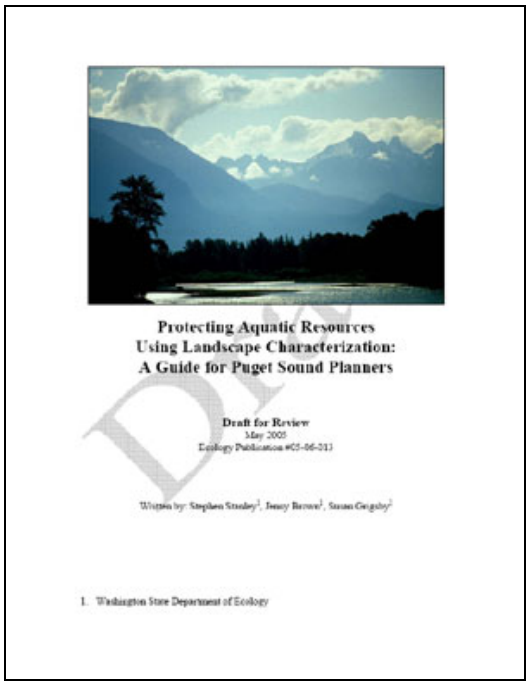

Draft Protecting Aquatic Resources Using Landscape Characterization: A Guide for Puget Sound Planners

---

Responses to Comments

February 2006
Ecology Publication #06-06-009
Printed on recycled paper

Draft Protecting Aquatic Resources Using Landscape Characterization: A Guide for Puget Sound Planners

---

Responses to Comments

February 2006
Ecology Publication #06-06-009

Printed on recycled paper

This document is available on the Department of Ecology web site at
http://www.ecy.wa.gov/biblio/0606009.html.

For a CD or printed copy of this report, contact:

Department of Ecology Publications Distribution Office
Address: PO Box 47600, Olympia WA 98504-7600
E-mail: jewi461@ecy.wa.gov
Phone: (360) 407-7472

Refer to Publication #06-06-009

For the Draft *Protecting Aquatic Resources Using Landscape Characterization: A Guide for Puget Sound Planners* refer to Publication #05-06-013.

For the Final *Protecting Aquatic Ecosystems: A Guide for Puget Sound Planners to Understand Watershed Processes* refer to Publication #05-06-027.

Published by the Department of Ecology's Shorelands and Environmental Assistance Program, P.O. Box 47600, Olympia, WA 98504-7600. If you have special accommodation needs or require this publication in an alternate format, please contact Tim Schlender at 360-407-6096 (Voice) or TTY (for the speech or hearing impaired) at 711 or 800-833-6388.

Table of Contents

Introduction to This Document

This document contains all of the comments that the state Department of Ecology received in the fall of 2005 during the public review of the draft *Protecting Aquatic Resources Using Landscape Characterization: A Guide for Puget Sound Planners* (Ecology Publication #05-06-013). Changes to the draft to address the comments resulted in the final document *Protecting Aquatic Ecosystems: A Guide for Puget Sound Planners to Understand Watershed Processes* (Ecology Publication #05-06-027). Twenty individuals provided comments, and a list of those individuals is provided in Table 1.

The authors of the draft asked reviewers to provide general comments on readability as well as technical comments regarding the accuracy of the information presented.

The comments received are organized into topic areas listed in the table of contents. Since the final document represents a significant reorganization of the draft, we felt the topic areas would enable the reader to follow the changes between documents. For each comment submitted, the authors 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).

The comments are numbered sequentially within each topic area. Very similar or related comments are all listed under that same comment number. For example, in the topic area of General Comments, the first ten main comments are numbered G-1 to G-10, but there are 21 separate comments from individual reviewers.

Table 1. List of Reviewers of Draft.

Name of Individual	Affiliation at the Time of Review
Allison Aldous, PhD, Wetland Ecologist	The Nature Conservancy
Tim Beechie, PhD, Fisheries/Watershed Ecologist	Northwest Fisheries Science Center
Susan Bolton, PhD, Hydrologist	Department of Forest Resources, University of Washington
Derek Booth, PhD, Geologist/Geomorphologist	Department of Civil Engineering, University of Washington
Janet Carroll, Watershed Planner	Snohomish County Surface Water Management
Randy Davis, Shoreline Planner	Department of Ecology
Dick Gersib, Wetland Ecologist	WA Department of Transportation
Arthur Gold, PhD, Biogeochemist	University of Rhode Island
Noel Gurwick, PhD, Wetland Ecologist/ Biogeochemist	Stanford University
Tom Hruby, PhD, Wetland Ecologist	WA Department of Ecology
Mary Kentula, PhD, Wetland Ecologist	Environmental Protection Agency
Krystyna Kowalik, Hydrogeologist	WA Department of Ecology
Gino Lucchetti, Fisheries Ecologist	King County
Patricia Olson, PhD, Hydrogeologist	WA Department of Ecology
John Owens, Planner	Makers, Inc.
Doug Peters, Planner	Community Trade and Economic Development
Joanne Schuett-Hames, Fish/Wildlife Biologist	WA Department of Fish & Wildlife
Peter Skidmore, PhD, Hydrologist/Aquatic Ecologist	The Nature Conservancy
Linda Storm, Grants Manager, Ecologist	Environmental Protection Agency
Tom Winter, PhD, Hydrologist/Hydrogeologist	US Geological Survey

Overall Impression of Guidance

O-1 Comment*: Allison Aldous:* I think this is a really solid framework for developing freshwater management, protection, and restoration plans. The document is well organized, logical, and well written. Kudos to the authors!

O-2 Comment: *Tim Beechie:* The concept and general approach is a good one. There are a few details that should be addressed to clarify Parts I and II in terms of the details (mainly in tables 3 and 4).

O-3 Comment: *Susan Bolton:* Overall the document provides a useful resource for planners. It is a good draft that needs some editing and clarification. The level of detail and clarity of writing varies from section to section.

O-4 Comment: *Derek Booth:* I've finished my review of this document. Regardless of what you may imagine is the "tone" of my comments, I really DID like it! I think you reach a little too far, but I've always admired what Dick Gersib did for wetlands and I think you've made a respectable translation. This will be very helpful to a lot of people.

O-5 Comment: *Dick Gersib:* First and foremost, I believe you got the landscape context right, and you should all be commended to that accomplishment. As I told Stephen via telephone last week, I was invited by the Environmental Law Institute to participate in a national workshop to develop guidance on doing compensatory wetland mitigation at a landscape context. At this workshop, of about 30 technical people doing "watershed" work, it quickly became apparent that many people were doing site-specific work at landscape scales, but few were actually putting individual sites in a landscape context. There is a huge difference between the two and your approach does the latter. I can't emphasize enough how significant a distinction this is, and your guidance gets it right. Your foundational concepts are rock solid in my view. Good Job!!

O-6 Comment*: Dick Gersib:* While I've spent a fair amount of time expressing concerns, I want you to know that I believe that you have taken a huge step forward in your development of these landscape characterization methods. The fact that you are in a position to encourage local planners and biologists to think "landscape processes" is, by itself, a giant step forward for natural resource protection and management. My comments are only intended to provoke additional thought and discussion on specific parts of your approach in light of what I have learned or observed through our watershed characterization work. I'm sure many of my comments can be immediately discarded as me simply not understanding your process clearly. However, if my comments can help improve your work in just one small area, than I consider it time well spent.

O-7 Comment*: Mary Kentula:* Here is my review of the Ecology Landscape Guidance. As you will see in the review, I really liked the document. I wish that I had more time to spend on the Appendices. I suspect that's where my input would be most useful. That said, it's very clear what you are recommending and why so if someone disagrees they can do something different using your process. I think that's very important because it's impossible to get everyone to agree on everything, especially regarding the issues you are trying to address. The real value in what you have done is the process.

I reviewed the document, "Draft Guidance for protecting Aquatic Resources in Puget Sound," by reading the main manuscript and scanning the appendices. I found the manuscript to be clear and well organized. It is both a beautiful and useful document. I especially liked the format (walking the reader through the process being presented) and the text boxes and think both contribute to the overall utility. The emphasis is on the appropriate scale for what is being presented. The method is well documented. I was impressed by the citations of very recent publications.

O-8 Comment: *Krystyna Kowalik:* During my professional work I have implemented a similar approach for City of Trondheim, Norway. Although not called a Landscape Approach there, it was a multidisciplinary approach, which provided planners with base maps like ones that Stephen and his team provided. My background in hydrogeology and engineering geology was useful for the project. In addition, I used morphology (morphology being an earth science that encompasses all land forms and processes that create or alter them) as the basis of the land evaluation.

Here is the commonality between Stephen's and my work, which allowed me to evaluate the SEA team project and appreciate its importance and high quality.

I applaud Ecology and SEA program for writing such a sound guideline for these planners, who always have used an interdisciplinary approach in the planning process. The publication of this Guide is very timely and may become essential for the urban planning process of sustainable communities. I give this document my highest recommendation.

O-9 Comment: *Gino Lucchetti:* First and foremost, congratulations on producing an extremely well done document. I read it and have relatively little to critique (see attachment for comments). I was impressed with how well you presented the information and guidance. I think it will be a valuable help for planners everywhere.

Overall I thought the document was excellent -- well written, well organized and with no major flaws in fact, logic or rationale. I did not have time to think through all the procedures for planners, but on the surface they make sense and should be a vast improvement form current ways of assessing watersheds and landscapes.

O-10 Comment: ***John Owen:*** I've looked through the paper and think that it will be an extremely useful tool from a planning/management stand point. In fact, I think that it will take us to a whole new place in our abilities to deal with the larger scale, and will help planners, public officials and citizens to better understand these issues**.**

Response: *Thanks!*

General Comments

G-1 Comment: Foundational assumption. *Dick Gersib:* I sense that this document works from a foundational assumption that you identify key areas for multiple ecological processes and then focus your efforts there. Initially I saw the logic in this approach but I am concerned that when characterizing how humans have altered ecological processes that you are omitting large parts of the landscape. For example, in a catchment that has recessional outwash, till, alluvium, and bedrock, different levels of development will have varying effects on surface and sub-surface water movement. I may not be fully understanding your approach, but I believe we need to characterize the condition of the entire catchment and not just "key areas". For example, in your evaluation of surface water runoff, you characterize the condition of rain on snow areas, wetland, lakes, and floodplains, and recharge soils. Numerous catchments in Puget Sound are dominated by till. Without looking at how humans alter the surface water runoff on these till soils you will likely be missing the source for huge changes in runoff. Just ask King County if develop on till hasn't had a major effect on aquatic resources. I believe that parts of the landscape are clearly more sensitive to human alteration than others, but I'm not convinced that we can ignore the effects of human develop in any part of a catchment. This is where I think the modeling work can really help provide direction and guidance. By modeling the effects of different land use intensities on different geologic landforms can help us provide insight into both the extent of process alteration and were to place future growth.

Response: *This and other comments were helpful to redefining how we dealt with the water movement process in this document. We have developed a far more specific and comprehensive conceptual model of water movement that considers the entire catchment and how different geologic deposits (including till) and types of alterations affect water movement. Now all aspects of water movement are tied into the assessment of key areas and alterations. We feel that we cannot say that human alterations everywhere have an effect but rather that we need to be clear about what effect is important in which areas; this kind of specificity will allow planners to identify the types of development or activities (if any) that may minimize alteration to different aspects of each process.*

G-2 Comment: Biota as processes.

P Skidmore: **Page 1 -** Biota were probably much more important as landscape processes in the past than now. The sheer volume of salmon spawning and perhaps more importantly beaver dam complexes, was probably sufficient 100 years ago to warrant consideration of being included as essential processes at the landscape scale.

