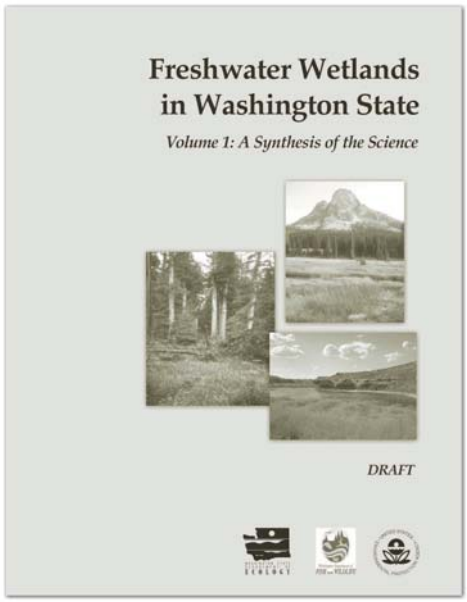

Draft Freshwater Wetlands in Washington State Volume 1: A Synthesis of the Science

Responses to Comments

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Washington Department of FISH and WILDLIFE

March 2005
Ecology Publication #05-06-007

♻ *Printed on Recycled Paper*

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Volume 1: A Synthesis of the Science

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For the Draft *Freshwater Wetlands in Washington State – Volume 1: A Synthesis of the Science* refer to Publication #03-06-016.

For the Final *Wetlands in Washington State - Volume 1: A Synthesis of the Science* refer to Publication #05-06-006.

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Introduction

This document contains all of the comments that the state Department of Ecology received in the fall of 2003 during the public review of the draft of *Freshwater Wetlands in Washington State - Volume 1: A Synthesis of the Science.* Twenty-nine individuals or groups provided comments. A list of the reviewers is provided in Table 1 and in Appendix 1-D of Volume 1.

The authors of the draft of Volume 1 asked reviewers to provide technical comments regarding the accuracy of the information presented in the synthesis. In addition, reviewers responded to a questionnaire that was developed by the authors and that accompanied the document. The questions are listed below. The authors also requested that reviewers keep these questions in mind while completing their technical review:

1. Have we misinterpreted cited references?

2. Is there a topic or subject of importance we are leaving out and how do we fill those gaps?

3. Are there important references we have missed for topics covered in Volume 1?

4. Are we putting the wrong emphasis on any topic or presenting anything in a biased way?

The authors asked a series of more detailed questions in the questionnaire that accompanied the draft document. For example, the authors posed four separate questions regarding the topic of "wrong emphasis/bias."

Reviewers were asked to focus on issues regarding organization and clear writing and to identify any topics of importance the authors may have left out. All questions in the questionnaire are listed in the first section of this document. Please note, however, that not all of those who reviewed the draft answered the questions in the questionnaire.

The comments received are organized into sections in the pages that follow. The first section contains the reviewer's answers to the questions in the questionnaire. The remaining sections contain comments organized sequentially by chapter and within each chapter by section, page, etc.

For each comment submitted, the authors of Volume 1 have prepared a response, describing how they addressed the comment; whether they agreed and made a change, or if they disagreed the reason why, or acknowledging the comment if no change was made (i.e., Comment noted). In some cases, the intent of the comment was unclear and no change was made. Occasionally an explanation was given to clarify a point made in Volume 1 that may have been misinterpreted or that was unclear.

In addition to their comments, some reviewers suggested new references as requested by the authors of Volume 1. The authors' intention was to fill data gaps regarding relevant articles that had been missed. Also, the authors asked reviewers to provide citations to support changes or additions to the text that they suggested. A table containing a list of all new references suggested by the reviewers is presented at the end of this document. For each, the table also displays if the reference was obtained. If a reference was not obtained, an explanation as to why is provided. The same criteria used to review the titles in the original literature search were used when reviewing the suggested references. See Appendix 1-C in Volume 1 for a description of the methods used to complete our search and review of the literature.

The comments are numbered sequentially within each section, for example, comments for Chapter 2 range from 2.1 to 2.162. There are 162 comments for that chapter. The exception is the numbering system for the questionnaire which uses abbreviations for the different question/topic instead of the number of the chapter. For example, comments on organization are O-1 through O-14, whereas comments concerning bias are B-1 through B-16.

Occasionally, a reviewer's writing couldn't be deciphered, and in such cases we use a "_____" to represent that a word is missing as a result.

Prior to the completion of these responses to comments, a summary of the more substantive issues raised by the reviewers and responses to them, was prepared and posted on the project web site. The responses in this document supersede the responses in the summary and they have subsequently been removed from the web site. What remains however, is the summary of comments which continues to serve as a condensation of the most important comments. The summary is available at http://www.ecy.wa.gov/programs/sea/bas_wetlands.

Table 1. List of Reviewers of Volume 1.

Name of Individual or Organization	Affiliation at the Time of Review (if Individual)
Paul Adamus, PhD	Private Consultant
Jeff Azerrad, Wildlife Biologist	WA State Department of Fish and Wildlife
Joann Bartlett, PWS	Wiltermood Associates
Doug Beyerlein, PE	Aqua Terra Consultants
Elizabeth Binney, PhD, PWS	ATSI
Catherine Conolly, PWS and Teresa H. Vanderburg, PWS (submitted comments jointly)	Adolfson Associates
Brent Davis, Wetland Biologist	Clark County Community Development Department
Tim Determan, Puget Sound Ambient Monitoring Program Coordinator	WA State Department of Health
Donald F. Flora	Private citizen
Richard R. Horner, PhD	University of Washington
Richard Jack	WA State Department of Ecology
Jim Kelley, PhD	Parametrix, Inc.
Bernard L (Bud) Kovalchik, retired U.S. Forest Service -- Eastern Washington Area Ecologist	Kovalchik Riparian Wetland Consulting
Ivan Lines, Regional Biologist	Ducks Unlimited, Inc.
Scott Luchessa, Certified Ecologist, MS.	Ecological Solutions, Inc.
Chris L. McAuliffe, Ecologist	Private citizen, retired from the Seattle District of the Army Corps of Engineers
Elliot Menashe, Environmental Consultant	Greenbelt Consulting
Jeff Meyer, PWS	Parametrix, Inc.
Jim Mitchell, PE, PWS	Mitchell Consultants L.L.C.
Lyn Morgan-Hill, Natural Resources Specialist	Whatcom County Planning and Development
Francis Naglich	Ecological Land Services, Inc.
Scott Williams, Land Planner	Puget Sound Energy
Klaus Richter, PhD, PWS	King County Department of Natural Resources
Scott J. Rozenbaum, PWS, Certified Professional Soil Scientist	Rozewood Environmental Services, Inc.
Todd Thompson, Fish & Wildlife Program Lead	Spokane District Bureau of Land Mngmt
WETNET (Audubon) Science Committee	
Megan White	WA State Department of Transportation
Bob Zeigler	WA State Department of Fish and Wildlife
Unidentified Individual	

Questionnaire

The following comments were provided by reviewers in response to the authors' questionnaire on Volume 1. The questionnaire was divided into four sections: Organization and Clear Writing; Emphasis; Misrepresentations, Omissions, and Errors; and References. The following first lists the title of the section in the questionnaire, then the specific questions (in italics), followed by the reviewers' comments. The comments have been grouped into major topics rather than by question because some answers were not specific to the questions. The last section includes comments, usually positive, that do not suggest changes in writing or emphasis.

As previously mentioned, many of the reviewers also provided detailed comments on specific chapters or sections of Volume 1. These detailed comments are presented, *verbatim*, along with responses to them in the sections that follow the questionnaire.

1.0 Organization and Clear Writing

Questions posed to reviewers:

1.1 Are there chapters or sections that are poorly organized, unclear, or illogical?

1.2 If yes, which chapters or sections are they?

1.3 Do you have any ideas or suggestions to improve the organization of Volume 1?

Comments on Organization

O-1 Comment: Most of the document is clearly written, and logically organized. The use of "gray boxes" with detailed information is very helpful.

Response: No change needed.

O-2 Comment: The document is long and could be condensed. One recommendation is to reduce text in the sections called "Chapter Contents." These appear redundant with the Table of Contents and do not need as much emphasis.

Response: We have had both positive and negative responses to the existing organization, such as the "Chapter Contents". It seems, therefore, that we cannot meet the needs of every user, and we have decided to err on the side of having the document be too long and too organized. Therefore, we did not change the format and organization to reduce the length of the document.

O-3 Comment: Separate data sources from data gaps within the text. Placement of data sources at the beginning of the sections is logical. However, we suggest placing the data gaps discussion towards the end of the section but before the Chapter Summary and Conclusions.

In many cases throughout the document, data gaps have been inadvertently missed in the "Data Sources and Data Gaps" section because the emphasis is placed on information sources. For example, the data gaps discussed throughout Chapter 6 (limitations of studies cited for mitigation success, etc.) are not summarized in the "Data Sources and Data Gaps" section. In our opinion, data gaps are important in that they will serve to direct future research in wetland science in Washington.

Response: The intent of the sections on data gaps was to identify the broad areas where information was lacking. We did not attempt to develop exhaustive lists of all the specific information that would be needed to fully understand all wetland functions in Washington or all impacts of human activities.

O-4 Comment: The organization is very good throughout. The text is clear and logical. If anything, for some of us there may be too much "organization" in the sense that we are carefully told what, when, where and how everything is going to occur (e.g., readers guides, chapter contents, scopes & overviews) when we are "chewing at the bit" to get into details. For your wide range of readers such a detailed and descriptive structure is very helpful, but for ecologists it tends to be boring.

Response: See the response to Comment O-2.

O-5 Comment: We found the format very time consuming and difficult to use.

Response: See the response to Comment O-2.

O-6 Comment: Why do you really want to put this information together? I mean what are the distinct questions for which you want to get insights? I can't pick them out, and without them I think the whole thing gets too strung out. The organization, especially in Chapter 4 is very hard for me to deal with, because I don't know what the document is particularly trying to draw out and for what reason. It seems like its purpose is to put it down if it was written somewhere, whether or not it has anything to do with any larger interest. In fact, it uses this lockstep organization to cover a subject even if nothing has been written. For illustration, I got really impatient with the organization around sections 4.3.1 and 4.3.2, where we have two paragraphs that say nothing and deflect the reader from keeping track of where this is going. I think the remedy is to state the questions you want to elucidate and then draw from the literature to lead toward the best answers you can come up with. There is a great deal of material here, a real accomplishment in assembling it, and I would like to see it put to some clearly enunciated, important purposes.

Response: This comment is difficult to respond to. We believe the basic purposes of the document were clearly laid out in the introductory chapter. Unlike most scientific

documents, this one is not intended to try to answer specific questions but to provide a summary of the scientific literature on wetlands that can be used to inform wetland protection and management. The goal was to summarize all relevant information in a format that can be used by planners and regulators working for local jurisdictions. Therefore, we did not revise the text to enunciate specific questions as suggested by the reviewer.

O-7 Comment: I found the current organization, while logical and complete, hinders an easy and complete review of many wetland impacts issues. I recommend the authors consider revising the document's organization so that each function is presented as a chapter or at least as a 2nd level heading. Within each of these sections, for each function, present:

1. The general definition and discussion of the function, the variables that are important in understanding the function, etc. (as currently presented in Chapter 2)

2. The type of human activities that may impact this function, including a description of the specific impact pathways (as currently presented in Chapter 3 and 4)

3. Management issues related to this function (as currently presented in Chapter 5)

4. Mitigation science and effectiveness related to the function (as currently present in Chapter 6)

5. Conclusions, data needs or gaps, and potential key management considerations (currently presented in various locations or absent).

It seems this approach could be more user friendly, as it would break a large comprehensive document into a greater number of complete, yet "bite-size" units. Future end users are also likely to consider wetland protection on a function-by-function basis, and this organizational approach would help that review and understanding.

Response: Same response as O-2. We have had both positive and negative responses to the existing organization. It seems, therefore, that we cannot meet the needs of every user, and we decided not to change the format and organization.

O-8 Comment: The sheer bulk of literature available can cause one's head to swim, because of this one has the tendency to pigeon hole a given individual paper with others that may have a differing perspective. It is the subtle differences in perspective that may hold the key to a fuller understanding of the topic. Perhaps some in depth discussion around key papers in a subject area in narrative style would be helpful.

Response: We do not believe this approach is suited for a literature review. The goal is to provide a broad summary of all relevant literature, not just a few of the key papers. However, where a study was deemed to be particularly relevant to the geographic setting or issue, we placed a greater emphasis on it.

O-9 Comment: The use of case studies will give more immediacy to the paper. Inclusion of supporting papers say in wildlife biology, water quality and land use could serve as focusing instruments for narrative style.

Response: See response to Comment O-8.

O-10 Comment: Photos, drawings and graphs imbedded in the text are good ways to keep the reader awake and his eyes entertained.

Response: No response or change needed.

O-11 Comment: In Chapter 4, the discussion of effects is confusing because of the organization. For example: disturbances to soils and vegetation are discussed in multiple sections such as 4.3 and 4.12. I think that the problem stems from the organization of sub-section by function because disturbances discussed not only affect function, but also affect physical characteristics of the wetland. In my mind, the primary effects of disturbance are alterations to the physical nature of the system and changes in function are secondary affects that are the direct result of the physical alteration.

Response: The discussion is organized by functions because that is the focus of wetland regulations and protection. As a result there is some redundancy in the format, but this was considered useful to those wanting to read only parts of the document relevant to their issue. Therefore, the original organization in Chapter 4 was kept.

O-12 Comment: The use of numbered references in Tables 6-2+ is cumbersome. In most cases only one reference is cited. Name and date form of citing the reference would easily fit into the tables.

Response: The primary reason the reference numbers were used in place of citations in the tables is due to Tables 6-11, Table 6-12 and Table 6-13. All of these tables often have many citations (reference numbers) for a singe row. To include the citation for each article would increase the size of these tables and make them cumbersome.

We changed the text by using citations for all the other tables and moved Table 6-1 into the recommendations section and use reference numbers for the articles that are cited in Tables 6-11, 12, and 13.

O-13 Comment: We noted that some of the more important key points discussed in the document did not end up as strongly stated in the key points section. One example is the discussion on the bottom of page 3-11 on impervious surfaces. There is no research, for example, on the accuracy of the 10% threshold for non-forested watersheds in eastern Washington. The key point listing is not reflective of the statements made in the analysis. We found several of these problems in the document. In the case in Chapter 3, it appears that the key point is "watered down" to reduce its importance.

Response: We have re-evaluated the key points as we revised the document and made changes where we thought changes were needed. The threshold of 10% was deleted from the discussion.

O-14 Comment: Resolve conflict in conclusions between text and table in Chapter 5. Table 5-7 information (giving minimum and maximum buffer widths) is in conflict within the paragraph discussion immediately following Table 5-8 in reference to Castelle et al. (1994). This conflict should be resolved to improve reader understanding.

Response: We evaluated the conflict as described and made appropriate changes in the text and table.

Comments on Clear Writing

CW-1 Comment: I note that the target audience is general, with a special concern for local interests; planners, commissioners, health workers, teachers, students etc. (and why not?). May I suggest that there is good opportunity to enhance its effectiveness by editing for faster reading and more comprehension? To illustrate what I mean, I calculated a "fog-index" on a selected paragraph (page 5-35, third bulleted paragraph). (Note: the paragraph was the second one I read from a randomly selected page during a short search for an example.)

Number of sentences : 2
Number of words: 58
Number of "hard" words (def. more than 3 syllables): 14

FI= (A+B)(0.4),
where A= total words/total sentences = 58/2= 29
and B= [(total "hard" words)/(total words)1*100
= [14/581(100)= 29
FI= (29+24)(0.4) = 21.1

The fog index is 21.2, nearly twice the upper range 10 recommended for easy reading and good comprehension for an average reader (contact me for reference). I rewrote the paragraph to see if I could lower the index:

"The literature shows that the longer the path taken by the pollutant through the buffer, the more pollutant is removed. This is because the heavy particles carrying the pollutant settle soon after they enter.-But, smaller particles take longer to settle, and plant roots require time to remove dissolved nutrients."

Now, I'll redo the calculation:

Number of sentences : 3 Number of words: 50
Number of "hard" words (def; more than 3 syllables): 7

FI= (A+B)(0.4),
where A= total words/total sentences = 50/3= 17
and B= [(total "hard" words)/(total words)1*100
= [7/501 (100)= 14
Fl= (17+10)(0.4) = 11 (That's not bad!)

Now, I will be the first to admit that my sampling was unconscionably limited (1), and the minimum recommended number of words per sample is supposed to be 100, but I make my point. I think you can agree that the information flows easier, and it says pretty much the same thing. Now, this kind of edit is not easy. But it might be worthwhile if its effectiveness is increased.

Response: We tried to reduce the FOG index as each author revised the document. However, an extensive re-write by our editors to significantly reduce the FOG is very time consuming. Therefore, a complete rewrite was not done.

CW-2 Comment: In our opinion, wetlands should be defined in the beginning of this document prior to a discussion of functions and values (Chapter 2). While this discussion does occur later in Chapter 5 - The Science and Effectiveness of Wetland Management Tools, we recommend that the discussion occur at the beginning to set the stage for future chapters. The Growth Management Act (GMA) requires that local governments protect and preserve critical areas, one of which is wetlands. Distinguishing between wetlands and other critical area resources is important for local planners and officials. We recommend the following issues be discussed in this new introduction:

Response: We do not concur with the suggestion to revise the introduction. Therefore, the introduction was not added. The distinctions laid out in the GMA do not necessarily reflect scientific perspectives. Below we have responded to each proposed issue recommended for the introduction.

1. What are wetlands - how are they defined scientifically? What aquatic areas are not considered wetlands?

Response: Wetlands have no rigorous scientific definition because they represent an ecotone. The only rigorous definition we have is the legal one established by regulations. The definitions we have to use for other critical areas are those used in the GMA.

2. How are these areas important to the landscape and watershed from a scientific basis?

Response: The role of wetlands in the landscape and watersheds is a topic covered in Chapter 2. However, we do not believe it is necessary to lay out the reasons why wetlands are important. We start with the premise that wetlands are important and valuable as stated by laws and policies. It is not the purpose of this report to review all the literature that discusses how and why wetlands are worth protecting.

3. How were wetlands mapped at a national level? Accuracy of the NWI maps.

Response: NWI maps are analytical tools used in managing and protecting wetlands. They are not scientific reports or articles that describe how wetlands function or how they might be impacted by human activities. While we (and others) have experienced the poor accuracy of the NWI maps we are unaware of any scientific literature that documents their accuracy. The NWI is discussed in Volume 2 as a management tool.

4. Why are adjacent uplands important to wetlands from a scientific basis?

Response: The functions that buffers provide in protecting wetlands are described in Chapter 5.

5. How do wetlands differ from streams or other aquatic resources, such as deepwater lakes?

Response: This report is not intended as a review of how wetlands differ from other aquatic resources. We have focused on freshwater wetlands and how they function. To answer this question would require writing another lengthy report that compares the processes and structures in different aquatic habitats.

6. Why is the connection between these aquatic resources important?

Response: Connections between aquatic resources are an integral part of the habitat that a wetland provides. The importance of such connections is discussed in Chapter 3.

CW-3 Comment: Beef up and clarify Section 3.2. It is titled the 'Overview' yet it is very short, only 14 pages. Work on consistency of terms and voice through the document.

Response: The Overview has been re-written to address consistency.

CW-4 Comment: Most chapters are clear and follow a defined order. However, it is clear that the document is a draft because there is not one tone or voice throughout the work. Not all authors have taken the same approach and placed the same value on some of the terms. On page 2-8 the definition of disturbance is presented. "All the disturbances discussed and reviewed here are significant enough to impact wetlands and their functions." Again, on page 3-3, "All disturbances discussed herein are considered to

have significant impacts on the ecosystem." Yet the 'significance' of a disturbance is treated differently in different sections. Table 3-3 on page 3-35 identifies almost all activities as, 'land use creates a significant disturbance of environmental factors', yet on page 4-4 there is a discussion on scale of impacts to wetland functions.

Response: Each author attempted to improve the consistency of word usage during revisions to each chapter.

CW-5 Comment: The term "Impacts" is used everywhere in the document, especially in the section headings. I use this term commonly to describe a negative rather than a positive. As the document states in numerous places, some impacts to wetlands are positive. I wonder if the term "effects" should be substituted for "impacts." This may need input from the English Department.

Response: The discussion of the concept of impacts has been expanded and better defined in the revised text.

CW-6 Comment: We recognize it is difficult to separate the scientific research from the policy and management guidelines in these chapters. However, we recommend that the document should either acknowledge up front that science and policy are blended in Chapters 5, 6 and 7 or an attempt should be made to remove the policy information from Volume 1. For example, the discussion of the Washington State Wetland Rating System may be more appropriately covered in Volume 2 (Management Recommendations) of this effort. While it is important to discuss that wetlands are rated according to function and value in order to determine level of priority, sensitivity to disturbance, and importance for protection, a detailed discussion of the rating system itself, in our opinion, becomes a policy discussion.

As another example, replacement ratios are a management tool that is based partly on science and partly on professional judgment. We agree that the science indicates not all mitigation projects are successful, as outlined in Chapter 5. The science points to mitigation ratios somewhat higher than 1:1 to offset these failures. However, since the science is not definitive at this point in time, use of mitigation rations greater than 2:1 appear to be based upon policy decisions to use ratios both as a disincentive to wetland disturbance, as well as a way to manage the risks associated with wetland impact.

Response: Chapters 5 and 6 attempt to summarize the science related to several common management tools. We disagree that these chapters blend policy and science. In fact, they attempt to clearly separate the two by specifically addressing the published scientific information on tools used for management. They do not discuss the pros and cons of different ratios. Chapter 7 has been re-written and the discussion of policy has been moved to Volume 2.

2.0 Emphasis

Questions posed to reviewers:

2.1 Are we putting the wrong emphasis on any topic or presenting anything in a biased way?

2.2 If yes, what are we incorrectly emphasizing or what have we presented in a biased way?

2.3 If yes, what chapter and section contain the incorrect emphasis/bias?

2.4 Please provide rationale and citations.

More Emphasis on Social Functions of Wetlands

E-1 Comment: I would like to see education/research etc. included under a possible heading of social functions along with your three broad ecological categories (per page 2-3 and Table 2-1). I believe in Volume 2 it will be too easy to minimize and ignore wetlands in urban areas because of their absence of high ecological function even though they may be socially important and therefore they will receive little protection using your criteria. Although they exhibit limited ecological function, their current and future social importance may be great and will continue to increase in proportion to urban populations and their needs for varied recreational and educational activities. It is within urban areas where 85% of populations live and in which urban wetlands get heavy usage (e.g., in Seattle, Green Lake, Foster Island, University of Washington Arboretum, Forbes Cr. Park). I suspect wetlands at one time also existed in "poorer" neighborhoods. Unfortunately, the poor and car-less urban populations may not have the resources to get to and appreciate the wetlands with biogeochemical, hydrological and food web, habitat and other ecological functions you protect in wetlands elsewhere. I suspect there is significant literature in the social science periodicals on the "value" of urban wetlands to citizens.

Response: The intent of this report was to cover the ecological functions because of limited resources and experience of the authors. This limitation is acknowledged in the document. A review of the social functions would require reviewing literature in the fields of sociology and psychology and the expertise of a sociologist to interpret the information. These resources were not available to us.

However, the consideration of social functions and values is a particularly important task for local governments to address in their decision making regarding protection of urban wetlands. Chapters 6 and 7 in Volume 2 discuss the need to incorporate social needs and values in regard to wetlands and comprehensive and other plans. Volume 2 suggests that these plans should be based on a landscape approach and incorporate community involvement.

More Emphasis on Processes

E-2 Comment: Processes, determine structure which determine function - although not always linearly and in one direction (as per Figure 2-2). Consequently, I believe there should be a greater emphasis on processes, although from a realistic viewpoint, this is the most difficult aspect for which to find information and to integrate into wetland protection. Regardless, other jurisdictions have addressed such an approach ([Maryland Department of Natural Resources, 2001 #4804], [San Diego County, 1998 #7527]). It will be interesting to see how this model of interacting process, structure and function will be incorporated into Ecology's Volume 2-guidance document. Will it be possible to keep these three intact and functioning within the traditional buffer approach protection method?

Response: We believe Volume 1 does place a great emphasis on landscape processes. Volume two will also place a heavy emphasis on the value of using a landscape approach to analyzing and protecting wetlands as supported by the scientific information in chapters 2 and 7 of Volume 1.

Different Emphasis on Sediment Deposition

E-3 Comment: In Chapter 2, recognize that wetlands have natural "sink" and "source" functions. For example, in Section 2.5.1 - Functions That Improve Water Quality, we believe that the emphasis has been placed on sediment pollution only. In our opinion, wetlands function naturally as depositional areas for sediment and this should be recognized. We understand the rate of sedimentation has increased with human disturbance and development; however, some accumulation of sediments and fine soils is a natural sink function of wetlands.

Response: We disagree that emphasis has been placed on the sediment pollution. Therefore, no change has been made to the text. Sections 2.5.1.2-2.5.1.4 address other types of pollutants. We also are very carefully avoiding discussions of what might be "natural" functions from those that have developed as a result of human activities. Such an approach is based on the now unsupported ecological paradigm of "equilibrium."

Emphasis on Other Assessment Tools besides WFAM

E-4 Comment: Chapter 2 relies heavily on information gathered through the development of the Washington State Functional Assessment Method. However, the functional assessment method for linear projects developed by Washington State Department of Transportation is not cited or referenced (Null et al. 2000). While WFAM may be more comprehensive, the Null et al. document is considered part of the "best available science" literature according to the list prepared by the Office of Community Development (2001) and should be included.

Response: The focus in Chapter 2 is how wetlands function, not what methods are available to assess functions. The linear method developed by WSDOT is based on the WAFAM. It does not describe how wetlands function or how they can be impacted by disturbances. Instead it is a method used, when applied to an individual wetland, to determine the performance of functions through a qualitative description of those functions based on expert opinion. These methods and others that have been used in the state are listed, with their benefits and limitations, in Volume 2.

E-5 Comment: Further, use of unpublished data collected during the development of WFAM should be reconsidered in this document. If data are not publicly available for peer review, then we believe it may not be appropriate for use in this guidance document for local governments.

Response: We have left the reference to unpublished data as mentioned in the comment intact in Volume 1. Observations reported as "unpublished data" in Volume 1 were collected in the field by interdisciplinary technical teams. The data were offered for review by request during the public review of the documents. Data are available on request at any time and we have maintained transparency in Volume 1 by indicating the use of such data in the text.

E-6 Comment: WFAM: The discussion of functions is too biased toward WFAM. These sections [Chapter 2, Sections 2.4 and 2.5] leave the reader with the impression that only WFAM functions are important and/or relevant within the State of Washington. Taking a quote from page 2-26: "The list of functions defined here does not represent all the functions performed by wetlands in the state. It does, however, represent the functions that were determined to be valuable and that need to be considered when managing wetlands."

This means that these sections are based more on expert opinion rather than synthesis. As a result of this bias, a local jurisdiction that concludes WFAM is not the best or only tool to use to understand wetland functions in their framework for managing wetlands will find this document to be less useful.

Response: The methods for assessing functions that were developed represent a statewide effort by a group of experts to identify the most relevant functions provided by the state's freshwater wetlands. One goal of the process was to identify those functions that were important to managing and protecting wetlands. Since one goal of this document is also to provide such information, the methods were used as a primary source of information on wetland functions important for managing and protecting wetlands. Furthermore, an extensive review of the literature was done and is cited in the documents describing the methods.

The methods therefore can be considered BAS because they reviewed the literature, represent the consensus of a large group of wetland experts in the state, and they were peer reviewed. Other methods that have been used in the state are listed, with their benefits and limitations, in Volume 2.

Emphasis on Research Done Outside of the Pacific Northwest

E-7 Comment: Research that has been conducted outside of our region is sometimes identified in the text of Volume 1. However, this research is not consistently identified. For example, when discussing phosphorus removal functions of wetlands in Chapter 2 (p. 2-35) references are used from England (Walbridge 1993) without the reader being aware of the location of the study.

While we agree that "non-regional" information may be useful for determining the science of wetlands in Washington State, we urge caution in extrapolating data from outside of the PNW region without the readers' knowledge of use of such data. For example, use of Naugle et al. 2001 to emphasize the value of protecting small wetlands does not reveal that these researchers were referring specifically to prairie potholes, which have little ecological bearing to most small wetlands in western Washington.

Response: References that report on information or data from Washington are identified in the text. If no such reference is made then it can be assumed that the information was not developed in Washington.

We do consider the work done by Naugle to be appropriate for Washington because we have many small "pothole" type wetlands in eastern Washington. A similar argument can be made regarding research conducted in the PNW. Does a study in SE Washington have applicability to Puget Sound? In fact, is a study conducted in eastern King County relevant to western King County? It depends.

E-8 Comment: There needs to be more of an emphasis on the fact that much of the literature cited is for wetlands in other geographic regions of the county. Therefore, there is an assumption, particularly regarding wetland functions, that wetlands in Washington function similarly. It also may be prudent to expound on this concept and indicate that the lack of Washington-specific studies in such areas represent data gaps.

Response: See response to E-7. Also, see response to data gaps O-3.

Need Emphasis on Artificially Isolated Wetlands

E-9 Comment: On page 5-10, we suggest that the document address isolated wetlands that do not naturally occur in the landscape. While isolated wetlands, such as playa wetlands, prairie potholes and vernal pools featured in the document are unique and naturally occurring, they are generally uncommon in Washington and are limited to the arid east side of the state. Isolated wetlands can also exist in the landscape due to past disturbances and man-made features. For example, isolated wetlands may result from gravel mining or borrow operations for highway construction. While these types of wetlands do not provide the high functions and values that prairie potholes, playa wetlands, or vernal pools do, they can provide some important functions and values on a case-by-case basis.

Response: We concur that isolated wetlands that result from human activities can provide important functions and values. We found no literature that differentiated between "naturally-occurring" isolated wetlands and human-created isolated wetlands. No change to text needed.

Changing Emphasis on Compensatory Mitigation

E-10 Comment: Section 6.4.5 discusses performance standards, but does not adequately describe the learning curve within the scientific community related to developing appropriate success criteria. In our professional experience, performance standards outlined for wetland mitigation areas have changed significantly since the early 1990s. At that time, performance standards were hinged unrealistically on vegetative cover, specifically shrub and tree cover, which in many cases was unattainable within the three to five years that mitigation projects were monitored. In addition, no flexibility was allowed in the performance standards for recruitment of desired native species. For example, wetland mitigation sites that had high mortality of installed native plants but which were well vegetated with recruited natives such as willow and alder were deemed unsuccessful due to mortality of the installed plants.

Performance standards used today reflect a learning curve over the past 10 to 15 years in mitigation science. We now design our wetland mitigation areas as successional systems. In our opinion, the performance standards we use today are much more likely to be flexible and attainable and more accurately reflect the biological function of the mitigation wetland.

Response: We believe the last full paragraph on p.6-17 addresses this. We encountered only one study that specifically compared performance standards from pre-1995 with performance standards from post 1995. The study cited in the paragraph on p.6-17 (Cole and Shafer 2002) did not find that performance standards from the late 1980's differed from performance from the late 1990s.

E-11 Comment: While it is true that wetland mitigation must be designed correctly and built correctly to function well, we often see that mitigation projects are not properly inspected for appropriate grades during construction, or are not regularly monitored and maintained. In our professional opinion, follow-up work after the construction of the mitigation area is a key factor in why mitigation areas often fail. Inspections must occur following grading and planting. Monitoring and maintenance must occur regularly to track progress. Performance bonding and regulatory enforcement are also important elements to ensure success. In our experience, wetland mitigation projects monitored a minimum of 5 years are more successful than those monitored for a lesser time period. This should be emphasized on pp 6-18 and 6-19.

Response: We agree with your points. However, Section 6.4.6 Monitoring and Section 6.4.7 Maintenance are summarizing scientific literature on compliance with monitoring and maintenance requirements. Most of the points you make are addressed in the sections on recommendations, primarily Section 6.10.1, Section 6.10.2, and Section

6.10.3. We did not encounter studies that conducted an analysis of the effect of grading inspections, monitoring, maintenance, or performance bonding on the success or level of compliance of projects. Two studies evaluated the effect of follow-up after a project has been implemented on that project's success. This is discussed in Section 6.4.8.

E-12 Comment: The mitigation chapter does a very thorough job in looking at all aspects of where mitigation can fail especially from a regulatory perspective. These regulatory failures can be fixed with appropriating staff and time. However, I know such a commitment is difficult because of a lack of funding and staffing. Although the ecological failures, in part are attributable to limited cost and time, I believe they are more so failures by our inability too practically (cheaply and quickly) deal with complex ecosystems given our limited knowledge.

Response: Except for the literature linking follow-up with more successful projects (described in Section 6.4.8), we did not encounter scientific literature that analyzed why projects fail. Most studies make recommendations for how to improve mitigation success, but this is not generally based on experimental evidence. No change was made to the text.

Changing Emphasis on Buffers

E-13 Comment: I think there's a lot of emphasis on the wetland and its immediate "buffer" area because this is what traditional wetland ecologists are most familiar with and studied (for example wetland ecology and delineation), and agencies have traditionally regulated (wetlands and their buffers). As you well know however, conservation biologists, landscape ecologists, and more recent wetland ecologists are telling us is that it's the context (of existing wetlands as well as for mitigation sites) that play major roles in the ability of a wetland to continue to provide functions at ongoing levels (in part as per your discussions on pages 2-8, 2-13, figures 2-2). It will be interesting to see how Ecology implements these ecological principles in Volume 2.

Response: Comment noted. No change needed to the text of Volume 1.

E-14 Comment: Buffer functions (Chapter 5) in the urban landscape are difficult to assess. It is clear there is a lack of controlled, replicated studies (i.e., a gap) on the functions of buffers with respect to protection of wetland functions, especially food web support, biological diversity, and wildlife habitat.

Response: We concur. However, basic principles of how buffers function apply to any landscape setting. Our recommendations for buffers in Volume 2 take into account the varying landscape settings in Washington and we suggest different buffer widths for urban areas. No changes to the text of Volume 1 were made.

E-15 Comment: Buffer functions [Chapter 5 sections 5.2 - 5.4]: Buffers can also increase a wetland's capacity to resist changes that result from invasion of pathogens, invasive plants, domestic pets, etc. These functions are not listed in 5.5.2, but some of them are

discussed in 5.5.3.3 and 5.5.4. In my mind there is a separate class of function here that warrant their own sub-section.

Response: There is very little research on these buffer functions and we have included those that we could find. We do not believe there is enough information to justify a separate sub-section. No changes to the text of Volume 1 were made.

Too Much Emphasis on Department of Ecology

E-16 Comment: It is being marketed as a joint document from WDFW, EPA and Ecology. In my opinion it is not that.

Response: Comment noted. No changes were made to the document based on this comment.

E-17 Comment: In my read of the document there is a bit of an anti-hunting tone that would not be in a document from our agency because that is what we do. It portrays DOE philosophy such as no longer trying to hold the line on wetland losses. It is not a bad document. It is a very good synopsis of Ecology's data and philosophy. It is just that I do not believe it to be comprehensive nor consensus. That may not be other's analysis but it is mine.

Response: We are unclear as to where we have used an anti-hunting tone in the document. We do not address the recreational uses of wetlands of which hunting is one. If the comment concerns the literature on the effects of lead shot, the information applies to lead shot used in shooting ranges that contain wetlands, not use during hunting. No change has been made to the text.

The vast majority of citations used in Volume 1 are not those published by Ecology, therefore this is not a synopsis of Ecology's data and philosophy. There is a reliance on Ecology documents and data in regard to functions and function assessment, however the rationale for doing so is explained in the document. Also, our goal in synthesizing the scientific information on freshwater wetlands was not to arrive at consensus.

E-18 Comment: It has been very difficult for me to get literature and data incorporated in past comment opportunities. We do not even get a formal response where we might be able to offer a minority opinion.

Response: The commenter was one of a select number of reviewers from Ecology and WDFW that had the opportunity to participate in an internal review of an early draft. We received their comments near the time we had to wrap up our revisions to prepare the document for public review and therefore did not have time to address their comments. We communicated to the reviewer that we would address their comments on the internal draft when we responded to the comments we received on the draft that was reviewed by the public.

E-19 Comment: Ecology also hopes to market this as best available science. It does not include information (literature) from resource agency and university species experts. It does not include most of the key elements of National Academy of Science reports on Wetland identification and mitigation. It relies heavily on what studies DOE has done or contracted for.

Response: We did not attempt to individually contact agency and university experts. We attempted to include all relevant information that we could identify through the process outlined in chapter one of the document, which relied heavily on published, peer reviewed literature. Since Ecology has done or contracted for very few studies and our bibliography includes nearly one thousand references we do not agree that this document relies on Ecology studies. We have asked for reviewers to suggest any specific relevant literature that we may have missed through the peer and public review processes. Based on peer reviewer's comments, we have added more data from the National Academy reports.

Comments on Bias, Expert Opinion, and Best Available Science

B-1 Comment: Did not see any major problems regarding these issues.

Response: No response needed.

B-2 Comment: Bias comes with what was selected to emphasize; however, justification for the emphasis was adequately explained.

Response: No response needed.

B-3 Comment: Throughout the document we find information which does not meet the criteria in Chapter 1 Introduction. In these sections, speculation is inserted where research is lacking.

Response: The criteria in Chapter 1 is based on the rule developed by the Department of Community, Trade and Economic Development. The Best Available Science rule states that the judgment of experts is an acceptable form of "best available science." Such assumptions ("speculations") are supported in the document with a clearly stated rationale based on interpretation of current information. We would understand the reviewers' concerns if these types of statements were not clearly identified as hypotheses or assumptions and were not supported by a clear rationale, therefore we will not be revising these assumptions or hypotheses. Where these types of statements were not clearly identified as assumptions or hypotheses of the authors of Volume 1, the text has been clarified.

B-4 Comment: I am more nervous where the document hypothesizes or assumes something to be true simply in the absence of evidence to the contrary.

Response: Some hypotheses can be made based on scientific principles and logical inferences in the absence of direct research to support the hypothesis. See also Comment B-3.

B-5 Comment: WAC 365-195-900 provides assessment criteria to assist in determining whether information constitutes the best available science. Appropriate sources of scientific information as defined in WAC 365-195-900 include research, monitoring, inventory, survey, modeling, assessment, synthesis and expert opinion. It goes on to state that "Reviewers of Volume 1 are asked to judge the reliability of the sources we used, including any gray literature."

Given that the final Volume 1 document will serve as a guide for revisions to local critical areas ordinances and will certainly be cited in various future legal proceedings, I feel that it is important that Volume 1 sticks to "appropriate sources of information" as defined above. There are several cases in the sections that I reviewed where the authors have made speculative statements that, in my opinion, went beyond these parameters. Examples provided include:
Section 2.5.1.4 (Pg. 2-37) states: "In the absence of research to the contrary, it can be assumed that wetlands in all regions of the state and in all wetland classes have the potential to remove toxic metals and organic compounds based on the composition of their soils" [underline added].

I feel that statements and/or conclusions based "in the absence of research to the contrary" are not based on "appropriate sources of scientific information." To the contrary, they are based on speculation in the absence of appropriate sources of scientific information. In this case, the authors recovered a few paragraphs later by stating: "It is not possible, therefore, to make any definitive conclusions about the potential for all wetlands with clay soils to remove toxic compounds." However, there are several statements where the authors did not provide an appropriate follow-up disclaimer.

Section 4.3.1 (Pg.4-5) states: "No information was found on how changing the physical structure of wetlands impacts their hydrologic functions . . ." One could hypothesize that removing erect and persistent vegetation . . . may impact the reductions in water velocity that occur in wetlands."

Section 4.10.1 (Pg. 4-49) states: "In the absence to any information to the contrary, however, it is possible to hypothesize that salinization will probably not change how wetlands perform these functions."

Unfortunately, the authors carried this speculative statement into Section 4.10.9 (Pg. 4-53) the "Summary of Key Points:"

"No information was found on the impacts of salinization on the hydrologic functions of wetlands, but it is possible to hypothesize that impacts, if any, are minor"

Section 7.5.1 (Pg. 7-10) states: "It may be hypothesized, however, that this approach may result in the loss of wetlands whose restoration might be important for improving processes and functions at the landscape level" [underline added]

Section 4.12.5.5 (Pg. 4-70) states: "They [Leonard et al. 1993] theorized that these species may be implicated in the decline of the northern leopard frog but have no definitive data to support this hypothesis" [underline added]. If there is no definitive data to support this hypothesis, perhaps this statement should not be included.

Section 5.5.3.4 (Pg. 5-34) states: "Their research was conducted within forests adjacent to open water lakes, but it would be valid to extrapolate their findings to forested communities adjacent to permanent, large open wetlands that could create the same 'light and shade effect'

Response: See response for B-3 and B-4. Some of the discussions have been expanded to provide a better rationalization for the hypotheses.

B-6 Comment: Chapter 7 goes beyond a synthesis of "best available science". However, it provides a lead into Volume 2. The question is, does Volume 2 go beyond the requirement for "best available science"?

Response: Chapter 7 attempts to summarize the literature on cumulative impacts to wetlands. Part of the job of conducting a synthesis of the literature is to provide summary statements about the literature. We have revised Chapter 7 to ensure that it does not go beyond a synthesis of BAS. Volume 2 provides agency recommendations "based" on the BAS. It is not in and of itself, BAS.

B-7 Comment: BAS Sources: Perhaps a number of my concerns could be addressed by clearly identifying each finding according to the BAS sources listed in Table 1 of WAC 365-195-905. In particular, what is truly synthesis vs. expert opinion? Many findings include a statement such as, "in the absence of research to the contrary, it can be assumed that…" Such findings are untested hypotheses formulated based on the intuition, experience and expert opinion(s) of the authors.

Response: See response to Comments B-3, 4, & 5. We did not believe clearly identifying each finding according to the BAS table was worth the extra effort needed. Only about 100 of the more than 800 references cited do not meet the highest criteria of the WAC (peer reviewed published articles). Expert opinion does constitute BAS if it is referenced, placed in context, and includes logical conclusions and reasonable inferences.

B-8 Comment: First, the use of the term 'significance' is significant. With the reliance on the term significance, and disturbance and impact, problems could occur in the SEPA process when local SEPA administrators interpret this document. SEPA language states, is there any significant impact to … caused by thus and such. With all wetland impacts or disturbance labeled as significant, all projects, even those with minor wetland impacts are raised to a higher level of environmental scrutiny. In some cases, additional review is

justified, in other cases, it is not. We recommend that the word "significant" be generally stricken from the document and replaced with "important", or another adjective not linked to a SEPA determination process and legal review.

Response: Word usage has been reviewed and changed where the meaning was ambiguous.

B-9 Comment: The second bias that is very clear in this document is the definition of disturbance (quoted above) and how in most parts of the document this is black and white. All wetland impacts are bad, significantly bad. This simply is not true. Disturbance does impact and change the environment for sure. But impacts do vary along a continuum. Some are temporary, or minor, or moderate or significant.

Response: We did not find any literature on the topic of temporary or minor disturbances that could be reviewed. However, we agree that there are obvious differences in the scale and duration of impact from projects such as utility installation. These differences will be reflected in the recommendations in Volume2.

B-10 Comment: Third, Chapter 4 is written in a clearly negative tone. Nearly each section is titled "Impacts to…" and leads one to believe that there is no physical way humans can exist on earth without impacting wetlands. Although this may be true to some extent, it is not reasonable to place that amount of emphasis since we presume the author(s) are human as well. The remainder of the document is relatively neutral in tone and presentation.

Response: We were unable to find a precise scientific definition of the word "impact." All the definitions of impact found in the EPA regulatory guidance and Federal Register include both the negative and the positive aspects of "impacts." We have re-written the introduction to Chapter 4 to highlight the fact that we are basically discussing the impacts of human activities that reduce the value of wetland functions to society.

B-11 Comment: Logging [Chapter 3, Section 3.5]: the term "Logging" has a negative ring to it and only captures the harvest phase of timber production. The term "Forestry" better encompass the potential affects of road building, harvesting, site regeneration, fire suppression, chemical applications, etc.

Response: We revised our terminology and used Forestry to encompass the full range of activities described.

B-12 Comment: Impact [Chapter 4]: The term "impact" has a precise definition in a scientific context. I suggest use the term "affect". In the realm of environmental policy "impact" is a value-laden term that presumes the affect in question is undesirable. Also terms such as "indirect impact", "secondary impact", "cumulative impact" and "long-term impact" are oxymorons.

Response: See response to B-10.

B-13 Comment: Land uses [Chapter 5, Table 5-7]: The definitions of "low intensity" and "high-density" need to be made very clear in this context. Most GMA comprehensive plans and Zoning ordinances consider 5000 sq. ft. urban lots "low density" residential development. The language you use here could influence how local jurisdictions apply the science.

Response: Table 5-7 includes one reference to land uses from one study. For more information on how those are defined one should read the study. We have attempted to address this issue in more detail in Volume 2. We do not believe that local jurisdictions will base their buffer regulations on one citation from one table in this report.

B-14 Comment: Section 6.10.6 and 6.10.7 Mitigation Banking. Appears to present the perceived positives and ignore any concerns. This section is not balance. We have offered some references to provide a more balanced view.

Response: Section 6.10.6 summarizes the recommendations from the literature for how mitigation banking could be used to improve compensatory mitigation. We acknowledge that the literature on mitigation banking has not been fully covered in Vol. 1, which is why we specifically reference readers to a recent Ecology document discussing mitigation banking in much more detail in the final paragraph of the section on p. 6-71. In addition, Section 6.5.6.2 discusses the use and effectiveness of mitigation banking, which we believe provides a more balanced, if not negative, view of banking. The text of Volume 1 was not revised.

B-15 Comment: I think that emphasis on greater diversity (and abundance) of vegetation and wildlife is important but only if diversity considers native species rather than all species in general which is often the case. In addition, native species diversity exists across all our wetlands and not necessarily within each one. We may have low diversity at single wetlands although unique species. Thereby these low diversity wetlands contribute to the regional biodiversity. This is what we found for amphibian [Richter, 2000b #3006], bird [Richter, 2000c #2597] and small mammal [Richter, 2000d #7514] classes in that the "best" wetland(s) only exhibited a maximum of 60% regional biodiversity found collectively in all wetlands. I believe such a distributional, diversity pattern more closely mimics the natural environment.

Response: We disagree that diversity should consider only native species. The issue is one of "invasive" vs. "non-invasive." The focus on the higher importance on native species rather than the role a species plays in the ecosystem is a concept associated with the "equilibrium" paradigm in ecology that is no longer accepted by most ecologists. No change was made to the text.

B-16 Comment: Temporal scales [Chapter 4]: The discussion of disturbance seems focused on short-term effects and does not give equal consideration to long term effects. There needs to be a discussion of temporal scales and relationships between natural disturbance regimes and human disturbance regimes. I'm sure there is a data gap here, but we will need a reasoned basis to require mitigation for temporal losses of function in Volume II.

Response: See response to Comment B-9, MOE-14, MOE-16 and MOR-27. As the reviewer mentions, this is a data gap. We did not find any literature on this topic that could be reviewed. However, we agree that there are obvious differences in the scale and duration of impact from projects such as utility installation. These differences will be reflected in the recommendations in Volume2.

3.0 Misrepresentations, Omissions, and Errors

Questions posed to reviewers:

3.1 Are there any conclusions that you believe misrepresent the cited references?

3.2 If yes, specify the reference and how you feel we have misrepresented the author's conclusions.

3.3 Is there a topic or subject of importance we are leaving out? For instance, we know we don't address subjects such as control of non-native, invasive plants or peat mining.

3.4 If yes, which subject/topic is missing?

3.5 Please provide rationale and, if possible, citations to help us fill this gap.

General

MOE-1 Comment: I think you did a good job in accurately referencing the literature.

Response: Thank you.

MOE-2 Comment: Unknown. We have not had sufficient time to research the citations and their use as references. We strongly suggest that Ecology contract a third party (not the authors or Ecology) to perform this quality control step.

Response: We welcome quality control by a third party regarding references, however, funding and time restraints do not allow us to do so.

Research Done Outside of the Pacific Northwest

MOE-3 Comment: I have not reviewed all of the cited references. So, it is not possible to conclude whether the document accurately cites all of them. However, much of the literature cited on wetland functions is based on studies done in different geographic regions. This seems to be a potential misrepresentation or at least an omission. As noted above, more emphasis should be placed on the apparent fact that Pacific Northwest wetlands may function differently than those wetlands in different geological regions.

Response: See response to E-7.

Groundwater Recharge

MOE-4 Comment: I cannot provide any citations at this time but it seems likely that much like streams different wetlands types likely provide at least seasonal groundwater recharge, depending on the geological deposits and hydraulic head. I believe there is a conclusion in Chapter 2 that slope HGM wetland types do not recharge groundwater and wetlands do not provide base flow support to streams. Neither of these positions appears to be supported by specific literature citations. Seems as though there needs to be citations from hydrogeological studies examining the hydrologic functions of Pacific Northwest wetlands to support such positions. Although it appears likely that each wetland may only provide limited recharge, especially slope HGM types and depressional HGM types, cumulatively these may be significant contributors to recharge and/or base-flow support.

Response: A very recent review of the hydrologic functions on wetlands has just been published and has been included in the synthesis. The conclusion of the review is that very few wetlands have any potential for recharge. No change has been made to the text.

Guidance in the Absence of Information

MOE-5 Comment: Does acknowledging that you left something out let you "off the hook" for covering such material in this document? Invasive species, for example, as you mention is one of our greatest threats to wetlands as well as other ecosystems. Increasing amounts of literature is available and therefore this topic should be included in context of this literature.

Regardless, in the absence of information (Information Known to be Lacking Section - p 3) BAS still provides suggestions. Foremost is the invocation of the "Cautionary Principle." Perhaps, DOE can provide BAS-supported guidelines (for local jurisdictions) on what to do in an absence of information. As a start I suggest that the Cautionary Principle be specifically identified "up front", as well the "Do no Harm" Principle.

Response: By acknowledging subjects not covered in the document, we were not trying to get "off the hook" but trying to inform the reviewer by describing the scope of the synthesis. The idea was that knowing the scope, the reviewer wouldn't spend unnecessary time commenting about the absence of those subjects and the reader of the final document would know the subjects are not covered.

In regard to invasive species, we assessed that much of the literature dealt with the technical aspects of control of those species. We determined that the particulars regarding how to control them was not within the scope of this synthesis. Therefore, we are not including this information.

The "Cautionary Principle" and "Do no Harm Principle" are aspects of management and protection. These concepts are policy not science, and are addressed in Volume 2.

Regulatory Time Frame Must be Increased

MOE-6 Comment: The regulatory time frame must also be increased to better represent ecological time frames. I understand the difficulty in accomplishing this goal, however this Volume 1 is supposed to deal just with the science, and not interject policy which says it takes a long time. In Volume 2 we have to figure out how to meet this requirement.

Response: Comment noted.

Protecting Populations Not Just Species

MOE-7 Comment: The wildlife coverage in this BAS seems to be targeting species rather than populations. Species can be protected within wetlands but population safeguards require landscape protection, particularly connections between wetlands and between wetlands and essential upland habitats. You do mention this in Section 4.11 although I think specifically including text on metapopulation dynamics and source-sink aspects could augment the text. Regardless I am hopeful the concept of population protection through connections will be included for wetland protection in Volume 2.

Response: The concepts associated with meta-populations represent fairly complex ecological hypotheses that are currently undergoing significant revisions in the ecological literature. Recent articles in the Annual Revue of Ecology and Systematics and Ecological Applications put into question how these concepts should be applied when managing natural resources, so we decided the concept needs more development by scientists before we include it in the synthesis. Our intention is to include some of the concepts of population dynamics and the need for connectivity in recommendations we make in Volume 2.

More Difficult Issues May Not Be Reviewed

MOE-8 Comment: Clearly the literature on wetlands is extensive and continues to accelerate at an increasing pace. The review may be "thin" in some sections but overall I do not think the document missed much. For example, the review is thorough in identifying specific studies and detailed results such as buffer distances suggested to protect wetland functions and the extensive coverage of mitigation definitions, successes and failures. The larger more difficult issues that remain, such as (a) identifying methods to protect wetland processes (which are really required to protect wetland functions), and (b) how do we get information and use it to adequately mitigate for wetland losses of acreage and functions, may not be reviewed as well as the simpler, more straightforward material.

Response: We provided information regarding methods to assess and protect wetland processes in Volume 2 in the context of using a landscape approach, as well as suggestions as how to use that information to better protect wetlands. Without knowing

what straightforward material was missed, we can not respond to our deficiency in reviewing it.

Complicated and Intractable Issues Need to Be Highlighted

MOE-9 Comment: It seems to me the document mentions all the important points, yet tends to minimize complex and difficult issues or perhaps "assumes them away" either by the tacit assumption they are not under Ecology's purview or acknowledging they are complex and must be considered by local jurisdictions. To some extent this is true, however if Ecology does not try to protect wetlands on a landscape level and across jurisdictional boundaries than who will? It is exactly these complicated and seemingly intractable issues/problems that need to be highlighted, discussed and resolved. It's relatively easy to focus on site specific wetland ecological characterizations and protection issues but without the adjoining area, watershed and landscape context, such a focus will be inadequate to stem the loss of wetland acreage and functions. I know Volume 2 will attempt to look at landscapes, processes etc., however the importance of such an approach should be strongly identified in Volume 1. I fear that beefing up our historical approach although necessary is not enough. We need some new approaches. I believe it is the new approaches that represent BAS, rather than beefed up traditional approaches.

Response: We re-assessed our conclusions regarding the need for a landscape approach and cross-jurisdictional cooperation in Volume 1 to determine if, as the reviewer comments, we don't adequately relate the importance of using such an approach, versus simply "beefing up" our historical approach. The literature was clear in pointing out the need to protect wetlands from a landscape context in addition to protecting on the scale of a specific site. Chapter 2 discusses the important role of landscape scale processes in determining wetland structure and function. Chapter 7 discusses some of the literature that stresses the need for cross jurisdictional cooperation and gives some examples of where this has been tried.

As mentioned above, the guidance in Volume 2 places great emphasis on the need to address wetland protection using a landscape approach and the need for cross-jurisdictional cooperation. Volume 2 also describes ways in which local jurisdictions can analyze the wetland resource using a landscape approach. The Department of Ecology, however, is not in a position to mandate such an approach, nor is the Department able to implement such an approach since we have no authority to regulate or manage land uses except those that directly impact wetlands.

Nationwide Permits

MOE-10 Comment: The U.S. Army Corps of Engineers Nationwide Permit process was not discussed in the regulatory section.

Response: There is no regulatory section in Volume 1. We did not discuss the Corps' Nationwide Permit process because there was no scientific data on the program.

Landscape-Based Regulation

MOE-11 Comment: Why not state the case for landscape based regulation and offer up the literature in support, in con.

Response: Although we haven't organized the document to include a specific section that exclusively deals with landscape-based regulation, we feel we have synthesized the scientific literature in Volume 1 that does support using a landscape approach to protecting wetlands. Therefore, we have not revised Volume 1 to address this.

It is clear from the literature in the synthesis that the focus on site-specific regulatory approaches in the past is not adequate. We recommend in Volume 2 using a landscape-based approach that incorporates both regulatory and non-regulatory approaches to address the loss of wetland acres and functions. Non-regulatory measures such as restoration of wetlands can also address restoration of landscape processes.

Lacking Research of Local References

MOE-12 Comment: We believe that research of local references was lacking effort. For example, near the bottom of page 3-16 there is a statement that no information was found regarding disturbance caused by irrigation on the Olympic Peninsula. There are reports on reduced flows in the Dungeness River prepared by USGS, Irrigation Districts, and others. In our brief review of the references section of the document, we found many instances of what we believe to be omissions. In cross checking with the references section of the document it appeared that only general, easy to obtain references were cited. No real effort was taken to locate region specific information. Attached to this letter as is Attachment A - a list of BAS references we noted were absent from the document. A number of them could assist Ecology in 'filling the data gaps' where the reviewers claimed that there was no information present.

Response: Thank you for providing references that could assist us in filling data gaps. We reviewed the additional titles suggested to us by reviewers and attempted to obtain those that are relevant to the synthesis. After we reviewed those references, we incorporated the information in the appropriate section in the document.

In regard to local references, our statement referring to lack of information on the effects of irrigation on the Olympic Peninsula was in reference to papers that describe the effect on wetlands in particular. We revised the text to be clearer in that regard. However, our major emphasis admittedly was to find information that has been published in peer reviewed journals or reports that have clearly undergone peer review because these provide the best assurance that the information meets the requirements of the WAC on "best available science."

Admittedly, because of funding and staffing constraints and the massive number of articles we had to screen and read from the traditional scientific literature, we didn't spend much time obtaining and evaluating studies done by irrigation districts, local jurisdictions or others that may not have used a peer review process. We acknowledge there is information available in project reports, research summaries, and other such documents but we did not have the resources to subject these to determine if peer review process was used or to check the expertise of the authors. Local governments and others are encouraged to obtain such local studies that are known to them and evaluate if they meet the requirements of BAS (WAC 365-195). If so, we encourage them to use the information in their revisions of their protection programs.

Inferences about Impacts and Functions

MOE-13 Comment: Section 4 has many instances of inferences about impacts and functions of wetlands when we believe that data is available. More careful and thorough research is needed. For example, in section 4.3.1 on page 4-5 there is a cause and effect scenario that poorly reflects science and literature. We struggle to see how this is Best Available Science (BAS).

Response: We disagree. We were unable to find specific citations for some of the inferences (called hypotheses) made. Statements such as "we believe data is available" are difficult to address without some additional citations being provided. One of the purposes of the peer review was to identify references we may have missed. If the reviewers cannot suggest additional information, we are unable to provide any further documentation for the hypotheses. The hypotheses themselves, however, can be considered BAS as defined by the WAC because it represents expert judgment supported in the document with a clearly stated logical rationale, with a context and based on interpretation of referenced literature. In some cases additional information was provided to support hypotheses, otherwise the hypotheses have been retained in the text. See also Comment B-3, B-4, and B-5.

Temporary Wetland and Buffer Impacts

MOE-14 Comment: We strongly suggest that an analysis of temporary wetland and buffer impacts be presented and analyzed. These should not be presented in the same importance as permanent impacts. Section 3 tends to focus on more permanent modifications and their effects. It would be useful if a comprehensive literature review could be conducted on temporary modifications, such as a power or pipeline installation, maintenance, or repair, to describe natural recovery times. A thorough review of this topic may lead to different recommendations for 'mitigation' and long term wetland monitoring.

Response: We did not find any literature on this topic that could be reviewed. However, we agree that there are obvious differences in the scale and duration of impact from

projects such as utility installation. These differences are reflected in the recommendations in Volume Two.

Regulatory Follow-Up

MOE-15 Comment: A topic that we believe deserves more attention is Regulatory Follow-up. Section 6.4.8 of the report provides compelling evidence that: (1) the amount of follow-up by permitting agencies has a direct impact on the success of wetland mitigation projects and; (2) that agency follow-up is woefully inadequate. Though it may seem difficult for DOE to impact the amount of regulatory follow-up that local jurisdictions provide, suggested mitigation ratios should not be increased to compensate for mitigation failures that may occur because of the lack agency follow-up. We suggest an educational program by DOE to inform local jurisdictions of the importance of follow-up on wetland mitigation projects.

Response: We concur with this statement and recommended greater agency follow-up a long with many other improvements in mitigation site selection, design, monitoring and maintenance, rather than increased ratios. However, studies would need to be conducted to determine to what degree follow-up affects the level of success of a project before a reduction in replacement ratios could be justified.

GMA Requirements in Conflict with Protection of Functions

MOE-16 Comment: Lastly, there appears to be no reference to the Growth Management Act. (GMA) Sensitive areas rules are an outgrowth of the GMA. As you know, the primary goal of GMA is to accommodate planned growth within designated "urban growth areas" so that sprawl can be limited and rural areas preserved. Protecting the functions of sensitive areas is an important part of any development. However, the inherent nature of the compact, dense development patterns that are mandated in the urban growth area are incompatible with preservation or complete replacement of the functions of a wetland prior to development. We believe less restrictive mitigation standards for wetlands located within designated urban growth areas are consistent with overall intent of GMA.

Response: We mention the Growth Management Act briefly in Chapter 1 in regard to requirements associated with the use of best available science and revisions to ordinances for critical areas. A summary of the GMA relating to the protection of critical areas, and a description of rulings of the Hearings Boards applicable to this subject, are provided in Volume 2.

The balancing of the different goals of the GMA is a task that needs to be undertaken by each jurisdiction. There is no intent of Volumes 1 and 2 to argue one side or the other of these issues. The intent of volumes 1 and 2 are to provide the scientific basis for making these decisions. Less restrictive standards may be consistent with the overall intent of GMA, but the scientific information indicates that there will be a net loss of wetland functions, or values, as a result.

Linkage to WDFW Priority Habitat and Species

MOE-17 Comment: WDFW considers wetlands to be a Priority Habitat. Wetlands can also meet one or more definitions of a Priority Species Area. Integration of Habitat Conservation and Wetland Protection is critical for preserving ecological functions at the landscape scale. WDFW's PHS Documents could be referenced as a source of species specific and landscape scale science for habitat functions.

Response: This synthesis report is not intended to provide information on the specific habitat needs of individual PHS species. This has been done very well by the Washington Department of Fish and Wildlife in their PHS documents. We also reviewed the PHS documents about wetland-dependent priority species but were unable to find any information on ecological functions at the landscape scale. Therefore, no change was made to the text.

Materials Extraction

MOE-18 Comment: The discussion seems to focus on mining for the purpose of mineral extraction, but a majority of the mining activity in the State is for materials extraction (rock, gravel, sand, etc.) There are different impacts associated with this type of surface mining (sedimentation, re-direction of groundwater, etc.) and the processing that occurs. Some of these impacts are location dependent. For example; floodplains and river beds are often where the desired resources are located. These impacts appear to be contemplated in Table 3-3, but are not discussed in the text.

Response: Gravel mining has been added to the discussion in the mining section.

Redirection of Runoff by Developments

MOE-19 Comment: I was looking in the document for any study or reference treating the decrease of water to wetlands as a result of developments re-directing runoff to stormwater detention ponds. I am increasingly observing this situation in the field, where certain portions of wetlands are drying out because they no longer receive runoff. Was this treated and I just missed it, or is there no study regarding it?

Response: We were unable to find any references documenting such an observation, therefore no revisions were made to the text.

Interdunal Wetlands

MOE-20 Comment: After looking through the document I did not see any references to interdunal wetlands. Was this because there are no studies that reference them, or were

they intentionally not covered, as in the case of wetlands impacted by cranberry bogs? If they were intentionally not covered then this section should somehow express that.

Response: Interdunal wetlands are considered a subset of depressional wetlands, and the discussion about depressional wetlands also applies to them in general. We likewise have not discussed all the different subclasses in other regions of the state. A more specific discussion of interdunal wetlands is found in the rating system for western Washington. However, no additions were made to Volume 1.

Marine Seeps and Spring Wetlands

MOE- 21 Comment: Couldn't find marine seeps or spring wetlands. Have slope but they are upland high mountain types. Need marine seeps and spring wetlands. Check description of marine wetlands on my web page with link to Ecology publication on vegetation management for shoreline homeowners. It might have some information that can help.

Response: We were unable to access the web site mentioned, and thus were unable to understand what was meant by a "marine seep." If the reviewer means freshwater seeps that discharge under the ocean, then these were not covered in this review of freshwater wetlands. Wetlands that are fed by springs are covered in the discussions of the wetlands in the different hydrogeomorphic classes (depressional or slope). They were not judged to function any differently than other wetlands in these classes and were not specifically identified. No change has been made to the text.

Pits and Mounds, Hummocks

MOE-22 Comment: Also nothing on pit and mound or hummocks in forests…they come up as not being wetlands because of the upland species.

Response: We were unable to find any information on the role pit and mounds play in controlling how wetlands function. As a result, a discussion of this structural factor was not possible.

Invasive Species

MOE-23 Comment: There needs to be a section on invasive species. There is lots of emphasis on water, but invasives are the #1 reason wetland restorations fail. I didn't see the words "invasive species" even mentioned anywhere. Since any disturbance cause invasives to enter a site, maybe 3.2 is the right place...but in any case I think they ought to be called out in a separate section and discussed in detail.

Response: See response to Comment MOE-5. In regard to invasive species, we assessed that much of the literature dealt with the technical aspects of control of those species. We determined that the particulars regarding how to control them was not within the scope of

this synthesis. The general role that invasive species play in the wetland ecosystem are discussed as impacts in Chapter 4.

Cranberry Growing

MOE-24 Comment: I was disappointed that cranberry production issues were omitted from the document. The impacts of growing and harvesting this crop on Washington peatland can be severe, both from a wetland function and a water quality perspective. These potential impacts should be described in a document purporting to provide a synthesis of the state of Washington freshwater wetland science. The inclusion of additional information about peat harvesting and cranberry production will round out your efforts to document wetland functions and stressors in Washington and improve this valuable reference for years to come.

