attached comments.)***

*Ecology has ignored the potential cost impacts of this rule on sediment cleanups. MTCA cleanup levels apply directly to sediments when those are addressed under MTCA itself. MTCA cleanup levels also apply by reference to the broader range of sediment response actions conducted under the state sediment management standards at WAC Chapter 173-204 and to any sediment actions conducted under the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Ecology's failure to identify and evaluate the potential costs of this rule on sediment response actions is a fundamental gap. Ecology has stated that the proposed rule change is not intended to affect the cleanup of sediments contaminated with mixtures of dioxins/furans, cPAHs and PCBs and this issue instead will be addressed during the 5-year review of the Sediment Management Standards (SMS). This response is insufficient and inaccurate because Ecology cannot adequately evaluate the costs and benefits of a proposed rule "assuming" future rulemaking outcomes. More fundamentally, this proposed rule will impact sediment cleanups independent of and well before the next SMS 5-year review process...There are a significant number of sites in Washington where sediments affected by mixtures of dioxin, cPAHs, and/or PCBs are a concern and where these substances could drive remedial requirements. Of the 3,207 sites listed on Ecology's confirmed and suspected contaminated sites list as of May 8, 2007…182 sites had dioxin, cPAHs, and/or PCBs as confirmed or suspected sediment contaminants. **(Dana Dolloff, Rayonier, p. 14-15 of attached comments.)***

*Ecology's decision to categorically exclude sediment sites from evaluation of potential cost impacts, when its own documents developed outside this rulemaking show that there are 182 sediment sites that have the contaminants addressed by this rule, creates a fundamental flaw in the cost-benefit analysis. **(Dana B. Dolloff, Rayonier, p. 15 of attached comments.)***

*The potential cost impacts of the proposed rule revisions at sediment sites are not evaluated in the Cost Benefit Analysis (Ecology 2007)…Moreover, Ecology's apparent expectation that sediment cleanups in urban regions with widespread, ambient concentrations of dioxins/furans, CPAHs, and PCBs will qualify for Method C cleanup levels based on area background concentrations should be recognized clearly in an explicit policy statement about the application of Method C at sediment sites. If such a policy is not Ecology's intent, the costs of the rule revision to sediment site cleanups should be recognized by the cost benefit analysis. **(Jennie Goldberg, City of Seattle, p. 3-4.)***

Ecology's Response to Public Comment

- Issues Associated With Sediment Cleanup Standards. Several people asked how the proposed rule revisions would impact sediment cleanup actions.[39] Ecology reviewed this issue during the rulemaking process and believes the proposed revisions would have minimal impacts on sediment cleanup standards. This issue is discussed earlier in this document (See Issue 2-9).

[39] WAC 173-340-760 states that "…[i]n addition to complying with the requirements in this chapter, sediment cleanup actions conducted under this chapter must comply with the requirements of chapter 173-204 WAC…" (the Sediment Cleanup Standard). Consequently the general risk policies and procedures specified in WAC 173-340-708 apply to sediment cleanup actions.

Issue 7-5: Did Ecology adequately consider the potential cost impacts of the proposed rule revisions on residential and commercial properties?

Summary of Issue

Ecology's Preliminary Economic Analysis considered the following changes in costs as a result of the proposed rule amendments:

- Sampling expenditures associated with defining the nature and extent of soil contamination
- Expenditures associated with preparing Terrestrial Ecological Evaluations (TEE)
- Expenditures associated with evaluating multiple hazardous substances and multiple exposure pathways
- Site cleanup expenditures associated with measures to remove, treat, or cover contaminated soils with clean materials (e.g., soil or pavement)

Public Comments and Concerns

Several organizations stated that the proposed rule revisions will adversely impact commercial and residential property values and sales. They stated that Ecology had not adequately considered these impacts when preparing the cost benefit analysis. For example:

> *Ecology has been unclear about how it will deal with dioxin contaminated residential sites, stating only that they will be dealt with on a case- by- case basis. This leaves the property owner in a quandary: facing potentially expensive cleanup costs, and under full disclosure rules, unable to sell a home site. Owners with contaminated property will see significant declines in home values. These property value losses and/or site cleanup costs have not been included in Ecology's rule-making cost benefit analysis. In fact, the cost benefit analysis completely ignores residential cleanup economic impacts…Conflicts over dioxin cleanup will lead to expensive litigation and lengthy legal delays in resolution. Ecology's failure to properly consider the economic impacts of its proposed new rules on residential and commercial properties across the state is a serious omission which will bring uncertainty and disruption to residential real estate markets, and negatively affect the value of home sites which may contain background levels of dioxins. This situation is further aggravated by Ecology's lack of a consistent regulatory approach to residential cleanup which would preserve property values...At a minimum, Ecology should bring economic surety to residential property values by establishing cleanup action standards above urban background levels and eliminating uncertainty in the environmental regulator process for homeowners of our state.* ***(Don Madison, Port Angeles Business Association, p. 1-2.)***
>
> *Ecology's failure to properly consider the economic impacts of its proposed new rules on residential and commercial properties across the state is a serious omission which will bring uncertainty and disruption to residential real estate markets, and negatively affect the value of home sites which may contain background levels of dioxins. This situation is further aggravated by Ecology's lack of a consistent regulatory approach to residential cleanup which would preserve property values. At a minimum, Ecology should bring economic surety to residential property values by establishing cleanup action standards above urban background levels and eliminating uncertainty in the environmental regulator process for homeowners of our state.* ***(Steve Marble, Sequim Association of Realtors, p. 2.)***

Organizations also noted that application of the proposed rule revisions would adversely impact cost of real estate transactions and that this impact has not been adequately addressed in the draft CBA. For example:

> *Ecology has ignored the potential costs the rule could impose on industrial, commercial and residential property transactions. The proposed rule would impose additional costs on sellers and buyers of property containing dioxins/furans, cPAHs and PCBs near or above the new cleanup levels. Apart from the impact on property values, the rule would impose additional property transaction costs. Ecology must consider these potential costs so that the public is apprised of them and can comment on them...In addition to the impact from a reduction in property values, the rule also would impose additional property transaction costs, such as the costs associated with conducting additional due diligence and performing more extensive and more costly Phase I and Phase I1 site assessments to evaluate the property against the more stringent standards. These factors could produce a chilling effect on property transactions. Ecology must consider these potential costs so that the public is apprised of them and can take them into account in reviewing and commenting on the proposed rule.* ***(Dana B. Dolloff, Rayonier, p. 3 and p. 21 of attached comments.)***
>
> *By effectively lowering the Method B cleanup levels for chlorinated dioxins/furans and c-PAHs, Ecology will cause more properties to fall into a "gray zone" where concentrations are too low to require remediation and yet too high to allow a "no further action" determination. Lower cleanup levels mean "No Further Action" determinations will be harder to obtain. Over time, more sites will end up having institutional controls because more sites will have concentrations exceeding the proposed cleanup level while being too low to require remediation. Industrial or commercial properties with deed restrictions are harder to sell and often require the seller to reduce its asking price to account for the increased or perceived risk associated with the property. The proposed amendments to MTCA reduces the liquidity of real property assets for those properties having contaminant concentrations higher than "no further action" levels yet below those levels that require immediate remediation. Persons or corporations owning affected properties will have added difficulty and incur increased costs when selling their property or using it as collateral for development. Loan terms for capital improvements may be more costly to compensate lenders for the incremental increase in risk associated with loaning money on property that is perceived as contaminated.* ***(Ken Johnson, Weyerhaeuser, p. 5.)***

Ecology's Response to Public Comment

Ecology disagrees that the amended rule will result in huge impacts on real estate transactions and property values as speculated in the above comments. The cleanup standards established by the final rule are essentially the same standards that have been in use under the MTCA rule for over 15 years prior to the Rayonier lawsuit without the speculated impacts. Ecology's experience with other sites having similar area-wide contamination (such as the Tacoma Smelter Plume and Everett Asarco sites) is that the contamination did not have significant impacts on real estate transactions or property values. This is supported by a wide range of studies in published literature on the impact of contaminated sites on property values. (See also the Final Cost Benefit Analysis).

Ecology believes that by moving forward with these rule amendments, the uncertainty of the cleanup standards for these chemical mixtures will be clarified, moving cleanups forward faster and reducing, not increasing, uncertainties regarding cleanups.

Due diligence requirements such as Phase I and Phase II site assessments are not a requirement in the MTCA rule, but rather a standard imposed on commercial real estate transactions by lenders. Phase I site assessments typically consist of a paper review of the site use and regulatory history of the site. Phase II site assessments typically involve soil and/or ground water sampling at sites where the Phase I site assessment reveals contamination may have resulted from past operations at the site. The need for these studies is not triggered by exceedances of cleanup levels, since such data typically doesn't exist or is of limited quality, but rather by the operational history of the site. Thus, Ecology disagrees that the rule amendments will result in added costs for due diligence.

Ecology does not believe that, as a result of the rule amendments, more properties will fall within a "gray zone" of having contamination too low to trigger the need for remediation yet too high to receive a no further action determination and that this will result in more sites having institutional controls. Parties responsible for the contamination and subsequent cleanup have to meet the cleanup requirements in the MTCA rule, the effect of which is to rely on institutional controls as a last resort where cleanup is not practical. As discussed in the CBA, the additional area potentially needing remediation as a result of the rule amendments is rather small and the cost of the additional cleanup moderate. These modest costs stem from the nature of this contamination (a thin layer on the ground surface) that is readily removed. As a result, it is anticipated responsible parties will use more permanent remedies resulting in cleanup rather than less certain institutional controls.

As noted in the draft CBA, some additional land area could be considered contaminated under the proposed rule compared to the baseline, resulting in more properties needing cleanup. The final CBA has been revised to evaluate the potential additional cost impacts for property access and relocation compensation as a result of the rule amendments.

Issue 7-6: Will the proposed rule revisions limit the beneficial re-use of PAH-contaminated sediments?

Summary of Issue

The MTCA statute and rule requires the use of cleanup technologies that are "permanent to the maximum extent practicable". Safe reuse of waste materials is an option that would meet this statutory requirement. However, there are a wide variety of factors that need to be considered when selecting a suitable method of cleanup for a site, in addition to this factor (see WAC 173-340-360).

No changes were proposed to these parts of the MTCA rule.

Public Comments and Concerns

Two individuals expressed the opinion that the change in the carcinogenic PAH cleanup levels could eliminate the ability to reuse sediments contaminated by wood waste. For example:

> *The economic analysis with respect to PAH is very simplistic. Projects with Ecology to remove wood waste from old saw mill areas would fail under the proposed changes. If you are going to beneficially reuse this material, you need to meet the most stringent MTCA criteria. Currently they meet these criteria, but will not meet them after this change. The cost impact is tens to hundreds to millions of dollars based on the amount of wood coming out of Puget Sound and area lakes. This also has the effect of slowing down if not stopping a lot of the cleanups because the cost becomes disproportionate to the benefit.* ***(Clay Patmont, Testimony at May 10, 2007 Public Hearing.)***

Ecology's Response to Public Comment

After the May 10th public hearing, this individual identified a site where reuse of sediments impacted by wood waste is being considered as a potential disposal option for these materials. This is a site at Port Gamble, Washington where experimental technology is currently being used to leach salt water from the wood waste to create a potentially useful organic product (topsoil or compost). Based on a review of available data from the Port Gamble site, as discussed in Issue 4-5, reuse of this material is not anticipated to be impacted by the rule amendment as only one (1) sample out of 30 would fail the Method B carcinogenic PAH soil cleanup level under the amended rule but pass under the current MTCA rule requirements. This sample is in an area of the site separated from the other samples and would not impact the usability of the wood waste.

It is currently unknown if reuse of the wood waste as proposed will prove to be a viable option at this site or other sites. Other contaminated sediment sites have used capping or deep water disposal, alternatives that are not impacted by the rule amendment. In addition, carcinogenic PAHs will not always be a contaminant of concern at sites impacted by wood waste. Based on this review Ecology does not agree with the assertion that the final rule will cost "tens to hundreds of millions of dollars" and have the effect of slowing down if not stopping a lot of these types of cleanups. To draw such a conclusion is purely speculative and unsupported by available information, especially given experimental nature of this technology, that carcinogenic PAHs will not always be a key contaminant of concern at other sites where this cleanup method might be considered, and the common use of other technologies in sediment cleanup.

Issue 7-7: Will the proposed rule revisions increase the costs of preparing periodic reviews at sites with some type of institutional controls?

Summary of Issue

In evaluating the potential compliance costs associated with the proposed rule revisions, Ecology considered four types of expenditures:

- Sampling expenditures associated with defining the nature and extent of soil contamination;
- Expenditures associated with preparing TEE;
- Expenditures associated with evaluating multiple hazardous substances and multiple exposure pathways; and
- Site cleanup expenditures associated with measures to remove, treat, or cover contaminated soils with clean materials (e.g., soil or pavement)

Public Comments and Concerns

Several individuals and organizations expressed the opinion that the proposed rule revisions would increase the costs of performing periodic reviews. For example:

> *…Sites where remedial action has been completed under MTCA or CERCLA are subject to ongoing review every 5 years to confirm that the remedy remains protective. Sites with remaining dioxins/furans, cPAHs and PCBs will be evaluated during their 5-year review under the more stringent cleanup levels proposed in this rulemaking if those become part of the MTCA regulations. The PEAA has not given any consideration to the additional costs this proposed rule could impose on sites that are subject to these 5-year reviews.* ***(Dana B. Dolloff, Rayonier, p. 17 of attached comments.)***

Ecology's Response to Public Comment

As noted in Issue 2-11, WAC 173-340-702(12) was added to the MTCA regulation in 2001 to address the implications of changes to cleanup standards on on-going and completed cleanups. In general, this provision states that cleanups completed under a prior standard are not required to be reopened just because the standard changes in a future rule-making. WAC 173-340-420 provides the criteria to be used to determine if a remedy that left contamination behind remains protective of human health and the environment. The rule amendments do not modify these provisions.

In general, periodic (or five-year) reviews are only conducted at sites where contamination in excess of the cleanup standards has been left behind after cleanup. Typically these are sites where the contamination is so extensive that it is not practical to remove or treat the contamination in its entirety. At these sites hot spot removal or treatment is conducted with the remainder of contamination sealed off using containment technology such as burying the remaining contamination under a "cap" consisting of a geomembrane and a soil layer. The purpose of the periodic review at these sites is to determine if the cap is still effectively containing the contamination. Small changes in cleanup standards, as provided for in this rule amendment, will not change this evaluation and thus will not change the costs of these periodic reviews. Should the review find the containment system is not working effectively, the repair costs would be the same.

Issue 7-8: Did Ecology identify all of the potential benefits associated with the proposed rule revisions?

Summary of Issue

When evaluating the proposed rule, Ecology identified several potential impacts on health and social values. Ecology expects increased remediation (if any) of contaminated soils to create the following types of benefits:

- Reduced risks to human health (cancer mortality and incidence, and noncancer health effects);
- Reduced ecological risks to plants and wildlife; and
- Improved existence and bequest values for health and the environment.

Public Comments and Concerns

Several individuals and organizations expressed the opinion that Ecology failed to consider a number of important benefits associated with the proposed rule revisions.

- Health Insurance Rates: One organization stated that the proposed rule revisions would impact insurance rates and costs to health facilities:

  … The costs are not only going to impact the person, but their insurance rates and the costs to health facilities. Also there is a generational cost not considered. ***(Darlene Schanfald, OEC, Testimony at May 14, 2007 Public Hearing.)***

  You must balance these pressures [of economic interests] with awareness of the long term health care impacts, including the cost of subsidizing and providing health care to those who are damaged by residual toxins your agency has failed to remove from the environment. You may also want to balance these pressures with the recognition that other economic benefits are

derived by the businesses that engage in these clean-up efforts, for surely that is a fair part of what must happen to effect toxin removal. ***(Susan Svitak, p. 1.)***

Ecology's Response to Public Comment

It is possible that insurance rates will be affected as a secondary impact of the proposed rule. This impact, however, is likely to occur after a period of reduced cancer and other illness rates, and the resulting reduced utilization of health care facilities. Due to the inherent lags in both remediation and reductions in cancer (dioxins/furans can result in cancer even decades after exposure), this benefit would be realized many years into the future—making the present value of these benefits negligible. This is also the case for an inter-generational benefit of avoided illness.

Ecology also acknowledges that employees for remediation contractors will benefit from any jobs and wages created by additional cleanup work resulting form this rule amendment.

While Ecology acknowledges that these benefits might exist as a result of the proposed rule, it does not consider them appropriate to include in the CBA due to their large uncertainty and secondary nature. If, however, these impacts are realized in a timely fashion at actual cleanup sites, they will create a benefit in excess of that estimated in the CBA.

Issue 7-9: Did Ecology develop reasonable estimates of the increased sampling and analysis costs when evaluating the potential compliance costs associated with the proposed rule revisions?

Summary of Issue

Ecology concluded that the proposed rule revisions would increase sampling and analysis costs associated with performing conformational sampling. Ecology has estimated more areas would require cleanup (average of 1.65 acres/pulp mill). Ecology estimated that the sampling costs for this additional acreage are likely to be $11,550/ 1.65 acre average site. In preparing this estimate, Ecology assumed (1) sampling and analysis and consultant time of $700/sample and (2) ten samples taken per additional acre remediated.

Public Comments and Concerns

Several individuals and organizations expressed the opinion that Ecology under-estimated the increased sampling and analysis costs associated with implementing the proposed rule revisions.

- Unit Costs for Dioxin Analyses. Several organizations and individuals stated that current costs for dioxin analyses were higher than the cost estimates used to prepare the draft cost-benefit analysis. For example:

  Samples are over $1000 each, which is a burden on the people taking the sample. ***(Dana Dolloff, Rayonier, Testimony at May 14, 2007 Public Hearing.)***

  [T]he cost per sample identified by Ecology ($700) for chlorinated dioxin/furan analyses is too low .A review of current prices for dioxin/furan soil analyses (EPA Method 8290) ranges from $1000 to $1400 per sample. Most laboratories qualified to conduct this analyses are also out-of-state so this work is typically subcontracted through a local lab that will add a mark up to the analysis cost for the handling and subcontracting effort. Ecology also fails to include the costs for QA/QC samples and the cost for the consultant to review, validate, and present the results of the data. ***(Ken Johnson, Weyerhaeuser, p. 6-7.)***

- Costs for Analyzing Additional PAH compounds. One person expressed the opinion that adding 18 PAH compounds to the list of PAHs used to characterize PAH mixtures would double or triple analytical costs:

  The proposed changes to the list of carcinogenic polycyclic aromatic hydrocarbons (cPAH) adds an additional 18 compounds to the list of compounds used to characterize cPAH mixtures. Where it is true that these compounds may not be required, there is also the option that they may be. These additional compounds are not typically analyzed and so laboratories will have to do method development to determine the best means of detecting these additional compounds and optimizing the performance to ensure the lowest concentrations by which these additional compounds can be reliable reported. This takes time, both on the instrument and manpower and hours. In addition once the method is developed then it must be implemented. Currently the MTCA has seven cPAH that are used to characterize cPAH mixtures, so these additional compounds are quite a substantial increase. Simply purchasing the standards necessary lo support the analyses will more than double with these additional cPAH. Also the amount of time it takes to optimize the instrument and perform the analyses will increase. This will result in increased costs to perform the analyses. I would estimate the amount of increase in costs simply for the analysis to more than double and most likely it would more than triple. This is not the "unchanged" cost that your forecasts project. ***(Jennifer L. Holmes, Ph.D. STL Seattle, p. 2)***

- Costs Associated With Performing Congener-Specific PCB Analyses. One person stated that congener-specific PCB analyses would be significantly higher than measuring total PCB concentrations:

  …There is also a significant impact in the methodology for Polychlorinated Biphenyl (PCB) mixtures. Currently PCB mixtures are characterized by examining the Aroclor or Aroclors and reporting the concentration as a total. The costs associated with these analyses can vary based on the clean up necessary to the sample matrix and turn around time desired however they typically range from $75 - $125. The proposed rule change, although optional, could change this methodology in a significant manner in that rather than the Aroclor being measured it is proposed to measure 17 individual congeners, however as many as 209 congeners could be required. This again would require many laboratories that do not currently perform this type of analyses to perform costly method development. The analysis time will increase and the costs are substantial. . The recent Northwest Regional Sediment Evaluation Framework Interim Final suggests applying this approach to tissue. It estimates costs involved for these analyses will be over well over $300 dollars. Laboratories that currently provide analyses of all 209 congeners typically charge over $1000 per sample for such analyses as it is required to be done by high resolution mass spectrometry. It therefore seems unreasonable for the DOE to forecast that the cost associated with sampling and analysis for site characterization to be unchanged. Clearly the costs of analysis alone will more than triple and most likely go up by a factor of 5 or more ***(Jennifer L. Holmes, STL Seattle, Ph.D., pp. 1-2.)***

Ecology's Response to Public Comment

In response to comments regarding the estimated soil sampling and analysis costs under the rule, Ecology has revised the Cost-Benefit Analysis (CBA) to reflect updated sampling cost values.

- Dioxin/Furan Sampling. The $700 per sample cost used in the preliminary CBA is consistent with surveyed quotes per sample based on EPA survey and adjustments (EPA, 2005). This allows for a 30 percent re-processing rate due to error, dilution, and contamination, but actual rates seem to reflect a larger percentage of duplicate processing—driving the actual cost up to roughly $1100 per sample.

Ecology's experience with dioxin/furan soil sampling identifies a similar range of real prices. Bids to Ecology for sample analysis have been as low as $595 including duplicates (Pacific Rim Labs, Canada) or $560 charging for duplicates as an extra sample (Pace Analytical). Ecology believes that sampling and analysis costs for private entities are likely to be higher—especially for smaller numbers of samples than are submitted by Ecology. These higher bids include $1,040 (Analytical Perspectives).

Ecology has re-evaluated sampling costs in the Final CBA based on a range of $600 to $1100 per sample. This change is reflected in the Final CBA.

- Carcinogenic PAH Sampling. Ecology recognizes that standard analytical methods are not available and/or routinely used for many of the carcinogenic PAH compounds included on the Cal EPA list and that requiring expanded analysis would result in additional cost. However the current MTCA rule requires carcinogenic PAH contaminated sites to analyze for seven PAH compounds. Ecology may require analysis for additional carcinogenic PAH compounds on the California EPA list "…should site testing data or information from other comparable sites or waste types indicate the additional compounds are potentially present at the site." This provision was not changed by the rule amendment. The amendment does not require testing beyond what is already required. As such, no additional analytical costs for carcinogenic PAHs result from the rule amendment.

- Congener-Specific PCB Sampling. Ecology recognizes that congener-specific PCB analyses may cost more than total PCB analytical methods. However, some parties responsible for cleanup may chose to do congener-specific analyses, for a variety of reasons. The amended rule simply recognizes this as an option and provides standards for how to use this information when calculating cleanup levels and determining compliance under MTCA. It does not require congener-specific analyses. As such, no congener-specific PCB analytical costs result from the rule amendment.

Issue 7-10: Did Ecology develop reasonable estimates on the additional acreage that might be affected by the proposed revisions to the dioxin cleanup standards?

Summary of Proposed Rule

As discussed in the Preliminary Economic Analysis, Ecology conducted modeling of pulp mill dioxin emissions to determine the potential impact of these emissions on nearby soils. Based on this modeling, Ecology concluded the difference between the baseline and proposed rule amendment cleanup levels would result in an estimated additional 1.65 acres of soil remediation per pulp mill site being needed as a result of the rule amendment.