Tom Hruby: need to spell out why this approach still works in absence of biota

Derek Booth: Tell us that this omission isn't critical

Derek Booth: See Karr, 1991; similar but you've left out biotic interactions which may be equally important. At least know that this is only one perspective.

Response: *As we have defined watershed processes to involve physical and chemical interactions, our methods here do not address the biological processes that occur at a watershed. These are being developed by WDFW (Erik Neatherlin and Joanne Schuett-Hames) for use in the future but their absence does not invalidate these methods for understanding the physical/chemical watershed processes.*

Linda Storm: Explain how biodiversity or environmental conditions change with process alteration and how those effects are different for streams and wetlands. Tie this back to maintaining biological systems.

Response: *This changes have been made in sections 1.1and 1.3 of the final guidance. An example of processes operating in streams and wetlands has been provided in each of these sections. We have also stated that successful protection and restoration of our aquatic ecosystems is dependent on considering watershed processes.*

G-3 Comment: Link figure I-1 to EPA 3-Tiered Approach. *Linda Storm*: Incorporate the National EPA 3-tiered framework of landscape assessment, site specific assessment and monitoring into document.

Response: *Appendix J (Framework for Planning at the Landscape Scale) now incorporates the EPA 3-tiered approach.*

G-4 Comment: Discuss what guidance does. *Derek Booth:* Page 3, last paragraph tells us what the guidance document doesn't do, but it would be much more useful to tell us what it does do! Also say why it's important that this guidance doesn't present methods for assessing functions (he gives his rationale).

Response: *These suggestions have been incorporated into the final document (see the executive summary and introduction).*

G-5 Comment: Process-function-structure section not useful. *Peter Skidmore:* Figure 1-2, Page 3, "Process, Structure, Function" – this figure does not work well for me conceptually. I am struggling with the difference between "drivers" and "controls". These concepts, if different, should be clearly defined relative to one another. Climate, in this figure, is one of a number of drivers. This should be stated in the figure caption, that this is one example. And if climate is used as an example of a driver, all the other components of this figure should relate to that driver. The ones in the box do not. Overall, this figure could be helpful conceptually, but its details leave me confused as they don't really provide a consistent example related to a driver.

Derek Booth: Page 3—The "process-structure-function" paradigm is not as useful as you make it out to be, and I wonder if you need it at all. Its problem? Consider "flow regime"—yes, a process, and one that in turn affects physical habitat in a stream that in turn contributes to the suitability (or not) of the resident biota. But the flow regime is also a direct influence on biota without any "structural" intermediary. If the flow isn't right, fish and bugs die, and it doesn't make a bit of difference what you do (or what the flow did) with the channel structure. Indeed, this paradigm invites "restoration" at the business end of a backhoe rather than through attention to watershed processes, and as such it is actually antithetical to your underlying premise. Me, I'd drop it and never look back.

Derek Booth: Function is not displayed in Figure I-2 except via structure

Dick Gersib: Small arrow between structure to landscape processes. Arrow down from structure (on left) to function.

Gino Lucchetti: Pg 3: Where's vegetation? Suggest adding vegetation (including its by-product- LWD) in the landscape process box or renaming the box to "Landscape physical processes". To me aquatic habitat is primarily the result of the mixing of water, sediment AND vegetation (and, technically speaking, the feedback actions of all the other animals, but vegetation is the dominant biologic factor).

Response: *This section and the accompanying figure have been removed from the final document. We concluded that neither were helpful to readers and caused more confusion*

Linda Storm: Provide a better definition of processes that incorporates scale. Do this by showing examples of how alteration of processes at the larger scale affects functions at the site scale. Also be clear that we are not predicting site specific effects with this guidance. Look at Karr and National Biological Wetland Assessment Group work and Rob Brooks work in Pennsylvania.

Response: *The guidance document has been revised to incorporate these comments. Section 1.1 contains a new definition of processes that addresses scale. Section 1.3 describes how processes at the watershed scale affect functions at the*

site scale. The Executive Summary has been revised to clearly state that the methods do not establish a direct connection between alterations at the larger scale and ensuing impacts at the site scale.

G-6 Comment: Physical vs. geologic feature. *Susan Bolton:* Page 4. It's not clear to me what the difference is between physical and geologic features. Don't physical features include geologic features?

Response: *Yes, those terms were duplicative. This section has been removed from the final document.*

G-7 Comment: Goals and objectives. *Dick Gersib: S*ee my notes adjacent to page 5. It appears there are goals and objects scattered throughout pages 5, 7, 8, 14, and 18. I suggest that you organize your goals and objectives in one single place in the report. I also sense that you have goals that really should be objectives and objectives that are goals. I'm usually not so picky about things like this but in this case, I think it's essential that you clearly define your goals of the document. How this guidance document can and cannot be used. This is important in light of my concerns noted in #1 above. (*DG's* notes are as follows:)

Objectives:Page 8 – Assist in identifying patterns for future development; Page 7 – 1. Use existing environmental data and 2. use existing land use info; Provide quantitative or qualitative prediction of risk by human activities to natural resources; P. 7 – 1. ID relationship between processes and natural resources 2. ID relative importance of different areas for maintaining processes 3. ID risks of human activities to processes and resources 4. ID measures to maintain key processes/aquatic resources.

Goals: Page 14; 1. Be easily adaptable for use in other regions (*DG* disagrees – focus on Puget Sound and get it right there first); 2. Be flexible in the type complexity of data used; 3. Support adaptive mgmt in land use planning; Page 8 – assist planner in meeting planning goals for resource protection of state and local regs/laws; Page 5 – minimize risk to resources from human activities; Page 7 – Protect aquatic resources; Page 8 NGO's restore, manage, and conserve aquatic resources; Page 18 – id relationships between key processes and important areas to guide identification of restoration locations and option (but see DB's notes about over reaching)

Results/Application: Policy decisions/land management based on risk by different land uses or management actions

Audience: NGO's, local governments managing natural resources in Puget Sound

Response: *These comments helped us revise the main document so that goals and objectives were presented only once!*

G-8 Comment: Figure I-3. *Susan Bolton:* Figure I-3 - It's not clear to me why you switch to 'map types' for step 5 when all of the other steps are 'map areas' Aren't you still mapping areas? Why not say 'map areas with alterations to key processes? I suggest changing this throughout the document.

Derek Booth: Figure 1-3 is confusing and not helpful at all.

Mary Kentula: p. 6 figure I-3—The relationship between scoping and characterization in the figure is not clear. It is explained in the text in the paragraph that follows the figure.

Response: *Figure I-3 has been removed.*

G-9 Comment: Additional reasons to use framework needed. *Tom Hruby:* p.8 – 2. need another bullet in first set of bullets…. • Protect resource as per state law

Response: *We have removed this section and incorporated this suggestion into the executive summary by listing the state resource management acts and how the methods can be used to meet the requirements of these laws (also see appendix J).*

G-10 Comment: Specify target audience. *Linda Storm:* Be clear about who can use this guidance and for what purpose.

Response: *This is now clarified in the Executive Summary and the Introduction to the Guidance.*

G-11 Comment: Level of expertise needed to implement method. *Dick Gersib: Repeatability and Level of Expertise* - I am concerned about the methods repeatability and level of expertise required to do landscape characterization. The title states that it is guidance for Puget Sound planners and yet it was mentioned that planners, local jurisdiction biologists, or consultants can be expected to apply the tool. The variability is great when comparing each user's technical background. Your Leavenworth example (pages 12-13) is a good illustration. With your (Stephen) wetland experience and the services of a local hydrogeologist, you interpreted the data and came to some logical conclusions. A consulting firm would have reasonable potential to come up with similar results. However, I am concerned that a local planner or pair of local biologists would have a difficult time interpreting the data in a similar manner and coming to the same conclusions that you or a consultant would. This could be a misconception on my part, but I sense that you provide reasonable steps and detail for compiling and handling data but substantially less guidance on how to interpret the data. Groundwater – surface water relationships are complex. Oversimplifying complex systems and the interpretation of human affects on complex systems by non-subject area specialists is a formula for bad decisions. How many times have you seen subject area specialists disagree? Putting local planers or biologists in a position to interpret this

same kind a data is asking them to do more than they are capable of doing. As we talked by telephone, the solution may be to help them in the interpretation process by establishing cause and effect relationships, that allows them to work through a more structured cause and effect matrix approach (an "if this, then this" process).

This issue is all about managing risk. Mistakes made in selecting a wetland restoration site to maximize environmental benefits has very limited risk to surrounding residents or natural resources. However, making mistakes on where to site a new development can have major long-term effects on natural resources well outside the development footprint. You may want to explore the possibility of stratifying your methods into characterization suitable for different levels of technical expertise. Local planners can use the tool for certain things that have low environmental risks. Local biologists can use the tool for other additional characterization applications that have addition environmental risk, while the methods can be used by interdisciplinary technical teams for all possible applications.

Response: *We agree that the interpretation of the characterization would require involvement of a* ***hydrologist, geologist, or hydrogeologist, along with a GIS analyst and an aquatic ecologist****. This is now clearly stated in both the executive summary and the methods guidance. If you use the mapping methods and data sources in Appendix H, you will get repeatable results in terms of areas of the watershed that are important for a process. However, integration of this information into decision making is not repeatable, regardless of the source of the data. Integration at the planning level can be variable due to local policies and political circumstances, but should be based on the interpretation of the team of specialists. This is why it is important to have the specialists involved throughout the characterization. (See Comment G-31 for additional discussion.)*

Linda Storm: Specify the type of expertise that is required to apply the methods.

Response: *The expertise required to apply the guidance is now set forth in the Executive Summary and Step 1 of the guidance (section 2.2.1).*

G-12 Comment: Leavenworth example. *Derek Booth:* Page 12-13: this example seems premature—all of the details raise more questions than are resolved by your "answer." If previous pages had been more concrete, you'd not be feeling the need for an example. Without the full background, however, this seems very flimsy.

Dick Gersib: What datasets were used? Residents were concerned about clearing in the Upper watershed – how was the characterization used to discount this assumption in lieu of your conclusions? Was this all about taking the professional opinion of a hydrologist or were you letting your results stand on their own – none of this is clear from the description. Raises issue of whether you can expect a local planner to come up with the same (replicated) outcomes that you did. [See DG's comments about acknowledging that this is one method, 3 levels of analysis (for

planner, limited technical support, and for interdisciplinary team), and 3 different outcomes potentially]

Restoring ecological processes would mean plugging drains rather than putting more water into a wetland – that's good problem solving but not restoration.

Response: *We have removed the Leavenworth example based on the comments above. We agree that it did not help readers to understand the methods.*

G-13 Comment: Sub surface vs. groundwater. *Susan Bolton:* Page 13 Figure I-5 - You switch from using 'subsurface' to using ground water. It's not clear to me anywhere in the document whether you use these terms synonymously or whether they have separate definitions in your work.

Response: *We now have added a section describing the delivery, movement and loss of water in which we explicitly define subsurface flow versus other types of water movement.*

G-14 Comment: Scoping discussion. *Peter Skidmore:* Page 14 – Scoping. What should the outcome or product of scoping be? It is not clear from this text how this relates to "Characterization" in section C. If scoping is different than characterization, which I know you mean for it to be, need to clearly state how one relates to the other. If that distinction is not possible, then perhaps scoping and characterization can be a single component of the approach and more clearly related.

Peter Skidmore: Section II. C. Page 15. Three items listed (i., ii, and iii) - how do these differ from the scoping process? This seems like scoping to me.