Response: We understand your concern regarding cranberry production and peat harvesting. The effects of growing cranberries in wetlands and peat mining are not covered in this document because of the time and funding constraints of the project and the limited area of the state that is affected by cranberry production and by peat mining. We agree that these issues should be addressed through a similar process (as should estuarine wetlands and many other topics). However, we have done the best we can with the resources we have.

Fencing

MOE-25 Comment: Our professional experience has shown that fencing of wetland buffers has been effective in reducing human encroachment and vegetation disturbance, particularly in residential areas. Sarah Cooke's study in 1992 found that fencing is effective to protect wetlands from human encroachment. Fencing is also a requirement of compensatory wetland mitigation projects in the Portland Oregon area, as described in Shaich and Franklin (1995). Fencing should be discussed on p. 5-48 of the document.

Response: A statement on fencing (citing Cooke) has been added to the text.

Amphibian Corridors

MOE-26 Comment: Add bullet to acknowledge amphibian dispersal needs and corridors. On p. 5-39, in the summary table, the document should acknowledge amphibian corridors.

Response: There is no summary table on page 5-39. However, the need for maintaining connectivity between wetland and terrestrial habitats is noted in the third bullet on that page. No change needed.

Domestic Pets

MOE-27 Comment: Add bullet to mention domesticated pets. On p. 5-45, we recommend that pets be listed in the summary table.

Response: The impact of pets on wildlife is covered in section 4.12.5.2 and in 5.5.4.2. However, no studies were found that addressed the role of buffers in reducing predation on wildlife by pets, thus we do not believe it is appropriate to add any additional information on pets in this section.

Removal of Pathogens

MOE-28 Comment: There is no information on the state of science regarding wetlands as processors of fecal bacteria or pathogens (relative to Table 2.5 and Section 2.5.1.). There was at one time a great deal of local interest in using wetlands (natural or constructed wetlands to treat runoff from farms, urban areas, etc. to remove pathogens. There has been some research of field studies. I have seen some of them. I don't have time now, but I might be willing to assist in a literature review (contingent on management approval, of course).

Response: A section on how wetlands remove pathogens has been added.

Temporary Impacts

MOE-29 Comment: To expand on the need for a discussion of temporary impacts on wetlands and buffers we will present our observations of wetland permitting and utilities in several jurisdictions. A couple of the examples presented below do not reflect on issues that can be addressed or corrected by this Ecology document. These serve only to point out examples of 'overpermitting' due to the inability of the respective ordinances to make additional exceptions or modifications because the Best Available Science has not been presented about the topic of temporary impacts. No changes will be made to local critical areas ordinances unless backed up by science. And, if science could say that in some instances, a one time impact, or periodic impact through maintenance with large gaps of time between occurrences does not have the same long term effect as a permanent modification. Then changes could be made at the local level.

In some cases, impacts from utilities within a road right of way must be addressed, analyzed and permitted similar to any other development. Yet, the right of way impacts, conducted by the utility in this case, are only temporary.

Response: See Comment B-9, B-16, MOE-14 and MOE-28. We did not find any published literature on the topic of impacts of temporary projects such as utility lines that could be reviewed. However, we agree that there are obvious differences in the scale and duration of impact from projects such as utility installation. These differences are reflected in the recommendations in Volume2.

MOE-30 Comment: Other problems have arisen with the required mitigation of impacts in these utility areas. In another example, care was taken to locate the pipeline in an existing transportation corridor. The pipeline, installed at the toe of slope, passed through a wetland. Mitigation commenced with wetland plantings and long term monitoring. The success of the mitigation plantings was compromised by the county road maintenance crew, directed to trim vegetation within the right of way. Success, as measured by traditional monitoring methods, did not occur.

We are very interested in seeing the recommendations for regulations presented in Volume 2 when available. We sincerely hope that the document will include a recommendations section on sites that will be temporarily impacted and that these types of operations will not be dealt with and permitted like permanent modifications.

Response: We attempted to address the concerns of the reviewer in Volume 2 and it is covered in more detail in mitigation guidance that is also being developed in conjunction with these 2 volumes (http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm).

Loss of Semi-Permanent and Seasonal Wetlands

MOE-31 Comment: It is noted in your work and from the literature review that compensatory mitigation is most often producing open water wetlands. Research would further indicate cattails and other predictably tolerant and strongly competitive species eventually ring these. I believe these wetlands are created because we don't have the knowledge or skills, and don't want to spend the time and money to mitigate for the complex wetlands destroyed. Although it is a well known fact that bogs, fens and forested wetlands may not be reproducible, my experience suggest that for the west side, seasonally flooded and semi-permanently flooded wetlands are also equally difficult to establish (given our current expertise). These semi-permanent and seasonal wetlands also have a unique biota, which continues to be lost.

Response: We agree that it is difficult to reproduce the hydroperiod for seasonal and semi-permanent wetlands. However, it can be done. The scientific literature indicates that seasonal wetlands and semi-permanent wetlands can be "successfully" created, restored, and enhanced. No change to text required.

Landscape Ecology/Conservation Biology Are Lacking

MOE-32 Comment: I've seen a couple recent cases where DOE staff's application of Volume I may result in mitigation requirements that do not integrate well with fish and wildlife habitat mitigation required under Federal (ESA) and/or local habitat conservation regulations. While Volume I emphasizes the importance of a "watershed approach", it limits its focus to traditional wetland science at a watershed scale and lacks connections to general principles of Landscape Ecology and Conservation Biology.

Response: We added a section that describes the ecological principles that are useful for managing natural resources. and additional references and syntheses to improve our coverage of general principles of landscape ecology and conservation biology. See also Comment MOE-7 and a reviewers concern that we are not addressing metapopulation dynamics.

Difficulty in Translating Science into Management

MOE-33 Comment: The document covered traditional wetland protection methods comprehensively and fairly. It additionally includes the literature on the difficult and newer aspects of ecosystem protection of conservation biology. It is the integration and application of conservation principles into new classification and protection system that will be critical. I recognize that Ecology may not want to consider such large scales in wetland protection but unless such difficult issues are addressed wetland functions may not be protected.

The challenge ahead for Ecology in Volume 2, and local jurisdictions in the preparation of their own Sensitive Areas Ordinances, is to implement the best available science for wetland protection. Now that we reviewed the BAS, it is the application of BAS that will be the test for wetland protection.

Response: We appreciate your comment and generally agree with your viewpoint. Our goal in Volume 2 is to provide guidance that applies best available science and supports the improvement of wetland protection especially by local governments in Washington. No change required in text.

MOE-34A Comment: I don't think this document provides enough specific background and analysis to "translate" the findings into the needed options and recommendations to regulate or manage wetlands. For each major impact pathway and function, a greater discussion of factors that control the magnitude of degradation in Washington is needed. Regional variations and variations by HGM classes are also needed. For example, Section 3.3.2 discusses impacts to hydrology, and makes much of a "10% threshold" of watershed development, above which impacts may occur. In this section, it is appropriate to discuss stormwater detention as mitigation for hydrologic impacts. Some level of stormwater mitigation is required by most development in Washington, but detention standards vary. It is misleading to discuss impacts of impervious surfaces and wetland hydrology as if there were no attempts to mitigate these impacts. If the document discussed the range of detention standards typically employed in Washington and how functional impacts may vary across this range, then there is a basis for Volume 2 to present options and recommendations for policies and regulations. Other matters to consider are HGM class: Are slope wetland functions more or less susceptible to hydrologic impacts? Are the mechanisms of impact different? Are the functions impacted by increased hydrology different across wetland classes?

Response: We do not agree that the document fails to provide enough information or analysis to support translation into options and recommendations for protecting wetlands.

We screened the available literature for its relevance to Washington conditions and issues and eliminated that which clearly had no relevancy. We understand that the determination of what is relevant to Washington is a subjective decision in many cases and we have tried to rely on literature that was derived from the Pacific Northwest or a similar landscape or that expressed general principles relevant to most landscapes. We attempted to explain the screening process better by revising Appendix C.

Unfortunately we were unable to find any information to address the issues brought up in the second part of the comment.

MOE-34B Comment: A second example is the discussion on small wetlands. Section 5.3.3 discusses some habitat function of small wetlands (it is curious that hydrologic or water quality functions are not mentioned -are these functions the authors feel small wetlands don't provide?). Considering the merits of small wetlands is valid, because as the document notes, many are unprotected by local regulations. However, the section leaves the reviewer with the impression that all small wetlands are significant habitat for amphibians, which, in my opinion, is extremely misleading when the full range of small wetlands in Washington is considered. If the section included a discussion on how the range of functions provided by small wetlands varies (across landscapes and HGM classes), some of the most significant factors that may control which functions they provide, and how the relative significance of these functions might be assessed, then a basis for defining management options and regulations is established.

Response: The text in Volume 1 was revised to clarify that small wetlands encompass a wide range of wetland characteristics, similarly to larger wetlands. The text in Chapter 5 of the draft of Volume 1 was intended to address the common misconception that small wetlands are unimportant. We failed to make it clear that not all small wetlands are equally important. However, there are no data of which we are aware regarding small wetlands in Washington to suggest a different approach to assessing their functions or values than is used for larger wetlands. Also, we did not find any literature on the water quality or hydrologic functions of small wetlands.

Research Done Outside the Pacific Northwest

MOE-35 Comment: Limitations of the transferability of studies to other areas/wetlands should be acknowledged in the introduction of the document and readers reminded on these limitations in each sub-section titled "Data Gaps".

Response: We added language to Chapter 1 and other parts of the document to address this comment and other comments regarding transferability of research from locations out of the state.

Inadequate Knowledge Base for Wetland Mitigation

MOE-36 Comment: You summarize that the majority of compensatory mitigation projects were neither fully successful nor complete failures. This may be subjectively true but I think we still do not have enough mitigation projects that have been consistently and rigorously monitored for ecologically meaningful time periods to answer this question comprehensively. I acknowledge your write-up seems to document this fact as well and I am reinforcing the importance of this finding. Just mitigating a wetland, i.e., obtaining water and plants, for the most part is not a good criteria for success given the unique and complex functions that wetlands provide. I am especially skeptical of our ability to mitigate and replace lost groundwater interchange, soil exchange and wildlife habitat functions. Moreover, at this time of our mitigation knowledge, I believe we may be providing generic and homogeneous, low-diversity wetlands.

Response: We agree that compensatory mitigation projects have not been monitored for a sufficient enough time to understand or fully characterize how they will develop and sustain themselves in the long term. However, regulators and wetland scientists have not yet developed performance standards or success criteria that target or measure characteristics or conditions indicative of long-term sustainability and performance of unique and complex functions. The best that has been done is function assessment methods, which measure indicators of functions.

Realistically, regulators cannot hold applicants' accountable to monitor and maintain sites for the centuries it may take to develop some of the unique and complex functions that you mention. In the interim, regulators and the authors of many of the cited studies use the presence of water and plants as an indicator that at a minimum wetland conditions have been established, allowing succession and natural processes to develop the site over time.

Finally, the goal of compensatory mitigation is to replace the lost wetland acreage and functions. Though we acknowledge that a few high quality wetlands are lost each year to permitted impacts, the vast majority of wetland impacts in Washington are too low diversity, homogeneous, wetlands that have been degraded by agriculture and/or surrounded by urban land-uses. No change to text is required.

MOE-37 Comment: For mitigation projects, I do not believe we have carried out any strong scientific monitoring programs to tell us the cause of wetland failures other than in broad general terms. I agree with the science advocating setting up each mitigation project as an experiment. It is only through experimentation that the specific reasons for success and failure can be empirically established, and then be applied to future projects. I think our current monitoring information is pretty "marginal" in providing substantive information for the collective benefit of better wetland mitigation.

Response: We agree that only through experimentation and scientific evaluation will we continue to learn about wetland functions and how they develop over time, particularly on different soils, in different ecoregions, HGM and Cowardin classes. However, this

type of experimentation is better suited to academic studies and non-regulatory restoration/creation/enhancement. In the regulatory context, on the rare occasions when experimental monitoring is proposed it is typically for an experimental compensatory mitigation approach or site design. Such an approach or design generally has a higher risk of failure because it has not been tried before.

The risk is acknowledged and accepted by the regulatory agencies because detailed monitored will be performed to provide information on site development that is generally not available for mitigation sites. However, the purpose of compensatory mitigation is not to educate, that is the role of academic science. The role of compensatory mitigation is to compensate for lost wetland acreage and function.

Monitoring of compensatory mitigation wetlands is, of necessity, focused on determining whether a site is in regulatory compliance. Compliance measures should and typically do include performance standards, which are intended to indicate and measure whether a site has provided the required acreage and functions of wetland compensation. No change to text is needed.

Need for Synthesis and Updates

MOE-38 Comment: However, I question the need of a synthesis of the literature. Is it necessary to satisfy the "best available science" requirement? Would a reference list along with a rationale of how the list was generated be enough?

Response: During focus groups held before undertaking this project, local governments voiced a need for a synthesis such as Volume 1 to be developed. Providing a reference list and rationale leaves the onerous task of obtaining, reading and synthesizing references into a form useable for local governments up to local jurisdictions who for the most part don't have the resources to complete such a task. The process involves reviewing thousands of references that may be applicable to the management and protection of wetlands in Washington. This task was more massive then we anticipated. No change text is needed.

MOE-39 Comment: I am concerned that I could not find a provision within Volume 1 that allows for updates or revisions to the reference list. Best available science changes with each new publication of relevant literature. A provision for, at a minimum, annual updates to the reference list needs to be implemented into Volume 1.

Response: We agree that it would be beneficial to provide regular updates to Volume 1. We however don't have the funding or staff to do so at this time. No change needed to the text.

4.0 References

Literature sources recommended by reviewers of Volume 1 are included at the end of this document.

Posting of Literature Sources on Web

R-1 Comment: I think it is a great service to have the papers available on the web. The more we can get permission to post the better. In the list of cited literature a brief review and maybe the abstract of the paper would help a researcher target his readings in a more focus manner.

Response: We agree. As inferred in the comment, we can't do so because many are copyrighted and it requires considerable effort to get permission to post them. A brief review or abstract in the cited reference list would make the document exceedingly long since there are close to 1000 cited references. No change made in the document.

We also considered posting abstracts and our notes recorded during reading of the articles. However there is a shortage of staff and numerous software problems, including difficulty with making them universally accessible, making these notes extremely difficult to access electronically. We are archiving the paper copies or reprints of articles we cited in a repository that will be available to the public by appointment.

Need to Review Original Literature

R-2 Comment: Referencing material that was not specifically reviewed by the authors of this document is undesirable, can lead to erroneous interpretations, and undermines the scientific credibility of the document. This same concern applies to many of the numerous other general review documents relied upon by the authors. An effort should be made to rely less on general review.

Response: The Core Team guiding the project discussed this matter and determined that adding hundreds of additional references cited in these syntheses was an onerous task. They also determined that syntheses of the literature that were themselves peer reviewed as syntheses were reliable and they judged that these syntheses meet the criteria for BAS (WAC 365-195) just as effectively as the original articles. In fact, synthesis documents are particularly useful and efficient in capturing a wide range of literature. No change has been made.

Editorial Comments

Ed-1 Comment: We note that the term "this data" is incorrectly used throughout this document, including Section 6.6.3 (Pg. 6-39) "Replacement Rations Required and Achieved." The

proper use of the term is "these data." Please complete a word search for the whole document and make the switch.

Response: We completed a search on each chapter and found one location in which "this data" is used, the page cited in the reviewers comment. We corrected the text. Other locations use "the data" etc.

Ed-2 Comment: There is a lack of cross-referencing of sections on the same/or closely related topics. Cross-referencing would be very helpful for the vast majority of users of this document who are guaranteed not to have read this document cover to cover and have not thoroughly read the Table of Contents. This cross-referencing should be completed on all subjects where discussions appear in more than one section of the document (i.e., hydrology, using the watershed approach, nutrients, HSPF modeling applications, invasive/exotic species, etc.). This can be done using an index at the end. Word allows for very complicated indexing. Cindex and Windex are two other programs that will create indexes.

Response: We explored Cindex and Windex and determined that we are unable to add an index given time, resources, and software challenges. We attempted to provide more cross referencing as we revised the text.

Ed-3 Comment: The document needs an index.

Response: See response to Comment E-2.

Ed-4 Comment: It would be extremely helpful if there were some mention at the end of Section 6.5.6 (Pg.6-30) "Wetland Mitigation Banking" of another discussion on this subject later on in Section 6.10.6 (Pg. 6-70) "Mitigation Banking." Likewise, Section 3.3.8 (Pg. 3-21) "Increased Levels of Salt Resulting from Agriculture" should also reference Section 4.10.1 (Pg. 4-49) "Impacts of Increasing Concentrations of Salt on Hydrologic Functions."

Response: We added a sentence in these two places to cross reference these related subjects.

Ed-5 Comment: The summary sections are a very good addition; some of which are really concise while others seem a little too general (i.e., Section 2.5.4).

Response: We reviewed each summary and made those that seem too general more specific.

Ed-6 Comment: Have you considered tabs for the individual chapters?

Response: We did consider tabs but decided not to use them because of the added cost and use of paper.

Ed-7 Comment: "• An increase the acidity of surface waters." Insert "in" between increase and the.

Response: Change has been made.

Ed-8 Comment: This is an EPA grant product, so the grant number and project officer need to be placed in the document, preferentially on the title page or inside cover. The EPA logo on the front is not enough.....

Response: We made the additions.

Ed-9 Comment: Typo: 3.6 p. 3-33 top of 2nd bullet

Response: We corrected the typo.

Ed-10 Comment: It seems this [3.4.7.1 Other Disturbances Resulting from Urbanization, Page 3-31] should be Section 3.4.8.

Response: We made the correction.

Ed-11 Comment: Section 3.2 does not appear to set up the remainder of Chapter 3 very well.

Response: We disagree. We believe it does a good job at introducing the rest of the chapter (disturbances caused by human activities on the land) given that the following topics are covered: link between functions, land uses and changes; types of disturbances from land uses; and disturbances in the movement of water, quality of water, and connectivity of habitats.

Ed-12 Comment: Chapter 4 has redundancy with the labeling (and content) of the sections.

Response: The redundancy is intentional since the same 8 impacts are discussed for each topic, for example, negative impacts of changing the amount of water in wetlands and negative impacts of increasing the amount of toxic contaminants.

Positive Comments

The following are positive comments provided by reviewers. No responses or changes to the text were needed.

PC-1 Comment: We would like to compliment the team on preparation of a thorough and comprehensive synthesis of the science related to wetlands in the State of Washington. As authors of best available science papers for local governments, we understand the difficulty and time it took to compile this information. We commend you and the project team on the readability of the text. The team has done an admirable job compiling and summarizing information on wetlands in the State of Washington.

PC-2 Comment: It is far easier to review and edit a draft document than to produce the draft in the first place. The draft document must have been quite an effort. My comments should be received in that spirit. I hope they help to improve the report.

PC-3 Comment: The authors are to be commended on the organization and flow of this document. This is a huge improvement on the preliminary draft I remember reading through in June or July of 03. The title indicates that this document is intended to be a "Synthesis of the Science" and the content doesn't disappoint. An excellent job was done sticking to the "relevant" science from a technical/professional standpoint.

I did take the time to read the entire document and feel that there is certainly something in here for everyone My review was based largely on the following premise: "Could I find it, Could I understand it, Could I apply it." Overwhelmingly, my answers to all of these questions were yes. Which, considering my fairly steep learning curve in deciphering what Tom H. has to say sometimes, is fairly significant.

My hat is off to whomever did the editing of this document, as well as to the cadre of authors who waded through the proverbial muck to pull it all together.

PC-4 Comment: Before I provide my comments I would like to say that the draft synthesis of the science regarding freshwater wetlands in the state of Washington is an effort for which the development team should be proud. Good job, even in the draft form it reflects the obvious hard work that was expended. The core team did a good job on developing this draft.

PC-5 Comment: We believe that it will help provide important information on wetlands functions and mitigation to a wide range of interested parties. Overall, this document is a good primer and a very beneficial contribution to this highly complex topic.

PC-6 Comment: I previously reviewed this synthesis on wetlands a number of months back, and from the looks of the latest draft, it is obvious a great deal of time was spent revising this report. Although the previous report provided a vast amount of pertinent information, I thought it could use a sizable amount of reorganization. In addition, I felt the report was not geared towards many of those that make up the intended audience (e.g., individuals without a science background). Based on my latest review of the draft dated August 2003, neither of these issues plagues this much-improved version.

PC-7 Comment: I appreciate the time and effort put into Volume 1. The literature review appears to be thorough and complete. The synthesis reinforces my opinion that not a lot is known about the wetlands in our region. . I value the efforts that have been and are being put into this synthesis.

PC-8 Comment: Looks great…a lot of people put a lot of work into it. Keep up the good work.

PC-9 Comment: I believe the document is well-written and well-referenced…, overall…a great job with a few minor exceptions. I appreciated when the document stated the findings of

what particular studies concluded, or when there was no study that had been found for a given issue. In general, the document does a good job of putting similar-type findings within an understandable context.

PC-10 Comment: I read through/skimmed the document. I don't have time to review it in detail, but felt that it was a useful synthesis of information about wetlands and could be useful for local governments.

PC-11 Comment: I'm in awe with regard to the amount of literature that you guys reviewed!!! Overall I find the material to be very useful—someone has done a lot of work for me reviewing the literature. I intend for this document to stay within easy reach on my bookshelf. Nice piece of work!

PC-12 Comment: In general, I found the document to be well written, with little bias, and very well done. I have several specific comments and random thoughts that are presented below; please forgive any philosophical biases on my part… I applaud and appreciate the effort that has gone into this document. I do not feel there has been any rampant misinterpretation or bias in this report.

PC-13 Comment: My comments apply to the entire document. I feel this is going to be an extremely useful document for me. Actually, I have already referred to it several times. The chapters are organized in a sensible, easy to follow format and cover most if not all of the concerns relating to wetlands and impacts on wetlands.

PC-14 Comment: In general, the document up to this point has been well written. I commend the technical editor(s), for his/her [their] job has been quite good. I commend all the authors on this document. It isn't an easy task. I have written a part of the forested wetlands section (the soils section) for Sarah Cooke's forested wetland impact bibliography, so I know the challenges to some degree, though this [yours] seems much more complicated.

PC-15 Comment: The document includes much technical information that once in a while even made my eyes glaze over. It is inevitable to some degree, since so much information is packed in.

PC-16 Comment: We would like thank the Department of Ecology and Sheldon Associates for producing this document. When completed, this resource will be invaluable to both local governments and activists. While overall this is an excellent document, we do have comments on some areas, which are set forth below.

PC-17 Comment: We want to commend the authors, reviewers and editors for producing this draft Best Available Science document. It covers the baseline of many general wetland issues. The Summary of Key Points sections are extremely helpful to the reader for a quick reference. We like the fact that they are interspersed within the smaller subsections and not saved to the end of the chapters, increasing their use and value.

Information contained within the gray boxes is also useful and pertinent. For example, the discussion on functions and values (page 2-7) validated, in a scientific document, the differences between the two. We are glad to see the term 'functional value' brought up in this document.

We are also pleased to see a more realistic discussion on buffers and recommended widths. There are many different functions performed by a buffer. A 'one size fits all' approach is simplistic and does not get to the root behind the need to buffer a wetland. We liked how the discussion for buffering for water quality, wildlife habitat etc. was all split out. This will help Ecology (and other regulators) in the future in providing recommended buffer widths for different wetland systems. An example, practical application could be an urban setting where the large buffer recommendations for wildlife would not apply for at least two reasons. First, those species requiring large buffers are not present in an urban environment. Second, due to possible conflicts with human and wildlife, managing for such species, is not appropriate.

We are pleased that Ecology has extensively used Desbonnet et al. 1994 in their analysis of buffers. We also believe it is a comprehensive representation of Best Available Science.

PC-18 Comment: First hats off to your efforts. It is certainly a daunting task you all have undertaken.

PC-19 Comment: Actually I thought most of this report was very clear and the organization is vastly improved from the previous draft.

PC-20 Comment: I really found the information well organized and very informative. I was able to relate things to what I thought would happen in certain circumstances (in terms of functional values and the impacts of development) and found that I was assuming (in some cases) correctly. I also learned a few things that I have been unable to really research, seeing as we are busy consultants with little outside time.

Chapter 1 - Introduction

General Comments

1.1 Comment: Generally, the document should acknowledge that while studies might scientifically investigate an issue (e.g. potential wetland functions or controls on functional performance) and develop general principles that can seem predictive of new situations or for a variety of actions, they are only transferable to a degree. One scientific study in a given situation and context is usually not directly predictive of similar circumstances in a different setting, because most natural systems have too many variables for studies to be readily transferable. I think this is especially true for wetlands, where, as the authors of this document note, there are numerous and different processes controlling wetland functions operating at the site, landscape, and regional scales. Few, if any, scientific studies have considered all variables in a manner that allows wide generalizations to a wide variety of wetlands over wide geographic areas. I feel this needs to be acknowledged in the introduction to the document, and that readers are reminded of the limitation in each sub-section titled "Data Gaps".

Response: We agree that scientific studies are transferable and predictive to different degrees. However, part of the role of a synthesis is to summarize many studies and scientific articles, glean the general principles as well as determine whether they apply to this geographic area. The definition of "synthesis" in Webster's 7th Collegiate Dictionary is "deductive reasoning" and "the combining of often diverse conceptions into a coherent whole." We feel we have accomplished this in Volume 1.

However, to acknowledge some of these limitations, we provided some clarification in the draft of Volume 2 "Guidance for Managing and Protecting Wetlands". In brief, we say that many experiments tend to be very site specific and may not be applicable outside the immediate geographic area where the experiments were performed. Some may be applicable only to other similar settings and others may be applicable to a wide range of settings. Therefore, one must extrapolate, interpret, and synthesize all the information collected and determine how it pertains specifically to Washington.

We also say in the draft of Volume 2 that the science doesn't often provide a "bright line" in regard to directly relating to managing the resource, with very few experiments demonstrating true cause-and-effect relationships.

We added text in Chapter 1 that is similar to that in Volume 2 and provide this kind of clarification regarding the limitations of the science information.

Introduction to the Document

Page 1-1

1.2 Comment: Add a bullet to indicate that in some cases, the authors also hypothesize on various functions or disturbances to function when literature was not found.

Response: We added clarifying language regarding this issue. Also, see our response to Comment 1.1.

1.3A Comment: I don't think this document provides enough specific background and analysis to "translate" the findings into the needed options and recommendations to regulate or manage wetlands. For each major impact pathway and function, a greater discussion of factors that control the magnitude of degradation in Washington is needed. Regional variations and variations by HGM classes are also needed. For example, Section 3.3.2 discusses impacts to hydrology, and makes much of a "10% threshold" of watershed development, above which impacts may occur. In this section, it is appropriate to discuss stormwater detention as mitigation for hydrologic impacts. Some level of stormwater mitigation is required by most development in Washington, but detention standards vary. It is misleading to discuss impacts of impervious surfaces and wetland hydrology as if there were no attempts to mitigate these impacts. If the document discussed the range of detention standards typically employed in Washington and how functional impacts may vary across this range, then there is a basis for Volume 2 to present options and recommendations for policies and regulations.

Response: We do not agree that the document fails to provide enough information or analysis to support translation into options and recommendations for protecting wetlands. We screened the available literature for its relevance to Washington conditions and issues and eliminated that which clearly had no relevancy. We understand that the determination of what is relevant to Washington is a subjective decision in many cases and we have tried to rely on literature that was derived from the Pacific Northwest or a similar landscape or that expressed general principles relevant to most landscapes. We will attempt to explain the screening process better by revising Appendix 1-C.

The issues of stormwater are relevant to compensatory mitigation, and are addressed in the "Guidance on Wetland Mitigation in Washington Parts 1 and 2" that will be published in the spring of 2005. Furthermore, we were unable to find any information in the scientific literature on the relationships between stormwater detention and wetland functions.

1.3B Comment: Other matters to consider are HGM class: Are slope wetland functions more or less susceptible to hydrologic impacts? Are the mechanisms of impact different? Are the functions impacted by increased hydrology different across wetland classes?

Response: These issues are discussed in Chapters 2-4 where information is available.

1.3C Comment: A second example is the discussion on small wetlands. Section 5.3.3 discusses some habitat function of small wetlands (it is curious that hydrologic or water quality functions are not mentioned - are these functions the authors feel small wetlands don't provide?). Considering the merits of small wetlands is valid, because as the document notes, many are unprotected by local regulations. However, the section leaves the reviewer with the impression that all small wetlands are significant habitat for amphibians, which, in my opinion, is extremely misleading when the full range of small wetlands in Washington is considered. If the section included a discussion on how the range of functions provided by small wetlands varies (across landscapes and HGM classes), some of the most significant factors that may control which functions they provide, and how the relative significance of these functions might be assessed, then a basis for defining management options and regulations is established.

Response: We revised the text to clarify that, with a few exceptions, small wetlands provide similar functions to larger wetlands and that they are generally no more nor less important than larger wetlands.

Page 1-2

1.4 Comment: RCW 36.70A.172 [1] requires that all city and county governments **must include** not "rely" on BAS when developing their critical areas ordinances and regulations.

Response: We have made the correction.

1.5 Comment: Paragraph 4 - It is implied that "Gray literature, personal communications, and conference proceedings" are usually peer reviewed. It would be best to clarify that personal communications, gray literature, and papers in conference proceedings are not peer reviewed and are subject to personal interpretations and experiences that can lead to distorted or incorrect conclusions. Consider adding text to clarify the distinction between published peer-reviewed scientific papers and other forms of less scientifically rigorous information (and their limitations).

Response: We deleted the use of the term "gray literature" because it is pejorative. In some cases, we used conference proceedings, reports, and other documents when other information was lacking, but we were unable to determine the level of peer review.

1.6 Comment: Paragraph 5 - Unpublished data are used that have been peer reviewed. Similar to comment as above, there are significant-differences between the "peer review" process initiated/conducted by the authors of a report or study and an anonymous peer-review conducted by an independent scientific journal. When a journal initiates the peer review of a paper, the reviewers are (l) picked by the editors (not the authors), and (2) reviewers are able to remain anonymous. As a result, the reviewers are not limited to "friendly" reviews, and due to anonymity are able to freely provide potentially unflattering comments without fear of recrimination and/or offending/alienating the authors who may be friends. The opposite is typically true when the "peer review" is solicited in-house or

among friends and associates. Hence, please consider limiting the use of the term "peer review" to studies/papers published in a scientific journal.

Response: We disagree that solicited peer review of Ecology documents implies bias. The peer review process used by Ecology solicits input from a wide range of reviewers who can remain anonymous if they choose.

We clarified what we meant by the term peer review, especially in regard to paragraph 5 where we state that, although data collected during calibration of methods for function assessment and rating is unpublished, it has been peer reviewed. In this instance, peer review means that comments were solicited on the methods, and their calibrations, from a broad range of people on a mailing list of hundreds of people, as well as experts from various disciplines, not just a select few that were in house or close associates.

However, observations reported as "unpublished data" in Volume 1 were collected in the field by interdisciplinary technical teams. The data were offered for review, beyond the technical teams, during the public review of the documents when specifically requested.

1.7 Comment: Paragraph 5, lines 4-6 - Do conference proceedings, personal communications, and other "gray" literature that were occasionally used meet the CTED rules for scientific information as specified in WAC 365-195-905?

Response: Gray literature, such as conference proceedings and personal communications, may be considered BAS if it meets the criteria in the rule for "expert opinion." The rule specifies numerous types of sources that are considered scientific information as long as they have characteristics, specified for each type. The types of scientific information are listed in the text of Chapter 1 and include expert opinion. There is no specific category for conference proceedings or personal communications.

The characteristics for each type, including expert opinion, are defined in Appendix B, as stated in WAC 365-195-905, and those characteristics needed for each type of information are provided in a table in that appendix. For expert opinion, the BAS rule requires that the following characteristics be met:

- Logical conclusions and reasonable inference
- Context
- References

No change is needed to the text in response to this comment.

See also the response to Comment 1.6.

Section 1.1 Scope of Volume 1

Page 1-3

1.8 Comment: After looking through the document I did not see any references to interdunal wetlands. Was this because there are no studies that reference them, or were they intentionally not covered, as in the case of wetlands impacted by cranberry bogs? If they were intentionally not covered then this section should somehow express that.

Response: Interdunal wetlands were not covered specifically. Interdunal wetlands are a subset of depressional wetlands and, at the level of detail provided in this document, general comments made about depressional wetlands also apply to interdunal wetlands. We also did not discuss the differences between other subclasses in the hydrogeomorphic classification of wetlands in Washington.

1.9 Comment: While the document states it is to cover freshwater wetlands, portions discuss saline wetlands. The introduction should state which saline wetlands are covered and why.

Response: The discussion of wetlands in Volume 1 that could be considered "saline" are the "alkali" wetlands in eastern Washington and the estuarine wetlands in western Washington. These wetlands are considered to be wetlands with special characteristics in the wetland rating system, and are mentioned only in relation to the rating system. We did not review any literature on these wetlands, nor did we include any of the information about these types of wetlands in the synthesis.

Section 1.5 Conclusions

Page 1-9

1.10 Comment: The technical/peer review of this document by outside persons must be documented in a responsiveness summary (i.e. a "response to comments" document) as is commonly done for EIS, NPDES permits, or other public review processes.

Response: We have responded formally in this document to each comment.

Chapter 2 – Wetlands in Washington and How They Function

General Comments

2.1 Comment: I have two general concerns regarding the inclusion of the lowlands of Southwestern Washington in the same eco-region as the Puget Sound lowlands Eco-region: I think it's going to be a minor issue for the Western Washington Rating System, but we've run into some questions in applying WAFM. I'm most concerned about application the landscape tool to mitigation planning and design. While I understand the practicality of lumping vs. splitting in this case, I want to see mitigation and restoration efforts in Clark County to achieve ecological rather than regulatory success. Hopefully our current wetland restoration strategy project will address these issues and give us a better understanding of the similarities and differences between the Southwestern Washington and Puget Sound lowlands.

Response: In Washington, the technical committees and "assessment" teams that developed methods for assessing wetlands and the wetland rating system created the regions that, based on their expertise and knowledge, best reflected differences in the functions performed, or differences in how the functions are performed. These assumptions were confirmed by the teams during the extensive field testing that took place. The experts involved, and the peer reviewers of the methods, judged that wetlands in southwest Washington have similar functions, and perform those functions in similar ways. As a result, wetlands in western Washington were lumped together into one region for the purposes of understanding their functions. Furthermore, the landscape tool being developed by the Department of Ecology does differentiate between glaciated and non-glaciated areas in the Puget Sound Lowlands. We look forward to learning about conclusions made during Clark County's wetland restoration project.

2.2 Comment: With respect to the extensive discussion of functions, I would like to see (I have always wanted to see this in all the verbiage about wetland functions) a rooting in the general concepts of ecology. Whereas functional ecology is a long established concept, every discussion of wetland functions seems to spring from a place with no background. Also, ecology links structures and functions, a link too infrequently made in wetland discussions. Functions arise out of the combination of structures present and their interrelationships. The failure to incorporate and appreciate this, I believe, has contributed to, among other negative outcomes, the poor record of being able to reestablish functions in wetlands. I would like to see the section start with a concise review from the general ecological literature of these points before moving into the wetlands literature on the subject.

Response: In Section 2.2.3 we consider that we have tied the discussion of functions to the links between structure, processes and functions as requested by the reviewer. A section on ecological principles has been added to Chapter 2.

2.3 Comment: The discussion of water quality functions relies on a small body of literature. While the paper Reinelt and Horner (1995) is cited elsewhere, its findings are not very well represented here.

Response: The main citation on the water quality functions is Adamus et. al. 1991, which is itself a major review of the literature up to that date. Rather than citing all the references cited in the review, we cite the conclusions presented in that review. The review by Adamus was based on over 1000 articles. Where appropriate we have added more recent citations in our revision of Volume 1.

Section 2.1 Reader's Guide to This Chapter

Page 2-1

2.4 Comment: Good statement. "Chapter 2 presents information on wetlands in Washington and how they function. It introduces the concept that the performance of functions is controlled by a number of environmental factors … wetland classes."

Response: Comment noted. No action needed.

Section 2.2 Introduction and Background on Wetland Functions

Page 2-3

2.5 Comment: I found the use of the term ecosystem in Section 2.21 page 2-3 to be awkward and nontraditional. I do not believe this is the common usage for the term.

Response: We disagree. The term "wetland" ecosystem, or the "ecosystem in wetlands," is relatively common. A search of the internet found over 208,000 references to "wetland ecosystem." The University of Washington even has a "Wetland Ecosystem Team."

2.6 Comment: Paragraph 3 First Sentence - Awkward.

Response: Sentence re-worded.

2.7 Comment: Paragraph 4 - Our classification (at least mine) are more than simple lists of plant communities. It has been completed at the "dominance" level (stand level) by the classifications by Crawford and Kovalchik for eastern Washington. What about all the good works from Wayne Elmore's "Proper Functioning Condition" team?

Response: The comment was made regarding a paragraph that provides a historical perspective on functions, it does not discuss classification. Wetland classifications, and the classification for eastern Washington are discussed in Section 2.3 (see response to comment 2.29).

2.8 Comment: Paragraph 4, first sentence - Good.

Response: Comment noted. No response needed.

2.9 Comment: Last Sentence. Good.

Response: Comment noted. No response needed.

Page 2-4

2.10 Comment: paragraph 3 - Are they not watershed scales as well?

Response: Watershed scales are in between the microscopic and continental scales mentioned in the text and thus are included. Although the reviewer is correct, we did not think it necessary to list all the scales at which wetland functions occur.

2.11 Comment: Paragraph 4 - Good! Ecological?"

Response: Comment noted. Unable to determine the intent of the question.

Page 2-7

2.12 Comment: Box on Page 2-7 - Glad you are concerned about fixing the confusion!

Response: Comment noted. No response needed.

2.13 Comment: Box on Page 2-7 - Good clarification, but where does this document stand on this issue? I consider "opportunity" to often be more closely related to wetland value, not function. If and when it is, you have muddled functions and values, which you rightfully seem to want to avoid.

Response: Comment noted. Relating opportunity to value or to function depends on how the two are defined. In Washington State technical teams developing function assessment methods defined functions to include opportunity (see Section 2.4).

2.14 Comment: Box on Page 2-7 - There is the statement that "society, however, does not necessarily attach value to all functions." Is this a factual statement based upon a study or survey of societal values towards wetlands? What is society? Is it America, or Washington State, or Puget Sound? I tend to have more faith in the human capacity to understand environmental issues. If humans don't value all wetland functions, then why? Perhaps they have simply not been educated. This statement appears to be somewhat of an over-generalization.

Response: The statement was changed to read "society does not attach the same value to all functions." This is a direct summary of the quote from the National Research Council.

2.15 Comment: Box on Page 2-7 - In the 1980's and 1990's there were several meanings included in terms "functions and values." These terms were used to explain why wetlands were important. The term, "Value" was used not just to identify importance to society but also to indicate the degree to which wetlands functioned. For example, a wetland that had high diversity and density of birds and mammals had a relatively high "value" for the function of fish and wildlife. Essential habitats that were limited had a high "value" for species maintenance, for example, mature forested wetlands that provide large snags with nesting habitat for cavity nesting ducks. Adamus (1983) identified function, importance to the function and significance of wetland function. Significance of wetland function was identified by Adamus as the relevance or usefulness to human interests.

Value can also indicate importance of a location's function. For example a slope wetland may provide and essential habitat component (water and minerals) for band-tailed pigeon. A wetland with high wetland "values" may be concentration sites for a particular species (high densities) or have very high diversity of animals. A wetland may provide a critical life function at a critical time; for example elk calving or coho salmon rearing in high stream flows.

Response: Comment noted. This is why we have tried to clarify how we use the term "values." Although Adamus lumped value and function together (importance of function, significance of function as relevant or useful to humans), the technical teams developing the function assessments for Washington decided that it was more accurate and useful to separate the function of a wetland from its value. Separating value from function provides clearer information about what a wetland does versus what is valued for, thus providing better information for managing and protecting wetlands.

2.16 Comment: Last Paragraph - Sentence currently reads: "This function will, therefore, change if the wetland is drained so no surface water remains." We would like to point out that permanent open water is not a requirement for out of channel rearing habitat for coho salmon. Seasonally flooded wetlands, that may be dry part of the year, are used by coho in high winter flows for refugia and rearing.

Response: Sentence re-written to avoid confusion.

Page 2-8

2.17 Comment: Paragraph 3 (BOX) - Users of this document will need to know what level or intensity of disturbance is substantial enough to cause a significant impact. Since the goal of Volume 2 is to develop management options and regulations to protect wetlands, this volume needs to consider relationships between the intensity of the various disturbances and functional impacts to wetlands.

Response: The concept of "significant" impact has been changed to "documented" impacts. The concept of thresholds of disturbance above which impacts become "significant" may not be valid since all disturbances have some impacts (R. Horner, personal communications). Determining what is a "significant" impact depends on the viewpoint of the observer and is a value judgment. As such it is in the realm of public policy and this is discussed in Volume 2.

Page 2-9

2.18 Comment: Box on Terms used to refer to Drainage - Same thing?

Text to which this comment relates: "Surface and subsurface water flows through the landscape within drainage systems. These drainage systems are often called basins, sub-basins, watersheds, or river basins depending on the size of the area. In this document, drainage systems are generally referred to using one of two terms"

Response: No change was made. The comment is unclear and no guidance is provided on what should be changed.

Page 2-10

2.19 Comment: Figure 2-1 - This figure is quite simplified. I think it is incorrect without an arrow indicating that the mineral and nutrient concentrations can control the chemical transformation processes.

Response: Comment noted. But, the information presented is limited to that found in the reference. This figure is from the model developed by Barbara Bedford and is used to illustrate that model. It does not try to incorporate all interactions.

Page 2-11

2.20 Comment: Top Bullets - Watershed processes described by authors such as Beechie and Bolton are the movement and routing of water, sediment, nutrients and pollutants, large woody debris and energy. However it also seems that one excluded process is needed to fully understand watershed processes: ***the movement and routing of plant and animal genetic material.*** This is significant in native versus exotic plant communities, and interactions that take place in biological food chains and relationships.

Response: Comment noted. But, the information presented is limited to that found in the reference. These bullets are from the model developed by Naiman et al. (1992) and are used to illustrate that model. They do not try to incorporate all interactions.

2.21 Comment: Figure 2-2 - Process-structure-function Model. Vegetation classifications are important tools here (i.e., for understanding functions and processes.

Response: Comment noted. "Plant communities" was added to list of structural elements in a wetland.

2.22 Comment: Figure 2-2 -Process – structure – function. Not measuring along linearly and in one direction.

Response: Intent of comment unclear. Unable to respond.

Page 2-13

2.23 Comment: Table 2-2 - If one considers the "landscape level" as the watershed or bordering ecosystems of a wetland, there are also scales at the regional level that can affect these environmental factors and functions in a significant way. For example: Input and timing of water occurs at a regional or sub-regional scale dependent on rainfall –regional variations in elevation, orographic effects, etc. affects hydrology and hydrologic functions of wetlands.

Input of nutrients and toxic contaminants is partially affected by atmospheric transport and deposition processes (acid rain is one example that is known to have substantial effects on aquatic systems in some environments).

Response: We agree. Our definition of landscape is more inclusive than just the watershed. A box defining terms is being added to this chapter.

2.24 Comment: Table 2-2 - Deposition of salts is also controlled at the landscape level, as the routing of water to the wetland will affect the loading of salts to the wetland. It will also affect the relative proportion of evaporation vs. flow through, a key factor in salt accumulation.

The types and levels of salts in soil that are transported to a wetland via natural or irrigation waters also control the concentration of salts distributed to the wetland in surface water at the landscape level.

Response: We agree. However, at present this is only a hypothesis and we found no information on which to support this hypothesis even though it is a plausible effect. We did, however, find references on the effects of salt at the site-scale. For this reason we listed "mostly site" in the second column rather than "site" only.

Page 2-14

2.25 Comment: I think the third category of function is better described as "biological" rather than "maintenance of habitat and food webs". Habitat and food webs are one way of evaluating and describing a subset of the biological functions a wetland may provide.

Response: We are using the terms "habitat and food webs" to maintain consistency with the way functions were named by technical committees who developed the function assessment methods for Washington State.

Page 2-15

2.26 Comment: Line 1- Suggest adding "and quantity" to the first sentence such that it reads "…the source and quantity of water;…"

Response: Change made.

2.27 Comment: Bullets - Physical – what about biological? Are you talking broad scale? Vegetation/communities are both above and below ground (roots, fungi, bacteria, micro-fauna.

Response: "Biological interactions" added to the list of controls.

Section 2.3 Classification of Wetlands in Washington…

Page 2-16

2.28 Comment: Paragraph 1 - USFWS Classification System – This value of this system should not be disregarded. The system uses a variety of sub-class designations and modifiers that capture a substantial amount of information. The system is actually quite detailed, and useful in understanding potential biological functions of wetlands, as it identifies vegetation types, water permanence and regime, water chemistry and other special conditions. For most wetlands, the classification allows some assessment of hydrologic and water quality functions. At least in western WA, if one were required to describe wetland functions using only a USFWS map vs. only a map showing the HGM classifications used in the Ecology Functional assessment manual, I think that generally the USFWS map would allow a more complete description for most functions. The principal limitation in WA seems to be that the watershed influence cannot always be judged for palustrine wetland classes. This is because flow through vs. isolated hydrology is not known if a riverine subclass is not linked to the palustrine wetland. The most useful system, in my opinion, would be to add an HGM modifier to the USFWS system.

Response: The statewide teams developing the methods for assessing wetland functions considered using the Cowardin Classification, but decided the HGM classification provided a better and more intuitive understanding of wetland functions. We were unable to link the descriptors used in Cowardin with specific functions. Furthermore, at a national level, the HGM classification was developed specifically to address the shortcomings of Cowardin as they related to assessing functions.

2.29 Comment: I'm afraid I was very critical of the absence of Rex and my classifications, as I should be! They are very important _____ for understanding plant and community ecology in the "east-side." I can only conclude a "west-side" bias to the report. Otherwise a huge and noble task, though understandable rather genetic. In bibliography and not in text where it should be. I noticed again that the document is ignoring Rex Crawford's classifications (and management) publications for eastern Washington. Rex's is published and mine is still on the Wenatchee NF website. However mine is available for use and folks should do so. It will be published sometime this winter by PNW. I consider these major omissions.

My classification cover 6,000,000 plus acres. The Columbia Basin is now big? – BIG! Where are commonly need, geomorphology – based stream classification such as Rosgan or Montgomery and Buffington. Sorry – but I find the states stream classification very unusable. Bias!? You bet!

Do whatever you wish at this late date. However, if you ignoer my work (10 years worth), you are missing some of the best information on wetland and riparian systems for eastern WA. I did not simply "list" communities but diverted greatly from traditional classifications so that I could provide more information on management, processes, and functions. Its too bad PNW has been so slow getting the publication out - perhaps people would be more understanding of it's value then.

Additional Comment Written in the Text: The classifications by Crawford and Kovalchik complete the Cowardin Classification at the dominance or site/stand specific level. If you mention Cowardin, it is imperative that you understand and include these classifications in this publication. They are more than simple lists of plant communities! See e-mail exchanges. Rex and I provide classification used for looking at wetlands at the stand scale. I feel Rex and my classifications are getting users into the functional arenas.

Response: The discussion of classifications is being expanded to include other vegetation based classifications that were developed in Washington including those by Kovalchik for the east side and Kunze for the west side. This response also addresses Comment 2.7

Page 2-17

2.30 Comment: Table 2-3 - This table illustrated how HGM classes provide little ability to judge habitat functions. See comment about USFWS classification and HGM.

Response: The table is being expanded to include information on how the classification relates to functions.

Page 2-18

2.31 Comment: Paragraph 1 - A substantial drawback to these assessments is that they generally are not scaled to any actual scientific measures of functional performance. They generally lack any real quantitative understanding of the actual rates of functional performance in a wetland, how rates vary, and the relative significance of functional performance rates for wetlands compared to adjacent, non-wetland ecosystems. As a result, their accuracy and reliability is likely to be low.

Response: Assessments that are scaled to actual scientific measures of functional performance are by their nature very laborious and time consuming, requiring much research. There are no function assessment methods that have been developed to be rapid and applied at any time of year that are based on these quantitative measures of performance. Instead the assessments developed for Washington were based on surrogates to quantitative measurements. These surrogates are called "indicators" or "variables" which were chosen based on information existing literature and the expertise of regional experts regarding specific functions.

Some limitations are associated with any of the methods that use indicators and these limitations are clearly stated in the documents describing the assessment methods. The limitations are also discussed in Hruby, T. 1999. Assessment of wetland functions: What they are and what they are not. Environmental Management 23:75-85. Despite the limitations, the methods do reflect the potential of performing functions adequately for protecting and managing wetlands (Hruby, 1999).

Page 2-20

2.32 Comment: Text to Which it Relates: " *Generally the Montane regions include areas above 3,000 feet (915 m) elevation, and the Lowlands of Eastern Washington include all other areas in the "Dry" domain, outside the Columbia Basin, and below 3,000 feet (915m) elevation."* 3,000 as a divider within _____ area so diverse in climate and geology is, 2500 feet east of but in the vicinity of Snoqualmie Pass is in the Pacific _____ zone, are areas of high precipitation and essentially maritime driven. 3000 feet near Tonasket is in low-precipitation associated with continental climate and much drier vegetation of Douglas-Fir, Ponderosa Pine, Shrub-Steppe."

Response: We agree that the elevation of the boundaries can vary. That is why we use the word "generally." It was not feasible in this review to describe all the variations in the boundary found within the state.

2.33 Comment: Section 2.3.4.1 - You are missing terrace wetlands which are driven by water sources other than from shading. The area involved in some cases may be a huge compound to the floodplain.

Response: This comment is unclear to us. Wetlands on riverine terraces in Washington can usually be classified as "Flat" or "Slope" wetlands. They are Riverine only if flooded directly by the river or stream.

2.34 Comment: Section 2.3.4.1 - Please define the term active floodplain in terms of recurrence interval; frequently flooded means more than 50% of the time which may infer the < 2 year flood.

Response: We are not including the recurrence interval in this brief description because it is different in different regions of the state, and not all regions have had their riverine wetlands defined in terms of recurrence interval. Adding all this information here would, we believe, cause confusion. More detailed information is available in the methods for assessing functions and in the rating system. Because of the detail involved we refer the reader to those other documents.

Page 2-22

2.35 Comment: Section 2.3.4.3 - Is this where the terrace wetlands belongs?

Response: Terrace wetlands may be depressional, flats or slope, so they do not belong to any single class.

2.36 Comment: Section 2.3.4.3 - Suggest replacing "daylights" with "surfaces"

Response: Change made.

Page 2-23

2.37 Comment: Section 2.3.4.4 - Lacustrine Fringe (Lake-Fringe) Wetlands. Definitions of "lakes and ponds." The differences in size and depth between states, between agencies researching etc. drives me nuts. Why can't we all agree on a common system of definition, regulation, and management guidelines across the board?

Response: It would be nice to have a common definition. Unfortunately different agencies have different mandates and reasons for defining lakes. The definition used here is based on ecological principles and we have had to define lakes differently on the east and west sides based on ecological factors.

2.38 Comment: Section 2.3.4.4 - It seems like it would be useful to mention the definition of deep water (i.e., ≥ 6.6 ft. at ordinary low water) used in Cowardin et al. and how this relates to the definition of lacustrine fringe wetlands.

Response: Clarification added.

Section 2.4 Overview of Wetland Functions in Washington State

2.39 General Comment: Some wetlands are very diverse in their structures and processes, this provides a broad range of these functions. Other wetlands are surprisingly simple with a corresponding reduction in the number of diversity of the function that can be provided. See Classification!

Response: Comment noted. No changes needed.

Page 2-27 (and 2-46)

2.40 Comment: Recharging Groundwater - In our work we found the groundwater discharge function to be much more prominent than the account here. In our intensive studies of two wetlands, we found recharge to occur only on the relatively rare occasions when the wetland water levels were way up and providing a strong static head to drive water through the reluctant till. The most complete account is in the master's thesis by M. Surowiec (1989), UW Civil Engineering.

Response: Groundwater discharge is not a function, per se, of wetlands: it is an "occurrence." Initially the consensus of the teams developing the methods for assessing functions in Washington (Hruby et al. 1999, Hruby et al. 2000) was that "groundwater discharge" was not a wetland function. It is a process that occurs in the landscape. More recently, other wetland hydrologists were consulted from around the country and they supported this initial conclusion (R. Jackson and R.J. Pierce, personal communications). In many systems, the discharge occurs along the stream bottom and hill sides with no wetlands present at all.

2.41 Comment: Recharging Groundwater - I cannot provide any citations at this time but it seems likely that much like streams different wetlands types likely provide at least seasonal groundwater recharge, depending on the geological deposits and hydraulic head. I believe there is a conclusion in Chapter 2 that slope HGM wetland types do not recharge groundwater and wetlands do not provide base flow support to streams. Neither of these positions appears to be supported by specific literature citations. Seems as though there needs to be citations from hydrogeological studies examining the hydrologic functions of Pacific Northwest wetlands to support such positions. Although it appears likely that each wetland may only provide limited recharge, especially slope HGM types and depressional HGM types, cumulatively these may be significant contributors to recharge and/or base-flow support.

Response: Some wetlands do provide recharge, but not many (see previous comment about the relatively rare occurrence of this function). Recharge requires a significant hydraulic head and enough storage in the wetland to keep the water in the wetland until it has had time to percolate.

With regard to "baseflow" support: Initially the consensus of the teams developing the methods for assessing functions in Washington (Hruby et al. 1999, Hruby et al. 2000) was that "baseflow support" may be provided by some wetlands, but it was not important enough to assess. More recently, other wetland hydrologists were consulted from around the country and they supported this initial conclusion (R. Jackson and R.J. Pierce, personal communications). There were three major reasons why this function was not judged to be important:

1) Wetlands whose major source of water is groundwater are not providing the function since they do not store significant amounts of surface water to recharge the baseflows.
2) Most surface water left over from spring rains and melting will have evaporated by the late summer when baseflow is most needed. If water is present late in the summer it is usually a result of groundwater.
3) And in eastern Washington: Given the high rate of evapotranspiration (ET) in (in excess of 36 in./yr in many areas), wetlands have to store very large amounts of water before there is a net balance of water going to groundwater. A simple water balance would suggest that a wetland has to impound more than 36 inches (deep) of surface water for there to be a net gain to groundwater in areas where the rate of ET is 36 inches. A net gain to groundwater, and therefore support to baseflow, is possible only when the amount of surface water stored in the wetland is greater than the amount lost through evapotranspiration.

2.42 Comment: Regarding "general habitat functions"- Assessing this function is redundant and unnecessary when habitat functions for invertebrates, amphibians, fish, birds, mammals, and plants are assessed.

Response: General Habitat Suitability is defined as the characteristics or processes present in a wetland that indicates a general suitability for a broad range of wetland dependent species; more than the 6 groups listed. For example, the general habitat function incorporates elements that are important to decomposers and other microbial life.

The function also includes processes or characteristics within a wetland that help maintain ecosystem resilience (characteristics that are important in maintaining the ecosystem when it is disturbed). This function is not focused on individual species groups like the other habitat functions, but rather it emphasizes the elements in a wetland that help support a range of different animal species.

Page 2-28

2.43 Comment: Supporting Food Webs - Regarding "supporting food webs" function: This should be renamed to capture the concept that the function, as described, is considering food webs that are primarily external to the wetland. "Export of production" "Food transport" "Support to food webs in adjacent systems" are potential names that are more explanatory.

Response: The names of the functions are those developed for the "Methods for Assessing Wetland Functions" in the state. These names are retained in this review to maintain consistency.

Section 2.5 How Wetlands Perform Functions in Washington State

Page 2-29

2.44 Comment: Table 2-5 Wetland associated birds-Common snipe can occur in emergent slope and flat wetlands in eastern WA. Slope Ag wetlands in western WA can also support this species.

Response: We were unable to confirm the observation that common snipes occur in slope wetlands. All the published information on Snipes state that this species is found in wetlands with open water or ponded water (not a characteristic of slope wetlands). We also contacted biologists with the Washington State Department of Fish and Wildlife but were unable to confirm this observation.

2.45 Comment: Table 2-5 - This table gives the dangerous illusion of being able to predict function simply using HGM class. It needs a caveat in the header stating otherwise. Actual performance depends on site characteristics. P should stand for "potentially performed", not performed.

Change P to NS: Slope Wetlands, Reducing Peak Flows
Change NS to P: Flats – Removing Sediment, Metals
Change NS to P: Slope – Wetland Birds, and Lacustrine-Recharging Groundwater
(I can document most of these suggestions – contact me to discuss)

Response: Changes made with the exception of the last one. We were unable to confirm that wetland-associated birds, as we have defined them in Washington State (Hruby et al. 1999, Hruby et al. 2000) commonly use slope wetlands. Thus, we have listed the information as "NS-Functions are probably not performed to any degree that provides important values to society." Groundwater recharge requires that the water levels in the wetland are higher than that of the groundwater to create a hydraulic head that drives the water into the ground. Water levels in lakes are usually an expression of groundwater and this means there is very little head, if any, to push the water into the ground.

2.46 Comment: Table 2-5 - I believe this should have a caveat for western versus eastern Washington. Based on my extensive field work on slope wetlands in northern Nevada, I believe these areas do provide functions for Reptiles, Amphibians, Birds and Mammals. I could not tell you if the creatures I saw were "wetland associated" or not but they most assuredly used them for drinking, habitat and food. In fact, many of these wetlands supplied structural complexity, connectivity, food sources, and microclimate. My point being that in arid/semi-arid areas users of these slope wetlands are by definition "wetland associated". It is also very possible that I do not understand the difference in such terms as "wetland associated" and "wetland dependent".

Response: "Wetland associated" vertebrates are those that require aspects of the wetland ecosystem to support one or more of their life requirements. Species that can survive in the absence of wetlands or open water are not considered "wetland associated." It is true that wetlands in arid and semi-arid environments provide habitat and "oases" for a large number of species, and this is captured in the function called "general habitat."

2.47 Comment: Table 2-5 -Habitat for Anadromous Fish - There is no mention in the document of potential for stranding fish. In some areas, this is a major concern for mitigation planners.

Response: Fish tend to be stranded in situations where human alterations have modified the habitat. As such this is not part of a wetland function, but rather an issue in mitigation planning as mentioned in the comment. This issue has been added to the section on impacts of human activities on fish.

2.48 Comment: Table 2-5 Habitat for Wetland-Associated Birds - We question the listing of slope wetlands as not performing food, shelter, breeding, or resting functions to any significant degree for Wetland-Associated Birds.

Response: See Comment 2.46 above on "wetland-associated"

2.49 Comment: Table 2-5-There is no information on the state of science regarding wetlands as processors of fecal bacteria or pathogens (relative to Table 2.5 and Section 2.5.1.).

Response: The list of functions discussed in this document was not meant to be all inclusive. The list only represents those functions that were chosen as highly important when developing the methods for assessing functions in the state. A discussion of all possible functions was not feasible with the resources on hand. Mention of the removal of pathogens, however, has been added in the text where appropriate.

2.50 Comment: Table 2-5 - There was at one time a great deal of local interest in using wetlands (natural or constructed wetlands to treat runoff from farms, urban areas, etc.) to remove pathogens. There has been some research of field studies. I have seen some of them. I don't have time now, but I might be willing to assist in a literature review (contingent on management approval, of course).

Response: The design and use of wetlands for treating polluted waters is an important topic, but not one covered in Volume 1. The literature on this topic is extensive and several text books have been written. We did not, however, consider this aspect of wetland functions to be critical in helping local governments protect and manage wetlands and, for lack of resources, decided not to cover this topic.

Page 2-30

2.51 Comment: Paragraph 3 - Kadlec and Knight (1996) provide a good description of removal processes in wetlands. Most sediment removal is simply by gravitational forces and not filtration. Most chemical removal processes that occur in wetlands are not true "filtration" processes. They are more complex mass transfer processes to sediment or other adsorption sites and often mediated by microbial processes (see for example Kadlec and Knight 1996, page 271).

Response: Discussion has been expanded to include this reference and points made by the reference.

2.52 Comment: Paragraph 4 - How typical is this for WA? Also check the cited sources to verify that they say it was the vegetation, not geomorphology, that was mostly responsible. Otherwise reword.

Response: Text has been re-worded.

2.53 Comment: Paragraph 5 - The use of "sediment pollution" is misleading here, as sediment is not always a pollutant. In nearly every river, stream, or wetland, some component of sediment naturally derived. Sediment transport and deposition is a natural process of all stream systems; some systems have naturally higher levels than others do. Sediment removal and water quality "improvement" is a natural function provided by many wetlands regardless of human activities.

Response: Text was changed to note that the important factor is removal of excess sedimentation caused by human activities.

2.54 Comment: Paragraph 5 - "Less than 65 % of the sediment eroded from uplands exits watersheds that contain wetlands." Compared to what percent of sediment that exits from watersheds that do not contain wetlands?

Response: The study cited did not document sediment going through watersheds without wetlands.

Page 2-31

2.55 Comment: Wetlands in the Flats Class, First Line - The Palouse! Columbia Basin region in general! Worst case scenario.

Response: There are no indications that we find wetlands in the Flats class in the Columbia Basin and the Palouse. By definition wetlands that are "flats" have to receive all of their water from precipitation falling within the boundary of the wetland. Thus, "flats" wetlands will probably not form in areas where the rate of evapotranspiration is higher than the rate of rainfall because the waters will tend to evaporate before wetlands can form.

2.56 Comment: Wetlands in the Flats Class - Many have high opportunity for retaining wind-blown sediments, especially in eastern Washington.

Response: See comment above. Given that there are no wetlands in the Flats Class in the Columbia Basin or the Palouse, the opportunity doesn't exist.

2.57 Comment: Wetlands in the Flats Class - Hard to imagine "flats" at all.

Response: See response to Comment 2.55 above.

2.58 Comment: Wetlands in the Depressional Class - If they get excessive sediment, even though changes by ecology/community/functions and perhaps no longer a wetland.

Response: Comment noted. This is a change caused by excess sediment and is discussed in Chapter 4.

Page 2-32

2.59 Comment: Wetlands in the Slope Class - I can't agree with you when you say this. Clarify. Yes! And contradicts 1st paragraph. *(comment regards unclear statements about removing sediment)*

Response: Text clarified to avoid this seeming discrepancy.

Page 2-33

2.60 Comment: Wetlands in the Riverine Class – Something bothers me here. Not the whole story. – erosion—deposition—erosion—deposition-- A yearly _____ to some degree, depending on flow, magnitude.

Response: Text clarified to include the concept of erosion and deposition.

2.61 Comment: Bullets - Simplify this to say the key factor is how much water gets into the shallow vegetated areas how frequently and for how long.

Response: The bullets represent the indicators used in the methods for assessing functions and it was thought important to include them here. The bullets represent the factors that affect how frequently and for how long water gets into the vegetated areas and we judged it important to list these factors rather than just a summary of the process.

2.62 Comment: Make up your mind: phosphorus or phosphorous.

Response: Spelling has been standardized.

Pages 2-33 to 2-35

2.63 Comment: While it is likely beyond the scope of this document to discuss phosphorus removal extensively, the discussion presented is extremely simplified. This should be acknowledged and more through references cited. Kadlec and Knight 1996, Wetzel 2000, and Richardson and Vepraskas 2001 provide good descriptions of the overall process. Sand and silt soils are also capable of adsorbing and removing phosphorous.

Response: Clarification and additional references added.

2.64 Comment: Statements about wetlands retaining phosphorus if they retain sediment. Too simplistic. Integrate better with the caveat on Page 2-33 second paragraph from bottom, about anoxic conditions remobilizing; this can happen often.

Response: See response to comment above.

Page 2-35

2.65 Comment: Box, Paragraph 2 - Phosphorus removal in water is also dependent on pH, alkalinity, and hardness.

Response: Text in box is a quote and cannot be changed. Additional clarification added in text.

2.66 Comment: Section 2.5.1.3 Removing Nitrogen - While it is likely beyond the scope of this document to discuss nitrogen removal extensively, the discussion presented is extremely simplified. This should be acknowledged and more through references should be cited. Kadlec and Knight 1996, Wetzel 2000, and Richardson and Vepraskas 2001 provide good descriptions of the overall process. Volatilization of ammonium nitrogen is a second pathway for the complete removal of nitrogen from aquatic systems (Vymazal 1995, Wetzel 2001). This occurs at higher pH (greater than 7.5) and may be more significant in alkaline wetlands in eastern WA. Alternating reduced and oxidized conditions are not required for nitrogen removal from soils, and the processes of nitrification and denitrification can occur simultaneously in both upland and wetland soils

(see Wetzel 2001, Vymazal 1995). Upon death, not all nitrogen is leached from plant materials. Where subsequent decay is not complete (i.e. organic soils are accreting) burial of organic nitrogen in organic matter is a nitrogen removal mechanism that occurs in wetlands (Kadlec)

Response: Clarification and some of the additional references listed in the comment have been added. Not all the references above were cited because they provided much of the same information.