Public Comments and Concerns

One organization questioned the basis of Ecology's estimate of additional acreage affected by the proposed revisions to the dioxin cleanup standards:

> *The PEAA concludes that the proposed rule changes would result in only 1.65 additional acres of soil remediation, at a cost of $144,000, for each of three pulp and paper mills in the state. The entire foundation for this conclusion is its air dispersion modeling. Ecology does not provide sufficient information regarding the input parameters it used in running the air dispersion model. The very little information Ecology does provide about the air model's input suggests a significant error regarding the hypothetical pulp mill's emissions impact…. Ecology's emission*

rates and total mass associated with the different emission rates used to calculate the dioxin/furan soil concentrations and contours are implausible. In fact, a single facility emitting dioxin/furan mixtures at the upper end of Ecology's rates would be releasing 160% of the total known US dioxin/furan air emissions estimated by EPA for the year 2000…Ecology incorrectly presents the mg TEQ per day values on page 8 1 of PEAA. The 1.2 to 69 mg TEQ per day range cannot represent dioxin/furan air emissions from pulp mills, because this is inconsistent with its DSA reference…Using the dioxin/furan "ash load" range average of 22.4 mg TEQ/d for a model input, instead of the "air load" emission rate value of 0.17 mg TEQ/d that Ecology provides in its DSA, results in about a 130-fold over-estimate of the mill's emissions. Using the 69 mg TEQ/d end of the range results in a 400-fold overestimate. ***(Dana B. Dolloff, Rayonier, p. 18-20 of attached comments.)***

Ecology's Response to Public Comment

The Final CBA has been updated to provide readers clearer information about the air deposition model and underlying parameters. In addition, the technical information underlying the model will be filed in the Rule File and available to the public upon request.

Ecology acknowledges that the dioxin emission rates used in the modeling are conservatively high and probably overestimate the impact to soils. Making any downward adjustment in emissions rates in this model would reduce estimated costs. For example, looking only at the lowest emissions rate used in Ecology's modeling (9.6 mg TEQ/day), the estimated increase in acreage per site needing remediation resulting from this rule revision is 0.0 – 1.2 acres, with a median value of 0.6 additional acres to be remediated.

Ecology also acknowledges the emissions rates used in the modeling are in excess of the 2000 toxics release inventory emissions. Those 2000 emissions, however, reflect facilities with modern air pollution controls. Ecology agrees dioxin emissions from facilities with modern air pollution controls will not significantly impact soils. The modeling is intended to reflect a worst case scenario of historic emission rates prior to the advent of modern air pollution controls.

Issue 7-11: Did Ecology use an appropriate regulatory baseline when estimating the increased compliance costs associated with the proposed rule revisions?

Proposed Rule

Ecology has calculated the cleanup levels that the proposed rule requires, and compared those to cleanup levels required under the current rule. In making that comparison, Ecology has evaluated the incremental changes relative to the following regulatory baseline:

- Regulatory Baseline: Cleanup levels are established for each congener or PAH compound using a cancer risk level of 10^{-6} (as opposed to applying 10^{-6} risk level to the whole mixture). The TEF methodology published by the EPA (1989) is used to calculate a toxic equivalent concentration for each congener, which can be compared to the cleanup level for 2,3,7,8 TCDD. The total site risk (taking into account all congeners, other hazardous substances, and multiple exposure pathways) cannot exceed a cancer risk of 10^{-5}. Under this approach, cleanup levels must also:
    - Comply with all applicable and relevant and appropriate requirements;

- Comply with the requirements based on preventing non-carcinogenic health risks (Hazard Index must be less than one); and

- Comply with the ecological protection requirements in the MTCA rule.

Public Comments and Concerns

One organization questioned the methodology used by Ecology to establish the baseline case for the CBA:

> *In Section 3.2 of the Economic Analysis, Tables 1 and 3, Ecology's evaluation of the costs and benefits of the proposed rule change are based on a flawed comparison between the existing CLARC-based cleanup levels (CULs) versus the baseline cleanup levels…Ecology's definition of the baseline cleanup level is "based on median cleanup level at dioxin/furan contaminated sites in Washington State". This is an inappropriate definition of the baseline case, and appears to significantly underestimate the cost difference for cleanups using the existing CLARC-based CULs versus the baseline CUL. The use of median historic cleanup levels for dioxins/furans as the baseline CUL is inappropriate because historic cleanup levels based on 10-5 aggregate target risk would also be influenced by the presence of other co-occurring carcinogens, such as arsenic or PAHs. When this happens, the MTCA rule requires that the cleanup levels established for individual substances be adjusted downward if the total risk posed by the entire mixture exceeds either of these limits. Therefore, the historic CULs are likely artificially low. A more appropriate approach is to estimate the CUL assuming dioxins/furans are the only carcinogens occurring at a site. Under this plausible assumption, the baseline CUL is estimated simply by multiplying the CLARC-based CUL for dioxin/furan mixtures (which is based on 10-6 risk) of 6.7 ppt (Table 1) by 10, to obtain an 10-5 equivalent value of 67 ppt. Using this more appropriate baseline, CUL results in a Method B soil cleanup level (without the bioavailability adjustment) that is 90 percent lower (more stringent) than cleanup levels that would be established under the baseline. Once the new bioavailability adjustment is made, the Method B soil cleanup level is 84 percent lower (more stringent) than cleanup levels that would be established under the baseline. These results indicate that the cost of the proposed rule change would be considerably greater than currently indicated by Ecology in their Preliminary Economic Analysis.* ***(Ken Johnson, Weyerhaeuser, p. 5-6.)***

Ecology's Response to Public Comment

Ecology recognizes that the method used to establish the baseline case for the preliminary CBA may have been unclear. The cleanup level estimated for the baseline is not the median cleanup level used at sites to date. This is because the baseline approach has not yet been used to set cleanup levels at any site. Rather, sites have been historically using the method described in CLARC to set cleanup levels. For this reason, Ecology needed an estimate of cleanup levels that would result if the rule wasn't amended and the approach in the Rayonier settlement became common practice. To do this, Ecology calculated cleanup levels using actual data: congener-specific analyses from sites contaminated with dioxin/furan mixtures. For the purpose of these calculations, it was assumed no other contaminants were present at the site. In general, the following procedure was used:

- For a sample at a site, calculate a mixture concentration corresponding to a 10^{-5} risk;

- For the same sample, calculate a mixture concentration corresponding to a 10^{-6} risk for individual congeners;

- The most stringent concentration from the above two calculations constitutes the cleanup level for the sample;

- Repeat the above calculation for all samples at the site; and
- Calculate the median cleanup level of all samples at the site.

For dioxin mixtures, Ecology found that the actual baseline cleanup level on all sites to be lower than the 67 ppt indicated in the comment, due to the fact that one particular congener drives the cleanup level.

A similar process was used to establish the baseline case for carcinogenic PAH mixtures.

The Final CBA has been updated to clarify how actual site data was used to establish the baseline case cleanup level.

Issue 7-12: Did Ecology use appropriate assumptions on remedial technologies and unit costs when evaluating the increase in soil remediation costs?

Summary of Issue

The preliminary economic analysis used a weighted average of remedial unit costs in order to reflect a typical cleanup that would involve the use of a mix of cleanup technologies. To maintain conservative estimates, the highest weight was placed on excavation and disposal of soils, as this unit cost was the largest. Table 15 summarizes the unit costs estimated and assumed weights assigned to the five applicable remedial options in the preliminary economic analysis.

Table 15: Weighting Scheme for Weighted Average Remedial Cost per Cubic Yard

Remedial Options Selected for final remedy	Unit cost, $/yd	Remediation Portion, %
A: Excavation and Disposal at a Subtitle D Landfill	$176	50%
B: In-Situ Capping with an Engineered Soil Cover	$101	30%
C: In-Situ Capping with a Vegetated Surface	$18	10%
D: In-Situ Capping with a Wood Chip Surface	$36	5%
E: Fencing	$37	5%

This weighting scheme is based on Ecology's experience with applying the MTCA rule to other soil contamination sites. This was intended to provide a conservative (high) estimate of cost of the rule amendment by placing a higher weight on the most expensive remedial methods. The above weighting scheme generated Ecology's weighted average cost, per unit, of $124 per cubic yard of soil remediated.

Public Comments and Concerns

One organization questioned the information used by Ecology to estimate remediation costs:

> *In Appendix C of the Economic Analysis, Ecology's in-situ capping remedy (capping with wood chip surface) is not a suitable remedy. As a result, the costs for remedial methods are underestimated…Remediation of chlorinated dioxin/furan contaminated soil will require, at a minimum, a biotic barrier with an impervious and more permanent cover, such as a minimum 0.5 ft of gravel. Experience indicates Ecology would not allow a cover comprised of wood chips. Site drainage will need to be addressed to ensure the cover is protected and that the underlying soils do not erode. Depending on the site, it is also possible that in situ capping by covering it in place may be subject to the requirements of WAC 173-350-400(3)(e). Woodwaste landfills containing low-level chlorinated dioxins/furans must comply with the applicable requirements of WAC 173-350. Woodwaste landfills are considered limited purpose landfills under WAC 173-*

350-100, and as such must be closed with a final cover meeting the requirements of WAC 173-350-400(3)(e)(ii). This regulation requires a geomembrane cover in addition to a two-foot-thick anti-erosion soil layer. The cover system and related improvements to meet these requirements for Weyerhaeuser's Smith Island woodwaste landfill closure cost $123,700 per acre (2005 dollars). ***(Ken Johnson, Weyerhaeuser, p. 5-6.)***

Ecology's Response to Public Comment

Ecology agrees that the "in-situ capping with wood chip surface" and "in-situ capping with vegetated surface" remediation methods are probably not suitable for most cleanup sites being evaluated in the CBA. These remediation methods have been used at sites with area-wide lead and arsenic soil contamination and may not be suitable at many dioxin contaminated sites.

The Final CBA includes updated values for the unit cost of soil remediation that excludes these remediation methods, resulting in somewhat higher remediation costs.

Issue 7-13: Did Ecology adequately evaluate the costs associated with evaluating background concentrations of dioxins, PAHs, and PCBs?

Summary of Issue

Under RCW 70.105D.020, a "facility" includes a place where a hazardous substance has "come to be located". By rule (WAC 173-340-200), the term "site" means the same as "facility". Under WAC 173-340-350(7)(c)(B), a site remedial investigation must, among other things, characterize the "areal and vertical distribution and concentrations of hazardous substances in the soil due to the release." These provisions were not changed by the rule amendment.

Public Comments and Concerns

Several organizations submitted comment that the increased cost associated with evaluating background contaminant levels had not been adequately addressed in the CBA:

I believe this analysis is flawed and dramatically underestimates the ubiquitous nature of low-level PAH concentrations in urban residential soils, and in many areas that are not currently subject to MTCA cleanup requirements. The proposed change would increase substantially the number of affected sites, the affected soil volumes and the associated economic impacts...The change in risk level for PAH compounds (through regulation of PAH mixtures as individual compounds) will reduce by a factor of 2 to 5 the effective cleanup level for these compounds, and dramatically increase the volumes of affected contaminated soils. This is likely to occur not just at contaminated sites such as refineries, wood treating sites or petroleum contaminated sites, but will likely occur in many of our State's older neighborhoods and urban areas. Where typical residential background PAH concentrations have been studied, they have typically ranged between 0.1 and 1 mg/kg carcinogenic PAH (prior to application of the TEF methods). The proposed rule change operates within this concentration range and will likely create a substantial[40] increase in affected soil volumes. The background information provided with the proposed rule did not include consideration of residential and urban background PAH

[40] In his testimony at the May 10th meeting, Mr. Larsen stated that "…as the cleanup levels decrease by a factor of two, I think you will typically see a quadrupling of the soil volumes…"

concentrations and their effect on the economic impacts of the proposed rule change. ***(Mark Larsen, Anchor Environmental, p. 2-3.)***

Chapter 4 of the Economic Analysis is compromised in that it does not address how it will address background concentrations of chlorinated dioxin/furan and c-PAH's. At this point the number of samples collected by Ecology to characterize chlorinated dioxin/furan (or c-PAHs) soils in Washington is below the 20 or more samples that WAC 173-340-709 requires for defining background concentrations. Without current and substantial soil characterization data to determine the "background concentration" for various land use types, an assessment on the number/type of sites potentially impacted by the proposed rule and an evaluation on the projected benefit and cost of the proposed rule, is not possible…. ***(Ken Johnson, Weyerhaeuser, p. 6-7.)***

I think by getting so close to area background you're going to kick in a significant increase in the transaction costs. One only has to look at what's happening in the lower Duwamish waterway and places like that and how much effort it takes to define area background in the context of the cleanup. ***(Clay Patmont, Testimony at May 10, 2007 Public Hearing.)***

The costs associated with conducting site-specific background studies, including the time and effort to coordinate with adjacent property owners, sampling and analyses cost, and additional reporting costs, must be included in the final cost-benefit analysis. ***(Carlotta Cellucci, Tetra Tech, p. 1.)***

Ecology's Response to Public Comment

Ecology disagrees that requiring a more stringent Method B soil cleanup level to address human health concerns under the rule amendments will result in more background sampling. As noted above, under RCW 70.105D.020, a "facility" includes any place where a hazardous substance has "come to be located." By rule (WAC 173-340-200), the term "site" means the same as "facility." Under WAC 173-340-350(7)(c)(B), a site remedial investigation must, among other things, characterize the "areal and vertical distribution and concentrations of hazardous substances in the soil due to the release." These provisions were not changed by the rule amendment. Thus, the extent of the site needing investigation and consideration under the rule amendment is no different than the baseline.

See also the response to Issue 3-8.

Issue 7-14: Will the proposed rule revisions increase the level of effort necessary to consult/negotiate with Ecology Site Managers?

Summary of Issue

The MTCA rule provides for two types of cleanup processes—sites under formal Ecology oversight, and sites conducting independent remedial actions. Sites under formal Ecology oversight are sites where the cleanup is being conducted under an Ecology order, agreed order or consent decree. Remedial actions conducted at these sites are subject to review and approval by the Ecology site manager assigned to the site. Extensive public notice and participation is required for these sites. Independent remedial actions are cleanups conducted without Ecology oversight. At these sites, consultation with Ecology is not required, although many responsible parties will seek an informal opinion about the adequacy of the cleanup from Ecology through Ecology's voluntary cleanup program. Minimal public notice (through Ecology's Site Register) is conducted at these sites. No changes were proposed to the rule provisions prescribing these processes.

Public Comments and Concerns

One organization submitted comment maintaining that the increased level of effort required to consult with Ecology had not been adequately addressed in the CBA:

> *In Appendix C and Section 5.2 in the Economic Analysis, Ecology's calculated cost of remediation fails to include a level of effort necessary to consult with Ecology to agree on the remediation effort. Public perception of dioxin contamination has demonstrated that there is great concern and fear about potential exposure. Because of this perception, there is additional burden on Ecology and the regulated party to demonstrate that investigation and remediation are fully compliant with applicable regulations. Decisions about the appropriate level of effort applied to the remediation is often under more public scrutiny which results in overly cautious Site Managers which cause extra work and money. The Preliminary Economic Analysis fails to include this extra effort in its analyses.* ***(Ken Johnson, Weyerhaeuser, p. 7.)***

Ecology's Response to Public Comment

Ecology disagrees that the rule amendment will somehow cause Ecology site managers to be more cautious, resulting in extra work and cost of cleanup. As noted above, the rule provisions related to the cleanup processes, role of the Ecology site manager and public participation are not changed by the rule amendment. In reality, the cleanup standards resulting from the proposed rule amendments are comparable to or less stringent that the standards being used at cleanup sites to date. If anything, the clarification of cleanup standards under the rule amendments will make cleanups more understandable to the public and reduce the time Ecology site managers need to spend answering inquiries from the public and in discussions with consultants doing the work. Thus, there is no additional cost of Ecology oversight or consulting with Ecology about cleanup imposed by the rule amendment.

Issue 7-15: Will the proposed rule revisions increase the costs of complying with the ecological assessment provisions in the MTCA rule?

Summary of Issue

The MTCA statute requires cleanups to be protective of human health and the environment. To implement this requirement, the MTCA rule requires soil cleanup standards to address protection of plants and animals at a site. WAC 173-340-7490 through 7494 describe the process and requirements for this, called a terrestrial ecological assessment. In summary, the rule requires sites to demonstrate either:

(1) there is no significant habitat or species of concern and the site is exempt from setting soil cleanup levels that are protective of plants and animals; (2) the site has limited habitat and can qualify for a simplified terrestrial ecological assessment and less stringent soil cleanup levels; or, (3) the site has high quality habitat or endangered/threatened species and must conduct a site-specific, detailed terrestrial ecological assessment to establish protective soil cleanup levels. This analysis doesn't need to be done if a cleanup addressing human health concerns results in ecological impacts not being an issue at the site. No substantive changes were proposed to these provisions.

The Preliminary Economic Analysis noted that, to the extent the rule revisions result in more stringent cleanups to protect human health, an added benefit is that these more stringent cleanups will be a savings of not having to evaluate the terrestrial ecological impacts of the site.

Public Comments and Concerns

One organization submitted comment maintaining that the proposed rule revision may increase the size of a site, requiring a site-specific terrestrial ecological assessment:

> *The Executive Summary, Section 5.2.2 and Appendix F of the Economic Analysis, identifies avoided compliance costs with Terrestrial Ecological Evaluation as a benefit of this proposed amendment. This assumption may be incorrect if the increase of site size drives the site into a site-specific Terrestrial Ecological Evaluation (TEE). …In the case of chlorinated dioxin/furan, Ecology concludes that "the proposed rule does not change calculations for terrestrial ecological cleanup standards". The Department concludes that in this case, a site cleanup is driven by the ecological standards under the baseline and will not be affected by the proposed rule, and there will be no change in the ultimate level of remediation. This would only be true if MTCA terrestrial ecological dioxin cleanup levels are involved. Ecology fails to consider, however, that the potential increase in the size of the "site" could drive the site into completing a site-specific TEE if it is vegetated or if the site is adjacent to a naturally vegetated area. If this site has other constituents present, the ultimate level of remediation will be significantly increased and more costly because Ecology is applying the new ECO soil screening levels (SSLs) for soils. These ECO SSLs are significantly lower (more stringent) than the ecological soil concentration provided for in Tables 749-2 and 749-3. For example the soil cleanup level for lead could drop from 250 mg/kg to as low as 118 mg/kg. (Note - soil contamination with lead is common on pulp mill sites.) (Ken Johnson, Weyerhaeuser, p. 7)*

Ecology's Response to Public Comment

Ecology disagrees that requiring a more stringent Method B soil cleanup level to address human health concerns under the rule amendments will result in an expansion of the site. Under RCW 70.105D.020, a "facility" includes and place where a hazardous substance has "come to be located". By rule (WAC 173-340-200), the term "site" means the same as "facility". Under WAC 173-340-350(7)(c)(B), a site remedial investigation must, among other things, characterize the "areal and vertical distribution and concentrations of hazardous substances in the soil due to the release." These provisions were not changed by the rule amendment. Thus, the extent of the site needing investigation and consideration under the rule amendment is no different than the baseline. A terrestrial ecological evaluation must look at the entire site, not just the area exceeding a human health standard.

Ecology reasserts that the more stringent cleanups are to protect human health, the larger the area that will already be addressed by the remedy. As such there is a potential benefit (savings) that a terrestrial ecological assessment may not even need to be done at some sites, as provided by WAC 173-340-360(7)(c)(iii)(F)).

Chapter 8: State Environmental Policy Act

Summary of Issue

The SEPA analysis of the proposed rule amendments conducted by Ecology noted that archeological artifacts may be encountered at some cleanup sites. It noted that should such artifacts be encountered, a site-specific plan would need to be prepared to preserve or minimize disturbance of these resources.

Public Comments and Concerns

Ecology received comment from one organization about the potential for cleanup actions to impact cultural sites and the need for appropriate safeguards and sensitivity at these locations:

> *And also, please keep in mind the fact that there may be Indian Burials and graveyards in places you are cleaning up (old mill sites for example). It would be good for you to figure out how to deal with this issue sensitively and fairly when working with Tribes. The wishes of the tribes to protect and respect their ancestors should be upheld to the fullest.* ***(Wendy Sampson, p. 1.)***

Ecology's Response to Public Comment

Ecology acknowledges that Indian burials and graveyards may be encountered at sites that are being cleaned up. We understand that Tribes want to protect and respect the resting places of their ancestors. Ecology includes potentially impacted Tribes in any public notices about site work. We also routinely consult with Tribes when they indicate they have an interest in a site and work to accommodate these interests. We intend to continue to do so.

Chapter 9: Small Business Impacts

Small Business Economic Impact Statement

When Ecology filed the preliminary draft of these rule amendments and the associated economic analyses, Ecology did not believe there to be any small businesses required to comply with the rule amendments. For this reason, Ecology did not file a Small Business Economic Impact Statement (SBEIS) at that time.

Upon further review following public comment, Ecology found that a small number of small businesses may be impacted by the rule amendments. In order to examine disproportionate impacts on small versus large businesses required to comply with the rule amendments, Ecology has now performed the required analysis of small-business impacts, as discussed further in the Small Business Economic Impact Statement (SBEIS).

Ecology reviewed the list of cleanup sites in Washington, the current and proposed rules, and experience administering the existing MTCA rule. Based on that review, Ecology continues to believe that most small businesses are unlikely to be affected by these rule amendments. Refer to the SBEIS for a full discussion of this issue.

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Appendix A

Final Rule Amendments

AMENDATORY SECTION (Amending Order 97-09A, filed 2/12/01, effective 8/15/01)

WAC 173-340-708 Human health risk assessment procedures. (1) **Purpose.** This section defines the risk assessment framework that shall be used to establish cleanup levels, and remediation levels using a quantitative risk assessment, under this chapter. As used in this section, cleanup levels and remediation levels means the human health risk assessment component of these levels. This chapter defines certain default values and methods to be used in calculating cleanup levels and remediation levels. This section allows varying from these default values and methods under certain circumstances. When deciding whether to approve alternate values and methods the department shall ensure that the use of alternative values and methods will not significantly delay site cleanups.

(2) **Selection of indicator hazardous substances.**

When defining cleanup requirements at a site that is contaminated with a large number of hazardous substances, the department may eliminate from consideration those hazardous substances that contribute a small percentage of the overall threat to human health and the environment. The remaining hazardous substances shall serve as indicator hazardous substances for purposes of defining site cleanup requirements. See WAC 173-340-703 for additional information on establishing indicator hazardous substances.

(3) **Reasonable maximum exposure.**

(a) Cleanup levels and remediation levels shall be based on estimates of current and future resource uses and reasonable maximum exposures expected to occur under both current and potential future site use conditions, as specified further in this chapter.

(b) The reasonable maximum exposure is defined as the highest exposure that is reasonably expected to occur at a site under current and potential future site use. WAC 173-340-720 through 173-340-760 define the reasonable maximum exposures for ground water, surface water, soil, and air. These reasonable maximum exposures will apply to most sites where individuals or groups of individuals are or could be exposed to hazardous substances. For example, the reasonable maximum exposure for most ground water is defined as exposure to hazardous substances in drinking water and other domestic uses.

(c) Persons performing cleanup actions under this chapter may

use the evaluation criteria in WAC 173-340-720 through 173-340-760, where allowed in those sections, to demonstrate that the reasonable maximum exposure scenarios specified in those sections are not appropriate for cleanup levels for a particular site. For example, the criteria in WAC 173-340-720(2) could be used to demonstrate that the reasonable maximum exposure for ground water beneath a site does not need to be based on drinking water use. The use of an alternate exposure scenario shall be documented by the person performing the cleanup action. Documentation for the use of alternate exposure scenarios under this provision shall be based on the results of investigations performed in accordance with WAC 173-340-350.

(d) Persons performing cleanup actions under this chapter may also use alternate reasonable maximum exposure scenarios to help assess the protectiveness to human health of a cleanup action alternative that incorporates remediation levels and uses engineered controls and/or institutional controls to limit exposure to the contamination remaining on the site.

(i) An alternate reasonable maximum exposure scenario shall reflect the highest exposure that is reasonably expected to occur under current and potential future site conditions considering, among other appropriate factors, the potential for institutional controls to fail and the extent of the time period of failure under these scenarios and the land uses at the site.