Peter Skidmore: Section III. C. Page 25, Figure III-1This diagram hints at how "scoping" relates to the rest of the flow diagram. But when "Scoping" was discussed earlier, it was not clear how it related or well articulated. Consider using this diagram in previous section that discusses scoping, and articulate what products or purpose of scoping

Tom Hruby: p.14 – B. goals of scoping?

Derek Booth: Page 14, "Scoping" is presented as an optional step, but of course it is critical. The discussion of stakeholders is out-of-place in a technical document but is certainly important in the planning process. This doesn't really work here as written, however. Do more than recommend scoping – it's really step 1.

Response:. *We have now included a first step which incorporates a scoping process (i.e. Step 1: Define the Purpose of the Analysis.")*

G-15 Comment: Table 1 (Types of aquatic resources based on their HGM characteristics). *Tom Hruby*: p.16 – in Table 1….Marine …add 'not addressed'

Derek Booth: What do you call lakes that are less than 7' deep?

Derek Booth: Seems like this has borrowed a bit heavily from the WETLAND HGM approach. Are there no other aquatic resources but wetlands to be found on slopes and in depressions? Maybe so, but seems a bit forced.

Response: *Table 1 has been removed from the document.*

G-16 Comment: Contributing area not correct scale to consider input. *Peter Skidmore: Section* II. C. page 18, third paragraph**:** Also within this paragraph, it states that "contributing area" is the source for inputs of phosphorus, nitrogen, pathogens, etc. Many of these can and are closely tied to point sources, not just non-point sources. Feedlots and dairy farms for example. And even beyond point sources, small areas of floodplain agricultural land can produce 100% of the undesirable inputs listed, but shouldn't really be considered at the scale of "contributing area" – they drain directly to the stream even when the majority of the watershed is upland or forest.

Response: *The final has been revised to not identify the entire contributing area as the source of inputs of phosphorous, nitrogen, pathogens. The guidance now ties inputs to land use activity.*

G-17 Comment: Addressing issues outside of your jurisdiction. *Janet Carroll:* If you are a local jurisdiction and some of the landscape processes occur outside your jurisdiction, what do you do? Most jurisdictions don't work together on their plans or regulations. When you were working on this strategy how did you perceive this obstacle being overcome?

Response: *The guidance recommends that local jurisdictions characterize processes that occur outside of their jurisdiction since it will still determine what type of planning decisions for protection and restoration you will undertake within your jurisdiction. This type of situation will occur primarily with cities. As you know, there is no state law that presently requires jurisdictions to work together on plans and regulations. It is hoped that this method would encourage jurisdictions to work cooperatively since it will help illustrate how actions in one jurisdiction will impact resources in an adjoining jurisdiction.*

G-18 Comment: How to deal with gw contributing areas of different size than watershed? *Janet Carroll:* Page 28. How would a groundwater contributing area that is smaller than the surface water contributing area affect the analysis?

Response: *In discussing this with our hydrologist we could not see a situation where the gw contributing area would be smaller than surface water contributing area for the Puget lowlands under unaltered conditions. This may occur in a higher altitude mountainous watershed where exposed bedrock was present for a*

significant portion of the watershed. If the extent of the contributing area for ground and surface water are different, you would conduct the analysis for the larger area, in this case the surface watershed. In Step 2 we have tried to provide clearer guidance on this.

G-19 Comment: Combining delivery and removal into one category. *Susan Bolton:* It seems like the document doesn't distinguish between overland flow-surface runoff and streamflow. These are two separate processes that seem to be lumped. It seems to be a particular difficulty when talking about delivery and removal of pollutants. The processes for removal differ a bit depending on whether you are talking about overland flow-surface runoff or streamflow. This seems to be an area where confusion in the user could develop. The combining of the processes of delivery and removal into one category is a bit confusing. I think the methods would be clearer if you separated them even if you don't separate surface runoff and streamflow.

Response: *The methods now account for overland flow-surface flow as a separate component from surface flows in streams and rivers. Indicators for movement of pathogens as overland flow are identified (impervious surface) while indicators for the movement of other indicators were not clearly identified in the literature. The methods are now much more specific as to the removal mechanisms for nitrogen, phosphorous and toxins. We believe that these changes will reduce confusion present in the first draft over the delivery and removal components.*

G-20 Comment: Table 3. Need to include important things but not overload the list with everything – done well but need to explain the things left out. (Referring to table 3 in main document) *Derek Booth:* I think the challenge with this approach is that either you are tractable but oversimplified, or comprehensive but cumbersome. Everything really <u>is</u> connected to everything else, as I'm sure you know! Your challenge is 1: to hit the 'sweet spot' where everything important is included without making too long a list and 2: convince the reader that in leaving some stuff out, you haven't left out anything <u>too</u> critical. Decent job here on #1, but no acknowledgement of #2.

Response: W*e have now added discussions of why certain things were left out of the characterization. Usually this comes down to the fact that it is not possible, using regionally available data, to map all components of a process. However, even these components of a process are now included in all the tables (ie. For key areas and alterations) and users are encouraged to address these components using local data when possible.*

G-21 Comment: Should focus only on things humans can change (referring to Table 3, pg 19 in main guidance): *Dick Gersib:* Your approach is good…however, I'm concerned that this table does not identify the proper inputs, movement, and loss factors for each process. I suggest you focus on where humans alter natural processes rather than focusing on attributes that we can't or shouldn't change.

Response: *We have eliminated table 3 and have developed, in Appendices A through G, more detailed diagrams and tables for each process that more fully address the suite of inputs, moment and loss factors. Further, in these appendices we identify under the alterations section, indicators for those components of each process that can be altered by humans.*

G-22 Comment: Use of the Term "Control." *Linda Storm*: Consider alternative term that is more reflective of the dynamic nature of these processes such as components and/or mechanisms.

Response: *We have incorporated the term component into the process diagrams. We have also continued to use the term "controls" since it is established in papers published on describing processes for the purpose of restoration (i.e. Beechie and Bolton 1999, Beechie et al. 2003).*

G-23 Comment: Data needs. *Dick Gersib:* I'm concerned that key datasets may not be available to complete an adequate landscape characterization throughout the Puget Sound region. *Current* data on wetlands, floodplains, dikes/levees, and stream channel straightening are just a few big data holes in some/many parts of Puget Sound. *DG*'s experience is that readily available/existing data is NOT adequate for this type of characterization

Response: *This comment was very useful in helping us revise the guidance. The review draft of these methods attempted to provide examples of products that included the identification of specific restoration sites. The purpose of the examples was not to indicate that planners alone could apply this guidance and develop these types of conclusions, but rather to show how characterization could <u>contribute</u> to those kinds of decision. It was not made clear in the draft document that decisions about a particular site would require the integration of the information from the characterization with additional subbasin analysis. The present guidance now clearly describes products only at the watershed scale which includes identification of <u>areas</u> most suitable for protection and restoration. This type of "coarse scale" characterization can be accomplished using existing data.*

*We used multiple indicators for most processes in order to provide a complete picture of all the components of a process. The ones that can be identified with existing data are in **bold**. We have identified additional mapping methods that require more accurate data or local expertise that will provide additional refinement of the characterization. These typically deal with individual components of a process, such as nitrogen loss in riparian areas, and these indicators are not in bold.*

Even if these more refined indicators are not a currently available dataset, they serve as a placeholder for applying this portion of the methods as data become available. Therefore, we believe that these methods provide a framework for a

characterization that serves as a risk management tool, that makes data gaps transparent, and that allows for modifications as new information and data become available.

Linda Storm: Be explicit about the types of data layers required and that you need GIS expertise to apply the methods.

Response: This is now provided in appendix H.

G-24 Comment: Assumptions qualified. *Mary Kentula:* p. 35, Methods—I liked the fact that you qualified the assumptions behind the methods and were very clear that the method does not mean that there is a specific relationship between land cover and the process being considered.

Response: *We have maintained these caveats and even added further wording to make the limitations and potential uses of these methods clear.*

G-25 Comment: Good to focus on application. *Mary Kentula:* p. 38, Application of Results—I like the emphasis on the uses of the method and its products presented in this section.

Response: *Thanks!*

G-26 Comment: Steps of synthesis need detailing. *Tom Hruby:* p.39-40 – need to add a paragraph before Figure IV-1 about how to do the synthesis…identify areas where aquatic resources are 1) relatively undisturbed, 2) moderately disturbed, 3) highly disturbed.

Response: *These suggestions have been incorporated into the final document. To accomplish this we have developed a suggested approach which graphically displays the degree of alteration for each sub basin so that a planner or manager can compare these sub basins and make preliminary decisions on where restoration and protection measures may be most appropriate (see section 2.1.5. This way the range of disturbance suggested in the comment is incorporated but no specific threshold is identified.*

G-27 Comment: Multiple processes are unmanageable. *Dick Gersib:* Example is with water and N – doesn't this get unmanageable when you overlay all important processes?

Peter Skidmore: Section IV. A. Page 41 I am concerned when reviewing the examples put forth on this page that the methods presented may be too simple to consider multiple processes/impacts. The reality of most watersheds is that many factors come to play – and may require a more sophisticated approach. I think the framework is fine, but does it allow for consideration of multiple processes and issues. To address this, you may want to consider more of an algorithm framework

– where there is an option for multiple factors to be weighted relative to one another.

Response: *If all of the watershed processes are analyzed, a lot of data and maps do result from these methods. Initial users of this guidance (i.e. Whatcom County) have found a variety of ways to map this information so that it is useful and easily understood. Based on the users experience we recommend at least three maps for each process (one for key areas, one for alterations, and one overlaying both of these). At this point, comparing the maps visually for areas supporting several processes appeared to work relatively well. We considered using an algorithm approach but this requires putting value on some processes over others, something on which we did not feel we could provide guidance. However, individual users of these methods can develop an algorithm that integrates their values and priorities in order to facilitate interpretation of these data.*

G-28 Comment: Application of approach. *Derek Booth:* Page 39-40. Too much specificity and prescriptive actions are promised by this method. It's not that good; on the other hand, the conceptual framework (namely, that alteration to geographic areas are likely to affect watershed processes, and so activity in those areas can degrade watercourses and aquatic resources) is sound. But--this approach does not establish causality and can only partly infer it. That's not enough to move to any solution more specific than producing advice to eliminate the human disturbance." This needs a more explicit disclaimer of its limitations--certainly, to identify pristine areas worthy of protection, and possibly to identify the most problematic areas of existing degradation.

Derek Booth: In general, your challenge is to create a method that is both tractable and valid. At the moment you are pretty successful in both arenas, but the need to meet criterion #1 (i.e., ease of use, readily available data, simplicity of analysis) puts some rigid boundaries on how far one can take the outputs of this exercise (i.e. where it ceases to be valid, because you're overshot the power of the method). Is this method useful for identifying areas that need attention?—yes. Prioritizing areas needing attention?—in some special cases, yes, but in general, probably not beyond a “go/no-go” decision. Recommending specific restoration activities?—no, I don't think there's any chance that this method can do that. The greatest failing that I see in the current draft is an inability to articulate reasonable limits on how specifically the results can be applied, and how little (or much) additional site-specific information and expertise is going to be needed to make reliable recommendations for action.

Derek Booth: Page 39 second paragraph – I do like the method, but I fear you imply too much for its ability to yield detailed prescriptions.

Derek Booth: Page 43 #6 question – I am doubtful that the method can really determine this.