Page 2-36

2.67 Comment: I believe some newer research show greater removal with increasing (not decreasing) loading**.**

Response: No citations were provided with this comment and we were unable to track down references on this subject.

2.68 Comment: This needs to mention that some wetlands potentially can appear to be N sources, at least seasonally, if they attract significant concentrations of waterfowl, pets (dog poop), or support nitrogen-fixers (especially Slope wetlands covered with *Alnus* sp Page).

Response: Clarification added.

2.69 Comment: Ammonification – not ONLY denitrification – can convert soluble N to gaseous N.

Response: Ammonification occurs at very low rates in wetlands except maybe at high pH in alkali systems. Clarification has been added.

2.70 Comment: Plant growth can remove N from the system if N is translocated to belowground biomass at sites with rapid depositional conditions.

Response: Even if N is translocated below ground it will eventually become available to groundwater as the roots decompose.

2.71 Comment: Paragraph 5 - Some nitrogen is removed by woody plants when it is assimilated into the wood of shrubs and trees. Also, there are references to wetlands throughout the text as "aquatic system," such as in the second sentence of this paragraph. It seems inappropriate to call wetlands aquatic systems unless they have permanent inundation.

Response: Woody material eventually also releases any organic nitrogen on its decomposition. We disagree with the definition of aquatic systems as needing permanent inundation. For example, riparian areas are considered part of the aquatic system and they also do not have permanent inundation (National Research Council 1995, see list of references in Volume 1).

2.72 Comment: Last Paragraph - It seems that position in the landscape influence nitrogen loading, especially where there are anthropogenic sources, and therefore nitrogen removal. Perhaps the paragraph should be modified to clarify that landscape position may affect nitrogen removal where wetlands receive increased nitrogen loads, such as from urban runoff. Clearly a montane wetland would not receive the same N loading as a riverine flow-through wetland on a river that receives sewage effluent.

Response: The discussion in this chapter is centered on the factors within a wetland itself that "create" the function. The question we are trying to answer is: What structures or processes in the wetland allow it to perform the function. This is called the "potential" for the function. The factors that influence the loading is called the opportunity, and as mentioned in the comment, this is a factor of the wetland's position in the landscape. It is independent of the factors within the wetland itself, and is discussed in more detail in the rating system. We did not try to discuss the differences between potential and opportunity in this volume.

Page 2-37

2.73 Comment: Section 2.5.1.4 – Removing Metals and Toxic Organic Compounds - Text states: "In the absence of research to the contrary, it can be assumed that wetlands in all regions of the state and in all wetland classes have the potential to remove toxic metals and organic compounds based on the composition of their soils" [underline added]. I feel that statements and/or conclusions based "in the absence of research to the contrary" are not based on "appropriate sources of scientific information." To the contrary, they are based on speculation in the absence of appropriate sources of scientific information. In this case, the authors recovered a few paragraphs later by stating: "It is not possible, therefore, to make any definitive conclusions about the potential for all wetlands with clay soils to remove toxic compounds." However, there are several statements where the authors did not provide an appropriate follow-up disclaimer.

Response: The BAS rule states that the judgment of experts is an acceptable form of "best available science." Such assumptions in the document are supported with a clearly stated rationale based on interpretation of current information. Also, statements based on expert opinion of the authors are clearly labeled as such. We would understand the reviewers' concerns if these types of statements were not clearly identified as hypotheses or assumptions and were not supported by a clear rationale.

2.74 Comment: Section 2.5.1.4 – Removing Metals and Toxic Organic Compounds - My first series of comments are with respect to Section 2.5.1.4 "Removing Metals and Toxic Organic Compounds". On page 2-38 of the draft there is the section with the title Wetlands with C* Soils, I make the following comments:

The conclusion "It is not possible, therefore, to make any definitive conclusions about the potential for all wetlands with clay soils to remove toxic compounds' is probably accurate, but the approach used in this section to get to this conclusion I do not believe is sound. I believe that the conclusions in this section are probably accurate, but I don't believe the literature cited and the method or logic that is used to get to the conclusions is appropriate.

I would suggest that the following conclusion be changed as shown: "There is little information on the chemical properties of clays derived from deposited by glacial activity or aquatic sediments."

I do not think that the Bluemle (1999) reference is in any way appropriate for defining clay" soils or that it should be even used as a starting point for this whole discussion. Also I read the entire Bluemle article and did not find the information attributed to article. In other words, the cited information about "the three types of soils..." is not contained in the article (unless the citation is incorrect).

I believe "clay, might be defined better by using a reference such as:
"Dictionary of Geological Terms" 'Robert L. Bates and Julia A. Jackson (editors), American Geological Institute, May, 1984. Or; "Glossary of Soil Science Terms", Soil Science Society of America, Madison, WI, 1996. Or perhaps; Miel, Daniel (1982) "Introduction to Soil Physics." Academic Press, New York. Page 25.

1 do not accept that one of the types of soils that are called "clay" are "those that consist of very finely ground rock formed by glaciers" (see page 2-38 of the draft). Such finely ground rock is commonly called "rock flour" or "glacier flour". The AGI "Dictionary of Geological Terms" (see reference above) defines "rock flour" as "Finely ground rock particles, chiefly silt size, resulting from glacial abrasion." (Italics and underline are mine.) The Glossary of the "All About Glaciers" section of The University of Colorado National Snow & Ice Data Center web site (http://nsidc.org/) defines “glacier flour” as “a fine powder of silt and clay – sized particles that a glacier creates as its rock-laden ice scrapes over bedrock." (Italics and underline are mine.)

"Rock flour” or "Glacier flour" does not necessarily mean clay. Quite the contrary, it probably indicates silt size particles.

The section of the draft on "Wetlands and Clay Soils seems to infer that lacustrine and marine clays are not smectite (montmorillonite/bentonite) or kaolinite clay minerals. I do not believe this inference is valid.

There is a standard reference (albeit somewhat older) that might be appropriate to use in the discussions of this section on Clay soils. This reference is:
Dixon,].B. and S.B. Weed (eds.), "Minerals in Sod Environments." Soil Science Society of America, Madison, WI, 1989.

Response: Discussion on clays has been changed to reflect these comments. Also, the term clay is used in 3 different ways: to designate a diverse group of fine-grained minerals, as a rock or sediment term, and as a particle-size term. Rock flour consists of clay sized particles of rock generated by the erosive action of glaciers. We have found that rock flour or glacier flour is often called clay in the Pacific Northwest because its particle size falls in the range assigned to clays. This is the reason we are including rock flour under the term glacial clays.

2.75 Comment: Sedimentation Bullet - The bullet for "*sedimentation"* and reference to *"Canning as cited in Newton (1989)"*-there are numerous references characterizing urban runoff in Washington and the U.S. To increase the credibility of this document, primary references should be cited wherever practical. Referencing material that was not specifically reviewed by the authors of this document is undesirable, can lead to erroneous interpretations, and undermines the scientific credibility of the document. This same concern applies to many of the numerous other general review documents relied upon by the authors. An effort should be made to rely less on general review.

Response: We agree that primary references should be cited where practical. Unfortunately, we were unable to obtain the reference by Canning that was cited in Newton 1989. Existing syntheses, however, that have been peer reviewed are an important source of information because they represent the ideas and consensus of other scientists. We do not consider such syntheses to undermine the scientific credibility of the document.

2.76 Comment: Adsorption Bullet - This section would benefit from a brief discussion of exchangeable vs. extractable cation exchange capacity.

Response: We believe such a discussion is too technical for a general review such as this.

2.77 Comment: Paragraph 2 - "In Washington, the experts..." It is a stretch to infer that sediment removal is analogous to toxic compound removal. Toxic compounds that are bound to sediments may change forms in the wetlands especially if the pH fluctuates. *The Chemistry of soils (Sposito, 1989)* contains a pretty good discussion

Response: The intent here was to describe one of the processes by which toxics are removed. If a wetland receives toxics that are bound to sediments it will remove them along with the sediment. Text has been re-written to clarify this.

2.78 Comment: Bullet 3 - The bullet "*chemical precipitation*"- Precipitation of dissolved iron is common in wetlands where anaerobic groundwater containing reduced iron compounds surfaces. In the aerobic surface environment (either within surface soils or surface water), the iron compounds oxidize into insoluble forms and precipitate out from solution. During this process, phosphorous, metals and other compounds bind to the iron, and co-precipitate with the iron hydroxides (see Kadlec and Knight 1996, Wetzel 2001).

Response: Comment noted. Clarification added.

Page 2-38

2.79 Comment*:* Wetlands with clay soils section (same section as above, pg. 2-38) A better discussion of clay mineralogy can be found in the Handbook of Soil Science (Sumner ed. 2000). information on the mineralogy of clay soil in Washington can be found on the NRCS/USDA soils web page.

Response: The discussion of clay soils has been expanded and re-organized to better clarify the issues. See response to Comment 2.74.

2.80 Comment: Wetlands with Volcanic Ash - At this point, the only major thing that caught my eye as potentially incorrect is found in the soils section on page 2-38. Under the subtitle of Wetlands with Volcanic Ash:

There has been repeated volcanic eruptions from Mount St. Helens (likely multiple dozens). Dr. Nick Foit of the Dept. of Geology over at WSU (509) 335-3009 could probably give you a quick ballpark number on how many eruptions have been documented based on tephra identifications. Secondly, Glacier Peak was the next most active ash-producing volcano in our state. Again, Nick can give you some general information. Locally, Mt. Adams, Mt. Rainier, and Mount Baker would also have added some tephra layers in some areas, though their tephra was pretty coarse-textured. But frequently, the chemical composition of the magma rising in each of these volcanoes changed over the hundreds of thousands of years; some compositions being more silica-rich (and more explosive) while others have been more fluid. In contrast, Mount Mazama (eruption 6,850 yrs BP) dumped a notable volume of material throughout a large portion of the state. I just had an ash deposit collected in a Lopez Island wetland (organic soil deposit) verified by Nick Foit's Microbeam Laboratory as Mount Mazama. I don't want a reader to get mislead that Washington State has only been affected by Mazama and the 1980 eruption of Mt. St. Helens. There are dozens of other eruptions that dumped ash here and there, though mainly east of the Cascades. Ash deposits on the west side are much rarer and more localized, depending on the wind currents and eruption direction (exception, of course, is Mount Mazama).

Response: Text has been edited to reflect other sources of ash.

2.81 Comment: Secondly, volcanic ash does not weather into bentonite (at least not to my knowledge and all my textbooks). Volcanic ash typically weathers to a clay called allophane. If left alone to weather even further, allophane weathers to another clay called imogolite (Check out the 12th edition of "The Nature and Properties of Soils" by Nyle C. Brady and Ray R. Weil (a classic college soils text book). I have never heard of these secondary clay minerals weathering into bentonite. Now, in highly weathered soils (Ultisols and Oxisols) of the tropics and semitropics, and in Alfisols and even in Inceptisols of some temperate regions, various clays will weather into usually goethite, hematite, and/or gibbsite (basically Fe-Al oxides). Again, referencing Brady probably works, though I do have other more detailed soil genesis texts that could be referenced. I think it would be important to verify this "bentonite" byproduct. I think it is incorrect. In

Brady's book, he mentions allophane's and imogolite's ability to absorb high amounts of phosphate, es Page in acid soils (though this doesn't really answer the question of your section on absorbing toxic compounds).

Response: There seems to be some discrepancy in the literature on the types of clays that are the product of the weathering of ash. The references listed, and others such as descriptions of andisols (soils derived from ash) on the web do identify allophone as a weathering product. On the other hand, a bibliography on bentonite has numerous articles indicating a volcanic origin for the clay (Bentonite & Tonstein Bibliography This compilation was updated on 16 June 2004. *http://www.st-and.ac.uk:28080/gg/html/bentrefs.html*) Articles identifying bentonite as a derivative of volcanic ash include:

Bohor B F, Hatch J R & Hill D J 1976. Altered volcanic ash partings as stratigraphic marker beds in coals of the Rocky Mountain region. American Association of Petroleum Geologists Bulletin 60 651.

Bohor B.F, Philips R E & Pollastro R M 1979. Altered volcanic ash partings in Wasatch Formation coal beds of the northern Powder River basin. U S Geological Survey Open-File Report 79-1203 21pp.

As a result of this discrepancy the reference to the type of clay formed has been generalized to "several different types."

2.82 Comment: Wetlands with Volcanic Ash - In the section of the draft on "Wetlands with Volcanic Ash" the following statement is made: "Volcanic ash that is washed or deposited into wet areas is in time transformed into bentonite clays (Bluemle 1999)". Again, I do not believe the Bluemle article is an appropriate primary reference for this section of the draft. The Bluemle article is very specific to the Badlands of North Dakota. Geologic or chemical processes that occur there may or may not be applicable to freshwater wetlands in Washington.

It is commonly accepted (I don't have a specific reference for this) that Allophane, Imogolite, and other poorly crystalline clays are the common weathering products of volcanic ash. However, I don't know if these clay minerals are produced from ash in a wetland environment. A reference on this subject that may be productive is: McDaniel, PAGEA., A.L. Fallen, and M.A. Fosberg. 1997. "Genesis of Non- Allophanic E Horizons in Tephra-Muenced Spodosols. Sod Sci. Am. 1. 61:21 I- 217.

Response: See response to Comment 2.81.

2.83 Comment: Paragraphs 3 & 4 Clay Soils - Regarding the "chemical properties of clays derived from glacial activity" and "clays in Whatcom County" – large areas of Washington and the northern U.S. have been subjected to glaciations and are highly productive agricultural or timber producing areas. In these areas, extensive research on soil properties and productivities is available. I suggest this literature be consulted.

Cation exchange capacity is one indicator of the ability of soils to bind metals, and soil surveys for Whatcom Co. indicate reasonably high cation exchange capacities. These capacities are generally similar to soils from an un-glaciated are lacking marine soils are parent material (Multnomah Co., OR.) See chemical data available as a '.pdf' file at:
http://www.or.nrcs.usda.gov/pnw_soil/washington/wa673.html
http://www.or.nrcs.usda.gov/pnw_soil/oregon/or051.html

Response: The text was changed to suggest the possibility of similar chemical properties based on the information from the Natural Resources Conservation Service.

2.84 Comment: Wetlands with Volcanic Ash – It is likely that there are sufficient characterizations of Mt. St. Helens and Mt. Mazama volcanic ash layers, and that the evaluations would allow some determination as to how the soils might bind toxic compounds. A "grab bag" of references on volcanic soil provided by our soil scientist includes: (References below also placed in file for references.)

Ugolini, F.C. and Dahlgren, R.A. 1991. Weathering environments and occurrence of imogolite/allophane in selected Spodosols and Andisols. Soil Sci. Soc. Am. J. 55:1166 1171.

Ugolini, F.C., Dahlgren. R., LaManna, J., Nuhn, W. and Zachara, J. 1991. Mineralogy and weathering processes in recent and Holocene tephra deposits of the Pacific Northwest, USA. Geoderma 51:277 299.

Takahashi, T., Dahlgren, R. and PAGE van Susteren. 1993. Clay mineralogy and chemistry of soils formed in volcanic materials in the xeric moisture regime of northern California. Geoderma, 59:131 150.

Dahlgren, R.A. and M. Saigusa. 1994. Aluminum release rates from allophanic and nonallophanic andosols. Soil Sci. Plant Nutr. 40(1): 125 136.

Dahlgren, R.A. 1994. Quantification of Allophane and Imogolite. In: J.E. Amonette and L. Zelazny (eds.) Quantitative Methods in Soil Mineralogy. Soil Sci. Soc. of America, Madison, WI. 677:430 451.

Shoji, S.M. Nanzyo, and R.A. Dahlgren. Volcanic Ash Soils Genesis, Properties and Utilization. Elsevier, Amsterdam. 288 Page (Book).

Gasser, U.G., R.A. Dahlgren, C. Ludwig and A.E. Läuchli. 1995. Release kinetics of surface associated Mn and Nl in serpentinitic soils: Ph effects. Soil Science 160(4):273 280.

Dahlgren, R.A., J. PAGE Dragoo and F.C. Ugolini. 1997. Weathering of Mt. St. Helens tephra under a cryic udic climatic regime. SSSAJ 61:1519 1525.

Dahlgren, R.A., F.C. Ugolini, and W.H. Casey. 1999. Field weathering rates of Mt. St. Helens tephra. Geochim. et Cosmochim. Acta, 63(5):587 598.

Ugolini, F.C., and R.A. Dahlgren. 2002. Soil development in volcanic ash. Global Environmental Research 6(2):69 81.

Southard, S. B. and R. J. Southard. 1989. Mineralogy and classification of andic soils in Northeastern California. Soil Science Society of America Journal 53:1784 1791.

Schiffman, PAGE and R.J. Southard. 1996. Cation exchange capacity of layer silicates and palagonitized glass in mafic volcanic rocks: A comparative study of bulk extraction and in situ techniques. Clays and Clay Minerals 44(5):624 634.

Schiffman, PAGE, H.J. Spero, R.J. Southard, and D.A. Swanson. 2000. Controls on palagonitization versus pedogenic weathering of basaltic tephra: Evidence from the consolidation and geochemistry of the Keanakako'i Ash Member, Kilauea Volcano. Geochemistry Geophysics Geosystems, an Electronic Journal of the Earth Sciences. Vol. 1, 16 pages. http://www.g cubed.org/gc2000/2000GC000068/fs2000GC000068.html

Response: See response to Comment 2.81. We were unable to locate all of the references listed above. Of those that we did, none addressed the issue of weathering of ash under "hydric" soil conditions in wetlands.

2.85 Comment: Section with the title Wetlands with Organic Soils - This section simply states that peat bogs and fens in Washington State have the necessary soil conditions to react and absorb toxic compounds. I just wish to point out that there is a whole body of literature that deals with the use of peat in wastewater treatment. This literature in some cases explains the process for the removal of toxic compounds by organic peat. You may wish to consider this literature if there is a desire to expand the information provided in the draft. Designed, constructed peat filters are used to treat all kinds of wastewater. State and county health departments (including the WA State Dept. of Health) are very aware of this use of organic soils.

Productive references might be-,

Brooks, J.L., C.A. Rock, and R.A. Struchtenieyer. 1984. Use of peat for on-site wastewater treatment: 11 Field studies. J. Environ. Qual. 13:524-530.
Couillard, D. 1994. The use of peat in wastewater treatment. Wat. Res. Vol 28, No.6, p Page 1261 - 1274.

Washington State Department of Health. 1997. Guidelines for Peat Filters (Final Draft).
The Couillard reference (above) indicates that the use of peatland for the treatment of domestic, settled wastewater was effective, even in cold northern climates.

Response: This section is only an overview of the function, and we did not wish to go into a detailed discussion of the actual chemistry involved. Additional references however have been added to point readers to more detailed information.

2.86 Comment: Last Paragraph - Complexation of metals and organic toxicants with dissolved organic substances in pore-water and water in wetlands with organic soils is another method of toxicant removal.

Response: Clarification added.

Page 2-39

2.87 Comment: Paragraph 1 Regarding function of slope wetlands – Slope wetlands that have substantial groundwater seepage may perform nutrient and toxic chemical removal functions at a high level. These wetlands could result in functions similar to sub-surface flow treatment wetlands described in Kadlec and Knight (1996). The relatively slow rates of water movement in soil, and the extensive contact time with soil particles would promote removal of phosphorus, metals, and other compounds.

Response: The reason why slope wetlands are not mentioned is that the groundwater that flows subsurface does not carry many of the pollutants that are effectively removed in sub-surface flow treatment wetlands. The groundwater flowing subsurface in slope wetlands will in most cases not contain these surface water pollutants because they would have been adsorbed or transformed before they reach the wetland.

2.88 Comment: End of Paragraph 2 -NO, the presence of toxics in the watershed affects OPPORTUNITY, not effectiveness

Response: Effectiveness, as used in this report, is the combination of both potential and opportunity; not just the potential to perform the function.

2.89 Comment: Paragraph 2 - The potential to remove toxicants is dependent in part on the loading rate to wetlands. Because depressional wetlands often only receive toxicants from atmospheric deposition, the net removal potential appears to be higher for those wetlands receiving more pollutants, such as those that have multiple sources of pollutants (e.g., urban runoff and atmospheric deposition).

Response: Comment noted. We make the same conclusion but use the word "effectiveness" rather than "potential" because "potential" has a very specific meaning in the rating system and in the methods for assessing functions.

2.90 Comment: Comment concerns the following text - *This combined water storage and slowing action lowers flood heights and reduces erosion downstream and on adjacent lands. It also helps reduce floods and prevents water logging of agricultural lands*. - Maybe it's because I can come up with so many sites, specific examples, this paragraph bothers me. I can argue that strongest slowing raises water levels access a floodplain which is natural on wide, lower gradient valley bottoms. Eroded gullies that are not functioning properly can lower flood heights and prevent water logging of AG lands.

Response: This text is a quotation so we are unable to clarify the specific text. The reference may be more specific to headwater wetlands that desynchronize flood flows.

2.91 Comment: Paragraph 3 - While it is true that wetlands downstream of urban areas provide flood control benefits, isn't it true that wetlands upstream of urban areas provide the greatest flood control functions? Flooding is only a problem when developed areas are threatened. Perhaps this should be noted.

Response: This text is a quotation so we are unable to clarify the specific text. The reference is to wetlands that have a greater opportunity because the water regime in urban areas is highly altered and more prone to flooding. When reading the quotation, it can be assumed that there are further resources downstream that can be damaged by flooding.

Page 2-40

2.92 Comment: Section 2.5.2.1 Reducing Peak Flows - HGM class (i.e. depression) is an important indicator of this function. The bullet "Amount of flooding……" is exactly what this function is, and not an indicator. If one knew the answer to this bullet, the remaining indicators would be irrelevant. An important indicator not listed is the amount of live storage volume in wetlands relative to total volume of stream discharge during flood stages. The last bullet should be revised. If storage in wetlands is large, relative to flood discharges and upstream storage in lakes and reservoirs, then wetlands can provide this function.

Response: Corrections made and bullets expanded to include live storage and "relative" storage.

2.93 Comment: Paragraph 2: Considering most watersheds have a greater proportion of storage area in the soil of uplands than wetlands, it appears that uplands provide proportionally greater peak flow reduction potential than wetlands. Is the first sentence where Adamus et al. is cited accurate? Perhaps peak flow reduction is provided particularly (only?) when uplands have become saturated?

Response: The data reviewed by Adamus et al. would suggest that wetlands actually do provide more storage. In the absence of references to the contrary, we intend to keep this statement.

2.94 Comment: Last paragraph - The first sentence in this paragraph seems to support the previous comment.

Response: See response to Comment 2.92.

Page 2-41

2.95 Comment: Paragraph 3 - Riverine wetlands – regardless of whether a floodplain is wetland, the floodplain increases the cross sectional area of the stream, resulting in lower water elevations and slower velocities. In addition, backwater storage contributes to reducing flood elevations and velocities because of the time it takes to fill these areas during floods. This occurs regardless of whether backwaters are upland or wetland.

Response: Floodplains do have functions that are similar to riverine wetlands. The discussion in this report, however, is limited to wetlands.

2.96 Comment: Paragraph 4 - By storing ONLY the precipitation within their boundaries, Flats nonetheless help desynchronize runoff peaks. Change Table 2-5 accordingly.

Response: Paragraph 4 states that they do store precipitation falling within their boundaries and Table 2-5 states that flats may perform the function but not to any significant degree. We believe no change is needed in the table since the amount of storage is small relative to that found in other wetlands.

2.97 Comment: Paragraph 5 - The role of mature forest canopies in collecting water and potentially reducing runoff or recharge is quantified in Bauer and Mastin (1997). There are likely additional data regarding the hydrologic function forest canopies provide, including Harr et al. (1982).

Response: Commentor indicates these references make the same point already referenced in the text. We were, however, unable to obtain these references at the University of Washington Library so they cannot be cited as well.

2.98 Comment: Paragraph 5 re: slope wetlands - Confusing. Why not? They certainly have pure storage capacity at certain times of the year? It gets confusing where you combine contradictory statements like this.

Response: Text clarified to indicate slope wetlands only perform only one of the two major hydrologic processes (storage and velocity reduction).

2.99 Comment: Paragraph 5 - This paragraph seems to contradict the earlier statement about the lack of knowledge about the functions of slope and flat HGM types (i.e., gaps). While individual slope and flat wetlands may not provide a significant amount of peak flow reduction, it seems likely that they may provide a significant amount when they are considered together (i.e., cumulative effect).

Response: See response to Comment 2.98

Page 2-42

2.100 Comment: Paragraph 6, Wetlands in Eastern Washington -See comment re: storage in canopies.

Response: See response to Comment 2.95.

2.101 Comment: Paragraph 6- Is this citation of southeast coastal wetlands appropriate?

Response: We do not expect that the process of velocity reduction by vegetation is qualitatively different in different regions. Water flows downhill in all regions and can be slowed by vegetation in all regions.

Page 2-43

2.102 Comment: Paragraph 1 and bullets - At times, pure storage when available.

Response: We did not find any specific references that storage results in velocity reduction, but storage is implied in the first bullet, channel constriction since a constriction will cause flows to back-up and be stored in the wetland.

2.103 Comment: Paragraph 2 - Interesting!

Response: Comment noted. No changes necessary.

2.104 Comment: Paragraph 5 - See comment above regarding riverine wetlands.

Response: See response to Comment 2.95.

Page 2-44

2.105 Comment: Paragraph 3 - Willows, alders, sedges etc. are great in eastern Washington.

Response: These species added to discussion of lacustrine wetlands in eastern Washington (paragraph 6).

2.106 Comment: Paragraph 3 - While this assessment seems logical, most lacustrine wetlands occur in locations that are protected from moderate and strong winds and waves, indicating geomorphic factors are more critical than wetlands in most cases. Shorelines exposed to moderate and strong winds are typically unvegetated.

Response: We disagree. We have observed numerous large lakes in both eastern and western Washington that have extensive fetches and vegetated wetlands along the shoreline.

2.107 Comment: Paragraph 3 - Define woody. Overemphasis on woody. By woody I presume you mean trees and logs. Shrubs or ____ (i.e. _____) are natural potential _____ many eastern Washington storms. This is where vegetation classification system tied to geomorphology are so helpful to understanding the status/potential of wetland and riverine systems.

Response: The definition of woody vegetation is fairly well established in the botanical and wetland literature. It includes both trees and shrubs. However, there are no references on this page to woody vegetation specifically, and we do understand the reference to woody vegetation and geomorphology made here.

2.108 Comment: Paragraph 4 - Many wetland depressions in eastern Washington are filled by snowmelt, and they may play a role in runoff hydrology during the snowmelt period.

Response: The discussion has been expanded to include snowmelt.

Page 2-45

2.109 Comment: Paragraph 3, first sentence - to what, whose work?

Response: Comment unclear. Unable to respond.

Page 2-46

2.110 Comment: Paragraph 2**:** Given the admission about gaps on the functions of slope and flat HGM types, perhaps the statement that these do not provide groundwater recharge is inappropriate. It seems that under certain conditions where flow from flats and slope wetlands occur at the margin of the wetland areas into adjacent uplands some recharge could occur.

Response: The literature indicates that groundwater recharge occurs only when there is a significant amount of "head" in the water to provide the driving force. Slope wetlands by definition do not store surface water and therefore cannot generate the head necessary to drive water into the ground. Furthermore, most slope wetlands are a place for groundwater discharge, not recharge.

2.111 Comment: Box - Without the wetlands the water would not be a surface expression. So, how can the discharge function be discounted and not considered baseflow support? Headwater wetlands sustain stable flows in headwater streams during summer low-flow periods.

Response: A wetland would function to support baseflow only if the water leaving the wetland during low flows is water that was stored within the wetland. If the wetland acts only as a discharge point for groundwater, the flow is not a function of the wetland, but rather a function of the geomorphic setting. The water would be discharged whether the wetland is present or not.

Page 2-48

2.112 Comment: Paragraph 1 - White-tail deer seek wetlands as winter cover in the eastern U.S. (where wetlands ore dominated by coniferous forest that provide greater thermal protection and food than adjacent deciduous forests). I am not aware that this strategy occurs in WA. Ring-necked pheasants and opossum are introduced species in Washington. The points made would more pervasive if examples of native species that are relevant to Washington are identified.

Response: The species listed were those from the reference cited in the synthesis by Adamus et al. 2001 which did not provide geographical information. We did not find a similar discussion specific to Washington.

2.113 Comment: Paragraph 4 - Reggiero et. al 1988 report that species preference for a particular habitat feature or habitat characteristic may be the best indicator of species dependence in the long term. Although an individual may survive under conditions they do not prefer, the population as a whole, living under sub-optimal conditions would likely suffer substantial declines in the long run. This situation is also discussed by Stoltzenburg:

"Fragmentation entails a biological fallout more complicated than an arithmetic reduction of living open space might intuitively suggest. Ecologists have lately begun to see more clearly what happens when, say, a big forest suddenly becomes a small forest squeezed by development. From the isolated remnant disappear the wide roamers--the bears, big cats and wolves. The same goes for the deep forest specialists, types like the hooded warbler, the goshawk and the marten. Flooding in from the outside are the generalists, the common species of the edge--the starlings and cowbirds, the opossums and raccoons. Like an onion peeled by the layers, there comes a point when the core becomes nothing but the edge, a place where the generalists rule."

"According to population theory, the fewer the individuals, the more potentially devastating the purely random forces of nature. A roll of the demographic dice can leave a small population with too many old, too few females, too little genetic variability--too little internal rebound to survive. Natural catastrophes, like fires, storms, droughts and disease--blows that might dent a big population--can crush a small one." The Fragment Connection by William Stolzenburg, Nature Conservancy, July/August 1991: Page 20.

Response: There is an extensive library of information about habitat and fragmentation. We have not synthesized this literature unless it dealt specifically with wetlands.

2.114 Comment: Wetland Habitat - The use of wetlands as habitat is dependent in part on the surrounding upland habitat. Isolated habitat does not function in the same capacity as wetlands that are.

Response: We agree, this issue is discussed in much greater detail in Chapter 3.

2.115 Comment: Last paragraph**:** Modify the definition of wetland-dependent species? These are species that require wetlands to complete one or more phase of their life cycle, such as amphibians.

Response: We cannot modify the definitions given because these represent the definitions as used in the citations as noted.

2.116 Comment: Add to bullets paragraph 3 - Horizontal and vertical/Landform diversity, i.e., soil surface topography.

Response: We cannot modify the definitions given because these represent those used in the citation**.** The list can be expanded only if we have citations to support the conclusion made in the introductory sentence of the factors that contribute to species richness and abundance.

Page 2-49

2.117 Comment: Paragraph 1, Structural Complexity - You could show a plant just the opposition of a wetland dominated by one plant association – itself dominated almost totally by one sedge. Still important diversity within an otherwise forest or shrink-steppe dominated landscape.

Response: Comment unclear, but does not seem to be one that requires any changes. A sedge wetland next to a forested wetland would have a higher structural complexity than a wetland with only one type of vegetation. The complexity of the landscape, where a wetland is found within a matrix of upland habitats is not a characteristic that occurs within the wetland itself.

2.118 Comment: Paragraph 1, Structural Complexity See West and Kelsey (2000) and O'Connell et al. (2000) for recent data on the value of riparian systems to wildlife in western WA and OR.

Response: West and Kelsey reference was obtained and reviewed, but it dealt strictly with riparian areas. The O'Connell reference does not differentiate between types of riparian habitat and therefore was not considered as useful as the Kauffman et al. reference.

Page 2-50

2.119 Comment: Paragraph 1, connectivity - Why just aquatic connectivity!"

Response: Text changed to reflect all types of connectivity, and the discussion has been expanded.

2.120 Comment: Paragraph 1, riverine connectivity - And its potential is much greater.

Response: See response to Comment 2.119.

2.121 Comment: Paragraph 2, Abundant Food Sources - Sipple (2002) consists of text on the EPA web page and lacks any references to the scientific literature. Use of this information undermines the credibility of this document, Ecology should rely on the primary references, or at a minimum, scholarly reviews that provide literature citations. Leeper and Taylor's (1998) finding of 700,000 animals per square meter of wetlands should be put in perspective against other ecosystems (do coniferous forest have 1.5 million or 100,000 animals???).

Response: References in addition to Sipple have been included. Also, we did not find any references similar to that of Leeper and Taylor for the upland ecosystems.

Page 2-51

2.122 Comment: Use of Wetlands by Vertebrates in WA - How relevant is OR data?

Response: The citations used did not differentiate between Washington and Oregon. The assumption is that data from both states is relevant and similar because many of the ecoregions are similar.

2.123 Comment: Pages 2-51 & 53 - For westside riparian systems, research reported by West and Kelsey (2000) and O'Connel et al. (2000) conflict with the information presented in this section. The above referenced findings should be discussed and considered, as they represent extensive and recent field research from WA. (Also in file for references)

Response: The references identified in the comment were reviewed but we did not find any information that conflicted with the data presented in Kauffman et al. Furthermore, both references did not differentiate between riparian wetlands and other riparian areas, so the data were not comparable.

2.124 Comment: Last Sentence; Figure 2-12: Make clear that not all riparian areas are wetlands.

Response: Clarification made that data is from riparian wetlands.

2.125 Comment: Graphics and Introductory Text Pages 2-52 & 53. There is no question wetlands are important to wildlife. In managing wetlands, we need to identify the critical relationships between wetlands and wildlife. In general, the critical relationships are for those animals that are water dependent.

The Kaufman et al. 2000 data show that for birds about 17, 13, and 23 percent of species are "closely associated" with eastside riparian, westside riparian, and herbaceous wetlands respectively. Their definition "closely associated" should be provided; I presume it is close to meaning "wetland dependent". These are the species that wetland managers should be concerned with, because they are the species that are at risk if wetlands are poorly managed. The habitat function of wetlands to these wetland dependent species should really be the focus the bird and mammal analysis and review presented in this study. "Generally associated" species have a wide degree of adaptability, and should not be a major focus of wetland management.

This general use by non-wetland dependent species should be presented after the sections that consider the requirements of wetland dependent species. It seems the appropriate context should be that "if wetlands are protected for wetland dependent species and other wetland functions, then an added benefit of having more habitats for non-wetland dependent species is realized".

Wetlands and wetland buffers should not necessarily be designed to maintain non-wetland dependent upland wildlife, as other provisions of the GMA address these species.

Response: We are unable to provide a definition for "closely associated" because none was provided in the reference. The issues of management are addressed through the rating systems and the standards for protection developed in Volume 2.

Page 2-52

2.126 Comment: Paragraph 1 - Why are you lumping riparian areas and wetlands together? This seems misleading. Birds and mammals that use riparian areas are not necessarily wetland dependent. This should be made clear.

Response: The categories are those found in the reference cited. No additional data were provided in the citation to subdivide riparian uplands from riparian. From an ecological perspective these two types of aquatic resources function in similar manner and it is very difficult to impose a jurisdictional definition on this type of ecosystem when collecting ecological data. The information however, pertains to "wetland" species as identified in the citation.

Page 2-53

2.127 Comment: Paragraph 2 - Is this bay in South Carolina comparable to wetlands in Washington? Is this a palustrine or estuarine system?

Response: The wetland in South Carolina was a seasonal palustrine system with some characteristics that are similar to those in Washington. This is the only article we found where actual densities of invertebrates were counted in a wetland.

2.128 Comment: Invertebrates –The invertebrate section should reference and draw from Batzer et al.'s (1999) classic book, Invertebrates in Freshwater Wetlands of North America. Also, West Nile should at least be mentioned, with the caveat that not all wetland types can support WN mosquitoes.

Response: The suggested reference on invertebrates was obtained and information therein was added where appropriate. West Nile Virus is mosquito born disease as are numerous others such as equine encephalitis yellow fever, and malaria. This document does not address the public health issues associated with the animals that use wetlands and that can act as vectors for human diseases (e.g. rabies). This is not an issue of how wetlands function and how humans impact wetland functions. Furthermore, there are no data supporting the hypothesis that not all wetland types can support vectors for WN virus. The information on mosquito species that are vectors in the US is incomplete because the distribution of the virus keeps expanding. It is pre-mature to conclude that there are certain types of wetlands that do not support all the possible mosquito vectors for the disease.

Page 2-54

2.129 Comment: Bullet #5 - This seems a bit redundant. Might want to incorporate this with bullet number 3.

Response: Correction made.

2.130 Comment: If have not already, you might consider reading through WDFW's Priority Habitat and Species Recommendation for amphibians and reptiles for additional life history information. The link to the publication is:
http://www.wa.gov/wdfw/hab/vol3.pdf

Response: We have reviewed the recommendations but decided not to include this information in the document because it is too specific, and it is for individual species. The discussion in this document is meant to be more generic, and tries to identify general characteristics of the habitat that are important for a group of species.

Page 2-55

2.131 Comment: Bullet 3. The dependence of amphibian populations on stable water levels reported by Richter and Azous (2001) may be overstated for several reasons: The historical condition of the study wetlands has not been evaluated. It is possible historical landuses or impacts (forestry, farming, wetland draining, fire, etc.) eliminated habitat and species independent of urbanization and the potential changes in hydrologic regimes associated with impervious surfaces.

- Relation to forest cover –see page 153 of Azous and Horner (2001)- The correlation between amphibians and to forest habitat is stronger than the correlation with waterlevel fluctuations, which is quite weak (see their figure 5-3, page 155).
- Findings of Ostergaard 2001 suggest that in constructed stormwater ponds that are designed to have high water level fluctuations, native amphibians successfully breed. As with natural wetlands, the presence of nearby forestland is important.
- Much of this document relies heavily on Wetland and Urbanization (Azous and Horner 2001), studies that focus urbanization impacts to depression wetlands that impound water. Ecology authors should evaluate the applicability of the findings to other HGM classes and to other regions.
- Richter (1997) discusses the significance of water level fluctuations on amphibians, and identifies declines in water level following egg attachment as a source of egg mortality. Declines in water levels are not typically associated with urban runoff, the typical scenario for wetlands are short duration increases in water level of various magnitudes. It seems probable that the numerous other factors discussed in Richter (1997).

Ecology should acknowledge that the Azous and Horner book has been recently peer reviewed and elements of the study approach and findings questioned (Condrey 2003).

Response: We do not believe we are overstating the importance of water level fluctuations on amphibians by including it as one factor in a list of factors. The importance of forest cover has been added as an additional bullet. The authors of the Azous and Horner book have responded to the criticisms found in the book review by Condrey and their response is reproduced, in its entirety, in the response to Comment 4.55 (Chapter 4).

2.132 Comment: Paragraph 1 - Is Sofgren spelled correctly? Sjorgen?

Response: Correct name is Per Sjogren Gulve, so reference should be "Gulve". Correction made.

2.133 Comment: Bullet #2 -Parallel Structure – start with bold text.

Response: Bolding is used to highlight main factor being discussed. Text did not lend itself to starting each bullet with the main factor.

2.134 Comment: Paragraph 2 - The sentence should be modified (if appropriate) relative to the likelihood that other ambystomid salamanders seek shelter in rodent burrows. Also, clarify the tiger salamander is present in eastern Washington, according to the distribution maps published by the USGS found at http://www.mp2-pwrc.usgs.gov/armiatlas/species.cfm?recordID=173592.

Response: Data on use of rodent burrows by other salamanders was not found so it could not be cited. Information on the distribution of Tiger salamanders in eastern WA added to text.

Page 2-56

2.135 Comment: Bullet 1 - I did not see anything in the reference cited (Brinson 1993a) that stated this so explicitly. In Oregon, many Slope wetlands (e.g., springs) have ponded surfaces during all or part of the year. Slope wetlands that discharge cool groundwater at the margins of rivers are absolutely essential to salmonid habitat in eastern Oregon.

Response: Reference changed to Brinson et al. 1995 that makes these points specifically. Also slope wetlands may discharge groundwater that goes into streams, but they do not provide habitat for salmonids within their boundaries because they do not have surface water the fish can access.

2.136 Comment: Bullet 2 - Note the surface water connection to a wetland does not have to be permanent for salmonids to enter a wetland to rear. The surface water connection may only occur in winter in high stream flow months.

Response: Clarification added.

2.137 Comment: Bullet 2 - Lake? Kokanee

Response: Bullets relate to anadromous fish as mentioned in preceding paragraph.

2.138 Comment: Bullet 4 - Interesting…winter freezing?

Response: No information on freezing was found.

2.139 Comment: All Habitat Sections - Should add Water Quality among the bulleted lists of influencing factors.

Response: The requirements for water quality are different for each species and this information is too specific to include in "general" bullets. The impacts of water quality on habitat are described in Chapters 3 and 4.

2.140 Comment: Bullet 4 - Coho and other wetland associated fishes rear in wetlands with waters only a few inches deep in stream flood plains especially when plant cover exists. While deeper pools are best for coho in wall-based systems, juvenile coho and Olympic mud-minnow move out of the channels into seasonally flooded wetland areas with only a few inches of water.

Response: Comment noted. No changes to text necessary.

2.141 Comment: Last Bullet - Undercut banks are equally or more important.

Response: We agree they may be important but no citations were provided and we could not find any.

Page 2-57

2.142 Comment: Resident Fish, First Bullet - Olympic mud-minnow rear in wetlands with waters only a few inches deep in stream flood plains especially when plant cover exists. While deeper pools are best for coho in wall-based systems, juvenile coho and Olympic mud-minnow move out of the channels into seasonally flooded wetland areas with only a few inches of water.

Response: Comment noted. No change to text; cannot add to text without references.

Page 2-58

2.143 Comment: Bullet 2 - Width not size

Response: Change made.

2.144 Comment: Bullet 2 -The study reported is one that lists one of the least buffers for bird function of wetlands. This is definitely not optimal habitat that would meet species needs as area undergoes thermal stresses or disease losses. This is one of the smaller buffers (50 feet) proposed to meet bird habitat needs.

Response: The reference was used because it is the only one with specific data for western Washington and the data reflect the minimum buffer needed in one location. We need to include published information that represents different viewpoints whether it agrees with our pre-conceived notions or not.

2.145 Comment: Bullet 3 -Both downed and standing dead wood is important, especially on the east-side for downed wood where the decay process is not as quick. This is especially true for Pileateds. See some of the research done for Pileateds in the central Oregon coast range.

Response: Pileated woodpeckers are not considered "closely associated" with wetlands (Johnson and O'Neil 2001), and we have focused our literature search only for structural elements in wetlands that are critical to species that are "closely associated".

2.146 Comment: Bullet 5 - (add) In a wetland distance – greater the number of wetlands.

Response: Cannot add without additional citations.

2.147 Comment: Bullets 6, 7 - Sub-category make the paragraph all one paragraph.

Response: We disagree, especially since we have different citations for each point.

2.148 Comment: Last Bullet - This states a full canopy can limit access to open water. There are some species that benefit from open canopies such as the great blue heron. However they can range 10 miles or more between nesting and feeding grounds and closed canopy would generally not be listed as an impediment to bird habitat. Most neotropical migrant species would benefit from relatively closed canopies. It might be best to delete this bullet.

Response: These bullets refer only to wetland-dependent species. The habitat requirements for other types of birds that might use a wetland are too extensive to include in this review. A closed canopy was listed as an impediment to habitat for the great blue heron by the wildlife biologists developing the methods for assessing functions in Washington.

2.149 Comment: Bullets - Wetland patch size is likely important to some species.

Response: We agree, but we did not find any references about the importance of patch size for wetland-dependent birds.

2.150 Comment: Wetland-Dependent (or Associated) Mammals - Might want to include a percent figure here for east vs. west side use.

Response: We could not find any data on this issue.

Page 2-59

2.151 Comment: Paragraph 1 - What about small mammals?

Response: Information given is only for the four species considered to be wetland-dependent. Mink might be considered as a small mammal.

2.152 Comment: Bullet 3- "Freezing of a pond to the bottom can be disastrous to muskrat populations Schmitke 1971." The study listed is one in Alberta. Except for high mountain lakes are ponds freezing to the bottom a common occurrence in Washington state?

Response: Freezing to the bottom is a common occurrence in shallow ponds of eastern Washington as noted in Hruby et al. (2000).

2.153 Comment: Bullet 4- River otter also feed on shellfish, crayfish, amphibians and also birds and small mammals. If fish present are very small coho salmon they would not provide much of a food source for river otter. Paulson 1998 (University of Puget Sound Mammals of Washington) states that east of the Cascades river otters are only associated with large rivers.

Response: Comment noted. Other references consulted confirm the statement. The bullet has been deleted.

Page 2-60

2.154 Comment: Section 2.5.3.4 Habitat for Plants - Add a bullet "Woody material – forest – distance to other wetlands." R----- & Azous.

Response: The comment is too cryptic. We do not understand the point being made about forest. May be similar to comment 2.156.

2.155 Comment: Bullet 5 – should be "ranges" of water depths

Response: Correction made.

2.156 Comment: Add bullet…"Other wetlands/proximity**"**

Response: Bullet added. Assume comment similar to 2.154.

2.157 Comment: Section 2.5.3.4 Habitat for Plants - I think it would be useful for this section to consider which wetland types in Washington support vegetation types that might not be protected through protection of wildlife habitat or other functions (i.e. are there "gaps" that could impact wetland functions or values associated with plants):

- Rare or endangered plant species (e.g. water Howellia).
- Rare or unusual vegetation types (e.g. bogs, vernal pools (?), alkaline meadows (?), but not red alder forests).

This discussion could serve as the basis for developing special management standards for these more unusual wetland types.

Response: The protection and regulation of wetlands requiring additional consideration due to the characteristics above are addressed in Volume 2. The methods to protect their unique characteristics, and the scientific basis for this protection, are documented in the Appendices of Volume 2.

2.158 Comment: Page 2-60 and Other Habitat Sections -All these sections focus too much on alpha diversity. Mention should at least be made of gamma diversity, e.g., the equally important ability of some species-poor, structurally bland-looking wetlands to support species that might not occur in more diverse wetlands. Richness in diverse wetlands often is mainly comprised of common generalist species.

Response: The published literature on wetlands has focused on alpha diversity. We were unable to find references discussing beta-diversity.

Page 2-61

2.159 Comment: Bullet 3 Summary of Key Points - Statement about recharge is false. "Losing streams" (riverine flow-through HGM class) that recharge groundwater are a common phenomenon in some areas.

Response: See response to Comment 2.41.

2.160 Comment: Bullet 3 Summary of Key Points - I don't agree with this statement about impounding wetlands being the only wetlands with the potential to provide groundwater recharge. I have seen several slope wetlands which receive surface water, which then infiltrate water into the ground at the base of the wetland. These wetlands do not impound water, but at the same time, are apparently recharging groundwater. Am I missing something here? Maybe the statement is a bit too definitive.

Response: See response to Comment 2.41.

Page 2-62

2.161 Comment: Bullet 1 -While wetlands and riparian areas make up a small part of the range of elk they spend disproportionate time in these environments –often at times of high sensitivity such as calving.

Response: Elk would still be considered as wetland users rather than wetland dependent because they do not require wetlands for their survival.

2.162 Comment: Bullet 2 - Add "Wetlands and…" to last sentence.

Response: Correction made.

Chapter 3 – Environmental Disturbances Caused by Human Activities and Uses of the Land

General Comments

3.1 Comment: It is clear that the document is a draft because there is not one tone or voice throughout the work. Not all authors have taken the same approach and placed the same value on some of the terms. On page 2-8 the definition of disturbance is presented. "All the disturbances discussed and reviewed here are significant enough to impact wetlands and their functions." Again, on page 3-3, "All disturbances discussed herein are considered to have significant impacts on the ecosystem." Yet the 'significance' of a disturbance is treated differently in different sections. Table 3-3 on page 3-35 identifies almost all activities as, 'land use creates a significant disturbance of environmental factors', yet on page 4-4 there is a discussion on scale of impacts to wetland functions. (This comment is also in the general compilation for Volume 1)

Response: We will try to improve the consistency of word usage during the final editing.

3.2 Comment: Section 3.2 does not appear to set up the remainder of Chapter 3 very well.

Response: Section 3.2 is an introduction to the following sections, and we cannot address this comment without a more specific understanding of what "set up" means.

3.3 Comment: We strongly suggest that an analysis of temporary wetland and buffer impacts be presented and analyzed. These should not be presented in the same importance as permanent impacts. Section 3 tends to focus on more permanent modifications and their effects. It would be useful if a comprehensive literature review could be conducted on temporary modifications, such as a power or pipeline installation, maintenance, or repair, to describe natural recovery times. A thorough review of this topic may lead to different recommendations for 'mitigation' and long term wetland monitoring.

Response: We did not find any literature on this topic that could be reviewed. However, we agree that there are obvious differences in the scale and duration of impact from projects such as utility installation. These differences will be reflected in the recommendations in Volume Two.

Section 3.1 Reader's Guide to this Chapter

Page 3-2

3.4 Comment: (add) Changing temperatures to the bullets

Response: Temperatures are highly variable in wetlands and not considered an important "disturbance" of the ecosystem as it is in streams.

Section 3.2 Introduction to Human-Caused Disturbances at the Landscape Scale

3.5 Comment: Beef up and clarify Section 3.2. It is titled the 'Overview' yet it is very short, only 14 pages. Work on consistency of terms and voice through the document.

Response: We are confused by this comment. The title of Section 3.2 is "Introduction to Human-Caused Disturbances at the Landscape Scale." It is not titled "Overview" in the text, however the title in the Table of Contents appears as "Overview." The section is 10 pages long and we feel that it covers the important background information needed for text that follows in that chapter. Therefore, no change was made. Regarding the second part of the comment, we attempted to improve the consistency of terms and voice.

Page 3-3

3.6 Comment: Paragraph 1 - This section relies heavily on Wetland and Urbanization (Azous and Horner 2001). Ecology should acknowledge that the Azous and Horner book has been peer reviewed and elements of the studies methods and results question by Condrey (2003). Gaps exist because Azous and Horner (2001) report findings for urbanization impacts to impounding wetland depressions only. The relevance to other impacts (agriculture and mining), other regions, and to other HGM classes has not been evaluated.

Potential errors exist in evaluating the results because the historical condition of the study wetlands has not been evaluated. It is possible historical landuses (forestry, farming) eliminated some species independent of urbanization and potential changes in hydrologic regimes.

Response: We agree that gaps in information exist, and that the work done by the wetland research program at the University of Washington was not complete. However, this information is among the best that exists for Washington. The impacts of other types of land use are discussed in more detail in the relevant sections of Chapter 3. Text has been clarified to reflect that the research was done in depressional wetlands. See response to Comment 4.55 (Chapter 4) for the response of Azous and Horner to the review by Condrey.

Page 3-4

3.7 Comment: Second Bullet - Add the word "may" such that the first sentence reads "The maintenance of residential lawns is an example of a human activity that may affect environmental factors that control wetland functions."

Response: Word has been added.

Page 3-5

3.8 Comment: Fig 3-1 Diagram summarizing the environmental factors that control functions of Good (add on chart after Draining) Fillings.

Response: This comment was unclear, and we did not understand what the suggested changes to Figure 3-1 are.

3.9 Comment: The evaluation of impacts on landscape processes focuses on "connectivity". There are many other landscape variables affected by development and human disturbance. See Chapters 3-6 of Forman and Godron (1986), Feemark (2002), or Primack (2002) for discussions of landscape patches, corridors, matrices, networks, and structure. Ecology should explain why these landscape parameters are not considered.

Response: The focus of the discussion has been changed from one of "connectivity" to "fragmentation." Furthermore, connections between habitats are one of the major "controls" by which animals and plants move across the landscape. The lack of connections, or the spatial distribution of connections, are what form patches, corridors, matrices etc. The structural elements of the landscape described by the reviewer are a result of connections or of their lack.

3.10 Comment: Figure 3-1 is weak, despite the author's excellent reputation. The concepts are not complete in any of the categories. For example, the left hand column could be revised to include a formula developed back in the 1940's by Hans Jenny, a very prominent soil scientist**:** (Jenny, H. 1941. Factors of soil formation. McGraw Hill, New York).

S = f {c, p, C, V, B, R, T)

c= Soil chemical properties p = Soil physical properties: texture, organic content, clays,

C= Climate, including the effect of altitude, V = vegetation growing on the soil, B =

Biotic external properties: competitive interactions, R = Topography; and T = Time

If we rewrite this for wetland formation we have:
W = f {S(c+p),C,V,B,R, T}.

This is more complete than the "basic environmental conditions" on the list of environmental controls on wetlands. For instance, hydrology controls are depth, duration, and frequency of inundation. This is a more standard way to term hydrology than input and timing of water and fluctuation of water. There are many items that have not been listed, and the physical structure of the wetland is not an environmental control in and of itself. The "floating" human caused disturbances on the right (tilling of soil etc.) do not comprise a complete list and you wonder what they are for. I suggest you omit them.

Response: The graphic is not meant to provide an exhaustive list of all factors because that would make the graphic too cumbersome. Each term, such as geology, topography and climate represents a wide variety of related factors. This is necessary to make the graphic understandable. We have clarified this in the legend.

Page 3-6

3.11 Comment: Table 3-1. Question: When you list a "site disturbance" is site restricted to inside the wetland boundary?

Response: The sentence defining site scale in the first paragraph of Section 3.2.2 has been clarified to mean the wetland itself and its immediate surroundings.

3.12 Comment: Table 3-1. Question: What about current velocity? Current/improving areas

Response: Current velocity added to table.

3.13 Comment: Table 3-1. Other disturbances – Chapter 4 of this document evaluates a number of other disturbances. For completeness, they should all be noted and the scale of disturbance listed in this table.

Response: Adamus et al. (2001) reviewed the impacts of the major disturbances on animals and plants and did not consider these impacts to be important enough to warrant separate sections, and we decided to keep the same level of organization as Adamus et al.

3.14 Comment: Table 3-1 is missing some disturbances such as changing the duration of water levels. This is mentioned on Pg. 3-6, Paragraph 2 below, so the author knows this. If the Adamus table is not complete, then either don't use it or revise it by adding the additional information that would make it complete and quote more than one author.

Response: "Duration" has been added as a descriptor of water level fluctuations in the table.

Page 3-8

3.15 Comment: Box – Good, What about velocity (2nd paragraph)

Response: The definitions are based on the citations given. None of them used the word "velocity" in their definitions.

3.16 Comment: 3.2.3.1 – Paragraph 1 - Ziemer (1998) is missing. Bauer and Mastin (1997) have quantified some of these hydrologic variables for forests in Puget Sound. They found about 25 percent of rainfall from mixed forests growing on till soil becomes direct runoff. The statement "Shallow groundwater (water less than 20 feet……." is over simplified. Where shallow groundwater ends up is variable, and depends on local geologic conditions and climate. In till dominated areas, much shallow groundwater becomes streamflow, but some recharges deeper layers. In areas with sandy subsoils, shallow groundwater may move into and recharge deep aquifers.

Response: Ziemer reference added to list of citations. Bauer and Mastin dealt specifically only with forests and reference was considered redundant with Ziemer. Infiltration is considered in the previous sentence. We did not want to get into specific details of all the different ways water can move across the landscape in this chapter because this issue is not too relevant to wetland functions. The reference to depths was deleted to avoid confusion.

3.17 Comment: Paragraph 1 - Ziemer 1998 is missing from the references.

Response: Ziemer reference added to list of citations.

3.18 Comment: Paragraph 2, Line 3: Change "rerouted" to "transpired." Plants transpire water.

Response: Change made.

3.19 Comment: Paragraph 3 - Surface flow results when precipitation exceeds saturated flow of soil water.

Response: This comment is made in the first sentence on page 3-9.

Page 3-9

3.20 Comment: Paragraph 1 - The discussion on the movement of water in undisturbed landscapes should be modified. In portions of the state that have been glaciated, there is also lateral flow along the contact between the soil mantle and underlying aquitards, such as glacial till and Lawton clay deposits in the Puget Trough. Water also flows into cracks and fractures in bedrock.

Response: Valid points, but we did not want to get into specific details of all the different ways water can move across the landscape in this chapter because this issue is not particularly relevant to how wetlands function.

3.21 Comment: Paragraph 3 - In addition to your ideas, when vegetation is removed, direct impact of raindrops dislodge small soil particles that can effectively block soil macropores. This in turn increases surface flow at the expense of sub-surface flow.

Response: Valid point, but we did not want to get into the details of the processes by which each activity changes infiltration. These details are not necessary for local planners and managers to understand the impacts of human activities on the landscape.

3.22 Comment: Paragraph 3 word change - The disturbances to water movement and sources created by specific land uses are described later in this chapter. ~~whereas~~ Literature on the resulting impacts to wetland functions is synthesized in Chapter 4.

Response: Change made.

Page 3-10

3.23 Comment: Figure 3-2 - Does this figure finding for Washington? If so, make it more relevant by explaining further. It should be noted that these relationships are variable (Konrad and Booth 2002), and factors such as slope, soil types, underlying geologic conditions, climate, and other factors can cause substantial local variations. Studies by Konrad (2000) have been unable to demonstrate that impacts to baseflow or the extent of perennial streams associated with urbanized watersheds in the Puget Sound area.

Response: The data in the figure is from Beyerlein (1999) who did the study in Washington. Text has been changed to reflect the location.

Page 3-11

3.24 Comment: Paragraph 1 - What about storm ponds?

Response: Storm ponds are supposed to mitigate the impacts of impervious surface in a watershed, but we have been unable to find any studies to confirm or deny this hypothesis.

3.25 Comment: Paragraph 2- I don't think the Azous and Horner study can be cited as support of this statement. See review published in Condrey (2003). Shortcomings of the study, that limit over generalizing are:

- Limited to depression wetlands
- Historical conditions of the wetlands are unknown, and thus impacts of logging and farming may be intermingled with those of impervious surface.

The study design was not controlled for impervious surfaces, a variable of key interest. Many other watershed conditions that are affected by urbanization (e.g. upland forest cover, wetland vegetation, connectivity, predation by pets, edge effects, etc.) are intermingled, and may vary independently from impervious area.

Response: We have reproduced the response of the authors of the Azous and Horner book to Condrey in the responses to Chapter 4 (response to Comment 4.55).

3.26 Comment: Paragraph 2 - Should the reference to the 10% impervious surface threshold be Booth and Reinelt 1993 or Booth 1991 and not Azous and Horner?

Response: All of these references used the same data to make a conclusion about a 10% threshold. Further correspondence with Richard Horner, however, indicates this threshold may no longer be valid (see Comment 3.28) regarding why it may no longer be valid), and the text will be changed to reflect this.

3.27 Comment: Box, Last Sentence of the First Paragraph - The referenced study by May makes no impact on the reader unless the size and location and character of the sub-basin is known. Is the 60% runoff contributed by lawns in a suburban or rural area? Is this sub-basin the size of one house on a few acres or an entire city covering square miles?

Response: We were unable to obtain a copy of the referenced study so the conclusion from it was deleted.

3.28 Comment: Paragraph 2 - The matter of a 10 percent threshold of imperviousness (or any threshold) has been a subject of my research the past 9 years (working with streams since finishing the big wetlands project). Naturally, we have a lot of data and conclusions on this by now (and reports and papers). We are thoroughly convinced that there is no threshold; deterioration begins immediately and progresses at a rapid rate as soon as any amount of urban development begins. A lot is gone by the time impervious gets to 10 percent. I wiped threshold from my vocabulary, in this context, a long time ago.

Response: See response to Comment 3.26.

3.29 Comment: Paragraph 3 - Booth et al. 2002 is missing in the references.

Response: Citation added to list of references.

Page 3-12

3.30 Comment: Table 3-2 - Add Hicks citation

Response: Citation added.

3.31 Comment: Table 3-2 -There are many other studies of impervious that are not represented. If you would like some of our papers (on streams), let me know. I am not simply forwarding them because they are outside your scope of wetlands, although they do show tendencies that, I believe, are applicable among different aquatic ecosystems. Meanwhile, our wetlands data (on many fewer locations than we have in our stream database) show the same tendency of no threshold.

Response: See response to Comment 3.26.

3.32 Comment: Table 3-2 - Steedman 1988 is missing in the references.

Response: Citation added.

3.33 Comment: Last Paragraph - Here you have current velocities.

Response: See response to Comment 3.12.

Page 3-13

3.34 Comment: Paragraph 1 - Since when are point sources no longer the dominant?

Response: The Environmental Protection Agency considers non-point pollution the Nation's Largest Water Quality Problem (Pointer No. 1 EPA841-F-96-004A)

3.35 Comment: Paragraph 1 - Is there a reference to support the statement that nonpoint-source pollution is "the dominant" source of pollutants to surface water? Clearly it is significant, but I think it is inaccurate to suggest it is the dominant source.

Response: See response to Comment 3.34.

3.36 Comment: Section 3.2.5. - There is a huge body of research on habitat fragmentation. Check with Dave Manuwal in the Forestry Department of the UW and ask him to send some of the references your way. I read a dissertation two years back on habitat fragmentation and there were at least 200 references. I am guessing that many are either about wetlands or the concepts could be applied to wetlands.

Response: We agree that there is a large body of research on fragmentation. However, in searching the databases we found very little that is specific to wetlands.

3.37 Comment: First Sentence Paragraph 2 – Add "isolated" before "patches."

Response: Change made.

Section 3.3 Disturbances Caused by Agriculture

Page 3-15

3.38 Comment: Section 3.3.1 – Chapell et al.'s (2001) paper did not relate exclusively to wetlands but also included upland riparian habitats. Hence the statement that there has been a net loss of wetlands in the Columbia Basin (attributed to Chappel et al.) is incorrect. Chappell's conclusion related to riparian areas, most of which were non-wetlands (Chappell, personal comm.). Moreover, the data for these estimates were not generated/collected by Chappell but came from another study. Consider deleting this reference since most of the area is comprised of upland riparian habitat. Having said this,

in the professional opinion of local experts (e.g., Ron Friesz, Barb Aberle) to whom I've spoken to, they believe that irrigation practices and the Bureau of Reclamation projects greatly increased the area of wetlands in the Columbia Basin.

Response: We checked the original citation in Chappell and agree that it is difficult to extract information about wetland as opposed to all riparian areas. The statistics therefore were deleted. It is difficult to judge the loss or gain of wetlands that have resulted from irrigation. We have added one reference (Forster et al. 1984) that documents some increases in wetland area. Another factor, however, that needs to be added into the discussion is the loss of wetlands resulting from dam construction in the old Columbia River floodplain. The other issue is that wetlands may have been more common in the scablands part of the basin than assumed by many. The fish and wildlife service did a limited survey of wetlands in Lincoln County (dry areas outside the irrigated lands) and found large numbers of wetlands.

3.39 Comment: Third Paragraph, Second Sentence - I disagree with Chappell's conclusion (presuming that he is quoted correctly) that new wetlands have developed in **some** areas, there is still a net loss in eastern WA. I have no doubt that there may presently be a net loss--more wetlands lost than created. However, to say that wetlands have developed in **some** areas is a gross understatement of what has occurred in the Columbia Basin. Much of this region receives less than 10" annual precipitation and would be classified as desert by most definitions. Prior to the irrigation projects this region had significantly fewer wetlands and wetland acreage than it does presently. Crab Creek for example used to dry up in the summer time and now has a perennial flow of a few hundred CFS. Banks Lake, Scooteney Reservoir, Eagle Lakes, Potholes Reservoir, Winchester and Frenchman Wasteways, the Desert Wildlife Area, Columbia, McNary and Toppenish National Wildlife Refuges, to name a few would not exist without the irrigation projects. I think it should be stated in your document that the irrigation projects have resulted in the creation of a significant number (I don't have an acreage figure, but maybe someone like Jim Blanchard with BOR in Ephrata could come up with a figure) and acreage of wetlands.

Should add the following as documentation that agriculture is the factor responsible for most direct wetland losses:

Shaich, J. 2000. Wetland Regulatory Compliance in the Willamette Valley, Oregon: 1982 to 1994. Oregon Division of State Lands, Salem, OR.

Bernert, J.A., J.M. Eilers, B.J. Eilers, E. Blok, S.G. Daggett, and K.F. Bierly. 1999. Recent wetlands trends (1981/82- 1994) in the Willamette Valley, Oregon, USA. Wetlands.19:545-559.

Response: See previous response to Comment 3.38. It is difficult to judge the loss or gain of wetlands that have resulted from irrigation. Information from Bernert et al. 1999 was added to the text.

3.40 Comment: Paragraph 5 - Good

Response: No change necessary.

Page 3-16

3.41 Comment: We believe that research of local references was lacking effort. For example, near the bottom of page 3-16 there is a statement that no information was found regarding disturbance caused by irrigation on the Olympic Peninsula. There are reports on reduced flows in the Dungeness River prepared by USGS, Irrigation Districts, and others. In our brief review of the references section of the document, we found many instances of what we believe to be omissions. In cross checking with the references section of the document it appeared that only general, easy to obtain references were cited. No real effort was taken to locate region specific information. Attached to this letter as is Attachment A - a list of BAS references we noted were absent from the document. A number of them could assist Ecology in 'filling the data gaps' where the reviewers claimed that there was no information present.