(ii) Land uses other than residential and industrial, such as agricultural, recreational, and commercial, shall not be used as the basis for a reasonable maximum exposure scenario for the purpose of establishing a cleanup level. However, these land uses may be used as a basis for an alternate reasonable maximum exposure scenario for the purpose of assessing the protectiveness of a remedy. For example, if a cap (with appropriate institutional controls) is the proposed cleanup action at a commercial site, the reasonable maximum exposure scenario for assessing the protectiveness of the cap with regard to direct soil contact could be changed from a child living on the site to a construction or maintenance worker and child trespasser scenario.

(iii) The department expects that in evaluating the protectiveness of a remedy with regard to the soil direct contact pathway, many types of commercial sites may, where appropriate, qualify for alternative exposure scenarios under this provision since contaminated soil at these sites is typically characterized by a cover of buildings, pavement, and landscaped areas. Examples of these types of sites include:

(A) Commercial properties in a location removed from single family homes, duplexes or subdivided individual lots;

(B) Private and public recreational facilities where access to these facilities is physically controlled (e.g., a private golf course to which access is restricted by fencing);

(C) Urban residential sites (e.g., upper-story residential units over ground floor commercial businesses);

(D) Offices, restaurants, and other facilities primarily devoted to support administrative functions of a

commercial/industrial nature (e.g., an employee credit union or cafeteria in a large office or industrial complex).

(e) A conceptual site model may be used to identify when individuals or groups of individuals may be exposed to hazardous substances through more than one exposure pathway. For example, a person may be exposed to hazardous substances from a site by drinking contaminated ground water, eating contaminated fish, and breathing contaminated air. At sites where the same individuals or groups of individuals are or could be consistently exposed through more than one pathway, the reasonable maximum exposure shall represent the total exposure through all of those pathways. At such sites, the cleanup levels and remediation levels derived for individual pathways under WAC 173-340-720 through 173-340-760 and WAC 173-340-350 through 173-340-390 shall be adjusted downward to take into account multiple exposure pathways.

(4) **Cleanup levels for individual hazardous substances.** Cleanup levels for individual hazardous substances will generally be based on a combination of requirements in applicable state and federal laws and risk assessment.

(5) **Multiple hazardous substances.**

(a) Cleanup levels for individual hazardous substances established under Methods B and C and remediation levels shall be adjusted downward to take into account exposure to multiple hazardous substances. This adjustment needs to be made only if, without this adjustment, the hazard index would exceed one (1) or the total excess cancer risk would exceed one in one hundred thousand (1×10^{-5}).

(b) Adverse effects resulting from exposure to two or more hazardous substances with similar types of toxic response are assumed to be additive unless scientific evidence is available to demonstrate otherwise. Cancer risks resulting from exposure to two or more carcinogens are assumed to be additive unless scientific evidence is available to demonstrate otherwise.

(c) For noncarcinogens, for purposes of establishing cleanup levels under Methods B and C, and for remediation levels, the health threats resulting from exposure to two or more hazardous substances with similar types of toxic response may be apportioned between those hazardous substances in any combination as long as the hazard index does not exceed one (1).

(d) For carcinogens, for purposes of establishing cleanup levels under Methods B and C, and for remediation levels, the cancer risks resulting from exposure to multiple hazardous substances may be apportioned between hazardous substances in any combination as long as the total excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}).

(e) The department may require biological testing to assess the potential interactive effects associated with chemical mixtures.

(f) When making adjustments to cleanup levels and remediation levels for multiple hazardous substances, the concentration for individual hazardous substances shall not be adjusted downward to less than the practical quantitation limit or natural background.

(6) **Multiple pathways of exposure.**

(a) Estimated doses of individual hazardous substances resulting from more than one pathway of exposure are assumed to be additive unless scientific evidence is available to demonstrate otherwise.

(b) Cleanup levels and remediation levels based on one pathway of exposure shall be adjusted downward to take into account exposures from more than one exposure pathway. The number of exposure pathways considered at a given site shall be based on the reasonable maximum exposure scenario as defined in WAC 173-340-708(3). This adjustment needs to be made only if exposure through multiple pathways is likely to occur at a site and, without the adjustment, the hazard index would exceed one (1) or the total excess cancer risk would exceed one in one hundred thousand (1×10^{-5}).

(c) For noncarcinogens, for purposes of establishing cleanup levels under Methods B and C, and remediation levels, the health threats associated with exposure via multiple pathways may be apportioned between exposure pathways in any combination as long as the hazard index does not exceed one (1).

(d) For carcinogens, for purposes of establishing cleanup levels under Methods B and C, and for remediation levels, the cancer risks associated with exposure via multiple pathways may be apportioned between exposure pathways in any combination as long as the total excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}).

(e) When making adjustments to cleanup levels and remediation levels for multiple pathways of exposure, the concentration for individual hazardous substances shall not be adjusted downward to less than the practical quantitation limit or natural background.

(7) **Reference doses.**

(a) The chronic reference dose/reference concentration and the developmental reference dose/reference concentration shall be used to establish cleanup levels and remediation levels under this chapter. Cleanup levels and remediation levels shall be established using the value which results in the most protective concentration.

(b) Inhalation reference doses/reference concentrations shall be used in WAC 173-340-750. Where the inhalation reference dose/reference concentration is reported as a concentration in air, that value shall be converted to a corresponding inhaled intake (mg/kg-day) using a human body weight of 70 kg and an inhalation rate of 20 m^3/day, and take into account, where available, the respiratory deposition and absorption characteristics of the gases and inhaled particles.

(c) A subchronic reference dose/reference concentration may be used to evaluate potential noncarcinogenic effects resulting from exposure to hazardous substances over short periods of time. This value may be used in place of the chronic reference dose/reference concentration where it can be demonstrated that a particular hazardous substance will degrade to negligible concentrations during the exposure period.

(d) For purposes of establishing cleanup levels and remediation levels for hazardous substances under this chapter, a reference dose/reference concentration established by the United States Environmental Protection Agency and available through the "integrated risk information system" (IRIS) data base shall be used. If a reference dose/reference concentration is not available through the IRIS data base, a reference dose/reference concentration from the U.S. EPA Health Effects Assessment Summary Table ("HEAST") data base or, if more appropriate, the National Center for Environmental Assessment ("NCEA") shall be used.

(e) If a reference dose/reference concentration is available through IRIS, HEAST, or the NCEA, it shall be used unless the department determines that there is clear and convincing scientific data which demonstrates that the use of this value is inappropriate.

(f) If a reference dose/reference concentration for a hazardous substance including petroleum fractions and petroleum constituents is not available through IRIS, HEAST or the NCEA or is demonstrated to be inappropriate under (e) of this subsection and the department determines that development of a reference dose/reference concentration is necessary for the hazardous substance at the site, then a reference dose/reference concentration shall be established on a case-by-case basis. When establishing a reference dose on a case-by-case basis, the methods described in "Reference Dose (RfD): Description and Use in Health Risk Assessment: Background Document 1A", USEPA, March 15, 1993, shall be used.

(g) In estimating a reference dose/reference concentration for a hazardous substance under (e) or (f) of this subsection, the department shall, as appropriate, consult with the science advisory board, the department of health, and the United States Environmental Protection Agency and may, as appropriate, consult with other qualified persons. Scientific data supporting such a change shall be subject to the requirements under WAC 173-340-702 (14), (15) and (16). Once the department has established a reference dose/reference concentration for a hazardous substance under this provision, the department is not required to consult again for the same hazardous substance.

(h) Where a reference dose/reference concentration other than those established under (d) or (g) of this subsection is used to establish a cleanup level or remediation level at individual sites, the department shall summarize the scientific rationale for the use of those values in the cleanup action plan. The department shall provide the opportunity for public review and comment on this value in accordance with the requirements of WAC 173-340-380 and 173-340-600.

(8) **Carcinogenic potency factor.**

(a) For purposes of establishing cleanup levels and remediation levels for hazardous substances under this chapter, a carcinogenic potency factor established by the United States Environmental Protection Agency and available through the IRIS data base shall be used. If a carcinogenic potency factor is not

available from the IRIS data base, a carcinogenic potency factor from HEAST or, if more appropriate, from the NCEA shall be used.

(b) If a carcinogenic potency factor is available from the IRIS, HEAST or the NCEA, it shall be used unless the department determines that there is clear and convincing scientific data which demonstrates that the use of this value is inappropriate.

(c) If a carcinogenic potency factor is not available through IRIS, HEAST or the NCEA or is demonstrated to be inappropriate under (b) of this subsection and the department determines that development of a cancer potency factor is necessary for the hazardous substance at the site, then one of the following methods shall be used to establish a carcinogenic potency factor:

(i) The carcinogenic potency factor may be derived from appropriate human epidemiology data on a case-by-case basis; or

(ii) The carcinogenic potency factor may be derived from animal bioassay data using the following procedures:

(A) All carcinogenicity bioassays shall be reviewed and data of appropriate quality shall be used for establishing the carcinogenic potency factor.

(B) The linearized multistage extrapolation model shall be used to estimate the slope of the dose-response curve unless the department determines that there is clear and convincing scientific data which demonstrates that the use of an alternate extrapolation model is more appropriate;

(C) All doses shall be adjusted to give an average daily dose over the study duration; and

(D) An interspecies scaling factor shall be used to take into account differences between animals and humans. For oral carcinogenic toxicity values this scaling factor shall be based on the assumption that milligrams per surface area is an equivalent dose between species unless the department determines there is clear and convincing scientific data which demonstrates that an alternate procedure is more appropriate. The slope of the dose response curve for the test species shall be multiplied by this scaling factor in order to obtain the carcinogenic potency factor, except where such scaling factors are incorporated into the extrapolation model under (B) of this subsection. The procedure to derive a human equivalent concentration of inhaled particles and gases shall take into account, where available, the respiratory deposition and absorption characteristics of the gases and inhaled particles. Where adequate pharmacokinetic and metabolism studies are available, data from these studies may be used to adjust the interspecies scaling factor.

(d) ((~~When assessing the potential carcinogenic risk of mixtures of chlorinated dibenzo-p-dioxins (CDD) and chlorinated dibenzofurans (CDF) either of the following methods shall be used unless the department determines that there is clear and convincing scientific data which demonstrates that the use of these methods is inappropriate:~~

~~(i) The entire mixture is assumed to be as toxic as 2, 3, 7, 8 CDD or 2, 3, 7, 8 CDF, as applicable; or~~

~~(ii) The toxicity equivalency factors and methodology~~

~~described in: EPA. 1989. "*Interim procedures for estimating risks associated with exposure to mixtures of chlorinated dibenzo-p-dioxins and dibenzofurans (CDDs and CDFs) and 1989 update*", USEPA, Risk Assessment Forum, Washington, D.C., publication number EPA/625/3-89/016.~~)) **Mixtures of dioxins and furans.** When establishing and determining compliance with cleanup levels and remediation levels for mixtures of chlorinated dibenzo-p-dioxins (dioxins) and/or chlorinated dibenzofurans (furans), the following procedures shall be used:

(i) **Assessing as single hazardous substance.** When establishing and determining compliance with cleanup levels and remediation levels, including when determining compliance with the excess cancer risk requirements in this chapter, mixtures of dioxins and/or furans shall be considered a single hazardous substance.

(ii) **Establishing cleanup levels and remediation levels.** The cleanup levels and remediation levels established for 2,3,7,8 tetrachloro dibenzo-p-dioxin (2,3,7,8-TCDD) shall be used, respectively, as the cleanup levels and remediation levels for mixtures of dioxins and/or furans.

(iii) **Determining compliance with cleanup levels and remediation levels.** When determining compliance with the cleanup levels and remediation levels established for mixtures of dioxins and/or furans, the following procedures shall be used:

(A) Calculate the total toxic equivalent concentration of 2,3,7,8-TCDD for each sample of the mixture. The total toxic equivalent concentration shall be calculated using the following method, unless the department determines that there is clear and convincing scientific data which demonstrates that the use of this method is inappropriate:

(I) Analyze samples from the medium of concern to determine the concentration of each dioxin and furan congener listed in Table 708-1;

(II) For each sample analyzed, multiply the measured concentration of each congener in the sample by its corresponding toxicity equivalency factor (TEF) in Table 708-1 to obtain the toxic equivalent concentration of 2,3,7,8-TCDD for that congener; and

(III) For each sample analyzed, add together the toxic equivalent concentrations of all the congeners within the sample to obtain the total toxic equivalent concentration of 2,3,7,8-TCDD for that sample.

(B) After calculating the total toxic equivalent concentration of each sample of the mixture, use the applicable compliance monitoring requirements in WAC 173-340-720 through 173-340-760 to determine whether the total toxic equivalent concentrations of the samples comply with the cleanup level or remediation level for the mixture at the applicable point of compliance.

(iv) **Protecting the quality of other media.** When establishing cleanup levels and remediation levels for mixtures of dioxins and/or furans in a medium of concern that are based on protection of another medium (the receiving medium) (e.g., soil levels

protective of ground water quality), the following procedures shall be used:

(A) The cleanup level or remediation level for 2,3,7,8-TCDD in the receiving medium shall be used, respectively, as the cleanup level or remediation level for the receiving medium.

(B) When determining the concentrations in the medium of concern that will achieve the cleanup level or remediation level in the receiving medium, the congener-specific physical and chemical properties shall be considered during that assessment.

(e) ((~~When assessing the potential carcinogenic risk of mixtures of polycyclic aromatic hydrocarbons, either of the following methods shall be used unless the department determines that there is clear and convincing scientific data which demonstrates that the use of these methods is inappropriate:~~

~~(i) The entire mixture is assumed to be as toxic as benzo(a)pyrene; or~~

~~(ii) The toxicity equivalency factors and methodology described in *"CalEPA. 1994. Benzo(a)pyrene as a toxic air contaminant. Part B: Health Assessment."* Published by the Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Berkeley, CA.~~)) **Mixtures of carcinogenic PAHs.** When establishing and determining compliance with cleanup levels and remediation levels for mixtures of carcinogenic polycyclic aromatic hydrocarbons (carcinogenic PAHs), the following procedures shall be used:

(i) **Assessing as single hazardous substance.** When establishing and determining compliance with cleanup levels and remediation levels, including when determining compliance with the excess cancer risk requirements in this chapter, mixtures of carcinogenic PAHs shall be considered a single hazardous substance.

(ii) **Establishing cleanup levels and remediation levels.** The cleanup levels and remediation levels established for benzo(a)pyrene shall be used, respectively, as the cleanup levels and remediation levels for mixtures of carcinogenic PAHs.

(iii) **Determining compliance with cleanup levels and remediation levels.** When determining compliance with cleanup levels and remediation levels established for mixtures of carcinogenic PAHs, the following procedures shall be used:

(A) Calculate the total toxic equivalent concentration of benzo (a) pyrene for each sample of the mixture. The total toxic equivalent concentration shall be calculated using the following method, unless the department determines that there is clear and convincing scientific data which demonstrates that the use of this method is inappropriate:

(I) Analyze samples from the medium of concern to determine the concentration of each carcinogenic PAH listed in Table 708-2 and, for those carcinogenic PAHs required by the department under WAC 173-340-708 (8)(e)(iv), in Table 708-3;

(II) For each sample analyzed, multiply the measured concentration of each carcinogenic PAH in the sample by its corresponding toxicity equivalency factor (TEF) in Tables 708-2 and 708-3 to obtain the toxic equivalent concentration of

benzo(a)pyrene for that carcinogenic PAH; and

(III) For each sample analyzed, add together the toxic equivalent concentrations of all the carcinogenic PAHs within the sample to obtain the total toxic equivalent concentration of benzo(a)pyrene for that sample.

(B) After calculating the total toxic equivalent concentration of each sample of the mixture, use the applicable compliance monitoring requirements in WAC 173-340-720 through 173-340-760 to determine whether the total toxic equivalent concentrations of the samples comply with the cleanup level or remediation level for the mixture at the applicable point of compliance.

(iv) **Protecting the quality of other media.** When establishing cleanup levels and remediation levels for mixtures of carcinogenic PAHs in a medium of concern that are based on protection of another medium (the receiving medium) (e.g., soil levels protective of ground water quality), the following procedures shall be used:

(A) The cleanup level or remediation level for benzo(a)pyrene in the receiving medium shall be used, respectively, as the cleanup level or remediation level for the receiving medium.

(B) When determining the concentrations in the medium of concern that will achieve the cleanup level or remediation level in the receiving medium, the carcinogenic PAH-specific physical and chemical properties shall be considered during that assessment.

(v) When using this methodology, at a minimum, the ((~~following~~)) compounds in Table 708-2 shall be analyzed for and included in the calculations((~~: Benzo[a]pyrene, Benz[a]anthracene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Chrysene, Dibenz[a,h]anthracene, Indeno[1,2,3cd]pyrene~~)). The department may require additional compounds ((~~from the CalEPA list~~)) in Table 708-3 to be included in the methodology should site testing data or information from other comparable sites or waste types indicate the additional compounds are potentially present at the site. *NOTE: Many of the polycyclic aromatic hydrocarbons ((~~on the CalEPA list~~)) in Table 708-3 are found primarily in air emissions from combustion sources and may not be present in the soil or water at contaminated sites. Users should consult with the department for information on the need to test for these additional compounds.*

(f) **PCB mixtures.** When establishing and determining compliance with cleanup levels and remediation levels for polychlorinated biphenyls (PCBs) mixtures, the following procedures shall be used:

(i) **Assessing as single hazardous substance.** When establishing and determining compliance with cleanup levels and remediation levels, including when determining compliance with the excess cancer risk requirements in this chapter, PCB mixtures shall be considered a single hazardous substance.

(ii) **Establishing cleanup levels and remediation levels.** When establishing cleanup levels and remediation levels under Methods B and C for PCB mixtures, the following procedures shall be used unless the department determines that there is clear and convincing scientific data which demonstrates that the use of these methods is inappropriate:

(A) Assume the PCB mixture is equally potent and use the appropriate carcinogenic potency factor provided for under WAC 173-340-708 (8)(a) through (c) for the entire mixture; or

(B) Use the toxicity equivalency factors for the dioxin-like PCBs congeners in Table 708-4 and procedures approved by the department. When using toxicity equivalency factors, the department may require that the health effects posed by the dioxin-like PCB congeners and nondioxin-like PCB congeners be considered in the evaluation.

(iii) **Determining compliance with cleanup levels and remediation levels.** When determining compliance with cleanup levels and remediation levels established for PCB mixtures, the following procedures shall be used:

(A) Analyze compliance monitoring samples for a total PCB concentration and use the applicable compliance monitoring requirements in WAC 173-340-720 through 173-340-760 to determine whether the total PCB concentrations of the samples complies with the cleanup level or remediation level for the mixture at the applicable point of compliance; or

(B) When using toxicity equivalency factors to determine compliance with cleanup or remediation levels for PCB mixtures, use procedures approved by the department.

(g) In estimating a carcinogenic potency factor for a hazardous substance under (c) of this subsection, or approving the use of a toxicity equivalency factor other than that established under (d), (e) or (f) of this subsection, the department shall, as appropriate, consult with the science advisory board, the department of health, and the United States Environmental Protection Agency and may, as appropriate, consult with other qualified persons. Scientific data supporting such a change shall be subject to the requirements under WAC 173-340-702 (14), (15) and (16). Once the department has established a carcinogenic potency factor or approved an alternative toxicity equivalency factor for a hazardous substance under this provision, the department is not required to consult again for the same hazardous substance.

((~~(g)~~)) (h) Where a carcinogenic potency factor other than that established under (a)((~~, (d) and (e)~~)) of this subsection or a toxicity equivalency factor other than that established under (d), (e) or (f) of this subsection is used to establish cleanup levels or remediation levels at individual sites, the department shall summarize the scientific rationale for the use of that value in the cleanup action plan. The department shall provide the opportunity for public review and comment on this value in accordance with the requirements of WAC 173-340-380 and 173-340-600.

(9) **Bioconcentration factors.**

(a) For purposes of establishing cleanup levels and remediation levels for a hazardous substance under WAC 173-340-730, a bioconcentration factor established by the United States Environmental Protection Agency and used to establish the ambient water quality criterion for that substance under section 304 of the Clean Water Act shall be used. These values shall be used unless

the department determines that there is adequate scientific data which demonstrates that the use of an alternate value is more appropriate. If the department determines that a bioconcentration factor is appropriate for a specific hazardous substance and no such factor has been established by USEPA, then other appropriate EPA documents, literature sources or empirical information may be used to determine a bioconcentration factor.

(b) When using a bioconcentration factor other than that used to establish the ambient water quality criterion, the department shall, as appropriate, consult with the science advisory board, the department of health, and the United States Environmental Protection Agency. Scientific data supporting such a value shall be subject to the requirements under WAC 173-340-702 (14), (15) and (16). Once the department has established a bioconcentration factor for a hazardous substance under this provision, the department is not required to consult again for the same hazardous substance.

(c) Where a bioconcentration factor other than that established under (a) of this subsection is used to establish cleanup levels or remediation levels at individual sites, the department shall summarize the scientific rationale for the use of that factor in the draft cleanup action plan. The department shall provide the opportunity for public review and comment on the value in accordance with the requirements of WAC 173-340-380 and 173-340-600.

(10) **Exposure parameters.**

(a) As a matter of policy, the department has defined in WAC 173-340-720 through 173-340-760 the default values for exposure parameters to be used when establishing cleanup levels and remediation levels under this chapter. Except as provided for in (b) and (c) of this subsection and in WAC 173-340-720 through 173-340-760, these default values shall not be changed for individual hazardous substances or sites.

(b) Exposure parameters that are primarily a function of the exposed population characteristics (such as body weight and lifetime) and those that are primarily a function of human behavior that cannot be controlled through an engineered or institutional control (such as: Fish consumption rate; soil ingestion rate; drinking water ingestion rate; and breathing rate) are not expected to vary on a site-by-site basis. The default values for these exposure parameters shall not be changed when calculating cleanup levels except when necessary to establish a more stringent cleanup level to protect human health. For remediation levels the default values for these exposure parameters may only be changed when an alternate reasonable maximum exposure scenario is used, as provided for in WAC 173-340-708 (3)(d), that reflects a different exposed population such as using an adult instead of a child exposure scenario. Other exposure parameters may be changed only as follows:

(i) For calculation of cleanup levels, the types of exposure parameters that may be changed are those that are:

(A) Primarily a function of reliably measurable

characteristics of the hazardous substance, soil, hydrologic or hydrogeologic conditions at the site; and

(B) Not dependent on the success of engineered controls or institutional controls for controlling exposure of persons to the hazardous substances at the site.

The default values for these exposure parameters may be changed where there is adequate scientific data to demonstrate that use of an alternative or additional value would be more appropriate for the conditions present at the site. Examples of exposure parameters for which the default values may be changed under this provision are as follows: Contaminant leaching and transport variables (such as the soil organic carbon content, aquifer permeability and soil sorption coefficient); inhalation correction factor; fish bioconcentration factor; soil gastrointestinal absorption fraction; and inhalation absorption percentage.

(ii) For calculation of remediation levels, in addition to the exposure parameters that may be changed under (b)(i) of this subsection, the types of exposure parameters that may be changed from the default values are those where a demonstration can be made that the proposed cleanup action uses engineered controls and/or institutional controls that can be successfully relied on, for the reasonably foreseeable future, to control contaminant mobility and/or exposure to the contamination remaining on the site. In general, exposure parameters that may be changed under this provision are those that define the exposure frequency, exposure duration and exposure time. The default values for these exposure parameters may be changed where there is adequate scientific data to demonstrate that use of an alternative or additional value would be more appropriate for the conditions present at the site. Examples of exposure parameters for which the default value may be changed under this provision are as follows: Infiltration rate; frequency of soil contact; duration of soil exposure; duration of drinking water exposure; duration of air exposure; drinking water fraction; and fish diet fraction.