Derek Booth: Page 43 #6 First sentence of response – If this is the answer, then upfront you need to tell users that this approach is unsuitable for urban and urbanizing areas…

Derek Booth: Page 43 #5 first paragraph: There comes a point where you will have to acknowledge the limits of this method, and the need for other approaches. When will that be??

Derek Booth: Page 44 bullets on 6b: I think this is stretching the utility/defensibility of the method.

Janet Carroll: Page 44. bullet 2 about California Creek – doesn't look like an accurate statement to me.

Derek Booth: Page 48 discussion of Figure IV-7– OK- for this, I agree that the discrimination looks a little better than just 'all altered areas'. But perhaps that's the point – this method is reasonable but it's not rocket science and at least as often as not the only results it can yield are obvious ones (e.g. 'protect unaltered areas). That's only a problem if you pretend that it's much deeper than that…

Derek Booth: Page 49 discussion of Figure IV-7 - You're too tangled up in the details – this method won't stand such a degree of refinement (discussion of area #3). Discussion of area #1 – Why? How did that come out of the model??

Derek Booth: Page 50 discussion of Figure IV-8 – Isn't this premature?

Response: *These comments were extremely helpful. The final document has been revised to focus on identifying areas at the watershed scale important for protecting and restoring key areas for watershed processes. It also clearly states the limitations of the method, including: it does not provide site level restoration or mitigation plans; and does not establish a direct connection between alterations at the larger scale and ensuing impacts at the site scale.*

G-29 Comment: Protected areas? *Derek Booth:* Page 40 below #4. Note that all of this is oriented towards id'ing important degraded areas. What about important and still pristine areas? I.e. what of protection? My bet is that this is where the technique will be most useful, because the relatively crude analysis of causalities embodied here is not as severe a drawback as when trying to fix what's already broken.

Response: *We agree that protecting areas that are not degraded is the easiest and also most certain way to protect watershed processes. Our latest version of this guidance places equal emphasis on protection and restoration as the information on watershed processes is equally useful to both endeavors.*

G-30 Comment: Cause and effect. *Dick Gersib: Cause and Effect* – As we discussed via phone on 6/13, I really feel your method and ours can be strengthened

substantially by modeling work that helps us better understand cause and effect relationships. We should start with water movement.

Response: *We are in the process of conducting modeling on the examples (Drayton Harbor) provided in the methods. We look forward to integrating the findings into later revisions of the guidance.*

G-31 Comment: Providing guidance on interpreting results. *Dick Gersib: Page 42 –* How do you deal with conflicting results? For example, organic wetlands are great for nitrogen removal and bad for fecal coliform removal. Since the N and the fecals are both coming from cows and humans, what do you do? Do you ignore one in lieu of trying to solve the other? This gets back to my concern that there needs to be clear guidance on interpreting and using results.

Dick Gersib: One of the core assumptions of our watershed characterization work at WSDOT is that the extent of alteration to ecological processes has substantial influence on the long-term environmental benefits derived from a single restoration site. Based on Derek's work (in press) that you reference, he suggests different management strategies for different levels of land use intensity. Based on the approach, we assume that the primary management strategy within areas of intact ecological processes is preservation, for areas with partially altered ecological processes it is restoration/rehabilitation, and extensively altered processes is stewardship. This approach allows us to place each restoration site in a landscape context by characterizing the level of press disturbance that humans are placing on each potential restoration site. This is a key part of our overall process of identifying restoration sites having the greatest potential to maximize environmental benefits over the long-term. While your approach identifies potential restoration sites within key areas, I would suggest that additional steps and guidance that help place potential restoration sites in a landscape context relating to the level of human disturbance would add value to your process. I might add, in a similar manner, there are things that WSDOT needs to take from your process and incorporate into ours.

His notes then suggest: If the geographical areas important to maintaining processes are identified, what happens if those areas are:

1. Intact
2. Partially altered
3. Extensively altered

Does condition dictate right/wrong actions?

Tom Hruby: p.20- how much degradation will no longer justify protection?

Derek Booth: You need to decide if your recommended priority is to save pristine important areas or refurbish impacted important areas. At the conceptual scale of this approach, what's your recommendation? And if the answer is, "it depends on

the study area," then that should be a reminder of the limits of how specific (or not) your recommendations for a particular study area can go.

Response: *We have revised the draft guidance so that its primary purpose is to identify, at the watershed scale, those key areas for processes that are intact and key areas that are altered. This information can then be used to specify protection measures for intact areas and restoration measures for altered areas. Additional guidance on how to determine which key areas should be identified for protection and restoration is provided by Figure II-5 and section 2.1.5. This guidance does not provide site specific recommendations or measures for protection and restoration. The site specific measures will have to be developed by resource managers and/or planners working in conjunction with local experts and citizens. Suggestions as to how this guidance can be applied within existing state planning frameworks is provided in Appendix J.*

G-32 Comment: Figure IV-4. *Derek Booth:* Looks to me that you've simply ID'd the undisturbed areas and recommended that they remain undisturbed. How much more is really necessary?

Response: *Comment noted. Two things are necessary: 1. The areas important for restoration also need to be identified and 2 because some type of development will occur in an area identified as having "undisturbed "processes, measures must be identified by the local government that protects those processes. With low impact development designs and other ideas, this is often possible without completely restricting human activities; however, in some cases, it is not possible. These decisions need to be made by the user of the methods.*

G-33 Comment: Conclusions/Interpretation offered in first draft. *Derek Booth:* Page 51 and 52 – what's different between Lower Dakota Ck Area 3 and Upper California Ck (in terms of the recommendations)

Derek Booth: Page 52 Lower California Ck Areas 2 and 3 recommendations – So… should we be more or less protective of areas that are important but have already been altered? I think most landscape ecologists would say 'save everything', but if you have to choose then save the best first.

Rationale for final conclusion unclear – where did this come from?

Response: *We have removed most of this analysis from the final and offered an improved, simplified approach.*

G-34 Comment: **Historic Conditions**. *Linda Storm*: Don't make assumption that entire landscape was forested under historic conditions. Look at River History Project work by Collins and Montgomery. Acknowledge that under historic conditions other plant communities were present (example of Chehalis Basin – 70% forest and 20% scrub-shrub and 10% wet meadow).

Response: *Comment noted. We have made this assumption for only two components of the water movement process (shallow subsurface flow and recharge) based on the work by Booth et al (2002 and 2003). For the scale this method is applied (i.e. watershed) and the type of coarse scale results it provides, mapping the specific classes of native vegetation does not appear to be necessary.*

G-35 Comment: Future land use. *Dick Gersib:* Please consider evaluating the condition of ecological processes, where possible, under both current and future planned land use conditions. Selecting potential restoration sites under only current land use conditions adds risk that a site is capable of maintaining functions in the long-term by not factoring in the planned growth that will occur in the future. For example, higher levels of land use intensity will likely adversely affect water movement, but the planned conversion of dairy or agricultural lands to rural residential will likely have a positive affect on N, P, and fecal loading rates.

Response: *Comment noted. This is an intended use of these methods – planners should be able to understand how future development may affect watershed processes. This is listed as a potential use in the executive summary now as it is an important application of the methods.*

G-36 Comment: Applicability to very urban areas. *Dick Gersib:* Your application of this tool in Puget Sound appears limited to Drayton Harbor catchments…and that's OK. I just want to caution that urban and rapidly urbanizing areas are a completely different beast. Additional work should be done in areas of increasing land use intensity to ensure applicability. At WSDOT, we have just finished our 4th watershed characterization project and we are still adding to and adapting the methods as we run into new challenges. Bottom line – provide your document to local jurisdictions as interim guidance and pick new areas in Puget Sound to run and refine your model.

Response: *This is a good suggestion. We are intending to update this guidance through the application of pilot projects and have included"footer" with a version number and date in it (the guidance will also be posted online). So this will be a method that evolves as it is used. Additionally, this method has now been used throughout Whatcom County in both urban and rural areas and not just in Drayton Harbor (See Whatcom County SMP Characterization published February 2006.*

G-37 Comment: Help get the reader to the deliverable that he/she needs. *Dick Gersib:* This could be a spin-off from my concerns about the documents goals and objectives, but I really sense that you are trying to do too many things in one simple five step process. Consider reorganizing the guidance by purpose or application to more clearly provide direction/guidance on what is needed to do certain things. For example, using the guidance to identify wetland restoration sites and planning for future growth demonstrates the diversity of the tool. Again, it may be just me not comprehending the document, but I think the average reader would benefit from

seeing the steps needed to get to identifying restoration sites separately from the steps and decision points needed to develop a plan for siting future growth.

Response: *We have rewritten the final document so that it focuses on identifying areas for protection and restoration of watershed processes. Guidance on locating areas of future growth has also been simplified and reduced in scope. We provide some suggestions of how the characterization information can be synthesized or examined, but the application of this information to decision making is something that is so variable, depending upon the user and the situation, that we did not develop specific guidance.*

G-38 Comment: Title of areas of importance. *Dick Gersib:* Suggests 'Areas with high potential for changing snowmelt and runoff' in the rationale section be worded 'Areas with a high potential for naturally attenuating rain on snow events'. Similarly 'Areas important for surface storage of water' be 'Areas with high potential for naturally storing surface water'

Response: *These areas have been redefined as "key areas" with physical characteristics that are important to a particular watershed process.*

G-39 Comment: Missing link to GMA or SMA. *Tom Hruby and Randy Davis.* Need to explain how this method can be used within existing state planning laws.

Response: *As these methods can be used in a broad range of planning efforts related to resource management, we developed Appendix J which outlines how this method may be applied as part of the requirements of the GMA and SMA.*

Comments on Sections That Have Been Removed or Replaced

Comments on Table 2, Main Document.

G-40 Comment. Relationship of processes to aquatic resources. *Dick Gersib*: *System vs. Site Approach* – On page 15 you state that the approach is built around three questions. The first is: What are the landscape-scale processes that are key to maintaining aquatic resources and their functions? Again, I could be misunderstanding your methods, but Table 2 indicates to me that you have a preconceived picture of what a specific aquatic resource is or how it functions. If this is the case, it concerns me. For example, for the key landscape processes of depressional wetlands, you have listed groundwater movement but not surface water runoff. My preference is to assume that stream catchments support a diversity of wetland resources even within the same wetland class. In the Soos Creek catchment, we noted depressional bogs, depressional fens, and a diversity of mineral soil depressional wetlands that differed significantly in their landscape

position and water source. **Bolding** groundwater movement may be critical for fens but not for bogs only a mile or more away. I feel uncomfortable making the assumptions that you make in Table 2 based on the diversity of wetlands within a relatively small catchment.

Depressional wetlands having different landscape positions have different water sources. *Dick Gersib*: **Bolding** groundwater may be appropriate for fens but completely inappropriate for bogs. In the Covington Drift plain, there are lots of fens and bogs – both depressional wetlands. Same with wetlands on marine deposits and outwash deposits in the Nooksack.

Response: *Based on this comment we have removed Table 2 from the document. Key or important areas are no longer defined by the specific components of processes that we believed to be more important than others. The methods now make the assumption that all key areas for processes are important to aquatic resources and that the specific linkages of components of processes to specific types of aquatic ecosystems are not necessary to define. It is also clear that it would be a very difficult task to identify such linkages. The methods in the scoping step do allow a user, based on local knowledge/data, to assess specific processes that are important to a specific aquatic resource.*

G-41 Comment: Other factors to consider in processes assessment. *Tim Beechie:*
Page 16: Table 2. The choice of factors to include in this table is a little confusing.

- There is no light or heat component, which would seem important (and related to riparian functions, water quality).
- And perhaps fine organic matter is important? I'm not pressing to include all these, but the listed elements should be consistent in level of detail and should try not to miss main classes of inputs to aquatic systems.