Response: Our major emphasis was to find information that has been published in peer reviewed journals or reports that have undergone some peer review. This reviewer has provided a list of additional references, and we have reviewed the list and incorporated those we were able to obtain and that were relevant to wetlands. These provide the best assurance that the information meets the requirements of the WAC on "best available science".

In addition, there is some information available in project reports, research summaries, and other such documents but we did not have the resources to subject these to a peer review process or to check the expertise of the authors. Local governments and others are encouraged to obtain, review and incorporate information from local studies that meet the requirements of BAS (WAC 365-195).

3.42 Comment: Positive effects of grazing deserve mention, too. Short-rotation grazing can be used as management tool for reducing percent-cover of some non-native invasive plants.

Response: We do not dispute the potential that grazing has positive effects on upland vegetation, but in reviewing the citations provided by the reviewers we were unable to find any that addressed wetland vegetation specifically. We, therefore, decided not to include this information.

3.43 Comment: Paragraph 1 - Haying and grazing would likely, as Turner et. al. (1987) report, have the same effect on biological functions as draining or filling wetlands. However, this land use is unlikely to eliminate the hydrologic functions provided by the wetlands.

Response: As mentioned in the text, the Turner citation refers only to pothole wetlands. We don't expect these to have extensive hydrologic functions such as flood storage and desynchronization because of their geomorphic location.

3.44 Comment: Paragraph 3 - Cop Out!

Response: We acknowledge that cranberry farming may have significant impacts on wetlands, and are sorry we were unable to address this issue due to limited resources.

3.45 Comment: General on Section 3.3.2, 3.3.3, 3.3.4 - Irrigation practices often include reservoirs and diversion structures that affect stream flows and potentially the water levels in riparian wetlands. Where streamflow is diverted to agricultural land (e.g. the Methow River), water levels in riparian wetlands may fall during the irrigation season. Where reservoirs impound water and stream systems distribute irrigation water (e. g. the Yakima River), riparian wetlands may have more water during the irrigation season but less during the fall, winter, and early spring when reservoirs fill.

Response: The decreases in water levels are addressed generally in Section 3.3.3. We were unable, however, to find specific studies that report on the impact of diversions on riparian wetlands.

3.46 Comment: Paragraph 5 - In arid regions, it is often a necessary practice to apply irrigation water in excess of plant needs to assure that salts are flushed from the soil in tailwater. This practice prevents salt build up in soils and reduced fertility.

Response: Comment noted. This is interesting information but the comment doesn't indicate how this relates to wetlands.

Page 3-17

3.47 Comment: Last Sentence and 3-18 Top. This currently reads: "In this sense, virtually all wetlands in irrigated regions could be considered 'irrigated wetlands'. While wetlands in proximity to irrigation would be irrigation-influenced calling them irrigated wetlands would not be accurate in many cases and could lead to regulatory exclusions. Recommend this be deleted.

Response: The text is a quote and cannot be changed.

Page 3-19

3.48 Comment: Paragraph 1 – What is "tailwater?"

Response: The same thing as irrigation "wastewater." The term is defined in the sentence in which it is used.

3.49 Comment: Paragraph 2 - Removal and extirpation of beaver in many watersheds have affected hydrology and wetland size. James R. Sedell and Karen J. Luchessa in 1982 wrote:

> *"Most early descriptions of Northwest rivers are recorded in British and United States Army journals. They tell of valleys so wet that trails followed `the borders of mountains.'*

In Oregon and Washington, a common practice in very early times was to travel on the edges of the hills and not along the valley floors (Dicken and Dicken, 1979). British army journals described the Tualatin Valley as `mostly water connected by swamps' (Ogden 1961, p. 122). Much of this flooding was a result of beaver activity and accumulated sediment, fallen trees, and living vegetation in the channels. Because the bottom land had accumulated fine silts and organic matter of alluvial origin, the land was fertile and the task of draining the land for farming began early in Oregon and Washington."

Also diking and dams played a major role:
Lost habitat nurtured salmon
Dams and dikes wiped out the fishes' lower Columbia River nursery, says a study that has implications for fish restoration

09/29/03
JOE ROJAS-BURKE
A vast network of marshes and side channels along the lower Columbia River once sheltered and fed hordes of young salmon preparing for life at sea. Nearly two-thirds of the swampy habitat has disappeared, according to a new study that is one of the first to calculate the impact of a century's worth of diking and dam-building on the river's lowest freshwater reach.

The findings by environmental researchers at Oregon Health & Science University highlight the immense challenge facing agencies and conservation groups trying to restore pivotal habitats for endangered salmon. Hundreds of dikes have converted the broad floodplain into privately owned farm and pastureland. Massive upriver dams protect entire cities and towns from flooding.

Habitat loss is one of the leading causes of the Pacific salmon crisis. Although Columbia Basin salmon populations have rebounded in recent years, numbers remain a fraction of the historic abundance, and a dozen groups are listed as threatened or endangered. "What we have done is clarify what the tradeoffs are. Society has to make the value judgments," said David Jay, an associate professor at OHSU's OGI School of Science and Engineering. He co-authored the study with graduate student Tobias Kukulka, now at the University of Rhode Island. The work was published last week in the Journal of Geophysical Research -- Oceans.

For decades, conservation efforts largely ignored the lower river and estuary, regarding them as a mere conduit for passing fish. That view has drastically changed during the past five years, as studies have revealed how marshes along the lower river and estuary serve as a vital nurseries where young salmon gain size and strength before facing the rigors of adult life in the open ocean. A place of food and shelter "These shallow water habitats do lots of things," said Dan Bottom, a biologist with the National Marine Fisheries Service who is leading estuary studies in the Columbia and other rivers.

The slow-moving, tea-colored waters of marshes support an abundant food chain of plankton, insects and crustaceans. Shaded pools and side channels also offer hiding places from predators and main river flood torrents. Chinook salmon, in particular, make extensive use of such habitat, Bottom said. Some Chinook linger in lower-river side channels and marshes for as long as four months, he said.

Kukulka and Jay focused on a 25-mile stretch of the lower Columbia. Their work, funded by the U.S. Army Corps of Engineers and the National Marine Fisheries Service, shows how it may be possible to focus restoration efforts to get the most from limited dollars.

The researchers developed a mathematical model, run on a computer, to represent the chaotic interaction of ocean tides and shifting river flows. The program makes it possible to estimate how high the river would rise -- and how much land would be inundated -- if there were no dikes or dams during the spring freshet, the massive surge of runoff from melting snow in the mountains.

55 dams hold back water Now 55 dams, built to generate power and control flooding, hold back enough water to reduce the Columbia's peak spring flows nearly in half. If no dikes had been built, the dams alone would eliminate about 29 percent of the lower river marshes and channels historically available for salmon during May, June and July, the researchers concluded.

Dikes alone would take water from about 52 percent of the habitat, their model estimated. Together, dikes and dams have eliminated about 62 percent of the shallow water habitat, or about 6,900 acres.

"It is a little shocking how big the changes have been," Jay said. But he found reassurance in the result that diking is a bigger contributor than dam operations. "There are probably areas where dikes can over time be removed at lower cost than altering flow-management," he said. Releasing more water for habitat would be costly because it would leave less water for power generation in the summer.
But dike removal could meet strong local resistance.

A fear of a lost tax base "It's the kind of thing communities fear -- the idea of land coming out of production and the loss of tax base," said Ian Sinks, a biologist with the Columbia Land Trust. The Vancouver-based nonprofit has purchased hundreds of acres along the lower Columbia for the creation of havens for threatened salmon, Columbian

white-tailed deer and other wildlife. To reassure residents around Grays River, Sinks said, the tax-exempt land trust has agreed to keep paying property taxes on recently acquired acres.

Bottom, the federal biologist, said the new computer model is helping to fill a glaring gap in knowledge of salmon habitat needs in the lower river. Government and private groups have begun buying former wetlands and funding restoration projects, but the effort lacks a coordinated plan to prioritize and focus limited dollars, Bottom said.

"What you are seeing right now is a lot of ad hoc stuff," he said. "No one has developed a good snapshot of what the opportunities are, what habitats are most important to try to restore."

Response: Comments noted. The text and quotes do not reflect any changes to the data presented in the original text in Volume 1. The statistics in the newspaper article were interesting but we could not include them without information about the original sources of these data.

3.50 Comment: Paragraph 3 - The 5.5-inch water level fluctuation referred to seems unlikely to be biologically significant in the context of widely varying annual and seasonal rainfall conditions, snowmelt patterns, etc. that arid wetlands experience. Has this observed hydrologic impact been tied to functional changes in a wetland ecology or chemistry?

Response: The impacts on the ecosystem of these fluctuations are discussed in Chapter 4.

Page 3-20

3.51 Comment: Section 3.3.6 Increased Input of Nutrients Resulting from Agriculture - We are not familiar with this definition of BOD - Sylvia et al. 1998 defines BOD as biological oxygen demand - amount of oxygen consumed in 5 days by biological processes breaking down organic matter.

Response: Biological oxygen demand and Biochemical oxygen demand are synonymous as far as we could determine by searching the web. Some references use one term and others use the other to mean the same thing – the biological breakdown of organic matter.

Page 3-21

3.52 Comment: Paragraph 1 - There are recent "media" reports of contaminants in wastewater treatment sludge that is applied to agricultural fields. If valid, the practice may represent an impact pathway for wetlands that receive runoff form agricultural lands where such applications occur.

Response: We were unable to find any documentation of contaminants from treatment sludge entering wetlands. Generally, regulations restrict the application of contaminated sludges on agricultural products.

3.53 Comment: Paragraph 3, Line 1: The discussion on farming practices and type of chemicals needs to be broadened. Fate and transport processes are major mechanisms contributing to the amounts and types of pollutants that reach surface or groundwater.

Response: We decided to limit the discussion specifically to wetlands, and what impacts wetlands. Each subject we treat could be broadened to discuss a broader range of issues and the actual physical, chemical and biological processes that take place, but this was not the purpose of this review.

3.54 Comment: Section 3.3.8 Disturbances caused by Agriculture - Increased Levels of Salt Resulting from Agriculture - This section of the draft deals with "Disturbances Caused by Agriculture." Obviously one of the possible disturbances to wetlands from agricultural activities is an increased level of salt in the wetlands. I do not believe section 3.3.8 provides information about how this (increase in salt) might occur other than to say "Irrigation return waters are often high in salt content." I realize that Chapter 4 of the draft describes the impact of increased salt on the wetland and I don't think that I am confusing the function or purpose of section 3.3.8 (in Chapter 3) with that of section 4.10 of Chapter 4. However, I don't believe section 3.3.8 fulfills its presumed mission of describing the disturbance and how it occurs. It is quite possible that I do not understand the mission of Chapter 3.

Section 3.3.8 describes how soils (not wetlands) become saline or why they are saline in and environments. This is all well and good, but I don't really see what this has to do with increased levels of salt in wetlands. It seems the focus should be on how an increase in the salinity of a wetland soil/water system can occur due to agricultural practices. Modification of the local water table due to agricultural practices may possible increase the salt level of a wetlands As noted in the draft, wetlands receiving water from irrigated areas may be subject to higher salt concentrations. However, I only see the Adamus et al. 2001 reference as providing information about how wetlands may receive increased salts. Unfortunately, I do not readily know of literature that addresses the issue of increased salt levels in wetland systems.

Response: We decided to focus the discussion to the disturbances themselves and limited the discussion of how they occur because that would have required an entire volume by itself. The discussion about salt formation from irrigation has been clarified to describe how the salt gets to wetlands.

Page 3-22

3.55 Comment: 3.3.9 Reduced Connectivity Resulting from Agriculture - Fragmentation depends on the particular landscape matrix. Agricultural effects are not all bad. Like wetlands, some types of agricultural lands serve as refugia or corridors for wildlife in urbanizing landscapes.

Response: This is an interesting hypothesis but we were unable to find any documentation describing agriculture in urbanizing landscapes serving as refugia.

3.56 Comment: 3.3.9 Reduced Connectivity Resulting from Agriculture - Research is available on how agriculture affects habitats and should be cited. A starting point is Chapter 13 in Johnson and O'Neil, eds. (2001)

Response: Chapter 13 in Johnson and O'Neil does not address the impacts of fragmentation on wetland habitat. The reference, however, has been included as a further source for those interested in exploring the impacts of agriculture on habitat in general.

3.57 Comment: Section 3.3.10 Other Disturbances Resulting from Agriculture - Substantial information on the effects of agriculture on soil properties is available. The "no-till" farming practice is but one outcome of this research. Perhaps NRCS publications should be consulted.

Response: We decided to focus the discussion to the disturbances themselves and limited the discussion of how they occur because that would have required an entire volume by itself.

Page 3-23

3.58 Comment: Bullet 2 - Irrigation projects such as dams flooded riparian wetlands above the dam with the dam pool and removed spring freshet flows from wetlands below the dams. Both wetlands above and below dams are affected.

Response: A section on the impacts of dams on water flows has been added.

Section 3.4 Disturbances Caused by Urbanization

Page 3-23

3.59 Comment: Third Sentence - Isn't "compaction of soil" similar or nearly the same as "increased areas of impervious surface."? Compacted soil leads to impervious area. It is an either-or sort of thing.

Response: We disagree. Impervious surface implies that no water gets through the surface. Compacted soil however, often does let some water through.

Page 3-24

3.60 Comment: Box on Page - May's dissertation is on streams; he was not part of our wetlands grad. student team. However, many others were who are not recognized here. Most are cited somewhere else in the document and should be pulled together here.

Response: The reference to May was deleted and a link to all the other research published was added to the box.

3.61 Comment: Section 3.4.1 Disturbances to the Physical Structure of Wetlands Resulting from Urbanization - It is undeniable that urbanization is adversely affecting the structure and functions of wetlands. A major gap that does not appear to be adequately addressed in this document is the level of functions that such impacted wetlands provide.

Response: We agree that disturbed wetlands can still provide functions, and the methods we have been developing to assess and characterize functions reinforce that observation. This document, however, is focused on identifying disturbances and the effects of these disturbances on wetlands so managers and regulators will have a better understanding of what it is they may need to do to protect wetlands. It is not the intention of this document to discuss the level of functions present in disturbed wetlands.

3.62 Comment: Section 3.4.2 Increased Amount of Water in Wetlands Resulting from Urbanization - the characterizations described in Azous and Horner applies to depression wetlands only, as the vast majority of wetlands studies are of the depression HGM class. Cole et al. 2002 indicate that factors controlling hydrology in the same HGM can vary, and models developed in one region should not be transferred to other areas.

Response: We agree that some factors may not be transferable as reported by Cole et al. However, basic principles that are elucidated in research in one geographic location are transferable to other regions with similar conditions. For example, we do not think it is inappropriate to conclude that impervious surfaces increase the surface flows and decrease the recharge, regardless of where this occurs. Even though the amounts of recharge and surface flow may differ between regions, but the basic principle still applies.

3.63 Comment: Last Paragraph - There needs to be a citation or citations added to support the statement that there are "strong" correlations between the effects of urbanization in a watershed and the hydrologic processes in that watershed. The use of the words strong and correlation suggest statistically significant relationships. If this is the intent, than the relationships and their correlation factor should be clearly identified. At the very least, a list of the correlations (i.e., thresholds) discussed in Section 3.2.3.3 should be added to ensure this is not taken out of context.

Response: Citation provided, and the word "strong" has been replaced with "statistically significant." We do not however, think it is appropriate in this report to provide the

numeric correlation coefficient because most users of this document will probably not understand its technical meaning.

Page 3-25

3.64 Comment: Section 3.4.2.1 Increased Frequency of Erosive Flows - Especially for slope wetlands, increased runoff from developed areas can increase erosion and create channelized flow in wetlands that previously had little surface flow or channels.

Response: This is a good hypothesis but we did not include this observation because we did not find any reference to this in the literature.

Page 3-26

3.65 Comment: Section 3.4.2.3 Consequences of Changes in Water Regime, Last Paragraph - The Holland et al. (1995) study should not be considered "science" and reported here, as the Ecology authors seem to identify serious questions its methodology and results.

Response: We decided to include this reference because it reflects research done in the Northwest and has been published in a peer reviewed journal (Wetlands). As scientists we report on what has been published but reserve the right to question some of the "methods" used.

Page 3-27

3.66 Comment: Paragraph 1 - These findings apply only to depression wetlands. Water level fluctuation does not integrate velocity, volume, or retention times, which are critical hydrologic parameters that control water quality functions of wetlands (see Kadlec and Knight 1996).

Response: This section discusses only the impacts of urbanization on water level fluctuations. The other "critical hydrologic" factors are indicators of function and are discussed in Chapter 2.

Page 3-28

3.67 Comment: Section 3.4.4 Increased Input of Sediment Resulting from Urbanization - These studies do not address slope wetland types.

Response: Clarification has been added that references in the first paragraph deal with depressional and riverine wetlands.

Page 3-29

3.68 Comment: Paragraph 1 -The 1966 references used are outdated. If they are retained, they need to be put in the proper context, such as by using the adverb "historically." Suggest revising this discussion using contemporary data. The Ecological Society of America (ESA) has recently published a document on nitrogen cycling and pollution. ESA. 1997. Human Alteration of the Global Nitrogen Cycle: Causes and Consequences. Issues in Ecology Number 1.

Response: 1966 is a typographical error – the dates should be 1996.

3.69 Comment: Section 3.4.6 Increased Input of Toxic Contaminants Resulting from Urbanization - The USGS (Voss et al. 1999, Bortleson and Davis 1997) have characterized water quality conditions in several small creeks near Seattle. These studies should be cited.

Response: Information from the Voss and Bortelson citations was added.

3.70 Comment: Paragraph 4 - Part of sentence reads: "greatest concentration of pollutants in surface runoff is typically observed in the fall with the first rains following summer drought (Booth 1991)." NOAA Fisheries has more recent studies on this and the consequences to coho that try to move upstream with first rains. A Seattle Post Intellegencer article described the study. Note: First flow stormwater events have been shown to kill a high percentage of adult coho in urban sytems – another impact of increased impervious surface and stormwater. -
NMFS (2003- Strategies for Puget Sound conference) report 88% mortality in one urban stream a few hours after the coho salmon entered the stream system. -

> Urban Runoff Killing Salmon in Washington
> By J.R. Pegg
> SEATTLE, Washington, February 7, 2003 (ENS) - Every time it rains in Seattle, the storm water sweeps a wide array of urban pollutants into the city's creeks. Faced with mounting evidence that this runoff is killing endangered salmon at alarming rates, state and city officials are wrestling with the economic and environmental consequences of new plans to further protect the city's creeks.
>
> A new report from the National Marine Fisheries Service, cited at this week's Shared Strategy for Puget Sound Conference, includes a comparison by scientists of a West Seattle creek, which has undergone extensive rehabilitation efforts, with a rural creek outside the city.
>
> Hundreds of coho salmon are dying in streams that absorb contaminated runoff from cities, researchers have found. (Photo courtesy U.S. Environmental Protection Agency)

> During the six-week study, the scientists found that 88 percent of the coho salmon entering the urban creek died within a few hours, most before spawning. Just one of the fish entering the rural stream perished. The scientists have not yet reached a final conclusion, but water quality is the primary suspect. The researchers plan to examine samples from the dead fish for evidence of exposure to polycyclic aromatic hydrocarbons, compounds found in automobile exhaust and other air pollution which eventually make their way into the water. . .

Response: The newspaper article was not included because newspaper articles can be considered only as "hearsay" unless specific citations are given. The NMFS information appeared in an abstract of an oral presentation, and as such, is also not peer reviewed. Since this information does not contradict the information in Booth et al., it was not included.

Page 3-30

3.71 Comment: Section 3.4.6.1 Heavy Metals and Hydrocarbons, Paragraph 2 - Canning and Newton 1989 is missing from the references. Their conclusion may be valid for one time sedimentation events, but where sediment derived from stormwater discharges are constantly being discharged to wetlands, a layer of sediment contamination is likely to be buried by more contaminated sediment. Thus, there is always contamination in the biologically active zone. Where sediments from non-contaminated or less contaminated sources (bank erosion, down cutting, construction sites, farming, etc.) mix with contaminated sediments, then concentration of stormwater derived contaminates is decreased, and may not be ecologically significant

Response: Clarification added.

3.72 Comment: Section 3.4.6.1 Heavy Metals and Hydrocarbons, Paragraph 2 - It is my understanding that particulate forms of metals (i.e., adsorbed forms) can become dissolved forms when sediments become anaerobic or pH changes thereby changing the speciation of the metals.

Response: Yes, **pH** and **Er** are important in determining the mobility of some metals and this is discussed in more detail in Chapter 2. A reference to the information in Chapter 2 has been added to the text. In general, however, metals from urban settings tend to accumulate in wetlands as documented in the literature.

Page 3-30

3.73 Comment: Section 3.4.7 Reduced Connectivity (Fragmentation of Habitat) Resulting from Urbanization - Are there any figures specific to Washington? I think this would be of interest to the reader because the NW has grown faster than the rest of the nation based on latest census. Maybe the GAP data can provide some local insight.

Response: We were unable to find any references specific to Washington.

Page 3-31

3.74 Comment: Section 3.4.7.1 Other Disturbances Resulting from Urbanization. - It seems that the literature is quite clear that another impact of urbanization is from domestic animals, especially dogs and cats. I suggest adding another bullet identifying the impacts of domestic animals on native fauna, such as passerine birds and small mammals.

Response: We consider dogs and cats under the category of "exotic" animals in the bullet. We have added clarification in the document.

Section 3.5 Disturbances Caused by Logging

Page 3-32

3.75 Comment: Bullet 7 - (actually looks like it is the paragraph under the bullet list since there are only 6 bullets). Logging roads and mass wasting can take a heavy toll on exiting wetlands in a basin. Presence of roads greatly increases erosion and potential for mass wasting events. See FEMAT Study. Logging roads and mass wasting could be the last bullet.

Response: We agree that logging has impacts. However, we are not addressing all the details of disturbances caused by forest practices because this information is being synthesized in another document by the Washington State Department of Natural Resources. Erosion and mass wasting are a subset of increased sedimentation listed in the bullet.

3.76 Comment: Disturbances Caused by Logging - Unless Cooke (In Press) has been released for peer review and is available to the public, this document should not be cited. There is a ton of other references to cite on the impacts of logging, such as FEMAT (Forest Ecosystem Management Assessment Team). 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Report of the Forest Ecosystem Management Team for the U.S. Department of Agriculture, Forest Service.

Response: The Department of Natural Resources has had the Cooke document peer reviewed and revisions are being made in response to those comments. Therefore it did not make sense, given our limited resources, to repeat the synthesis being completed for that project.

Section 3.6 Disturbances Caused by Mining

3.77 Comment: Books that address mining impacts include: Ripley, E., R. Redmann, and A. Crowder (1996) and Sengupta, M. (1993). Some additional discussion here is warranted for a credible analysis. For example, mining can fill or excavate wetlands, alter stream channels and water distribution, alter watershed boundaries, intercept groundwater and distribute it to the surface.

Response: We agree that there are potentially other impacts from surface mining. We were, however, unable to obtain the two references identified to determine how relevant they were to wetlands. Given the relatively limited surface mining that occurs in Washington, we did not consider it imperative to provide more detailed information that was available in the Adamus et al. (2001) review.

3.78 Comment: There needs to be a distinction between the many different types of mining. This seems to refer to hardrock mining. Sand and gravel mining of alluvial deposits does not result in the same types of impacts described in this section.

Response: We were unable to find any information on the impacts of gravel mining. We have added that the information included is for hardrock mining and that information on sand and gravel mining is a data gap.

Section 3.7 Chapter Summary and Conclusions

Page 3-33

3.79 Comment: Paragraph 5 - Pollutants, particularly metals, also are bound by dissolved organics through the process of chelation. Any organic chemistry text book describes this process, such as Manahan, S.E. 1991. Environmental Chemistry. Fifth Edition. Lewis Publishers, Chelsea, Michigan. Another useful text is Harrison, R.M. (Ed). 1992. Understanding Our Environment: An Introduction to Environmental Chemistry and Pollution. The Royal Society of Chemistry, Cambridge, UK.

Response: We agree, but decided not to provide information to this technical level in the synthesis. Understanding the chemical processes involved is not critical for managing and protecting wetland resources.

Page 3-35 and 3-36

3.80 Comment: Table 3-3 - Mining books sited above indicate salinity as a potential impact from certain types of mining. The analysis of mining impacts should be updated upon review of above referenced books and additional literature. There is no indication as to what "++" means.

Response: ++ is a typographical error. It should be xx. We did not consider salinity to be an important impact from the type of mining done in Washington State.

3.81 Comment: Table 3-3 - Column 4 (Urbanization) contains two errors. The symbol ++ in the last row (Other Disturbances) and "nm0" in the Increasing the Concentrations of Salt row.

Response: These typographical errors have been corrected.

Chapter 4 – Impacts of Human Disturbances on the Functions of Wetlands

General Comments

4.1 Comment: Chapter 4 has redundancy with the labeling (and content) of the sections.

Response: The redundancy is intentional because this report is meant to be used as a reference. Readers are not expected to read the entire report.

4.2 Comment: Richter and Roughgarden is listed as "2002 in press" when the bibliography indicates it is an unpublished manuscript.

Response: The citation was deleted because we were unable to confirm its current status.

4.3 Comment: Unless the references cited in Adamus et al. 2001 have been reviewed by the authors of this document, any references cited by Adamus et al and included in the references should be identified by adding "as cited by Adamus et al."

Response: The sections that are based on the Adamus review are identified in Section 4.1.3. We decided not to put "as cited in…" for every occasion because it would have made the text very cumbersome. This approach was approved by Paul Adamus, the lead author of the 2001 report.

4.4 Comment: In this impacts chapter you intensify (try to) Washington examples (studies) and other location studies (non-Washington). However, you are inconsistent in applying this structure to all functions, I think you should be consistent.

Response: We did not have an equal amount of local (Washington) information for all functions, so the presentation may seem inconsistent. Unfortunately, we were unable to do anything about this.

4.5 Comment: Section 4 has many instances of inferences about impacts and functions of wetlands when we believe that data is available. More careful and thorough research is needed. For example, in section 4.3.1 on page 4-5 there is a cause and effect scenario that poorly reflects science and literature. We struggle to see how this is Best Available Science (BAS).

Response: We were unable to find the data mentioned above, and one purpose of the peer review was to seek information where data were lacking. If reviewers were unable to recommend additional sources, we must assume data are not readily available. Reviewers were also asked to comment on the veracity of the hypotheses suggested. "Synthesis" is defined by Webster's Collegiate Dictionary as "the combining of often diverse conceptions into a coherent whole" and "deductive reasoning." Proposing hypotheses from existing information, therefore, is consistent with the goals of this report, which is to synthesize existing information about wetlands. All hypotheses are identified, and readers can use their judgment to determine if the deductions are appropriate.

Section 4.1.Readers Guide to This Chapter

Page 4-3

4.6 Comment: Paragraph 1 - Azous and Horner (2001) provide several studies, not "numerous studies", the reported studies are generally limited to depression wetlands. Also, be aware of recent review of this book (Condrey 2003).

Response: Word changed to "several." We do have the review by Condrey, which is a book review that appeared in the journal *Wetlands*. Please note that book reviews in journals usually do not undergo the same level of peer review as scientific reports. We also have re-printed (with permission) the response of the authors to the book review. Their response is found in the response to Comment 4.55.

4.7 Comment: Bullets - Citations of key studies documenting the changes in wildlife habitat should be provided.

Response: Citations are too numerous to list in the bullets and are provided in each section.

Section 4.3 Impacts of Changing the Physical Structure within a Wetland

Page 4-5

4.8 Comment: Section 4.3.1 Impacts of Changing Physical Structure on Hydrologic Functions - I am nervous about the hypothesizing here. Keep in mind that a dense vegetation layer, especially if it is scrub-shrub or forest, could actually increase the height of the flood because the stems displace water storage area. While rate of flow may decrease, height of flood could increase, and nobody knows the downstream result. All in all, I think we need to be careful of hypothesis without some study to back it up.

Response: All the studies we have reviewed indicate that vegetation reduces water velocities. The question of vegetation displacing storage is more difficult to address. We were unable to find any information of the significance of this factor in reducing flood

storage. We reviewed some of the models developed for water dynamics in wetlands, however, and were unable to find any that used the volume of vegetation as a variable in reducing storage. This would suggest this factor is not significant in the overall water dynamics in wetlands. (A review of hydrologic models is found in Hammer and Kadlec 1986. A model for wetland surface water dynamics. In: Water Resources Research 22:1951-1957; and Kittleson,J.M. 1988. Analysis of flood peak moderation by depressional wetland sites. In: Hook, D.D. (ed.) The Ecology and management of wetlands Vol. 1: Wetland Conservation. Timber Press, Portland OR. 99-111).

4.9 Comment: Text states: "No information was found on how changing the physical structure of wetlands impacts their hydrologic functions . . ." It would seem that the Manning roughness coefficients commonly used in hydraulics and hydrologic analysis would explain the impact of vegetation on water velocities.

Response: We were unable to find any information on how vegetation may affect the roughness coefficient. We are also lacking information on how to calculate a roughness coefficient based on stem densities or thickness.

4.10 Comment: One could hypothesize that removing erect and persistent vegetation . . . may impact the reductions in water velocity that occur in wetlands.

Response: We do not think emphasis on the word "may" is needed since this is a hypothesis. We do not think it is necessary to highlight qualifiers in the text.

Page 4-6

4.11 Comment: Section 4.3.3 Impacts of Changing the Physical Structure…on Plants – What is the impact of lethal toxics to the seed bank?

Response: We were unable to find any information on this question.

4.12 Comment: Section 4.3.3 Impacts of Changing the Physical Structure…on Plants - Removing vegetation from wetlands can result in potential invasion by invasive species. In forested wetlands, it could initiate long-term plant trend of succession. Where vegetation trees shade standing water, increases in algal production or growth of aquatic plants could result.

Response: The facilitation of invasive species has been added to text.

4.13 Comment: Paragraph 4 - What about the type of Grazer (e.g. native vs. domesticated)?

Response: We were unable to find any information on differences in the effects of grazers by "native vs. domesticated" for this region. Differences have been found between cattle and buffalo east of the Rockies, but we decided this information was not appropriate for Washington because we do not have these very large grazers here (Belsky, AJ 2000. Livestock Grazing and weed invasions in the arid west. Report of the Oregon Natural Desert Association). We do not think the data can be extrapolated to elk, which is the largest "native" herbivore in Washington, because their grazing patterns are different.

4.14 Comment: Paragraph 4 - The timing and duration of grazing are also important factors that determine the impacts of grazing on riparian and wetland vegetation. There is a large volume of literature, such as Practical Approaches to Riparian Resource Management: An Educational Workshop. 1989. Gresswell, R.E., B.A. Barton, and J.L. Kershner (editors). U.S. Bureau of Land Management, Billings, Montana, that indicate that sensitive areas can support grazing provided the timing and duration of grazing is properly managed (i.e., appropriate rest and rotation).

Response: Timing has been added as a factor. Duration is already listed.

Page 4-7

4.15 Comment: Paragraph 1 - WDFW has increased plant species diversity in some wetlands with selective grazing. This has been the case with Reed canarygrass wetlands in the Chehalis River basin when selectively grazed allowed Carex obnupta and C. rostrata to emerge as dominants and Columbia Basin where grazing cattails increase Scirpus and Carex in the plant community. Without grazing, the sedges were out competed by the taller growing aggressive plants. The results of grazing may have been influenced by soil type and the time and purpose of grazing. The problem with grazing is the restoration of woody plants is discouraged and introduction of non-native seeds. (See Livestock Grazing and Weed Invasions in Arid West by A. Joy Belsky and Jonathan Gelbard, April 2000. Oregon Natural Desert Association.) Also Kanterud, H.A. 1986. Effects of Vegetation Manipulation on Breeding Waterfowl in prairie Wetlands – A literature Review, US Department of the Interior Fish and Wildlife Service Fish and Wildlife Technical Report 3 shows mixed results from grazing that may be related to intensity of the grazing.

Response: Clarifications added that the effects of grazing may be different based on timing and grazing intensity. The references cited above were reviewed, but not added to the citations because they did not address wetland plants specifically and provided no conclusions that were different from those found in the existing citations.

4.16 Comment: Paragraph 2 - The numbers and types of invertebrates in wetlands may be related to hydroperiod. Seasonal wetlands both grazed and ungrazed can produce invertebrate populations. Some literature Munro (1963) and Hopper (1972) suggest that moderate grazing of wetlands could increase invertebrates. Munro (1963) suggests allowing a shift to planktonic algal production occurs. While there are many ecological reasons for not grazing wetlands, including impacting water quality, native plant communities, especially woody plants, and fish impacts, impacts on invertebrate communities from grazing does not appear to be a major impact.

Response: The impacts of changing hydroperiod are discussed in Section 4.4. As noted in the comment, grazing does not seem to have a major impact on invertebrates and so this was not mentioned in the text. The focus of this chapter is to identify major negative impacts to wetland functions (not all impacts) that result from human activities because these are the ones that need to be "managed" if functions are to be protected.

Page 4-8

4.17 Comment: Section 4.3.5 - You might consider contacting WDFW (Dave Anderson) to see what information is available from the latest W. Pond Turtle research. However, this might not apply b/c WPT's maybe more associated with deep water.

Response: According to the WDFW recovery plan for the pond turtle, the physical structure of a wetland does not seem to be a major factor in the habitat requirements of the pond turtle.

4.18 Comment: Paragraph 2 - There is no Adams and Bury 1998 in the references. The proper citation appears to be Adams et al. 1998.

Response: Citation has been corrected in text and bibliography.

4.19 Comment: Last Paragraph - The Thurston county spotted-frog site, which is one of the few western Washington locations for spotted frog, is partially grazed.

Response: Comment noted. No changes necessary.

Page 4-9

4.20 Comment: Paragraph 5 - Grazing wetlands has both increased and decreased bird density and diversity in wetlands. Grazing precludes the establishment of new woody vegetation and would impact many neotropical migrants as a result. However, grazing of monocultures of reed canarygrass or cattail increases waterfowl, wading bird and shorebird feeding use by opening up the area and providing access to plants and invertebrates. Often times, the benefit or impact can correlate to the degree of the grazing disturbance.

Response: We were unable to find any information on the positive effects of grazing on birds. The following is a quote from a literature review on the impact of grazing on birds. "Cattle grazing impacts on bird communities are chiefly manifested through direct effects such as trampling of nest sites for ground-nesting birds, and indirect effects such as alteration of habitat structure (Taylor 1986) and community composition. Researchers have found cattle grazing to cause reduced species richness of all birds (Capitol Reef N.P - Willey 1994), songbirds (northern Utah - Duff 1979), riparian passerines (Oregon - Taylor 1986), and raptors (northern Utah - Duff 1979). Again, comprehensive literature reviews are the most telling in terms of grazing effects. One by Saab et al. (1995) concluded that grazing in the west has led to a decline in abundance of 46% of the 68 neo-tropical migrants that utilize riparian habitats. Another review by Bock et al. (1993) similarly reported that on some western sites up to 40% of riparian birds have been found to be negatively impacted by grazing." Accessed October 8, 2004 http://www.rangenet.org/directory/jonesa/litrev.html#effects_on_faunal

4.21 Comment: Paragraph 5 - There are many different guilds and species of birds. Is the reference to "many birds" an accurate citation of Kauffman et al. 2001? Perhaps it is more specific to waterfowl or shorebirds?

Response: Kauffman does not limit the discussion to waterfowl and shorebirds. Text changed to read "many guilds of birds."

4.22 Comment: Paragraph 6 - Define wetland and riparian birds as appropriate. Explain, if possible, how these compare to wetland dependent and wetland users classifications.

Response: Text was clarified to birds associated with wetlands.

4.23 Comment: Paragraph 7 - Is the reference to Ammon and Stacey 1999 to over-grazed areas?

Response: The authors did not define their study areas as "over-grazed."

Page 4-10

4.24 Comment: Paragraph 1 - Grazing can remove bird habitat nesting cover and impact production. In the Columbia Basin, heavy grazing next to wetlands removed buffer vegetation and reduced waterfowl production by 50% (Foster et al. 1984).

Response: Information and citation added.

4.25 Comment: Paragraph 6, Last Line - Suggest adding a sentence or modifying the existing one, such as "Based on this study, controlled grazing that does not contribute to structural changes in vegetation, appears to have no significant effect on the abundance and distribution of small mammals." The same or similar change should be made to the bullet in the summary on p. 4-11.

Response: Sentence added to main text, but the detail was not considered necessary in the summary bullets.

Page 4-11

4.26 Comment: Top Bullet on Page, Last Sentence - "Impacts…from vegetation removal can only be hypothesized since no information was found in the literature." If there is no information, then let us avoid the temptation to hypothesize.

Response: The rule for Best Available Science states that the judgment of experts is an acceptable form of "best available science." Such hypotheses in the document are supported with a clearly stated rationale based on interpretation of current information. We would understand the reviewers' concerns if these types of statements were not clearly identified as hypotheses or assumptions and were not supported by a clear rationale. See response to comment 4.5.

4.27 Comment: Bullet 2 - The most severe impacts from grazing is to fish and this has been reported. Grazing of riparian wetlands have precluded the establishment of woody vegetation and stream shade. Streams listed as failing to meet water quality standards in agricultural areas most often occur because of temperature, biochemical oxygen demanding material and fecal coliform bacteria. While some of these impacts occur from dairy waste, others occur from grazing sensitive habitats. Cattle grazing in riparian wetlands lead to streambank erosion. Grazing of riparian wetlands prevents the establishment of vegetated corridors and could affect those mammal species with a very strong correlation to cover, such as mink and martin. We have observed cover also affects mice and mole populations. When wetlands are restored and grazing removed, mice populations explode. They are no longer taken by hawks, owl, heron and coyote in large numbers, and there is increased predation and girdling of planted woody vegetation. This necessitates protection on woody plants to maintain their survival.

Response: Impacts to fish from the removal of vegetation are documented in section 4.3.6, but the references were not specific to grazing. We were unable to find any information linking grazing in wetlands to impacts on fish, and none were provided in the comment. The impacts of grazing on other animals are discussed in the respective sections if the information was found in the literature.

Section 4.4 Impacts of Changing Amount of Water in Wetlands

4.28 Comment: Same comment here. Too much hypothesis and not enough science. It could be this way or that way, and we can say that all day long. Like I said before, by and large, the document does a good job avoiding hypothesis without foundation, except in a few spots.

Response: See response to Comment 4.26.

4.29 Comment: Section 4.4.1 - Make clear that for flood reduction or increase, the wetland must receive floodwaters or be hydrologically connected to flood-prone areas. Although loss of flood storage for any individual depressional wetland may be small, cumulative impacts from the widespread impacts of urbanization on many small wetlands in a given watershed could be large. In addition, loss of appreciable flood storage in one or more large depressional wetlands could result in large reductions in available flood storage. Such scenarios would likely exacerbate flooding in watersheds with flood prone areas. Assuming climate change predictions will increase the annual amount of rainfall in much of western Washington, the combination of climate change and increasing urbanization is likely to result in increased flooding and increased frequency of larger flood events (i.e., those with longer recurrence intervals such as a 100-year event).

Response: Clarification made.

4.30 Comment: Section 4.4.2 - This section supports earlier comments on section 2.5.1.4, that it should not be assumed that sediment removal is analogous to toxic compound removal.

Response: Point was clarified in Section 2.5.1.4.

4.31 Comment: Section 4.4.2 - Perhaps most simply, flooding wetlands brings a greater volume of surface water in contact with wetland plants, soils, and the chemical processes that lead to water quality improvement. Flooding wetlands can change residence time, the distribution of aerobic and anaerobic environments, and a variety of microbial and non-microbial chemical processes. These factors can affect the water quality improvement functions of wetlands. Kadlec and Knight (1996) and other literature provide further discussion.

Response: Clarification and the reference were added to text.

Page 4-12

4.32 Comment: Paragraph 1, Lines 1 and 2: Is there any evidence that wetlands in Washington receive or are sinks for inorganic mercury? If so, please add references as appropriate. Otherwise, the premise is inaccurate and wetlands will not be a source of methyl mercury. However, if wetlands receive trace metals from urban runoff and increased flooding results in increased anaerobiosis, there could be increased levels in dissolved forms of metals as particulate forms change to dissolved forms.

Response: We do not have specific data about mercury in Washington's wetlands, although mercury is a water quality issue in many waters of the State. We can hypothesize, therefore, that mercury is present in some of the state's wetlands and can be released under anaerobic conditions. This hypothesis has been added to the text.

4.33 Comment: Paragraph 2 - Denitrification is not dependent on seasonal inundation. In permanently inundated soils and sediments, denitrification is a common feature and occurs at the aerobic-anaerobic interface in sediments, or in the oxidized rhizosphere of plant roots. Likewise, non-flooded soils contain anaerobic micro-sites (often associated with decomposing organic matter) that are sites of denitrification. The denitrification process is closely coupled (both spatially and temporally) with nitrification processes (see Wetzel 2001, Richardson and Vepraskas 2001, Chapter 9 in Ford 1993, and Vymazal 1995).

Response: Text has been corrected. The function that is dependent on seasonal inundation is the total removal of nitrogen.

4.34 Comment: Paragraph 2 - Denitrification is an anaerobic process. So, assuming the presence of organics (i.e., source of N) and anaerobic bacteria, the amount of anaerobic area is what controls the rate of denitrification. Therefore, unless permanently inundated areas lack anaerobic conditions, bacteria, and sources of N to reduce increased flooding would be expected to increase the amount of denitrification regardless of what is happening in seasonally saturated areas. If seasonally saturated areas also possess conditions conducive to denitrification, then the amount of denitrification would be expected to increase even more. This paragraph should to be modified to more accurately reflect the process of denitrification. See for example: Ecological Effects of Wastewater: Applied Limnology and Pollutant Effects by E.B. Welch and T. Lindell 1992.

Response: See response above.

4.35 Comment: Section 4.4.3 Impacts of Changing Amounts of Water on Plants - put definition of richness in the glossary.

Response: Richness is already in glossary.

Page 4-13

4.36 Comment: Put definition of drawdown in glossary.

Response: Drawdown added to glossary.

4.37 Comment: Paragraph 6 - A good example of how this germination "window" can be affected is through hydrologic modification of stream flow may affect cottonwood germination in riparian areas of western rivers (see Rood et al. 1995.

Response: Reference was not added because it addresses riparian areas and not wetlands.

Page 4-14

4.38 Comment: Section 4.4.4 - These discussions seem to focus only on invertebrates found in depression wetlands with at least seasonal ponding. What about other wetland types?

Response: We were unable to find information focusing on other types of wetlands.

4.39 Comment: 6th bullet: The reference to Layzer et al. appears to pertain to mussels. So, perhaps it pertains to epibenthic invertebrates and not all. In addition, complete freezing is a pretty rare thing in Washington with the possible exceptions of montane systems and those in eastern Washington.

Response: Freezing is a common occurrence in eastern Washington wetlands.

4.40 Comment: Section 4.4.4.1 Impacts of Reduced Amount of Water on Habitat for Invertebrates - References to drought and drawdown section are for a desert stream (Stanley et al. 1994) and Minnesota (Hershey et al. 1999), respectively. Perhaps it is reasonable to extrapolate the findings of these studies to eastern Washington, which may have climates and conditions that are somewhat similar to those in the cited literature. However, it seems unlikely that this information would be applicable to western Washington. It seems prudent to modify this section to put the findings of these studies in the proper context, such as indicating that these findings may be applicable in eastern Washington wetlands that appear to have somewhat similar climatic regimes. In addition, drawdown (Stanley et al. 1994) tends to be a pretty rapid change in water levels specific to regulated impoundments. As such, perhaps the findings of that study are only applicable to regulated impoundments and not wetlands with more natural hydrologic regimes.

Response: Clarification added.

Page 4-15

4.41 Comment: Paragraph 1 - Reduced species richness is important to note. The impacts could be expounded upon to address the potential implications to food-web dynamics and nutrient cycling as well as other ecological processes. There needs to be more synthesis on the implications of impacts on wetland ecology. Did the research cited also note a change in species abundance? If so, it seems clear there are implications for the health of whatever predators the specific functional group of invertebrates represents (e.g., shredders, collectors, gougers, etc.). In addition, if the invertebrates are detritivorous, perhaps this has implications for nutrient cycling.

Response: The references listed did not discuss the implications for nutrient cycling.

4.42 Comment: Section 4.4.4.2 - I would appreciate your adding a box, like the one on 4-13 but substituting the word "invertebrate" for "plant" (URL is the same). This is a parallel database to the one for plants and may find similar application.

Response: Box added.

4.43 Comment: Paragraph 2 - The reference, Murkin et al. 1991, seems applicable to regulated systems (diked marshes). If so, this needs to be made clear. While there certainly are many wetlands in Washington that are diked, the proper perspective must be noted as appropriate.

Response: We do not agree that the Murkin reference may be applicable to regulated systems because the changes to the water regime in regulated systems can vary in timing and intensity from those reported by Murkin. This may impact invertebrates in different ways than those reported.

4.44 Comment: Paragraph 4, Line5 - There is a reference to Ludwa and Richter 2000. In the references, there are two references: Ludwa and Richter 2000a and 200b. Which of these is applicable here? Both?

Response: It is Ludwa and Richter (b). Correction made to text.

4.45 Comment: Paragraph 5 - Modify this paragraph to indicate that it is clear in the literature that invertebrate diversity, abundance, and richness are in part dependent on habitat diversity and richness as well as habitat quality. So, any impacts that reduce either of these variables are likely to result in changes in invertebrate community structure. For example, changes in hydrology that result in changes in specific habitat types, such as seasonally saturated emergent vegetation classes, would be expected to result in a change in the invertebrate community structure.

Response: The factors influencing invertebrates are discussed in Chapter 2, and we did not want to repeat this information in Chapter 4. Other changes in water regime (other than increases in the amounts of water) are discussed in the other sections of this chapter.

Page 4-16

4.46 Comment: Section 4.4.5 - The introductory paragraph may be inapplicable to PNW wetland amphibians since the lentic-breeding (i.e., those that breed in wetlands) amphibians in the PNW are drought tolerant. This makes sense since the PNW Region experiences a prolonged summer drought. Data from a comprehensive study in the Puget Lowlands (Adams MJ, 2000. Ecological Applications 10(2):559-568) indicates that ranid frogs had higher survival in wetlands that dry seasonally. Bill Leonard's experience is that both perennial and seasonally ponded wetlands have diverse amphibian communities, however, large wetland complexes with both perennial and seasonal pond habitat components are most diverse.

Response: The study by Adams attributed the higher survival in seasonal ponds to the lack of predation by bullfrogs, not to the duration of ponding. In fact, the one permanent pond without exotic species had higher survival.

4.47 Comment: Paragraph 1 - This is out of place, and should belong in Section 4.11.5.1

Response: Text moved.

4.48 Comment: Paragraph 3 - This gives me the impression that Painteds are more affected than other species. If that's not the case, change to (e.g., painted…)

Response: Text modified to clear up this impression.

4.49 Comment: Paragraphs 2 and 4 - Is there literature that supports the 2 sentences in this paragraph? The last sentence of this paragraph is incomplete. The impact of higher water levels on amphibians is not discussed in Section 4.4.5, yet paragraph 4 makes a conclusion of impact. The conclusion must be substantiated and referenced.

Response: Sentence was re-written, and there is a citation for these observations. Impacts from both drying and flooding are described and citations are given.

4.50 Comment: Section 4.4.6 - Water level changes that increase and decrease water depth and wetland area can increase or decrease habitat available to fish (see: Hudon, C. 1997 and Slitvitzky 2002).

Response: The reference by Hudon was for riparian areas only, We could not apply this to wetlands. The Slitvitzky reference was too general, and, again, no information specific to wetlands was found.

Page 4-17

4.51 Comment: Section 4.4.7.1 - In the pervious section you discuss losses of fish due to drawdown. Therefore, it would seem iterative that drawdown's might lead to numbers of wading or piscivorous_____??? birds. You might see if there's research to support that.

Response: No research on this subject was found.

4.52 Comment: Section 4.4.7.2 Impacts of Increased Amounts of Water on Bird Habitat - This section introduces "dredging" and "reservoirs" as impact pathways affecting birds. They have not previously been identified and should be discussed in Chapter 3.

Response: These factors have been added to Chapter 3.

4.53 Comment: Paragraph 5, line 7- "…of zooplankton, a food source for several guilds of wildlife." Suggest using "birds" in place of "wildlife."

Response: Change made.

Page 4-18

4.54 Comment: Section 4.4.8 - Information can be found in Slitvitzky 2002 and Kallemeyn et al. 1988. I suspect that there are numerous other FERC re-license documents, BLM irrigation facilities, etc. where this issue has been evaluated. State wildlife agency studies of fur bearing mammals may provide additional information.

Response: The reference suggested by the reviewer addresses impacts of dams that are general, and are not specific enough to extrapolate to wetlands.

Section 4.5 Impacts of Changing the Fluctuation of Water Levels within a Wetland

4.55 Comment: There is an over-reliance on King County's much touted wetland study presented in "*Wetlands and Urbanization*". Apparently, serious concerns regarding some of the fundamental methods and findings of the studies are questioned in a published review articles in an important scientific journal *Wetlands* (see Condrey 2003). At least one Ecology co-author to this document is aware of the article, as should be all listed authors, since they are members of Society of Wetland Scientists the publisher of the review. At a minimum, good science should compel Ecology to seek clarification from the book's contributing authors, to independently consider and discuss any new facts, and consider the merits of the divergent opinions. Ecology should also acknowledge to reviewers of their document that controversy exists regarding the findings of *Wetlands and Urbanization*.

Response: Following is the response by the authors of the book *Wetlands and Urbanization, Implications for the Future* in regard to the comments by Richard Condrey in his review of the book. The review was published in *Wetlands*, Volume 23, no. 1, 2003.

General response

The bottom line question provoked by the review is whether the criticisms presented in the Wetland review article are substantive enough to reduce the value of the book and the associated individual research projects as a resource for Best Available Science on protecting wetlands in the Puget Sound Lowlands. We agree that a number of the comments made by the reviewer would improve the book; most long-term research compilations would benefit from further editing.

We do not, however, agree that our results are unsubstantiated. It is important to recognize that while urbanization is in the title of the book, our results are more specific than that. Urbanization is the result of a complex change in ecosystem processes that

varies based on the condition of the watershed. Wetlands and Urbanization measures and analyzes a number of indicators of watershed condition, such as the percent of forest cover and water level fluctuation in wetlands, in an attempt to understand what specific fundamental processes are driving the losses observed in wetland biodiversity observed in the PSWSMRP studies. Prior to the inception of this study, little to no long-term research had been done on an ecosystem level that examined urbanization processes anywhere in the United States or in the Pacific Northwest. The individual studies represented by this program and the interconnected examination of the data and ecosystem components was, in fact, novel and extremely significant to our current understanding of wetland ecosystems, especially those in the Pacific Northwest.

Specific responses
For the purpose of efficiency of response to the review, we have grouped similar criticisms and summarized and addressed them below.

The book is:

- ***Poorly edited***
- ***Narrowly focused***
- ***Unable to fulfill the promises of its title***
- ***Provides no epilogue discussing impacts of the program on wetland science or management.***

The book would be definitely improved through the addition of new information and by additional editing. The book had, from the beginning, a narrow focus and the authors would also have preferred a different title for the book that better represented the narrower focus of the work. (Note: The title came from the theme of the last conference presenting the, then, final results of the Puget Sound Wetlands and Stormwater research program (PSWSRP). These results were published under that title in the final report. At that time our audience was local and our presentations were aimed at showing the implications of stormwater management strategies on wetlands.)

The publishing company, Lewis Publishers, selected this title in order to market a larger audience. The authors also wanted to add an epilogue but the publishers felt this was not necessary. Although many of the papers in the book could stand alone, we expected that the book would be viewed as a whole with chapters, not as individual papers. As a result a number of discussions in the individual chapters build on work and conclusions documented in other chapters. The reviewer's assumption that the chapters are stand alone may represent his preference however, the structure of the book does not affect the accuracy of the studies, nor their focus, which was to determine what fundamental relationships were driving the conditions we observed in wetlands. None of these criticisms affect the scientific conclusions of the work as a whole, nor do they affect the conclusions made by individual studies; they simply reflect the reviewer's preferences for format and editing.

- ***Lacking in outside peer review***
- ***Only amphibian work peer reviewed***

We agree that the book would have undoubtedly benefited from more peer review, however, more than the amphibian work documented in the book was peer reviewed. The following published articles document portions of studies presented in Wetlands and Urbanization.

Thom, R. M., A. B. Borde, K. O. Richter and L. F. Hibler. 2001. Influence of urbanization on ecological processes in wetlands. p.5-16. In Wigmosta, M. S. and S. J. Burges (eds.) Land Use and Watersheds: Human Influence on Hydrology and Geomorphology in Urban and Forest Areas. American Geophysical Union, Washington, D.C.

Reinelt, L., R. Horner and A. Azous. 1998. Impacts of urbanization on palustrine (depressional freshwater) wetlands--research and management in the Puget Sound Region. Urban Ecosystems. 2:219-236.

May, C.W., R.R. Horner, J.R. Karr, B.W. Mar, E.B. Welch. 1997. Effects of urbanization on small streams in the Puget Sound lowland ecoregion. Watershed Protection Techniques 2(4):483:-494.

R. R. Horner, D. B. Booth, A. Azous and C. W. May. 1996. Watersheds Determinants of Ecosystem Functioning In Effects of Watershed Development and Management on Aquatic Ecosystems. Proceedings of an Engineering Foundation Conference, Edited by L. A. Roesner, Pp 251-274, American Society of Civil Engineers, New York.

K. O. Richter and A. L. Azous. 1995. Amphibian Occurrence and Wetland Characteristics in Lower Puget Sound Wetlands. WETLANDS. Journal of the Society of Wetland Scientists. Vol. 15, No. 3.

Reinelt, L.E. and Horner, R.R. 1995. Pollutant removal from stormwater runoff by palustrine wetlands based on comprehensive budgets. Ecological Engineering, 4:77-97.

Some of the non-peer reviewed literature

Sparling, D. S., A. Calhoun, D. Hoskins, M. Micacchion and K. Richter. 2003. Using amphibians in bioassessment. Evaluating wetland condition for nutrient criteria: an outreach workshop, USGS. Atlantic Beach, NJ.

Sparling, D. W., K. O. Richter, A. Calhoun and M. Micacchion. 2001. Methods for evaluating wetland condition: Using amphibians in bioassessments of wetlands. U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA 822-R-01-0071.

In addition to published articles and conference proceedings, there are a large number of technical studies from the PSWSMRP documenting results on an annual and biannual basis. These were reviewed by the scientists, engineers and regulatory authorities that comprised our technical review community, which advised us throughout the program. Issues and concerns about methods and results were addressed in each year of the program internally, through our technical review committee, and in a large number of conference presentations.

- ***Lacking in references after 1997***

The majority of references in the book are dated 1997 or earlier because the majority of research was completed between 1986 and 1997. Once the program was completed in 1997, there were no additional concerted literature reviews completed and that is reflected in the references. The book was written as a proceedings to a final conference that was held in 1998. The book represents these edited and finalized papers. The

book was published in 2000, (although the book says 2001). There was a delay in publication, but the literature was up-to-date at the time the studies were completed.

Throughout the study there was a paucity of data relating specifically to wetlands and the effects of urbanization. This situation has changed, probably due to some extent, to the work of the PSWSMRP. Prior to the PSWSMRP there were no other comparable studies looking at the ecology of wetlands and the effects of stormwater management.

- ***Cannot recommend for a general audience***

We agree with this comment. The book was never meant to be generally applicable for all wetland ecosystems throughout the United States or the world. General trends found during the research can certainly apply to other areas. The book was intended for scientists, engineers, regulators and managers working with wetlands and stormwater management issues. In addition to the analyses contained within the book, it provides a substantial reference for information on the types and diversity of species found in freshwater palustrine wetlands in the Pacific Northwest, as well as the range of water quality, hydrologic and habitat conditions. Our dominant purpose for the book was to make available the data collected and analyzed by the PSWSMRP over the ten year period of the program to a larger group of Pacific Northwest users.

- ***Largely unable to support its conclusions***
- ***Caution its use in Puget Lowland***

There are several general comments suggesting the results and conclusions of the book are largely unsubstantiated. Considering the 10 year length of the PSWSMRP study, the annual reporting of study results, the sources of its financial support (predominantly EPA, Ecology, University of Washington, and King County), its comprehensive multi-disciplinary design, the quality of scientists involved directly or as technical reviewers during the life of the study, and the extent to which local jurisdictions have relied on its results, this criticism of the reviewer is the most serious mentioned in the review. General comments are difficult to respond to without a recitation of the individual papers comprising the book. We can respond to the few specific examples provided by the reviewer. These are individually addressed below.

- ***Why didn't the data collected from 1993 to 1995 and analyzed by N. T. Chinn confirm the multi-variate model for predicting water level fluctuations (WLF) documented in Chapter 8? The statement is inconsistent with the chapter's conclusion that the model can be used to predict WLF.***

The best Taylor equation from the 1988-91 data set for WLF (cm) was:
*WLF (cm) = 14.5 + 0.52*TIA + 14.1*OC - 0.11*Forest (R^2=0.79)*

The best Chinn fit for the 1993/1995 data was:
*WLF (cm) = 12.8 + 0.3*TIA + 4.5*OC - 0.04*Forest (R^2=0.62)*

Outlet constriction was a binary (0 or 1) value and was the same for both data sets. TIA and Forest cover were represented by the percent of the watershed in impervious or forest cover and were different for the two different data sets because of development in the intervening years.

Chin noted the "baseline" model was not verifiable with the 1993/1995 data. This was due to differences in climatic and rainfall conditions for the two different data sets, which would have a potentially significant influence on the coefficients for the equations. This should have been better explained in the Chapter as it was not reasonable to compare the model fits or "verify" the Taylor model without accounting for these differences. In hindsight we would have described the comparison of the two models differently, and had Chinn look more closely at the effects of differences in rainfall.

- ***Chapter 13 has a statement in the conclusions that recommends minimizing impervious surfaces and maximizing forest retention as the most effective strategies for minimizing stormwater impacts over the long term. This statement is not supported within the chapter and therefore considered to be unsubstantiated by the reviewer.***

Chapter 13 was intended to build on results and discussions reported in other chapters of the book and not intended to be a stand-alone paper. The concluding statement referred to in the review was meant to reflect part of the discussion found in this chapter covering the importance of landscape factors, particularly the retention of forest cover, to providing long-term protection of wetlands. The relationship between forest cover and wetland conditions is explored in the examination of wetland hydrology, and in the analyses of amphibian, mammal, and bird distributions and richness documented in chapters 8, 5, 7 and 12, respectively.

- ***A major conclusion of the study is that we observed reduced richness of plant and animal species among wetlands with more urbanized watersheds yet for plants, that is only substantiated by one statement in Chapter 10 with no supporting figures or tables. Also the test was represented in the results section of the chapter as statistically significant and in the conclusion as not significant.***

The introductory paragraph to Chapter 10 states "The question we asked was whether plant richness would decrease in wetlands subjected to increasingly frequent stormwater runoff events that occur as a result of urbanization in the watershed." This question was evaluated based on the differences between treatment wetlands (those that underwent at least a 10% increase in impervious area) and control wetlands (those with less than a 10 % increase in impervious area) and it was evaluated based on the relationships between plant richness in wetland habitats and mean WLF.

We used p<= 10% as the cutoff for statistical significance in the plant studies. That is a very conservative cutoff for statistical significance in biological systems. The probable significance of the test results referred to by the reviewer in his comment was 11% for the treatment wetlands as compared with 56% and 48% for the control wetlands. The statement in the book says that "treatment wetlands showed the most significant drop in overall plant richness" (Page 258). That is the case. The reviewer must have misunderstood this information during his reading of the chapter.

The reviewer has a point in that the conclusions should have made it clear that the statistical relationship between wetlands with watersheds that increased in urbanization

(% impervious area) (the treatment wetlands) and plant richness was weakly significant whereas the Chapter conservatively stated that the declines were evident but the statistical significance did not meet our cutoff. The discussion on pages 259 through 261 is frank in its explanation of what hypotheses were tested and what the results were and were not. We feel strongly that we addressed what conclusions were substantiated and which were conjectures that needed further evaluation and should only be used to identify trends.

While the relationship between plant richness and urbanization (measured by % impervious area) may be weakly significant, the relationship between WLF and plant richness is significant for emergent and scrub-shrub habitats particularly in the early growing season (Chapter 10, pages 258-261). WLF was found to increase as forest cover decreases (documented in Chapter 8, pages 227-229). In the Pacific Northwest, the loss of forest cover is typically the dominant land cover change occurring during the process of urbanization. These results also contribute to the finding that urbanization affects plant and animal richness.

- ***The reviewer suggests interpretations of amphibian results are open to interpretation.***

There are likely other interpretations but the reviewer provides no specifics on alternative scenarios to address in this response.

Page 4-20

4.56 Comment: Section 4.5.1 - It would seem that if changes in water level fluctuations occurred than live storage or flood storage capacity has changed. Increased fluctuations would show greater storage and decreases would indicate less storage. For water velocity (and also retention time), changes in water level fluctuations would have a variable influence, depending on the cause of the fluctuations. If the outlet constriction of a wetland was increased, fluctuation would increase, velocity would decline, and retention time increase. If fluctuations increased because of greater peak flow, velocity would increase, and retention times decrease. In wetlands where recharge was actually occurring, an increase in water depth and the ground area flooded would, theoretically increase recharge. The magnitude would depend on many factors, including the duration of the change, and the hydraulic conductivity of the substrate.

Response: Storage capacity is a structural element of the wetland itself that is independent of the amount of water coming in. The question is to determine if the increased flows or fluctuations will change the structure of the wetland (e.g. cause scouring and thereby increase storage). Text was clarified to make this point.

4.57 Comment: 1st Bullet - This seems to contradict the hypothesis stated in lines 3 and 4 of paragraph 1 in Section 4.4.1. Restate the hypothesis in Section 4.4.1 here?

Response: Section 4.4.1 addresses the total amount of water coming into a wetland whereas this section addresses fluctuations. It is possible to have higher water level fluctuation without increasing the total amount of water that it receives.

4.58 Comment: Section 4.5.2, Paragraph 1 - It is possible to hypothesize impacts on water quality functions. For example, assuming that increased duration and magnitude of flooding produces anaerobic conditions favorable to denitrification, increased N removal could be expected. Similarly, if there are sinks of particulate forms of metals in sediments that become anaerobic as a result of changing water level fluctuations, it is reasonable to expect changes in the amount of dissolved forms of metals being released from the previously aerobic sediments. I suggest that appropriate modifications be made to reflect these transformation processes.

Response: We agree that it is possible to hypothesize changes that result from increased duration, but the factor being considered here is increased fluctuations that may be independent of duration. See Section 4.4.2.

4.59 Comment: Section 4.5.2 - Where increased fluctuations also increase retention time, water quality functions could increase. Greater fluctuations could result in greater areas of anaerobic substrate, greater water contact with wetland soils, and thus increased wetland control over water quality conditions.

Response: See response to Comment 4.58.

Page 4-21

4.60 Comment: Section 4.5.3 - Paragraph 2 indicates the Azous and Cooke (2001) "consistently found a decline in plant species richness…". This statement is not correct and is misleading. First, the relationship between water level fluctuations was found to be inconsistent among the 26 King County wetlands. The relationship was not found in aquatic bed plant communities and it was not found in forested plant communities. Other studies cited by the authors (Ewing, K. 1996. Tolerance of four wetland plant species to flooding and sediment deposition. J. Experimental Botany 3:6 p131) indicate inconsistency in the relationship, as they found 2 species of sedge, red alder, and Oregon ash to be resilient to repeated cycles of flooding and drying.

The relationship for the emergent and shrub communities must also be questions, as a variety of other factors may affect species richness in the wetlands independent of water level fluctuations.

A significant factor the study did not address is how historical disturbances may have affected wetland plant communities, and whether historical influences could be more substantial and controlling than the present water level regime. In each of the studies 26 wetlands, a variety of historical landuse disturbances independent of waterlevel fluctuation could have significantly altered wetland vegetation from natural conditions. These disturbances could alter species richness independent of waterlevel fluctuations. The potential disturbances not evaluated include: past farming (grazing, hay production, row crop production), wetland draining or channelization (including historic water level modifications of Lake Washington for two study sites), timber harvest, forest fires,

dredging and/or other construction impacts. Each of these disturbances could establish new patterns of plant succession with long-lasting influences on vegetation. The influences on vegetation diversity could be unrelated to waterlevel fluctuations and could "mask" the influence more recent urbanization might have on wetland vegetation. Without consideration of these other disturbance factors, the conclusions the authors make are not scientifically valid.