(c) When the modifications provided for in (b) of this subsection result in significantly higher values for cleanup levels or remediation levels than would be calculated using the default values for exposure parameters, the risk from other potentially relevant pathways of exposure shall be addressed under the procedures provided for in WAC 173-340-720 through 173-340-760. For exposure pathways and parameters for which default values are not specified in this chapter, the framework provided for by this subsection, along with the quality of information requirements in WAC 173-340-702, shall be used to establish appropriate or additional assumptions for these parameters and pathways.

(d) Where the department approves the use of exposure parameters other than those established under WAC 173-340-720 through 173-340-760 to establish cleanup levels or remediation levels at individual sites, the department shall summarize the scientific rationale for the use of those parameters in the cleanup action plan. The department shall provide the opportunity for public review and comment on those values in accordance with the

requirements of WAC 173-340-380 and 173-340-600. Scientific data supporting such a change shall be subject to the requirements under WAC 173-340-702 (14), (15) and (16).

(11) **Probabilistic risk assessment.** Probabilistic risk assessment methods may be used under this chapter only on an informational basis for evaluating alternative remedies. Such methods shall not be used to replace cleanup standards and remediation levels derived using deterministic methods under this chapter until the department has adopted rules describing adequate technical protocols and policies for the use of probabilistic risk assessment under this chapter.

[Statutory Authority: Chapter 70.105D RCW. 01-05-024 (Order 97-09A), § 173-340-708, filed 2/12/01, effective 8/15/01; 91-04-019, § 173-340-708, filed 1/28/91, effective 2/28/91.]

AMENDATORY SECTION (Amending Order 97-09A, filed 2/12/01, effective 8/15/01)

WAC 173-340-740 Unrestricted land use soil cleanup standards.

(1) **General considerations.**

(a) Presumed exposure scenario soil cleanup levels shall be based on estimates of the reasonable maximum exposure expected to occur under both current and future site use conditions. The department has determined that residential land use is generally the site use requiring the most protective cleanup levels and that exposure to hazardous substances under residential land use conditions represents the reasonable maximum exposure scenario. Unless a site qualifies for use of an industrial soil cleanup level under WAC 173-340-745, soil cleanup levels shall use this presumed exposure scenario and be established in accordance with this section.

(b) In the event of a release of a hazardous substance to the soil at a site, a cleanup action complying with this chapter shall be conducted to address all areas where the concentration of hazardous substances in the soil exceeds cleanup levels at the relevant point of compliance.

(c) The department may require more stringent soil cleanup standards than required by this section where, based on a site-specific evaluation, the department determines that this is necessary to protect human health and the environment. Any imposition of more stringent requirements under this provision shall comply with WAC 173-340-702 and 173-340-708. The following

are examples of situations that may require more stringent cleanup levels.

(i) Concentrations that eliminate or substantially reduce the potential for food chain contamination;

(ii) Concentrations that eliminate or substantially reduce the potential for damage to soils or biota in the soils which could impair the use of soils for agricultural or silvicultural purposes;

(iii) Concentrations necessary to address the potential health risk posed by dust at a site;

(iv) Concentrations necessary to protect the ground water at a particular site;

(v) Concentrations necessary to protect nearby surface waters from hazardous substances in runoff from the site; and

(vi) Concentrations that eliminate or minimize the potential for the accumulation of vapors in buildings or other structures.

(d) Relationship between soil cleanup levels and other cleanup standards. Soil cleanup levels shall be established at concentrations that do not directly or indirectly cause violations of ground water, surface water, sediment, or air cleanup standards established under this chapter or applicable state and federal laws. A property that qualifies for a Method C soil cleanup level under WAC 173-340-745 does not necessarily qualify for a Method C cleanup level in other media. Each medium must be evaluated separately using the criteria applicable to that medium.

(2) **Method A soil cleanup levels for unrestricted land use.**

(a) **Applicability.** Method A soil cleanup levels may only be used at sites qualifying under WAC 173-340-704(1).

(b) **General requirements.** Method A soil cleanup levels shall be at least as stringent as all of the following:

(i) Concentrations in Table 740-1 and compliance with the corresponding footnotes;

(ii) Concentrations established under applicable state and federal laws;

(iii) Concentrations that result in no significant adverse effects on the protection and propagation of terrestrial ecological receptors using the procedures specified in WAC 173-340-7490 through 173-340-7493, unless it is demonstrated under those sections that establishing a soil concentration is unnecessary; and

(iv) For a hazardous substance that is deemed an indicator hazardous substance under WAC 173-340-708(2) and for which there is no value in Table 740-1 or applicable state and federal laws, a concentration that does not exceed the natural background concentration or the practical quantification limit, subject to the limitations in this chapter.

(3) **Method B soil cleanup levels for unrestricted land use.**

(a) **Applicability.** Method B soil cleanup levels consist of standard and modified cleanup levels determined using the procedures in this subsection. Either standard or modified Method B soil cleanup levels may be used at any site.

(b) **Standard Method B soil cleanup levels.** Standard Method B cleanup levels for soils shall be at least as stringent as all of the following:

(i) **Applicable state and federal laws.** Concentrations established under applicable state and federal laws;

(ii) **Environmental protection.** Concentrations that result in no significant adverse effects on the protection and propagation of terrestrial ecological receptors established using the procedures specified in WAC 173-340-7490 through 173-340-7494 unless it is demonstrated under those sections that establishing a soil concentration is unnecessary.

(iii) **Human health protection.** For hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, those concentrations that protect human health as determined by evaluating the following exposure pathways:

(A) **Ground water protection.** Concentrations that will not cause contamination of ground water at levels which exceed ground water cleanup levels established under WAC 173-340-720 as determined using the methods described in WAC 173-340-747.

(B) **Soil direct contact.** Concentrations that, due to direct contact with contaminated soil, are estimated to result in no acute or chronic noncarcinogenic toxic effects on human health using a hazard quotient of one (1) and concentrations for which the upper bound on the estimated excess cancer risk is less than or equal to one in one million (1×10^{-6}). Equations 740-1 and 740-2 and the associated default assumptions shall be used to calculate the concentration for direct contact with contaminated soil.

(I) **Noncarcinogens.** For noncarcinogenic toxic effects of hazardous substances due to soil ingestion, concentrations shall be determined using Equation 740-1. For petroleum mixtures and components of such mixtures, see (b)(iii)(B)(III) of this subsection.

[Equation 740-1]

$$\text{Soil Cleanup Level (mg/kg)} = \frac{\text{RfD} \times \text{ABW} \times \text{UCF} \times \text{HQ} \times \text{AT}}{\text{SIR} \times \text{AB1} \times \text{EF} \times \text{ED}}$$

Where:

RfD	=	Reference dose as defined in WAC 173-340-708(7) (mg/kg-day)
ABW	=	Average body weight over the exposure duration (16 kg)
UCF	=	Unit conversion factor (1,000,000 mg/kg)
SIR	=	Soil ingestion rate (200 mg/day)
AB1	=	Gastrointestinal absorption fraction (1.0) (unitless)
EF	=	Exposure frequency (1.0) (unitless)
HQ	=	Hazard quotient (1) (unitless)
AT	=	Averaging time (6 years)
ED	=	Exposure duration (6 years)

(II) **Carcinogens.** For carcinogenic effects of hazardous substances due to soil ingestion, concentrations shall be determined using Equation 740-2. For petroleum mixtures and components of such mixtures, see (b)(iii)(B)(III) of this subsection.

[Equation 740-2]

$$\text{Soil Cleanup Level (mg/kg)} = \frac{\text{RISK x ABW x AT x UCF}}{\text{CPF x SIR x AB1 x ED x EF}}$$

Where:

RISK	=	Acceptable cancer risk level (1 in 1,000,000) (unitless)
ABW	=	Average body weight over the exposure duration (16 kg)
AT	=	Averaging time (75 years)
UCF	=	Unit conversion factor (1,000,000 mg/kg)
CPF	=	Carcinogenic potency factor as defined in WAC 173-340-708(8) (kg-day/mg)
SIR	=	Soil ingestion rate (200 mg/day)
AB1	=	Gastrointestinal absorption fraction (1.0) (unitless). May use 0.6 for mixtures of dioxins and/or furans
ED	=	Exposure duration (6 years)
EF	=	Exposure frequency (1.0) (unitless)

(III) **Petroleum mixtures.** For noncarcinogenic effects of petroleum mixtures, a total petroleum hydrocarbon cleanup level shall be calculated taking into account the additive effects of the petroleum fractions and volatile organic compounds substances present in the petroleum mixture. Equation 740-3 shall be used for this calculation. This equation takes into account concurrent exposure due to ingestion and dermal contact with petroleum contaminated soils. Cleanup levels for other noncarcinogens and known or suspected carcinogens within the petroleum mixture shall be calculated using Equations 740-4 and 740-5. See Table 830-1 for the analyses required for various petroleum products to use this method.

[Equation 740-3]

$$C_{soil} = \frac{HI \times ABW \times AT}{EF \times ED \left[\left(\frac{SIR \times AB1}{10^6 mg/kg} \sum_{i=1}^{n} \frac{F(i)}{RfDo(i)} \right) + \left(\frac{SA \times AF}{10^6 mg/kg} \sum_{i=1}^{n} \frac{F(i) \times ABS(i)}{RfDd(i)} \right) \right]}$$

Where:

C_{soil} =	TPH soil cleanup level (mg/kg)
HI =	Hazard index (1) (unitless)
ABW =	Average body weight over the exposure duration (16 kg)
AT =	Averaging time (6 years)
EF =	Exposure frequency (1.0) (unitless)
ED =	Exposure duration (6 years)
SIR =	Soil ingestion rate (200 mg/day)
AB1 =	Gastrointestinal absorption fraction (1.0) (unitless)
F(i) =	Fraction (by weight) of petroleum component (i) (unitless)
SA =	Dermal surface area (2,200 cm^2)
AF =	Adherence factor (0.2 mg/cm^2-day)
ABS =	Dermal absorption fraction for petroleum component (i) (unitless). May use chemical-specific values or the following defaults:

- 0.0005 for volatile petroleum components with vapor press > = benzene
- 0.03 for volatile petroleum components with vapor press < benzene
- 0.1 for other petroleum components

RfDo(i) = Oral reference dose of petroleum component (i) as defined in WAC 173-340-708(7) (mg/kg-day)

RfDd(i) = Dermal reference dose for petroleum component (i) (mg/kg-day) derived by RfDo x GI

GI = Gastrointestinal absorption conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.8 for volatile petroleum components
- 0.5 for other petroleum components

n = The number of petroleum components (petroleum fractions plus volatile organic compounds with an RfD) present in the petroleum mixture. (See Table 830-1.)

(C) **Soil vapors.** The soil to vapor pathway shall be evaluated for volatile organic compounds whenever any of the following conditions exist:

(I) For gasoline range organics, whenever the total petroleum hydrocarbon (TPH) concentration is significantly higher than a concentration derived for protection of ground water for drinking water beneficial use under WAC 173-340-747(6) using the default assumptions;

(II) For diesel range organics, whenever the total petroleum hydrocarbon (TPH) concentration is greater than 10,000 mg/kg;

(III) For other volatile organic compounds, including petroleum components, whenever the concentration is significantly higher than a concentration derived for protection of ground water for drinking water beneficial use under WAC 173-340-747(4).

See subsection (3)(c)(iv)(B) of this section for methods that may be used to evaluate the soil to vapor pathway.

(c) **Modified Method B soil cleanup levels.**

(i) **General.** Modified Method B soil cleanup levels are standard Method B soil cleanup levels, modified with chemical-specific or site-specific data. When making these modifications, the resultant cleanup levels shall meet applicable state and federal laws, meet health risk levels for standard Method B soil cleanup levels, and be demonstrated to be environmentally protective using the procedures specified in WAC 173-340-7490 through 173-340-7494. Changes to exposure assumptions must comply with WAC 173-340-708(10).

(ii) **Allowable modifications.** The following modifications can be made to the default assumptions in the standard Method B equations to derive modified Method B soil cleanup levels:

(A) For the protection of ground water, see WAC 173-340-747;

(B) For soil ingestion, the gastrointestinal absorption fraction, may be modified if the requirements of WAC 173-340-702 (14), (15), (16), and 173-340-708(10) are met;

(C) For dermal contact, the adherence factor, dermal absorption fraction and gastrointestinal absorption conversion factor may be modified if the requirements of WAC 173-340-702 (14),

(15), (16), and 173-340-708(10) are met;

(D) The toxicity equivalent factors((~~, as described~~)) provided in WAC 173-340-708 (8)((~~, may be used for assessing the potential carcinogenic risk of mixtures of chlorinated dibenzo-p-dioxins, chlorinated dibenzofurans and polycyclic aromatic hydrocarbons~~)) (d), (e), and (f), may be modified if the requirements of WAC 173-340-708 (8)(g) and (h) are met;

(E) The reference dose and cancer potency factor may be modified if the requirements in WAC 173-340-708 (7) and (8) are met; and

(F) Other modifications incorporating new science as provided for in WAC 173-340-702 (14), (15) and (16).

(iii) **Dermal contact.** For hazardous substances other than petroleum mixtures, dermal contact with the soil shall be evaluated whenever the proposed changes to Equations 740-1 or 740-2 would result in a significantly higher soil cleanup level than would be calculated without the proposed changes. When conducting this evaluation, the following equations and default assumptions shall be used.

(A) For noncarcinogens use Equation 740-4. This equation takes into account concurrent exposure due to ingestion and dermal contact with soil.

[Equation 740-4]

$$C_{soil} = \frac{HQ \times ABW \times AT}{EF \times ED\left[\left(\frac{1}{RfDo} \times \frac{SIR \times AB1}{10^6 mg/kg}\right) + \left(\frac{1}{RfDd} \times \frac{SA \times AF \times ABS}{10^6 mg/kg}\right)\right]}$$

Where:

C_{soil} =	Soil cleanup level (mg/kg)
HQ =	Hazard quotient (unitless)
ABW =	Average body weight over the exposure duration (16 kg)
AT =	Averaging time (6 years)
EF =	Exposure frequency (1.0) (unitless)
ED =	Exposure duration (6 years)
SIR =	Soil ingestion rate (200 mg/day)
AB1 =	Gastrointestinal absorption fraction (1.0) (unitless)
SA =	Dermal surface area (2,200 cm^2)
AF =	Adherence factor (0.2 mg/cm^2-day)
ABS =	Dermal absorption fraction (unitless).
	May use chemical-specific values or the following defaults:
	• 0.01 for inorganic hazardous substances
	• 0.0005 for volatile organic compounds with vapor press > = benzene
	• 0.03 for volatile organic compounds with vapor press < benzene
	• 0.1 for other organic hazardous substances
RfDo =	Oral reference dose as defined in WAC 173-340-708(7) (mg/kg-day)
RfDd =	Dermal reference dose (mg/kg-day) derived by RfDo x GI

GI = Gastrointestinal absorption conversion factor (unitless).

May use chemical specific values or the following defaults:

- 0.2 for inorganic hazardous substances
- 0.8 for volatile organic compounds
- 0.5 for other organic hazardous substances

(B) For carcinogens use Equation 740-5. This equation takes into account concurrent exposure due to ingestion and dermal contact with soil.

[Equation 740-5]

$$C_{soil} = \frac{RISK \times ABW \times AT}{EF \times ED \left[\left(\frac{SIR \times AB1 \times CPFo}{10^6 mg/kg} \right) + \left(\frac{SA \times AF \times ABS \times CPFd}{10^6 mg/kg} \right) \right]}$$

Where:

C_{soil} = Soil cleanup level (mg/kg)

RISK = Acceptable cancer risk (1 in 1,000,000) (unitless)

ABW = Average body weight over the exposure duration (16 kg)

AT = Averaging time (75 years)

EF = Exposure frequency (1.0) (unitless)

ED = Exposure duration (6 years)

SIR = Soil ingestion rate (200 mg/day)

AB1 = Gastrointestinal absorption fraction (1.0) (unitless). May use 0.6 for mixtures of dioxins and/or furans

CPFo = Oral cancer potency factor as defined in WAC 173-340-708(8) (kg-day/mg)

CPFd = Dermal cancer potency factor (kg-day/mg) derived by CPFo/GI

GI = Gastrointestinal absorption conversion factor (unitless).

May use chemical-specific values or the following defaults:

- 0.2 for inorganic hazardous substances
- 0.8 for volatile organic compounds and for mixtures of dioxins and/or furans
- 0.5 for other organic hazardous substances

SA = Dermal surface area (2,200 cm^2)

AF = Adherence factor (0.2 mg/cm^2-day)

ABS = Dermal absorption fraction (unitless). May use chemical-specific values or the following defaults:

- 0.01 for inorganic hazardous substances
- 0.0005 for volatile organic compounds with vapor press > = benzene
- 0.03 for volatile organic compounds with vapor press < benzene and for mixtures of dioxins and/or furans
- 0.1 for other organic hazardous substances

(C) Modifications may be made to Equations 740-4 and 740-5 as provided for in subsection (3)(c)(ii) of this section.

(iv) **Soil vapors.**

(A) **Applicability.** The soil to vapor pathway shall be evaluated for volatile organic compounds whenever any of the following conditions exist:

(I) For other than petroleum hydrocarbon mixtures, the proposed changes to the standard Method B equations (Equations 740-1 and 740-2) or default values would result in a significantly higher soil cleanup level than would be calculated without the proposed changes;

(II) For petroleum hydrocarbon mixtures, the proposed changes to the standard Method B equations (Equations 740-3, 740-4 and 740-5) or default values would result in a significantly higher soil cleanup level than would be calculated without the proposed changes;

(III) For gasoline range organics, whenever the total petroleum hydrocarbon (TPH) concentration is significantly higher than a concentration derived for protection of ground water for drinking water beneficial use under WAC 173-340-747(6) using the default assumptions;

(IV) For diesel range organics, whenever the total petroleum hydrocarbon (TPH) concentration is greater than 10,000 mg/kg;

(V) For other volatile organic compounds, including petroleum components, whenever the concentration is significantly higher than a concentration derived for protection of ground water for drinking water beneficial use under WAC 173-340-747(4).

(B) **Evaluation methods.** Soil cleanup levels that are protective of the indoor and ambient air shall be determined on a site-specific basis. Soil cleanup levels may be evaluated as being protective of air pathways using any of the following methods:

(I) Measurements of the soil vapor concentrations, using methods approved by the department, demonstrating vapors in the soil would not exceed air cleanup levels established under WAC 173-340-750.

(II) Measurements of ambient air concentrations and/or indoor air vapor concentrations throughout buildings, using methods approved by the department, demonstrating air does not exceed cleanup levels established under WAC 173-340-750. Such measurements must be representative of current and future site conditions when vapors are likely to enter and accumulate in structures. Measurement of ambient air may be excluded if it can be shown that indoor air is the most protective point of exposure.

(III) Use of modeling methods approved by the department to demonstrate the air cleanup standards established under WAC 173-340-750 will not be exceeded. When this method is used, the department may require soil vapor and/or air monitoring to be conducted to verify the calculations and compliance with air cleanup standards.

(IV) Other methods as approved by the department demonstrating the air cleanup standards established under WAC 173-340-750 will not be exceeded.

(d) **Using modified Method B to evaluate soil remediation levels.** In addition to the adjustments allowed under subsection (3)(c) of this section, adjustments to the reasonable maximum

exposure scenario or default exposure assumptions are allowed when using a quantitative site-specific risk assessment to evaluate the protectiveness of a remedy. See WAC 173-340-355, 173-340-357, and 173-340-708 (3)(d) and (10)(b).

(4) **Method C soil cleanup levels.** This section does not provide procedures for establishing Method C soil cleanup levels. Except for qualifying industrial properties, Method A and Method B, as described in this section, are the only methods available for establishing soil cleanup levels at sites. See WAC 173-340-745 for use of Method C soil cleanup levels at qualifying industrial properties. See also WAC 173-340-357 and 173-340-708 (3)(d) for how land use may be considered when selecting a cleanup action at a site.

(5) **Adjustments to cleanup levels.**

(a) **Total site risk adjustments.** Soil cleanup levels for individual hazardous substances developed in accordance with subsection (3) of this section, including cleanup levels based on applicable state and federal laws, shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure. These adjustments need to be made only if, without these adjustments, the hazard index would exceed one (1) or the total excess cancer risk would exceed one in one hundred thousand (1×10^{-5}). These adjustments shall be made in accordance with the procedures specified in WAC 173-340-708 (5) and (6). In making these adjustments, the hazard index shall not exceed one (1) and the total excess cancer risk shall not exceed one in one hundred thousand (1×10^{-5}).

(b) **Adjustments to applicable state and federal laws.** Where a cleanup level developed under subsection (2) or (3) of this section is based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of one (1), the cleanup level must be adjusted downward so that the total excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}) and the hazard index does not exceed one (1) at the site.

(c) **Natural background and PQL considerations.** Cleanup levels determined under subsection (2) or (3) of this section, including cleanup levels adjusted under subsection (5)(a) and (b) of this section, shall not be set at levels below the practical quantitation limit or natural background, whichever is higher. See WAC 173-340-707 and 173-340-709 for additional requirements pertaining to practical quantitation limits and natural background.

(6) **Point of compliance.**

(a) The point of compliance is the point or points where the soil cleanup levels established under subsection (2) or (3) of this section shall be attained.

(b) For soil cleanup levels based on the protection of ground water, the point of compliance shall be established in the soils throughout the site.

(c) For soil cleanup levels based on protection from vapors,

the point of compliance shall be established in the soils throughout the site from the ground surface to the uppermost ground water saturated zone (e.g., from the ground surface to the uppermost water table).

(d) For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be established in the soils throughout the site from the ground surface to fifteen feet below the ground surface. This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities.

(e) For soil cleanup levels based on ecological considerations, see WAC 173-340-7490 for the point of compliance.

(f) The department recognizes that, for those cleanup actions selected under this chapter that involve containment of hazardous substances, the soil cleanup levels will typically not be met at the points of compliance specified in (b) through (e) of this subsection. In these cases, the cleanup action may be determined to comply with cleanup standards, provided:

(i) The selected remedy is permanent to the maximum extent practicable using the procedures in WAC 173-340-360;

(ii) The cleanup action is protective of human health. The department may require a site-specific human health risk assessment conforming to the requirements of this chapter to demonstrate that the cleanup action is protective of human health;

(iii) The cleanup action is demonstrated to be protective of terrestrial ecological receptors under WAC 173-340-7490 through 173-340-7494;

(iv) Institutional controls are put in place under WAC 173-340-440 that prohibit or limit activities that could interfere with the long-term integrity of the containment system;

(v) Compliance monitoring under WAC 173-340-410 and periodic reviews under WAC 173-340-430 are designed to ensure the long-term integrity of the containment system; and

(vi) The types, levels and amount of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the draft cleanup action plan.

(7) **Compliance monitoring.**

(a) Compliance with soil cleanup levels shall be based on total analyses of the soil fraction less than two millimeters in size. When it is reasonable to expect that larger soil particles could be reduced to two millimeters or less during current or future site use and this reduction could cause an increase in the concentrations of hazardous substances in the soil, soil cleanup levels shall also apply to these larger soil particles. Compliance with soil cleanup levels shall be based on dry weight concentrations. The department may approve the use of alternate procedures for stabilized soils.

(b) When soil levels have been established at a site, sampling of the soil shall be conducted to determine if compliance with the

soil cleanup levels has been achieved. Sampling and analytical procedures shall be defined in a compliance monitoring plan prepared under WAC 173-340-410. The sample design shall provide data that are representative of the area where exposure to hazardous substances may occur.