Joanne Schuett-Hames: Delivery and routing of heat is very important for riverine ecosystems and probably others.

Susan Bolton: Pg 17 Table 2 Do you wish to limit organic loading to just large woody debris? The loss of leaf fall inputs and potential increases in other carbon loads may be important also. Perhaps you can indicate that carbon inputs come in various forms but you are focusing only on the form of LWD?

Tim Beechie: And perhaps fine organic matter is important?

Response: *Comments noted. We agree that these are also important processes to aquatic ecosystems but budget and time constraints limited us to initially selecting the six processes of the movement of water, sediment, phosphorous/toxins, nitrogen, pathogens, and large woody debris, Updates to these methods may consider these other processes (heat, light, fine organic matter).*

G-42 Comment: Wording order. *Tom Hruby:* p.17 – to table….reverse wording to start with 'removal of…' for everything

Response: *As suggested we now describe all processes as the "delivery, movement and loss of …." .*

G-43 Comment: May not be necessary for landscape characterization. *Dick Gersib:* Not sure if this is important/essential for landscape characterization. It's all about putting individual sites in a landscape context. See his notes across from page 17

Response: *We have decided that this step (Table 2) of identifying the specific linkages between key areas/processes and aquatic ecosystems is not necessary.*

G-44 Comment: Table 2 and Appendix E content, Surface water runoff also critical. *Susan Bolton*: I would think that 'surface water runoff' was critical for estuaries, lakes and depressional wetlands, but maybe that's just because I'm a hydrologist.

Derek Booth: Add channel adjustment /migration to riverine systems

Derek Booth: ***N and P not key to riverine ecosystems****:* I thought this (P) was mainly a lacustrine/ receiving water issue. And that N isn't usually a limiting nutrient, is it?

Peter Skidmore: ***LWD not so important to depressional wetlands****:* Suggest deleting "Large Woody Debris" item from the Depressional Wetland resource.

Joanne Schuett-Hames: LWD important for lacustrine

Peter Skidmore: ***Slope wetland resource should have other processes identified as key:*** "Slope wetland" resource, should have all the same processes as the rest, including sediment, nutrient, delivery, transport and removal.

Derek Booth: Surface water runoff (i.e. its absence) should be added to slope wetlands

Alison Aldous: ***Both N and P limiting in estuarine systems***. There is an assumption in this document that estuarine primary production is N-limited and thus that this element should be controlled for preventing eutrophication. This is supported by the one publication I have that discusses nutrient limitation in Washington estuaries (Bernhard and Peele 1997). However, evidence from the literature suggests both N- and P-limitation (or co-limitation) of primary production in estuaries in general (Howarth 1988; Fisher et al. 1995). Which element is limiting may depend on a number of abiotic factors, including light and turbidity, hydrology and mixing, and sediment characteristics (Howarth 1988; Fisher et al. 1995), as well as time of year and which primary producer is being considered. For

example, algae and cyanobacteria production could be limited by one thing while salt marsh vegetation production is limited by something else. Thus it seems a safer bet to assume either N or P could be limiting and thus both should be controlled.

Response: *These comments led us to conclude that it was inappropriate to identify key areas that were linked to specific types of aquatic ecosystems. Therefore we have removed Table 2 (and its associated step) and Appendix E in the latest version of the guidelines*

G-45 Comment: Mammalian sources of pathogen – too narrow. *Susan Bolton:* Page 17 Table 2 – I think this is the first mention of 'mammalian pathogen delivery and removal. It is well explained in Appendix B, but I didn't read that until much later. Is there a way to get the description of this 'process' inserted into the text somewhere? Or maybe you can shorten it to read 'pathogens' which is more understandable and is what is used in the list of processes on page B-3.

Tim Beechie: Mammalian pathogens is vague, and may be too narrow. For example fecal coliform comes from both mammals and birds as I recall.

Gino Lucchetti: Pg 17, Table 2: Why would the "Mammalian pathogen delivery and removal" be more important in estuaries than in rivers, lakes etc… is it only because of shellfish beds? Also, I would suggest a different phrase. It seems this process largely deals with human-derived pathogens or just pathogens in general.

Peter Skidmore: "Mammalian pathogens" – why restricted to mammalian? What about fish or bird borne?

Doug Peters: Pathogens should include protozoans and nematodes too.

Response: *We have changed the terminology used to name this process to "Delivery, Movement and Loss of pathogens' to address these comments. We have added protozoans and viruses to the definition of pathogens.*

G-46 Comment: Combine N and P into one process (i.e. Nutrients). *Tim Beechie:* Nitrogen and phosphorous are very specific and narrow classes compared to 'mammalian pathogens'. Perhaps a general term like 'nutrient' would be better?

Peter Skidmore: Why not combine phosphorus and nitrogen items as "Nutrient delivery and removal" rather than specifying. A higher degree of detail is used in these than others. For example, sediment may be suspended or bedload – very different things, but not differentiated in this context as nitrogen and phosphorus were.

Response: *Nitrogen and phosphorus are kept separate because different mechanisms, and therefore different landscape features, are important for the*

removal of these two nutrients. We have combined phosphorus and toxin delivery, movement and loss as similar mechanisms are involved for both of these processes.

G-47 Comment: Need transport component in LWD and sediment. *Peter Skidmore:* "sediment delivery and removal" and "LWD delivery and removal" – should add "transport" to both of these. Delivery and removal imply inputs and outputs. But both are also stored in the stream, and transported through the stream, and strongly influence habitat and function while in the stream, not just when being added to or removed from the stream.

Peter Skidmore: ***Overall:*** the importance of in-channel sources/inputs, transport, and storage for many categories is not well represented. In alluvial streams in particular, the in-channel and floodplain components may be the most influential.

Joanne Schuett-Hames. Movement of LWD included?

Peter Skidmore: ***Sediment delivery:*** Overall, the categories used to describe this process do not capture the importance of in-channel and channel banks to sediment inputs, transport, and storage. In alluvial systems, channel bars and banks are probably the most important sources of sediment and storage areas for sediment, inputs and loss. Add "Channel and bank erosion" to list of controls of this process. Important areas would be within the channel and its banks. The channel itself is a hugely important source of sediment.

Response: *We have added an in-channel component to the movement of LWD and sediment to address these comments.*

Comments on Appendix B (Analysis of alterations) – *NOTE: The original Appendix B has been reorganized into a separate appendix for each process. Each of these separate appendices deals with important areas and alterations for a process. All of these comments refer to the original appendix B. The decision to revise the appendices was made largely in response to these comments.*

G-48 Comment: Appendix B & Introduction in Main Document and Figure B-1, Conceptual model of the delivery, movement and loss of water in watersheds. *Tom Winter*: My central comment is that you need to identify groundwater as an additional input into the watershed – add to diagram in figure B-1; could be handled with words instead of making the diagram more complex. I agree that gw recharge boundaries sometimes don't coincide with surface water boundaries. There is increasing recognition that groundwater discharge is occurring along the perimeter of the shoreline into the ocean. So this is "loss" out of the analysis area or watershed and should be included in figure B-1.

Response: *We have revised the text and the conceptual model (Figure B-1) to include groundwater as an input (delivery) and loss from a watershed.*

G-49 Comment: Use of Hydrologic Landscape Units to replace Figure B-1 and B-2 *Tom Winter*. The figures depicting the effect of alterations on recharge and subsurface flow are difficult to understand. Suggest that you replace them with a hydrological landscape unit (HLU) that is adapted to reflect conditions in the Puget lowlands.

Response. *Thank you for this comment. We have developed HLU's (figures B3, B4, B9 and B10) to depict recharge and subsurface flow in unaltered and altered conditions*.

G-50 Comment: General Appendix B (Alterations to Water). *Susan Bolton:* Appendix B is not as clearly or well written as the other sections.

Response: *Appendix B, analysis of alterations, has been extensively revised and edited and is now a section of each of the 6 separate appendices (one for each process) that deal with key areas and alterations to those areas.*

G-51 Comment: Indicators of alteration are sometimes GIS features and sometimes effects of alteration. *Derek Booth*: First paragraph says it's an appendix of GIS indicators but then the indicator column in the table seems to muddle GIS indicators with direct data showing a problem. Note that in addition to being apples and oranges, they don't occur in the same spatial relationship with 'the problem', so they're really not equivalent at all.

Derek Booth: Table B-1 The "Indicators" column is a mix of GIS-sensed land features (e.g., straight-line hydrography or non-forested areas) and data showing damage (e.g., contaminant loads)--so it muddles cause and effect, which is more than just a problem of clarity because these different types of data don't have the same spatial relationship to the "problem" you are trying to identify.

Dick Gersib: High turbidity loads is not a landscape attribute (Page B-14)

Response: *This point was raised several times. The published methods do no use data that measures environmental impacts as a GIS indicator. Only indicators applicable at a watershed scale are now included.*

G-52 Comment: Redundancy. *Derek Booth:* Page B-2, third paragraph of Appendix B. OK for justification but you should maintain a more limited suite of mapping techniques.

Response: *The new layout of the appendices (by organized by process rather than by key area or alterations) reduces unnecessary repeating of methods.*

G-53 Comment: Processes includes delivery and transport and removal. *Susan Bolton*: Page B-2, B-3 - Ground water, sediment, phosphorus, nitrogen, pathogens,

and toxins and large wood debris are not really processes. Their generation, transport and delivery are processes.

Response: *We have been more consistent in how we refer to the processes, always including delivery, movement or loss rather than just the element or material being moved.*

G-54 Comment: Prefer 'delivery and routing'. *Dick Gersib*: Instead of input, use movement and loss

Response: *We have decided that delivery, movement and loss are more descriptive of what a process does than delivery and routing.*

G-55 Comment: Removal. *Dick Gersib*: You can remove gw by pumping but the removal of N by denitrification; all other is transformation / storage

Joanne Schuett-Hames: Sediment removal is really storage

Response: *All aspects of each process that involve temporary storage have now been listed under the 'movement' component of the process. Only aspects that involve permanent removal of a factor, such as denitrification, are included in the 'loss' component.*

G-56 Comment: Mapping methods of wetlands. *Dick Gersib:* On page B-9 of appendix B it states: "To map the loss of wetland area, use the National Wetland Inventory data layer as the current wetland extent and the hydric soils on less than 2% slope data layer (that was created in the important areas analysis) as the potential wetland area. Place the NWI layer on the hydric soil layer; depressional wetlands have likely been lost anywhere the hydric soil layer extends beyond the NWI layer and is visible" Valid but scary assumptions.

Response: *Comment noted. No statistical analysis of the validity of this method for identifying depressional wetlands and their loss has been conducte. However a quick assessment of its applicability in several Puget Sound watersheds suggested that it was reasonable for identifying depressional wetlands and their loss at a coarse scale.*

Dick Gersib. Page B-15 – riverine wetlands can have <2% slope; how do you differentiate depressional from riverine?

Response: *For these methods we consider any wetland within a riverine setting of less than 2% gradient, underlain with hydric soils, to be a riverine depressional wetland. Under the HGM profiles listed in the Western Washington Wetland Assessment Methods, this type of HGM setting would include riverine flow through and riverine impounded. So the mapping methods will capture some riverine flow through wetlands (the riverine impounded are clearly depressional wetlands). For*

the purpose of identifying areas that contribute to the components of the processes, we believe that it is not necessary to exclude "riverine flow through wetlands." For example, the depressional wetlands in riverine settings, as identified and mapped under these methods, will all contribute to the storage of water during flooding, trapping of sediment, storage of phosphorous, loss of nitrogen. Some of the "riverine impounded" HGM wetland types may remove sediment or nitrogen at higher rates but this method is not designed to provide a precise quantitative value of the rates at which these processes perform.