The Cooke and Azous (2001) data fail to show an "especially detrimental" sensitivity of wetland plants to wetland hydrology. Cooke and Azous (2001)(Table 3-5, Ch 13 in Wetlands and Urbanization) summarize the range of hydrology observed for plants found in the 26 King County wetlands. A review of this table finds that over the suite of wetlands examined, every species listed is capable of existing in a range of hydrologic conditions. For nearly all cases, the range of water depths a species was observed to occur in is quite broad, and for every species listed, the range exceeds the threshold values for stormwater management impacts established by Azous and Cooke (2001). A broad tolerance of wetland plants to hydrologic conditions is also reported in Wheeler (1999).

It seems very problematic that these findings are now the basis of wetland and stormwater management guidelines (see Chapter 14 of Azous and Horner 2001), Stormwater Management Manual for Western Washington (Ecology 2001) and King County Stormwater Management Manual (King County 1998). These manuals specify precise limits on waterlevel impacts, some as little as 2 inches, which are based on an incomplete or flawed ecological analysis of the relationship between wetland hydrology and wetland vegetation.

Response: Text was edited to make it clear that the observations were a correlation not a cause and effect relationship. Also, the lack of correlation with aquatic bed and forested wetlands is mentioned in the first paragraph on page 4-21. We were unable, however, to determine the validity of the criticism of the effects on vegetation. No contradictory references were provided so the only published information we have is in the references cited.

4.61 Comment: Paragraph 6 - Many wetlands have naturally fluctuating water levels. There are hydrologic ecotones where there are gradations of time of inundation and saturation with native plants. Some peat systems fluctuate between inundation and drought cycles each year still with native plants that have adapted to that sequence. However, when sudden changes in hydrology occur, vegetation might not adjust and this could allow for non-native plant introduction and eventual dominance.

Response: We agree that some wetlands have large fluctuations naturally. In the draft, we have attempted to identify the information that discusses how change in fluctuations caused by human activities can affect wetlands regardless of how much they fluctuate naturally.

4.62 Comment: Paragraph 6 - Suggest expounding on the conclusions to include that fluctuations in water levels are likely to result in shifts in the composition, distribution, and abundance of plants, especially in situations where there is a relatively stable hydroperiod with low level fluctuations. Furthermore, from my experience, the presence of invasive species in wetlands suggests that the system is already experience fluctuating water levels. In other words, species composition can be used to predict whether there are fluctuating water levels. Lastly, I have seen undisturbed wetlands that exhibit naturally widely fluctuating water levels. So, it appears important to note that there are some wetlands that experience large, natural fluctuations. This appears to be especially true of lacustrine fringe systems in montane ecoregions that experience seasonal floods, as well as in regulated systems, such as Chester Morse Lake, which has extensive fringing wet meadows.

Response: The conclusion was clarified to indicate likely shifts in the composition, distribution, and abundance of plants. We were unable to find any information, however, that the presence of invasive species was a result of only increasing fluctuating water levels. Also see previous response on natural fluctuations.

4.63 Comment: Section 4.5.4 - Again, the authors of this document should be cautious when relying on Azous and Horner (2001). The findings of Ludwa (1994), and Ludwa and Richter (2001) appear to be incorrectly reported. These authors state (see p136 in Azous and Horner 2001) "*We may not be able to readily identify unique insect assemblages associated with watershed urbanization*", and "*landscape traits, such as urbanization within watersheds, may not be as significant in structuring the emergent insect communities as water permanence or other unidentified factors*". On page 137, they state: "*considerable additional work needs to be undertaken to describe the benthic macro invertebrate communities of the palustrine wetlands of the Pacific Northwest, particularly in more wetlands of high urbanization and varied hydrology"*.

Response: Azous and Horner is not a citation in this section. We disagree that the findings of Ludwa are incorrectly reported. Ludwa (in his master's thesis 1994) found a correlation between taxa richness and level of human induced stress. No changes have been made to the text.

Page 4-22

4.64 Comment: Paragraph 1 - It is likely that there is more recent published literature that was put out after the major Missouri floods. The major project assessing flood impacts in Missouri was the "Missouri Resource Assessment Project." AKA-"MorAP"

Response: We were unable to find any information about invertebrates on the MorAP home page or in the scientific literature.

4.65 Comment: Paragraph 1 & 2 - The discussion on page 4-22 seems unconvincing as it describes *"extreme frequencies and amplitudes"* in Missouri. What are these extremes, and how might they relate to Washington State wetland conditions? Studies of flood

events in Arizona ephemeral streams, British Columbia rivers, and Oklahoma intermittent streams should not be extrapolated to wetlands because of the substantial difference high water (velocities and substrate scour) may control stream invertebrates vs. high water (low velocity and low scour) conditions in wetlands.

Response: Text clarified to indicate these are conditions during major floods and the observations were made in riverine wetlands not depressional ones. Examples from streams in British Columbia and Oklahoma were deleted.

4.66 Comment: Paragraph 1, Lines 6 – 9 - Reference to repeated exposure and desiccation that occurs in a short period of time in arid systems (i.e., Arizona streams) must be put in clear context. Such inferences may be appropriate for more arid regions in eastern Washington where similar conditions may exist. However, it is clear that such data should not be applied in western Washington where such conditions do not exist.

Response: See previous response for Comment 4.65.

4.67 Comment: Paragraph 2 - The studies cited appear to pertain to rivers (lotic ecosystems) and perhaps riverine wetlands. It should be made clear to what wetland systems (i.e., palustrine, riverine, lacustrine), if any, these studies pertain to or whether they are more pertinent to aquatic ecosystems (rivers).

Response: See response to Comment 4.65.

4.68 Comment: Paragraph 5, Line 4 - It seems inappropriate to cite a publication that is in press and is incapable of being reviewed. I suggest citing earlier work done by Klaus or perhaps a personal communication.

Response: Citation has been deleted.

Page 4-23

4.69 Comment: Paragraph 1 - Again, the authors of this document should be cautious when relying on Azous and Horner (2001).

Response: See response to Comment 4.55.

4.70 Comment: Section 4.5.6 - This description should clarify whether the referenced study examined any off-channel wetland habitat, or were evaluations limited to stream channels? Higher stream flows and overbank flooding could increase the amount of off channel habitat available and provide more refuge areas to escape high flow. In addition, as with invertebrates (see comment above) higher velocities associated with increased flow have much less ability to influence wetland environments, because it is usually quite low in wetlands.

Response: Text clarified that this information related to the watershed as a whole and not specifically wetlands.

4.71 Comment: Last Sentence - Be careful of the assumption here. Other degradations from impervious area include pollutants in the runoff and increased water temperatures. Do we have evidence of how much water level fluctuations play a part relative to these other degradations?

Response: Text clarified to avoid strong inferences.

4.72 Comment: Paragraph 3, Line 2 - The correct genus for cutthroat trout is *Oncorhynchus*.

Response: Change made.

4.73 Comment: Paragraph 3 - I believe that the referenced studies showed that there is a marked degradation in habitat structure caused by channel instability that is associated with increases of 8 to 10% impervious surface area in the watershed. Please modify the paragraph to more clearly indicate this relationship.

Response: Paragraph modified.

4.74 Comment: Section 4.5.7 - Delete, because no evidence (as was noted) that fluctuations were responsible.

Response: We disagree. Although no data on cause and effect have been presented, water level fluctuations are a major impact of development and data do show reductions in bird richness. The data are worth a mention.

Page 4-24

4.75 Comment: Section 4.5.8, Impacts - It seems that flooding of some mammal's dens, burrows and raceways could be detrimental to those populations.

Response: We are not comfortable suggesting such a hypothesis for water level fluctuations because there are too many possible scenarios, some of which may be counter to the hypothesis (e.g. decreases in water level fluctuations resulting from dams etc. may reduce flooding of dens along rivers).

Section 4.6 Impacts of Changing the Amounts of Sediment

4.76 Comment: Section 4.6.1., Last Sentence - "Some wetlands with a lot of erosion…" - How much is a lot? Is it more than some? Is it less than a ton? This statement sounds very unscientific.

Response: The phrase "a lot" was deleted.

4.77 Comment: Section 4.6.1 - As noted, increased sediment input to some wetlands will reduce live storage and affect hydrologic functions. If not documented for wetland systems, it is likely documented for lakes and reservoirs. However, sediment inputs to "dead storage areas of a wetland would have little impact on flood storage functions.

Response: Point clarified that this is most critical for closed wetlands where most of the storage can be considered "live" storage.

4.78 Comment: Section 4.6.1, Paragraph 1 - Add additional assumptions to clarify that a net reduction in flood storage would result assuming no scouring and a net increase in sediment accumulation. This is touched on in the second paragraph but could be made clearer.

Response: Clarification added.

Page 4-25

4.79 Comment: Section 4.6.2 - If wetlands are subjected to substantial sedimentation and lose substantial live or dead storage, then hydrologic residence times will increase and water quality functions could potentially decrease. Substantial sedimentation could bury organic soils and affect various microbial processes or chemical processes that control some water quality functions. For example, denitrification is dependent upon readily available organic carbon, and if this carbon (e.g. organic soils) is buried by inorganic sediments, the denitrification process could be reduced.

Response: We are uncomfortable making any general hypotheses because additional sediments could also improve the water quality functions (e.g. additional capacity to bind phosphorus).

4.80 Comment: Sections 4.6.3 through 4.6.7, Changing the Amount of Sediment - The persistence of some wetland ecosystems (certain deltatic marshes, lakeshore marshes, estuarine and salt marshes) is dependent on ongoing sedimentation. Increasing amounts of sediment may increase or maintain the area of wetland present. Decreasing the amount of sediment can decrease the amount of wetland present if subsidence or sediment transport processes are present (see Mistch and Gosslink 2000 p 85, 380 for general references to this process). These changes affect the amount of wetland habitat available to fish and wildlife.

Response: More information was provided in the introduction describing both increases and decreases in sediment resulting from human activities.

4.81 Comment: Section 4.6.3 - Suggest indicating that in riverine and depressional flow-through wetlands, which may have upstream sources of seed, that burial of plants may result in short term changes in structure. Plant recruitment through deposition of seed from upstream sources, germination, and establishment of new plants, can reestablish

populations of buried species. In the last ¶ in this section, I suggest replacing the word "are" with "may be" to make it read "…rare (such as bogs) may be highly sensitive to burial." Although it seems likely that peatland plants would be susceptible to increased sedimentation, unless there is a reference to support the statement as it is written, it should be modified.

Response: We do not consider this type of information appropriate for this section because it is intended to discuss the negative impacts resulting from sedimentation caused by human activities. Furthermore, there are many factors involved in re-establishment (e.g. seeds brought in by wind (cattails) or birds). The second comment was accepted and the changes made in the wording.

Page. 4-28

4.82 Comment: Last paragraph - I don't dispute that increased sedimentation could alter vegetation structure, but killing submerged vegetation seems pretty extreme. This seems more likely for episodic inputs of sediment from mass wasting or large flood events. I suggest rewriting the sentence to read "One can hypothesize, however, that sedimentation will impact birds by altering habitat structure or the abundance or availability of aquatic vegetation or prey items."

Response: Suggested changes made.

Page 4-29

Section 4.7 Impacts of Increasing the Amount of Nutrients

4.83 Comment: Top of Page - Mitsch and Gosslink (2000), p 774 or Wetzel (2001) p 273-274 provide more accurate definitions of eutrophication.

Response: Definition of eutrophication added.

4.84 Comment: Section 4.7.1 - Manning coefficients of roughness commonly used in hydrologic studies could be used as a citation to help strengthen this hypothesis.

Response: We do not have any information on how wetland vegetation might change Manning's Coefficient. Therefore, no change will be made.

Page 4-30

4.85 Comment: Section 4.7.2 and 4.7.3 - In general, and within limits, there are positive feedback processes that link nutrient availability and water quality functions. Greater nutrient inputs to a wetland can increase plant growth, increasing the demand for nutrients, and increase the net removal of nutrient by the wetland. Kadlec and Knight (1996) should be consulted to develop a more comprehensive discussion.

Response: In general, increased plant growth does not result in an increase in net removal because the nutrients become available again on the death to the plants (see Hruby et al. 1999).

4.86 Comment: Section 4.7.2 - Research suggests that riparian forests dominated by red alder (*Alnus rubra*) may act as sources of nitrogen during certain times of the year. Sorry, couldn't find my references on this. Alders in montane areas also may be natural sources of nitrogen to wetlands and aquatic ecosystems during certain times of the year.

Response: We agree that alder can be a source of nitrogen to the aquatic system. The issue, however, that we are exploring is the potential impact of increased nitrogen resulting from human activities that are larger than the natural "background" effects.

Page 4-31

4.87 Comment: Section 4.7.3 - This section is intriguing, given the tendency to add amended topsoil and organic matter to mitigation sites that will draw down and be oxygenated for extended periods of the growing season. Mitigation site designers and resource agency staff who issue permits should consider the implications of increased nutrients on plant communities.

Response: We agree there are many implications important to restoring wetlands that arise from the scientific information, but this type of information is not the focus of Volume 1. Such information is relevant to our guidance on mitigation, and we will attempt to include this in that document.

Page 4-32

4.88 Comment: Section 4.7.4 - Would appreciate your adding a box, like the one on 4-31 but substituting the word "invertebrate" for "plant" (URL is the same). This is a parallel database to the one for plants and may find similar application.

Response: Done.

4.89 Comment: 3rd Bullet - Metro research publications on lakes and streams suggest that urban runoff will result in invertebrate communities that are pollution tolerant. This typically results in reduced richness, increased abundance of pollutant tolerance spp., and reduced abundance of pollutant intolerant species. Although some of these changes are a result of changing habitat structure, similar effects might be expected in wetlands receiving urban runoff that result in changes in habitat structure, especially as a result of sediment accumulation and increases in invasive species. Potential sources include Metro. 1990. Quality of Local Lakes and Streams 1989-1990 Update. Municipality of Metropolitan Seattle, Water Resources Section, Water Pollution Control Department, Seattle, WA. Gavin, D.V. 1987. Toxicants in Urban Runoff. In: Proceedings of Northwest Nonpoint Source Conference. Seabloom, R. and g. Plews (editors). Washington Department of Social and Health Services, Olympia, WA.

Response: This section addresses the specific impacts of nutrients on invertebrates. The urban studies referenced in the comment address urban pollutants in general, most of which are toxic compounds, not nutrients. We have added additional citations, where appropriate, on some of the research in the Puget Sound Area we did not mention in the draft.

Page 4-33

4.90 Comment: Section 4.7.5 - How about a sidebar on how nutrients cause deformities in frogs?

Response: We did not find any references on how nutrients cause deformities in frogs in wetlands.

Page 4-34

4.91 Comment: Section 4.7.7 1st Bullet - Are frogs really a significant prey item for "many" wetland birds as suggested? Or should many be changed to "some?"

Response: Change made.

Page 4-35

Section 4.8 Impacts of Increasing the Amount of Toxic Contaminants

4.92 Comment: Section 4.8.1 - Metals, oils, acidity, salt, herbicides/____, pathogens e-coli etc. BT Xemobiotics

Response: We did not think in necessary to list all the different types of contaminants in this section.

4.93 Comment: Section 4.8.1 - Substantial information on some metals and other elements in wetlands is contained in Vymazal (1995), Kadlec and Knight (1996), DeSousa et al. (2000), Raskin and Ensley (2000), and Klaine (1993). This section is very cursory, as there is extensive literature on various toxic compounds in soil, sediment, other aquatic systems, and wetlands.

Response: We agree there is extensive literature on the impacts of contaminants on wetland biota. We were unable to find, and the references listed above do not address, the issue of impacts from toxic compounds on how well wetlands reduce flooding, recharge groundwater, or decrease erosion.

Page 4-36

4.94 Comment: 2nd Bullet - At what concentrations did iron and manganese affect the growth of fen species? Are these concentrations observed in urban runoff? Need to put the literature in context with concentrations observed in the literature for each of the bullets and how these may compare to concentrations likely to be seen in urban runoff, which appears to be the primary source of potential degradation of Washington's wetlands.

Response: This information is from the Adamus et al. review. We could not access the information to determine the concentrations used.

4.95 Comment: 4th Bullet - How about residential and farm runoff?

Response: We did not find any information on the toxicity to wetland plants from herbicide use in residential areas and farms.

4.96 Comment: Section 4.8.4 - Change the words "resulted in" to "correlated with" or "associated with." No causation was proven by the cited study. Likewise on p. 4-63 Ontario study. Search text for other statements that imply causation based on mere correlation, and change/reword in a similar manner.

Response: Changes made.

Page 4-37

4.97 Comment: Paragraph 1 - Good

Response: No changes needed.

4.98 Comment: Paragraph 1 - The study by Anna Hicks was in Massachusetts, not the PNW.

Response: Correction made.

4.99 Comment: Paragraph 1 - Did we really mention toxicity? I thought it was urbanization and impervious area!

Response: The reference is from Ludwa (1994). Correction has been made.

4.100 Comment: Paragraph 2 - Overlap in toxic family genes but no species.

Response: There is some overlap in species, especially in riverine wetlands.

4.101 Comment: Paragraph 3 - I think this may be data on behavioral effect on inverts from toxins.

Response: We were unable to determine if the reference made any conclusions that the impacts on invertebrates were a result of a change in behavior caused by the heavy metals. This information is from Adamus et al. 2001, and we were not able to obtain the original citation.

4.102 Comment: Paragraph 3 - Need to expound upon the discussion of metal toxicity to indicate that both acute and chronic toxicity is also dependent on the forms of the metals. In general, dissolved forms are more bio-available and toxic than particulate forms. In addition, toxicity is dependent on receiving water chemistry, such as temperature, pH, and hardness. Furthermore, toxicity varies for different species. Some are more sensitive than others. These facts are evident in the EPA recommended water quality criteria (see for example p 7 of: National Recommended Water Quality Criteria: 2002. EPA-822-R-02-07. U.S. EPA, Office of Water, Office of Science and Technology, Washington D.C., which can be found at http://www.elaw.org/assets/pdf/USEPAcriteria.pdf) and Washington State Water Quality Standards for toxic substances (i.e., WAC 173-201A) found at http://www.leg.wa.gov/wac/index.cfm?fuseaction=Section&Section=173-201A-240.

Response: We do not think it is necessary to go into this level of detail in this general review. Information at this technical level would be overwhelming for the intended audience. Information on the sensitivity of different species is given in Table 4-1.

Page 4-38

4.103 Comment: Section 4.8.4.2 - Although the citations for this are on the following page, I suggest you place the corresponding reference(s) next to each statement on this page. So the reader can readily determine its source. However, keep the table on page 4-39, it's very helpful.

Response: This information is from the Adamus review. We could not specifically attribute the bullets to individual citations.

4.104 Comment: Section 4.8.4.2 and Table 4-1 - There is no doubt that there are many nasty pollutants in the environment in large part due to our own livelihoods. However, unless the pollutants cited in this section are ubiquitous in the environment, which they are not, it should be modified to reflect pollutants found in urban runoff, atmospheric deposition, or other sources of pollutants to wetlands. Why are polycyclic aromatic hydrocarbons, which are pervasive in the environment, not included in this section or Table 4-1? PAHs are known to be in urban runoff in local and national urban runoff studies. Suggest that these be included. Could cite Reinelt and Horner's Puget Sound Wetlands and Stormwater Management Research Program work or the Metro or Gavin publications previously mentioned.

Response: All the information available from the EPA non-point web page would suggest that contamination in runoff depends on what toxic compounds are used in the uplands. We were unable to find specific information on the quantity and type of toxics used in all areas of Washington, so we cannot specifically predict what might be found in the runoff. We, therefore, decided to include all of the information that has been collected by Adamus et al. (2001) on the toxicity of contaminants in invertebrates. The EPA Quality Criteria for Water, 1986 (EPA 440/5-86-001) discusses the impact of almost 100 different pollutants (mostly chemicals) on the health and safety of humans and aquatic life. We assume most of these are used in Washington at some time or another. On the issue of PAH's: the review by Adamus and our review did not find any studies on the impacts of PAH's on invertebrates in wetlands.

Page 4-39 & 40

4.105 Comment: Table 4-1 - I have yet to see information about biomagnification. It's an important concept when discussing contaminants. I believe it is fairly well researched, although I cannot provide a reference for you beyond "Silent Spring."

Response: We agree that bio-magnification is an important ecological concept, but we did not judge it to be one we need to address in a discussion of specific impacts of toxic compounds to wetland fauna. This review is not meant to be an exhaustive synthesis of all that we know about the impacts of toxic compounds on the natural ecosystems. Where appropriate, we do make reference that certain pollutants accumulate in fauna. The references we found and cite about wetlands did not make specific reference to bioaccumulation in wetlands.

4.106 Comment: Table 4-1, Last row on the page - Pathogen not a "contaminant"

Response: We disagree. Contaminant (Webster's Dictionary) "Something that soils, stains, or infects or makes unfit by introduction of unwholesome or undesirable elements."

Page 4-40

4.107 Comment: Section 4.8.5 - Add Canadian? data base

Response: Unable to respond because no reference for a Canadian database was provided.

4.108 Comment: Bullets - Pathogens?

Response: We did not find references of the impacts of human generated pathogens on amphibians.

4.109 Comment: Section 4.8.5 - It is not very helpful to identify generally that different pollutants are toxic without putting the information in context, such as at what concentrations. In addition, the toxicity data should be put in the context of acute and chronic effects and the potential sources of the toxicants. Most chemicals are toxic at some level but these may be unlikely to occur in the environment. Are concentrations that have been observed to be toxic at manufacturer recommended application rates? Higher? Lower?

Response: We agree that toxicity data on individual species is available, but we did not consider it critical in this general synthesis. For those interested in pursuing this topic further, we do provide references where this information is available. We do not have information on the concentrations of these toxic substances in the wetlands of Washington so we are not in a position to determine how they relate to the recommendations made by the manufacturer. Furthermore, many contaminants can be bio-accumulated, and the recommendations made by manufacturers for application do not address this issue.

4.110 Comment: Section 4.8.6 - Is it a habitat for fish or just on fish?

Response: Should be "in the habitat" for fish. Correction made in all appropriate headings.

Page 4-41

4.111 Comment: Paragraph 2 - Where usual concentrations.

Response: Clarification made.

4.112 Comment: Paragraph 3 - How about Rotenone to kill fish. It also kills amphibs!

Response: We were unable to find references on the toxicity of Rotenone to amphibians in wetlands.

4.113 Comment: 3rd Bullet - The toxicity of lead is well known. However, lead shot is no longer allowed. Again, toxicity should be placed in the context of likely sources, fate and transport mechanisms, and the likelihood of these being found in Washington.

Response: Lead shot is allowed on firing ranges and runoff provides a possible pathway into wetlands if they are located near the range.

Page 4-42

4.114 Comment: Box - Is lead still commonly used? Steel shot!

Response: See response to Comment 4.113

Page 4-43

4.115 Comment: Section 4.8.8 - I'm sure there IS literature on this – there apparently just wasn't time to search it e.g., muskrats and all kinds of toxics. Rephrase here and elsewhere.

Response: Text was rephrased.

4.116 Comment: Section 4.8.9 - It seems unlikely that contaminants would effect hydrologic functions with one exception, sediment.

Response: Exception noted in the summary.

4.117 Comment: Section 4.8.9 - pH influences the toxicity of metals (AL) etc.

Response: Comment noted. We did not consider this to be a critical point to include in the summary. It is mentioned in the text.

Section 4.9 Impacts of Changing Acidity

Page 4-44

4.118 Comment: Paragraph 1 - Identify the pH at which denitrifying bacteria are affected. Is it likely that such changes in pH would occur from potential sources of acid in the urban environment? It seems unlikely that nonpoint pollution is likely to cause changes in pH of a magnitude that would adversely affect water quality functions, especially considering the slightly acidic nature of rainfall and soils in this region. The only likely scenario I can think of is changes in pH caused by changes in hydrology to peatlands. For a good review of western Washington peatlands and acidity mechanisms see Chapter 3: Chemistry of some *Sphagnum*-dominated peatlands in western Washington. http://yosemite.epa.gov/R10/ecocomm.nsf/37aa02ee25d11ce188256531000520b3/9a6226e464ecdb3f88256b5d0067de0d?OpenDocument.

Response: Information on the pH at which denitrification is impaired was not found in the citation and other literature we reviewed.

4.119 Comment: Section 4.9.3 - pH influences the toxicity of metals etc.

Response: We were unable to find information on how pH might affect toxicity of metals in wetlands. We were uncomfortable extrapolating other studies to wetlands because of the possible effects of organic chelators and ion exchanges possible in wetlands soils.

Page 4-45

4.120 Comment: Section 4.9.4 - pH increase == 1→ 7→ 14

Response: When pH increases, acidity is reduced; when pH decreases, acidity increases. We believe there are no errors in the text.

4.121 Comment: Section 4.9.4 - Increase in pH increase in inverts

Response: A statement regarding this is made in the last sentence of page 4-45.

4.122 Comment: Paragraph 1 - Should include the results of the National Acid Precipitation Assessment Program (NAPAP) study, which is available at http://books.nap.edu/books/0309050820/html/31.html. See also Villella, Rita F. 1989. Acid Rain Publications by the U.S. Fish and Wildlife Service, 1979-1989; NAPAP. 1987. Precipitation chemistry and ecosystem function in Olympic National Park: baseline research for acid precipitation studies. NAPAP. 1998. NAPAP biennial report to Congress.

Response: This information is not specific enough to wetlands. We were unable to determine how it might apply to wetlands without an exhaustive search and comparison of all invertebrate species that might be associated with wetlands.

4.123 Comment: Table 4-2 - Lower pH? Titles add to More Tolerant of low pH and add to Less Tolerant of low pH

Response: Clarification added.

Page 4-47

4.124 Comment: Paragraph 1 - Low pH

Response: We prefer to use the term "increased acidity" since that may have more meaning for the intended audience.

4.125 Comment: Paragraph 2 -Yes – how tied to amphibs?

Response: We were unable to respond because we do not understand the question.

4.126 Comment: Paragraph 5 - I believe the current theory is pathogens.

Response: Possible hypothesis, but we cannot report it without some additional information.

4.127 Comment: Section 4.9.5 - Include the results of the NAPAP study as applicable in this and other sections addressing the impacts of acidity. Also, put the likelihood of changes in acidity in context of probable sources that could result in measurable changes in pH.

Response: NAPAP information is not specific enough to wetlands. We were unable to determine how it might apply to wetlands without an exhaustive search and comparison of all amphibian species that might be wetland-associated in Washington.

4.128 Comment: Last paragraph – Look at Robinson et. al. 1976, from 1980, Medez 1976.

Response: We could not find the references suggested because the citation were not complete in the comment.

Page 4-48

4.129 Comment: Section 4.9.8 - I don't see why a "shift" from fish eating to plant eating mammals would occur, since the species are unlikely to competitively excluding each other from wetlands. If acidification were to become severe and eliminate food resources for fish-eating mammals, fish eating mammals would simply be excluded, probably with little effect on herbivores.

Response: Community composition is a term that reflects abundances of species relative to each other. The shift that is hypothesized is one where the ratio of fish-eating to herbivorous mammals would decrease. In this case, it is not correlated with competition.

4.130 Comment: Section 4.9.8 - The suggested hypothesis seems unlikely. From what I recall of the NAPAP results, if shift in pH are large enough to cause the loss of fish, invertebrate also are decreasing. Perhaps it is a matter of clarifying how extreme a change is being hypothesized.

Response: This hypothesis is one presented by Adamus and Brandt 1990 based on their review of the literature. We are unwilling to change it unless some data contrary to this hypothesis are presented.

Page 4-49

Section 4.10 Impacts of Increasing the Concentrations of Salt

4.131 Comment: Section 4.10.1 - Mts and E Washington issues?

Response: The hypothesis applies to all regions of the state. This has been added to the text.

4.132 Comment: Section 4.10.1 - Unfortunately, the authors carried this speculative statement into Section 4.10.9 (Pg. 4-53) the "Summary of Key Points:"

Response: We consider that hypotheses, based on our understanding of how wetlands function and in the absence of more definitive information, are an important part of a synthesis of the science. See response to comment 4.5.

4.133 Comment: Section 4.10.1 - "No information was found on the impacts of salinization on the hydrologic functions of wetlands, but it is possible to hypothesize that impacts, if any, are minor" [underline added].

Response: We consider salinization to be a technical term that our target audience would consider "jargon." We prefer to describe the process to make it more understandable.

Page 4-50

4.134 Comment: Paragraph 4 - Salt concentration will change plant communities. Estuarine restoration where tidal waters have sufficient salinities produced immediate kills of reed canarygrass and caused eventual mortality to crabapple and spruce and resulted in salt marsh communities. Cattails often withstand some salinity and narrowleaf cattail (*Typha angustofolia*) is frequently found in estuarine environments near salt marsh communities.

Response: We agree that changing salt concentration will change the distribution of plants. We used the term "plant populations" to avoid a semantic discussion of what is a plant "community."

Page 4-51

4.135 Comment: Section 4.10.5 - Scott Jackson? MASS. In Washington? In general be clear and consistent.

Response: Text clarified.

4.136 Comment: Section 4.10.6 - Fish need special physiology to deal with saline conditions. Freshwater organisms will loose water across cell membranes when salinities reach certain levels and without a way to osmoregulate, these freshwater species will not survive. Anadromous and catadromous fishes have specialized ways to osmoregulate.

Response: We believe this level of technical discussion is not needed in this synthesis about fish in freshwater wetlands. Furthermore, the osmoregulatory capabilities of anadromous and catadromous fish change as they mature and move between fresh and salt water so we are not in a position to make any hypotheses about the impact of an increase in salinity in wetlands.

Page 4-52

4.137 Comment: Section 4.10.7 - Like the other discussion on toxicity of pollutants, the effects of increasing salinity should be placed in context. I suggest identifying the specific concentrations at which effects are being observed and putting the results in context of probable or potential sources of increasing salinity, such as return flows from irrigation or whatever the sources could be. Note the concentration or range of concentrations that have been observed to cause adverse affects in Section 4.10.9 too.

Response: We did not do extensive data searches to address these issues of identifying specific concentration for individual species. We believe this is too detailed for a general review such as this. We are also unable to place the effects in "context" because information is lacking for Washington. We do not know how much agriculture and irrigation practices have increased the salinity.

Page 4-53

4.138 Comment: Bullet 3 - Isolating subpopulations is an impact to genetic integrity within populations that also could occur.

Response: In order to maintain textual flow among the different bullets, we decided not to list all the different ways genetic integrity could be impaired through fragmentation.

Section 4.11 Impacts of Decreasing the Connection Between Habitats

4.139 Comment: Section 4.11 - Are the following three factors said to be other dominant factors by Gibbs 2000? As it is currently written that's what it appears to say, but is not entirely clear to the reader.

Response: A new paragraph was started to avoid confusion.

4.140 Comment: Section 4.11 - WOW great heading

Response: No change necessary.

4.141 Comment: Section 4.11 Paragraph 1 - Change "of" to thus. Awkward! change isolates to isolating

Response: We disagree. Wording in text not changed.

4.142 Comment: Section 4.11, Bullet 1 - What do you mean? Harris did not specifically select wetlands, did he?

Response: New paragraph added to avoid confusion.

4.143 Comment: Section 4.11, Bullet 4 - This is obtuse! Why don't you just say "weeds" or something big!

Response: Parasites was the example given in the reference cited. We did not wish to revise the information provided by the author of the reference.

Page 4-54

4.144 Comment: Section 4.11.1 - If development, roads, power lines etc. causes the fragmentation you can pretty well tell that it's going to effect "flows."

Response: Comment noted. No changes to text necessary.

4.145 Comment: Section 4.11.1 - More hypothesizing on the basis that there is an "absence of any information to the contrary." So in the absence of absolute proof that God does not exist, we can assume that God does exist? Or vice-versa? I feel more comfortable when the document simply states "No information…was found."

Response: See response to Comment 4.5.

4.146 Comment: Section 4.11.2 - Same argument as above for 4.11.1!

Response: See response to Comment 4.5.

4.147 Comment: Section 4.11.3 - Try.

Response: One new reference (2002) found and added.

4.148 Comment: Section 4.11.3 - Increasing fragmentation could increase the potential to introduce or spread invasive species. This is an edge effect that has been clearly documented in the literature.

Response: All the literature we have reviewed on invasive species addressed the issue of providing "corridors of disturbance," such as roads, that facilitate the invasion of plants. This is conceptually different from the idea of fragmentation and the breaking up of natural corridors (e.g. fragmentation can occur outside the immediate area of a wetland, whereas the introduction of invasive plants usually is mediated by generating a disturbance that extends into or through a wetland.). Therefore, no change will be made.

4.149 Comment: Section 4.11.4 - But what about uplands? And they why wouldn't the same finding hold for wetlands

Response: The invertebrate fauna in uplands is very different from that found in wetlands, so it is difficult to extrapolate data from uplands to wetlands.

Page 4-55

4.150 Comment: Paragraph 1 - Terrestrial? 11 structure (regardless of terrestrial or aerial dispersers?)

Response: See comment above.

4.151 Comment: Section 4.11.5.1 - This statement seems to contradict a statement made on page 2-51 paragraph 2 sentence 4. Is it "all but or spp" as said by Kauffman et al 2001 or 57% as stated here???

Response: This is a typographical error. The number should be 97%.

4.152 Comment: Section 4.11.5.1 - How about being more specific and saying "breeding"

Response: We believe that impacts to breeding are too restrictive a concept. Impacts could also be described in terms of genetic viability which represents a broader concept than breeding.

Page 4-56

4.153 Comment: Paragraph 2 - Replace * with *higher abundance and species richness*, ***Strike out*. *** *Suggested or actual determined by the study*. Text: Declines in the richness of amphibian species have also been documented as urban land use increases (Lehtinen et al. 1999, Knutson et al. 1999, Richter and Azous 2001a). A landscape analysis of habitats for anurans (frogs and toads) in Wisconsin and Iowa showed that anurans were positively* associated with uplands, wetland forests, and emergent wetlands and negatively associated with urban land (Knutson et al. 1999). A positive association, in this case, means** higher abundance and species richness*. The negative association with urban land is attributed*** by the authors to:

Response: We prefer to keep our text. The comments do not change the meaning. No changes are necessary.

4.154 Comment: Last Paragraph - Yes, that's why I propose protection of wetland complexes! …as a first step.

Response: Comment noted. No changes necessary.

Page 4-57

4.155 Comment: Paragraph 1 - Up to a threshold level as you mention! I would re-write, unclear! Be more direct.? Unclear!

Response: Text clarified.

4.156 Comment: Paragraph 2 -Yes! Add "Movement" to Text:
"Other studies indicate that there is a threshold for extent of wetland isolation or distance between wetlands for each amphibian species. Several studies of maximum distances of amphibian movement to breeding habitats indicate that amphibian reproductive success* is affected by wetland isolation and terrestrial habitat condition".

Response: Word added.

4.157 Comment: Bullet 1 - Add "in the PNW"

Response: Text added.

4.158A Comment: Bullet 2 - Unclear

Response: Text clarified

4.158B Comment: Bullet 3 - I believe toads are an exceptions. They seem to move furthest of any species.

Response: The author cited did not suggest toads move farther.

Page 4-58

4.159 Comment: Section 4.11.5.2 Last Paragraph - What about the painted turtle?

Response: Painted turtle added.

4.160 Comment: Section 4.11.5.2 - Only one study was found to address fragmentation, not "No studies"

Response: As stated in the text, the study focused on loss of upland habitat, not of fragmentation between wetlands. Therefore, no change is needed.

4.161 Comment: Section 4.11.5.2, Paragraph 2 - What does "significant risks" mean? "high" "moderate"?

Response: This is statistically significant. "Statistically" added to text.

4.162 Comment: Section 4.11.5.2, Paragraph 3 - I would think less so, because they do not have moist thin skin! that dries out. Aquatic reptiles vs. terrestrial reptiles.

Response: Comment noted. No changes to text necessary. Both wetland reptiles in Washington are turtles and have a "hard" skin.

4.163 Comment: Section 4.11.7 - I'm unsure of this! Especially when it comes to invasive species! Cowbirds, cats!

Response: This may be true. We were unable to find any information on the subject and do not have enough other information to make a reasoned hypothesis.

Page 4-59

4.164 Comment: Section 4.11.7 - Because of the high mobility of birds, they are much less dependent on habitat connections to maintain their populations, access habitats, or remain widely distributed in fragmented landscapes. Most of the examples presented here seem to be assessing the general habitat mosaic or habitat matrix at a site that provides for certain habitat requirements, and not a dependence on connections or corridors between habitat sites.

Response: The concept of fragmentation has been re-defined throughout the report.

4.165 Comment: Section 4.11.7 - Suggest modifying the discussion of habitat fragmentation impacts on wildlife to reflect the range of findings. I just read an excellent review but cannot seem to find it at the moment. Will forward the reference as soon as I can.

Response: We have not yet received the reference so are unable to modify discussion.

4.166 Comment: Bullet 1 - Delete first bullet. This has nothing to do with connections.

Response: The concept of "connections" has been expanded to include reduction of habitat area.

4.167 Comment: Bullet 2 - In what states?

Response: Iowa, clarification has been added to the text in indicate which state.

4.168 Comment: Last paragraph on page - More recently published work is found in a compilation produced by John Marzluff at the University of Washington. I believe some of the chapters in "Avian Ecology & Conservation. In an Urbanizing World" (2001) deal with this issue, however, I don't believe they touch upon wetlands in urban landscapes.

Response: We checked the Marzluff reference and yes, it does not address wetlands in urban landscapes. Therefore, we did not add the information.

4.169 Comment: Bullet - Again, are you, will you, protect wetland complexes since they are so important?

Response: This is an issue that needs to be addressed at the local level through their Critical Areas Ordinances. In Volume 2, we are suggesting that local jurisdictions protect such complexes by doing a "landscape analysis" in their planning process.

4.170 Comment: Paragraph 2, First Sentence - Add – and adjoining area? Text: "Pattern of wetland habitat use varies between different wetland-dependent bird species (Naugle et al. 1999):"

Response: Addition made.

4.171 Comment: Paragraph 3 - Winter used the tropics suggest wide-ranging species but that's not what you meant?

Response: Clarification made.

4.172 Comment: Last Paragraph - This may be true but you need to tie into section title "Connections between habitats on Birds"

Response: The concept of fragmentation has been redefined to include concepts developed in this paragraph.

Page 4-60

4.173 Comment: Paragraph 1 - "Sterile" wetlands. I would expect SOFT water, not hard, to be "sterile." Check the reference.

Response: The term sterile has been replaced with less productive since that was the meaning used by the author.

4.174 Comment: Paragraph 4 - Fragmentation affects bird nest predation and brood parasitism. Native songbirds nesting in highly fragmented landscapes have greater nest failure rates than those nesting in less fragmented landscapes (see Ferguson et. al. 2001, in Johnson and O'Neil, Donnely et al. 2002, Johnston (2001).

Response: These references are not specific enough to wetlands and wetland associated birds to be included in the synthesis.

Page 4-61

4.175 Comment: Section 4.11.8 - It should be noted that most of the mammals evaluated in Richter and Azous (2001) are not wetland dependent (water shrew being the notable exception), and would be expected to use forest and fields as their primary habitats. For most of these species, these mammals would be expected to persist in the landscape because of the maintenance of other habitat types, and not through connections to wetlands.

Response: Clarification added.

4.176 Comment: Section 4.11.8 - Pretty trim section! This needs to be beefed up!

Response: We were unable to find any additional information on mammals in wetlands.

4.177 Comment: Section 4.11.8, Paragraph 3 - Add reference "the ecology of roads"

Response: Not enough information was provided for us to obtain the reference.

4.178 Comment: Section 4.11.8 - "Boy," there are references out there identifying home ranges, dispersed distances etc. in mammals.

Response: Most of the literature does not have information about wetlands. We did not review general information that was not wetland specific.

4.179 Comment: Section 4.11.9, Bullet 1 - I don't agree. Check Booth and others Farini,

Response: Not enough information was provided for us to obtain the reference.

4.180 Comment: Section 4.11.9, Bullet 2 - You didn't have a strong case for inverts!

Response: Text changed from "all" to "most."

4.181 Comment: Section 4.11.9, Bullet 3 - Check against your text to see if true! ** ??? no way!!! You mean connections don't you?

Response: The concept of fragmentation has been redefined to include information reviewed.

4.182 Comment: Section 4.11.9, Bullet 4 - And bird sickness especially among native "sensitive species."

Response: Not enough information was provided for us to obtain references supporting this conclusion.

Page 4-62

4.183 Comment: Section 4.11.9, Bullet 5 - Cross out ~~birds~~ and add inverts and birds

Response: Text clarified.

4.184 Comment: Section 4.11.9, Bullet 5 - What does this mean? I have issues with my daughter and son but do wildlife have issues?

Response: Text clarified.

Section 4.12 Impacts of Other Human Disturbances

4.185 Comment: Paragraph 1 - Omit it and add "according to wet function.

Response: Correction made.

4.186 Comment: Paragraph 1 - What type of diversity if reduced - Wildlife? Plants? Herps?

Response: Text states it's the richness and evenness of plants.

4.187 Comment: Paragraph 3 - Text: Invasive plants...Their increased dominance" Areal dominance?

Response: With plants, dominance is usually assumed to be areal dominance. Clarification made in the text.

Page 4-63

4.188 Comment: Section 4.12.2 - I recall another study in Mass (Amherst, MA) that looked at the value of amphibian migration tunnels constructed for passing of spotted salamanders. Although this is not a panacea for road building, there were some positive results from this work out of University of Mass.

Response: The author of this section of Volume 1, Tom Hruby, was involved with those studies in the 80's. As far as he knows, none of the reports or articles were ever published on the subject. The conditions of the geographic locations and the experiments were so different from conditions in Washington that we do not believe they would apply here, so they were not reported.

4.189 Comment: Section 4.12.2 - There are studies in Washington State documenting impacts of roads on wildlife. A Department of Game published a study by Perry and Overly, 1977, Impact of Roads on big game distribution in portions of the Blue Mountains of Washington 1972-1973. This study showed main roads reduced elk use up to one quarter mile away, secondary roads reduced use up to ½ mile away and primitive roads reduced elk use of to 1/8 mile away. In 1976-7, Department of Wildlife found migratory bird use increased 30-50 fold on three Columbia Basin wetlands where parking lots and access were relocated to areas 0.25 to 0.5 mile from the wetlands (Foster et al.1984).

Response: We agree, there is much more information on the impacts of roads on non-wetland-dependent species. We, however, were trying to limit the literature review to wetland-dependent species. We were unable to determine if the migratory birds in the study were wetland-dependent or just users of wetlands.

4.190 Comment: Section 4.12.2 - Your discussion of the impact of roads on wildlife. Several years ago we did a comprehensive river basin study in the Blue Mountains. My portion dealt with sediment and anadromous fish habitat in the Tucannon River. Erosion and subsequent sediment deposition within the River had a severe adverse impact on salmonid egg incubation--as it does everywhere. On private lands most of the sediment came from sheet and rill erosion on non-irrigated croplands. On the national forest most of the sediment originated on roads. There was a significant positive correlation between amounts of sediment entering the stream on national forest with miles of. Again, I don't think this is unique to the Blue Mountains, but maybe should be included in your document.

Response: See response to Comment 4.1.7.0 above. Also, no reference was provided. Therefore, we, could not access the information regarding detriment to fish habitat as it related to wetlands.

4.191 Comment: Section 4.12.2, Paragraph 2 - Increasing mortality from what? Is fragmenting habitat a sub-category of restricting movement between populations?

Response: Mortality from road kills. Clarification added.

4.192 Comment: Section 4.12.2, Paragraph 3 - Add to sentence 2, paragraph 3 – "*and forest removal"* and delete last sentence

Response: Corrections made.

4.193 Comment: Paragraph 5, Sentences 2 and 3 - What does really mean? I don't get it. Behavior? Sickness, density?

Response: Populations, declines, and mortality were words used by the authors to indicate reduced abundance. Text clarified.

Page 4-64

4.194 Comment: Paragraph 1 – Give examples of ecological effects.

Response: The text is changed to say "effects on populations."

4.195 Comment: Section 4.12.3 i.e., pigeons Good!.

Response: Comment noted. No changes necessary.

4.196 Comment: Paragraph 5, Bullet 1 - Loss of hearing? What are examples of physiological changes? Infertility?

Response: Bullets reorganized. Stress and hypertension added as physiological changes.

4.197 Comment: Paragraph 5, Bullet 2 - Aren't these physiological effects?

Response: These effects were moved to first bullet.

Page 4-65

4.198 Comment: Bullet 1 - Behavioral things. Owl migration? Desertion of nests? from what? Desertion, predation?

Response: No information on impacts to owl migration or desertion of nests in wetlands was found. Behavioral responses are described in the second bullet on the previous page and in the first paragraph on page 4-65.

4.199 Comment: Paragraph 1 - Sudden? Loud? Without forest screening??

Response: This information is derived from the synthesis of Adamus et al. 2000. The terms sudden and loud were not defined.

4.200 Comment: Paragraph 2 - Deer? Antelope? When discussing "ungulates."

Response: This information is derived from the synthesis of Adamus et al. 2000. The ungulates were not defined.

4.201 Comment: Paragraph 3 – Are thresholds the maximum or minimum?

Response: Thresholds are presented as ranges (e.g. 36-58 decibels).

4.202 Comment: Paragraph 3 - Identify typical background noise levels in urban areas and more rural areas in Washington to put this data in context. I believe that the noise levels in urban areas, especially near highways, commercial, and industrial land uses is well above the threshold levels identified.

Response: We were unable to find information on background noise levels in Washington.

4.203 Comment: Paragraph 4 - Wordy jargon!

Response: Text simplified.

Page 4-66

4.204 Comment: Paragraph 1 - Is it trail construction, or trail usage by people? construction? operation?

Response: This information is derived from the synthesis of Adamus et al. 2000. "Trail development" was not defined.

4.205 Comment: Bullet 3 and 4 - Same to me!

Response: Pair bonds are between two adults. This is different from parent-offspring bonds.

4.206 Comment: Paragraph 2, Sentence 1 - pray tell what was it? Fowl? Duck? in-pond, noises, machine?? Wow what "unexpected" finding!!

Response: The source of recreational disturbance was not mentioned.

4.207 Comment: Paragraph 3 - Number of birds?

Response: Abundance means the total number of birds.

4.208 Comment: Paragraph 3 - Sentence states: "Recreational shooting poses additional threats to wildlife if lead shot is used." In Washington State it is unlawful to possess shot other than nontoxic shot when hunting for waterfowl, coot or snipe. Lead shot has not been allowed for waterfowl hunting for some time in Washington State. It is not allowed at all in many areas of the state for any purpose. In some parts of the state lead shot can be used for upland game birds and could be occasionally be accidentally fired into wetlands when hunting pheasant or target practicing. Overall the potential for impact is much reduced from the days when lead shot was used for waterfowl hunting.

Response: Lead shot is still allowed for skeet shooting and on ranges in Washington. This lead shot poses a hazard to birds. See Comment 4.113.

4.209 Comment: Paragraph 4 - Walking/running out-of-car experiences? With short focal-length lenses no doubt!!

Response: Comment noted. No changes necessary.

Page 4-67

4.210 Comment: Line 1 - Which species and what did it show? (other than GBH)??

Response: Great Blue Heron added to text since this is the one that is also found in Washington.

4.211 Comment: Paragraph 1 - What contributes to the loss of needs?

Response: Text clarified to indicate "habitat" needs.

4.212 Comment: Paragraph 2 - I think it depends – hunting yes, bird-watching no! But urban densities are so much higher!! User rate is greater!

Response: Comment noted. No changes necessary. The commentor has made some hypotheses, but we were unable to confirm them in our review of the literature.

4.213 Comment: Section 4.12.5 - There have been serious impacts to wetlands from some exotic animal introductions: carp and grass carp, bass, and nutria. There are other species for which impacts are more difficult to discern, for example California quail or Chinese pheasant.

Response: Possible impacts from these species can be hypothesized. This has been added to the text with the caveat that no information was found.

Page 4-68

4.214 Comment: Paragraph 1 – Are these species in eastern Washington?

Response: Yes, all these species are found in eastern Washington, as well as western.

4.215 Comment: Bullet 1 – What kind of changes in soil? Be specific.

Response: This information is derived from the synthesis of Adamus et al. 2000. "Changes in soils" was not defined.

4.216 Comment: Section 4.12.5.2 - Good, I didn't know this! Reference!

Response: Reference cited is Barrat 1997.

4.217 Comment: Section 4.12.5.3 - Cowbirds are exotic wildlife that impact native songbirds in agricultural and urban landscapes (see Ferguson et. al. 2001, in Johnson and O'Neil)

Response: We could not find the reference to cowbirds in Ferguson et al.

4.218 Comment: Section 4.12.5.3 - I'd like to see a listing of the "30% of these species" in a table.

Response: We do not think this level of detail is necessary in this review. For those wanting a list, Table 3 page 429 in Witmer and Lewis 2001 is the source of the 30%.

4.219 Comment: Paragraph 4 - Is the reference to zebra mussel relevant? Does it occur in wetlands?

Response: It occurs in riverine wetlands and its distribution now extends into the Missouri River watershed (http://nas.er.usgs.gov/zebra.mussel/map/zmyr2004.gif,

Accessed October 18 2004). This is close enough to Washington to pose a potential future danger.

4.220 Comment: Section 4.12.5.5 - Since there are 2 amphibs that are introduced how come you write nothing about the second one?

Response: We found no information on the ecological impacts of the introduced green frog. All of the research we found addressed only the bullfrog.

4.221 Comment: Section 4.12.5.5 - Declining in the PNW

Response: Comment noted. No changes necessary.

Page 4-70

4.222 Comment: Section 4.12.5.5 - In WDFW's recovery plan, it is noted that bullfrogs and large-mouth bass eat juvenile hatchling western pond turtles. However, I am not sure if they have empirically determined the actual effect on bullfrogs on WPT populations in Washington.

Response: Comment noted. No changes necessary.

4.223 Comment: Paragraph 3 - Direct as well as indirect effects. My theory is that in ecologically complex wetlands, lots of structure, bullfrogs do not exclude other amphibs. It's in simple wetlands that they "take over."

Response: Comment noted. No reference provided; therefore, no changes were made. Also, we do not understand how excluding is different from "taking over."

4.224 Comment: Paragraph 6 - If there is no definitive data to support this hypothesis, perhaps this statement should not be included.

Response: Hypotheses from experts also provide important information that can be considered as Best Available Science when experimental data are lacking. See other responses to comments similar to this scattered in the comments for Volume 1.

4.225 Comment: Paragraph 1 - Why this decline?

Response: The decline of amphibians has been well recorded. The reasons for the decline, however, have been very difficult to demonstrate. The data would suggest that there is no single reason for the decline, but that it may be caused by different factors in different areas or by a synergistic effect of several factors. These are discussed individually in the appropriate sections on the different disturbances.

4.226 Comment: Section 4.12.5.6 - What about native – exotic fish interactions?

Response: We found that the literature on native-exotic fish interactions did not address wetlands or look at these interactions in wetlands. In addition, according to experts, non-riverine wetlands in eastern Washington did not have any "native" species.

4.227 Comment: Section 4.12.6, Bullet 4 - Depends on a multitude of other wetland factors such as… native amphibs present, fish and wetland "complexity." Delete last sentence.

Response: We agree that there are other factors involved. This section, however, deals with invasive species. The operative word in the bullet is "can alter," not "will alter." We do not agree that the last sentence should be deleted. The data on the impacts of bull frogs is ambiguous.

Section 4.13 Chapter Summary and Conclusions

Page 4-72

4.228 Comment: Bullet 1 - Also timing?

Response: We did not find any information on the impacts resulting from timing of human disturbances.

4.229 Comment: Bullet 4 - Increases in

Response: There are also impacts from decreases in sediment (e.g. sediment retained by dams). The word "changes" is being kept.

4.230 Comment: Bullet 5 - Are there non-toxic contaminants? I guess so.

Response: Contaminant – (Webster's Dictionary) Something that soils, stains, or infects or makes unfit by introduction of unwholesome or undesirable elements. Sediment can be considered as an non-toxic contaminant.

4.231 Comment: Bullet 10 - Change "access" to "use".

Response: Correction made.

Page 4-74

4.232 Comment: Table 4-3 - Either explain the ++ symbol or correct the table as appropriate

Response: ++ changed to xx.

4.233 Comment: Table 4-3 - Comment g salts on wetlands should have a literature on impacts to wetland biota.

Response: The literature is described in Section 4.10 in the text.

Page 4-75

4.234 Comment: Table 4-4 - It seems that changing the physical structure of the wetland through filling or draining would have significant impacts to all the fish and wildlife listed. Many of the impacts could depend upon the degree of the disturbance.

Response: We agree that complete destruction of the wetland would have significant impacts. This was covered in the beginning. The question we were considering was: What are the impacts of "incomplete" changes to the physical structure of the wetland?

4.235 Comment: Table 4-4 - first row: Delete the word "to" from the Disturbance Type.

Response: Correction made.

Chapter 5 – The Science and Effectiveness of Wetland Management Tools

Section 5.1 Reader's Guide to this Chapter

Page 5-1

5.1 Comment: Paragraph 4: Ecological? Rather then "biological wetlands"

Response: Either term would probably be reasonable as a way to describe those wetlands that meet the three parameters of hydrology, soils, and vegetation. However, the term biological is one that has been used historically to describe those wetlands that meet a scientific definition as opposed to a political one, so we will stick with the term "biological."

Page 5-2

5.2 Comment: Section 5.1.3 - A significant data gap remains with regard to the actual level wetlands provide functions and their actual levels of performance relative to the Ecology models. The dearth of actual quantification of wetland functions for most wetlands systems creates large uncertainty in our ability to know the real importance of wetlands across landscapes.

Despite the involvement of local, regional, and national experts in developing models, the complexity of wetlands and the lack of quantifications result in substantial uncertainty. An example of the risk of making wrong assessments is the view Ecology and others have now accepted with regard to the groundwater recharge/discharge functions of wetlands (see p2-45 and 2-46 in this report). A few years ago this function was widely attributed to wetlands yet is now recognized (in most situations) as minor or absent.

Response: We agree that a data gap remains at described. We do not, however, consider this to be a "fatal flaw" that negates the use of decision-making tools such as the methods for assessing functions and the rating system. The application of such tools in managing wetlands is discussed more fully in Hruby T. 1999. Assessment of wetland functions: What they are, and what they are not. Environmental Management 23:75-85. The issue of recharge/discharge is discussed in the responses to comments 2.40 and 2.41.

5.3 Comment: Section 5.1.3 - I didn't get this as it seems to contradict the information that follows in the next sections.

Response: It is difficult to respond to this comment as no details are provided. We do not perceive that the description of data sources and gaps in section 5.1.3 is contradicted by the information in the following sections.

Page 5-3

5.4 Comment: Paragraph 2 - In most natural situations, there is little true overland flow across uplands. Therefore, buffers would not be expected to attenuate overland flow.

Response: The point is well-taken that overland flow is rare in natural settings, though it may occur more frequently in developed settings where discharges of runoff are directed to the outer portion of a buffer. This issue is addressed in Section 5.5.3.1. No changes to text needed.

Section 5.3 How Wetlands are Defined and Delineated

Page 5-5

5.5 Comment: Line 1 –Delete "the process of conducting."

Response: Change has been made.

5.6 Comment: Paragraph 1 Even on disturbed sites?

Response: The Corps and Ecology definitions reference all three parameters being present under "normal circumstances," and the delineation manuals specify how one determines if the three parameters are met. Both disturbed sites and problem-area wetlands are exceptions to the general rule. We have revised the text to add "in most cases" to clarify that there may be exceptions.

5.7 Comment: Section 5.3.2 - Ecological? Rather then "biological wetlands."

Response: See answer to Comment 5.1 above.

Page 5-6

5.8 Comment: Paragraph 3 - The statements here concerning isolated waters are not quite accurate. 1): The Corps defines "isolated waters" in their 1986 regulations at 330.5(a) 26 ii which state in part: "Other non-tidal waters of the U.S. including adjacent wetlands that are not part of a surface tributary system to interstate waters or navigable waters of the U.S." are isolated waters. In layman's terms, this means that if the water has no surface water connection to a navigable/interstate water, they are isolated—note the emphasis is "waters" not wetlands. So streams, etc., that do not connect to navigable/interstate waters are also isolated. Wetlands that are adjacent to waters that have a connection are jurisdictional; it is not true that wetlands with no surface water connection are isolated.

In fact, the Supreme Court decision (SWANCC) held only that isolated wetlands, whose only interstate connection is use by migratory birds are not "waters of the United States."

What was overturned here is the issue of using interstate commerce (i.e. migratory birds) to establish jurisdiction. Finally, as of late, there have been several court decisions and informal confidential guidance concerning these isolated waters and establishing jurisdiction. This Best Available Science document should only mention what the Supreme Court said and indicate that policy concerning this decision is still in flux and seems to change daily.

Response: Changes have been made to reflect the suggestions in this comment.

5.9 Comment: Paragraph 3 - Some prior converted wetlands or cropland are regulated by the federal government under the Clean Water Act. Originally "prior converted cropland" was a term used by the federal government to identify those wetlands that had been drained to the extent that they no longer retained wetland characteristics. They were, however, candidates for restoration. The Federal government was looking at whether "under normal circumstances" an area was wetland or not. The question was is a piece of land drained so that its normal circumstance is drained cropland and no longer wetland, farmed wetland and still wetland or abandoned cropland and reverted to wetland and not in a crop rotation. In 1996 the Farm Bill changed some definitions so there were no longer consistent federal definitions on what prior converted croplands were. For farm bill purposes if a land had ever been placed in crops, it was prior converted cropland regardless of its current hydrology. The US Army Corps of Engineers continued to regulate the wetter Prior Converted Croplands identified with the Corps 1987 Manual. More significant is the removed federal jurisdiction from wetlands that are isolated and without surface connection to navigable waters.

"Especially shallow wetlands that might be dry much of the year, but are maintained by repeated seasonal saturation or inundation, require protection even at times they are completely dry if they are to retain their functions . . . Agricultural wetlands, which for present purposes include both farmed and non farmed areas, are extensive within the United States. They often perform functions that are similar in nature to those of nonagricultural wetlands. Use of special definitions or criteria for the identification of agricultural wetlands is not justified because it leads to different delineation of wetlands on agricultural and nonagricultural lands."— National Academy of Sciences, 1995.

Response: We checked with the Seattle Corps of Engineers and were told that they do not regulate, under the Clean Water Act, any areas that meet the definition of prior converted croplands (T.J. Stetz, personal communication 2004). They do regulate farmed wetlands.

5.10 Comment: Paragraph 3: "Some" Prior Converted wetlands – not the ones in which jurisdictions use USACE guidance.

Response: See response to Comment 5.9 above.

5.11 Comment: Paragraphs 4 and 5 - The PC discussion is not quite correct. PC's not only are manipulated prior to Dec. 1985 and ponded or flooded as indicated. They must produce an agricultural commodity that requires planting a crop that requires annual tilling. There is no question that these areas may still be wetlands; however, by regulation they are not considered "waters of the U.S." In addition, I would add the statement that if these sites are abandoned (i.e. no tilling and planting has occurred for five consecutive years) and hydrophytic vegetation and wetland hydrology return then these areas are considered waters of the U.S.

Response: Changes have been made to reflect this comment.

Page 5-7

5.12 Comment: Paragraph 1 - I think there's enough science that you didn't need specific literature on that topic!

Response: Comment noted. No text revisions needed.

5.13 Comment: Section 5.3.3 - In Chapter 5, Section 5.3.3, where "small" wetlands are discussed and studies cited, include the size of the "small" wetland for each study cited. This will make the information more valuable. As acknowledged in the introduction of Section 5.3.3 Small Wetlands, size is defined variously. For me, with my experience with wetlands in northwest Washington, a small wetland is anything under about one-quarter acre—this is my "definition". A ten acre wetland in Louisiana is considered "small". For me, that would be a "large" wetland. Without stating the size of the "small" wetlands cited in the studies the implications of the study can be misleading or misconstrued.

Response: We have attempted to add this information where it is available in the studies cited.

5.14 Comment: Section 5.3.3 -The analysis of small wetlands should be re-written to help establish which small wetlands in a landscape may actually be providing important functions. From this analysis, protection guidelines can be developed (in Volume 2) that protect wetland functions. A discussion that focuses on wetland characteristics, biota, and functions of Washington's small wetlands is needed. Alternatively, if data show that all small wetlands, regardless of their physical, biologic, chemical or landscape attributes are providing important functions, than this section should demonstrate this situation. As the section is currently written, I find it misleading and overly defensive. Some other issues are outlined below.

Response: We have revised the text to clarify that "small" wetlands are a subset of wetlands defined exclusively by size, and that they can be expected to provide a similar range of functions as larger wetlands. While there is not a scientific basis for providing a greater degree of protection, neither is there a scientific basis for affording them lesser protection than other wetlands.

5.15 Comment: Paragraph 2 - Gibb's models also a useful 1993 reference here – for other classes

Response: This comment makes no sense and, thus, we cannot respond to it.

5.16 Comment: Paragraph 3, line 1- do you need this?

Response: We think it is a useful statement.

5.17 Comment: Paragraph 3, last line - I think what some have found i.e. self-serving Richter, is that the best wetlands only have 60 ages d/o of species found at all wetlands and that it takes all wetlands (small included) to have maximum diversity.

Response: This comment makes no sense and, thus, we cannot respond to it.

Page 5-8

5.18 Comment: Section 5.3.3.1 Are Snodgrss et al. (2000) findings relevant to Washington? Evaluate this by considering what state was it conducted in? Do we share some of the same species? In addition, what was the size range of the wetlands included in their studies?

Response: The study of amphibians by Snodgrass et al. was conducted in South Carolina. Their findings are considered relevant for two reasons: 1) The species of amphibians they studied are from similar genera as the species we have in Washington, and many of the species in the study fill the same niches as similar species in WA; 2) all amphibians have similar physiological needs. The wetlands included in their studies range in size from 0.3 hectares to 1.2 hectares.

5.19 Comment: Section 5.3.3.1 - Intermediate disturbance hypothesis! Greater richness found in intermediate habitat conditions. I think because he used the bullfrog as his amphib "model" other species may have decreased! *Yes, bullfrog +25,000 eggs red-legged frog only 1,500 Salamanders – 250 maximum.

Response: Comment noted.

Page 5-9

5.20 Comment: Paragraph 2 - Interesting, never knew this was the case!

Response: Comment noted.

5.21 Comment: Paragraph 2, line 2 - Change the reference to they at the end of the line to he or she as appropriate. Or, change the reference to make it agree with the plural pronoun "they."

Response: Since the gender of the author is unknown, we have revised the text to remove any gender-specific pronoun.

5.22 Comment: Paragraph 5 - In several, small wetlands don't have to demonstrate animal sickness to be critical. They can, could be "stepping stones" between larger wetlands!

Response: Comment noted.

5.23 Comment: Section 5.3.3.3 - The fact that only 1 of the small mammal species in this study is identified as wetland dependent may explain why small mammal distribution was not well correlated to wetland size. They don't really need wetlands to persist. In this case, obviously another factors would be important---that is the ability of upland buffers to provide upland habitat to non-wetland dependent mammals.

Response: Comment noted.

Page 5-10

5.24 Comment: Section 5.3.4 - A discussion of hydrologic and water quality functions is missing. Engineering studies show that small constructed wetlands can provide substantial hydrologic and water quality benefits. The same is likely true for certain natural wetlands that receive urban or agricultural runoff. In general, these functions could be readily replaced through mitigation (see Kadlec and Knight 1996, Daniels and Gilliam 1996, King County 1998, and Ecology 2000).

Response: More information on hydrologic and water quality functions has been added.

5.25 Comment: Section 5.3.4 - The latest issue of WETLANDS is full of papers about isolated wetlands. Please include this new information.

Response: This information has been added.

5.26 Comment: Section 5.3.4: The SWANCC decision eliminates federal (i.e., Corps) jurisdiction of some isolated wetlands, such as those that are solely considered regulated because of migratory bird use. As such, it does not appear to have affected the jurisdiction of the Seattle District of the U.S. Army Corps of Regulations or left "many" isolated wetlands unprotected in Washington as suggested. Suggest this paragraph be rewritten to reflect regional Corps guidance and any case law that has evolved to more accurately identify the types of isolated wetlands that are no longer regulated in Washington state. Otherwise, this is misleading.

Response: The Corps has issued no national or regional guidance on this issue. A personal communication with a senior staff in the Seattle Corps office clarified the current agency position on what constitutes an isolated wetland. This information has been added to the text along with a disclaimer that future court or administrative decisions may change how isolated wetlands are determined.