(c) The data analysis and evaluation procedures used to evaluate compliance with soil cleanup levels shall be defined in a compliance monitoring plan prepared under WAC 173-340-410. These procedures shall meet the following general requirements:

(i) Methods of data analysis shall be consistent with the sampling design. Separate methods may be specified for surface soils and deeper soils;

(ii) When cleanup levels are based on requirements specified in applicable state and federal laws, the procedures for evaluating compliance that are specified in those requirements shall be used to evaluate compliance with cleanup levels unless those procedures conflict with the intent of this section;

(iii) Where procedures for evaluating compliance are not specified in an applicable state and federal law, statistical methods shall be appropriate for the distribution of sampling data for each hazardous substance. If the distributions for hazardous substances differ, more than one statistical method may be required; and

(iv) The data analysis plan shall specify which parameters are to be used to determine compliance with soil cleanup levels.

(A) For cleanup levels based on short-term or acute toxic effects on human health or the environment, an upper percentile soil concentration shall be used to evaluate compliance with cleanup levels.

(B) For cleanup levels based on chronic or carcinogenic threats, the true mean soil concentration shall be used to evaluate compliance with cleanup levels.

(d) When data analysis procedures for evaluating compliance are not specified in an applicable state or federal law the following procedures shall be used:

(i) A confidence interval approach that meets the following requirements:

(A) The upper one sided ninety-five percent confidence limit on the true mean soil concentration shall be less than the soil cleanup level. For lognormally distributed data, the upper one-sided ninety-five percent confidence limit shall be calculated using Land's method; and

(B) Data shall be assumed to be lognormally distributed unless this assumption is rejected by a statistical test. If a lognormal distribution is inappropriate, data shall be assumed to be normally distributed unless this assumption is rejected by a statistical test. The W test, D'Agostino's test, or, censored probability plots, as appropriate for the data, shall be the statistical methods used to determine whether the data are lognormally or normally distributed;

(ii) For an evaluation conducted under (c)(iv)(A) of this subsection, a parametric test for percentiles based on tolerance

intervals to test the proportion of soil samples having concentrations less than the soil cleanup level. When using this method, the true proportion of samples that do not exceed the soil cleanup level shall not be less than ninety percent. Statistical tests shall be performed with a Type I error level of 0.05;

(iii) Direct comparison of soil sample concentrations with cleanup levels may be used to evaluate compliance with cleanup levels where selective sampling of soil can be reliably expected to find suspected soil contamination. There must be documented, reliable information that the soil samples have been taken from the appropriate locations. Persons using this method must demonstrate that the basis used for selecting the soil sample locations provides a high probability that any existing areas of soil contamination have been found; or

(iv) Other statistical methods approved by the department.

(e) All data analysis methods used, including those specified in state and federal law, must meet the following requirements:

(i) No single sample concentration shall be greater than two times the soil cleanup level. Higher exceedances to control false positive error rates at five percent may be approved by the department when the cleanup level is based on background concentrations; and

(ii) Less than ten percent of the sample concentrations shall exceed the soil cleanup level. Higher exceedances to control false positive error rates at five percent may be approved by the department when the cleanup level is based on background concentrations.

(f) When using statistical methods to demonstrate compliance with soil cleanup levels, the following procedures shall be used for measurements below the practical quantitation limit:

(i) Measurements below the method detection limit shall be assigned a value equal to one-half the method detection limit when not more than fifteen percent of the measurements are below the practical quantitation limit.

(ii) Measurements above the method detection limit but below the practical quantitation limit shall be assigned a value equal to the method detection limit when not more than fifteen percent of the measurements are below the practical quantitation limit.

(iii) When between fifteen and fifty percent of the measurements are below the practical quantitation limit and the data are assumed to be lognormally or normally distributed, Cohen's method shall be used to calculate a corrected mean and standard deviation for use in calculating an upper confidence limit on the true mean soil concentration.

(iv) If more than fifty percent of the measurements are below the practical quantitation limit, the largest value in the data set shall be used in place of an upper confidence limit on the true mean soil concentration.

(v) The department may approve alternate statistical procedures for handling nondetected values or values below the practical quantitation limit.

(vi) If a hazardous substance or petroleum fraction has never

been detected in any sample at a site and these substances are not suspected of being present at the site based on site history and other knowledge, that hazardous substance or petroleum fraction may be excluded from the statistical analysis.

[Statutory Authority: Chapter 70.105D RCW. 01-05-024 (Order 97-09A), § 173-340-740, filed 2/12/01, effective 8/15/01; 96-04-010 (Order 94-37), § 173-340-740, filed 1/26/96, effective 2/26/96; 91-04-019, § 173-340-740, filed 1/28/91, effective 2/28/91.]

NOTES:

Reviser's Note: The brackets and enclosed material in the text of the above section occurred in the copy filed by the agency.

AMENDATORY SECTION (Amending Order 97-09A, filed 2/12/01, effective 8/15/01)

WAC 173-340-745 Soil cleanup standards for industrial properties. (1) **Applicability.**

(a) Criteria. This section shall be used to establish soil cleanup levels where the department has determined that industrial land use represents the reasonable maximum exposure. Soil cleanup levels for this presumed exposure scenario shall be established in accordance with this section. To qualify as an industrial land use and to use an industrial soil cleanup level a site must meet the following criteria:

(i) The area of the site where industrial property soil cleanup levels are proposed must meet the definition of an industrial property under WAC 173-340-200;

Industrial soil cleanup levels are based on an adult worker exposure scenario. It is essential to evaluate land uses and zoning for compliance with this definition in the context of this exposure scenario. Local governments use a variety of zoning categories for industrial land uses so a property does not necessarily have to be in a zone called "industrial" to meet the definition of "industrial property." Also, there are land uses allowed in industrial zones that are actually commercial or residential, rather than industrial, land uses. Thus, an evaluation to determine compliance with this definition should include a review of the actual text in the comprehensive plan and zoning ordinance pertaining to the site and a visit to the site to observe land uses in the zone. When evaluating land uses to

determine if a property use not specifically listed in the definition is a "traditional industrial use" or to determine if the property is "zoned for industrial use," the following characteristics shall be considered:

(A) People do not normally live on industrial property. The primary potential exposure is to adult employees of businesses located on the industrial property;

(B) Access to industrial property by the general public is generally not allowed. If access is allowed, it is highly limited and controlled due to safety or security considerations;

(C) Food is not normally grown/raised on industrial property. (However, food processing operations are commonly considered industrial facilities);

(D) Operations at industrial properties are often (but not always) characterized by use and storage of chemicals, noise, odors and truck traffic;

(E) The surface of the land at industrial properties is often (but not always) mostly covered by buildings or other structures, paved parking lots, paved access roads and material storage areas--minimizing potential exposure to the soil; and

(F) Industrial properties may have support facilities consisting of offices, restaurants, and other facilities that are commercial in nature but are primarily devoted to administrative functions necessary for the industrial use and/or are primarily intended to serve the industrial facility employees and not the general public.

(ii) The cleanup action provides for appropriate institutional controls implemented in accordance with WAC 173-340-440 to limit potential exposure to residual hazardous substances. This shall include, at a minimum, placement of a covenant on the property restricting use of the area of the site where industrial soil cleanup levels are proposed to industrial property uses; and

(iii) Hazardous substances remaining at the property after remedial action would not pose a threat to human health or the environment at the site or in adjacent nonindustrial areas. In evaluating compliance with this criterion, at a minimum the following factors shall be considered:

(A) The potential for access to the industrial property by the general public, especially children. The proximity of the industrial property to residential areas, schools or childcare facilities shall be considered when evaluating access. In addition, the presence of natural features, manmade structures, arterial streets or intervening land uses that would limit or encourage access to the industrial property shall be considered. Fencing shall not be considered sufficient to limit access to an industrial property since this is insufficient to assure long term protection;

(B) The degree of reduction of potential exposure to residual hazardous substances by the selected remedy. Where the residual hazardous substances are to be capped to reduce exposure, consideration shall be given to the thickness of the cap and the likelihood of future site maintenance activities, utility and

drainage work, or building construction reexposing residual hazardous substances;

(C) The potential for transport of residual hazardous substances to off-property areas, especially residential areas, schools and childcare facilities;

(D) The potential for significant adverse effects on wildlife caused by residual hazardous substances using the procedures in WAC 173-340-7490 through 173-340-7494; and

(E) The likelihood that these factors would not change for the foreseeable future.

(b) **Expectations.** In applying the criteria in (a) of this subsection, the department expects the following results:

(i) The department expects that properties zoned for heavy industrial or high intensity industrial use and located within a city or county that has completed a comprehensive plan and adopted implementing zoning regulations under the Growth Management Act (chapter 36.70A RCW) will meet the definition of industrial property. For cities and counties not planning under the Growth Management Act, the department expects that spot zoned industrial properties will not meet the definition of industrial property but that properties that are part of a larger area zoned for heavy industrial or high intensity industrial use will meet the definition of an industrial property;

(ii) For both GMA and non-GMA cities and counties, the department expects that light industrial and commercial zones and uses should meet the definition of industrial property where the land uses are comparable to those cited in the definition of industrial property or the land uses are an integral part of a qualifying industrial use (such as, ancillary or support facilities). This will require a site-by-site evaluation of the zoning text and land uses;

(iii) The department expects that for portions of industrial properties in close proximity to (generally, within a few hundred feet) residential areas, schools or childcare facilities, residential soil cleanup levels will be used unless:

(A) Access to the industrial property is very unlikely or, the hazardous substances that are not treated or removed are contained under a cap of clean soil (or other materials) of substantial thickness so that it is very unlikely the hazardous substances would be disturbed by future site maintenance and construction activities (depths of even shallow footings, utilities and drainage structures in industrial areas are typically three to six feet); and

(B) The hazardous substances are relatively immobile (or have other characteristics) or have been otherwise contained so that subsurface lateral migration or surficial transport via dust or runoff to these nearby areas or facilities is highly unlikely; and

(iv) Note that a change in the reasonable maximum exposure to industrial site use primarily affects the direct contact exposure pathway. Thus, for example, for sites where the soil cleanup level is based primarily on the potential for the hazardous substance to leach and cause ground water contamination, it is the department's

expectation that an industrial land use will not affect the soil cleanup level. Similarly, where the soil cleanup level is based primarily on surface water protection or other pathways other than direct human contact, land use is not expected to affect the soil cleanup level.

(2) **General considerations.**

(a) In the event of a release of a hazardous substance at a site qualifying as industrial property, a cleanup action that complies with this chapter shall be conducted to address those soils with hazardous substance concentrations which exceed industrial soil cleanup levels at the relevant point of compliance.

(b) Soil cleanup levels for areas beyond the industrial property boundary that do not qualify for industrial soil cleanup levels under this section (including implementation of institutional controls and a covenant restricting use of the property to industrial property uses) shall be established in accordance with WAC 173-340-740.

(c) Industrial soil cleanup levels shall be established at concentrations that do not directly or indirectly cause violations of ground water, surface water, sediment or air cleanup standards established under this chapter or under applicable state and federal laws. A property that qualifies for an industrial soil cleanup level under this section does not necessarily qualify for a Method C cleanup level in other media. Each medium must be evaluated separately using the criteria applicable to that medium.

(d) The department may require more stringent soil cleanup standards than required by this section when, based on a site-specific evaluation, the department determines that this is necessary to protect human health and the environment, including consideration of the factors in WAC 173-340-740 (1)(c). Any imposition of more stringent requirements under this provision shall comply with WAC 173-340-702 and 173-340-708.

(3) **Method A industrial soil cleanup levels.**

(a) **Applicability.** Method A industrial soil cleanup levels may be used only at any industrial property qualifying under WAC 173-340-704(1).

(b) **General requirements.** Method A industrial soil cleanup levels shall be at least as stringent as all of the following:

(i) Concentrations in Table 745-1 and compliance with the corresponding footnotes;

(ii) Concentrations established under applicable state and federal laws;

(iii) Concentrations that result in no significant adverse effects on the protection and propagation of terrestrial ecological receptors using the procedures specified in WAC 173-340-7490 through 173-340-7493, unless it is demonstrated under those sections that establishing a soil concentration is unnecessary; and

(iv) For a hazardous substance that is deemed an indicator hazardous substance under WAC 173-340-708(2) and for which there is no value in Table 745-1 or applicable state and federal laws, a concentration that does not exceed the natural background concentration or the practical quantification limit, subject to the

limitations in this chapter.

(4) **Method B industrial soil cleanup levels.** This section does not provide procedures for establishing Method B industrial soil cleanup levels. Method C is the standard method for establishing soil cleanup levels at industrial sites and its use is conditioned upon the continued use of the site for industrial purposes. The person conducting the cleanup action also has the option of establishing unrestricted land use soil cleanup levels under WAC 173-340-740 for qualifying industrial properties. This option may be desirable when the person wants to avoid restrictions on the future use of the property. When a site does not qualify for a Method A or Method C industrial soil cleanup level under this section, or the user chooses to establish unrestricted land use soil cleanup levels at a site, soil cleanup levels must be established using Methods A or B under WAC 173-340-740.

(5) **Method C industrial soil cleanup levels.**

(a) **Applicability.** Method C industrial soil cleanup levels consist of standard and modified cleanup levels as described in this subsection. Either standard or modified Method C soil cleanup levels may be used at any industrial property qualifying under subsection (1) of this section.

(b) **Standard Method C industrial soil cleanup levels.** Standard Method C industrial soil cleanup levels for industrial properties shall be at least as stringent as all of the following:

(i) **Applicable state and federal laws.** Concentrations established under applicable state and federal laws;

(ii) **Environmental protection.** Concentrations that result in no significant adverse effects on the protection and propagation of wildlife established using the procedures specified in WAC 173-340-7490 through 173-340-7494, unless it is demonstrated under those sections that establishing a soil concentration is unnecessary.

(iii) **Human health protection.** For hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, those concentrations that protect human health as determined by evaluating the following exposure pathways:

(A) **Ground water protection.** Concentrations that will not cause contamination of ground water to concentrations which exceed ground water cleanup levels established under WAC 173-340-720 as determined using the methods described in WAC 173-340-747.

(B) **Soil direct contact.** Concentrations that, due to direct contact with contaminated soil, are estimated to result in no acute or chronic noncarcinogenic toxic effects on human health using a hazardous quotient of one (1) and concentrations for which the upper bound on the estimated excess cancer risk is less than or equal to one in one hundred thousand (1×10^{-5}). Equations 745-1 and 745-2 and the associated default assumptions shall be used to conduct this calculation.

(I) **Noncarcinogens.** For noncarcinogenic toxic effects of hazardous substances due to soil ingestion, concentrations shall be determined using Equation 745-1. For petroleum mixtures and components of such mixtures, see (b)(iii)(B)(III) of this

subsection.

[Equation 745-1]

$$\text{Soil Cleanup Level (mg/kg)} = \frac{\text{RfD x ABW x UCF x HQ x AT}}{\text{SIR x AB1 x EF x ED}}$$

Where:

RfD	=	Reference dose as specified in WAC 173-340-708(7) (mg/kg-day)
ABW	=	Average body weight over the exposure duration (70 kg)
UCF	=	Unit conversion factor (1,000,000 mg/kg)
SIR	=	Soil ingestion rate (50 mg/day)
AB1	=	Gastrointestinal absorption fraction (1.0) (unitless)
EF	=	Exposure frequency (0.4) (unitless)
HQ	=	Hazard quotient (1) (unitless)
AT	=	Averaging time (20 years)
ED	=	Exposure duration (20 years)

(II) **Carcinogens.** For carcinogenic effects of hazardous substances due to soil ingestion, concentrations shall be determined using Equation 745-2. For petroleum mixtures and components of such mixtures, see (b)(iii)(B)(III) of this subsection.

[Equation 745-2]

$$\text{Soil Cleanup Level (mg/kg)} = \frac{\text{RISK x ABW x AT x UCF}}{\text{CPF x SIR x AB1 x ED x EF}}$$

Where:

RISK	=	Acceptable cancer risk level (1 in 100,000) (unitless)
ABW	=	Average body weight over the exposure duration (70 kg)
AT	=	Averaging time (75 years)
UCF	=	Unit conversion factor (1,000,000 mg/kg)
CPF	=	Carcinogenic Potency Factor as specified in WAC 173-340-708(8) (kg-day/mg)
SIR	=	Soil ingestion rate (50 mg/day)
AB1	=	Gastrointestinal absorption fraction (1.0) (unitless). May use 0.6 for mixtures of dioxins and/or furans
ED	=	Exposure duration (20 years)
EF	=	Exposure frequency (0.4) (unitless)

(III) **Petroleum mixtures.** For noncarcinogenic effects of petroleum mixtures, a total petroleum hydrocarbon cleanup level shall be calculated taking into account the additive effects of the petroleum fractions and volatile organic compounds present in the petroleum mixture. Equation 745-3 shall be used for this calculation. This equation takes into account concurrent exposure due to ingestion and dermal contact with petroleum contaminated soils. Cleanup levels for other noncarcinogens and known or suspected carcinogens within the petroleum mixture shall be

calculated using Equations 745-4 and 745-5. See Table 830-1 for the analyses required for various petroleum products to use this method.

[Equation 745-3]

$$C_{soil} = \frac{HI \times ABW \times AT}{EF \times ED \left[\left(\frac{SIR \times AB1}{10^6 mg/kg} \sum_{i=1}^{n} \frac{F(i)}{RfDo(i)} \right) + \left(\frac{SA \times AF}{10^6 mg/kg} \sum_{i=1}^{n} \frac{F(i) \times ABS(i)}{RfDd(i)} \right) \right]}$$

Where:

C_{soil} = TPH soil cleanup level (mg/kg)

HI = Hazard index (1) (unitless)

ABW = Average body weight over the exposure duration (70 kg)

AT = Averaging time (20 years)

EF = Exposure frequency (0.7) (unitless)

ED = Exposure duration (20 years)

SIR = Soil ingestion rate (50 mg/day)

AB1 = Gastrointestinal absorption fraction (1.0) (unitless)

F(i) = Fraction (by weight) of petroleum component (i) (unitless)

SA = Dermal surface area (2,500 cm^2)

AF = Adherence factor (0.2 mg/cm^2-day)

ABS = Dermal absorption fraction for petroleum component (i) (unitless). May use chemical-specific values or the following defaults:

- 0.0005 for volatile petroleum components with vapor press > = benzene
- 0.03 for volatile petroleum components with vapor press < benzene
- 0.1 for other petroleum components

RfDo(i) = Oral reference dose of petroleum component (i) as defined in WAC 173-340-708(7) (mg/kg-day)

RfDd(i) = Dermal reference dose for petroleum component (i) (mg/kg-day) derived by RfDo x GI

GI = Gastrointestinal absorption conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.8 for volatile petroleum components
- 0.5 for other petroleum components

n = The number of petroleum components (petroleum fractions plus volatile organic compounds with an RfD) present in the petroleum mixture. (See Table 830-1.)

(C) **Soil vapors.** The soil to vapor pathway shall be evaluated for volatile organic compounds whenever any of the following conditions exist:

(I) For gasoline range organics, whenever the total petroleum hydrocarbon (TPH) concentration is significantly higher than a concentration derived for protection of ground water for drinking water beneficial use under WAC 173-340-747(6) using the default assumptions;

(II) For diesel range organics, whenever the total petroleum

hydrocarbon (TPH) concentration is greater than 10,000 mg/kg;

(III) For other volatile organic compounds, including petroleum components, whenever the concentration is significantly higher than a concentration derived for protection of ground water for drinking water beneficial use under WAC 173-340-747(4).

See subsection (5)(c)(iv)(B) of this section for methods that may be used to evaluate the soil to vapor pathway.

(c) **Modified Method C soil cleanup levels.**

(i) **General.** Modified Method C soil cleanup levels are standard Method C soil cleanup levels modified with chemical-specific or site-specific data. When making these adjustments, the resultant cleanup levels shall meet applicable state and federal laws, meet health risk levels for standard Method C soil cleanup levels, and be demonstrated to be environmentally protective using the procedures specified in WAC 173-340-7490 through 173-340-7494. Changes to exposure assumptions must comply with WAC 173-340-708(10).

(ii) **Allowable modifications.** The following modifications may be made to the default assumptions in the standard Method C equations to derive modified Method C soil cleanup levels:

(A) For the protection of ground water see WAC 173-340-747;

(B) For soil ingestion, the gastrointestinal absorption fraction may be modified if the requirements of WAC 173-340-702 (14), (15), (16), and 173-340-708(10) are met;

(C) For dermal contact, the adherence factor, dermal absorption fraction and gastrointestinal absorption conversion factor may be modified if the requirements of WAC 173-340-702 (14), (15), (16), and 173-340-708(10) are met;

(D) The toxicity equivalent factors((~~, as described~~)) provided in WAC 173-340-708 (8)((~~, may be used for assessing the potential carcinogenic risk of mixtures of chlorinated dibenzo-p-dioxins, chlorinated dibenzofurans and polycyclic aromatic hydrocarbons~~)) (d), (e) and (f), may be modified provided the requirements of WAC 173-340-708 (8)(g) and (h) are met;

(E) The reference dose and cancer potency factor may be modified if the requirements in WAC 173-340-708 (7) and (8) are met; and

(F) Modifications incorporating new science as provided for in WAC 173-340-702 (14), (15) and (16).

(iii) **Dermal contact.** For hazardous substances other than petroleum mixtures, dermal contact with the soil shall be evaluated whenever the proposed changes to Equations 745-1 and 745-2 would result in a significantly higher soil cleanup level than would be calculated without the proposed changes. When conducting this evaluation, the following equations and default assumptions shall be used:

(A) For noncarcinogens use Equation 745-4. This equation takes into account concurrent exposure due to ingestion and dermal contact with soil.

[Equation 745-4]

$$C_{soil} = \frac{HQ \times ABW \times AT}{EF \times ED \left[\left(\frac{1}{RfDo} \times \frac{SIR \times AB1}{10^6 mg/kg} \right) + \left(\frac{1}{RfDd} \times \frac{SA \times AF \times ABS}{10^6 mg/kg} \right) \right]}$$

Where:

C_{soil} = Soil cleanup level (mg/kg)

HQ = Hazard quotient (unitless)

ABW = Average body weight over the exposure duration (70 kg)

AT = Averaging time (20 years)

EF = Exposure frequency (0.7) (unitless)

ED = Exposure duration (20 years)

SIR = Soil ingestion rate (50 mg/day)

AB1 = Gastrointestinal absorption fraction (1.0) (unitless)

SA = Dermal surface area (2,500 mg/cm^2)

AF = Adherence factor (0.2 mg/cm^2-day)

ABS = Dermal absorption fraction (unitless). May use chemical-specific values or the following defaults:

- 0.01 for inorganic hazardous substances
- 0.0005 for volatile organic compounds with vapor press > = benzene
- 0.03 for volatile organic compounds with vapor press < benzene
- 0.1 for other organic hazardous substances

RfDo = Oral reference dose as defined in WAC 173-340-708(7) (mg/kg-day)

RfDd = Dermal reference dose (mg/kg-day) derived by RfDo x GI

GI = Gastrointestinal absorption conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.2 for inorganic hazardous substances
- 0.8 for volatile organic compounds
- 0.5 for other organic hazardous substances

(B) For carcinogens use Equation 745-5. This equation takes into account concurrent exposure due to ingestion and dermal contact with soil.