Comments on Appendix C (Alternative methods) –

G-57 Comment: Alternative approach (appendix C). *Tom Hruby:* p.11- top paragraph….don't assume that degraded means less protection; needs more discussion on how landscape info can be integrated into land use planning; identify areas outside aquatic resource that can change aquatic resources.

G-58 Comment: Figure C-1. *Susan Bolton:* Page C-1 – Figure C-1 – This figure is a bit confusing since you keep the original numbering of steps but you don't go in that order. I suggest adding a line to the caption that tells the reader to follow the solid blue lines for the correct order.

Derek Booth: Why do the arrows point 'upstream'? Step5 to 4 to 3?

G-59 Comment: Weakness of alternative approach. *Susan Bolton:* Section C – general comment- It is nice to provide an alternative method but I'd like to see more emphasis placed on trying to minimize the causes of the responses. I can see how a jurisdiction could skip directly to here, and continue putting band aids on symptoms without address causes. I suggest beefing this part up to be sure the causes remain the focus.

Derek Booth: I urge you to omit this "alternative option." Overall, your method is already "information-lite," but I think it's still credible. This, however, makes no pretense of considering the watershed as a whole; it just transports the bad-old-days of easy, symptomatic fixes to a GIS platform. Forget it!

Derek Booth: Give it a more useful name,e.g. 'Change-only mapping option'.

Derek Booth: This is really unclear. I know it's simple, but I don't really understand what you're telling people to do. I <u>think</u> that it is to assume that <u>if</u> you have aquatic resource problems, then you should just assume that any/all alterations are 'important'. I think this is misguided – invites jurisdiction-specific approach when true causes (i.e. elsewhere in the larger watershed). I also think it undermines your entire construct. Life is complicated, sometimes….tough luck!

Response: *Based on these comments we have removed the original Appendix C from the final document.*

Comments on Appendix E (Rationale)-

G-60 Comment; Purpose and utility of Table in Appendix E. *Susan Bolton:* Appendix E- This is a good idea to provide a rationale. I think it could be strengthened. What exactly are your intentions here? Do you want to provide extensive evidence for the scientific basis, or just justify why you did or did not decide a process was a key process. It looks more like a justification which is fine but then parts can be changed.

In some places you explain why something is not addressed and others you just state 'not addressed'. It is useful to have the explanation if possible.

Derek Booth: Table E-1 Do you need this table at all? People have written whole textbooks on each of your 2-sentence entries. I'm ok with the list of key processes, but the discussion of their importance is so incomplete (how could they not be?) as to be silly, and the "response to alteration" even more so. These are complex, interrelated systems; pretending otherwise serves no clear purpose.

G-61 Comment: Overland and in stream flow – drivers? *Susan Bolton:* Page E-2 - Is surface water runoff a driver for stream/hydrology? Again, it depends on what you mean by surface water runoff. If you mean overland flow, it may or may not be very important depending on the area of Puget Sound. If you mean in-stream flow, then it is not a driving process but rather the thing itself. This is the fuzziest component of the document and I think it needs to be clarified. Periphyton mats? Why is this suddenly included?

G-62 Comment: Groundwater. *Susan Bolton:* Page E-2 ground water- change 'a moderate influence' to 'are a temperature moderating influence'. Personally I'd avoid the use of stream orders and stick with small and medium sized streams.

G-63 Comment: Toxins. *Susan Bolton:* Pages E-3, 4 and 5- sentence on toxins is poorly written- Try – 'Toxins are not a natural component of aquatic resources'.

Response*: Based on these comments we have reorganized the document so that the information originally included in Appendix E was expanded upon within the separate appendices for each process.*

General Alteration Map -

G-64 Comment: % forest as indicator of alteration. *Dick Gersib: Figure III-10, Page 37* – you appear to assume that change in % forest is an adequate indicator of alteration. Urban areas with 65% TIA can have 20% forest just like an agricultural area can have 20% forest. Using only this indicator, you are making the assumption

that 65% TIA urban and 10% TIA ag are the same level of alteration. If this is your assumption, it isn't appropriate.

G-65 Comment: Sub categories as ag and urban not the same effect. *Peter Skidmore:* Section III. A. Page 35, Step 5. Methods: It may be worth considering a few subfactors within natural cover category. Urban and ag are not equal, especially from perspective of impervious cover.

G-66 Comment: General alteration map ignores wetland alteration. *Dick Gersib:* Just looking at % forest ignores hydrologic alterations such as wetland modification or stream channel modification. He also indicates in the end it's OK and makes sense but on Figure III-10 (map 5) he thinks we make too great an assumption.

G-67 Comment: Figure III-12 does not match Figure III-13. *Derek Booth:* But note that not all areas on Figure III-11 are flagged here. How do you reconcile that?

G-68 Comment: Analysis of Map 5 confusing. *Janet Carroll:* Page 36. I started to get confused here and didn't follow how to use this particular analysis for Map 5.

G-69 Comment: Adapt to 'natural cover' for non-forested areas. *Joanne Schuett-Hames:* Perhaps note that this can be adapted to 'natural cover' for areas such as prairies where forests may not be the dominant natural vegetation.

G-70 Comment: Figure III.2. *Susan Bolton:* Page 34 Figure III-8 - The line drawn around the area of intersection of two important processes doesn't seem to correspond exactly to the sum of the two areas. If these boundaries can be loosely defined, that is not clear in the text. Or maybe I just can't read the two maps well enough.

G-71 Comment: General alteration map may be as far as planners get and it's not far enough. *Dick Gersib:* I am concerned that the continued reference to the general alteration map (page 43 in #5) for interpretation will be the first and final step for planners.

G-72 Comment: Figure IV-5. *Derek Booth: #*1 area is not an area with minimal alteration (and important area) in Figure IV-4.

Response*: Based on these comments the general alteration map is no longer used in the document.*

Comments on Clear Writing

CW-1 Comment: Jargon definition. *Derek Booth:* adaptive management and other terms in third paragraph are new and not defined

Derek Booth: Page 1 – last paragraph – adaptive management framework undefined – See Ralph 2003

Susan Bolton: Page 1. If you are going to define landscape processes, you may also want to define basin, sub-basin and watershed. Usage of these terms is quite variable.

Peter Skidmore: Table 2: "Key Landscape Processes" heading. These are not defined until page 29. Definition should be associated with the first use of the term.

Peter Skidmore: Section II. C. Page 18, Second paragraph: "suite of environmental controls" – "control" has not yet been defined. Define controls much earlier in the document, and either differentiate from "drivers", or use only one term or the other.

Response: *For the latest revision, we have removed undefined jargon from the text and provided definitions for all other terms.*

CW-2 Comment: Landscape process – undefined. *Peter Skidmore:* page 1, text box - Landscape processes also form and maintain reach and sub-reach scale habitat. I think it should be noted in this context that local and reach-scale habitat health depends on landscape processes. This should not be overlooked in this definition of landscape processes.

Derek Booth: Page 2, 3—lots of jargon, poorly defined: "landscape processes," "adaptive management"…

Derek Booth: Page 1 landscape processes definition – why use process and environmental factors? Aren't they the same thing? Also input, movement and loss isn't clear. Definition is muddled.

Derek Booth: Page 2 – A. title includes 'landscape processes 'which haven't been defined until the following 1. Importance of landscape processes. Here you want to talk about the IMPORTANCE of landscape processes but you've realized that you first have to define them. Good job, but late!!!

Derek Booth: Page 2 second to last paragraph – decide whether you're going to call them landscape processes or larger-scale processes and then define them.

Gino Lucchetti: Introduction, pg 1: where (or how) is "landscape" defined and what is a landscape scale?

1) Pg 2: how are “landscape processes” different from watershed or other processes?
2) Pg 2: last paragraph, give examples of “landscape features”
3) Is there a difference between landscape processes and “processes w/in a landscape”?

Response: *In response to these comments we have chosen to call the processes ‘watershed processes’ and defined it on page 1 of the guidance. We no longer use the term” landscape process.”*

CW-3 Comment: Use of term ‘large scale’ incorrect. *P Skidmore:* page 2 – “large scale”. The terminology “large scale” is used incorrectly throughout the document. “Large scale” technically means a small area with not much. It is used in the first paragraph of this section to imply a large area. This is confusing and misleading. Scale refers to a ratio of dimensions on a map and those on the ground. “large scale” means a large ratio, such as 1:10, as opposed to 1:1,000,000. The former is large (1/10) compared to the latter 1/1,000,000). I suggest using “landscape scale” or “reach scale” to differentiate relative scales, rather than “small” and “large scale”.

Derek Booth: Larger than what?

Response: *We have refrained from using ‘landscape’ and ‘larger’ scale in our final methods as they were not clearly defined.*

CW-4 Comment: Text box issues. *Peter Skidmore:* Page 4 – Text box. “Drivers” and “Controls” should be added to this suite of definitions so that the full hierarchy within the conceptual model is defined concisely and in a single place. Also, would be helpful to have these definitions earlier, as many of these concepts are already used within text of previous pages. Another inappropriate use of “large scale” – consider using “landscape scale” instead. Lastly, the first sentence states that *processes* are factors that “cause changes to occur”… they are perhaps even more important in *maintaining* structure and function, rather than changing it. Maintaining function and structure is very important, and one of the essential reasons to maintain processes.

Response: *This text box has been deleted and we have removed the ‘large’ scale wording in other areas. We now state on page one of the methods that processes produce the structure and functions of aquatic ecosystems.*

CW-5 Comment: Always need landscape scale analysis. *Peter Skidmore:* Page 5 – Text box. This box implies that sometimes only local scale analysis is necessary. While local scale analysis may sometimes be necessary, and sometimes not, I think landscape scale analysis is *always* necessary. This is a good opportunity to make that point.

Response: *While this textbox is no longer in the document, we now emphasize that landscape analysis is key to successful protection, management and regulation of aquatic resources.*

CW-6 Comment: Dealing with uncertainty text box. Derek Booth: Second bullet repeats first bullet, basically, and third bullet details first bullet. Consider restructuring this box as it's really all one item. Or divide up into 1. Too big for systematic, detailed coverage; 2. Variability over time requires too long to analyze; 3. Interactions are complex and confound simple data collection efforts.

Derek Booth: Last sentence – I thought this document did that and that risk management addresses the uncertainties inherent in that effort…

Response: *In the revised document, we have rewritten this text box to address these concerns.*

CW-7 Comment: Five steps of the characterization not consistent. *Derek Booth:* Page 7 – text before text box; You just began with a collection of existing data. Now we're at step 2; if this is really step 1 then reorder the paragraph. Indeed, I think this is very premature detail. I LIKE the five step characterization. I think it is the right way to go but don't start the introduction of it with a 'how to' of required maps and analyses.

Derek Booth: Page 7 – list of what the characterization allows the user to identify and text box. Should be clear how/why these are 2 different lists. If the first one is a list of user GOALS, don't mix in any intermediate steps. Isn't the last bullet the only important one up there?

Response: *Per these comments the main document has been simplified with details reserved for later in the document (now in the appendices).*

CW-8 Comment: Protective development. *Derek Booth:* Page 51 first paragraph 'protective development' – No such thing as a 'protective' development. They all degrade resources, just… how much? May be use 'least damaging' instead.

Response: *Wording has been changed to reflect this comment.*

CW-9 Comment: Writing. *Tom Hruby*. Need to simplify text – 6th grade reading level.