5.27 Comment: Section 5.3.4 - The analysis of isolated wetlands should be re-written to help establish which isolated wetlands in a landscape may actually be providing important functions. From a revised analysis, protection guidelines can be developed that protect wetland functions, but the discussion must focus on wetland characteristics, biota, and functions of wetland types in Washington. If data show that all isolated wetlands, regardless of their physical, biologic, chemical, or landscape attributes, are providing important functions, than this section should demonstrate this is the case. As the section is currently written, I find it misleading and overly defensive.

Response: As with "small" wetlands, isolated wetlands are defined differently in the literature. This issue has reached prominence because of the recent Supreme Court decision. We have included new information from a September 2003 issue of the journal Wetlands that supports the notion that "isolated" wetlands perform the same suite of functions as non-isolated wetlands and that differences in function often have to do with factors other than their isolation.

5.28 Comment: Paragraph 1 - See information above regarding SWANCC. It is my interpretation that the linkage to Navigable waters was that the Court found that using the Interstate Commerce Clause in the Constitution was too far a reach to establish jurisdiction for isolated waters.

Response: Comment noted.

5.29 Comment: Paragraph. 3 - The statement "…sloped wetlands where surface water, if present, *re-enters the shallow groundwater zone at* the base of the wetland…" appears to conflict with the earlier statement that impounding wetlands are the only wetlands with the potential to provide groundwater recharge. What if the slope wetland is fed by a short segment of a stream or other surface water flow?

Response: We interpret the statement by Tiner in a different manner. We interpret this statement to mean that the recharge occurs along the downslope edge of the wetlands and thus near the boundaries of the wetland. We do not attribute this recharge to be a function of the wetland itself but rather a function of the soils and topography just outside the wetland. When the water leaves the surface, it no longer provides the water regime necessary to maintain a wetland. No change to text needed.

5.30 Comment: Paragraph. 3 - Yes, fringe wetlands of the Great Salt Lake, and such lakes in general.

Response: Comment noted.

5.31 Comment: Paragraph. 3, Line 3 - What about an inlet? That is if they receive water from another aquatic area?

Response: The Corps has been interpreting isolation to mean that the wetland is not connected by surface water to a navigable water. A wetland can have an inlet but must connect via surface water to a navigable water.

Page 5-11

5.32 Comment: Paragraph 2 - The statement that the Corps published 2 federal manuals is not specifically true. The 1989 manual was jointly published with NRCS, USFWS, and EPA.

Response: A change has been made to clarify this point.

Page 5-12

5.33 Comment: Lines 5 and 6 - This should read: (which is not *present* in the 1987 Corps manual).

Response: Change has been made.

5.34 Comment: Section 5.3.6 Bullet 1 - BAS requires us to protect "biological" wetlands and not jurisdictional wetlands or am I wrong? Rest of bullets – good

Response: BAS does not "require" anything. The GMA requires the use of the state definition and delineation manual, which define a subset of what many would consider "biological" wetlands.

Page 5-13

Section 5.4 Wetland Rating Systems

5.35 Comment: Paragraph 2, Lines 1 – 3 - Do wetland rating systems "measure" wetland characteristics? Perhaps the sentence should be rewritten something like "Wetland rating systems (or categorizations) are one of the numerous procedures that have been developed to analyze wetland, providing ways to identify, characterize, or estimate functions and social benefits (values)."

Response: Change made.

5.36 Comment: Paragraph 4 in, line 3- …tool that categorize*s* wetland…

Response: Change made.

Page 5-16

5.37 Comment: Section 5.4. 1.1 - Some very brief comments relative to section 5.4. 1.1 Bogs. The first two sub-sections focus on bogs, which I believe is appropriate, but the third sub-section, entitled "Bogs in Western and Eastern Washington", talks about bogs, fens, and peatlands. I suggest keeping these things separate. The subject of section 5.4. 1.1 is bogs, not fens or peatlands in general.

Response: The fens and peatlands are discussed here because Kunze identified more than sphagnum bogs. This is an important reference for Washington state, and we judged it important to include it in this synthesis. We tried to make it clear that bogs are a subset of the different types of wetlands classified by Kunze. The text has been changed to make this more clear.

Page 5-17

5.38 Comment: Paragraph 2, Line 3 - Based on my field work, I believe you should add *Gaultheria shallon, Vaccinium ovatum, and V. parviflorum.*

Response: There are many common plants in bogs, and we used labrator tea as only an example. It is not the intent of this section to provide a comprehensive list of common plants.

5.39 Comment: *Bogs in Western and Eastern Washington* You talk about Kunze, why did you miss Crawford and Kovalchik classification? Very little wetland classification work how occurred on the west side.

Response: Kovalchik's classification has been added to the discussion in Chapter 2. It is not appropriate in this section because the first level of the vegetative classification was forest, shrub, or emergent; not based on the species of bog vegetation. The classification does not separate Spaghnum bogs from other wetlands.

5.40 Comment: Last paragraph p. 5-17 - Not true. See Kovalchik draft classification.

Response: See response to comment above.

Page 5-18

5.41 Comment: Paragraph 2 - Do you need to differentiate raised bogs from others?

Response: We were unable to identify characteristics to separate raised bogs from other types of bogs in Washington, and therefore cannot differentiate them from other types of bogs.

Page 5-19

5.42 Comment: Section 5.4.1.3 - While mature forested wetlands have been created as part of compensatory mitigation since these requirements were not established until recently, it is highly likely that reforestation efforts in Washington have successfully established forest habitat on wetland soils. There may be planted stands of mature forested wetland that exist in Washington. It would be useful for Ecology, WDFW, other agencies, or other scientists to identify and characterize any such stands. Such analysis would help establish an understanding of the development of forested wetlands over time. The analysis would contribute to an understanding of the cumulative benefits that protecting, enhancing, and creating immature forested wetlands may provide over time.

Response: The Department of Ecology is undertaking a study of re-forestation in wetlands that have been logged. Unfortunately, the results of the study are not available at the time of this report.

5.43 Comment: Section 5.4.1.4 - Based on observations made by the technical team during development of the Eastern WA Functions Assessment work, it appeared clear that many (if not most) of the venial pool habitats were not jurisdictional wetlands because they dried before the start of the growing season. Please consider mentioning this in the BAS document.

Response: Vernal pools used in the calibration of the rating system were not subject to a formal "delineation," and thus we are unable to say whether they are fully jurisdictional. Vernal pools are identified as "problem areas" that require a close observation of vegetation and water regime during a short period of the year. We are not in a position to say that many (or most) vernal pools are not jurisdictional.

Page 5-20

Section 5.5 Buffers

5.44 Comment: It is appropriate that this section not address wildlife species that are not wetland dependent species. As discussed above (Section 2.5.3.2) the highest priority for buffers should be to protect wetland dependent species.

Response: We concur. We have adopted the terminology used in the text, Wildlife-Habitat Relationships in Oregon and Washington, by Johnson and O'Neil. They refer to species as "Closely Associated" , "Generally Associated" and "Present" with or in a particular habitat type. We have focused on species that are "Closely Associated" with wetlands. However, while wetlands may be critical habitat for these species, they are also utilized by many other species which may be Generally Associated with wetlands for meeting some of their life needs in certain contexts.

5.45 Comment: Buffers are terrestrial components of wetland systems. They define how the wetland functions and the biological connectivity on the landscape. - Buffers are components of habitat for species that spend part of their life cycles in aquatic and or wetland habitats and other portions in terrestrial uplands. See Brinson M.M. 1993. changes in the functioning of wetlands along environmental gradients. Wetlands 13:63-74. Note most scientific literature does not delineate wetlands from a regulatory standpoint but looks at the gradient as a whole. Research tends explore the needs of differing guilds or species such as structure needed or microclimate needed or how reproduction and rearing of young can occur in areas that are less likely to be flooded. Having refuge from normal high water events can be important survival techniques and buffers provide this refuge in many cases. WDFW PHS Riparian Document (Knutson and Naef) incorporates the concept that riparian areas are those that either influence the aquatic system or are incorporated in the wetland system.

Response: Comment noted. These points have been made in section 5.5.

5.46 Comment: Paragraph 1- Buffers are ecotones. Odum. (1959) defines "ecotone": "An ecotone is a transition between two or more diverse communities as, for example, between forest and grassland or between a soft bottom and hard bottom marine community. It is a junction zone or tension belt which may have considerable linear extent but is narrower than the adjoining community areas themselves. The ecotonal community commonly contains many of the organisms of each of the overlapping communities and, in addition, organisms which are characteristic of and often restricted to the ecotone. Often, both the number of species and the population density of some of the species are greater in the ecotone than in the communities flanking it. The tendency for increased variety and density at community junctions is known as the edge effect." (Eugene P. Odum, 1959, Fundamentals of Ecology, Second Edition, W.B. Saunders Company, Philadelphia, page 278.)

Response: This concept is described in Section 5.5.4.1. A change has been made to include Odum.

5.47 Comment: Paragraph 1 – buffers are "assumed" vegetated (add assumed)

Response: The second sentence makes clear that vegetation is assumed.

Page 5-21

5.48 Comment: Paragraph 1 - The document indicates there are studies that have examined buffer functions on attenuating surface water. If so they should be cited. Overland flow is rare because rainfall intensities rarely exceed the infiltration capacities of upland soils (refer to data in soil survey manuals), thus, attenuation of surface flow is unlikely to be a significant buffer function. Where overland flow occurs in buffers, it is most likely to be channelized.

Response: These studies are well-cited in the section on removing sediment. The concern about channelized flow is described in section 5.5.3.1.

5.49 Comment: Paragraph 2 - A substantial amount of the buffer literature documents the presence of upland wildlife in wetland buffers. GMA provides provisions to protect wildlife habitat, and these should be relied for maintaining non-wetland dependent wildlife. Critical wildlife functions of wetlands for wetland dependent wildlife must be fully protected by adequate buffers and other management standards.

Response: We concur. See answer to Comment 5.44.

5.50 Comment: Last sentence states: "This literature does not specifically address the role of buffers in providing connectivity between wetlands and other parts of the landscape." There is literature that does exist that deals with these issues. The National Academy of Science's Study 2001.Page 42:

> "*Wetlands as Animal Dispersal Corridors in Watersheds*
> *"Dispersal of plants and animals is influenced by the proximity and number of wetlands in a geographic area. Connectivity between (Harris 1988) and functional interdependence of wetlands with other landscape units (Bedford and Preston 1988) can also affect animal use because many species (e.g., some amphibians), require an upland-wetland matrix."*
>
> *Most wetland species or reptiles, amphibians, small mammals, and possibly non flying invertebrates do not have capabilities for overland migration if terrestrial corridors are obstructed . . ."*
>
> *"The functioning of many wetland animal populations on a long-term basis is inherent to the source-sink dynamics of metapopulations that require connectivity in the terrestrial landscape. (Gibbs 1993; Burke et al. 1995; Semlitsch 2000). Although populations of many or most wetland animals can fluctuate dramatically in numbers seasonally and annually (Pechmann et al. 1991), most wetland species will remain associated with a particular wetland as long as environmentally suitable conditions persist. However, hydroperiod variability can result in major fluctuations in the numbers of species from year to year (Snodgrass et al. 2000) with the consequence that alternative wetlands must be reached for breeding and feeding opportunities in some years. Many species take advantage of, and actually require alternative wetlands during periods of drought. To avoid extirpation from natural causes, a variety of isolated wetlands must be accessible by overland routes . . .Species need alternative wetlands in the landscape when a particular wetland experiences a period of environmental duress."*

Page 44:

"The aquatic and semi aquatic fauna that use wetlands are key components of wetland structure, productivity, and overall functioning. However, many species of animals for which the aquatic portion of a wetland is critical are equally dependent on the surrounding terrestrial habitat. The importance of terrestrial habitat beyond the margin of standard wetland delineation has been unequivocally demonstrated for salamanders and freshwater turtles (Burke and Gibbons 1995; Semlitsch 1998) and is implicit on the basis of ecology and behavior of other terrestrially dispersing species, including frogs, snakes, and mole crickets (Dole 1965; Semlitsch 1986; Seigel et al 1995) . . ."

"Based on these facts and principles, the incorporation of animal populations requiring terrestrial movement into the design of compensatory wetlands requires that interwetland distances be taken into account (Semlitsch and Bodie 1998). Local populations can be extirpated and regional species forced to extinction if there are no opportunities for recolonization of wetlands during periods of environmental stress (e.g. extended drought). Also an undisturbed upland buffer that goes beyond the jurisdictional wetland boundary under the Clean Water Act is essential for some species (Semlitsch and McMillian 1980; Burke and Gibbons 1995; Semlitsch 1998). Therefore both the terrestrial connectivity between wetlands in the landscape and the terrestrial habitat surrounding the prescribed wetland must be considered in designing mitigation wetlands." BZ

Response: The information from the NAS report referenced above discusses both the need to protect adjacent upland habitat to meet the full range of wetland-dependent wildlife needs and the need to provide connectivity between wetlands through the protection of terrestrial habitat. It does not state that buffers can or should provide for both needs. Buffers generally do not provide connectivity between wetlands except in rare circumstances (e.g. between wetland complexes). Section 5.5.4.3 of Volume I documents the importance of maintaining connectivity. The NAS reference has been added to that section.

5.51 Comment: Paragraph 1 - structure of ability of (awkward)

Response: We appreciate the suggestion but have retained that language.

5.52 Comment: Paragraph 2 sentence 3 - Is this what buffers are supposed to do!? "Corridors" provide connectivity

Response: In some cases, buffers can provide connectivity between wetlands and between a wetland and other habitat areas. While it is generally impractical to rely on buffers to maintain connectivity, there are situations where buffers can perform this role (e.g. wetland complexes where many small wetlands are in close proximity). No changes to text needed.

Page 5-22

5.53 Comment: Paragraph 2 - This is good.

Response: Thank you.

5.54 Comment: Last bullet on page - What about xenobiotics

Response: This comment makes no sense and, thus, we cannot respond to it.

Page 5-23

5.55 Comment: Paragraph 3, bullet 1 - You used this several times but what does it really mean? You may have described, but I no longer recall.

Response: This term is only used in one place. It is not an accurate reflection of the science and has been removed.

Page 5-25

5.56 Comment: BOX: Paragraph 2 - Most often riparian areas would be the connectors between wetlands and buffers or ectononal uplands on the landscape. The importance of intact corridors is stressed in Fevold et al 2001 (Karen Fevold, Christopher May, Hans Berge, Elissa Ostergaard, Habitat Inventory and Assessment of Three Sammamish River Tributaries: North, Swamp and little bear Creeks, May 2001, King County)

> *"A near continuous riparian corridor is important to stream ecosystem function (May et al 1997, Naiman and Bilby 1998, Wenger 1999 and Naiman et al. 2000). Road crossings, utility-line gaps, and other breaks in the riparian corridor fragment the stream-riparian ecosystem and allow direct access of surface water into the stream system (May et. Al 1997)(p.56 . . . Results of this study and others in the PSL region demonstrate that retention of a wide, nearly continuous riparian buffer in native vegetation has greater and more flexible potential than other options to uphold biological integrity when development increases. In newly developing areas riparian zones can be isolated from development, along with their associated streams. In developed landscapes riparian zones are often more lightly developed than upland areas, and could more easily be purchased and placed into protective status. (p. 61).*

Roni et al. point out: "Ideally, habitat restoration requires reconnecting isolated habitats and restoring the disrupted habitat-forming processes. It is important not to overlook the need to protect high-quality habitats." (Roni, P,. Beechie, T.J., Bilby, R.E. Leonetti, F.E. Pollock, M.M. and Pess G. R. 2002. A Review of Stream Restoration Techniques and a Hierarchical Strategy for Prioritizing Restoration in Pacific Northwest Watersheds. North American Journal of Fisheries Management 22;1-20, 2002. American Fisheries Society).

Response: The box on page 5-25 addresses the role of buffers in protecting a wetland's hydroperiod. The comment addresses habitat connectivity. We do not understand how the two relate. Habitat connectivity is addressed in section 5.5.4.3

5.57 Comment: box - Suggest replacing the word "determined" in line 8 with the word "indicates." Section 5.5.3 Buffers and Protection of Water Quality

Response: Change has been made.

5.58 Comment: bullets: Add new bullet – "They provide woody debris (often large) and organic inputs."

Response: This section deals with buffers' ability to protect wetland water quality. Page 5-36 addresses the importance of buffers providing woody debris and organic matter for maintaining habitat. This new bullet has been added.

Page 5-26

5.59 Comment: Section 5.5.3.1 - As stated above, surface flow under natural conditions within buffers is typically channelized. This analysis presented here most likely pertains to new discharges from upland areas into buffers. In general, sediment impact analysis should rely on project-level considerations of sediment discharges to buffers and the specific conditions in the buffers that would promote sediment removal. Buffers or treatment facilities sufficient to protect wetlands from significant ecological impacts should be provided.

Response: We concur and believe this issue is best addressed in Volume 2: Guidance for Protecting and Managing Wetlands.

5.60 Comment: Paragraph 2, Bullet 1 - Replace "fall" with "settle"

Response: Change made.

Page 5-28

5.61 Comment: Buffer Width and Effectiveness in Removing Sediment - Use of graphical information needed to illustrate buffer functions varying with width. In Chapter 5, we recommend that at least one graphic figure be added to the document to show the asymptotic relationship between sediment removal functions and buffer width (p. 5-28).

Response: We have added a graph to section 5.5.3.1 that illustrates the concept. See Figure 5-1.

5.62 Comment: Paragraph 3 - So!?? It really depends on what "threshold" levels your wetlands are functioning at. Would be happy with 15% E Coli. How about 5% E coli? Is an additional 15% sediment tolerable over 50 years?

Response: A statement has been added to the introduction to Section 5.5.3 to address the issues of thresholds, carrying capacity, etc.

Page 5-29

5.63 Comment: Tables 5-1, 5-2, 5-3 Always cite the original source, not "as cited in" or "cited by".

Response: Where we were able to obtain the original source, we cited it as such. For the few documents we could not find, we cited the author who used the original work in their synthesis document.

5.64 Comment: Section 5.5.3.2 - In general, impacts to water quality should rely on project-level considerations of the discharges to buffers and the specific conditions in the buffers that would promote pollutant removal. Buffers or treatment facilities sufficient to protect wetlands from significant ecological impacts should be provided.

Response: We concur and believe this issue is best addressed in Volume 2: Guidance for Protecting and Managing Wetlands.

5.65 Comment: Section 5.5.3.2 - Buffers may be sources of nitrogen during some parts of the year where nitrogen-fixing species, such as red alder, are a dominant component.

Response: A statement and citation regarding this issue has been added to the text.

Page 5-30

5.66 Comment: Paragraph 1 - Good.

Response: Thank you

Page 5-32

5.67 Comment: Section 5.5.3.3 - What about herbicides? See Rhett Jackson's work.

Response: We searched for studies by Jackson related to herbicides and were unable to find any. However, one new citation was found and has been added.

5.68 Comment: Paragraph 1 - Add "and herbicides" second sentence.

Response: We cannot find where this addition is suggested to be added, thus, we cannot respond to it.

5.69 Comment: Paragraph 1 - Fecal coliform bacteria that are used to monitor water quality are not pathogens. They are potential indicators of the presence of human pathogens. This is clear in the state's water quality standards WAC 173-201A and Ecology Publication # 00-10-072: Setting Standards for the Bacteriological Quality of Washington's Surface Waters among other documents.

Response: Text has been changed to note that fecal coliform bacteria are potential indicators of pathogens.

Page 5-33

5.70 Comment: Table 5-3 - Yes, but when we think of wetland buffers we rarely think of grass buffers! So what about shrubs and trees?

Response: The available studies focus on the use of grass buffers, with the exception of the forested buffer in the study by Doyle et al. We could not find any additional data about the effectiveness of forest or shrub buffers at removing toxicants and pathogens.

5.71 Comment: Section 5.5.3.4 - McMillan (2000) is not the originator of this concept, i.e., ability of forests to moderate temperature or climate. Use original source(s)/literature that demonstrates and explains the concept. For example:

Montieth, J.L. and M.H. Unsworth. 1990. *Principles of Environmental Physics.* Second edition. Edward Arnold, New York.
Or Oke, T.R. 1987. *Boundary Layer Climates.* Second edition. Routledge, New York.

Response: Text has been revised to reflect this comment.

Page 5-34

5.72 Comment: Line 1 - This applies equally to streams.

Response: Text has been revised to reflect this comment.

5.73 Comment: Paragraph 2 - Good points! Interesting! But, * why change the distance (131 ft vs. 120 ft

Response: Text has been changed to maintain consistency in distances.

Page 5-35

5.74 Comment: Paragraph 2 - change some to "Most" .."work by Milligan (birds) and our work _____, a_____, birds and mammals use of adjoining areas."

Response: This comment makes no sense and, thus, we cannot respond to it.

Page 5-36

5.75 Comment: Bullet 3 -…, and moderates water temperatures within adjacent wetlands to support temperature senstitive spp. (e.g. fish, amphibins).

Response: Text has been added to bullet # 3.

5.76 Comment: Paragraph 2, last sentence - We never monitored species richness beyond 1,640 so how can "you" say this? We're missing something in the interpretation.

Response: We have reviewed the source material again, spoken with one of the authors, and made revisions to the text.

Page 5-37

5.77 Comment: Paragraph 1 - I think aquatic reptiles – in turtles and also ducks use large woody debris to sun, rest and groom themselves

Response: Without a citation, we cannot add this as fact.

5.78 Comment: Paragraph 4 - Is this the width to protect wildlife in wetlands or wildlife in buffers themselves?

Response: The recommended widths are to "maintain wildlife habitat functions for… wetlands"; i.e. protect wetland-dependent wildlife, not all wildlife that may utilize upland areas (buffers) adjacent to wetlands.

5.79 Comment: Paragraph 5 - There are two Groffman et al 1991 references. Which one is this?

Response: Citations for Groffman et al. 1991 have been changed to 1991a and 1991b. This one refers to 1991a.

Page 5-38

5.80 Comment: Paragraph 1 - First sentence states: "However, no studies were reviewed for this synthesis that compared wildlife use of mature forested buffers with buffers composed of meadow, shrub land, logged forest, or younger forests. Brown et al 1985 lists primary breeding and feeding habitat for different species in wetland, riparian grass-

forb, shrub, open sap-pole, closed sap pole, large saw timber and old growth forest. There is a fair amount of wildlife literature of wetland associated species with mature forest. Different cavity nesting species of birds need different tree diameters at breast height (dbh). For example. Wood duck need an absolute minimum of 14 inch dbh but 24-30 inch dbh is preferred.

Response: The information in Brown et al 1985 does not address the use of upland habitats adjacent to wetlands or other riparian areas except to note the many different types of habitats used as primary or secondary habitat by a great number of species. For example, the Black-Crowned Night Heron uses a variety of wetland and riparian habitats, as well as water-shrub and water-forest edges, as primary habitat, and a variety of upland habitats, such as deciduous hardwood and evergreen hardwood (open sap-pole to old-growth) and grass-forb habitats, as secondary habitat. There is no way to take this kind of information for dozens of wetland-dependent species and draw conclusions about what type of adjacent upland habitat (buffer) is "best". We recognize that there are many studies that document the use of a particular type of adjacent habitat for some wetland-dependent species, but these suggest that the buffer "needs" vary from species to species. In some cases, grassland or shrub habitat would be "best" for a species; for other species, old-growth forest may be "best". As the statement reads, we have not found any studies of buffers that document different wildlife use of different types of buffer habitats. However, we have added a statement that wildlife-species have varying needs for different types of adjacent habitat for different life needs such as breeding, foraging and resting. We have cited Brown et al as the source.

5.81 Comment: Paragraph 1 - Remember richness alone may not be the goal as exotic and/or invasive species can increase richness, but be harmful. It's native and/or wetland-dependent, associated birds that need to be protected by buffers. Similar to the richness argument above. Diversity per se may not be the criteria to use! Especially if _____ mallard, Canada goose, etc.

Response: This section is just reporting what was found in the literature without passing judgment on it.

5.82 Comment: Paragraph 5 - (Reference(s)) are Ostergaard Richter…

Response: This comment makes no sense and, thus, we cannot respond to it.

Page 5-39

5.83 Comment: Reptiles - What about western pond turtle publications? See Bury, R.B. 1972. Habits and home range of the Pacific pond turtle, *Clemmys marmorata*, in a stream community. Ph. D. Thesis, University of California, Berkeley. Holland, D. 1994. The western pond turtle: habitat and history. W.S. Dept. of Energy, Bonneville Power Administration, Contract No. DE-BI79-92BP62137, Portland, OR. Holland, D.C. 1991. A synopsis of the ecology and status of the western pond turtle (*Clemmys marmorata*) in 1991. Report to the National Ecology Research Center, U.S. Fish and Wildlife Service,

San Simeon, California. Holland, D.C. and R.B. Bury. 1998. *Clemmys marmorata* (Baird and Girard, 1852), western pond turtle. In: P.C. Pritchard and A.G. Rhodin (eds). Conservation Biology of Freshwater Turtles. Chelonian Res. Monographs Volume II. Rathbun, G.B., N.R. Seipel and D.C. Holland. 1992. Nesting behavior and movement of western pond turtles, *Clemmys marmorata*. SW Naturalist 37:319-324.

Response: We have added information on the western pond turtle to the text.

Page 5-40

5.84 Comment: Paragraph 2 – Good.

Response: Thank you.

5.85 Comment: Paragraph 4 - Yes! It is difficult! The simple syntheses is that with 000-M you are in good shape but no one wants to hear that. I still think we need to get away from the donut model in which an equal width buffer is required around entire wetland. In certain directions, locations etc. 1,000 m is what it may take in that area, permittee locations c/or M 5 fine!

Response: Comment noted.

Page 5-42

5.86 Comment: Table 5-5 - Do these studies select distances based on several width analysis or did they pick one distance and find strong correlations?

Response: The studies in table 5-5 represent a mix of different types of studies. Some are studies that evaluated the life needs, including the home range, of a particular species (e.g. Allen 1982). Others looked at several distances from streams or wetlands and assessed what species were found (e.g. Semlitsch 1998). Still others are literature syntheses that looked at a number of studies and synthesized the information into recommended widths (e.g. Desbonnet et al. 1994).

Page 5-43

5.87 Comment: Section 5.5.4.2 - Although I do not know much about the effect of noise or light pollution on wildlife, I would assume that topography would have a fair impact on the effects of these factors. Therefore, I'd assume topography would influence a buffer size in terms of screening capacity.

Response: It makes sense that topography would influence the effect of noise or light on wildlife. Development on much higher ground (bluff) "adjacent" to wetlands should not have the same noise and light effects as a similar development adjacent and at the same elevation as a wetland. However, we found no literature that addressed the issue of topography in ameliorating the effects of noise or light.

5.88 Comment: Paragraph 3 - Text: "The effect of noise on wildlife is a topic of growing concern. Little research exists on the effective buffer widths required to filter sounds for wildlife. See Section 4.12.3 in Chapter 4 for a discussion of current literature on the effects of noise on wildlife."
In the PHS GBHE Pub the following buffers relate to flushing.

- Ontario, Canada Vos et all. 1985 300 meters
- Florida, Rogers & Smith, 1995 100 meters to reduce dist. from motor boats or people on foot.

Response: Rodgers and Smith is cited in the document. We were unable to locate Vos et al.

Page 5-44

5.89 Comment: Section 5.5.4.3 Ok so why not consider corridors?

Response: Corridors are mentioned here in the context of buffers. More on fragmentation and corridors can be found in Sections 2.3, 3.4, and 4.11 of Volume 1.

5.90 Comment: Paragraph 1, Last Line - but with landscape approval this would be possible

Response: Yes. Text has been added to include this concept.

Page 5-45

5.91 Comment: Bullet 1 - Unless it's very wide? Species protection vs. population protection!

Response: Comment noted. No change needed.

5.92 Comment: Bullet 4 - **"**jargon" "through visual and auditory intrusions" , say what you mean

Response: Text has been changed.

5.93 Comment: Last line - delete "various functions to protect" and rewrite

Response: Text has been re-written.

Page 5-46

5.94 Comment: Line 1 - Consequently, the buffer you select today will not be the buffer of the future! – 5 to 10 years etc.

Response: Comment noted. No change needed.

5.95 Comment: Paragraph 1 - delete "the filtering capability of the vegetation"

Response: We do not see the value in deleting this phrase. No change has been made.

5.96 Comment: Paragraph 3 - Consequently this information will be used in Volume 2 to better protect wetlands

Response: Comment noted. We are not altering the text in Volume 1 to point to every place where information will be used in Volume 2.

5.97 Comment: Section 5.5.5.2 - The other important factor to consider is with increased sun exposure at the edge of the buffer comes the risk of sunscald which may lead to the death of the tree, depending on species. As clearly stated in this section, buffers attenuate sound and provide visual barriers for some species. Another important function of buffers is their ability to influence the microclimate around wetlands (ie. solar input (shade), windbreak, temperature, input of organic material (leaves and wood), etc.)

Response: The ability of buffers to influence the microclimate of a wetland is covered in Section 5.5.3.4. However, we do not address sunscald because we found no literature on the subject.

Page 5-47

5.98 Comment: Paragraph 1 - Todd (2000) and Dillaha in 1993 not in references cited. determining buffer widths.

Response: Todd (2000) is in the references cited. We were not able to locate Dillaha (1993) so we reported what Todd said about Dillaha.

5.99 Comment: Section 5.5.5.4 Bullet 4 - Ongoing continuous? Over the years.

Response: We found no literature that reported an expected length of time for buffer function to be reduced. For sediment, it would depend on several characteristics, including loading rate, buffer slope and vegetation, etc.

5.100 Comment: Section 5.5.5.4 Bullet 4 - Delete last sentence.

Response: We do not agree with the suggestion to delete this sentence. The literature reports that reduction in buffer effectiveness over time is an important consideration.

5.101 Comment: Section 5.5.6 Bullet 1 and Bullet 2– add "function"

Response: We have added "function" to bullet number one. Bullet number two has been revised to emphasize the characteristics of the buffer.

Page 5-48

5.102 Comment: Paragraph 1 - Is this BAS or policy document? I think you need to keep them distinct in two documents!

Response: This is a BAS document. The literature to which this paragraph refers makes mention of the political realities that often override the science-based criteria that are recommended for setting buffer widths. This paragraph is not making any policy recommendations.

5.103 Comment: Paragraph 2 – Table 5-7 presents ranges for what? For protecting all functions?

Response: The "Comments" column in the table explains the functions to which the authors are referring. Additional text has been added to clarify this.

Page 5-49

5.104 Comment: Table 5-8 - Use more than one and more recent citations in Table 5-8. Desbonnet et al. 1994 is the single citation for Table 5-8 on p. 5-49, yet it is referred to as a summary table. We recommend that the summary table for pollutant removal effectiveness and wildlife habitat value be expanded to include other references. Also, a range of buffer widths should be provided rather than relying on a single research paper from 1994.

Response: Considerable information on buffer widths and ranges for particular functions are included in other sections of Chapter 5. A general summary table of recommended widths and ranges from buffer synthesis documents are included in Table 5-7. Table 5-8 is used verbatim from Desbonnet et al. (1994) because it is the single best summary table for buffer widths needed to protect wetland functions that any of the buffer synthesis documents have produced. This is explained better in the text now.

5.105 Comment: Paragraph 1 - Last two sentences read "However, the language in the Castelle et al report of 1994 states that the buffers should be a *minimum* of 49 to 98 feet. . .The report is most often quoted to imply that the full range of buffers should be between 49 and 98 feet." We expect one reason this is most often reported is to show consistency with existing setback requirements.

Response: Comment noted. No change suggested.

5.106 Comment: Paragraph 1 - Bingo! If you don't protect the processes nothing else matters?

Response: Comment noted. No change needed.

5.107 Comment: Paragraph 2 - Good approval supported by BAS!

Response: Comment noted.

Page 5-50

5.108 Comment: Paragraph 2 - Yes, this is BAS!

Response: Comment noted.

5.109 Comment: Paragraph 3 - I wish this were true in K.C.

Response: Comment noted.

5.110 Comment: Bullet 3 - But zone 1 has trees and shrubs so it would take a long time to establish

Response: Comment noted.

Page 5-51

5.111 Comment: Paragraph 2 - Interesting I just read Rodgers and Smith 97, 328ft (100 m), +131ft 40m = 459.1 _+meters this differs from what you have. Just for wetlands.

Response: Your interpretation of their recommendation is incorrect. Under Management Implications, they state, "Based on the mean plus 1.6495 standard deviations of the observed flushing distances plus 40m, a zone of about 100 m should be adequate to buffer foraging and loafing sites for most of the waterbird populations we studied…"

5.112 Comment: Section 5.5.6.1 Bullet 1 – four factors OK

Response: Comment noted.

5.113 Comment: Section 5.5.6.1 Bullet 4 – value suggested are only fair to good on Desbonnet's chart!

Response: Comment noted.

Section 5.6 Chapter Summary and Conclusions

Page 5-52

5.114 Comment: Paragraph 1 - Good

Response: Comment noted. No change is needed.

5.115 Comment: Paragraph 4- add to last line "although some studies suggest they have a "carrying capacity"

Response: Text has been revised to incorporate the suggestion.

5.116 Comment: Paragraph 5 - Yes, how will Volume2I address this issue?

Response: Volume 2 recommends taking a landscape-scale approach that addresses habitat connectivity as well as utilizing a regulatory, permitting approach that provides adequate buffers for protecting most wetland functions.

Page 5-53

5.118 Comment: Paragraph 1 - I just don't agree with these findings. The model I recommend is that if you built a wall around different functioning wetlands at these distances will you still have the initial viable population of invertebrates, amphibians, reptiles, birds and mammals – five years, ten years etc. later? I doubt it!

Response: We concur that utilizing buffers (even relatively large ones) in a site-by-site permitting approach will not protect and maintain viable wildlife populations for many species, particularly in urbanizing areas. We strongly recommend (in Volume 2) the use of a landscape-scale approach to protect wetland (and other aquatic resources). The text in this paragraph has been revised to include the concern that many authors expressed about the long-term viability of wildlife populations.

Chapter 6 – The Science and Effectiveness of Wetland Mitigation

General Comments

6.1 Comment: In general, Section 6 captured the main points of the mitigation process. It relies heavily on the two most recent comprehensive studies on mitigation success (National Research Council 2001 and W'DOE 2002). The latter is the most relevant to the Northwest. Its information was well applied in the appropriate amount, although I still have concerns about some of its conclusions.

My overriding comment relates to the apparent strict adherence to the definition of BAS. There is a lot of information, such as reports, mitigation plans, and monitoring reports, which have been reviewed and approved by various agencies. In particular, some of the WSDOT monitoring reports could be very useful, but may not specifically qualify as BAS.

Also, I assume that you talked to the Corps. Don't they have an internal evaluation of NWP mitigation projects that were permitted in last several years? I suspect that all or most of the Individual Permits were included in W'DOE 2002 study for 401 water quality certification purposes. This information could fill in some of the areas where there is little Washington information.

Response: Local governments are required to include Best Available Science (BAS) when revising their Critical Areas Ordinances. Therefore, we feel that it is important to abide by the definition and criteria for BAS when synthesizing the scientific literature on freshwater wetlands and specifically on compensatory mitigation. Information that has been published in peer reviewed journals or reports that have undergone some peer review provide the best assurance that the requirements of the WAC on "best available science" have been met. In addition, we did not have the time or resources to collect the reports and plans that you mention in addition to doing an extensive search of the published literature. Collecting, analyzing and synthesizing the numerous individual mitigation plans and reports by various agencies and organizations would be very time consuming.

However, some of the information you mention may meet the requirements of BAS and local governments are encouraged to use these sources as well as local studies to augment literature that is not peer reviewed and published.

Representatives from the Corps participated as members of the advisory committee for both Phase 1 (Johnson et al. 2000) and Phase 2 of the Wetland Mitigation Evaluation Study (Johnson et al. 2002). They did not mention nor provide an internal evaluation of NWP mitigation projects. No revision required.

6.2 Comment: A topic that we believe deserves more attention is Regulatory Follow-up. Section 6.4.8 of the report provides compelling evidence that: (1) the amount of follow-

up by permitting agencies has a direct impact on the success of wetland mitigation projects and; (2) that agency follow-up is woefully inadequate. Though it may seem difficult for DOE to impact the amount of regulatory follow-up that local jurisdictions provide, suggested mitigation ratios should not be increased to compensate for mitigation failures that may occur because of the lack agency follow-up. We suggest an educational program by DOE to inform local jurisdictions of the importance of follow-up on wetland mitigation projects.

Response: We concur with this statement and will be recommending greater agency follow-up along with many other improvements in mitigation site selection, design, monitoring and maintenance. However, studies would need to be conducted to determine to what degree follow-up affects the level of success of a project before a reduction in replacement ratios could be justified. No revision required.

6.3 Comment: Use full citations in tables and footnotes. The use of numbers instead of full citations in the tables of Chapter 6 is confusing to the reader. These numbers must be crosschecked with the reference numbers in Table 6-1 and are easily confused with other numerical information in the following tables. Using the full citations, including author and date, will eliminate the risk that the reader will become confused between actual scientific data (e.g., percentages, numbers of sites, numbers of projects evaluated, etc.) and a citation reference number.

Response: We agree. Reference numbers were replaced with citations on all tables except Table 6-11, 6-12, and 6-13. These are tables for recommendations from the literature and in many cases more than one study suggested that same recommendation. The use of reference numbers allows a recommendation to easily be attributed to numerous studies. Table 6-1 in the DRAFT was moved to the beginning of Section 6.10. It is, therefore, closer to the tables that use the reference numbers.

6.4 Comment: I understand, support and applaud the emphasis on Goals, Objectives and Performance Standards. This is definitely the way to approach this subject. I totally agree with the statements on maintenance, monitoring, and increased compliance. That being said, I will rattle off on some of my general concerns.

I am very much concerned about considering mitigation a failure when it does not meet performance standards that were proposed in the mitigation plan. We simply do not have enough information regarding new wetlands to determine what standards are acceptable. Wetlands, given that they meet hydrologic standards for wetlands, will develop as they can. Using reference wetlands as a standard and then using them as a basis for success (i.e. achieve what scientists wish to happen) is naïve; I simply do not have an answer to how else one establishes real ecological standards for these new systems. I believe that the quotation at the bottom of page 6-67 sums up my concerns. Putting this statement up front at least would caveat that we recognize the apples/oranges result of comparing systems of vastly different ages, landforms, and development scenarios etc. If we do not know how these new wetlands develop either vegetatively or through the development of organic matter in soils, as examples, then how do we consider mitigation sites failures?

The flip side of the coin is, outside of determining adequate water and limited invasive species exist on the wetland, I do not have an alternative.

Response: We believe your concerns regarding the somewhat arbitrary evaluations of project success are currently addressed (though perhaps not to the degree you would like) in section 6.3, the fourth and fifth paragraphs. In general, we tried to avoid using the term "fail" or "failure" except to maintain the word choice of a particular study's author. Though we agree that it is difficult or impossible to impose a specific ecosystem on a parcel of land, goals, objectives, and performance standards are the regulatory tool used to get applicants to do more than dig a hole in the ground or plant 100 trees in a pasture and walk away. Just because a project is not meeting all its performance standards does not mean that it is not performing wetland functions. At that point it is up to the regulatory staff to determine if the project has sufficiently compensated for what was lost.

At the end of Section 6.3 we have added a cross reference to Section 6.10.4, which discusses the issue of performance standards, including the shortcomings of existing performance standards (section 6.10.4.1), and the need for longer monitoring periods (section 6.10.4.3).

6.5 Comment: You summarize that the majority of compensatory mitigation projects were neither fully successful nor complete failures. This may be subjectively true but I think we still do not have enough mitigation projects that have been consistently and rigorously monitored for ecologically meaningful time periods to answer this question comprehensively. I acknowledge your write-up seems to document this fact as well and I am reinforcing the importance of this finding. Just mitigating a wetland, i.e., obtaining water and plants, for the most part is not a good criteria for success given the unique and complex functions that wetlands provide. I am especially skeptical of our ability to mitigate and replace lost groundwater interchange, soil exchange and wildlife habitat functions. Moreover, at this time of our mitigation knowledge, I believe we may be providing generic and homogeneous, low-diversity wetlands.

For mitigation projects, I do not believe we have carried out any strong scientific monitoring programs to tell us the cause of wetland failures other than in broad general terms. I agree with the science advocating setting up each mitigation project as an experiment. It is only through experimentation that the specific reasons for success and failure can be empirically established, and then be applied to future projects. I think our current monitoring information is pretty "marginal" in providing substantive information for the collective benefit of better wetland mitigation.

Response: We agree that compensatory mitigation projects have not been monitored for a sufficient enough time to understand or fully characterize how they will develop and sustain themselves in the long term. However, regulators and wetland scientists have not yet come up with performance standards or success criteria that target or measure characteristics or conditions indicative of long-term sustainability and performance of unique and complex functions. The best that has been done is function assessment methods, which measure indicators of functions. Realistically, regulators cannot hold

applicants' accountable to monitor and maintain sites for the centuries it may take to develop some of the unique and complex functions that you mention. In the interim, regulators and the authors of many of the cited studies use the presence of water and plants as an indicator that at a minimum wetland conditions have been established, allowing succession and natural processes to develop the site over time.

We agree that only through experimentation and scientific evaluation will we continue to learn about wetland functions and how they develop over time, particularly on different soils, in different ecoregions, HGM and Cowardin classes. However, this type of experimentation is better suited to academic studies and non-regulatory restoration/creation/enhancement. In the regulatory context, on the rare occasions when experimental monitoring is proposed it is typically for an experimental compensatory mitigation approach or site design. Such an approach or design generally has a higher risk of failure because it has not been tried before. The risk is acknowledged and accepted by the regulatory agencies because detailed monitoring will be performed to provide information on site development that is generally not available for mitigation sites. However, the purpose of compensatory mitigation is not to educate, that is the role of academic science. The role of compensatory mitigation is to compensate for lost wetland acreage and function. Monitoring of compensatory mitigation wetlands is, of necessity, focused on determining whether a site is in regulatory compliance. Compliance measures should and typically do include performance standards, which are intended to indicate and measure whether a site has provided the required acreage and functions of wetland compensation. No revision required.

6.6 Comment: Whether there was any information in the literature review about leaving a creation/restoration/enhancement site alone for a few years (one to two) to see what pops up in terms of desirable woody vegetation. I have had a few creation and restoration sites that meet the performance standards rather quickly because volunteerism is so high. I met with a biologist with Pierce County a while back and we were discussing whether to leave a site alone for a few years and then come up with a planting plan. I would like to know if there is some information available that has determined if this type of mitigation is more successful than planting immediately. Is there any literature about restoration of sites that a landowner has filled/graded/logged and was in violation and whether that type of restoration is more successful.

Response: We have added a reference (Kellog and Bridgham 2002.) to the discussion on Seed or Plant Source in Section 6.8.2.3, which discusses that low density planting of a restoration site offers no clear advantage over hydrologic restoration. However, a more in depth discussion of this topic is addressed in the *Guidance on Wetland Mitigation in Washington State* (draft 2004 available at: http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm *)*.

6.7 Comment: Oh and I had a thought about why restoration is not done as much as enhancement or creation-it doesn't seem that there are enough potential restoration sites available to conduct restoration because of development and the fact that many landowners/developers want to use formerly filled/impacted wetlands to conduct part of

the project. I am not sure if this is a fact presented in literature but it may be worth a study or additional review to find out why restoration is not done as often-it seems that in my experience restoration works best.

Response: We agree that performing a study to determine why restoration is not done as often would be extremely valuable. However, the purpose of this document is to review and synthesize existing scientific literature. At this point we have not found any study that has specifically explored this question. No revision required.

6.8 Comment: Have some information may eventually publish about mitigation success and reed canary grass/success for woody plants.

Response: We encourage you to publish this information and would be very interested in reviewing it when available. Comment noted.

6.9 Comment: The part about mitigation was particularly interesting to me because I am in the middle of monitoring, which is why I haven't been able to fully review the document, and I am finding a few things that I may eventually want to publish about creation/restoration/enhancement projects and what has worked for us in terms of plant material, how things are planted, what types of sites are we planting, and what works in terms of maintenance. I also have some new opinions about reed canary grass and the fact that some woody installed plants can do extremely well despite cover by RCG.

Response: We encourage you to publish this information and would be very interested in reviewing it when available. Comment noted.

Page 6-2

Section 6.1 Reader's Guide to this Chapter

6.10 Comment: Section 6.8 - Change heading to read as: Section 6.8, Functions and Characteristics Provided by Created or Restored Wetlands.

Response: We do not agree with this suggestion since some of the articles discussed in this section refer to wetlands that were enhanced.

6.11 Comment: Section 6.1.2 – This is sort of weird!

Response: The intent of the comment is not clear, therefore, no change has been made.

Page 6-3

6.12 Comment: Paragraph 3 – Change maximize to Minimize?

Response: The text was changed to clarify the meaning.

Page 6-4

6.13 Comment: Table 6-1 - Any WSDOT monitoring reports?

Response: No WSDOT monitoring reports were reviewed. Our major emphasis was to find information that has been published in peer reviewed journals or reports that have undergone some peer review. These provide the best assurance that the information meets the requirements of the WAC on "best available science." There is some information available in project reports, research summaries, and other such documents but we did not have the resources to subject these to a peer review process or to check the expertise of the authors. Local governments and others are encouraged to obtain, review and incorporate information from local studies that meet the requirements of BAS (WAC 365-195).

Section 6.2 Introduction and Background to Wetland Mitigation

6.14 Comment: Paragraph 1 - Can you be more direct! By defining what you mean by process! Specifically.

Response: The text has been amended to clarify the meaning.

Page 6-5

6.15 Comment: Line 1 – Delete "that are performed sequentially" add "sequence," also add WAC 197.11.768

Response: The requested changes have been made.

6.16 Comment: Section 6.2.1, Mitigation Sequencing – Application of mitigation sequencing occurs without regard to the net change in ecological functions (including the mitigation) a project might provide. Sequencing is contrary to scientific understandings of wetland ecology when wetlands are considered in a landscape perspective, because the sequencing decisions are made independent of the net ecological gains a project may provide.

Where project impacts occur to isolated (hydrologically and ecologically) or degraded wetlands in developed landscapes, mitigation may be able to establish or restore high quality wetland functions and provide a net ecological gain. This conclusion is acknowledged by Section 6.10.5, which identifies several decision factors (not just sequencing) should be considered when evaluating wetland impact projects.

Response: We do not agree. The literature does not support that wetland mitigation projects establish high quality wetland functions and provide a net ecological gain. Section 6.10.5 discusses recommendations for how to improve the future of wetland

mitigation. We agree that the future health of our wetland resources depends on using a landscape perspective and looking beyond the project specific wetland losses. However, the landscape perspective is currently not part of the paradigm for reviewing wetland impacts and developing mitigation proposals. Volume 2 provides guidance for improving the protections afforded to our wetland resources.

6.17 Comment: Item 5 - Projects that will result in the temporary alteration of a wetland, such as during installation or maintenance of an underground pipeline, typically utilize rectification as a mitigation measure. In the case of an underground pipeline that crosses through a wetland, vegetation, soil, and water movement would probably be disturbed and altered. Rectification would entail replacing the soil, restoring the water movement, and replanting or seeding the vegetation. The wetland acreage and functions are temporarily lost during construction.

Response: Comment noted. The text currently reflects this point of view.

6.18 Comment: Paragraph 5 - Monitoring wetland impacts has been a component of several development projects in King County, and Ecology should independently review these results, summarize them, and provide synthesis analysis in this document. Monitoring wetland impacts has been a component of the Snoqualmie Ridge master planned community, located in the City of Snoqualmie, King County. Development at this site included construction of a 4-5-lane parkway, residential neighborhoods, a neighborhood retail center, trails, a PGA tournament golf course, and various other infrastructures.

A team of qualified and experienced ecologists and engineers implemented pre- and post-construction monitoring of wetland, hydrologic, wildlife, meteorological, channel geomorphology, and water quality conditions. Post construction monitoring evaluated development effects on wetland hydrology, wetland vegetation, stream water quality, hydrologic changes, channel geomorphology, and fish populations. Potential development effects were evaluated in buffered wetlands adjacent to new development and control wetlands in undeveloped sub-basins.

The monitoring results indicate that the buffers imposed on the project (100 ft for Class 1, 50 ft for Class 2, and 25 foot for Class 3 wetlands), in combination with stormwater management facilities for water quality and water quantity were protective of wetland hydrology, wetland vegetation, fish habitat, channel morphology, and water quality. There is no indication the additional buffers would add additional aquatic functions. The data collected indicate the buffer sizes were, in this case protected existing functions, it is unknown, but possible that smaller buffers would have also protected the existing functions.

Other pre- and post construction wetland monitoring projects are ongoing in King County, including Highlands and Talus projects in Issaquah, Redmond Ridge, in Redmond, and SeaTac Airport projects in SeaTac.

Response: The monitoring for the projects mentioned in this comment had numerous problems that make the data unreliable. The reports were not adequately peer reviewed and cannot be considered BAS. The claim that the buffers were adequate to protect existing functions is not supported by the data in the reports.

6.19 Comment: Paragraph 2 - This may be policy verbiage but not scientific verbiage – you may want to distinguish the two here. I don't consider by avoidance a mitigation. Has every project that does not directly distance a wetland is carrying out mitigation.

Response: Avoidance is the fist step of the mitigation sequence as established in WAC 197.11.768. Paragraph 2 is an attempt to explain what this means by providing an example. We have made changes to clarify the text.

6.20 Comment: Paragraph 3 – "Reduces" means you still have a direct loss

Response: We have made changes to clarify the text.

6.21 Comment: Paragraph 5, First Sentence - Awkward; Do you mean monitoring in a mitigation measure that may be beneficial…

Response: We have made changes to clarify the text as suggested.

Page 6-6

6.22 Comment: Section 6.2.2 - The use of compensatory mitigation for wetland loss emerged in the 1980s (Roberts 1993, National Research Council 2001). The U.S. Army Corps of Engineers considered the process of mitigation as part of the National Environmental Policy Act of 1969. However, it wasn't until 1980 when the Environmental Protection Agency (EPA) issued new guidelines for Section 404(b)(1) of the Clean Water Act that mitigating for wetland losses by creating or restoring another wetland as compensation became widely acceptable (National Research Council 2001). Compensatory mitigation was seen as a way to speed up an arduous process of documenting avoidance and minimization efforts, while satisfying concerns about the loss of ecosystems and functions (Roberts 1993). Creating or restoring wetland area to compensate for permitted wetland losses was viewed and publicized as a way to allow development while preventing a net loss of wetland areas.

Response: Comment noted.

6.23 Comment: Paragraph 1, Bullet 4 - I have a scientific BAS problem with this one.

Response: Preservation is an accepted form of compensatory mitigation both on the state and federal level. Comment noted.

Page 6-7

Section 6.3 Success of Compensatory Mitigation Wetlands

6.24 Comment: Paragraph 5 - I agree! Good, but the requirement is one of BAS! The tail is wagging the dog!! We don't give the science for regulatory frameworks!

Response: This discussion and citation was included as a way to explain that evaluating "success" is somewhat arbitrary. Projects and ecosystems evolve over time, and an assessment at date X may not represent how the site functions at date Y. It is intended to provide some perspective to the data provided in the following table. No revision required.

6.25 Comment: Section 6.3.1 - Include results from Washington State Department of Transportation (WSDOT) Study on wetland mitigation success. WSDOT conducted studies within the state highway rights-of-ways to determine the success of wetland mitigation projects. These references are Lindstrum and Maurer (1999) and Celedonia (2002). Results from these studies should be included in the text of Section 6.3.1 - Results of Literature Studies.

Response: We do not agree that it is appropriate to discuss these reports in Section 6.3.1, because neither study looked at the "success" of mitigation wetlands. These documents focused on identifying scientifically-based benchmarks for establishing vegetation success standards on wetland compensatory mitigation projects (www.wsdot.wa.gov/eesc/design/roadside/default.htm#sos). The Lindstrum and Maurer (1999) report focuses on how a study to evaluate benchmarks for vegetation should be implemented. The Celedonia (2000) study is discussed and cited in Section 6.8.2.3 (Factors affecting plants) and Section 6.10.4.3. (Longer time periods needed to evaluate projects). No revision required.

Page 6-8

6.26 Comment: Table 6-2 - Acknowledge time since mitigation installation in Table 6-2. The length of time that a mitigation project has been "in the ground" is important for determining mitigation success. Table 6-2 should recognize the longevity of these projects since installation. The results might indicate that the most successful projects were installed "in the ground" the longest. Further, the table and text should distinguish between mitigation success east of the Cascade Mountains versus west of the mountains.

Response: The amount of time the projects were in the ground was not always specified. When it was, it was often a range of years. Johnson et al. (2002) compared the age of sites with success, however it was not included in this document because the results were not statistically significant. If the studies reviewed had presented a trend that younger projects were less successful than older projects, or vice versa, this would have been noted in the text of this document. Therefore, no change has been made.

The goal of this document is to provide a synthesis of a large number of studies and reports. All studies are cited in the text and a full reference is provided in the Bibliography. Readers are encouraged to refer to the source document for specific information that could not be included in this literature synthesis.

The general location of the projects is provided in the column "Location of Study" which allows the reader to place the project east or west of the Cascades.

6.27 Comment: Bullet 2 - I would reference these as well.

Response: References were be added to the text as suggested.

6.28 Comment: Table 6-2 - Good.

Response: Comment noted.

Page 6-9

6.29 Comment: Section 6.3.2, Bullet 1 - Plants & Animals/only – E abiotic and biotic; How do these differ in introduction??? Criteria

Response: We have changed the text of the introduction for clarity and consistency. The general criteria used for evaluation varied by study. They are summarized in Table 6.2 under the column "Evaluation criteria." The types of criteria used for evaluation are also summarized in Bullet 3 on p. 6-9.

6.30 Comment: Section 6.3.2, Bullet 3 - "Parameters" = Evolution criteria?

Response: Yes. In Bullet 3 the term "parameters" refers to the general evaluation criteria. We have changed the text as suggested for consistency.

Section 6.4 Compliance with Permit Requirements

6.31 Comment: Section 6.4 - This section would benefit from some discussion of unrealistic and unachievable success standards, such as 80 aerial cover of woody species in three years, or no cover provided by invasive plant species.

Response: Section 6.4 is intended to synthesize the scientific literature describing the level of compliance found for wetland mitigation projects. Performance standards were just one component. The studies generally did not identify the specific performance standards that were evaluated.

We added a discussion of unrealistic performance standards to Section 6.10.4.1, Shortcomings of Existing Performance Standards. In addition, the *Guidance on Wetland*

Mitigation in Washington State (draft 2004 available at: http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm) has a discussion on developing (and reviewing) performance standards in mitigation plans.

Page 6-11

6.32 Comment: Table 6-3 - This is "incredible" creating vernal pools, seasonal and semi-permanent wetlands is very difficult!! I'd like to know the mechanics of it.

Response: Comment noted. No change necessary. Please refer to the study for which the citation is provided in the text, though the study did not discuss the mechanics of it.

Page 6-13

6.33 Comment: Paragraph 1, First Sentence - Chopping writing; Don' make sense.

Response: We have revised the text to increase clarity.

6.34 Comment: Paragraph 2 - Add "four" studies

Response: We have revised the text as suggested.

6.35 Comment: Paragraph 3 - We suggest the following addition to this sentence. "The relatively high percentage of projects that were installed implies that the low levels of overall compliance result from inadequate design, installation, maintenance, follow-up, unrealistic permit requirements, or some combination."

Response: We do not agree with adding "unrealistic permit requirements" to paragraph 3. We did not review any scientific literature that mentioned unrealistic permit requirements as a reason for poor success of projects. No revision made.

6.36 Comment: Table 6-4 - I would like to see Table 6-3 side by side with Table 6-4.

Response: In order to maintain the readability and formatting of the document, it is not possible to place Tables 6.3 and 6.4 side by side. No revision made.

Page 6-14

6.37 Comment: Section 6.4.3 - Again, are these findings reflected in Volume 2? My feeling is you may be ignoring these facts.

Response: We attempt to address these findings in Volume II as well as in the *Guidance on Wetland Mitigation in Washington State* (draft 2004 available at: http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm). No revision required.

Page 6-15

6.38 Comment: Section 6.4.4 - This section would benefit from some discussion of impact acreage vs. ratio acreage required. For example, if one acre of wetland is filled, and one acre of wetland is created, there is no net loss of wetland acreage. At the same time, it is possible that there is a loss of functions, and likely there is a temporal loss of function.

Response: Section 6.4.4 synthesizes the studies that examined whether mitigation projects met their required mitigation acreage. The topics you mention are addressed in other sections of Chapter 6. For example, Section 6.5.3 and 6.5.4 discuss Enhancement and Preservation, respectively, and the potential for net loss of wetland area when they are used as compensation for wetland losses. Section 6.6 discusses Replacement ratios – what they are and how they are used to address the temporal loss of function. Section 6.7 discusses Replacing wetland acreage, which includes a synthesis of studies comparing the acreage of required mitigation to the acreage of permitted wetland losses. No revision required.

Page 6-17

6.39 Comment: Section 6.4.5 - Without mention of the problems of unrealistic, unachievable performance standards, the language leaves readers with the impression that poor planning implementation, and site maintenance is the only observed reason for failure to achieve performance standards. In many instances, regulatory and design staff have developed/negotiated performance standards that are unattainable (e.g., weed cover < 10%).

Response: We did not review any scientific literature that mentioned unrealistic permit requirements as a reason for poor success of projects. Section 6.4.5 focuses on the compliance aspect of goals, objectives, and performance standards – whether the standards were achieved. We added a discussion to Section 6.10.4.1 Shortcomings of Existing Performance Standards that mentions unrealistic performance standards.

6.40 Comment: Section 6.4.5 - Dennis Paulson (keynote talk at PNW SWS conference Tacoma, and pers. comm.) found surprisingly high odonate (dragonflies, damselflies) diversity at WSDOT mitigation sites (and stormwater ponds). Please consider mentioning that newly created wetlands (with standing water) have a reasonably high odonate diversity.

Response: We did not find any literature on this topic and cannot include the "findings" reported at a conference without a reference to a supporting document. No change made.

6.41 Comment: Section 6.4.5- Cole and Shafer evaluated mitigation criteria in Pennsylvania. How is that relevant to wetland mitigation criteria in Washington?

Response: We believe that studies of wetland mitigation from places outside of Washington, such as Pennsylvania, are relevant. The relevance of a study from

Pennsylvania, Michigan, Florida, etc. relates to examining how compensatory mitigation is doing in general as a management tool. Though many of the studies reviewed for the synthesis on mitigation were from other parts of the country, they came up with similar results regarding compliance, project installation, performance standard attainment, achieving wetland acreage, Cowardin classes provided, etc. This provides important information about compensatory mitigation, not just in Washington State, but in general. If the studies from other locations consistently came up with dramatically different results, there relevancy could be questioned. These results provide a comparison. We are not trying to compare wetland functions provided by Pennsylvania wetlands with Washington wetlands, rather this chapter compares and contrasts what is being found regarding the effectiveness of trying to compensate for wetland losses. Wetland mitigation is a relatively new science/regulatory tool. Many of the techniques and regulatory approaches are similar. No revision required.

6.42 Comment: Paragraph 2 - Are they empirical standards and/or goals or just verbiage? Also, what is the number of projects (need n =…).

Response: Most studies did not specifically identify the performance standards/goals that were evaluated. The number of projects evaluated (n) has been added to Table 6.7.

Page 6-18

6.43 Comment: Section 6.4.6 - This section would benefit from some discussion on monitoring techniques. Measuring & Monitoring Plant Populations (Elzinga et al.) and a comparison of two vegetative monitoring strategies implemented on 4 WSDOT mitigation sites (ICOET Conference proceedings, Bergdolt and Thomas, 2001) both contain good discussions on this topic.

Response: Section 6.4.6 focuses on compliance and whether compensatory wetlands were in compliance with their monitoring requirements. Therefore, no change has been made to the text. The topic of monitoring methods will be addressed in the *Guidance on Wetland Mitigation in Washington State* (draft 2004 available at: http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm).

6.44 Comment: Section 6.4.6 - Empirical goals etc. or subjective text goals? I'm more interested in what was monitored, how often and how the data was analyzed. Was it even meaningful?

Response: Most studies did not specifically identify the goals that were evaluated. Therefore, no change has been made in the text.

Page 6-19

6.45 Comment: Sentence 3 - Great news! We're real pros aren't we???

Response: Comment noted.

Page 6-20

6.46 Comment: Section 6.4.8, Last Paragraph - Unfortunately, in my experience, monitoring reports are generally self-serving documents. Many may indicate that (based on transects or some other "scientific method") the mitigation is functioning just fine when in fact problems are quite evident overall. Even with regulatory follow up that determines non-compliance, the consultant/consultant will claim all is ok. Regulatory follow up is required if for no other reason than to keep them honest.

Response: Comment noted.

Page 6-21

6.47 Comment: Bullet 2 – Define "specifics"

Response: The text has been revised to clarify the meaning.

6.48 Comment: Bullet 6 - Length of time is important as well!

Response: We agree. However, duration of monitoring is currently discussed in Section 6.10.4.3 – Longer Period Needed to Evaluate Projects. Therefore, no change has been made to the text.

Page 6-22

6.49 Comment: Box - The Mockler reference is of no value without some explanation of how she determined if projects replaced lost function. We suggest deleting this sentence.

Response: The text within the box provides no explanation of how any of the other studies made their determinations of success or effectiveness. The purpose of the box is to review the results of studies conducted in Washington. The Mockler study is relevant because it is one of only 5 studies of mitigation projects conducted in Washington State in the recent past. We revised the text by deleting the caveat.

6.50 Comment: The display at the top of the page should indicate that the percentages mentioned are only based on random samples and may not depict what occurs in other mitigation projects not studied. I realize that this information is laid out well in Sections 6.3 and 6.4 but this type of display is what will be quoted not the underlying backup information in those sections.

Response: We changed the text by adding a footnote that four of the studies sampled a sub-set of the applicable mitigation projects. However, Kentula et al. (1992) appeared to have inventoried the entire population of 404 permits in Washington requiring compensation.

Section 6.5 Types of Compensatory Mitigation

Page 6-23

6.51 Comment: Section 6.5.1, Paragraph 2 - It seems that planting trees in a degraded wet pasture would not be restoration but enhancement. If originally hydrology is restored and original vegetation communities replaced, that would be restoration. If you are merely planting trees on an exiting wetland, you would enhance and not restore wetlands.

Response: We agree. The point of the discussion under 6.5.1 is that some of the definitions of restoration are vague enough that an applicant could claim it was restoration if cedars were planted in a wet pasture that historically used to be a cedar forest, because it would be approximating a historic condition. As the text attempts to make clear, studies (including the mitigation studies conducted in Washington) have identified projects that proposed restoration, but the activities conducted would more appropriately be considered enhancement. This is a problem, but before we can fix it we have to first acknowledge the problem. The purpose of the first few paragraphs is to identify that there is a problem with how various entities and applicants define and apply the term restoration.

6.52 Comment: Last Bullet on the Page - The last bullet on this page is reflective of the current regulatory definition of wetland restoration (rehabilitation) required under Section 404, as defined in RGL 02-2. This definition is also consistent with the definition of restoration provided by the Society of Wetland Scientist (2000), the Society for Ecological Restoration (2002), and the leading text on wetland ecology (Mitsch and Gosslink 2000). It is also the definition adopted by more than 15 other federal agencies, including Fish and Wildlife Service, Environmental Protection Agency, Forest Service, Natural Resource Conservation Service, and National Oceanic and Atmospheric Services (see http://www.epa.gov/owow/wetlands/restore/defs.html#Fed).

The current definitions of restoration and enhancement provided in RGL 02-2 provide a clear distinction between restoration and enhancement. Actions that may improve the new or increased functions to a current wetland that do not attempt to substantially re-establish historical conditions are enhancement.

If a farmed wetland is in a pasture condition, but its historical vegetation and hydrologic condition supported forested wetland, planting the area with native forest vegetation meets well-accepted definitions of restoration. Excavating an open-water pond and thin-stemmed emergent vegetation as amphibian breeding habitat meets the enhancement definition.

Response: Opinions and interpretations of what constitutes restoration and what constitutes enhancement vary. The situation described in the text, which you noted "meets well-accepted definitions of restoration," another reviewer commented was clearly enhancement. The point of these first few paragraphs is to identify that there

appears to be a problem with how various entities and applicants define, interpret, and apply the term restoration. We revised the text to try to clarify this.

6.53 Comment: Bullet 2 - This rarely ever happens.

Response: Comment noted. No change required.

Page 6-24

6.54 Comment: Section 6.5.1.1 - National Academy of Sciences (2001) recommend restoration for mitigating wetland impacts: "Whenever possible, choose wetland restoration over creation. Select sites where wetlands previously existed or where nearby wetlands still exist. Restoration of wetlands has been observed to be more feasible and sustainable than creation of wetlands."

Response: We revised the document to incorporate the suggested text.

6.55 Comment: Paragraph 1 - Couldn't you find out? Call up Mary, John etc.

Response: We cannot follow up with every author to try to clarify statements made in reports. We do not have the time or contact information.