[Equation 745-5]

$$C_{soil} = \frac{RISK \times ABW \times AT}{EF \times ED \left[\left(\frac{SIR \times AB1 \times CPFo}{10^6 mg/kg} \right) + \left(\frac{SA \times AF \times ABS \times CPFd}{10^6 mg/kg} \right) \right]}$$

Where:

C_{soil} = Soil cleanup level (mg/kg)

RISK = Acceptable cancer risk (1 in 100,000) (unitless)

ABW = Average body weight over the exposure duration (70 kg)

AT = Averaging time (75 years)

EF = Exposure frequency (0.7) (unitless)

ED = Exposure duration (20 years)

SIR = Soil ingestion rate (50 mg/day)

AB1 = Gastrointestinal absorption fraction (1.0) (unitless). May use 0.6 for mixtures of dioxins and/or furans

CPFo = Oral cancer potency factor as defined in WAC 173-340-708(8) (kg-day/mg)

CPFd = Dermal cancer potency factor (kg-day/mg) derived by CPFo/GI

GI = Gastrointestinal absorption conversion factor (unitless). May use chemical-specific values or the following defaults:

- 0.2 for inorganic hazardous substances
- 0.8 for volatile organic compounds and mixtures of dioxins and/or furans
- 0.5 for other organic hazardous substances

SA = Dermal surface area (2,500 cm^2)

AF = Adherence factor (0.2 mg/cm^2-day)

ABS = Dermal absorption fraction (unitless). May use chemical-specific values or the following defaults:

- 0.01 for inorganic hazardous substances
- 0.0005 for volatile organic compounds with vapor press > = benzene
- 0.03 for volatile organic compounds substances with vapor press < benzene and for mixtures of dioxins and/or furans
- 0.1 for other organic hazardous substances

(C) Modifications may be made to Equations 745-4 and 745-5 as provided for in subsection (5)(c)(ii) of this section.

(iv) **Soil vapors.**

(A) **Applicability.** The soil to vapor pathway shall be evaluated for volatile organic compounds whenever any of the following conditions exist:

(I) For other than petroleum hydrocarbon mixtures, the proposed changes to the standard Method C equations (Equations 745-1 and 745-2) or default values would result in a significantly higher soil cleanup level than would be calculated without the proposed changes;

(II) For petroleum hydrocarbon mixtures, the proposed changes to the standard Method C equations (Equations 745-3, 745-4 and 745-5) or default values would result in a significantly higher soil cleanup level than would be calculated without the proposed changes;

(III) For gasoline range organics, whenever the total petroleum hydrocarbon (TPH) concentration is significantly higher than a concentration derived for protection of ground water for drinking water beneficial use under WAC 173-340-747(6) using the default assumptions;

(IV) For diesel range organics, whenever the total petroleum hydrocarbon (TPH) concentration is greater than 10,000 mg/kg;

(V) For other volatile organic compounds, including petroleum components, whenever the concentration is significantly higher than a concentration derived for protection of ground water for drinking water beneficial use under WAC 173-340-747(4).

(B) **Evaluation methods.** Soil cleanup levels that are protective of the indoor and ambient air shall be determined on a

site-specific basis. Soil cleanup levels may be evaluated as being protective of air pathways using any of the following methods:

(I) Measurements of the soil vapor concentrations, using methods approved by the department, demonstrating vapors in the soil would not exceed air cleanup levels established under WAC 173-340-750.

(II) Measurements of ambient air concentrations and/or indoor air vapor concentrations throughout buildings, using methods approved by the department, demonstrating air does not exceed cleanup levels established under WAC 173-340-750. Such measurements must be representative of current and future site conditions when vapors are likely to enter and accumulate in structures. Measurement of ambient air may be excluded if it can be shown that indoor air is the most protective point of exposure.

(III) Use of modeling methods approved by the department to demonstrate the air cleanup standards established under WAC 173-340-750 will not be exceeded. When this method is used, the department may require soil vapor and/or air monitoring to be conducted to verify the calculations and compliance with air cleanup standards.

(IV) Other methods as approved by the department demonstrating the air cleanup standards established under WAC 173-340-750 will not be exceeded.

(d) **Using modified Method C to evaluate industrial soil remediation levels.** In addition to the adjustments allowed under subsection (5)(c) of this section, other adjustments to the reasonable maximum exposure scenario or default exposure assumptions are allowed when using a quantitative site-specific risk assessment to evaluate the protectiveness of a remedy. See WAC 173-340-355, 173-340-357, and 173-340-708 (3)(d) and (10)(b).

(6) **Adjustments to industrial soil cleanup levels.**

(a) **Total site risk adjustments.** Soil cleanup levels for individual hazardous substances developed in accordance with subsection (5) of this section, including cleanup levels based on state and federal laws, shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure. These adjustments need to be made only if, without these adjustments, the hazard index would exceed one (1) or the total excess cancer risk would exceed one in one hundred thousand (1×10^{-5}). These adjustments shall be made in accordance with the procedures specified in WAC 173-340-708 (5) and (6). In making these adjustments, the hazard index shall not exceed one (1) and the total excess cancer risk shall not exceed one in one hundred thousand (1×10^{-5}).

(b) **Adjustments to applicable state and federal laws.** Where a cleanup level developed under subsection (3) or (5) of this section is based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of one (1), the cleanup level shall be adjusted downward so that total excess cancer risk does not exceed one in one hundred

thousand (1×10^{-5}) and the hazard index does not exceed one (1) at the site.

(c) **Natural background and analytical considerations.** Cleanup levels determined under subsection (3) or (5) of this section, including cleanup levels adjusted under subsection (6)(a) and (b) of this section, shall not be set at levels below the practical quantitation limit or natural background concentration, whichever is higher. See WAC 173-340-707 and 173-340-709 for additional requirements pertaining to practical quantitation limits and natural background.

(7) **Point of compliance.** The point of compliance for industrial property soil cleanup levels shall be established in accordance with WAC 173-340-740(6).

(8) **Compliance monitoring.** Compliance monitoring and data analysis and evaluation for industrial property soil cleanup levels shall be performed in accordance with WAC 173-340-410 and 173-340-740(7).

[Statutory Authority: Chapter 70.105D RCW. 01-05-024 (Order 97-09A), § 173-340-745, filed 2/12/01, effective 8/15/01; 96-04-010 (Order 94-37), § 173-340-745, filed 1/26/96, effective 2/26/96; 91-04-019, § 173-340-745, filed 1/28/91, effective 2/28/91.]

NOTES:

Reviser's Note: The brackets and enclosed material in the text of the above section occurred in the copy filed by the agency.

AMENDATORY SECTION (Amending Order 97-09A, filed 2/12/01, effective 8/15/01)

WAC 173-340-900 Tables.

Table 708-1: Toxicity Equivalency Factors for Chlorinated dibenzo-p-dioxins and Chlorinated Dibenzofurans Congeners

CAS Number	Hazardous Substance	Toxicity Equivalency Factor (unitless)[1]
	Dioxin Congeners	
1746-01-6	2,3,7,8-Tetrachloro dibenzo-p-dioxin	1
40321-76-4	1,2,3,7,8-Pentachloro dibenzo-p-dioxin	1
39227-28-6	1,2,3,4,7,8-Hexachloro dibenzo-p-dioxin	0.1
57653-85-7	1,2,3,6,7,8-Hexachloro dibenzo-p-dioxin	0.1
19408-74-3	1,2,3,7,8,9-Hexachloro dibenzo-p-dioxin	0.1
35822-46-9	1,2,3,4,6,7,8-Heptachloro dibenzo-p-dioxin	0.01

3268-87-9	1,2,3,4,6,7,8,9-Octachloro dibenzo-p-dioxin	0.0003
	Furan Congeners	
51207-31-9	2,3,7,8-Tetrachloro dibenzofuran	0.1
57117-41-6	1,2,3,7,8-Pentachloro dibenzofuran	0.03
57117-31-4	2,3,4,7,8-Pentachloro dibenzofuran	0.3
70648-26-9	1,2,3,4,7,8-Hexachloro dibenzofuran	0.1
57117-44-9	1,2,3,6,7,8-Hexachloro dibenzofuran	0.1
72918-21-9	1,2,3,7,8,9-Hexachloro dibenzofuran	0.1
60851-34-5	2,3,4,6,7,8-Hexachloro dibenzofuran	0.1
67562-39-4	1,2,3,4,6,7,8-Heptachloro dibenzofuran	0.01
55673-89-7	1,2,3,4,7,8,9-Heptachloro dibenzofuran	0.01
39001-02-0	1,2,3,4,6,7,8,9-Octachloro dibenzofuran	0.0003

(1) Source: Van den Berg et al. 2006. The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds.
Toxicological Sciences 2006 93(2):223-241; doi:10.1093/toxsci/kfl055.

Table 708-2: Toxicity Equivalency Factors for Minimum Required Carcinogenic Polyaromatic Hydrocarbons (cPAHs) under WAC 173-340-708(e)

CAS Number	Hazardous Substance	TEF (unitless)(1)
50-32-08	benzo[a]pyrene	1
56-55-3	benzo[a]anthracene	0.1
205-99-2	benzo[b]fluoranthene	0.1
207-08-9	benzo[k]fluoranthene	0.1
218-01-9	chrysene	0.01
53-70-3	dibenz[a, h]anthracene	0.1
193-39-5	indeno[1,2,3-cd]pyrene	0.1

(1) Source: Cal-EPA, 2005. Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II Technical Support Document for Describing Available Cancer Potency Factors. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. May 2005.

Table 708-3: Toxicity Equivalency Factors for Carcinogenic Polyaromatic Hydrocarbons (cPAHs) that May be Required under WAC 173-340-708 (8)(e)(v)

CAS Number	Hazardous Substance	TEF (unitless)(1)
205-82-3	benzo(j)fluoranthene	0.1
224-42-0	dibenz[a, j]acridine	0.1
226-36-8	dibenz[a, h]acridine	0.1
194-59-2	7H-dibenzo[c, g]carbazole	1
192-65-4	dibenzo[a, e]pyrene	1
189-64-0	dibenzo[a, h]pyrene	10
189-55-9	dibenzo[a, i]pyrene	10
191-30-0	dibenzo[a, l]pyrene	10
3351-31-3	5-methylchrysene	1
5522-43-0	1-nitropyrene	0.1
57835-92-4	4-nitropyrene	0.1
42397-64-8	1,6-dinitropyrene	10
42397-65-9	1,8-dinitropyrene	1
7496-02-8	6-nitrochrysene	10
607-57-8	2-nitrofluorene	0.01
57-97-6	7,12-dimethylbenzanthracene	10
56-49-5	3-methylcholanthrene	1

602-87-9	5-nitroacenaphthene	0.01

(1)Source: Cal-EPA, 2005. Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II Technical Support Document for Describing Available Cancer Potency Factors. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. May 2005.

Table 708-4: Toxicity Equivalency Factors for Dioxin-Like Polychlorinated Biphenyls (PCBs)

CAS Number	Hazardous Substance	TEF (unitless)(1)
	Dioxin-Like PCBs	
32598-13-3	3,3',4,4'-Tetrachlorobiphenyl (PCB 77)	0.0001
70362-50-4	3,4,4',5- Tetrachlorobiphenyl (PCB 81)	0.0003
32598-14-4	2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)	0.00003
74472-37-0	2,3,4,4',5-Pentachlorobiphenyl (PCB 114)	0.00003
31508-00-6	2,3',4,4',5-Pentachlorobiphenyl (PCB 118)	0.00003
65510-44-3	2',3,4,4',5-Pentachlorobiphenyl (PCB 123)	0.00003
57465-28-8	3,3',4,4',5-Pentachlorobiphenyl (PCB 126)	0.1
38380-08-4	2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)	0.00003
69782-90-7	2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)	0.00003
52663-72-6	2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)	0.00003
32774-16-6	3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)	0.03
39635-31-9	2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)	0.00003

(1)Source: Van den Berg et al. 2006. The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds. Toxicological Sciences 2006 93(2):223-241; doi:10.1093/toxsci/kfl055.

Table 720-1
Method A Cleanup Levels for Ground Water.[a]

Hazardous Substance	CAS Number	Cleanup Level
Arsenic	7440-38-2	5 ug/liter[b]
Benzene	71-43-2	5 ug/liter[c]
Benzo(a)pyrene	50-32-8	0.1 ug/liter[d]
Cadmium	7440-43-9	5 ug/liter[e]
Chromium (Total)	7440-47-3	50 ug/liter[f]
DDT	50-29-3	0.3 ug/liter[g]
1,2 Dichloroethane (EDC)	107-06-2	5 ug/liter[h]
Ethylbenzene	100-41-4	700 ug/liter[i]
Ethylene dibromide (EDB)	106-93-4	0.01 ug/liter[j]
Gross Alpha Particle Activity		15 pCi/liter[k]
Gross Beta Particle Activity		4 mrem/yr[l]
Lead	7439-92-1	15 ug/liter[m]
Lindane	58-89-9	0.2 ug/liter[n]

Hazardous Substance	CAS Number	Cleanup Level
Methylene chloride	75-09-2	5 ug/liter[o]
Mercury	7439-97-6	2 ug/liter[p]
MTBE	1634-04-4	20 ug/liter[q]
Naphthalenes	91-20-3	160 ug/liter[r]
PAHs (carcinogenic)		See benzo(a)pyrene[d]
PCB mixtures		0.1 ug/liter[s]
Radium 226 and 228		5 pCi/liter[t]
Radium 226		3 pCi/liter[u]
Tetrachloroethylene	127-18-4	5 ug/liter[v]
Toluene	108-88-3	1,000 ug/liter[w]
Total Petroleum Hydrocarbons[x]		
[Note: Must also test for and meet cleanup levels for other petroleum components--see footnotes!]		
Gasoline Range Organics		
Benzene present in ground water		800 ug/liter
No detectable benzene in ground water		1,000 ug/liter
Diesel Range Organics		500 ug/liter
Heavy Oils		500 ug/liter
Mineral Oil		500 ug/liter
1,1,1 Trichloroethane	71-55-6	200 ug/liter[y]
Trichloroethylene	79-01-6	5 ug/liter[z]
Vinyl chloride	75-01-4	0.2 ug/liter[aa]
Xylenes	1330-20-7	1,000 ug/liter[bb]

Footnotes:

a **Caution on misusing this table.** This table has been developed for specific purposes. It is intended to provide conservative cleanup levels for drinking water beneficial uses at sites undergoing routine cleanup actions or those sites with relatively few hazardous substances. This table may not be appropriate for defining cleanup levels at other sites. For these reasons, the values in this table should not automatically be used to define cleanup levels that must be met for financial, real estate, insurance coverage or placement, or similar transactions or purposes. Exceedances of the values in this table do not necessarily mean the ground water must be restored to those levels at all sites. The level of restoration depends on the remedy selected under WAC 173-340-350 through 173-340-390.

b **Arsenic.** Cleanup level based on background concentrations for state of Washington.

c **Benzene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

d **Benzo(a)pyrene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61), adjusted to a 1×10^{-5} risk. If other carcinogenic PAHs are suspected of being present at the site, test for them and use this value as the total concentration that all carcinogenic PAHs must meet using the toxicity equivalency methodology in WAC 173-340-708(8).

e **Cadmium.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.62).

f **Chromium (Total).** Cleanup level based on concentration derived using Equation 720-1 for hexavalent chromium. This is a total value for chromium III and chromium VI. If just chromium III is present at the site, a cleanup level of 100 ug/l may be used (based on WAC 246-290-310 and 40 C.F.R. 141.62).

g **DDT (dichlorodiphenyltrichloroethane).** Cleanup levels based on concentration derived using Equation 720-2.

h **1,2 Dichloroethane (ethylene dichloride or EDC).** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

i **Ethylbenzene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

j **Ethylene dibromide (1,2 dibromoethane or EDB).** Cleanup level based on concentration derived using Equation 720-2, adjusted for the practical quantitation limit.

k **Gross Alpha Particle Activity, excluding uranium.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.15).

l **Gross Beta Particle Activity, including gamma activity.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.15).

m **Lead.** Cleanup level based on applicable state and federal law (40 C.F.R. 141.80).

n **Lindane.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

o **Methylene chloride (dichloromethane).** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

p **Mercury.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.62).

q **Methyl tertiary-butyl ether (MTBE).** Cleanup level based on federal drinking water advisory level (EPA-822-F-97-009, December 1997).

r **Naphthalenes.** Cleanup level based on concentration derived using Equation 720-1. This is a total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.

s **PCB mixtures.** Cleanup level based on concentration derived using Equation 720-2, adjusted for the practical quantitation limit. This cleanup level is a total value for all PCBs.

t **Radium 226 and 228.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.15).

u **Radium 226.** Cleanup level based on applicable state law (WAC 246-290-310).

v **Tetrachloroethylene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

w **Toluene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

x **Total Petroleum Hydrocarbons (TPH).** TPH cleanup values have been provided for the most common petroleum products encountered at contaminated sites. Where there is a mixture of products or the product composition is unknown, samples must be tested using both the NWTPH-Gx and NWTPH-Dx methods and the lowest applicable TPH cleanup level must be met.

- **Gasoline range organics** means organic compounds measured using method NWTPH-Gx. Examples are aviation and automotive gasoline. The cleanup level is based on protection of ground water for noncarcinogenic effects during drinking water use. Two cleanup levels are provided. The higher value is based on the assumption that no benzene is present in the ground water sample. If any detectable amount of benzene is present in the ground water sample, then the lower TPH cleanup level must be used. No interpolation between these cleanup levels is allowed. The ground water cleanup level for any carcinogenic components of the petroleum [such as benzene, EDB and EDC] and any noncarcinogenic components [such as ethylbenzene, toluene, xylenes and MTBE], if present at the site, must also be met. See Table 830-1 for the minimum testing requirements for gasoline releases.
- **Diesel range organics** means organic compounds measured using NWTPH-Dx. Examples are diesel, kerosene, and #1 and #2 heating oil. The cleanup level is based on protection from noncarcinogenic effects during drinking water use. The ground water cleanup level for any carcinogenic components of the petroleum [such as benzene and PAHs] and any noncarcinogenic components [such as ethylbenzene, toluene, xylenes and naphthalenes], if present at the site, must also be met. See Table 830-1 for the minimum testing requirements for diesel releases.
- **Heavy oils** means organic compounds measured using NWTPH-Dx. Examples are #6 fuel oil, bunker C oil, hydraulic oil and waste oil. The cleanup level is based on protection from noncarcinogenic effects during drinking water use, assuming a product composition similar to diesel fuel. The ground water cleanup level for any carcinogenic components of the petroleum [such as benzene, PAHs and PCBs] and any noncarcinogenic components [such as ethylbenzene, toluene, xylenes and naphthalenes], if present at the site, must also be met. See Table 830-1 for the minimum testing requirements for heavy oil releases.
- **Mineral oil** means non-PCB mineral oil, typically used as an insulator and coolant in electrical devices such as transformers and capacitors measured using NWTPH-Dx. The cleanup level is based on protection from noncarcinogenic effects during drinking water use. Sites using this cleanup level must analyze ground water samples for PCBs and meet the PCB cleanup level in this table unless it can be demonstrated that: (1) The release originated from an electrical device manufactured after July 1, 1979; or (2) oil containing PCBs was never used in the equipment suspected as the source of the release; or (3) it can be documented that the oil released was recently tested and did not contain PCBs. Method B (or Method C, if applicable) must be used for releases of oils containing greater than 50 ppm PCBs. See Table 830-1 for the minimum testing requirements for mineral oil releases.

y **1,1,1 Trichloroethane.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

z **Trichloroethylene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

aa **Vinyl chloride.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61), adjusted to a 1×10^{-5} risk.

bb **Xylenes.** Cleanup level based on xylene not exceeding the maximum allowed cleanup level in this table for total petroleum hydrocarbons and on prevention of adverse aesthetic characteristics. This is a total value for all xylenes.

Table 740-1
Method A Soil Cleanup Levels for Unrestricted Land Uses.[a]

Hazardous Substance	CAS Number	Cleanup Level
Arsenic	7440-38-2	20 mg/kg[b]
Benzene	71-43-2	0.03 mg/kg[c]
Benzo(a)pyrene	50-32-8	0.1 mg/kg[d]
Cadmium	7440-43-9	2 mg/kg[e]
Chromium		
Chromium VI	18540-29-9	19 mg/kg[f1]
Chromium III	16065-83-1	2,000 mg/kg[f2]
DDT	50-29-3	3 mg/kg[g]
Ethylbenzene	100-41-4	6 mg/kg[h]
Ethylene dibromide (EDB)	106-93-4	0.005 mg/kg[i]
Lead	7439-92-1	250 mg/kg[j]
Lindane	58-89-9	0.01 mg/kg[k]
Methylene chloride	75-09-2	0.02 mg/kg[l]
Mercury (inorganic)	7439-97-6	2 mg/kg[m]

Hazardous Substance	CAS Number	Cleanup Level
MTBE	1634-04-4	0.1 mg/kg[n]
Naphthalenes	91-20-3	5 mg/kg[o]
PAHs (carcinogenic)		See benzo(a)pyrene[d]
PCB Mixtures		1 mg/kg[p]
Tetrachloroethylene	127-18-4	0.05 mg/kg[q]
Toluene	108-88-3	7 mg/kg[r]
Total Petroleum Hydrocarbons[s]		
[Note: Must also test for and meet cleanup levels for other petroleum components--see footnotes!]		
Gasoline Range Organics		
Gasoline mixtures without benzene and the total of ethylbenzene, toluene and xylene are less than 1% of the gasoline mixture		100 mg/kg
All other gasoline mixtures		30 mg/kg
Diesel Range Organics		2,000 mg/kg
Heavy Oils		2,000 mg/kg
Mineral Oil		4,000 mg/kg
1,1,1 Trichloroethane	71-55-6	2 mg/kg[t]
Trichloroethylene	79-01-6	0.03 mg/kg[u]
Xylenes	1330-20-7	9 mg/kg[v]

Footnotes:

a **Caution on misusing this table.** This table has been developed for specific purposes. It is intended to provide conservative cleanup levels for sites undergoing routine cleanup actions or for sites with relatively few hazardous substances, and the site qualifies under WAC 173-340-7491 for an exclusion from conducting a simplified or site-specific terrestrial ecological evaluation, or it can be demonstrated using a terrestrial ecological evaluation under WAC 173-340-7492 or 173-340-7493 that the values in this table are ecologically protective for the site. This table may not be appropriate for defining cleanup levels at other sites. For these reasons, the values in this table should not automatically be used to define cleanup levels that must be met for financial, real estate, insurance coverage or placement, or similar transactions or purposes. Exceedances of the values in this table do not necessarily mean the soil must be restored to these levels at a site. The level of restoration depends on the remedy selected under WAC 173-340-350 through 173-340-390.

b **Arsenic.** Cleanup level based on direct contact using Equation 740-2 and protection of ground water for drinking water use using the procedures in WAC 173-340-747(4), adjusted for natural background for soil.

c **Benzene.** Cleanup level based on protection of ground water for drinking water use, using the procedures in WAC 173-340-747 (4) and (6).

d **Benzo(a)pyrene.** Cleanup level based on direct contact using Equation 740-2. If other carcinogenic PAHs are suspected of being present at the site, test for them and use this value as the total concentration that all carcinogenic PAHs must meet using the toxicity equivalency methodology in WAC 173-340-708(8).

e **Cadmium.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit for soil.

f1 **Chromium VI.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

f2 **Chromium III.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). Chromium VI must also be tested for and the cleanup level met when present at a site.

g **DDT (dichlorodiphenyltrichloroethane).** Cleanup level based on direct contact using Equation 740-2.

h **Ethylbenzene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

i **Ethylene dibromide (1,2 dibromoethane or EDB).** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit for soil.

j **Lead.** Cleanup level based on preventing unacceptable blood lead levels.

k **Lindane.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit.

l **Methylene chloride (dichloromethane).** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

m **Mercury.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

n **Methyl tertiary-butyl ether (MTBE).** Cleanup level based on protection of ground water for drinking water use, using the

procedures described in WAC 173-340-747(4).

o **Naphthalenes.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). This is a total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.

p **PCB Mixtures.** Cleanup level based on applicable federal law (40 C.F.R. 761.61). This is a total value for all PCBs.

q **Tetrachloroethylene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

r **Toluene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

s **Total Petroleum Hydrocarbons (TPH).** TPH cleanup values have been provided for the most common petroleum products encountered at contaminated sites. Where there is a mixture of products or the product composition is unknown, samples must be tested using both the NWTPH-Gx and NWTPH-Dx methods and the lowest applicable TPH cleanup level must be met.