Derek Booth: Paragraphs 2 & 3 are vague and need to articulate the nature of your approach more directly. Try this, for example: "Aquatic resources are affected by conditions throughout their contributing watersheds, and in general become progressively more degraded with increasing human activity in those watersheds. The approach offered in this document is based on the rapid identification of those areas in a watershed that are likely to be of greatest importance to maintaining the health of those aquatic resources, together with the location(s) of most intensive

(and potentially degrading) human activity. Where these two conditions—areas of importance to resources, and areas of most intensive human activity—overlap, the need for restorative action is presumed to be greatest."

Derek Booth: Inconsistency of word 'framework' – 2 frameworks (adaptive mgmt and landscape approach)

Response: *We have attempted to rewrite the main document and appendices so that it is easier to understand.*

CW-10 Comment: Add summary. *Mary Kentula:* The one recommendation I have to improve the overall document is to add a summary or something that will bring the document to a logical conclusion and remind the reader of the main points that were covered. At the present time, the manuscript just ends.

Response: *Thank you for this comment. We now have a concluding section (2.2) that directs the reader to the appendices in order to apply the information generated in the five steps. It is suggested that this information can be used for developing a management plan to provide for the long term protection of aquatic ecosystems.*

CW-11 Comment: Organization of main document section I. *Peter Skidmore:* Section 1.C, Organization - it seems awkward to me that it is page 8 before this question is posed or answered. There is a lot of redundancy in the document so far.

Derek Booth: Other Approaches should be the last section not first. I'd insert an initial paragraph that summarizes all the points that follow – i.e. ANSWER your question clearly and succinctly. Right now it's very wordy and seems written by committee.

Peter Skidmore: Section 1.D.Organization – first sentence of this section (on page 10) suggests that a reader "read section 1". We already have read this Section by this point. Awkward organization and fairly redundant.

Response: *These suggestions for reorganization have been incorporated into the final document (see executive summary and introduction).*

.

CW-12 Comment: Rewording. *Tom Hruby:* p.4 – 2. 2nd paragraph, last sentence….conclude that restoration efforts are hampered by (insert) "not having" a clear understanding of how human activities have altered processes….

Derek Booth: Page 4, first paragraph is really vague and probably not needed. In contrast, page 5, section 3, introductory paragraph is explicit and the best text yet in the document. It should also appear much earlier.

Derek Booth: Page 7, last paragraph is not a clear presentation of your step-by-step approach. The box below is much clearer and more concise.

Derek Booth: Page 1 second paragraph – doesn't really say anything. Grammar is not correct.

Derek Booth: Reference to the larger framework on page 1 last paragraph is unclear – larger than what?

Mary Kentula: p. 8, C. 2--"Identify and avoid development patterns that are difficult and expensive to correct" is unclear. I don't have a picture of a development pattern that is "difficult" and would expect that fixing most problems after a development is in place would be expensive. Explain what is meant.

Peter Skidmore: Page 16. Bottom paragraph, fifth line: "These criteria can be used" – what criteria is this referring to?

Tom Hruby: p.14 – B Use bullets; 2nd paragraph. It "also" is advisable to….

Tom Hruby: p.15 – C. paragraph above diagram….add 'need to be protected' to sentence 3; to diagram, add 'activities compatible with altered processes that result in no further degradation'.

Tom Hruby: p.18 -1st paragraph, 1st sentence, add….'requires identifying the geographic areas "identified in Table 2" that are important for ….
Paragraph 3, 2nd to last sentence, replace 'are' with "can be" the entire "contributing area"; also, what about land uses mentioned in this sentence?

Response: *Suggested corrections have been made in the final document.*

CW-13 Comment: Example of risk assessment (or landscape scale analysis) needed
Tom Hruby: p.5 – example needed for 3.

Response: *We have revised this section so that it no longer refers directly to risk assessment so we have not included a specific example of this. Instead we focus on the example of the Drayton Harbor watershed used throughout the document to illustrate each step of the methods.*

CW-14 Comment: Unclear map. *Susan Bolton:* Page 51, Figure IV -9. The two sets of numbers of different colors made it difficult for me to understand this figure. Are important areas also numbered, even thought the legend just says yellow? Maybe one can be letters and the other numbers?

Response: *Figure has been replaced with a simpler figure.*

CW-15 Comment: Diagrams for Each Process. *Linda Storm*: Provide diagrams that illustrate each process addressed by the methods.

Response: *Individual diagrams that illustrate the components and controls of each process have been incorporated into the guidance (See Appendices A through G).*

Editorial Comments

E-1 Comment: Citations. *Derek Booth:* You do a lot of so and so, citing so and so… far better to look at the original source

Response: *All of these have been removed and we've examined the original sources that are cited in the final document.*

E-2 Comment: Phrase 'this guidance'. *Janet Carrol:* The term "this guidance" referring to the document is a little disconcerting and interrupted my reading when I encountered it. Can you use the terms "this guidance document?"

***Response*:** We discussed this at length with our editor and decided that the word "guidance" could be used as a noun; additionally, the agency has been using the word "guidance" as a noun for other DOE publications.

E-3 Comment: Inconsistent bolding. *Susan Bolton:* Page 8 - Why are 'planners' and 'non-profit organizations' in bold at the bottom of the page? Earlier you bolded words that you then defined but there are no definition boxes. After 'non-profit organizations' do you mean to say 'non-governmental agencies'? You say 'governmental agencies'.

Response: *We have corrected these problems by removing bolding for these words and for words defined and removed the term non-profit organization (we now just say the guidance can be applied by planners, resource managers and consultants, which should cover both non-governmental and governmental agencies).*

E-4 Comment: Don't use "Ibid". *Susan Bolton:* Page A-24 - change in reference style in last line - don't use *ibid* – just repeat the reference.

Response: *Done*

E-5 Comment: Rain-on-snow. *Patricia Olson*: "rain-on-snow" is not capitalized.

Response*: Correction made.*

Comments on Surface Runoff

SR-1 Comment: Appendix A: Use of the term "surface water" instead of "aquatic resource" when describing discharge. *Patricia Olson*: This occurs at springs or seeps that are often visible at the ground surface, but it can also occur directly into the aquatic resource. Just saying surface water may be a more straightforward description (e.g., an aquatic resource is the actual critter where water is a habitat component?)

Response: *We have made this correction and substituted the term "surface water."*

SR-2 Comment: Overland vs. streamflow. *Susan Bolton:* General – It seems like the document doesn't distinguish between overland flow-surface runoff and streamflow. These are two separate processes that seem to be lumped. It seems to be a particular difficulty when talking about delivery and removal of pollutants. The processes for removal differ a bit depending on whether you are talking about overland flow-surface runoff or streamflow. This seems to be an area where confusion in the user could develop.

Response: *To address this comment we have now included all components of water delivery, movement and loss in the guidelines, although methods don't exist for addressing each of these with available data.*

SR-3 Comment: Table A-1 – Vertical and lateral subsurface flow. *Patricia Olson*: I think that this is covered under the headings shallow subsurface flow. What could be added to clarify is lateral subsurface flow is more likely slopes.

Response: *This clarification has been added to the text in section 2.2.5 for "Vertical and lateral flow" in the fourth "bullet:" "on slopes of less permeable geology, water will move downslope as subsurface flow."*

SR-4 Comment: Snowmelt as input to runoff, not same as runoff. *Tim Beechie: Table 3(Important areas)* It seems to me that snowmelt is better classed as an input since it is a source of runoff. It is also tremendously important in the snow-dominated zone above the rain-on-snow zone.

Peter Skidmore: ***Table 3,*** Surface **water runoff:** Change "snowmelt/runoff" to simply "Runoff". Snowmelt is a form of runoff. For important areas, the entire watershed is relevant, not just rain on snow regions. It is not appropriate to restrict this to rain-on-snow zones, as these are just one piece of the equation. **Table 4 Surface water runoff:** same comments about snowmelt/runoff as above. Call it runoff, and add detail to the categories if appropriate. Runoff includes snowmelt, rain, and rain on snow.

Peter Skidmore: ***Table A1. Page A-3:*** This table indicates Snowmelt/Runoff as a key control on process. I recommend changing this to "Runoff" – snowmelt is one

component of runoff (runoff defined in Dictionary of Geologic Terms as: "That part of precipitation appearing in surface streams". Also, rain on snow is one aspect of precip and runoff that typically produces the greatest peak flows. However, these are not necessarily more significant geomorphically than lesser discharge associated with heavy rain or snowmelt alone. The highest flows (rain on snow *in some basins*) may be the most problematic for people, but are not necessarily the most important for habitat and maintaining channel form. Furthermore, not all basins in the Puget Sound have peak flows dominated by rain-on-snow. Some have peak flows dominated by rain, some by rain-on-snow, and others by snowmelt. I recommend that this component of the table be changed to "Runoff" and that it include rain and snowmelt. The area, then, would be the entire contributing catchment. Forestry practices above and below the rain-on-snow zone can have every bit as much impact on runoff.

Response: *As suggested we have moved snow melt to the delivery section of the delivery, movement and loss of water. Additionally snow dominated zones are included as key areas to be mapped.*

SR-5 Comment: Including "Snow Dominated Runoff Zone" as Key Area for Delivery (Table A-1). *Patricia Olson*: I still don't think that snow dominated runoff zone should be excluded as an important area. In the big landscape picture snowmelt is an important spring to later summer runoff delivery mechanism. In watersheds with headwaters in these areas, snowmelt is still an important source of baseflow and will affect groundwater recharge and levels at lower elevations. Refer to attached word document and graph for example. I realize that most counties won't have much say on what happens in this area, but they should be aware of how it will affect the ecological resources they can manage (so to speak). This is especially true if coordination between other entities occurs as we want to happen.

Response: *Snow dominated zones have been added to the table for controls and key areas for the delivery, movement and loss of water.*

SR-6 Comment: Including "Snow Dominated Runoff Zone" in Indicators for Alteration Table (Table A11). *Patricia Olson*: Again ROS is not the only important runoff mechanism in these watersheds. ROS only affects spring snowmelt runoff (an important component of baseflow and sustaining groundwater levels) when higher air temperatures and ppt occur in the snow dominated zone also (e.g., WY 2005). See also my comments on snowmelt zone importance in attached document.

Response: *We have include snow dominated zones in table B-1 and identified these areas as "an important source of water that can support baseflow and groundwater recharge" in section 2.1.2 of appendix B. Alteration to the "snow dominated zone" was inadvertently left out of the final alterations table (B-3) and will be included in a subsequent version.*

SR-7 Comment: Additional control for surface water movement. *Derek Booth:* Add channelized flow and sheet flow as major controls of surface water runoff. Important areas would be saturated areas of the catchment (perennial, seasonal or episodic).

Derek Booth: Add channelization via unsaturated zones – I don't know how you get these via GIS. But – they're real and this difficulty in easily mapping them is a reminder of the limitations of this method.

Response: *We have now included the overland flow component of water movement which identifies key areas as saturated areas on the landscape. Additionally, "watershed imperviousness, stormwater discharge, drainage ditches in saturated area and loss of seasonally saturated area," has been added as indicators of alteration to this component of water movement.*

SR-8 Comment: Response of finer grained deposits to increased precipitation. *Patricia Olson:* Clarification of following sentence: In coarse grained deposits, recharge related linearly to precipitation; however in finer grained deposits, recharge was initially a linear response to precipitation but eventually leveled off indicating that even increased precipitation did not produce greater recharge or groundwater flow." Because? If the intended audience is planners, non physical scientists, or other folks not well-versed in relationship between recharge, discharge and geology (I assume), then this should be further explained. One sentence should do, e.g., because surface deposits become saturated more quickly than more permeable deposits.