6.56 Comment: Paragraph 2 - Estuarine wetlands are often restored.

Response: We agree. However, the first sentence of paragraph 2 in Section 6.5.1.1 states that, "This emphasis on restoration is not reflected in the number of **freshwater**, compensatory restoration projects implemented on the ground." Also, the focus of this document is on freshwater wetlands. No change required.

6.57 Comment: Paragraph 3 - To fresh wetlands. Yes.

Response: Comment noted.

6.58 Comment: Paragraph 4 - Good.

Response: Comment noted.

Page 6-25

6.59 Comment: Section 6.5.2.2 - Need page number for quotes.

Response: We have not provided page numbers for any quotes provided in the document, and do not have the time to track them all down. Please refer to the cited reference if interested.

Page 6-26

6.60 Comment: Section 6.5.3 - It should be noted that the term "establishment" is currently used by federal agencies.

Response: Yes. RGL-02-2 uses the term "establishment" rather than the previously accepted term "creation." This document synthesizes studies and documents written before this regulatory guidance letter was produced. Therefore, this document uses the term "creation" rather than "establishment." We revised the text to make this clear.

6.61 Comment: Section 6.5.3 - It should be noted that at times, wetlands can be readily and inadvertently established as the result on various construction projects (e.g. Wetlands on fill placed in uplands). For this reason, Ecology exempts from regulations certain wetlands that are recently established on non-wetland sites.

Response: The purpose of this chapter is to synthesize the available scientific literature as it relates to freshwater wetlands and compensatory mitigation in Washington State. Therefore wetlands that are established "accidentally" is not a topic for which we searched the literature. In addition, this document is not meant to describe or clarify the state's regulations or guidance on wetlands. Therefore, no change has been made to the text.

6.62 Comment: Last Bullet - The enhancement elements included in the mitigation wetlands that these authors are concerned about are features that are known to be important to water dependent species of concern to wetland regulators. Decisions relating to enhancement, out-of-kind mitigation (i.e. changed HGM and or vegetation classes) must be considered in the context of project impacts, functional lift, and cumulative losses. Table 2-5 indicates the most common wetland types provide nearly the same functions. Considering the small amounts of wetlands affected, the general commonality of functions across HGM classes, and the increased mitigation ratios applied to this mitigation type, large "shifts" in functional performances at the landscape scale are unlikely.

Response: While Table 2-5 indicates that most common wetland types provide nearly the same functions, it does not suggest that these functions are performed to the same degree. The concern is that decisions regarding mitigation tradeoffs are made without regard to the landscape-scale cumulative effects. No revision required.

6.63 Comment: Bullets - Good.

Response: Comment noted.

Page 6-27

6.64 Comment: Section 6.5.3.2, Paragraph 1 - This is deceptive without some discussion of what the cited study considered to be fully or minimally successful.

Response: We agree. First, a general list of the evaluation criteria is provided in Table 6-2, and we added a cross reference from Section 6.5.3.2 to this table and to Section 6.3.1. Second, the box, Wetland creation vs. enhancement: Which contributes greater functions? on page 6-28 describes in more detail how the contribution to functions was evaluated. Finally, the reference is provided in the bibliography for readers that wish to understand specifically how a particular result was obtained. This study (Johnson et al. 2002) contained a very lengthy explanation of the methods and rationale used to evaluate mitigation projects. Since this is a synthesis document we cannot go into great depth to explain how every study was conducted.

6.65 Comment: Section 6.5.3.2, Paragraph 2 - This would benefit from some discussion about how the enhancement functions were rated against the functions that were lost to wetland impacts, and how the pre-impact functions were measured or determined.

Response: Please refer to the box, Wetland creation vs. enhancement: Which contributes greater functions? on page 6-28, which describes in more detail how the contribution to functions was evaluated. This study (Johnson et al. 2002) contained a very lengthy explanation of the methods and rationale used to evaluate mitigation projects. Since this is a synthesis document we cannot go into great depth to explain how every study was conducted. The reference is provided in the bibliography for readers that wish to understand specifically how a particular study was conducted or result was obtained.

6.66 Comment: Section 6.5.3.2, Paragraph 1 - I'd like to n (the sample size)!

Response: Since we cannot put in the sample size for every single reported percentage from all of the studies, we elected not to put it in here. Readers should review the cited reference for more information. No revision made.

Page 6-29

6.67 Comment: Section 6.5.4.1 - What kind of wetlands are preserved? Surplus areas? High quality, low quality? Location?

Response: The cited studies in this section did not mention the quality or location of preservation sites. We identified this as a data gap and added it to Section 6.1.3.

6.68 Comment: Section 6.5.4.2 - What was their size? Location? How chosen?

Response: This information was generally not available in the mitigation studies reviewed.

Page 6-30

6.69 Comment: Section 6.5.6, First Sentence - Unclear.

Response: The text of the first sentence has been clarified.

6.70 Comment: Section 6.5.6, Second Paragraph, Second Sentence - Unclear

Response: This sentence has been clarified.

6.71 Comment: Section 6.5.6.1 - This section would benefit from some discussion of the positive contributions of banking and advance mitigation, such as reducing or eliminating temporal loss of functions.

Response: The text in the second paragraph under Section 6.5.6 mentions the potential advantage banks may offer by reducing temporal losses. However, many banks are not "fully functional" when the majority of credits are used. Therefore, the use of banking may not "eliminate" temporal losses. No change required.

6.72 Comment: Section 6.5.6.1, First Sentence - Is it a requirement or a choice? Approval unclear – where's this VA. Usage district

Response: The text has been amended to try to clarify this. However, the article did not identify whether the applicants proposed using bank credits or the regulatory agency required it.

Page 6-31

6.73 Comment: Line 3 "had not yet been used for compensation purposes" - This is a good thing as we have two function wetlands for a time! But not built? What's going on here?

Response: The sentence was revised to clarify the meaning.

6.74 Comment: Section 6.5.6.2 - Wow! Unbelievable; any of you only have one

Response: Comment noted.

6.75 Comment: Section 6.5.7 - Yes, and… what does this really mean?

Response: We have amended the text to try to clarify.

Page 6-32

6.76 Comment: Section 6.5.7.2 - I don't get the logic of stating that in-lieu fees and mitigation banking can provide a mechanism to compensate for unregulated wetlands. If they are unregulated, how can you require them to be compensated for? What was Shabman et al

thinking? So if a farm pond which is dug in uplands, is filled or otherwise impacted, the farmer will pay in-lieu fees or be required to contribute to a mitigation bank? That's going to go over real well!

Response: This text does not refer to wetlands that are currently unregulated; rather it refers to regulated wetland losses that are so small compensation is not currently required. The text has been amended to clarify this.

6.77 Comment: Paragraph 1 - And why did they report?

Response: The purpose for and information from these reports is discussed in paragraphs 2 & 3. No change required.

6.78 Comment: Paragraph 2 - Great!

Response: Comment noted.

Page 6-33

6.79 Comment: Bullet 5 - The problem with enhancement of wetlands is a reduction in the wetland base. When one wetland and the functions it provides is lost, mitigating those functions by enhancing some functions on another wetlands translates to a loss of wetland base. There is a net loss of wetland area when a wetland is enhanced to compensate for wetland losses.

Response: We agree and that point is made at the beginning of Section 6.5.3 - Enhancement, Section 6.6.1 - Rationale for the use of Replacement Ratios (second to last paragraph), and Section 6.7.2 - Project-Specific Evaluations of Acreage Replacement (paragraph 3). No change required.

6.80 Comment: Bullet 2 - Add "restoration" before "site", delete "opportunity"

Response: We have made the suggested change.

6.81 Comment: Bullet 3 - Add "than 60%" to "less…effective."

Response: The other studies would be mischaracterized by adding the suggested text. However, the text was amended to clarify the meaning.

6.82 Comment: Bullet 6 - Add "as opposed to single goal projects…"

Response: We do not agree. The suggested text would not clarify or add value to the text. We did amend the text to clarify meaning of this sentence.

6.83 Comment: Bullet 7 - Not a lot of data!

Response: Comment noted.

6.84 Comment: Bullet 8 - I would use two bulleted paragraphs 1 for each

Response: We do not agree. The studies of banking and in-lieu fees have similar designs and results, and in a concise bullet it is easier to summarize the results together. Therefore, no change has been made to the text.

Page 6-34

6.85 Comment: Box - This is a difficult question! First part good! The Committee on Mitigating Wetland Losses determined that wetland size does affect wetland functions (National Research Council 2001). For example, "for water quality purposes, many small wetlands would be more effective than one large wetland covering the same area." The committee therefore concluded that "replacement area should be proportional to the area required to replace the functions lost" (National Research Council 2001).

Response: Comment noted.

6.86 Comment: Box - Brown and Veneman (2001) reference is missing in the Reference Section.

Response: The reference: "Brown, S.C. and P.L.M. Veneman. 2001. Effectiveness of compensatory wetland mitigation in Massachuetts, USA. *Wetlands* 21(4):508-518," is in the reference section of the draft of Volume 1 on page R-10.

Section 6.6 Replacement Ratios

6.87 Comment: Paragraph 1, Line 3 - This should read (for example the U.S. Army Corps of Engineers, *Seattle District* considers…ratios). It has come to my attention that not all districts are doing this.

Response: Thank you for this update. We have amended the text to reflect this information.

6.88 Comment: Paragraph 2 - In the example in the last sentence you would still have a net wetland loss if lost one acre of wetland and compensated by improving six acres of existing wetlands.

Response: Yes, we agree. We have amended the text to clarify that a larger replacement ratio for enhancement will not replace the wetland area lost, rather enhancement of a greater area (through a larger ratio) is meant to provide enough of an increase in functions to compensate for the functions lost.

Page 6-35

6.89 Comment: Section 6.6.1, Bullet 2 - Does this statement consider actual functions lost through impacts as compared to actual functions gained? In many cases, planned functions for mitigation sites far exceed functions lost through impacts.

Response: We agree that the functions planned for mitigation wetlands often exceed what is being provided by wetlands to be lost. But the point of using replacement ratios is to address the risk of failure that the planned functions will never be produced, and the temporal loss that it will take a decade or more for the planned functions to be provided at the proposed level.

The conclusions cited by both references in this bullet are based on literature reviews of studies of mitigation sites. In addition, the National Research Council study (2001) visited and evaluated some mitigation sites. The conclusions for the National Research Council study (2001) were generated by a panel of experts from academia, private consulting, a state department of transportation, and federal regulatory agencies. However, another conclusion from the National Research Council study was that information on the functions provided by the lost wetlands is generally not available. No change to text required.

6.90 Comment: Section 6.6.1, Paragraph 2 - But you have large ratio for enhancement etc. My feeling, as you know, is that we may just create larger failures!!

Response: The larger ratio is meant to address the risk of failure. However, if enhancement activities fail, at least a larger degraded wetland area has been protected, and it may develop into a scrub-shrub or forested wetland on its own within the next 30 to 50 years. No change to text required.

6.91 Comment: Last paragraph "Must" is not science based judgment! Use "should"

Response: We have revised the text to reflect the suggested change.

Page 6-36

6.92 Comment: Paragraph 1 - But still a loss of wetland area.

Response: We agree. The second sentence of this paragraph states that enhancement results in a net loss of wetland area. We added a sentence to clarify that the larger ratio is used to get an increase of functions over a larger area, and thereby try to compensate for the functions lost.

6.93 Comment: Paragraph 2 - Yes.

Response: Comment noted.

6.94 Comment: Paragraph 4 - Wow!!!

Response: Comment noted.

Page 6-37

6.95 Comment: Bullet 1 - Good point!

Response: Comment noted.

Page 6-38

6.96 Comment: Bullets 1-4 - I like this!

Response: Comment noted.

6.97 Comment: Paragraph 1 and 2 - Combine these two.

Response: The text has been revised to reflect the suggested change.

6.98 Comment: Last Sentence - Does this matter? Just pick the best procedure and consistently use it!

Response: We believe that the point being made in this sentence is relevant. If every consultant, county, state or federal agency uses a different method for assessing functions it is very difficult to track the loss or gain of functions on a national level or even within a single state or region. Even in Washington State we do not have a universally accepted and applicable method to use. WAFAM is pretty well accepted, but it is not universally applicable since methods have not been developed for every HGM class. The new Washington State Wetland Rating System may help with this, at least on a state level. No change required.

Page 6-40

6.99 Comment: Line 1 - But this doesn't answer the function question!

Response: We disagree. If consistent regulatory follow-up has a positive effect on the success and/or compliance of mitigation sites, as it appears to, then wetland functions should be provided. Perhaps the functions provided by the mitigation wetland are not the same as the functions lost, but that is more of an issue with what the regulatory agencies approved or required for mitigation. No change required.

6.100 Comment: Section 6.6.4 - Give me a break!!

Response: We revised the text to eliminate the implication that wetland compensation results in a net gain.

Section 6.7 Replacement of Wetland Acreage

6.101 Comment: Paragraph 1 - The sentence reads: "The no-net loss goal, however, 'does not mean that no further wetlands would be lost; rather, that mitigation and non-regulatory restoration will offset wetland losses.'" Both the Conservation Foundation's no net loss goal and Governor Gardner's Executive Orders on Wetland protection listed these goals. Both have the companion goals of long term gain in the quantity and quality of the wetland base. The loss of wetlands was to be primarily accomplished through closing regulatory loopholes and improving protection and management and the gain was to be accomplished through incentive programs.

"Interim Goal: to achieve no overall net loss of the nation's remaining wetlands base. "Long term goal: To increase the quantity and quality of the nation's wetlands resource base. "Although calling for a stable and eventually increasing inventory of wetlands, the goal does not imply that individual wetlands will in every instance be untouchable or that the no-net loss standard should be applied on an individual permit basis – only that the nation's overall wetlands base reach equilibrium between losses and gains in the short run and increase in the long term. The public must share with the private sector the costs of restoring and creating wetlands to achieve this goal."

"Achieving the interim and long-term objectives will require significant reforms, including a substantial reduction in the rate at which existing wetlands are being lost and a substantial increase in efforts to restore and create wetlands." - Protecting America's Wetlands: An Agenda Action, The Final Report of the National Wetlands Policy Forum, 1988, The Conservation Foundation, page 3.

We have not had the collective and political will to stop wetland losses and even state, federal and local bureaucracies have compromised the protection requirements to "obtain something rather than nothing." We have not funded wetland mitigation monitoring. We have reduced funding for wetlands planning and protection. We have had some gains in wetlands restoration in landowner incentive programs with land trusts, federal Wetland Reserve and Conservation Reserve programs and State Salmon Enhancement projects. However to combine the gains from incentive programs with unmet replacements from regulatory programs to claim we have stemmed losses is not consistent with the original goals. We are in effect combining "No Net Loss" and "Long Term Gain" to obtain "No Net Gain". This is unfortunate because many of our watersheds are only partially functioning and we will not obtain societal goals without the increases in wetland quantity and quality to produce fully function watersheds and the benefits they provide – healthy salmon stocks, fish and wildlife habitat, good water quality, flood control and so forth.

Response: We agree. The topic of "No Net Loss" is rather discouraging, both on a national and state level. However, Section 6.7, Replacement of Wetland Area, is intended to synthesize the scientific literature evaluating whether regulatory programs and projects requiring compensatory wetland mitigation have replaced the acreage of permitted wetland losses. No change required.

We believe that *Wetlands in Washington State: Volume 2, Guidance for Protecting and Managing Wetlands* (2004 DRAFT or as revised, available at: http://www.ecy.wa.gov/programs/sea/bas_wetlands/interestform.html) provides some recommendations for how the state and local governments can improve their protection of wetland resources, both on a regulatory and non-regulatory level.

Page 6-41

6.102 Comment: Section 6.7.1 - Since the use of this document is to establish new critical area ordinances for Washington counties and cities, studies evaluating the Clean Water Act Section 404 permit program are irrelevant. Ecology should consider the effectiveness of some of the many existing critical areas ordinances in effect in Washington. For example, what have the losses in wetland acres and function in jurisdictions with relatively strong wetland protection programs (King County, the City of Bellevue, City of Redmond) in the last 10 years? How do these losses compare to other communities with ill-defined programs (i.e. City of Auburn)? Without and evaluation of the effectiveness of existing wetland ordinances in Washington, how will Ecology or communities really know what regulatory schemes are adequately protective of wetlands?

Response: The purpose of Volume 1 was to review all of the relevant scientific literature that met the Best Available Science criteria for freshwater wetlands. We did not encounter any studies of the effectiveness of local critical area ordinances. We are not aware of any cities or counties in Washington that have conducted and published a before and after inventory of their wetland areas, nor a study of acreage of permitted or approved wetland impacts vs. acreage of compensatory wetland mitigation required. The only exception is King County, which published a report on the success of their compensatory mitigation efforts (Mocker et al. 1998). This study has been included in the Chapter 6 synthesis.

We do not agree that studies evaluating Section 404 permitting are irrelevant. The information synthesized from these studies provides a basis for comparison, particularly since most wetland impacts that occur in the state of Washington will require a Section 404 permit in addition to any local permits or approvals. Section 404 is a well established national regulatory program. The purpose of this section is to demonstrate the regional variations that occur regarding what is being required, as well as to demonstrate that studies reviewing more recent percents appear to be doing a better job of requiring mitigation acreage that meets or exceeds the wetland impact acreage.

6.103 Comment: Paragraph 4 - In the Kentula study, the 39 acres cited is what percentage of acres that were replaced in that time period?

Response: This information can be calculated from information available in Table 6-10 in the first row. It works out to be 35%. Calculating from hectares to acres and rounding to whole numbers resulted in numbers that appear inconsistent (39 acres in the text, but subtracting required compensation acreage from impact acreage in Table 6-10 results in 40 acres). We revised the text to ensure that numbers in the text are consistent with numbers from the table. However, we don't think adding this percentage into the text provides increased significance.

6.104 Comment: Section 6.7.1 - In the 1970's and early 1980's we saw hundreds of acres of wetlands each month converted to industrial and urban development. Since the courts have decided that isolated wetlands are not "waters of the United States," fills in isolated wetlands would not now need federal Section 404 Clean Water Act permits. This will make wetland losses more difficult to track.

Response: The state of Washington regulates impacts to isolated wetlands, and the Department of Ecology will attempt to track the acreage of impact as well as the acreage of compensation required. No change required.

Page 6-43

6.105 Comment: Paragraph 3 - If we have let wetland compensatory mitigation requirements be met by enhancing existing wetlands nearly 2/3rds of the time, it would appear that permitting agencies not requiring sufficient mitigation if we are going to try to reduce loss of wetland area and function.

Response: We agree. However, this document does not provide guidance on wetland protection, whereas *Wetlands in Washington State: Volume 2, Guidance for Protecting and Managing Wetlands* (2004 DRAFT are as revised, available at: http://www.ecy.wa.gov/programs/sea/bas_wetlands/) and The *Guidance on Wetland Mitigation in Washington State* (draft 2004 or as revised, available at: http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm) does. The guidance on mitigation discusses this and recommends that mitigation actions should focus on rehabilitation (e.g. restoring hydrologic processes to a degraded wetland), which will generally provide a greater lift of functions, and less on enhancing vegetative structure. No change required.

Page 6-44

Section 6.8 Functions and Characteristics Provided by Created, Restored, or Enhanced Wetlands

6.106 Comment: Bullets - Why did you reverse the order of these functions? From that used before and by others?

Response: The order was essentially based on the volume of literature that was available and needed to be synthesized. In addition, the information discussed in some sections does not really fit into a specific "function" box, which is why we added Characteristics to the title. To try to follow the same order for functions and characteristics that don't really fit into those boxes may have confused or frustrated readers.

Page 6-45

6.107 Comment: Paragraph 1 - The National Academy of Sciences report on wetland mitigation (2001) pointed out:

> *"Long-term management is especially important because wetland restoration and creation sites seldom achieve functional equivalency with reference sites or comply with permit requirements within 5 years. Up to 20 years may be needed for some wetland restoration or creation sites to achieve functional goals."*

With oxidation of organic soils caused when the wetland was drained until restored can cause wetland sites to be lower elevations than surrounding landscapes. It can take decades before accretion reaches equilibrium in some systems. What exists on a restoration site in the short term may not persist for the long term. Some functions may be very high for a while and change as the physical structure of the site changes. Species that use open space and disturbed areas may dominate until an area revegetates. Shorebird or waterfowl use of a wetland may be high at first but drop off as taller vegetation becomes established.

Response: We agree. Section 6.10.4.3 Longer Period Needed to Evaluate Projects, discusses some of these topics. In addition, the discussions in the sections on the various wildlife habitat guilds (Sections 6.8.1.1 Invertebrates & 6.8.1.3 Birds) mention that age of the site is an important factor influencing abundance, density, and/or diversity. No change required.

6.108 Comment: Paragraph 2 - We question how a minimally disturbed reference wetland relates to impacts on a typical wetland in an urbanized area.

Response: The purpose of Volume 1 was to review and synthesize the available scientific literature. Our synthesis of the study in question is intended to demonstrate that given time, restored wetlands can approximate the invertebrate taxon richness of reference wetlands. Though this specific study was conducted on non-regulatory restoration sites, we would interpret the findings to apply equally well to compensatory mitigation sites. We did not encounter any studies that specifically focused on invertebrates in urban wetlands. No change required.

6.109 Comment: Paragraph 4 - You bet!

Response: Comment noted.

Page 6-46

6.110 Comment: Paragraph 1 - The document should reference studies by Ostergaard (2000, 2001) that suggest several amphibian species commonly use stormwater management ponds, which have high levels of water level fluctuations, which is contrary to information provided in this paragraph.

Response: This chapter focuses on studies involving compensatory wetland mitigation and non-regulatory wetland creation, restoration, and enhancement. Though some stormwater ponds provide wetland functions and may meet the wetland definition, studies involving stormwater ponds are outside of the scope of this chapter. No change required.

6.111 Comment: Paragraph 2 – "amphibian communities outside of a restored or created wetland "What do you mean by outside?

Response: This refers to the conditions outside of the wetland that affects amphibians, as opposed to the conditions within the wetland's boundary. We have revised the text in this paragraph as well as the previous paragraph to clarify the meaning.

6.112 Comment: Paragraph 4 - Number out of how many possible and how many total?

Response: The text was revised to provide the information requested.

6.113 Comment: Paragraph 6, Sentence 1 - What about richness as well as abundance?

Response: The article did not specifically report on richness. The results indicate that there was no significant difference in the number of bird species between restored and reference wetlands. However, they did determine that the bird communities were significantly different and that density was greater at reference wetlands. This information has been incorporated into the text.

Page 6-47

6.114 Comment: Section 6.8.2 - I suggest you read Steven Pinker's book "The blank slate"? The modern denial of human nature. Great book – our brains are not wetlands. Also, the influences of competition and exclusion have not yet, started to operate!

Response: Comment noted.

Page 6-49

6.115 Comment: Paragraph 3 – "Change in type" means of the original, if restoration and enhancement or the original to the newly created one? Or both?

Response: We have revised the text to clarify this.

6.116 Comment: Paragraph 4 - This paragraph should note that the conversion of most farmed emergent wetland to forest or shrub wetland in western Washington is classified as restoration ("rehabilitation") per RGL 02-2) and federal agencies. This is because most farmed areas historically experience seasonal saturation sufficient to support forested wetland, but not wet enough to exclude trees in favor of native shrub or native emergent wetlands. The most notable exception to this is farmland protected by dikes the lower portions of estuaries; another exception that is more limited is where substantial ditching or sub-surface drains are present.

Response: We have added text to the paragraph to indicate that much of the current area of wet pasture may historically have been forested wetland.

However, whether a conversion from emergent pasture to forested wetland is restoration or enhancement is not the point of this section, and therefore, is not appropriate to mention. Please refer to the *Guidance on Wetland Mitigation in Washington State* (draft 2004 available at: http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm) for a more in-depth discussion of rehabilitation vs. enhancement.

Page 6-50

6.117 Comment: Section 6.8.2.3 Soil and Soil Disturbance - The addition of salvaged or donor hydric soil with high organic content to created or restored wetland will only provide long-term improvements to moisture and nutrient retention if they are placed in areas of long-term or permanent inundation or saturation. Should a draw-down of water result in the soil being oxidized, the organic matter will breakdown and disappear.

Response: Please refer to paragraph 4 on page 6-53 in Section 6.8.3, which indicates that even after a couple of years, the organic content is higher in areas with salvaged hydric soil or leaf compost compared with areas left untreated. The presence of organic matter amendments appears to be most critical in the first few years of plant establishment and

growth. We did not encounter any scientific literature that mentioned the complete disappearance of organic matter amendments over time. No change required.

Page 6-51

6.118 Comment: Paragraph 1 - We wondered if the statement that 80% cover being achieved by year 8 might not depend upon species used and environmental conditions. For example, tree plantings in peat suffer high mortality because of both high waters during parts of the winter growing seasons and summer drought conditions. Alder and cottonwood grow very fast and may reach greater amount of closure sooner than other species might. At times herbivores can destroy a crop of seedlings. So eight year estimates may be optimistic for many situations.

Response: We added a sentence to the text identifying the most abundant species in terms of frequency and cover.

6.119 Comment: Competition and Non-Native Vegetation - This section seems to be a collection of unrelated or poorly related references. It needs rewriting and something to bind it together.

Response: We disagree that the articles in this section are unrelated. They all involve some aspect of plant competition. However, we revised the text to provide a more integrated narrative.

6.120 Comment: Competition and Non-Native Vegetation - There is a great opportunity in this section to contribute to the dialog on weed problems at mitigation sites. Most wetlands in Washington today contain populations of exotic "weeds." Moreover, a great many "natural" and high- functioning wetlands have reed canarygrass cover in excess of 10% areal cover. Hence, it may no longer be appropriate to discuss the "success" of a mitigation site in terms of the percent cover by canarygrass (or many other non-native plants). Rather, mitigation success standards should be measured by how well the desired attributes (e.g., shrub or tree layer, ponding) are being attained. For example, while Celdonia did find >10% RCG cover at >50% of the mitigation sites he studied, he also found robust tree and shrub cover at most sites- indicating that these wetlands were on a trajectory to meeting their desired vegetative goals for establishment of scrub-shrub and forested vegetation. Please consider adding language to this effect.

Response: We have revised the text to incorporate more data from Celedonia's study regarding reed canary grass cover and canopy cover.

However, this section addresses plant competition rather than performance standards. Performance standards are addressed in Section 6.10.4. In addition, this topic is discussed at length in the *Guidance on Wetland Mitigation in Washington State* (draft 2004 available at: http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm).

6.121 Comment: Competition and Non-Native Vegetation - Not good results.

Response: Comment noted.

Page 6-52

6.122 Comment: Human manipulation. Note: repeated mowing has been used to control spartina and some other weed species. WDFW has used selective cattle grazing to control reed canarygrass in wetlands as well as monocultures of native cattail.

Response: We found a number of articles that discuss techniques used to control or eradicate invasive species. These articles were not specific to compensatory or non-regulatory wetland sites, and therefore were not included in this chapter. No change to text required.

Page 6-53

6.123A Comment: Paragraph 2 - This paragraph compares conditions in "reference" wetlands to those in mitigation wetlands. It is not clear that the conditions in the "reference" wetlands are similar to those in the wetlands that were filled. Where reference wetlands are not similar to the conditions of filled wetlands, judgments regarding the efficacy of the mitigation are not valid.

Response: You are correct that the studies cited in this section do not compare the created wetlands with the conditions at the wetlands which were lost. Information on specific soil characteristics, such as percent organic matter, is rarely available for the wetland impacts. This data is generally not collected in conjunction with a Section 404 permit. However, we disagree that it is not valid to compare a mitigation wetland to a reference wetland if the reference wetland is not similar to the conditions of the filled wetland. Wetlands provided as mitigation are often intended to provide a different type of Cowardin and/or HGM class than the wetland that was lost. In such cases it would not be appropriate to compare a newly created wetland of one wetland type with the wetland impact area if it was of another wetland type.

We have revised the text to mention that the "reference wetlands" used in all the studies cited in the second paragraph on p. 6-53 were either of the same wetland type as the mitigation wetlands, or they were adjacent to the mitigation wetlands.

6.123B Comment: In the absence of other data, the authors appear to make unjustified conclusions regarding excavation and organic matter accumulation in wetlands. Wetlands that contain open water or long duration flooding would be expected to accumulate less organic matter because of the typical relationship between plant production in ponds, lakes, and littoral wetlands compared to production in emergent shrub or forested wetlands (see Wetzel 2001). In the former, submersed vegetation and algal communities have less structural tissue that (cellulose and lignin) compared to the

latter. With less structural tissue, decomposition rates are faster in open water than in other plant communities, and less organic matter accumulates in soil.

Response: We have revised the text to clarify the meaning and provide "justification."

6.124 Comment: Paragraph 3 - By this criteria restoration is not successful.

Response: The studies cited in paragraph 3, p. 6-53 are not evaluating success. These studies compared percent organic matter in created/mitigation wetlands and reference wetlands. No change required.

Pages 6-53 through 6-55

6.125 Comment: Sections 6.8.3 and 6.8.4 - Great caution must be used in interpreting soil organic matter and ability of wetlands to remove and cycle nutrients or toxic compounds. For most common compounds of concern, there are more than one pathway for transformation, many "reservoirs" for storage, and more than one removal mechanism (see Kadlec and Knight 1996, Vymazal 1995. Ford 1993). For example, lower nitrogen content in mitigation wetlands vs. "reference" wetlands cannot be used to conclude that nitrogen removal through denitrification or ammonia volatilization is substantially different. The sediments of lakes, ponds, and littoral areas are known to have high rates of denitrification. In ponded environments, submersed plants can increase ph levels during periods of active photosynthesis, and when at or above pH 8, substantial ammonia volatilization can occur. The nitrogen stored in organic soils is likely less decomposable and less available for nitrification/denitrification processing, via microbial pathways than that found in flooded soils.

Regardless of potential differences in N storage and cycling rates that might exist, these processes are too complex to make conclusions regarding the efficiency of the two wetlands unless at least some key levels of nitrogen inputs, outputs, and internal storage and transfer processes are quantified (Kadlec and Knight 1996). Removal of other compounds can be equally complex interrelationships that defy simple conclusions based on limited data collection and analysis.

There is great uncertainty regarding the quantitative differences in chemical functioning between wetland types that may exist because detailed assessments of these functions are so rarely made. A relatively small change in wetland type (area and quality) would occur in any watershed as a result of "out-of-kind" mitigation approvals and numerous other landscape level factors exert substantial control water of quality conditions. These other landscape controls are independent of wetland type, and suggest that significant and measurable impacts to water quality would not occur as a result of out-of-kind mitigation that may superficially appear to modify nutrient cycling pathways.

Response: The articles cited in sections 6.8.3 and 6.8.4 are intended to synthesize the available scientific literature on created, restored, or enhanced wetlands and their soil characteristics and water quality attributes, respectively. Most of the articles provided

this information in comparison to reference wetlands. For information on how freshwater wetlands in general perform water quality functions refer to Section 2.5.1, Functions that Improve Water Quality.

It appears that the commenter is challenging the validity of the conclusions of the articles cited in these sections. These articles have been peer-reviewed and we have no reason to question the validity of their conclusions. However, we have amended the text in Section 6.8.3, paragraph 5, p.6-53 to indicate that the soil conditions observed in the various studies have the possibility to affect the listed attributes or functions.

Page 6-56

6.126 Comment: Section 6.8.5 - What about groundwater interactions?

Response: We did not encounter any literature that specifically looked at groundwater interactions in created, restored, or enhanced wetlands. No change to text required.

6.127 Comment: Bullets regarding HGM classes - It is not clear why the wetlands types identified are atypical - geomorphic processes establish various depressions, blind channels, etc. in riverine floodplains. Dams and beaver activity flood riparian areas and create in-stream depression wetlands. Beaver activity and glaciations have established depression wetlands and lakes on generally sloped landscapes.

Response: The criteria for what constitutes atypical HGM classes, provided at the bottom of p.6-56, were taken directly from Gwin et al. (1999). This article provides two tables (Table 2 and Table 3) which define the geomorphic setting, water source, and hydrodynamics for typical HGM classes and "atypical" HGM classes, respectively. This discussion and these tables are too detailed for Chapter 6, which is intended to be a synthesis of many articles. Please refer to the original article (the full citation is available in the References) for a more detailed discussion of atypical HGM classes.

However, we amended the text to clarify that Gwin et al. (1999) focused on HGM classes that were typical in the Portland metropolitan area. In addition we added text to clarify/define what we mean by atypical.

Page 6-57

6.128 Comment: Paragraph 1, Lines 2 – 4 - How can an enhanced wetland result in an atypical HGM class? Please explain.

Response: If the activities to enhance the wetland result in wetland morphology and a hydroperiod that would not "naturally" occur in that landscape setting, then the enhancement is probably resulting in an atypical HGM class. Excavating a permanently inundated pond in an existing seasonally saturated or inundated wetland is one example of an enhancement project that could result in an atypical HGM class. Another example

would be excavating depressions in an existing wetland on a slope, which required the construction of berms to hold the water. No change to text required.

6.129 Comment: Paragraphs 2-5 - At the watershed level, the studies cited do not show any negative consequence of establishing mitigation wetlands that may not entirely match all the features of natural wetlands. As shown in Table 2-5, most wetlands perform most functions. At the watershed level, the changes in function that may occur because mitigation wetlands do exactly not match the HGM characteristics of natural wetlands are likely to be small. The benefits of specific habitat features designed in what are purported to be "atypical" HGM classes may provide valuable habitat for aquatic organisms that have been lost due to historical and cumulative wetland losses.

Response: The citation on p. 6-57 involved studies of individual mitigation projects. These studies did not focus on watershed level effects. We did not encounter any scientific literature that focused on the effects of mitigation decisions on a watershed scale.

Though Table 2-5 indicates the most common wetland types provide nearly the same functions, it does not suggest that these functions are performed to the same degree. The concern is that decisions regarding mitigation tradeoffs are made without regard to the landscape-scale cumulative effects. Without any specific studies evaluating the watershed level affects of mitigation decisions we can conclude that they are neither small nor large. No change required.

6.130 Comment: Paragraph 3 - These are the easiest to create!!

Response: Comment noted.

Page 6-59

Section 6.9 Reproducibility of Particular Wetland Types

6.131 Comment: Section 6.9.1 - I also think that seasonal wetlands and semi-permanent wetlands fall in this category!!!

Response: We agree that it is difficult to reproduce the hydroperiod for seasonal and semi-permanent wetlands. However, the scientific literature indicates that seasonal wetlands and semi-permanent wetlands can be "successfully" created, restored, and enhanced. No change to text required.

6.132 Comment: Section 6.9.1 - While bog restoration may not be easy or simple, it may be a desirable mitigation strategy in some locations. It should be considered where peat mining or farming has disturbed historical bogs. The literature suggests that restoration should be pursued, even if the outcome is a wetland that does not completely match natural reference wetlands. Construction can establish hydrologic conditions suitable for

peat establishment, as I have observed drainage ditches along logging roads in the west Cascade foothills near North Bend. These ditches, which intercepted groundwater, were colonized by dense mats of sphagnum moss. On a small scale, sphagnum mass and other "bog" vegetation can be readily established and maintained as landscape features, which further suggests restoration is feasible.

Response: Section 6.9.1 is not intended to imply that it is impossible to restore a bog. The citations do indicate that some types of degradation cannot be restored. Further the citations indicate that restoration of a bog is dependent upon the water regime and water chemistry. The text was amended to point out that none of the studies of bog restoration were conducted in the Pacific Northwest.

6.133 Comment: Section 6.9.1 - i.e. let's stay out of bogs!

Response: Comment noted.

Page 6-61

6.134 Comment: Section 6.9.4 - The thinning of densely vegetated forested wetlands to reproduce the attributes of "mature forested reference wetlands" may be desirable. However, the identification of thinning as a "need" to obtain a mature forest is dismissive of the natural processes of forest succession, which includes stand establishment (dense vegetation) followed by natural thinning processes as the forest stand matures.

Response: This citation refers to establishing a forested wetland as compensatory mitigation. Within a regulatory time-frame, which is 10-20 years for forested systems, the use of thinning could be used to produce the attributes of a mature stand. Natural forest succession could entail at least 40 years, and in the absence of underplanting or a coniferous seed source, alders could continue to replace themselves generation after generation.

We amended the text to read: "Within a regulatory time-frame, compensatory mitigation wetlands may not reproduce the attributes of mature forested reference wetlands unless these sites are thinned (National Research Council 2001)."

6.135 Comment: Section 6.9.5, Bullet 1 - Centuries! 750 years! At least. This is how long it takes regular "normal" wetlands to develop!

Response: The text was amended to recognize that centuries may be necessary to "reproduce" some wetland types.

Section 6.10 Suggestions from the Literature for Improving Compensatory Mitigation

6.136 Comment: Section 6.10 - Didn't the Ecology study (Johnson et al.) also find a correlation between performance of mitigation sites and monitoring and reporting? If so, please mention and discuss.

Response: The study by Johnson et al. (2002) did not find a specific correlation between monitoring and success. Johnson et al. (2000 and 2002) did recommend that monitoring should be conducted and standardized reports submitted. Johnson et al. (2002) also recommended that monitoring of baseline conditions at a mitigation site should be conducted. Similar recommendations were made by other studies. These recommendations and reference numbers to the appropriate citations are included in Table 6-11, Table 6-12, and Table 6-13.

Johnson et al. (2002) did find that regulatory follow-up was associated with more successful projects. This is discussed in Section 6.4.8, Regulatory Follow-up. No change to text required.

6.137 Comment: Section 6.10, First Paragraph - Not true! Amen! I think there is "double dipping" here.

Response: We have amended the text in the last sentence of this paragraph to clarify that the recommendations come from the references cited in Table 6-10.

Page 6-62

6.138 Comment: Section 6.10.1 - Increasing replacement ratios should be considered only after the other steps in the mitigation process are evaluated and improved. Otherwise, the mitigation community will be doing more of all the things that have been determined to be lacking success.

Response: We agree that all of the recommendations in section 6.10 are important and should be implemented to improve the effectiveness of mitigation. The emphasis in Volume II and in the *Guidance on Wetland Mitigation in Washington State* is on improving the other steps in the mitigation process. We are only recommending higher ratios for enhancement.

Please refer to the document, *Guidance on Wetland Mitigation in Washington State,* (draft 2004 available at: http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm) which provides guidance on what replacement ratios applicants can expect, depending on the wetland type of the impact site and the type of compensation proposed. However, please note that replacement ratios are determined for each project on a case-by-case basis. No change required.

6.139A Comment: Section 6.10 - It seems there were a number of recommendations in National Academy of Sciences report on Wetlands Mitigation that were not included here and could be. They include those in the list following the other comments. See National Academy of Sciences report on wetland mitigation 2001. Why are National Academy of Science studies and reports not listed here?

Response: The National Academy of Sciences report is cited in Table 6-1 Literature sources and corresponding reference numbers. It is cited as National Research Council (2001) and was given the reference number 29. The National Academy of Sciences report is cited (via its reference number) in Table 6.11 and Table 6.12. Please refer to the responses for each suggested recommendation.

The recommendations in Volume 1 come from many literature sources and authors, and many of the sources had the same or very similar recommendations. The tables are provided to highlight the fact that many authors of studies and reports made the same recommendations (literature cited via its reference number). Recommendations were generalized and made somewhat broad so that similar recommendations could be lumped together. Anyone seeking to know more about a recommendation may refer to the literature cited (via its reference number).

6.139B Comment: Note: Even with restoration it can take decades for a site to reach equilibrium in the landscape and to fully function. When there appears no difference between a created and a restored wetland may because of the time interval in which the sites are measured are too short to measure distinctions.

Response: Comment noted. No change required.

6.139C Comment: You might want to check for information on invertebrates with James R. Karr who has worked on invertebrate biological monitoring efforts in streams and wetlands in Washington: *jrkarr@u.washington.edu* or 206-685-4748. Check also with US EPA. See web page: *http://www.epa.gov/owow/wetlands/wqual.miv.html*

Response : Index of biological integrity is a vast and somewhat controversial issue, particularly for use in wetlands. The Environmental Law Institute has published a document, *Measuring Mitigation: A Review of the Science for Compensatory Mitigation Performance Standards* (2004), which reviews the literature available on Indices of Biological Integrity. It has a summary section on invertebrates as well as an annotated bibliography. The document is available at: http://www.elistore.org/reports_detail.asp?ID=10991&topic=wetlands. At present, the IBI does not offer a reliable, rapid method for assessing or monitoring wetlands in Washington. No change to text required.

6.139D Comment: Wetlands can be valued because of the biodiversity function they provide, valued for biodiversity, water quality, and are examined differently. This is one reason people using water quality systems will have slightly different modeling and approaches than those using interacting communities.

Wetlands can be valued because of the biodiversity function they provide. Some wetlands are valued because of their sensitivity to severe reduction of biodiversity functions. Where functions are evaluated under Clean Water Act by Ecology and EPA, it is from the standpoint of water quality. In wildlife and biodiversity terms, a different suite of functions are examined and they are ranked on either sensitivity or the degree they function in terms of biomass or biodiversity. This is one reason people using water quality systems will have slightly different modeling and approaches than those using interacting communities.

Response: We agree. The federal and state laws that are used to regulate wetlands in Washington are laws to protect water quality (Federal Water Pollution Control Act and State Water Pollution Control Act). Both of these laws focus on regulating discharges of fill material into wetlands. However, the Guidance *on Wetland Mitigation in Washington* (draft 2004 available at: http://www.ecy.wa.gov/programs/sea/wet-updatedocs.htm) is an interagency document with Ecology, U.S. Environmental Protection Agency, and the U.S. Army Corps of Engineers. This guidance document recommends that most wetland impacts be evaluated using the revised wetland rating systems for eastern Washington and western Washington (Hruby 2004a,b) available at: http://www.ecy.wa.gov/biblio/0406025.html) or a function assessment method. Either the revised rating system or a function assessment would characterize wildlife habitat provided by the impact site. In addition to this, the Corps Headquarters adopted many of the recommendations made in the National Academy of Sciences report (NRC 2001) and directed all districts in RGL 02-02 to compensate for the functions lost. No change to text required.

6.139E Comment: In restoration, philosophy and endurance are important. Adaptive management is needed. Restoration comes about through experimental trial and error and adaptive management and not the result of a formula. See work done by Gersib et all at WSDOT 2003. See NMFS and National Academy of Sciences documents.

Response: We amended the text in Section 6.10.3 to incorporate the need for adaptive management into the recommendations. We also added this recommendation into Table 6-13.

Recommendations in the National Academy of Sciences report on wetlands mitigation (refer to comment 6.139A):

Riparian wetlands should receive special attention and protection, because their value for stream water quality and overall stream health cannot be duplicated in any other landscape position.

Response: We interpret this to mean avoid riparian wetlands, which is covered by the first recommendation in Table 6-11.

Pay attention to subsurface conditions including soil and sediment geochemistry and physics, groundwater quantity and quality and infaunal communities.

Response: This is addressed in recommendations 5 and 6 in Table 6-12.

Site selection for wetland conservation and mitigation should be conducted on a watershed scale in order to maintain wetland diversity, connectivity and appropriate proportions of upland and wetland systems. Regional watershed evaluation would greatly enhance the protection of wetlands and/or the creation of wetland corridors that mimic natural disturbances of wetlands in the landscape.

Response: This is addressed in recommendations 2 and 3 in Table 6-12. The concept of watershed planning and wetland mitigation is further addressed in Section 6.10.5.

All mitigation wetlands should become self-sustaining. Proper placement in the landscape to establish hydrogeological equivalence is inherent to wetland sustainability.

Response: This is addressed in recommendation 4 in Table 6-12.

Dispersal of plants and animals is influenced by the proximity and number of wetlands in a geographic area. Connectivity between (Harris 1988) and functional interdependence of wetlands with other landscape units (Bedford and Preston 1988) can also affect animal use because many species (e.g., some amphibians), require an upland-wetland matrix. Therefore both the terrestrial connectivity between wetlands in the landscape and the terrestrial habitat surrounding the prescribed wetland must be considered in designing mitigation wetlands.

Response: This is addressed in recommendation 9 in Table 6-12.

Whenever possible, choose wetland restoration over creation. Select sites where wetlands previously existed or where nearby wetlands still exist. Restoration of wetlands has been observed to be more feasible and sustainable than creation of wetlands . . .

Response: This is addressed in recommendation 3 in Table 6-12.

Avoid over-engineering the wetland design. Design the system for minimum maintenance. Set initial conditions and let the system develop. Natural systems should be planned to accommodate biological systems. The system of plants, animals, microbes, substrate and water flows should be developed for self-maintenance and design. Whenever possible, avoid manipulating wetland processes that require continual maintenance. Avoid hydraulic control structures and other engineered structures that are vulnerable to chronic failure and require maintenance and replacement. If necessary to design in structures, such as to prevent erosion until the soil has developed soil stability, do so using natural features such as large woody debris . . .

Response: This is addressed in recommendation 4 in Table 6-12.

When feasible, use natural recruitment for more resilient vegetation establishment. Some systems, especially estuarine wetlands are rapidly colonized, and natural recruitment is often equivalent or superior to plantings (Dawe et al. 2000). Try to take advantage of native seedbanks, and use soil and plant material salvage whenever possible.

Response: The text was amended to incorporate this information into Table 6-12.

Long-term management is especially important because wetland restoration and creation sites seldom achieve functional equivalency with reference sites or comply with permit requirements within 5 years. Up to 20 years may be needed for some wetland restoration or creation sites to achieve functional goals.

Response: We amended the text of recommendation 4 in Table 6-13 to state that more than 20 years may be needed. We also added the reference number for the NRC (2001) report.

Non-regulatory is not a counter balance. Wetland mitigation is a tierd approach of avoidance, minimization and compensation/monitoring to get to the goal of no net loss. On the otherhand non-regulatory efforts are public funded incentives. It is the way to get to long term gain of wetland area and functions. Combining non regulatory with regulatory gets to "no net gain" instead of no net loss and then long term gain.

Response: This addressed by recommendation 1 in Table 6-11.

Page 6-64

6.140 Comment: Table 6-12 - "deconsolidate soils"???

Response: We have amended the text to clarify that "deconsolidate" means to break-up soils in order to reduce compaction.

6.141 Comment: Table 6-12 - Can we speak English? use "Mark" "Post"

Response: We changed the text to clarify the meaning.

Page 6-65

6.142 Comment: Section 6.10.3 - There is no mention/discussion about the importance of including measurable and ecologically meaningful "interim performance measures" and success standards in mitigation plans. Because these are the basis for monitoring and compliance efforts, it is critical that these "measures" be carefully and thoughtfully developed. Ossinger (I 999) and a new WSDOT guidance document (Haddaway et al., in prep) elaborate on the importance of establishing measurable, functions-based performance objectives and success standards. We mention this here because developing performance objectives and success standards can certainly lead to improving design and

performance of a mitigation site. We recommend that you include this discussion in the document.

Response: We agree. For the most part recommendation 4 in Table 6-11 covers all these elements. However, the text was revised to incorporate the need for achievable standards. In addition, a citation (via reference number) for Ossinger (1999) was added to this recommendation, and the full citation for Ossinger (1999) was added to the References at the end of the document.

Page 6-66

6.143 Comment: Section 6.10.4.1 - This section would benefit from some discussion of unrealistic/ unachievable success standards.

Response: We did not encounter any scientific literature that mentioned unrealistic or unachievable success standards. However, we amended the text in Section 6.10.1 to include a discussion of the number of "significant and non-significant" performance standards encountered in Johnson et al. (2002). One of the criteria for a significant performance standard was that it was, "feasible (realistic) and not so rigorous that it could never be met, thereby setting sites up for failure." In addition we added a brief discussion of the need for achievable standards and the balance between accountability and flexibility, citing Ossinger (1999).

6.144 Comment: Bullets - This is the crux of all of this! Mitigation.

Response: Comment noted.

Page 6-67

6.145 Comment: Paragraph 1 - How about any wetland??? In the PNW seasonal wetlands are dry from August through September!!

Response: The comment refers to a direct quote from an article which we are unable to change. We agree that water is critical to any wetland. However, a performance standard for a specific water regime in a permanently ponded wetland may be less important than for a seasonal wetland which is attempting to establish a habitat (vegetation and animals) that is dependent upon a specific wet and dry cycle. No change required.

6.146 Comment: Section 6.10.4.2, Bullet 2 - See comments on 6-61 regarding studies on WLF and studies summarized in Azous and Horner (2001).

Response: We deleted the performance standard in question and the text was revised accordingly.

Page 6-68

6.147 Comment: Paragraph 1 - Yes!

Response: Comment noted.

6.148 Comment: Paragraph 2 - Who monitors for 20 years? Give me a break!

Response: We agree. The text has been revised to acknowledge that most sites are monitored for 10 years at the most.

Page 6-69

6.149 Comment: Bullets - The federal mitigation sequencing requirements of the Clean Water Act are a major impediment to County and City governments that may desire to more effectively maintain or increase wetland functions at the landscape level using mitigation banks and a watershed approach.

Response: We agree that currently there are impediments to implementing a landscape approach to address wetland impacts and mitigation in a jurisdiction, watershed, or region. There is a quote on p. 6-70 from Race and Fonseca (1996) that addresses the reality of what will be necessary to adopt a landscape approach. No change to text required.

The purpose of Section 6.10 and the following subsections, including Section 6.10.5.1, is to summarize or synthesize recommendations from the scientific literature for improving compensatory mitigation in the future. For the U.S. Army Corps of Engineers' general permit (issued through numerous nationwide permits) decisions regarding permitting, mitigation sequencing, wetland acreage, type, and certain aspects of compensation were pre-made on a regional level. In addition, RGL 02-2 directs districts to use a watershed approach when determining compensatory mitigation requirements.

Page 6-70

6.150 Comment: Paragraph 4 - Yes, but without such an approach wetland management will fail!

Response: We agree with the need for a landscape approach. The majority of Section 6.10.5.1 summarizes various authors' recommendations for how to implement a landscape approach. The purpose of this quote is to point out that truly implementing a landscape approach, for both wetland impacts as well as compensatory mitigation, will require a major regulatory change on the federal, state, and local level. No change required.

Page 6-71

6.151 Comment: Paragraph 2 - But time is $$ and large is not necessarily better nor more successful!

Response: We agree that a large site is not necessarily any better than a small wetland site. However, the National Research Council recommends restoration as the preferred type of compensation, yet Section 6.5.1.1 Use of Restoration, indicates that restoration of freshwater wetlands is rarely implemented as compensatory mitigation. One of the hypothesized reasons for the lack of restoration in Washington is that the majority of permitted impacts are relatively small and restoration is not a feasible compensation option. The point of this sentence is to emphasize that a mitigation bank could restore an area that an individual small project could not. No change required.

Page 6-72

Section 6.11 Chapter Summary and Conclusions

6.152 Comment: Paragraph 2 - What does "somewhere in between" mean ecologically? A verbiage hydrology – revegetation – birds?

Response: This is a summary for the whole chapter and is not an appropriate place to reiterate the various criteria used by each study to evaluate success. For more information on project success and how it was determined refer to Section 6.3.1 and Table 6-2. We deleted the phrase "somewhere in between" revised the text to clarify that most projects had an intermediate level of success.

Page 6-73

6.153 Comment: Paragraph 2 - What does "While on paper" really mean?

Response: "While on paper" is meant to distinguish between studies of mitigation that relied solely on permit files, as compared with studies that evaluated mitigation by visiting sites and conducting field analyses. The text was revised to clarify this.

Chapter 7 – Cumulative Impacts on Wetlands

Section 7.1 Reader's Guide to This Chapter

Page 7-2

7.1 Comment: Section 7.1.3 - I disagree with conclusions regarding the adequacy of data sources. There is no analysis presented on how effective local regulations have been at protecting wetlands or wetland functions. There is no assessment addressing or quantifying to what extent cumulative losses to aquatic functions are or are not occurring in Washington State under existing wetland CAO ordinances. There is no analysis of how the range of existing development review standards (including clearing and grading permits, extensive stormwater management requirements, CAO requirements, and other mitigations) may or may not be adequately protective of wetlands and aquatic environments in Washington State.

Response: We agree that there are few studies that have evaluated the relative effectiveness of local wetland protection programs. We have noted that there is a lack of studies of local wetland protection programs to provide any type of direct measurement of wetland impacts and cumulative impacts resulting from local programs. We also state that such research is needed.

However, given that the scientific literature provides ample information on what should be effective at protecting wetland functions (e.g. landscape approaches, buffers, mitigation standards), we can generally compare existing local programs against what science indicates is needed. Data from the Department of Community, Trade and Economic Development confirm that most cities and counties in Washington require buffers that are considerably less than the science indicates are necessary to protect functions. Likewise, existing local government mitigation standards are significantly less than the science supports. In addition, the King County study of mitigation (the only local government study we are aware of) found significant shortcomings in the county with the longest established program and the greatest number of wetland specialists on staff. Additionally, no city or county in Washington has developed and implemented a landscape-based approach to assessing and protecting wetlands.

Thus, even if local governments have state-of-the-art stormwater treatment programs and/or grade and fill regulations, it is reasonable to conclude that existing wetland protection programs in Washington are not adequately protecting wetland functions and values. We have re-written the chapter and section to provide this information.

Section 7.2 Introduction and Background on Wetland Loss and Cumulative Impacts

7.2 Comment: Reviewing the results of previous studies on wetland losses in the US is of no value in determining the nature and causes of ongoing cumulative impacts in Washington. The magnitude of ongoing cumulative impacts to wetland area and functions should be considered in reference to historical impacts to wetlands and functions (which this document establishes). Without identification of current and ongoing cumulative impacts to wetland dependent wildlife, the various physical functions, and the water quality functions that wetlands provide, how can this "synthesis" volume translate findings into regulation and policy (the intent of Volume 2) to meet GMA requirements?

This section should identify the Council on Environmental Quality definitions of cumulative impacts. The authors should be aware of approaches to conducting cumulative effect assessments under NEPA (see Council on Environmental Quality 1997).

Response: Comment noted; we added the definition of cumulative impacts as suggested (now Section 7.2). Three studies cited on page 7-3 do report on the continued losses in specific locations the Pacific Northwest. One study does specify percentages of loss in relation to each land use, and we added those percentages to the text.

7.3 Comment : The % of acres lost and the acreage figures presented, when calculated, amount to an area larger than the whole state. Also need to acknowledge the new wetlands created by the Columbia Basin Irrigation Project even if you don't have figures on acreage. Also, the figure is for a 200 year time span…the first 50 years didn't see any development since settlers hadn't yet started to displace the Native Americans…should include the last 150 years.

Response: There is a typographical error in the text. Dahl 1990 states 1.35 million instead of 135 million. We revised the text accordingly.

New wetlands created by the Columbia Basin Irrigation Project are discussed in Chapter 3. We don't want to repeat the discussion here because the intent of this section is to discuss net losses and cumulative impacts.

Page 7-3

7.4 Comment: Bullet 3 - This bullet should be eliminated, as the last sentence on page 3-26 seriously discredits the scientific validity of Holland et al. (1995).

Response: We have re-evaluated this bullet and the statements on page 3-26. We have deleted the statement on page 3-26 because the conclusions regarding water regime derived in the study were too vague. However, the study's conclusions regarding loss of wetlands are not contested.

Page 7-5

Section 7.3 Implications of Current Management Practices for Cumulative Impacts

7.5 Comment: Paragraph 5 - The lack of "consistent regulations from one jurisdiction to the next" may not really be the source of cumulative impacts to wetlands. The more probable source would be regulations that are not adequately protective of wetlands and wetland functions.

Response: The paragraph states that the lack of consistent regulations from one jurisdiction is one source of cumulative impacts to wetlands. We have added a section discussing the adequacy of protection of wetlands through local regulatory programs.

7.6 Comment: Paragraph 2, Last Line: The Growth Management Act was passed in 1990.

Response: We made the correction.

Page 7-6

7.7 Comment: Paragraph 6 - The document does not make the case, based in science and logic, that local regulatory programs are not adequately protecting wetland resources because there has been no evaluation of these programs and no synthesis analysis of their effectiveness. While it would not be possible to evaluate each CAO, evaluations of wetland area and functional losses under a high standard of protection (e.g. King County) vs. a low standard should be made.

The information in the document suggests that the most likely shortcoming of many existing CAOs is buffer protection for wildlife. The studies relied on however often did not limit findings to water dependent wildlife (see WFAM, Hruby 1999), nor are findings translated to the range of land uses present where they are applied.

Response: See response to Comment 7.1. Clarifications have been made in the text.

Most existing critical areas ordinances are inadequate to protect wetland functions and values for a variety of reasons. Many of them exempt wetlands based on size or isolation. Most have buffers inadequate to protect habitat for wetland dependent wildlife. Most have mitigation standards inadequate to ensure replacement of wetland area and/or function.

The point made in this section of Volume 1, however, deals more with the practice of protecting wetlands case-by-case, without considering the larger landscape, which has been evaluated and reported in the literature. All local governments in Washington regulate wetlands on a case-by-case basis. Therefore, even if data on the adequacy of

these regulations is lacking, the conclusions regarding relying solely on a case-by-case approach and the negative implications of doing so as reported in the literature, do apply.

Section 7.4 Cumulative Impacts are Difficult to Assess

7.8 Comment: Sections 7.4 and 7.5 - This section should identify the Council on Environmental Quality definitions of cumulative impacts. The authors should be aware of approaches to conducting cumulative effect assessments under NEPA (see Council on Environmental Quality 1997).

Response: See response to Comment 7.2. We have added a section on the need to assess cumulative impacts.

Page 7-9

Section 7.5 Assessing and Planning for Cumulative Impacts

(The information in this section has been removed from Volume 1 and added to Volume 2).

Page 7-10

7.9 Comment: Paragraph 2 - Mitigation sequencing requirements at the federal level represent a severe impairment of the flexibility local governments have in addressing wetland regulations at the landscape or watershed level. Mitigation sequencing does not allow trade-offs, it requires the least environmentally damaging practical alternative.

Response: Mitigation sequencing at the federal level applies only to projects with large wetland impacts. In practice, tradeoffs are permitted in a majority of Corps permit decisions. Mitigation banking and watershed or basin planning tied to a Corps Regional General Permit provide opportunities for implementing a landscape approach. That said, we concur that there are many difficulties in addressing wetland regulations at a landscape or watershed level. However, we do not agree that the federal sequencing requirements represent a severe impairment. Therefore, no change has been made to the text.

7.10 Comment: Last Paragraph - It seems there is little danger in losing degraded wetlands in the Snohomish River Estuary due to current regulatory protections. More problematic is finding a mechanism to restore them.

If there are no government or private sector revenue sources to restore them out-right, an option is to develop a regulatory scheme that will promote or require restoration. If this scheme is to incorporate an economically feasible mitigation banking model or similar incentive program, then regulatory bodies must consider a "trade-off". The trade-off between filling hundreds of acres of low function wetlands with differing HGM classes in exchange for several acres of re-established or rehabilitated estuarine wetlands must be ecologically acceptable.

Is this a wetland management approach being promoted in Section 7 of this document?
Response: The issue of how to protect or restore wetlands is discussed in Volume 2 in which different options are presented. Therefore, no change was made in Volume 1.

In Volume 2, we recommend restoration as part of a program to manage and protect wetlands by local governments; but we cannot require restoration. Making decisions about trade-offs are value judgments that need to be made locally.

Page 7-11

7.11 Comment: Paragraphs 4 & 5 - With regards to wetland function, science has little ability to "thoroughly" inform decision makers as to the "consequences of choices made" regarding wetland and other ecological functions. The most definitive information science can usually provide are generalized predictions based on relatively weak cause and effect relationships or cause and "affect hypothesizes".

Response: We replaced the word "thoroughly." Schueler and Holland's point is that decision-makers and the public need more accurate information to make more informed choices about how the entire aquatic system works, recognizing the consequences of difficult choices up front. Scientific information regarding the larger landscape will have its limitations and may not be "thorough" as the comment points out; however, even if the scientific information includes generalized predictions, it is more information than is currently used.

Page 7-13

7.12 Comment: Paragraph 4 - Smith and Jones (1997) is missing from the Lit Cited

Response: This reference is no longer cited in this chapter.

Page 7-14

7.13 Comment: Bullet 1 - Word choice. This is problem OPPORTUNITY, not "problem effectiveness."

Response: During revisions to Chapter 7, we eliminated the bullets.

Section 7.6 Chapter Summary and Conclusions

Page 7-16

7.14 Comment: Ecology has not presented convincing evidence that under currently imposed CAOs consistent and significant losses in wetland functions are occurring statewide. While wetland CAOs vary widely across the state, there have been no quantifications of

the overall performance of these programs and no real systematic evaluation of their effectiveness or deficiencies. There is no consideration of how stormwater management requirements, grading permit requirements, and other mitigations are implemented to protect critical areas and under what circumstances these are sufficient or inadequate. While there is no question that upland development affects non-water or wetlands dependent wildlife, there is little information presented in this document that shows, in Washington, wetland dependent wildlife are declining or otherwise being impacted by CAOs standards that are inadequate.

Upland wildlife also requires certain protections under GMA, and governments must specify fish and wildlife habitat conservation areas to maintain the viability of wildlife populations. Wetlands and wetland buffers should not necessarily be designed to maintain non-wetland dependent upland wildlife.

Response: See the responses to Comments 7.1 and 7.7. The recommendations made in Volume II on the buffer requirements of wildlife are specifically targeted at wildlife that is closely associated with wetland (e.g., amphibians, waterfowl, etc.). We agree that local governments need to protect upland wildlife as well through their critical areas ordinances

Additional References Suggested by Reviewers of Volume 1

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
GENERAL		
Comment: The latest issue of WETLANDS is full of papers about isolated wetlands. Please include this new information.	Yes	Authors have reviewed articles and added any new or different information presented to the synthesis.
Comment on Page 2-8 Paragraph 3 (BOX):: Some examples to consider, at least as examples, are graphs typically used to show the function of riparian buffers widths. [See Forest Ecosystem Management Assessment Team. 1993. Forest ecosystem management: an ecological, economic and social assessment. Washington, DC: U.S. Forest Service and collaborating agencies]. These authors graph for example, wood delivery to streams as a functions of distance, and show that 75% is provided in the first 100 feet, and that the next 70 feet of buffer provide about 25 %. This essentially provides some scaling to the intensity of buffer impacts. But, your are correct that there are many data gaps.	No	Not wetland specific enough. Wood delivery to wetlands was not considered to be an important characteristic of wetland functions.
The classifications by Crawford and Kovalchik complete the Cowardin Classification at the dominance or site/stand specific level. If you mention Cowardin, it is imperative that you understand and include these classifications in this publication. They are more than simple lists of plant communities! You might add the Wenatchee NF home WebPages to my reference - www.fsfedus/r6/wenatchee/ - so that folks can find it on the web. In press?	Yes	Authors have reviewed article and added any new or different information presented to the synthesis.
Richard Condrey critically reviewed Wetlands and Urbanization, edited by Azous and Homer, and published in 2001 in Volume 23, No. 1 of Wetlands, Journal of the Society of Wetland Scientists (March 2003). In our opinion, Ecology's document should address this critical peer review so that the reader is fully aware of the issues and potential limitations surrounding use of this publication. Condrey, R. 2003. Book Review: Freshwater wetlands and urbanization. Wetlands 23:206-208.	Yes	Authors of Volume 1 have the book review and a response from Azous and Horner is found in the response to Comment 4.55.
Society of Wetland Scientists, Wetlands Vol. 23(3): all pages Sept. 2003 —	Yes	Authors of Volume 1 have this and have included the information therein.