- **Gasoline range organics** means organic compounds measured using method NWTPH-Gx. Examples are aviation and automotive gasoline. The cleanup level is based on protection of ground water for noncarcinogenic effects during drinking water use using the procedures described in WAC 173-340-747(6). Two cleanup levels are provided. The lower value of 30 mg/kg can be used at any site. When using this lower value, the soil must also be tested for and meet the benzene soil cleanup level. The higher value of 100 mg/kg can only be used if the soil is tested and found to contain no benzene and the total of ethylbenzene, toluene and xylene are less than 1% of the gasoline mixture. No interpolation between these cleanup levels is allowed. In both cases, the soil cleanup level for any other carcinogenic components of the petroleum [such as EDB and EDC], if present at the site, must also be met. Also, in both cases, soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes, naphthalene, and MTBE], also must be met if these substances are found to exceed ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for gasoline releases.
- **Diesel range organics** means organic compounds measured using method NWTPH-Dx. Examples are diesel, kerosene, and #1 and #2 heating oil. The cleanup level is based on preventing the accumulation of free product on the ground water, as described in WAC 173-340-747(10). The soil cleanup level for any carcinogenic components of the petroleum [such as benzene and PAHs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if these substances are found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for diesel releases.
- **Heavy oils** means organic compounds measured using NWTPH-Dx. Examples are #6 fuel oil, bunker C oil, hydraulic oil and waste oil. The cleanup level is based on preventing the accumulation of free product on the ground water, as described in WAC 173-340-747(10) and assuming a product composition similar to diesel fuel. The soil cleanup level for any carcinogenic components of the petroleum [such as benzene, PAHs and PCBs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for heavy oil releases.
- **Mineral oil** means non-PCB mineral oil, typically used as an insulator and coolant in electrical devices such as transformers and capacitors, measured using NWTPH-Dx. The cleanup level is based on preventing the accumulation of free product on the ground water, as described in WAC 173-340-747(10). Sites using this cleanup level must also analyze soil samples and meet the soil cleanup level for PCBs, unless it can be demonstrated that: (1) The release originated from an electrical device that was manufactured after July 1, 1979; or (2) oil containing PCBs was never used in the equipment suspected as the source of the release; or (3) it can be documented that the oil released was recently tested and did not contain PCBs. Method B must be used for releases of oils containing greater than 50 ppm PCBs. See Table 830-1 for the minimum testing requirements for mineral oil releases.

t **1,1,1 Trichloroethane.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

u **Trichloroethylene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

v **Xylenes.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). This is a total value for all xylenes.

Table 745-1
Method A Soil Cleanup Levels for Industrial Properties.[a]

Hazardous Substance	CAS Number	Cleanup Level
Arsenic	7440-38-2	20 mg/kg[b]
Benzene	71-43-2	0.03 mg/kg[c]
Benzo(a)pyrene	50-32-8	2 mg/kg[d]
Cadmium	7440-43-9	2 mg/kg[e]
Chromium		
Chromium VI	18540-29-9	19 mg/kg[f1]
Chromium III	16065-83-1	2,000 mg/kg[f2]
DDT	50-29-3	4 mg/kg[g]
Ethylbenzene	100-41-4	6 mg/kg[h]
Ethylene dibromide (EDB)	106-93-4	0.005 mg/kg[i]
Lead	7439-92-1	1,000 mg/kg[j]
Lindane	58-89-9	0.01 mg/kg[k]
Methylene chloride	75-09-2	0.02 mg/kg[l]
Mercury (inorganic)	7439-97-6	2 mg/kg[m]

MTBE	1634-04-4	0.1 mg/kg[n]
Naphthalene	91-20-3	5 mg/kg[o]
PAHs (carcinogenic)		See benzo(a)pyrene[d]
PCB Mixtures		10 mg/kg[p]
Tetrachloroethylene	127-18-4	0.05 mg/kg[q]
Toluene	108-88-3	7 mg/kg[r]
Total Petroleum Hydrocarbons[s]		
[Note: Must also test for and meet cleanup levels for other petroleum components--see footnotes!]		
Gasoline Range Organics		
Gasoline mixtures without benzene and the total of ethylbenzene, toluene and xylene are less than 1% of the gasoline mixture		100 mg/kg
All other gasoline mixtures		30 mg/kg
Diesel Range Organics		2,000 mg/kg
Heavy Oils		2,000 mg/kg
Mineral Oil		4,000 mg/kg
1,1,1 Trichloroethane	71-55-6	2 mg/kg[t]
Trichloroethylene	79-01-6	0.03 mg/kg[u]
Xylenes	1330-20-7	9 mg/kg[v]

Footnotes:

a **Caution on misusing this table.** This table has been developed for specific purposes. It is intended to provide conservative cleanup levels for sites undergoing routine cleanup actions or for industrial properties with relatively few hazardous substances, and the site qualifies under WAC 173-340-7491 for an exclusion from conducting a simplified or site-specific terrestrial ecological evaluation, or it can be demonstrated using a terrestrial ecological evaluation under WAC 173-340-7492 or 173-340-7493 that the values in this table are ecologically protective for the site. This table may not be appropriate for defining cleanup levels at other sites. For these reasons, the values in this table should not automatically be used to define cleanup levels that must be met for financial, real estate, insurance coverage or placement, or similar transactions or purposes. Exceedances of the values in this table do not necessarily mean the soil must be restored to these levels at a site. The level of restoration depends on the remedy selected under WAC 173-340-350 through 173-340-390.

b **Arsenic.** Cleanup level based on protection of ground water for drinking water use, using the procedures in WAC 173-340-747(4), adjusted for natural background for soil.

c **Benzene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747 (4) and (6).

d **Benzo(a)pyrene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). If other carcinogenic PAHs are suspected of being present at the site, test for them and use this value as the total concentration that all carcinogenic PAHs must meet using the toxicity equivalency methodology in WAC 173-340-708(8).

e **Cadmium.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit for soil.

f1 **Chromium VI.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

f2 **Chromium III.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). Chromium VI must also be tested for and the cleanup level met when present at a site.

g **DDT (dichlorodiphenyltrichloroethane).** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

h **Ethylbenzene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

i **Ethylene dibromide (1,2 dibromoethane or EDB).** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit for soil.

j **Lead.** Cleanup level based on direct contact.

k **Lindane.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit.

l **Methylene chloride (dichloromethane).** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

m **Mercury.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

n **Methyl tertiary-butyl ether (MTBE).** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

o **Naphthalenes.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). This is a total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.

p **PCB Mixtures.** Cleanup level based on applicable federal law (40 C.F.R. 761.61). This is a total value for all PCBs. This value may be used only if the PCB contaminated soils are capped and the cap maintained as required by 40 C.F.R. 761.61. If this condition cannot be met, the value in Table 740-1 must be used.

q **Tetrachloroethylene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

r **Toluene.** Cleanup level based on protection of ground water for drinking water use, using the procedure described in WAC 173-340-747(4).

s **Total Petroleum Hydrocarbons (TPH).** TPH cleanup values have been provided for the most common petroleum products encountered at contaminated sites. Where there is a mixture of products or the product composition is unknown, samples must be tested using both the NWTPH-Gx and NWTPH-Dx methods and the lowest applicable TPH cleanup level must be met.

- **Gasoline range organics** means organic compounds measured using method NWTPH-Gx. Examples are aviation and automotive gasoline. The cleanup level is based on protection of ground water for noncarcinogenic effects during drinking water use using the procedures described in WAC 173-340-747(6). Two cleanup levels are provided. The lower value of 30 mg/kg can be used at any site. When using this lower value, the soil must also be tested for and meet the benzene soil cleanup level. The higher value of 100 mg/kg can only be used if the soil is tested and found to contain no benzene and the total of ethylbenzene, toluene and xylene are less than 1% of the gasoline mixture. No interpolation between these cleanup levels is allowed. In both cases, the soil cleanup level for any other carcinogenic components of the petroleum [such as EDB and EDC], if present at the site, must also be met. Also, in both cases, soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes, naphthalene, and MTBE], also must be met if these substances are found to exceed ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for gasoline releases.
- **Diesel range organics** means organic compounds measured using method NWTPH-Dx. Examples are diesel, kerosene, and #1 and #2 heating oil. The cleanup level is based on preventing the accumulation of free product on the ground water, as described in WAC 173-340-747(10). The soil cleanup level for any carcinogenic components of the petroleum [such as benzene, and PAHs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if these substances are found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for diesel releases.
- **Heavy oils** means organic compounds measured using NWTPH-Dx. Examples are #6 fuel oil, bunker C oil, hydraulic oil and waste oil. The cleanup level is based on preventing the accumulation of free product on the ground water, as described in WAC 173-340-747(10) and assuming a product composition similar to diesel fuel. The soil cleanup level for any carcinogenic components of the petroleum [such as benzene, PAHs and PCBs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for heavy oil releases.
- **Mineral oil** means non-PCB mineral oil, typically used as an insulator and coolant in electrical devices such as transformers and capacitors, measured using NWTPH-Dx. The cleanup level is based on preventing the accumulation of free product on the ground water, as described in WAC 173-340-747(10). Sites using this cleanup level must also analyze soil samples and meet the soil cleanup level for PCBs, unless it can be demonstrated that: (1) The release originated from an electrical device that was manufactured after July 1, 1979; or (2) oil containing PCBs was never used in the equipment suspected as the source of the release; or (3) it can be documented that the oil released was recently tested and did not contain PCBs. Method B or C must be used for releases of oils containing greater than 50 ppm PCBs. See Table 830-1 for the minimum testing requirements for mineral oil releases.

t **1,1,1 Trichloroethane.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

u **Trichloroethylene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

v **Xylenes.** Cleanup level based on protection of ground water for drinking water use, using the procedure in WAC 173-340-747(4). This is a total value for all xylenes.

Table 747-1
Soil Organic Carbon-Water Partitioning Coefficient (K_{oc}) Values: Nonionizing Organics.

Hazardous Substance	K_{oc} (ml/g)
ACENAPHTHENE	4,898
ALDRIN	48,685
ANTHRACENE	23,493
BENZ(a)ANTHRACENE	357,537
BENZENE	62
BENZO(a)PYRENE	968,774
BIS(2-CHLOROETHYL)ETHER	76
BIS(2-ETHYLHEXYL)PHTHALATE	111,123

Hazardous Substance	K_{oc} (ml/g)
BROMOFORM	126
BUTYL BENZYL PHTHALATE	13,746
CARBON TETRACHLORIDE	152
CHLORDANE	51,310
CHLOROBENZENE	224
CHLOROFORM	53
DDD	45,800
DDE	86,405
DDT	677,934
DIBENZO(a,h)ANTHRACENE	1,789,101
1,2-DICHLOROBENZENE (o)	379
1,4-DICHLOROBENZENE (p)	616
DICHLOROETHANE-1,1	53
DICHLOROETHANE-1,2	38
DICHLOROETHYLENE-1,1	65
trans-1,2 DICHLOROETHYLENE	38
DICHLOROPROPANE-1,2	47
DICHLOROPROPENE-1,3	27
DIELDRIN	25,546
DIETHYL PHTHALATE	82
DI-N-BUTYLPHTHALATE	1,567
EDB	66
ENDRIN	10,811
ENDOSULFAN	2,040
ETHYL BENZENE	204
FLUORANTHENE	49,096
FLUORENE	7,707
HEPTACHLOR	9,528
HEXACHLOROBENZENE	80,000
α-HCH (α-BHC)	1,762
β-HCH (β-BHC)	2,139
γ-HCH (LINDANE)	1,352
MTBE	11
METHOXYCHLOR	80,000
METHYL BROMIDE	9
METHYL CHLORIDE	6
METHYLENE CHLORIDE	10
NAPHTHALENE	1,191
NITROBENZENE	119
PCB-Arochlor 1016	107,285
PCB-Arochlor 1260	822,422
PENTACHLOROBENZENE	32,148
PYRENE	67,992
STYRENE	912

Hazardous Substance	K_{oc} (ml/g)
1,1,2,2,-TETRACHLOROETHANE	79
TETRACHLOROETHYLENE	265
TOLUENE	140
TOXAPHENE	95,816
1,2,4-TRICHLOROBENZENE	1,659
TRICHLOROETHANE -1,1,1	135
TRICHLOROETHANE-1,1,2	75
TRICHLOROETHYLENE	94
o-XYLENE	241
m-XYLENE	196
p-XYLENE	311

Sources:
Except as noted below, the source of the K_{oc} values is the 1996 *EPA Soil Screening Guidance: Technical Background Document*. The values obtained from this document represent the geometric mean of a survey of values published in the scientific literature. Sample populations ranged from 1-65. EDB value from *ATSDR Toxicological Profile* (TP 91/13). MTBE value from *USGS Final Draft Report on Fuel Oxygenates* (March 1996). PCB-Arochlor values from 1994 *EPA Draft Soil Screening Guidance*.

Table 747-2
Predicted Soil Organic Carbon-Water Partitioning Coefficient (K_{oc}) as a Function of pH: Ionizing Organics.

Hazardous Substance	K_{oc} Value (ml/g)		
	pH = 4.9	pH = 6.8	pH = 8.0
Benzoic acid	5.5	0.6	0.5
2-Chlorophenol	398	388	286
2-4-Dichlorophenol	159	147	72
2-4-Dinitrophenol	0.03	0.01	0.01
Pentachlorophenol	9,055	592	410
2,3,4,5-Tetrachlorophenol	17,304	4,742	458
2,3,4,6-Tetrachlorophenol	4,454	280	105
2,4,5-Trichlorophenol	2,385	1,597	298
2,4,6-Trichlorophenol	1,040	381	131

Source: 1996 *EPA Soil Screening Guidance: Technical Background Document*. The predicted K_{oc} values in this table were derived using a relationship from thermodynamic equilibrium considerations to predict the total sorption of an ionizable organic compound from the partitioning of its ionized and neutral forms.

Table 747-3
Metals Distribution Coefficients (K_d).

Hazardous Substance	K_d (L/kg)
Arsenic	29
Cadmium	6.7
Total Chromium	1,000
Chromium VI	19
Copper	22
Mercury	52
Nickel	65
Lead	10,000
Selenium	5

Hazardous Substance	K_d (L/kg)
Zinc	62

Source: Multiple sources compiled by the department of ecology.

Table 747-4
Petroleum EC Fraction Physical/Chemical Values.

Fuel Fraction	Equivalent Carbon Number[1]	Water Solubility[2] (mg/L)	Mol. Wt.[3] (g/mol)	Henry's Constant[4] (cc/cc)	GFW[5] (mg/mol)	Density[6] (mg/l)	Soil Organic Carbon-Water Partitioning Coefficient K_{oc}[7] (L/kg)
ALIPHATICS							
EC 5 - 6	5.5	36.0	81.0	33.0	81,000	670,000	800
EC > 6 - 8	7.0	5.4	100.0	50.0	100,000	700,000	3,800
EC > 8 - 10	9.0	0.43	130.0	80.0	130,000	730,000	30,200
EC > 10 - 12	11.0	0.034	160.0	120.0	160,000	750,000	234,000
EC > 12 - 16	14.0	7.6E-04	200.0	520.0	200,000	770,000	5.37E+06
EC > 16 - 21	19.0	1.3E-06	270.0	4,900	270,000	780,000	9.55E+09
EC > 21 - 34	28.0	1.5E-11	400.0	100,000	400,000	790,000	1.07E+10
AROMATICS							
EC > 8 - 10	9.0	65.0	120.0	0.48	120,000	870,000	1,580
EC > 10 - 12	11.0	25.0	130.0	0.14	130,000	900,000	2,510
EC > 12 - 16	14.0	5.8	150.0	0.053	150,000	1,000,000	5,010
EC > 16 - 21	19.0	0.51	190.0	0.013	190,000	1,160,000	15,800
EC > 21 - 34	28.0	6.6E-03	240.0	6.7E-04	240,000	1,300,000	126,000
TPH COMPONENTS							
Benzene	6.5	1,750	78.0	0.228	78,000	876,500	62.0
Toluene	7.6	526.0	92.0	0.272	92,000	866,900	140.0
Ethylbenzene	8.5	169.0	106.0	0.323	106,000	867,000	204.0
Total Xylenes[8] (average of 3)	8.67	171.0	106.0	0.279	106,000	875,170	233.0
n-Hexane[9]	6.0	9.5	86.0	74.0	86,000	659,370	3,410
MTBE[10]		50,000	88.0	0.018	88,000	744,000	10.9
Naphthalenes	11.69	31.0	128.0	0.0198	128,000	1,145,000	1,191

Sources:

1 **Equivalent Carbon Number.** Gustafson, J.B. et al., *Selection of Representative TPH Fractions Based on Fate and Transport Considerations. Total Petroleum Hydrocarbon Criteria Working Group Series*, Volume 3 (1997) [hereinafter *Criteria Working Group*].

2 **Water Solubility.** For aliphatics and aromatics EC groups, *Criteria Working Group.* For TPH components except n-hexane and MTBE, *1996 EPA Soil Screening Guidance: Technical Background Document.*

3 **Molecular Weight.** *Criteria Working Group.*

4 **Henry's Constant.** For aliphatics and aromatics EC groups, *Criteria Working Group.* For TPH components except n-hexane and MTBE, *1996 EPA Soil Screening Guidance: Technical Background Document*.

5 **Gram Formula Weight (GFW).** Based on 1000 x Molecular Weight.

6 **Density.** For aliphatics and aromatics EC groups, based on correlation between equivalent carbon number and data

on densities of individual hazardous substances provided in *Criteria Working Group.* For TPH components except n-hexane and MTBE, *1996 EPA Soil Screening Guidance: Technical Background Document.*

7 **Soil Organic Carbon-Water Partitioning Coefficient.** For aliphatics and aromatics EC groups, *Criteria Working Group.* For TPH components except n-hexane and MTBE, *1996 EPA Soil Screening Guidance: Technical Background Document.*

8 **Total Xylenes.** Values for total xylenes are a weighted average of m, o and p xylene based on gasoline composition data from the *Criteria Working Group* (m= 51% of total xylene; o= 28% of total xylene; and p=21% of total xylene).

9 **n-Hexane.** For values other than density, *Criteria Working Group*. For the density value, *Hawley's Condensed Chemical Dictionary,* 11th ed., revised by N. Irving Sax and Richard J. Lewis (1987).

10 **MTBE.** *USGS Final Report on Fuel Oxygenates* (March 1996).

Table 747-5
Residual Saturation Screening Levels for TPH.

Fuel	Screening Level (mg/kg)
Weathered Gasoline	1,000
Middle Distillates (e.g., Diesel No. 2 Fuel Oil)	2,000
Heavy Fuel Oils (e.g., No. 6 Fuel Oil)	2,000
Mineral Oil	4,000
Unknown Composition or Type	1,000

Note: The residual saturation screening levels for petroleum hydrocarbons specified in Table 747-5 are based on coarse sand and gravelly soils; however, they may be used for any soil type. Screening levels are based on the presumption that there are no preferential pathways for NAPL to flow downward to ground water. If such pathways exist, more stringent residual saturation screening levels may need to be established.

Table 749-1
Simplified Terrestrial Ecological Evaluation - Exposure Analysis Procedure under WAC 173-340-7492 (2)(a)(ii).[a]

Estimate the area of contiguous (connected) undeveloped land on the site or within 500 feet of any area of the site to the nearest 1/2 acre (1/4 acre if the area is less than 0.5 acre). "Undeveloped land" means land that is not covered by existing buildings, roads, paved areas or other barriers that will prevent wildlife from feeding on plants, earthworms, insects or other food in or on the soil.	
1) From the table below, find the number of points corresponding to the area and enter this number in the box to the right.	

Area (acres)	Points	
0.25 or less	4	
0.5	5	
1.0	6	
1.5	7	
2.0	8	
2.5	9	
3.0	10	
3.5	11	
4.0 or more	12	
2) Is this an industrial or commercial property? See WAC 173-340-7490 (3)(c). If yes, enter a score of 3 in the box to the right. If no, enter a score of 1.		
3) Enter a score in the box to the right for the habitat quality of the site, using the rating system shown below[b]. (High = 1, Intermediate = 2, Low = 3)		
4) Is the undeveloped land likely to attract wildlife? If yes, enter a score of 1 in the box to the right. If no, enter a score of 2. See footnote c.		
5) Are there any of the following soil contaminants present: Chlorinated dibenzo-p-dioxins/dibenzofurans, PCB mixtures, DDT, DDE, DDD, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, pentachlorobenzene? If yes, enter a score of 1 in the box to the right. If no, enter a score of 4.		
6) Add the numbers in the boxes on lines 2 through 5 and enter this number in the box to the right. If this number is larger than the number in the box on line 1, the simplified terrestrial ecological evaluation may be ended under WAC 173-340-7492 (2)(a)(ii).		

Footnotes:

a It is expected that this habitat evaluation will be undertaken by an experienced field biologist. If this is not the case, enter a conservative score (1) for questions 3 and 4.

b Habitat rating system. Rate the quality of the habitat as high, intermediate or low based on your professional judgment as a field biologist. The following are suggested factors to consider in making this evaluation:
Low: Early successional vegetative stands; vegetation predominantly noxious, nonnative, exotic plant species or weeds. Areas severely disturbed by human activity, including intensively cultivated croplands. Areas isolated from other habitat used by wildlife.
High: Area is ecologically significant for one or more of the following reasons: Late-successional native plant communities present; relatively high species diversity; used by an uncommon or rare species; priority habitat (as defined by the Washington department of fish and wildlife); part of a larger area of habitat where size or fragmentation may be important for the retention of some species.
Intermediate: Area does not rate as either high or low.

c Indicate "yes" if the area attracts wildlife or is likely to do so. Examples: Birds frequently visit the area to feed; evidence of high use by mammals (tracks, scat, etc.); habitat "island" in an industrial area; unusual features of an area that make it important for feeding animals; heavy use during seasonal migrations.

Table 749-2
Priority Contaminants of Ecological Concern for Sites that Qualify for

the Simplified Terrestrial Ecological Evaluation Procedure.[a]

Priority contaminant	Soil concentration (mg/kg)	
	Unrestricted land use[b]	Industrial or commercial site
METALS[c]		
Antimony	See note d	See note d
Arsenic III	20 mg/kg	20 mg/kg
Arsenic V	95 mg/kg	260 mg/kg
Barium	1,250 mg/kg	1,320 mg/kg
Beryllium	25 mg/kg	See note d
Cadmium	25 mg/kg	36 mg/kg
Chromium (total)	42 mg/kg	135 mg/kg
Cobalt	See note d	See note d
Copper	100 mg/kg	550 mg/kg
Lead	220 mg/kg	220 mg/kg
Magnesium	See note d	See note d
Manganese	See note d	23,500 mg/kg
Mercury, inorganic	9 mg/kg	9 mg/kg
Mercury, organic	0.7 mg/kg	0.7 mg/kg
Molybdenum	See note d	71 mg/kg
Nickel	100 mg/kg	1,850 mg/kg
Selenium	0.8 mg/kg	0.8 mg/kg
Silver	See note d	See note d
Tin	275 mg/kg	See note d
Vanadium	26 mg/kg	See note d
Zinc	270 mg/kg	570 mg/kg
PESTICIDES		
Aldicarb/aldicarb sulfone (total)	See note d	See note d
Aldrin	0.17 mg/kg	0.17 mg/kg
Benzene hexachloride (including lindane)	10 mg/kg	10 mg/kg
Carbofuran	See note d	See note d
Chlordane	1 mg/kg	7 mg/kg
Chlorpyrifos/chlorpyrifos-methyl (total)	See note d	See note d
DDT/DDD/DDE (total)	1 mg/kg	1 mg/kg
Dieldrin	0.17 mg/kg	0.17 mg/kg
Endosulfan	See note d	See note d
Endrin	0.4 mg/kg	0.4 mg/kg
Heptachlor/heptachlor epoxide (total)	0.6 mg/kg	0.6 mg/kg
Hexachlorobenzene	31 mg/kg	31 mg/kg
Parathion/methyl parathion (total)	See note d	See note d
Pentachlorophenol	11 mg/kg	11 mg/kg
Toxaphene	See note d	See note d
OTHER CHLORINATED ORGANICS		
Chlorinated dibenzofurans (total)	3E-06 mg/kg	3E-06 mg/kg
Chlorinated dibenzo-p-dioxins (total)	5E-06 mg/kg	5E-06 mg/kg
Hexachlorophene	See note d	See note d
PCB mixtures (total)	2 mg/kg	2 mg/kg
Pentachlorobenzene	168 mg/kg	See note d
OTHER NONCHLORINATED ORGANICS		

Priority contaminant	Soil concentration (mg/kg)	
	Unrestricted land use[b]	Industrial or commercial site
Acenaphthene	See note d	See note d
Benzo(a)pyrene	30 mg/kg	300 mg/kg
Bis (2-ethylhexyl) phthalate	See note d	See note d
Di-n-butyl phthalate	200 mg/kg	See note d
PETROLEUM		
Gasoline Range Organics	200 mg/kg	12,000 mg/kg except that the concentration shall not exceed residual saturation at the soil surface.
Diesel Range Organics	460 mg/kg	15,000 mg/kg except that the concentration shall not exceed residual saturation at the soil surface.