[1] **Yes** means the team for the project has acquired a copy of the ref. or it's already cited in Vol. 1; **No** means we didn't try to obtain the reference for the reason stated in the explanation; **Not Found** means we could not find or obtain the references

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Darnell, RM, Pequehnat, WE, Jones, BM, et al, 1976, Impacts on construction activities in wetlands of the United States, US Environmental Protection Agency, EPA 600/3-76/045	No	Reference is too dated and more recent information is available. There is no suggestion from the reviewer that the report provides any information that is not available in more recent works.
Hook, DD, Smith, HK, Gregory, J, et al, 1988, The ecology and management of wetlands: volume I: ecology of wetlands, Timber Press, Portland, OR	No	Reference is too dated and more recent information is available. There is no suggestion from the reviewer that the report provides any information that is not available in more recent works.
Maitland, PS and Morgan, NC, 1997, Conservation management of freshwater habitats: lakes, rivers, and wetlands, Chapman & Hall, New York, NY	No	Too general and does not discuss the impacts of human land-uses.
Schneider, CB and Sprecher, SW, 2000, Wetlands management handbook, US Army Corps of Engineers, Engineering Research and Development Center, ERDC/EL SR-00-16, at http://libweb.wes.army.mil/Archimages/10167.pdf	No	Not peer reviewed and other information on the subject is available
Strickland, Richard, editor, 1986, Wetland functions, rehabilitation, and creation in the Pacific Northwest : the state of our understanding: proceedings of a conference held April 30-May 2, 1986, Fort Worden State Park, Port Townsend, Washington, Washington State Dept. of Ecology	Yes	Authors of Volume 1 have this report but did not find any information in it that has not been covered by more recent literature
Thom, RM, Borde, AB, Richter, KO and Hibler, LF, 2001, Influence of urbanization on ecological processes in wetlands, in Land use and watersheds: human influence on hydrology and geomorphology in urban and forest areas, Wigmosta, MS and Burges, SJ, editors, American Geophysical Union, Washington DC —	Not Found	
Mitsch, W. and J. Gosselink. 2000. Wetlands. Wiley Publishers, New York, New York.	Yes	Already cited in Volume 1
Tiner, R. 1999. Wetland Indicators: A Guide to Wetland Identification, Delineation, Classification, and Mapping. Lewis Publishers, Boca Raton, Florida.	Yes	Authors of Volume 1 don't think we need to cite this since the federal and state delineation manuals set out the requirements for indicators.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
I briefly reviewed the Ecology publication (received on CD) "Freshwater Wetlands in Washington State, Volume 1." I looked at the References section and was surprised that there were very few references to research done at the University of Washington Center for Urban Water Resources Management. I recommend the publications listed in the University of Washington Center for Urban Water Resources Management List of Publications, Section F: Puget Sound Wetlands and Stormwater Management Research Program. This list of publications can be found at: http://depts.washington.edu/cuwrm/publictn/allpubs.pdf The information in these publications will add to your wetlands publication, especially Chapter 4.	Yes	Azous and Horner book on studies from UW already cited in Volume 1. The authors have the list of publications from the Stormwater Management Research Program.
Luna, Leopold's books, such as "A View of the river."	No	Not peer reviewed and other information on the subject is available
[Comment on Chapter 2] I believe there should be a greater emphasis on processes, although from a realistic viewpoint, this is the most difficult aspect for which to find information and to integrate into wetland protection. Regardless, other jurisdictions have addressed such an approach ([Maryland Department of Natural Resources, 2001 #4804], [San Diego County, 1998 #7527]).	Not found	Could not find publications by these agencies in UW catalog.
Montgomery, and Buffington's stream classification.	No	Not relevant (addresses only streams)
David Rosenberg's stream classification system "Applied River Morphology" book and catena publication.	No	Not relevant (addresses only streams)
You missed Elmore and others on PFC team.	No	Not relevant; method related to properly functioning conditions in streams.
Use original source(s)/literature that demonstrates and explains the concept. For example: Montieth, J.L. and M.H. Unsworth. 1990. *Principles of Environmental Physics.* Second edition. Edward Arnold, New York. Oke, T.R. 1987. *Boundary Layer Climates.* Second edition. Routledge, New York.	No	Too general, not specific to wetlands.
See work done by Gersib et all at WSDOT 2003. See NMFS and National Academy of Sciences documents	Yes	Authors of Volume 1 already have National Academy of Sciences document and have worked with Gersib.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
HYDROLOGY		
I am attaching one paper that references others. I recently completed a report to EPA on the whole project, but I have been told not to distribute it until they react. While it uses some approaches different from our earlier analyses, it shows the same tendencies, including that ecological decline, no matter how measured in terms of biological or habitat variables, does not exhibit thresholds. It was published in Linking Stormwater BMP Designs and Performance to Receiving Water Impact Mitigation edited by B.R. Urbonas and published by American Society of Civil Engineers, Reston, VA, in 2002.	Yes	Authors have reviewed article and added any new or different information presented to the synthesis.
JK: There are built projects in King County (i.e. Snoqualmie Ridge) where hydrologic monitoring of pre- and post- construction streams has occured. This project was built with substantial stormwater protections. The monitoring has included peer review (by the City of Snoqualmie experts) of consultant reports. See page 18 {comment 6-5; para 5] for furthur discussion.	Yes	Peer review by City of Snoqualmie experts found the study to be seriously flawed.
I also think that the Ecology and King County stormwater mannuals (which are presumably based in hydrologic and natural resource science) are consideration when discussing stormwater issues in Washington.	Yes	Ecology manual is discussed in Volume 2.
In our work we found the groundwater discharge function to be much more prominent than the account here. In our intensive studies of two wetlands, we found recharge to occur only on the relatively rare occasions when the wetland water levels were way up and providing a strong static head to drive water through the reluctant till. The most complete account is in the master's thesis by M. Surowiec (1989), UW Civil Engineering.	Not Found	Were unable to retrieve document from UW
Booth, D. B. 2000. Forest cover, impervious-surface area, and the mitigation of urbanization impacts in King County, Washington. Prepared for King County Water and Land Resources Division. Seattle, Washington. At http://depts.washington.edu/cuwrm/research/forest.pdf —	Yes	Authors of Volume 1 have this document but are reluctant to cite it because it has not been peer reviewed. Other peer reviewed documents have the same information.
Reinhelt, LE and Horner, RR, 1991, Urban stormwater impacts on hydrology and water quality of palustrine wetlands in the Puget Sound region, in the Proceedings: Puget Sound Water Quality Authority Research meeting, Seattle WA, January 1991	Yes	Already have in Horner and Azous.
Taylor, BL, Ludwa, KA and Horner, RR, 1995, Urbanization effects on wetland hydrology and water quality, in Puget Sound Research Proceedings, Robichaud, E, editor, Puget Sound Water Quality Authority, Olympia, WA	Yes	Already have in Horner and Azous.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Kallemeyn, L., M. Reiser, D. Smith, J. Thurber. 1988. Effects of regulated lake levels on the aquatic ecosystems of Voyagers National Park. IN: D. Wilcox, ed., Interdisciplinary approaches to freshwater wetlands research. Michigan State University Press, East Lansing, Michigan.	No	Report is dated and not specific to Washington or to wetlands.
Bauer, H. and M. Mastin. 1997. Recharge from Precipitation in Three Small Glacial-till Mantled Catchments in the Puget Sound Lowland, Washington. U.S. Geological Survey Water Resources Investigations Report 96-4219. Tacoma, Washington. [comment on Page 3-8] Bauer and Mastin (1997) have quantified some of these hydrologic variables for forests in Puget Sound. They found about 25 percent of rainfall from mixed forests growing on till soil becomes direct runoff.	No	Relates to forests, not wetlands.
Konrad, C. 2000. The frequency and extent of hydrologic disturbances in the Puget Lowland, Washington. Ph.D. Thesis. University of Washington, Seattle, Washington [comment on Page 3-10] Studies by Konrad (2000) have been unable to demonstrate that impacts to baseflow or the extent of perennial streams associated with urbanized watersheds in the Puget Sound area.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Konrad, C. and D. Booth. 2002. Hydrologic trends associated with urban development in the Puget Sound Basin, Western Washington. Water Resource Investigations Report 02-4040. U.S. Geological Survey. Tacoma, Washington.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Slitvitzky, M. 2002. Ecological impacts of water use and changes in levels and flows: A literature review. The Great Lakes Commission. Accessed on October 30, 2003 at: http://www.glc.org/wateruse/wrmdss/finalreport/pdf/Final_Review.pdf	No	Not specific to wetlands.
Missouri Resource Assessment Partnership Web site *http://www.cerc.usgs.gov/morap/* This consortium I believe did some work on wetlands and floodplains after the '93 & '95 100yr flood events. You discuss the effects of fluctuating water levels on pg 4-22 and their work may have some value	No	Not immediately relevant to PNW.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Page 3-19, Paragraph 2. Removal and extirpation of beaver in many watersheds have affected hydrology and wetland size. **James R. Sedell and Karen J. Luchessa in 1982** wrote: "Most early descriptions of Northwest rivers are recorded in British and United States Army journals. They tell of valleys so wet that trails followed `the borders of mountains.' In Oregon and Washington, a common practice in very early times was to travel on the edges of the hills and not along the valley floors (Dicken and Dicken, 1979). British army journals described the Tualatin Valley as `mostly water connected by swamps' (Ogden 1961, p. 122). Much of this flooding was a result of beaver activity and accumulated sediment, fallen trees, and living vegetation in the channels. Because the bottom land had accumulated fine silts and organic matter of alluvial origin, the land was fertile and the task of draining the land for farming began early in Oregon and Washington."	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Lost habitat nurtured salmon: Dams and dikes wiped out the fishes' lower Columbia River nursery, says a study that has implications for fish restoration (09/29/03) JOE ROJAS-BURKE A vast network of marshes and side channels along the lower Columbia River once sheltered and fed hordes of young salmon preparing for life at sea. Nearly two-thirds of the swampy habitat has disappeared, according to a new study that is one of the first to calculate the impact of a century's worth of diking and dam-building on the river's lowest freshwater reach. . . ."What we have done is clarify what the tradeoffs are. Society has to make the value judgments," said **David Jay**, an associate professor at OHSU's OGI School of Science and Engineering. He co-authored the study with graduate student **Tobias Kukulka**, now at the University of Rhode Island. The work was published last week in the **Journal of Geophysical Research -- Oceans**. . . . A place of food and shelter "These shallow water habitats do lots of things," said **Dan Bottom, a biologist with the National Marine Fisheries Service** who is leading estuary studies in the Columbia and other rivers. . .	No	Not peer reviewed and other information on the subject is available.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Kukulka and Jay focused on a 25-mile stretch of the lower Columbia. Their work, funded by the **U.S. Army Corps of Engineers and the National Marine Fisheries Service**, shows how it may be possible to focus restoration efforts to get the most from limited dollars. The researchers developed a mathematical model, . . .The program makes it possible to estimate how high the river would rise -- and how much land would be inundated -- if there were no dikes or dams during the spring freshet. . . If no dikes had been built, the dams alone would eliminate about 29 percent of the lower river marshes and channels historically available for salmon during May, June and July, the researchers concluded. Dikes alone would take water from about 52 percent of the habitat, their model estimated. Together, dikes and dams have eliminated about 62 percent of the shallow water habitat, or about 6,900 acres. "It is a little shocking how big the changes have been," Jay said. But he found reassurance in the result that diking is a bigger contributor than dam operations. .	No	Not relevant to wetlands.
LANDSCAPE/CONSERVATION BIOLOGY		
Page 3-30-31: Are there any figures [on population growth and urbanization] specific to Washington? I think this would be of interest to the reader because the NW has grown faster than the rest of the nation based on latest census. Maybe the **GAP data** can provide some local insight.	No	Too general.
Forman, R.T. and M. Gordon. 1986. Landscape ecology. Wiley & Sons, New York, New York. Freemark K., D. Bert, and M. Villard 2002. Patch-, landscape-, and regional-scale effects on biota. *In*: Gutzwiller, K., ed. Applying landscape ecology in biological conservation. Springer, New York, New York. Primack, R. 2002. Essentials of conservation biology. Sinauer Associates, Inc. Publishers, Sunderland, Maine. The evaluation of impacts on landscape processes focuses on "connectivity". There are many other landscape variables affected by development and human disturbance. See Chapters 3-6 of Forman and Godron (1986), Feemark (2002), or Primack (2002) for discussions of landscape patches, corridors, matrices, networks, and structure. Ecology should explain why these landscape parameters are not considered.	No	Comment addressed by citing references more specific to managing natural resources and wetlands.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Bayley, PB, 1995, Understanding large river-floodplain ecosystems BioScience 45(3): 153-158	No	Not specifically relevant to wetlands
Gustafson, EJ and Parker, GR, 1994, Using and index of habitat patch proximity for landscape design, Landscape and Urban Planning 29:117-130	No	Not specifically relevant to wetlands
See Debinski, D.M. and R.D. Holt. 2000. A survey and overview of habitat fragmentation experiments. Conservation Biology 14(2):342-355 This is an excellent review and clearly articulates some of the complexities in evaluating the effects of habitat fragmentation on wildlife, which can be extrapolated to the buffer function chapter.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Other papers that address habitat fragmentation are: Lindenmayer et al. 2002. Effects of forest fragmentation on bird assemblages in a novel landscape context. Ecol. Monographs 72(1):1-18	No	Not specific to wetland-dependent species
Fahrig, L. 2002. Effect of habitat fragmentation no the extinction threshold: a synthesis. Ecological Applications 12(2):346-353.	No	Not specific to wetland-dependent species
Schweiger et al. 2000. The interaction of habitat fragmentation, plant, and small mammal succession in an old field. Ecol. Monographs 70(3):383-400	No	Not specific to wetland-dependent species
The following reference provided in connection to "wetland-associated." The Fragment Connection by William Stolzenburg, Nature Conservancy, July/August 1991: p. 20.	No	Not peer reviewed and other information on the subject is available
[comment on Pg.3-13] There is a huge body of research on habitat fragmentation. Check with Dave Manuwal in the Forestry Department of the UW and ask him to send some of the references your way. I read a dissertation two years back on habitat fragmentation and there were at least 200 references. I am guessing that many are either about wetlands or the concepts could be applied to wetlands.	No	Beyond scope of Volume 1

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
WILDLIFE - GENERAL		
Johnson, D.H. and T.A. O'Neil. 2001. Wildlife-Habitat Relationships in Oregon and Washington. Oregon State University Press. Corvallis, OR. Note: This reference should be used in Section 2.5.3 when discussing functions related to wildlife habitat. Johnson, D.H. and T.A. O'Neil. 2001. Wildlife habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon. Ferguson, H., K. Robinette, and K. Stenberg. 2001. Wildlife of urban habitats. Pages 312-341 *in* D. Johnson and T. O'Neil, eds. Wildlife-habitat relationships in Oregon and Washington, pp 317-341. Oregon State University Press, Corvallis, Oregon	Yes	Articles from this book have been cited individually.
Weller, MW, 1979, The influence of hydrologic maxima and minima on wildlife habitat and production values of wetlands, in Proceedings of the National Wetland Symposium: Wetland Hydrology, Kusler, JA and Brooks, G, editors, Association of Wetland Managers Inc, Berne, NY	No	Too dated and more recent information has been cited on this issue.
O'Connel, M., J. Hallet, S. West, K. Kelsey, D. Manuwal, and S. Pearson. 2000. Effectiveness of riparian habitat management zones in providing habitat for wildlife. Timber, Fish and Wildlife Program, Wildlife Sciences Group, University of Washington, Seattle, Washington.	No	Not relevant (deals with forestry practices)
Payne, N. 1992. Techniques for wildlife management in wetlands. McGraw-Hill, New York, New York.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
West, S. and K. Kelsey. 2000. New findings and unanswered questions about wildlife in riparian zones. Summit 2000. Electronic Proceedings, available at: http://www.cfr.washington.edu/outreach/summit/proceedings.html (Accessed October 31,-2003).	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
[comment on page 2-49] See West and Kelsey (2000) and O'Connel et al. (2000) for recent data on the value of riparian systems to wildlife in western WA and OR. [comment on Page 2-51] For westside riparian systems, research reported by West and Kelsey (2000) and O'Connel et al. (2000) conflict with the information presented in this section. The above referenced findings should be discussed and considered, as they represent extensive and recent field research from WA.	Not found	

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
[comment on Page 2-47] Reggiero et. al 1988 report that species preference for a particular habitat feature or habitat characteristic may be the best indicator of species dependence in the long term. Although an individual may survive under conditions they do not prefer, the population as a whole, living under sub-optimal conditions would likely suffer substantial declines in the long run.	Not found	Not enough information provided to locate the reference.
Page 4-25 Sections 4.6.3 through 4.6.7 Changing the Amount of Sediment: The persistence of some wetland ecosystems (certain deltatic marshes, lakeshore marshes, estuarine and salt marshes) is dependent on ongoing sedimentation. Increasing amounts of sediment may increase or maintain the area of wetland present. Decreasing the amount of sediment can decrease the amount of wetland present if subsidence or sediment transport processes are present (see **Mistch and Gosslink 2000 p 85, 380** for general references to this process). These changes affect the amount of wetland habitat available to fish and wildlife.	Yes	Authors of Volume 1 already have Mitch and Gosselink and found no reference to the issue on the pages listed in the comment.
Page 5-38, Top Paragraph. First sentence states: "However, no studies were reviewed for this synthesis that compared wildlife use of mature forested buffers with buffers composed of meadow, shrub land, logged forest, or younger forests. **Brown et al 1985** lists primary breeding and feeding habitat for different species in wetland, riparian grass-forb, shrub, open sap-pole, closed sap pole, large saw timber and old growth forest. These is a fair amount of wildlife literature of wetland associated species with mature forest. Different cavity nesting species of birds need different tree diameters at breast height (dbh). For example. Wood duck need an absolute minimum of 14 inch dbh but 24-30 inch dbh is preferred.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Arner, D.H., H.R. Robinette, J.E. Frasier, and M.H. Grey. 1976. *Effects of Channelization of the Luxapalila River on Fish, Aquatic Invertebrates, Water Quality and Furbearers.* FWS/OBS-76-08. Washington, DC: U.S. Fish and Wildlife Service.	No	Dated, not specific to wetlands in WA
WILDLIFE - BIRDS		
In the PHS GBHE Pub the following buffers relate to flushing. • Ontario, Canada Vos et all. 1985 300 meters • Florida, Rogers & Smith, 1995 100 meters to reduce dist. from motor boats or people on foot.	No	Authors of Volume 1 already have publications by these researchers but with slightly different dates.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Grazing can remove bird habitat nesting cover and impact production. In the Columbia Basin, heavy grazing next to wetlands removed buffer vegetation and reduced waterfowl production by 50% (Foster et al. 1984).	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
We believe that there is a discussion in *Methods for Assessing Wetland Functions, Volume 1: Riverine and Depressional Wetlands in the Lowlands of Western Washington* (Hruby et al., 1999) that addresses the size of tree canopy openings necessary to attract migratory waterfowl to open water wetlands. Tom Hruby can provide this open canopy/waterfowl discussion and cite appropriate references in Section 4.3.7 (Pg. 4-9) "Impacts of Changing the Physical Structure on Habitat for Birds."	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Mazluff, John - various publications on urbanization and wildlife. Dr. Mazluff is an Associate Professor at the University of Washington in Ecosystem Sciences. He is currently studying long-term effects of urbanization on songbirds in the Seattle area. Dr. Mazluff is the author of *Avian Conservation and Ecology in an Urbanizing World* (2001). Johnston, R.F. 2001. Synanthropic birds of North America. Pages 49-67 *in*: J.M. Marzluff, R. Bowman, and R. Donnelly. Avian ecology and conservation in an urbanizing world. Kluwer Academic Publishers. Boston, Massachusetts. Marzluff, J.M. and K.J. McGowa, J. Roarke Donnelly, and R.L. Knight. 2001. Causes and consequences of expanding American crow populations. Pages 331-363 *in*: Marzluff, J.M., R. Bowman, and R. Donneley. Avian ecology and conservation in an urbanizing world. Marzluff, J. M., R. Bowman, R. Donnelly. 2001. Avian ecology and conservation in an urbanizing world. Kluwer Academic Publishers, Norwell, Massachusetts, USA. - You discuss the connection between bird species richness and urbanization. I think some of the papers in this book are more current than the citation you present in the report on page 4-59.	Yes See above	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis. Citations from the compendium however do not address wetland-associated birds. See above
Page 4-59: More recently published work is found in a compilation produced by John Marzluff at the University of Washington. I believe some of the chapters in "Avian Ecolog & Conserv. In an Urbanizing World" (2001) deal with this issue, however, I don't believe they touch upon wetlands in urban landscapes.	See above	See above

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Donnelly, R.E. 2002. Design of habitat reserves and settlements for bird conservation in the Seattle metropolitan area. College of Forest Resources University of Washington. Seattle, Washington.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Two citations might be of value to address my comment on page 5-43. They are both referenced in: Quinn, T., and R. Milner. 1999. Great blue heron (Ardea herodias). In E. M. Larsen and N. Nordstrom, editors. Management Recommendations for Washington's Priority Species, Volume IV: Birds [Online]. Available *http://www.wa.gov/wdfw/hab/phs/vol4/gbheron.htm*	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Page 4-60, Paragraph 4: Fragmentation affects bird nest predation and brood parasitism. Native songbirds nesting in highly fragmented landscapes have greater nest failure rates than those nesting in less fragmented landscapes (see Ferguson et. al. 2001, in Johnson and O'Neil, Donnely et al. 2002, Johnston (2001).	Yes	Not wetland related
Page 4-68: Cowbirds are exotic wildlife that impact native songbirds in agricultural and urban landscapes (see Ferguson et. al. 2001, in **Johnson and O'Neil**)	Yes	Not wetland related
WILDLIFE - INVERTEBRATES		
p. 4-45, ¶ 1: Should include the results of the National Acid Precipitation Assessment Program (NAPAP) study, which is available at http://books.nap.edu/books/0309050820/html/31.html. See also Villella, Rita F. 1989. Acid Rain Publications by the U.S. Fish and Wildlife Service, 1979-1989; NAPAP. 1987. Precipitation chemistry and ecosystem function in Olympic National Park: baseline research for acid precipitation studies. NAPAP. 1998. NAPAP biennial report to Congress. p. 4-47, Section 4.9.5: Include the results of the NAPAP study as applicable in this and other sections addressing the impacts of acidity. Also, put the likelihood of changes in acidity in context of probable sources that could result in measurable changes in pH.	Not found	Question relevance of studies to impacts on wetlands.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
p. 4-37, ¶ 3: Need to expound upon the discussion of metal toxicity to indicate that both acute and chronic toxicity is also dependent on the forms of the metals. In general, dissolved forms are more bioavailable and toxic than particulate forms. In addition, toxicity is dependent on receiving water chemistry, such as temperature, pH, and hardness. Furthermore, toxicity varies for different species. Some are more sensitive than others. These facts are evident in the EPA recommended water quality criteria (see for example p 7 of: National Recommended Water Quality Criteria: 2002. EPA-822-R-02-07. U.S. EPA, Office of Water, Office of Science and Technology, Washington D.C., which can be found at http://www.elaw.org/assets/pdf/USEPAcriteria.pdf) and Washington State Water Quality Standards for toxic substances (i.e., WAC 173-201A) found at http://www.leg.wa.gov/wac/index.cfm?fuseaction=Section&Section=173-201A-240.	No	Decided not to expand the discussion of metal toxicity because information was not judged to be relevant to protecting and managing wetlands.
p. 4-32, 3rd bullet: Metro research publications on lakes and streams suggest that urban runoff will result in invertebrate communities that are pollution tolerant. This typically results in reduced richness, increased abundance of pollutant tolerance spp., and reduced abundance of pollutant intolerant species. Although some of these changes are a result of changing habitat structure, similar effects might be expected in wetlands receiving urban runoff that result in changes in habitat structure, especially as a result of sediment accumulation and increases in invasive species. Potential sources include Metro. 1990. Quality of Local Lakes and Streams 1989-1990 Update. Municipality of Metropolitan Seattle, Water Resources Section, Water Pollution Control Department, Seattle, WA. Gavin, D.V. 1987. Toxicants in Urban Runoff. In: Proceedings of Northwest Nonpoint Source Conference. Seabloom, R. and g. Plews (editors). Washington Department of Social and Health Services, Olympia, WA.	No	Authors of Volume 1 already have current information in Adamus et al. (2001) which comes to the same conclusion.
Page 4-22: It is likely that there is more recent published literature that was put out after the major Missouri floods. The major project assessing flood impacts in Mossouri was the "Missouri Resource Assessment Project." AKA-"MorAP"	No	Not specific to WA.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
You might want to check for information on invertebrates with James R. Karr who has worked on invertebrate biological monitoring efforts in streams and wetlands in Washington: jrkarr@u.washington.edu or 206-685-4748. Check also with US EPA. See web page: http://www.epa.gov/owow/wetlands/wqual.miv.html	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Batzer, Darold P., Rader, Russell B., Wissinger, Scott A, editors, 1999, Ecology of wetland invertebrates: synthesis and applications for conservation and management, in Invertebrates in freshwater wetlands of North America: Ecology and Management, John Wiley & Sons, Inc.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
WILDLIFE – AMPHIBIANS & REPTILES		
p. 5-39, Reptiles, ¶ 2: What about western pond turtle publications? See • Bury, R.B. 1972. Habits and home range of the Pacific pond turtle, *Clemmys marmorata*, in a stream community. Ph. D. Thesis, University of California, Berkeley. • Holland, D. 1994. The western pond turtle: habitat and history. W.S. Dept. of Energy, Bonneville Power Administration, Contract No. DE-BI79-92BP62137, Portland, OR. • Holland, D.C. 1991. A synopsis of the ecology and status of the western pond turtle (*Clemmys marmorata*) in 1991. Report to the National Ecology Research Center, U.S. Fish and Wildlife Service, San Simeon, California. • Holland, D.C. and R.B. Bury. 1998. *Clemmys marmorata* (Baird and Girard, 1852), western pond turtle. In: P.C. Pritchard and A.G. Rhodin (eds). Conservation Biology of Freshwater Turtles. Chelonian Res. Monographs Volume II. • Rathbun, G.B., N.R. Seipel and D.C. Holland. 1992. Nesting behavior and movement of western pond turtles, *Clemmys marmorata*. SW Naturalist 37:319-324.	Yes (in part)	Were only able to locate Rathbun paper.
p. 2-55, ¶ 2: The sentence should be modified (if appropriate) relative to the likelihood that other ambystomid salamanders seek shelter in rodent burrows. Also, clarify the tiger salamander is present in eastern Washington, according to the distribution maps published by the USGS found at http://www.mp2-pwrc.usgs.gov/armiatlas/species.cfm?recordID=173592.	No	Beyond the scope of Volume 1 to consider distribution of individual species.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
If have not already, you might consider reading through WDFW's Priority Habitat and Species Recommendation for amphibians and reptiles for additional life history information. The link to the publication is: http://www.wa.gov/wdfw/hab/vol3.pdf Larsen E. M Technical Editor. 1997. Management recommendations for Washington's priority species volume III: amphibians and reptiles. Washington Department of Fish and Wildlife, Olympia, Washington, USA.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
You might consider contacting WDFW (Dave Anderson) to see what information is available from the latest W. Pond Turtle research. However this might not apply b/c WPT's maybe more associated with deep water.	No	Did find one additional paper on western pond turtle (Rathbun 1992)
Data from a comprehensive study in the Puget Lowlands (Adams MJ, 2000. Ecological Applications 10(2):559-568) indicates that ranid frogs had higher survival in wetlands that dry seasonally.	Yes	Review of article does not support this conclusion.
Blaustein, AR, Beatty, JJ, Olson, DH and Storm, RM, 1995, The biology of amphibians and reptiles in old-growth forests in the Pacific Northwest, US Forest Service, Pacific Northwest Research Station, Report PNW-GTR-337	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Semlitsch, RD, 2002, Critical elements for biologically based recovery plans of aquatic-breeding amphibians, Conservation Biology 16:619-629	No	Authors of Volume 1 have more recent and relevant Semlitsch article.
Shisler, J.K., J.P. James, J.P. Colletti, R.N. Wargo, 1987, Coastal wetland buffer zones for pond-breeding salamanders, Conservation Biology 12(5): pp. 1113-9	No	Not relevant to Washington.
WDFW Western Pond Turtle Recovery Plan link -- *http://www.wa.gov/wdfw/wlm/diversty/soc/recovery/pondturt/wptfinal.pdf* Might wish to cite this per my comments on page 4-70	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Page 4-63: I recall another study in mass (Amherst, MA) that looked at the value of amphibian migration tunnels constructed for passing of spotted salamanders. Although this is not a panacea for road building, there were some positive results from this work out of University of Mass.	No	One author (T. Hruby) was involved in these studies and does not consider them appropriate for Washington since the species and habitat conditions are so different.
Page 6-46, Paragraph 1: The document should reference studies by Ostergaard (2000, 2001) that suggest several amphibian species commonly use stormwater management ponds, which have high levels of water level fluctuations, which is contrary to information provided in this paragraph.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
WILDLIFE – MAMMALS		
Comment: There are studies in Washington State documenting impacts of roads on wildlife. A Department of Game published a study by Perry and Overly, 1977, Impact of Roads on big game distribution in portions of the Blue Mountains of Washington 1972-1973. This study showed main roads reduced elk use up to one quarter mile away, secondary roads reduced use up to ½ mile away and primitive roads reduced elk use of to 1/8 mile away. In 1976-7, Department of Wildlife found migratory bird use increased 30-50 fold on three Columbia Basin wetlands where parking lots and access were relocated to areas 0.25 to 0.5 mile from the wetlands (Foster et al.1984).	Yes	This is already cited in Volume 1.
Page 4-18 [changing amounts of water effects on mammals]: Information can be found in Slitvitzky 2002 and Kallemeyn et al. 1988. I suspect that there are numerous other FERC re-license documents, BLM irrigation facilities, etc. where this issue has been evaluated. State wildlife agency studies of fur bearing mammals may provide additional information.	Not Found	Neither of these researchers shows up in UW library catalog.
Page 4-63: There are studies in Washington State documenting impacts of roads on wildlife. A Department of Game published a study by **Perry and Overly, 1977,** Impact of Roads on big game distribution in portions of the Blue Mountains of Washington 1972-1973. This study showed main roads reduced elk use up to one quarter mile away, secondary roads reduced use up to ½ mile away and primitive roads reduced elk use of to 1/8 mile away. In 1976-7, **Department of Wildlife** found migratory bird use increased 30-50 fold on three Columbia Basin wetlands where parking lots and access were relocated to areas 0.25 to 0.5 mile from the wetlands (Foster et al.1984).	No, and unable to find Foster et al. 1984	References to big game are not included in this synthesis because these species are not wetland-dependent.
WILDLIFE – FISH		
Robinson et. al 1976, from 1980, Medez 1976. Page 4-47: Comment on this text: "No information was found on the impacts of acidity on fish in Washington's wetlands. In their review of the literature, Adamus et al. (2001) found that acidity can be directly toxic to fish, inhibit reproductive maturation, inhibit spawning behavior, induce emigration,"	Not found	Could not locate – not enough information

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
VEGETATION		
Houck, CA, 1996, The distribution and abundance of invasive plant species in freshwater wetlands of the Puget Sound lowlands, King County, Washington, Master's Thesis, University of Washington, Seattle, WA	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Rood, S., J. Mahoney, D. Reid, and L. Zilm. 1995. Instream flow and the decline of riparian cottonwoods along the St. Mary River, Alberta. Canadian Journal of Botany 73:1250-1260. [comment on Page 4-13, Paragraph 6] A good example of how this germination "window" can be affected is through hydrologic modification of stream flow may affect cottonwood germination in riparian areas of western rivers (see Rood et al. 1995.	No	Authors of Volume 1 have more recent articles on this subject.
Hudon, C. 1997. Impact of waterlevel fluctuations on St. Lawrence River aquatic vegetation. Can. J. Fish. Aquatic Sci. 54:2853-2865.	No	Addresses riparian areas not wetlands
A broad tolerance of wetland plants to hydrologic conditions is also reported in Wheeler (1999). Wheeler, B. 1999. Water and plants in freshwater wetlands. In: A. Baird and R. Wilby, eds. Eco-hydrology. Routeledge Press, New York.	Not Found	Could not locate in UW libraries.
MITIGATION		
Monitoring wetland impacts has been a component of several development projects in King County, and Ecology should independently review these results, summarize them, and provide synthesis analysis in this document. Monitoring wetland impacts has been a component of the Snoqualmie Ridge master planned community, located in the City of Snoqualmie, King County. Other pre- and post construction wetland monitoring projects are ongoing in King County, including Highlands and Talus projects in Issaquah, Redmond Ridge, in Redmond, and SeaTac Airport projects in SeaTac.	No	Is beyond scope of Volume 1 to address individual projects.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
There is a lot of information, such as reports, mitigation plans, and monitoring reports, which have been reviewed and approved by various agencies. hi particular, some of the WSDOT monitoring reports could be very useful, but may not specifically qualify as BAS. Also, I assume that you talked to the Corps. Don't they have an internal evaluation of NWP mitigation projects that were permitted in last several years? I suspect that all or most of the Individual Permits were included in W'DOE 2002 study for 401 water quality certification purposes. This information could fill in some of the areas where there is little Washington information.	No	Such reports are not generally considered to be BAS.
This section would benefit from some discussion on monitoring techniques. Measuring & Monitoring Plant Populations (Elzinga et al.) and A comparison of two vegetative monitoring strategies implemented on 4 WSDOT mitigation sites (ICOET Conference proceedings, Bergdolt and Thomas, 2001) both contain good discussions on this topic.	No	Tangential to focus of chapter. Could write a whole volume just on monitoring techniques.
Ossinger (1999) and a new WSDOT guidance document (Haddaway et al., in prep) elaborate on the importance of establishing measurable, functions-based performance objectives and success standards.	No	Not BAS. Authors already have other, peer reviewed documents saying the same thing.
Page 6-7: Include results from Washington State Department of Transportation (WSDOT) Study on wetland mitigation success. WSDOT conducted studies within the state highway rights-of-ways to determine the success of wetland mitigation projects. These references are Lindstrum and Maurer (1999) and Celedonia (2002). Results from these studies should be included in the text of Section 6.3.1 - Results of Literature Studies. **[see references in rows below]**	see next 2 rows	
Celedonia, M.T. 2002. Establishing Appropriate Benchmarks for Site Development by Documenting Successional Characteristics, Phase Two. Washington State Department of Transportation. Olympia, Washington.	Yes	Already in Volume 1.
Lindstrum, A. and M. Maurer. 1999. Establishing Appropriate Benchmarks For Site Development by Documenting Successional Characteristics, Final Report for Phase One. Washington State Department of Transportation. Olympia, Washington.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Kusler, JA and Kentula, ME, editors, 1990, Wetland creation and restoration: the status of the science, Island Press, Washington DC	No	Too dated for this topic.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Society of Wetland Scientists. 2000. Position paper on the definition of wetland restoration. SWS Wetlands Concerns Committee. Accessed on October 30, 2003 at: http://www.sws.org/wetlandconcerns/restoration.html	No	More current mitigation guidance document is cited in Volume 2.
SER (Society of Ecological Restoration Science and Policy Working Group). 2002. The SER Primer on Ecological Restoration. www.ser.org/.	No	Not specific to wetlands
Section 6.10.6 and 6.10.7 Mitigation Banking: Appears to present the perceived positives and ignore any concerns. This section is not balance. We have offered some references to provide a more balanced view. Gallagher, Carol Lee. Aquatic Habitat Mitigation: How Ports Can Improve the Process. 1992. Roberts, Leslie, Wetlands Trading Is a Loser's Game Say Ecologists. Science. Vol. 260. June 25, 1993. United States Army Corps of Engineers, National Wetland Mitigation Banking Study: Wetland Mitigation Banking. Virginia: Institute for Water Resources Publications, February 1994. United States Environmental Protection Agency and United State Fish and Wildlife Service. Mitigation Monitoring and Follow-Through Study 1992-1993.	No, but see explanation	Did not obtain Gallagher because it addresses marine issues not freshwater. Already have Roberts. Corps study was reviewed. Could not locate EPA/FWS study.
Page 6-62: See National Academy of Sciences report on wetland mitigation 2001. Why are National Academy of Science studies and reports not listed here? Comment: Last sentence states: "This literature does not specifically address the role of buffers in providing connectivity between wetlands and other parts of the landscape." There is literature that does exist that deals with these issues. The National Academy of Science's Study 2001.	Yes	Already cited in Volume 1.
FUNCTION ASSESSMENTS		
Null W.S., G. Skinner and W. Leonard. 2000. Wetland Functions Characterization Tool for Linear Projects. Washington State Department of Transportation. Environmental Affairs Office. Olympia, Washington.	Yes	Cited in Volume 2.
Reppert, R.T., W. Sigles, E. Stakhiv, L. Messman, and C. Meyers. 1979. Wetlands Values: Concepts and Methods for Wetlands Evaluation. Inst. for Water Resources, U.S. Army Corps of Engineers, Fort Belvoir, VA. Res. rpt. 79-R1.	Yes	Too dated. The science of wetland evaluation has progressed significantly since 1979.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Cole, A., R. Brooks, P. Shaffer, and M. Kentula. 2002. Comparison of Hydrology in Pennsylvania and Oregon (USA) as an Indicator of Transferability of Hydrogeomorphic (HGM) Functional Models Between Regions. Environmental Management 30:265-278.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
BUFFERS		
Buffers are components of habitat for species that spend part of their life cycles in aquatic and or wetland habitats and other portions in terrestrial uplands. See Brinson M.M. 1993. changes in the functioning of wetlands along environmental gradients. Wetlands 13:63-74.	Yes	Already cited in Volume 1.
WDFW PHS Riparian Document (Knutson and Naef) incorporates the concept that riparian areas are those that either influence the aquatic system or are incorporated in the wetland system.	Yes	Already cited in Volume 1.
Cooke Scientific Services, Inc. 1992. .Wetland Buffers - A Field Evaluation of Buffer Effectiveness in Puget Sound. Prepared for Washington Department of Ecology. Note: Fencing is evaluated as a good alternative to protect wetland buffers.	Yes	Have as part of Ecology document
Johnson, AW and Ryba, DM, 1992, A literature review of recommended buffer widths to maintain various functions of stream riparian areas, King County Surface Water Management Division, Seattle, WA	No	Stream riparian areas different than wetlands; also have more recent information.
Page 5-20: Buffers are ecotones. Odum. (1959) defines "ecotone": . . . (Eugene P. Odum, 1959, Fundamentals of Ecology, Second Edition, W.B. Saunders Company, Philadelphia, page 278.)	No	Not specific to wetlands.
Page 5-25, Paragraph 2. Most often riparian areas would be the connectors between wetlands and buffers or ectononal uplands on the landscape. The importance of intact corridors is stressed in Fevold et al 2001 (**Karen Fevold, Christopher May, Hans Berge, Elissa Ostergaard, Habitat Inventory and Assessment of Three Sammamish River Tributaries: North, Swamp and little bear Creeks, May 2001, King County**)	No	Not considered to be BAS

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Page 5-25, Paragraph 2. Roni et al. point out: "Ideally, habitat restoration requires reconnecting isolated habitats and restoring the disrupted habitat-forming processes. It is important not to overlook the need to protect high-quality habitats.. " (Roni, P,. Beechie, T.J., Bilby, R.E. Leonetti, F.E. Pollock, M.M. and Pess G. R. 2002. A Review of Stream Restoration Techniques and a Hierarchical Strategy for Prioritizing Restoration in Pacific Northwest Watersheds. North American Journal of Fisheries Management 22;1-20, 2002. American Fisheries Society).	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis. May be more relevant to Volume 2.
In the PHS GBHE Pub the following buffers relate to flushing. • Ontario, Canada Vos et all. 1985 300 meters • Florida, Rogers & Smith, 1995 100 meters to reduce dist. from motor boats or people on foot.	See comments	In Volume 1 we already have publications by these same researchers on the subject but with different dates.
WATER QUALITY		
p. 3-29, ¶ 1: The 1966 references used are outdated. If they are retained, they need to be put in the proper context, such as by using the adverb "historically." Suggest revising this discussion using contemporary data. The Ecological Society of America (ESA) has recently published a document on nitrogen cycling and pollution. ESA. 1997. Human Alteration of the Global Nitrogen Cycle: Causes and Consequences. Issues in Ecology Number 1.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
p. 4-12, ¶ 2: Denitrification is an anaerobic process. So, assuming the presence of organics (i.e., source of N) and anaerobic bacteria, the amount of anaerobic area is what controls the rate of denitrification. Therefore, unless permanently inundated areas lack anaerobic conditions, bacteria, and sources of N to reduce, increased flooding would be expected to increase the amount of denitrification regardless of what is happening in seasonally saturated areas. If seasonally saturated areas also possess conditions conducive to denitrification, then the amount of denitrification would be expected to increase even more. This paragraph should to be modified to more accurately reflect the process of denitrification. See for example: Ecological Effects of Wastewater: Applied Limnology and Pollutant Effects by E.B. Welch and T. Lindell 1992.	No	Authors of Volume 1 have other literature on subject, and the text was edited to clarify the issue.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Busnardo, Max J., Gersberg, Richard M., Rene Langis, Sinicrope, Theresa L., and Zedler, Joy B., 1992, Nitrogen and phosphorus removal by wetland mesocosms subjected to different hydroperiods, Ecological Engineering Vol 1:287-307	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Correll, DL, 1997, Buffer zones and water quality protection: general principles.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Haycock, N, Burt, T, et al, eds, 1996, Buffer Zones: their processes and potential in water protection: Proceedings of the international conference on buffer zones, Quest Environmental, Oxford UK	Yes	Authors of Volume 1 already have this article, and added any new or different information presented to the synthesis.
Bortleson, G. and D. Davis. 1997. Pesticides in selected small streams in the Puget Sound Basin. 1987-1995. U.S. Geological Survey Fact Sheet 067-97. Tacoma, Washington. Voss, F., S. Embrey, and J. Ebbert. 1999. Pesticides detected in urban streams during rainstorms and relations to retail sales of pesticides in King County, Washington. U.S. Geological Survey Fact Sheet 097-99. Tacoma, Washington.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Kadlec, R. and R. Knight. 1996. Treatment wetlands. Lewis Publishers. Bocca Raton, Florida. [comment on Page 2-30] Kadlec and Knight (1996) provide a good description of removal processes in wetlands. Most sediment removal is simply by gravitational forces and not filtration. Most chemical removal processes that occur in wetlands are not true "filtration" processes. They are more complex mass transfer processes to sediment or other adsorption sites and often mediated by microbial processes (see for example Kadlec and Knight 1996, page 271). [comment on Page 4-11] Perhaps most simply, flooding wetlands brings a greater volume of surface water in contact with wetland plants, soils, and the chemical processes that lead to water quality improvement. Flooding wetlands can change residence time, the distribution of aerobic and anaerobic environments, and a variety of microbial and non-microbial chemical processes. These factors can affect the water quality improvement functions of wetlands. Kadlec and Knight (1996) and other literature provide further discussion. Page 4-30: In general, and within limits, there are positive feedback processes that link nutrient availability and water quality functions. Greater nutrient inputs to a wetland can increase plant growth, increasing the demand for nutrients, and increase the net removal of nutrient by the wetland. **Kadlec and Knight (1996)** should be consulted to develop a more comprehensive discussion.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Wetzel, R. 2001 Limnology- Lake and River Ecosystems. Academic Press, San Diego, California. Kadlec and Knight 1996 – see row above Richardson, J. and M. Vepraskas. 2001. Wetland Soils. Lewis publishers, Boca Raton, Florida. [comment on page 2-35] While it is likely beyond the scope of this document to discuss phosphorus removal extensively, the discussion presented is extremely simplified. This should be acknowledged and more through references cited. Kadlec and Knight 1996, Wetzel 2000, and Richardson and Vepraskas 2001 provide good descriptions of the overall process. Sand and silt soils are also capable of adsorbing and removing phosphorous. [comment on Page 2-37] During this process, phosphorous, metals and other compounds bind to the iron, and co-precipitate with the iron hydroxides (see Kadlec and Knight 1996, Wetzel 2001). Page 6-53, Paragraph 2: Wetlands that contain open water or long duration flooding would be expected to accumulate less organic matter because of the typical relationship between plant production in ponds, lakes, and littoral wetlands compared to production in emergent shrub or forested wetlands (see Wetzel 2001).	Yes (in part)	Wetzel too general and not wetland specific. Kadlec and Knight – see previous row. Authors already have Richardson and Vepraskas. Comments were addressed without additional literature.
Daniels, R. and J. Gilliam. 1996. Sediment and chemical load reduction by grass and riparian filters. Journal of the Soil Science Society of America 60:246-251.	Yes	Already have in Volume 1.
Vymazal, J. 1995. Algal and element cycling in wetlands. Lewis Publishers, Boca Raton, Florida.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Page 4-29 (top of page?): **Mitsch and Gosslink (2000), p 774 or Wetzel (2001) p 273-274** provide more accurate definitions of eutrophication.	Yes (in part)	Mitsch and Goss already cited in Volume 1. Did not find Wetzel 2001.
TOXICS		
p. 3-33, ¶ 5: Pollutants, particularly metals, also are bound by dissolved organics through the process of chelation. Any organic chemistry text book describes this process, such as Manahan, S.E. 1991. Environmental Chemistry. Fifth Edition. Lewis Publishers, Chelsea, Michigan. Another useful text is Harrison, R.M. (Ed). 1992. Understanding Our Environment: An Introduction to Environmental Chemistry and Pollution. The Royal Society of Chemistry, Cambridge, UK.	No	Chelation was added to text without going into a lot more detail. Additional references on the chemical processes involved in chelation are not needed.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
It is a stretch to infer that sediment removal is analogous to toxic compound removal. Toxic compounds that are bound to sediments may change forms in the wetlands especially if the pH fluctuates. The Chemistry of soils (Sposito, 1989) contains a pretty good discussion on this subject.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Wetlands with clay soils section (pg. 2-38) A better discussion of clay mineralogy can be found in the Handbook of Soil Science (Sumner ed. 2000).	No	Too general. More specific texts on clay mineralogy in wetlands were found and used.
information on the mineralogy of clay soil in Washington can be found on the NRCS/USDA soils web page. MWDOT Regarding the "chemical properties of clays derived from glacial activity" and "clays in Whatcom County"– large areas of Washington and the northern U.S. have been subjected to glaciations and are highly productive agricultural or timber producing areas. In these areas, extensive research on soil properties and productivities is available. I suggest this literature be consulted. Cation exchange capacity is one indicator of the ability of soils to bind metals, and soil surveys for Whatcom Co. indicate reasonably high cation exchange capacities. These capacities are generally similar to soils from an un-glaciated are lacking marine soils are parent material (Multnomah Co., OR.) See chemical data available as a '.pdf' file at: http://www.or.nrcs.usda.gov/pnw_soil/washington/wa673.html http://www.or.nrcs.usda.gov/pnw_soil/oregon/or051.html [Comment on Page 2-38] Clay Soils: See chemical data available as a '.pdf' file at: http://www.or.nrcs.usda.gov/pnw_soil/washington/wa673.html http://www.or.nrcs.usda.gov/pnw_soil/oregon/or051.html	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
I believe "clay,, might be defined better by using a reference such as: "Dictionary of Geological Terms" 'Robert L. Bates and Julia A. Jackson (editors), American Geological Institute, May, 1984. Or; "Glossary of Soil Science Terms", Soil Science Society of America, Madison, WI, 1996. Or perhaps; Miel, Daniel (1982) "Introduction to Soil Physics." Academic Press, New York. Page 25. There is a standard reference (albeit somewhat older) that might be appropriate to use in the discussions of this section on Clay soils. This reference is: Dixon,].B. and S.B. Weed (eds.), "Minerals in Sod Environments." Soil Science Society of America, Madison, WI, 1989.	Not found	Other specific texts on clay mineralogy in wetlands were found and used.
volcanic ash does not weather into bentonite (at least not to my> knowledge and all my textbooks). Volcanic ash typically weathers to a clay> called allophane. If left alone to weather even further, allophane weathers> to another clay called imogolite (Check out the 12th edition of "The Nature> and Properties of Soils" by Nyle C. Brady and Ray R. Weil (a classic college> soils text book).	Yes	Other specific texts on clay mineralogy in wetlands were found that show bentonite is a weathering product of volcanic ash.
It is commonly accepted (I don't have a specific reference for this) that Allophane, Imogolite, and other poorly crystalline clays are the common weathering products of volcanic ash. However, I don't know if these clay minerals are produced from ash in a wetland environment. A reference on this subject that may be productive is: McDaniel, P.A., A.L. Fallen, and M.A. Fosberg. 1997. "Genesis of Non- Allophanic E Horizons in Tephra-Muenced Spodosols. Sod Sci. Am. 1. 61:21 I- 217.	Not found	Other specific texts on clay mineralogy in wetlands were found and used.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Designed, constructed peat filters are used to treat all kinds of wastewater. State and county health departments (including the WA State Dept. of Health) are very aware of this use of organic soils. Productive references might be-, Brooks, J.L., C.A. Rock, and R.A. Struchtenieyer. 1984. Use of peat for on-site wastewater treatment: 11 Field studies. J. Environ. Qual. 13:524-530. Couillard, D. 1994. The use of peat in wastewater treatment. Wat. Res. Vol 28, No.6, pp. 1261 - 1274. Washington State Department of Health. 1997. Guidelines for Peat Filters (Final Draft).\	Not found	UW library only has *Water Resources* through 1993.
Page 4-35: Substantial information on some metals and other elements in wetlands is contained in Vymazal (1995), Kadlec and Knight (1996), DeSousa et al. (2000), Raskin and Ensley (2000), and Klaine (1993). This section is very cursory, as there is extensive literature on various toxic compounds in soil, sediment, other aquatic systems, and wetlands. **[see rows below for specifics on references]**	see rows that follow	
De Souza, M., E. Pilon-Smits, and N. Terry. 2000. The physiology and biochemistry of selenium volatilization by plants. IN: I. Raskin and B. Ensley, eds., Phytoremediation of toxic metals. John Wiley & Sons, New York, New York.	No	Not specifically relevant to wetlands
Klaine, S. (1993). Wetland Ecotoxicology and Chemistry. Environmental Toxicology and Chemistry 12:2155-2307.	No	Too general; not specific to WA
Raskin, I and B. Ensley. 2000. Phytoremediation of toxic metals. John Wiley & Sons, New York, New York.	No	Not specific to wetlands
Zillioux, E., D. Porcella, and J. Benoit. 1993. Mercury cycling and effects in freshwater wetland ecosystems. Environmental Toxicology	Yes	Authors already have the article.
Sanpera C, Ruiz X, Jover L, Llorente G. Jabeen R, Muhammad A, Boncompagni E, Fasola M. 2003. Biomagnification Factors (fish to Osprey eggs from Willamette River Oregon, USA). for PCDDs, PCDFs., PCBs and OC pesticides.. ENVIRON MONIT ASSESS 84:275-315. This is a local citation that I found dealing with the concept of biomagnification. I think you should address this in the sections dealing with toxins (4-40) and I am sure that there is probably a better citation that is more specific to wetlands that the one referenced above.	No	Not specific to wetlands.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Ugolini, F.C. and Dahlgren, R.A. 1991. Weathering environments and occurrence of imogolite/allophane in selected Spodosols and Andisols. Soil Sci. Soc. Am. J. 55:1166-1171.	No	Doesn't appear to be specific to how soils could remove toxics in wetlands
Ugolini, F.C., Dahlgren. R., LaManna, J., Nuhn, W. and Zachara, J. 1991. Mineralogy and weathering processes in recent and Holocene tephra deposits of the Pacific Northwest, USA. Geoderma 51:277-299.	No	Doesn't appear to be specific to how soils could remove toxics in wetlands
Takahashi, T., Dahlgren, R. and P. van Susteren. 1993. Clay mineralogy and chemistry of soils formed in volcanic materials in the xeric moisture regime of northern California. Geoderma, 59:131-150.	No	Not relevant to wet soils
Dahlgren, R.A. and M. Saigusa. 1994. Aluminum release rates from allophanic and nonallophanic andosols. Soil Sci. Plant Nutr. 40(1): 125-136.	No	Doesn't appear to be specific to how soils could remove toxics in wetlands
Dahlgren, R.A. 1994. Quantification of Allophane and Imogolite. In: J.E. Amonette and L. Zelazny (eds.) Quantitative Methods in Soil Mineralogy. Soil Sci. Soc. of America, Madison, WI. 677:430-451 .	No	Doesn't appear to be specific to how soils could remove toxics in wetlands
Shoji, S.M. Nanzyo, and R.A. Dahlgren. Volcanic Ash Soils - Genesis, Properties and Utilization. Elsevier, Amsterdam. 288p. (Book).	Not Found	
Gasser, U.G., R.A. Dahlgren, C. Ludwig and A.E. Läuchli. 1995. Release kinetics of surface-associated Mn and Nl in serpentinitic soils: Ph effects. Soil Science 160(4):273-280.	No	Doesn't appear to be specific to how soils could remove toxics in wetlands
Dahlgren, R.A., J.P. Dragoo and F.C. Ugolini. 1997. Weathering of Mt. St. Helens tephra under a cryic-udic climatic regime. SSSAJ 61:1519-1525.	No	Doesn't appear to be specific to how soils could remove toxics in wetlands
Dahlgren, R.A., F.C. Ugolini, and W.H. Casey. 1999. Field weathering rates of Mt. St. Helens tephra. Geochim. et Cosmochim. Acta, 63(5):587-598.	No	Doesn't appear to be specific to how soils could remove toxics in wetlands
Ugolini, F.C., and R.A. Dahlgren. 2002. Soil development in volcanic ash. Global Environmental Research 6(2):69-81.	Not Found	
Southard, S. B. and R. J. Southard. 1989. Mineralogy and classification of andic soils in Northeastern California. Soil Science Society of America Journal 53:1784-1791.	No	Doesn't appear to be specific to how soils could remove toxics in wetlands
Schiffman, P. and R.J. Southard. 1996. Cation exchange capacity of layer silicates and palagonitized glass in mafic volcanic rocks: A comparative study of bulk extraction and in situ techniques. Clays and Clay Minerals 44(5):624-634.	No	Doesn't appear to be specific to how soils could remove toxics in wetlands

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Schiffman, P., H.J. Spero, R.J. Southard, and D.A. Swanson. 2000. Controls on palagonitization versus pedogenic weathering of basaltic tephra: Evidence from the consolidation and geochemistry of the Keanakako'i Ash Member, Kilauea Volcano. Geochemistry Geophysics Geosystems, an Electronic Journal of the Earth Sciences. Vol. 1, 16 pages. http://www.g-cubed.org/gc2000/2000GC000068/fs2000GC000068.html	No	Doesn't appear to be specific to how soils could remove toxics in wetlands
Page 3-29, Paragraph 4: Part of sentence reads: "greatest concentration of pollutants in surface runoff is typically observed in the fall with the first rains following summer drought (Booth 1991)." NOAA Fisheries has more recent studies on this and the consequences to coho that try to move upstream with first rains. A Seattle Post Intellegencer article described the study. [Urban Runoff Killing Salmon in Washington By J.R. Pegg February 7, 2003 Note: First flow stormwater events have been shown to kill a high percentage of adult coho in urban sytems – another impact of increased impervious surface and stormwater. **NMFS (2003- Strategies for Puget Sound conference)** report 88% mortality in one urban stream a few hours after the coho salmon entered the stream system.	No	P-I article is not BAS. Searched online but could not locate NMFS document.
FORESTED WETLANDS		
Oakley, AL, Collins, JA, Everson, LB, et al, 1985, Riparian zones and freshwater wetlands, in Management of wildlife and fish habitats in forest of western Oregon and Washington, Part I: Chapter narratives, ER Brown, ed., USFS Portland, OR, p57-80	Not found	
Verry, E. 1997. Hydrologic processes of natural northern forested wetlands. IN: C. Trettin, M. Jurgensen, D. Grigal, M. Gale, and J. Jeglum, eds. Northern Forested Wetlands. Lewis Publishers, Boca Raton, Florida. [comment on Page 2-46] References that support these conclusions are: Crum (1988) who identifies the low potential for peat soils to release water and support base flow due to their low hydraulic conductivity. Verry (1997) who presents and reviews data showing that base flow in streams originating from bogs and fens is largely maintained by storage in aquifers that discharge to the wetland, and not by water storage in wetland soils.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
LOGGING		
Page 3-32: Logging roads and mass wasting can take a heavy toll on exiting wetlands in a basin. Presence of roads greatly increases erosion and potential for mass wasting events. See **FEMAT Study.** Logging roads and mass wasting could be the last bullet.	No	Authors of Volume 1 are deferring discussion to Cooke report.
Harr, R.D., A. Levno, and R. Mersereau. 1982. Streamflow changes after logging 130-year-old Douglas fir in two small watersheds. Water Resources Research, 18:637-634.	No	Authors of Volume 1 are deferring discussion to Cooke report.
SMALL WETLANDS		
Semlitsch, RD, 2000, Size does matter: the value of small isolated wetlands, National Wetlands Newsletter: 5-13, non-inclusive	Yes	Already have
REGULATIONS		
ACOE (U.S. Army Corps of Engineers). 2002. Regulatory Guidance Letter No. 02-2. Guidance for the establishment and maintenance of compensatory mitigation projects under the Corps regulatory program pursuant to Section 404(a) for the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1999.	No	Have cited more current guidance in Volume 2.
Page 7-2: This section should identify the Council on Environmental Quality definitions of cumulative impacts. The authors should be aware of approaches to conducting cumulative effect assessments under NEPA (see Council on Environmental Quality 1997). Pages 7-6 through 7-9: This section should identify the Council on Environmental Quality definitions of cumulative impacts. The authors should be aware of approaches to conducting cumulative effect assessments under NEPA (see Council on Environmental Quality 1997). Council on Environmental Quality. 1997. Considering cumulative effects under the National Environmental Policy Act. Washington, D.C.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
King County Department of Natural Resources (DNR). 1998. King County surface water design manual. King County DNR, Water and Land Resources Division, Seattle, Washington.	No	Cite Ecology stormwater manual in Volume 2.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
MINING		
Ripley, E., R. Redmann, and A. Crowder 1996. Environmental affects of mining. St. Lucie Press, Delray; Florida. Sengupta, M. 1993. Environmental impacts of mining: monitoring, restoration, and control. Lewis Publishers, Boca Raton, Florida. [comment on Page 3-32] Books that address mining impacts include: Ripley, E., R. Redmann, and A. Crowder (1996) and Sengupta, M. (1993).	No	Too general
PEAT WETLANDS		
The reason why Sheldon has been unable find relevant information and articles on the impacts of peat mining is an issue of search language. The vast majority of peat mining and therefore peat literature is from outside the US. The root search term used by Sheldon and Associates was "wetland", which 'is a word mostly used in the US and in regulations. This word is not typically used in Canadian and international academic literature dealing with peat. The correct search term is ..peatland". Database searches on this term will surely be productive - (I can't actually check since the State Library limited their database services). Here is a couple of relevant citations which might help get them started: **[see rows below]** Fortunately, its not too hard to extrapolate from these international sources and locations to Washington State, since the Sphagnum substrate species are pretty much universally distributed. Most of the other vegetation is quite similar too, at least the major genera are the same. Because the vegetation is what makes the hydrology and other abiotic mechanics of the acrotelm and catotelm behave the way they do, changes in peatland functions are directly proportional to changes in vegetation. Changes in wildlife habitat quality appear to me to be more a function of fragmentation of the suitable habitat during mining (i.e. unsuitable bare/flooded areas interspersed with natural vegetation).	see rows below	
Price, J.S. and S.M. Schlotzhauer. 1999. Importance of shrinkage and compression in determining water storage changes in peat: the case of a mined peatland. Hydrological processes 13:2591-2601	No	Already have a related article by same researchers.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Lavoie, C. and L. Rochefort. 1996. The natural revegetation of a harvested peatland in Southern Quebec: A spatial and dendroecological analysis. Ecoscience 3:1 01 -11 1.	Yes	Already have this
Jonsson-Ninniss, S. and J. Middleton. 1991. Effect of peat extraction on the vegetation of Wainfleet Bog, Ontario. Canadian Field Naturalist 105:505-51 1.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Mazerolle, M.J., B. Drolet, and A. Desrochers. 2001. Small mammal responses to peat mining of southeastern Canadian bogs. Canadian J. of Zoology 79:296-302	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Mazerolle, M.J. 2003. Detrimental effects of peat mining on amphibian abundance and species richness in bogs. Biological conservation 1 1 3:215-223.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
Crum, H. 1988. A focus on peatlands. University of Michigan Press, Ann Arbor, Michigan.	No	Too general and dated.
MICROBES		
Ford, T.E. 1993. Aquatic microbiology, an ecological approach. Blackwell Scientific Publications, Boston, Massachusetts.	No	Too general and not specific to wetlands.
p. 4-44, ¶1: Identify the pH at which denitrifying bacteria are affected. Is it likely that such changes in pH would occur from potential sources of acid in the urban environment? It seems unlikely that nonpoint pollution is likely to cause changes in pH of a magnitude that would adversely affect water quality functions, especially considering the slightly acidic nature of rainfall and soils in this region. The only likely scenario I can think of is changes in pH caused by changes in hydrology to peatlands. For a good review of western Washington peatlands and acidity mechanisms see Chapter 3: Chemistry of some *Sphagnum*-dominated peatlands in western Washington. http://yosemite.epa.gov/R10/ecocomm.nsf/37aa02ee25d11ce188256531000520b3/9a6226e464ecdb3f88256b5d0067de0d?OpenDocument.	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.
AGRICULTURE		
Substantial information on the effects of agriculture on soil properties is available. The "no-till" farming practice is but one outcome of this research. Perhaps NRCS publications should be consulted.	No	Not wetland specific

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
p. 4-6, ¶ 4: The timing and duration of grazing are also important factors that determine the impacts of grazing on riparian and wetland vegetation. There is a large volume of literature, such as Practical Approaches to Riparian Resource Management: An Educational Workshop. 1989. Gresswell, R.E., B.A. Barton, and J.L. Kershner (editors). U.S. Bureau of Land Management, Billings, Montana, that indicate that sensitive areas can support grazing provided the timing and duration of grazing is properly managed (i.e., appropriate rest and rotation).	No	Reference is pretty dated – not as recent as references on grazing we already have in Volume 1.
Livestock Grazing and Weed Invasions in Arid West by A. Joy Belsky and Jonathan Gelbard, April 2000. Oregon Natural Desert Association.	No	Not wetland specific
Kanterud, H.A. 1986. Effects of Vegetation Manipulation on Breeding Waterfowl in prairie Wetlands – A literature Review, US Department of the Interior Fish and Wildlife Service Fish and Wildlife Technical Report 3	No	Reference is pretty dated – not as recent as references on grazing we already have in Volume 1.
Some literature Munro (1963) and Hopper (1972) suggest that moderate grazing of wetlands could increase invertebrates.	No	Suggested reference is quite dated. We have more recent references that reach the same conclusion.
[comment on Page 3-15] Should add the following as documentation that agriculture is the factor responsible for most direct wetland losses: Shaich, J. 2000. Wetland Regulatory Compliance in the Willamette Valley, Oregon: 1982 to 1994. Oregon Division of State Lands, Salem, OR. Bernert, J.A., J.M. Eilers, B.J. Eilers, E. Blok, S.G. Daggett, and K.F. Bierly. 1999. Recent wetlands trends (1981/82- 1994) in the Willamette Valley, Oregon, USA. Wetlands.19:545-559.	No	Already have cited similar data from the Willamette and we did not want to focus too much attention on Oregon by citing may similar references.
Bugg, R.L. and P.C. Trenham. 2003. Agriculture affects amphibians (Part 1): Climate change, landscape-scale dynamics, hydrology, mineral enrichment of water. Sustainable Agriculture (newsletter of UC SAREP), Spring 2003 15(1). http://sarepdevel.ucdavis.edu/newsltr/v15n1/sa-6.html	Yes	Not considered to be BAS (but has good list of references that were checked)
Bugg, R.L. and P.C. Trenham. 2003. Agriculture affects amphibians (Part 2): pesticides, fungi, algae, higher plants, fauna, management recommendations. Sustainable Agriculture (newsletter of UC SAREP), Fall 2003 15(2):8-11. http://sarepdevel.ucdavis.edu/newsltr/v15n2/sa-7.htm	Yes	Not considered to be BAS (but has good list of references that were checked)
[comment on Page 3-22] Research is available on how agriculture affects habitats and should be cited. A starting point is Chapter 13 in Johnson and O'Neil, eds. (2001)	Yes	Chapter already cited as a separate document.
Page 4-7: top. (See Livestock Grazing and Weed Invasions in Arid West by A. Joy Belsky and Jonathan Gelbard, April 2000. Oregon Natural Desert Association.)	Yes	Authors of Volume 1 have reviewed article and added any new or different information presented to the synthesis.

References Suggested by Reviewers and Reviewer Comments (Where Applicable)	Reference Obtained?[1]	Explanation
Also Kanterud, H.A. 1986. Effects of Vegetation Manipulation on Breeding Waterfowl in prairie Wetlands – A literature Review, US Department of the Interior Fish and Wildlife Service Fish and Wildlife Technical Report 3 shows mixed results from grazing that may be related to intensity of thegrazing.	No	Reference is pretty dated and addresses prairie wetlands that are not found in Washington
Page 4-10. top paragraph. Grazing can remove bird habitat nesting cover and impact production. In the Columbia Basin, heavy grazing next to wetlands removed buffer vegetation and reduced waterfowl production by 50% (Foster et al. 1984).	Not found	
Page 5-6: "Especially shallow wetlands that might be dry much of the year, but are maintained by repeated seasonal saturation or inundation, require protection even at times they are completely dry if they are to retain their functions . . . Agricultural wetlands, which for present purposes include both farmed and non farmed areas, are extensive within the United States. They often perform functions that are similar in nature to those of nonagricultural wetlands. Use of special definitions or criteria for the identification of agricultural wetlands is not justified because it leads to different delineation of wetlands on agricultural and nonagricultural lands."— National Academy of Sciences, 1995.	No	Assume he's referring to National Research Council 1995, which is already cited in Volume 1.