Footnotes:

a Caution on misusing these chemical concentration numbers. These values have been developed for use at sites where a site-specific terrestrial ecological evaluation is not required. They are not intended to be protective of terrestrial ecological receptors at every site. Exceedances of the values in this table do not necessarily trigger requirements for cleanup action under this chapter. The table is not intended for purposes such as evaluating sludges or wastes.
This list does not imply that sampling must be conducted for each of these chemicals at every site. Sampling should be conducted for those chemicals that might be present based on available information, such as current and past uses of chemicals at the site.

b Applies to any site that does not meet the definition of industrial or commercial.

c For arsenic, use the valence state most likely to be appropriate for site conditions, unless laboratory information is available. Where soil conditions alternate between saturated, anaerobic and unsaturated, aerobic states, resulting in the alternating presence of arsenic III and arsenic V, the arsenic III concentrations shall apply.

d Safe concentration has not yet been established. See WAC 173-340-7492 (2)(c).

Table 749-3

Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals[a]. For chemicals where a value is not provided, see footnote b.

Note: These values represent soil concentrations that are expected to be protective at any MTCA site and are provided for use in eliminating hazardous substances from further consideration under WAC 173-340-7493 (2)(a)(i). Where these values are exceeded, various options are provided for demonstrating that the hazardous substance does not pose a threat to ecological receptors at a site, or for developing site-specific remedial standards for eliminating threats to ecological receptors. See WAC 173-340-7493 (1)(b)(i), 173-340-7493 (2)(a)(ii) and 173-340-7493(3).

Hazardous Substance[b]	Plants[c]	Soil biota[d]	Wildlife[e]
METALS[f]:			
Aluminum (soluble salts)	50		
Antimony	5		
Arsenic III			7
Arsenic V	10	60	132
Barium	500		102
Beryllium	10		
Boron	0.5		

Bromine	10		
Cadmium	4	20	14
Chromium (total)	42[g]	42[g]	67
Cobalt	20		
Copper	100	50	217
Fluorine	200		
Iodine	4		
Lead	50	500	118
Lithium	35[g]		
Manganese	1,100[g]		1,500
Mercury, inorganic	0.3	0.1	5.5
Mercury, organic			0.4
Molybdenum	2		7
Nickel	30	200	980
Selenium	1	70	0.3
Silver	2		
Technetium	0.2		
Thallium	1		
Tin	50		
Uranium	5		
Vanadium	2		
Zinc	86[g]	200	360
PESTICIDES:			
Aldrin			0.1
Benzene hexachloride (including lindane)			6
Chlordane		1	2.7
DDT/DDD/DDE (total)			0.75
Dieldrin			0.07
Endrin			0.2
Hexachlorobenzene			17
Heptachlor/heptachlor epoxide (total)			0.4
Pentachlorophenol	3	6	4.5
OTHER CHLORINATED ORGANICS:			
1,2,3,4-Tetrachlorobenzene		10	
1,2,3-Trichlorobenzene		20	
1,2,4-Trichlorobenzene		20	
1,2-Dichloropropane		700	
1,4-Dichlorobenzene		20	
2,3,4,5-Tetrachlorophenol		20	
2,3,5,6-Tetrachloroaniline	20	20	
2,4,5-Trichloroaniline	20	20	
2,4,5-Trichlorophenol	4	9	
2,4,6-Trichlorophenol		10	
2,4-Dichloroaniline		100	
3,4-Dichloroaniline		20	

3,4-Dichlorophenol	20	20	
3-Chloroaniline	20	30	
3-Chlorophenol	7	10	
Chlorinated dibenzofurans (total)			2E-06
Chloroacetamide		2	
Chlorobenzene		40	
Chlorinated dibenzo-p-dioxins (total)			2E-06
Hexachlorocyclopentadiene	10		
PCB mixtures (total)	40		0.65
Pentachloroaniline		100	
Pentachlorobenzene		20	
OTHER NONCHLORINATED ORGANICS:			
2,4-Dinitrophenol	20		
4-Nitrophenol		7	
Acenaphthene	20		
Benzo(a)pyrene			12
Biphenyl	60		
Diethylphthalate	100		
Dimethylphthalate		200	
Di-n-butyl phthalate	200		
Fluorene		30	
Furan	600		
Nitrobenzene		40	
N-nitrosodiphenylamine		20	
Phenol	70	30	
Styrene	300		
Toluene	200		
PETROLEUM:			
Gasoline Range Organics		100	5,000 mg/kg except that the concentration shall not exceed residual saturation at the soil surface.
Diesel Range Organics		200	6,000 mg/kg except that the concentration shall not exceed residual saturation at the soil surface.

Footnotes:

a Caution on misusing ecological indicator concentrations. Exceedances of the values in this table do not necessarily trigger requirements for cleanup action under this chapter. Natural background concentrations may be substituted for ecological indicator concentrations provided in this table. The table is not intended for purposes such as evaluating sludges or wastes.
This list does not imply that sampling must be conducted for each of these chemicals at every site. Sampling should be conducted for those chemicals that might be present based on available information, such as current and past uses of chemicals at the site.

b For hazardous substances where a value is not provided, plant and soil biota indicator concentrations shall be based on a literature survey conducted in accordance with WAC 173-340-7493(4) and calculated using methods described in the publications listed below in footnotes c and d. Methods to be used for developing wildlife indicator concentrations are described in Tables 749-4 and 749-5.

c Based on benchmarks published in *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1997 Revision*, Oak Ridge National Laboratory, 1997.

d Based on benchmarks published in *Toxicological Benchmarks for Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process*, Oak Ridge National Laboratory, 1997.

e Calculated using the exposure model provided in Table 749-4 and chemical-specific values provided in Table 749-5. Where both avian and mammalian values are available, the wildlife value is the lower of the two.

f For arsenic, use the valence state most likely to be appropriate for site conditions, unless laboratory information is available. Where soil conditions alternate between saturated, anaerobic and unsaturated, aerobic states, resulting in the alternating presence of arsenic III and arsenic V, the arsenic III concentrations shall apply.

g Benchmark replaced by Washington state natural background concentration.

Table 749-4
Wildlife Exposure Model for Site-specific Evaluations.[a]

Plant	
K_{Plant}	Plant uptake coefficient (dry weight basis)
	Units: mg/kg plant/mg/kg soil
	Value: chemical-specific (see Table 749-5)
Soil biota Surrogate receptor: Earthworm	
BAF_{Worm}	Earthworm bioaccumulation factor (dry weight basis)
	Units: mg/kg worm/mg/kg soil
	Value: chemical-specific (see Table 749-5)
Mammalian predator Surrogate receptor: Shrew (*Sorex*)	
$P_{SB\ (shrew)}$	Proportion of contaminated food (earthworms) in shrew diet
	Units: unitless
	Value: 0.50
$FIR_{Shrew,DW}$	Food ingestion rate (dry weight basis)
	Units: kg dry food/kg body weight - day
	Value: 0.45
$SIR_{Shrew,DW}$	Soil ingestion rate (dry weight basis)
	Units: kg dry soil/kg body weight - day
	Value: 0.0045
$RGAF_{Soil,\ shrew}$	Gut absorption factor for a hazardous substance in soil expressed relative to the gut absorption factor for the hazardous substance in food.
	Units: unitless
	Value: chemical-specific (see Table 749-5)
T_{Shrew}	Toxicity reference value for shrew
	Units: mg/kg - day
	Value: chemical-specific (see Table 749-5)
Home range	0.1 Acres
Avian predator Surrogate receptor: American robin (*Turdus migratorius*)	
$P_{SB\ (Robin)}$	Proportion of contaminated food (soil biota) in robin diet
	Unit: unitless
	Value: 0.52
$FIR_{Robin,DW}$	Food ingestion rate (dry weight basis)
	Units: kg dry food/kg body weight - day
	Value: 0.207
$SIR_{Robin,DW}$	Soil ingestion rate (dry weight basis)

	Units: kg dry soil/kg body weight - day
	Value: 0.0215
$RGAF_{Soil, robin}$	Gut absorption factor for a hazardous substance in soil expressed relative to the gut absorption factor for the hazardous substance in food.
	Units: unitless
	Value: chemical-specific (see Table 749-5)
T_{Robin}	Toxicity reference value for robin
	Units: mg/kg - day
	Value: chemical-specific (see Table 749-5)
Home range	0.6 Acres
Mammalian herbivore Surrogate receptor: Vole (*Microtus*)	
$P_{Plant, vole}$	Proportion of contaminated food (plants) in vole diet
	Units: unitless
	Value: 1.0
$FIR_{Vole,DW}$	Food ingestion rate (dry weight basis)
	Units: kg dry food/kg body weight - day
	Value: 0.315
$SIR_{Vole,DW}$	Soil ingestion rate (dry weight basis)
	Units: kg dry soil/kg body weight - day
	Value: 0.0079
$RGAF_{Soil, vole}$	Gut absorption factor for a hazardous substance in soil expressed relative to the gut absorption factor for the hazardous substance in food.
	Units: unitless
	Value: chemical-specific (see Table 749-5)
T_{Vole}	Toxicity reference value for vole
	Units: mg/kg - day
	Value: chemical-specific (see Table 749-5)
Home range	0.08 Acres
Soil concentrations for wildlife protection[b]	
(1) Mammalian predator: $SC_{MP} = (T_{Shrew})/[(FIR_{Shrew,DW} \times P_{SB\ (shrew)} \times BAF_{Worm}) + (SIR_{Shrew,DW} \times RGAF_{Soil, shrew})]$	
(2) Avian predator: $SC_{AP} = (T_{Robin})/[(FIR_{Robin,DW} \times P_{SB\ (Robin)} \times BAF_{Worm}) + (SIR_{Robin,DW} \times RGAF_{Soil, robin})]$	
(3) Mammalian herbivore: $SC_{MH} = (T_{Vole})/[(FIR_{Vole,DW} \times P_{Plant, vole} \times K_{Plant}) + (SIR_{Vole,DW} \times RGAF_{Soil, vole})]$	

Footnotes:

a Substitutions for default receptors may be made as provided for in WAC 173-340-7493(7). If a substitute species is used, the values for food and soil ingestion rates, and proportion of contaminated food in the diet, may be modified to reasonable maximum exposure estimates for the substitute species based on a literature search conducted in accordance with WAC 173-340-7493(4). Additional species may be added on a site-specific basis as provided in WAC 173-340-7493 (2)(a). The department shall consider proposals for modifications to default values provided in this table based on new scientific information in accordance with WAC 173-340-702(14).

b Use the lowest of the three concentrations calculated as the wildlife value.

Table 749-5
Default Values for Selected Hazardous Substances for use with the Wildlife Exposure Model in Table 749-4.[a]

	Toxicity reference value (mg/kg - d)				
Hazardous Substance	**BAF_{Worm}**	**K_{Plant}**	**Shrew**	**Vole**	**Robin**
METALS:					
Arsenic III	1.16	0.06	1.89	1.15	
Arsenic V	1.16	0.06	35	35	22
Barium	0.36		43.5	33.3	
Cadmium	4.6	0.14	15	15	20
Chromium	0.49		35.2	29.6	5
Copper	0.88	0.020	44	33.6	61.7
Lead	0.69	0.0047	20	20	11.3
Manganese	0.29		624	477	
Mercury, inorganic	1.32	0.0854	2.86	2.18	0.9
Mercury, organic	1.32		0.352	0.27	0.064
Molybdenum	0.48	1.01	3.09	2.36	35.3
Nickel	0.78	0.047	175.8	134.4	107
Selenium	10.5	0.0065	0.725	0.55	1
Zinc	3.19	0.095	703.3	537.4	131
PESTICIDES:					
Aldrine	4.77	0.007[b]	2.198	1.68	0.06
Benzene hexachloride (including lindane)	10.1				7
Chlordane	17.8	0.011[b]	10.9	8.36	10.7
DDT/DDD/DDE	10.6	0.004[b]	8.79	6.72	0.87
Dieldrin	28.8	0.029[b]	0.44	0.34	4.37
Endrin	3.6	0.038[b]	1.094	0.836	0.1
Heptachlor/heptachlor epoxide	10.9	0.027[b]	2.857	2.18	0.48
Hexachlorobenzene	1.08				2.4
Pentachlorophenol	5.18	0.043[b]	5.275	4.03	
OTHER CHLORINATED ORGANICS:					
Chlorinated dibenzofurans	48				1.0E-05
Chlorinated dibenzo-p-dioxins	48	0.005[b]	2.2E-05	1.7E-05	1.4E-04
PCB mixtures	4.58	0.087[b]	0.668	0.51	1.8
OTHER NONCHLORINATED ORGANICS:					
Benzo(a)pyrene	0.43	0.011	1.19	0.91	

Footnotes:

a For hazardous substances not shown in this table, use the following default values. Alternatively, use values established from a literature survey conducted in accordance with WAC 173-340-7493(4) and approved by the department.

K_{Plant}: Metals (including metalloid elements): 1.01
Organic chemicals: $K_{Plant}=10^{(1.588-(0.578\log Kow))}$,
where $\log K_{ow}$ is the logarithm of the octanol-water partition coefficient.

BAF_{Worm}: Metals (including metalloid elements): 4.6
Nonchlorinated organic chemicals:
$\log K_{ow} < 5$: 0.7
$\log K_{ow} > 5$: 0.9
Chlorinated organic chemicals:
$\log K_{ow} < 5$: 4.7
$\log K_{ow} > 5$: 11.8

$RGAF_{Soil}$ (all receptors): 1.0
Toxicity reference values (all receptors): Values established from a literature survey conducted in accordance with WAC 173-340-7493(4).

Site-specific values may be substituted for default values, as described below:

K_{Plant} Value from a literature survey conducted in accordance with WAC 173-340-7493(4) or from empirical studies at the site.

BAF_{Worm} Value from a literature survey conducted in accordance with WAC 173-340-7493(4) or from empirical studies at the site.

$RGAF_{Soil}$ (all receptors): Value established from a literature survey conducted in accordance with WAC 173-340-7493(4).
Toxicity reference values (all receptors): Default toxicity reference values provided in this table may be replaced by a value established from a literature survey conducted in accordance with WAC 173-340-7493(4).

b Calculated from log K_{ow} using formula in footnote a.

Table 830-1
Required Testing for Petroleum Releases.

	Gasoline Range Organics (GRO) (1)	Diesel Range Organics (DRO) (2)	Heavy Oils (DRO) (3)	Mineral Oils (4)	Waste Oils and Unknown Oils (5)
Volatile Petroleum Compounds					
Benzene	X (6)	X (7)			X (8)
Toluene	X (6)	X (7)			X (8)
Ethyl benzene	X (6)	X (7)			X (8)
Xylenes	X (6)	X (7)			X (8)
n-Hexane	X (9)				
Fuel Additives and Blending Compounds					
Dibromoethane, 1-2 (EDB); and Dichloroethane, 1-2 (EDC)	X (10)				X (8)
Methyl tertiary-butyl ether (MTBE)	X (11)				X (8)
Total lead &other additives	X (12)				X (8)
Other Petroleum Components					
Carcinogenic PAHs		X (13)	X (13)		X (8)
Naphthalenes	X (14)	X (14)	X (14)		X (14)
Other Compounds					
Polychlorinated Biphenyls (PCBs)			X (15)	X (15)	X (8)
Halogenated Volatile Organic Compounds (VOCs)					X (8)
Other	X (16)	X (16)	X (16)	X (16)	X (16)
Total Petroleum Hydrocarbons Methods					

	Gasoline Range Organics (GRO) (1)	Diesel Range Organics (DRO) (2)	Heavy Oils (DRO) (3)	Mineral Oils (4)	Waste Oils and Unknown Oils (5)
TPH Analytical Method for Total TPH (Method A Cleanup Levels) (17)	NWTPH-Gx	NWTPH-Dx	NWTPH-Dx	NWTPH-Dx	NWTPH-Gx & NWTPH-Dx
TPH Analytical Methods for TPH fractions (Methods B or C) (17)	VPH	EPH	EPH	EPH	VPH and EPH

Use of Table 830-1: An "X" in the box means that the testing requirement applies to ground water and soil if a release is known or suspected to have occurred to that medium, unless otherwise specified in the footnotes. A box with no "X" indicates (except in the last two rows) that, for the type of petroleum product release indicated in the top row, analyses for the hazardous substance(s) named in the far-left column corresponding to the empty box are not typically required as part of the testing for petroleum releases. However, such analyses may be required based on other site-specific information. Note that testing for Total Petroleum Hydrocarbons (TPH) is required for every type of petroleum release, as indicated in the bottom two rows of the table. The testing method for TPH depends on the type of petroleum product released and whether Method A or Method B or C is being used to determine TPH cleanup levels. See WAC 173-340-830 for analytical procedures. **The footnotes to this table are important for understanding the specific analytical requirements for petroleum releases.**

Footnotes:

(1) The following petroleum products are common examples of GRO: automotive and aviation gasolines, mineral spirits, stoddard solvents, and naphtha. To be in this range, 90 percent of the petroleum components need to be quantifiable using the NWTPH-Gx; if NWTPH-HCID results are used for this determination, then 90 percent of the "area under the TPH curve" must be quantifiable using NWTPH-Gx. Products such as jet fuel, diesel No. 1, kerosene, and heating oil may require analysis as both GRO and DRO depending on the range of petroleum components present (range can be measured by NWTPH-HCID). (See footnote 17 on analytical methods.)

(2) The following petroleum products are common examples of DRO: Diesel No. 2, fuel oil No. 2, light oil (including some bunker oils). To be in this range, 90 percent of the petroleum components need to be quantifiable using the NWTPH-Dx quantified against a diesel standard. Products such as jet fuel, diesel No. 1, kerosene, and heating oil may require analysis as both GRO and DRO depending on the range of petroleum components present as measured in NWTPH-HCID.

(3) The following petroleum products are common examples of the heavy oil group: Motor oils, lube oils, hydraulic fluids, etc. Heavier oils may require the addition of an appropriate oil range standard for quantification.

(4) Mineral oil means non-PCB mineral oil, typically used as an insulator and coolant in electrical devices such as transformers and capacitors.

(5) The waste oil category applies to waste oil, oily wastes, and unknown petroleum products and mixtures of petroleum and nonpetroleum substances. Analysis of other chemical components (such as solvents) than those listed may be required based on site-specific information. Mixtures of identifiable petroleum products (such as gasoline and diesel, or diesel and motor oil) may be analyzed based on the presence of the individual products, and need not be treated as waste and unknown oils.

(6) When using Method A, testing soil for benzene is required. Furthermore, testing ground water for BTEX is necessary when a petroleum release to ground water is known or suspected. If the ground water is tested and toluene, ethyl benzene or xylene is in the ground water above its respective Method A cleanup level, the soil must also be tested for that chemical. When using Method B or C, testing the soil for BTEX is required and testing for BTEX in ground water is required when a release to ground water is known or suspected.

(7)(a) For DRO releases from other than home heating oil systems, follow the instructions for GRO releases in Footnote (6).

(b) For DRO releases from typical home heating oil systems (systems of 1,100 gallons or less storing heating oil for residential consumptive use on the premises where stored), testing for BTEX is not usually required for either ground water or soil. Testing of the ground water is also not usually required for these systems; however, if the ground water is tested and benzene is found in the ground water, the soil must be tested for benzene.

(8) Testing is required in a sufficient number of samples to determine whether this chemical is present at concentrations of concern. If the chemical is found to be at levels below the applicable cleanup level, then no further analysis is required.

(9) Testing for n-hexane is required when VPH analysis is performed for Method B or C. In this case, the concentration of n-hexane should be deleted from its respective fraction to avoid double-counting its concentration. n-Hexane's contribution to overall toxicity is then evaluated using its own reference dose.

(10) Volatile fuel additives (such as dibromoethane, 1 - 2 (EDB) (CAS# 106-93-4) and dichloroethane, 1 - 2 (EDC) (CAS# 107-06-2)) must be part of a volatile organics analysis (VOA) of GRO contaminated ground water. If any is found in ground water, then the contaminated soil must also be tested for these chemicals.

(11) Methyl tertiary-butyl ether (MTBE) (CAS# 1634-04-4) must be analyzed in GRO contaminated ground water. If any is found in ground water, then the contaminated soil must also be tested for MTBE.

(12)(a) For automotive gasoline where the release occurred prior to 1996 (when "leaded gasoline" was used), testing for lead is

required unless it can be demonstrated that lead was not part of the release. If this demonstration cannot be made, testing is required in a sufficient number of samples to determine whether lead is present at concentrations of concern. Other additives and blending compounds of potential environmental significance may need to be considered for testing, including: tertiary-butyl alcohol (TBA); tertiary-amyl methyl ether (TAME); ethyl tertiary-butyl ether (ETBE); ethanol; and methanol. Contact the department for additional testing recommendations regarding these and other additives and blending compounds.

(b) For aviation gasoline, racing fuels and similar products, testing is required for likely fuel additives (especially lead) and likely blending compounds, no matter when the release occurred.

(13) Testing for carcinogenic PAHs is required for DRO and heavy oils, except for the following products for which adequate information exists to indicate their absence: Diesel No. 1 and 2, home heating oil, kerosene, jet fuels, and electrical insulating mineral oils. The carcinogenic PAHs include benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(k)fluoranthene, benzo(a)anthracene, and benzo(b)fluoranthene.

(14)(a) Except as noted in (b) and (c), testing for the noncarcinogenic PAHs, including the "naphthalenes" (naphthalene, 1-methyl-naphthalene, and 2-methyl-naphthalene) is not required when using Method A cleanup levels, because they are included in the TPH cleanup level.

(b) Testing of soil for naphthalenes is required under Methods B and C when the inhalation exposure pathway is evaluated.

(c) If naphthalenes are found in ground water, then the soil must also be tested for naphthalenes.

(15) Testing for PCBs is required unless it can be demonstrated that: (1) the release originated from an electrical device manufactured for use in the United States after July 1, 1979; (2) oil containing PCBs was never used in the equipment suspected as the source of the release (examples of equipment where PCBs are likely to be found include transformers, electric motors, hydraulic systems, heat transfer systems, electromagnets, compressors, capacitors, switches and miscellaneous other electrical devices); or, (3) the oil released was recently tested and did not contain PCBs.

(16) Testing for other possible chemical contaminants may be required based on site-specific information.

(17) The analytical methods NWTPH-Gx, NWTPH-Dx, NWTPH-HCID, VPH, and EPH are methods published by the department of ecology and available on the department's internet web site: http://www.ecy.wa.gov/programs/tcp/cleanup.html.

[Statutory Authority: Chapter 70.105D RCW. 01-05-024 (Order 97-09A), § 173-340-900, filed 2/12/01, effective 8/15/01.]

NOTES:

Reviser's Note: The brackets and enclosed material in the text of the above section occurred in the copy filed by the agency.