Response. *This clarification has been added to section 2.1: "Precipitation Patterns"…."this pattern occurs as finer-grained materials and the overlying deposits become saturated, preventing water from moving downward to support groundwater recharge."*

SR-9 Comment: Important surface storage areas. *Peter Skidmore:* Also, suggest including "sloughs" as surface storage areas.

Response: *These would be captured by the depressional wetland analysis (i.e. any area with hydric soil and less than 2% slope).*

SR-10 Comment: Table A-2. Generalized relationship between surficial geology and soil permeability in a glaciated landscape. *Patricia Olson***:** Comment on Hydraulic conductivity of recessional outwash and alluvium in lowland**.** "131 is a known median value-range can be up to 550 m/d."

Response: *Comment noted. We have now changed the table (table B-2) so that it states that the hydraulic conductivity is ">100 ft/day".*

SR-11 Comment: Including low and high permeability deposits makes all areas important. *Tom Winter***.** For subsurface flow should not identify both low and high permeability deposits as important areas since the entire watershed would become important.

Response: *We have revised this section so that only areas on deposits of low permeability are important for shallow subsurface flow and areas on deposits with high permeability are important for recharge.*

SR-12 Comment: Impervious surfaces affect runoff, not just percolation/storage

Tim Beechie: Impervious surfaces, roads, etc. increases the rate of runoff. I understand how it can reduce storage as well, so perhaps both are relevant.

Peter Skidmore: **Table B-1 Page B-4, Runoff and Recharge**: Impervious surfaces are only mentioned or indicated in the recharge portion of this table. While their importance in limiting recharge is not questioned, I think the importance and impact of impervious surfaces on runoff should be highlighted in the runoff component. In more developed and lower elevation, or smaller watersheds, impervious surface may be one of the major influences on runoff, along with conversion of forest to residential and/or agriculture.

Derek Booth: In general, your approach seems to show its wetland legacy, which is not entirely useful for the suite of features and problems that you are considering. It also emphasizes forestry and agricultural landscapes (to the near-exclusion of urban ones), which is fine if you advertise it as such. However, it does not clearly exclude urbanization (and it will be applied in many such settings), and so the treatment of the urban environment needs to show a greater appreciation of those impacts than is currently offered. In particular, the listed alterations to surface-water generation, storage, and flow currently omit almost all of what happens after urbanization (e.g., "rain-on-snow" is not the full extent of potential human alterations to flow!).

Janet Carroll: Page 21, Table 4: Surface Water Runoff: In the category “Major controls of process” Snowmelt/runoff with the important area the process controls as mainly rain on snow zones. In urban areas, it isn’t the rain on snow zones that controls runoff, it is forested sites in general. There should be some data on this, or is it too all encompassing to use?

Derek Booth: Page A-3 Surficial runoff processes are incomplete, particularly with respect to other "controls" that can be altered by urbanization. See also p. A-10.

Derek Booth: ROS areas is fine for forestry-related activities but you’ve missed entirely the issues associated with urbanization and, to a lesser extent, ag.

Joanne Schuett-Hames. ROS discussion: This was devised for forest practices (more mid-elevation as you’ve stated). Probably most areas being developed will

be below these elevations but will cause dramatic changes to hydrology. I'd encourage hearty discussion e.g. with D. Booth on this.

Derek Booth: Table B-1 completely ignores urbanization as a process-changer!

Derek Booth: Move (?) or add impervious land cover to loss of surface storage

Derek Booth: Table B-1: How can this surface water runoff change be noted in the gw recharge section but not in the sw runoff section above?

Derek Booth: Page B-9. Proximate cause of runoff is reduction in infiltration – I disagree – it's not mainly a 'water balance' problem, it's a runoff process problem.

Derek Booth: I think this a HUGE surface water factor that must be considered when looking at all of the factors the cumulatively result in changes in surface water flows.

Derek Booth: Conversion of subsurface to surface flow is a common consequence of development and problematic

Derek Booth: Page B-10 spatial arrangement of EIA – This is correct but I'm not sure that Alberti et al. (in press, although you should ask her if it's really that far along…) actually say. There's nothing in there that I recall about pervious deposits, it's all about proximity and connectivity to the stream. Should be a number of refs on this general subject.

Response: *We have significantly revised the alterations section of the guidance, particularly for the components of the water delivery, movement, and loss process. The effects of urbanization and forest removal are now included. The revised version of the appendix for water delivery, movement and loss was reviewed again by Derek Booth which he found acceptable (with minor revisions).*

SR-13 Comment: Thresholds for effects of urbanization. *Derek Booth:* Page B-9 The "urbanization threshold" discussion is a misreading of the current literature. Impacts occur, and (depending on the monitoring technique) can be recognized at virtually any level of imperviousness.

Derek Booth: 10-25% of watershed – This happens at any level of EIA. You can make your own decision about when to raise a flag, but there's no 'no change/problem' threshold. See Booth et al. 2002 JAWRA

Derek Booth: Reluctance to identify threshold– No, it's just not a perspective that's consistent with the data. We don't say it's 'too complex' to apply a threshold (although we agree that it is complex!). We simply note that the data do not support such a model.

Response: *This section has been completely rewritten and updated with information from additional studies. The fact that degradation of aquatic ecosystems occurs at any level of EIA is now clearly stated, as is the fact that visible changes in channels can be see with about 10% of a watershed in EIA.*

SR-14 Comment: Unclear discussion of the effects of urbanization effects on movement of water. *Tom Winter*: The discussion of the removal of soils in urbanized areas and its effect on recharge is unclear.

Response: *This section has been significantly revised.*

SR-15 Comment: Loss of water is also inter-basin transfers and withdrawals. *Janet Carroll:* Also in the "Loss" row, what about discharge as a loss or removal of water from one watershed to another for use as potable water or using in sewage treatment.

Tim Beechie: Water withdrawal is also an important mover of surface water throughout Washington (e.g., Yakima River for a classic example).

Response: *We have now included this in the tables.*

SR-16 Comment: Loss of Water: Transpiration *Patricia Olson*: The question is "do you have to say anything other than it is a process that is not included in the analysis?" Transpiration is highly variable and complicated due to the differing plant physiology and strategies for survival.

Response: *Thank you for the comment. We have not provided further detail for this process as suggested due to its highly variable nature.*

SR-17 Comment: Additional alterations to surface water movement. *Dick Gersib:* Conversion of gw to sw.

Derek Booth: Add channelization, impervious surfaces, dikes – very incomplete.

Response: *These are now included more explicitly in the alterations section of the appendix covering the delivery, movement and loss of water.*

SR-18 Comment: Mapping methods detail. *Derek Booth:* How should one reconcile soil surveys and geologic maps where they do not agree (e.g., p. A-13, A-21, A-23)? This is a common problem.

Dick Gersib: Page. A-13 *Derek Booth:* Give it a more useful name, e.g. 'Change-only mapping option'.
Soils and geology data were compiled at different scales of analysis. There is redundancy here. Experience in Puget Sound indicates that surficial geology is a more generalized data set than soils.

Response: *These issues are addressed in Appendix H, the mapping methods appendix.*

SR-19 Comment: Table A-11. Mapping Methods. Water Delivery: Precipitation Quantity. *Patricia Olson*: Referring to sentence: "Low slope recharge areas with higher precipitation have potential for greater recharge." How does this tie in with previous statement concerning less influence on lower permeability deposits are initial infiltration?

Response: *To make this sentence clearer, we have revised it as follows: "recharge areas with higher precipitation have potential for greater recharge."*

SR-20 Comment: Table A-11. Mapping Methods. Surface Storage. *Patricia Olson*: Snow is also important storage – see previous comments on this. Use maps of areas that are snow-dominated (all higher elevations above the ROS zone) (larger the area the more likely that summer baseflow levels and hence stored groundwater levels will be sustained through the summer)

Response: *We have included "snow-dominated zones" in the "delivery" portion of this process, so we did not think it would be appropriate to map it twice as a key area. The storage function of these areas, we believe, is captured by the factors that control the timing of the snowmelt.*

SR-21 Comment: Use of the word "variable" for water levels in wetlands. *Tom Winter*: For Surface Storage under depressional wetlands it is stated that the "watershed with less than 4.5% of their area in wetland produced more variable water levels in depressional wetlands…The use of the word "variable" is unclear.

Response: *We have revised this sentence as follow: "watersheds with less than 4.5% of their area in wetlands produced a greater range of surface water level fluctuations in depressional wetlands…"*

SR-22 Comment: Lakes and non-depressional wetlands need to be included. *Derek Booth:* Why are lakes and non-depressional wetlands omitted wherever you discuss "water velocity" (e.g. A-19, A-21, A-25, B-15)?

Derek Booth: What about lakes for sediment removal?

Derek Booth: Lakes in addition to depressional wetlands and other wetlands too [for sediment removal]!

Response: *This was an oversight and lakes/depressional wetlands have been included as storage areas for sediment.*

SR- 23 Comment: Surface water in streams is stored in floodplains. *Tom Winter*: Clarify that "surface water" in streams can be temporarily stored in floodplains.

Response: *This change has been made.*

SR-24 Comment: Soils are part of the surface deposit (Appendix B, Movement of Water). *Tom Winter*: Specify that soils are part of surface deposits and that water percolates "through" into the surface geologic deposit.

Response: *This change has been made.*

SR-25 Comment: Saturated zones (appendix B Movement of Water). *Tom Winter*: Clarify that saturated areas are found at the "surface".

Response: *Sentence has been revised to state: saturated areas form on the surface where water can not infiltrate easily."*

SR-26 Comment: Floodplain identification. *Derek Booth:* Large floodplains – need 'rules' to ID floodplains from DEMs. And, of course, you'll miss all the little floodplains on all the other rivers.

Derek Booth: Does SSHIAP have this info (unconfined streams with floodplains)?

Derek Booth: Smaller river valleys: How about smaller floodplains being effective in just reducing flooding along those smaller streams?

Derek Booth: Large river valleys: This is an overly digested reading of Collins et al. Yes, the flood storage characteristics of the Snoqualmie are different from, e.g. the Cedar, but <u>both</u> have (or had!) active floodplains that store water.

Gino Luchetti: Pg A-11: Why isn't the Cedar (or Lake WA outlet or the Sammamish) considered a large river? The Cedar still has extensive floodplains and floodplain habitats.

Response: *We have altered this aspect of the guidance so that all floodplains are equally important. We don't provide specific guidance for delineating floodplain extent from DEM's on large floodplains as we assume planners will use local information to identify these areas (e.g. Nooksack, Skagit, Snohomish, Snoqualamie, Stilliquamish, Green, and White). SSHIAP data do identify confined and unconfined channel reaches which we use as an indicator of reaches without and with floodplains. Even if the Cedar is not included as a large river areas along it that have floodplains will be identified by the SSHIAP data.*

SR-27 Comment: Dikes. *Derek Booth:* Where do we ID dikes?

Response: *Dikes are identified using local data and this is indicated in the alterations table for water movement.*

SR-28 Comment: Location of rain on snow zones. *Gino Luchetti:* Pg A-10: What elevation range is considered "mid-elevation"? Last I knew, Rain-on-Snow events were primarily in the ~1,500 to 3,000 foot elevation range. It's not juts warm rain but also warm winds that create the most extreme conditions and that's why the differential buildup in clear-cuts is so problematic, because warm winds can access the snow in large clear cuts (plus more snow accumulates in them) but can't in forests.

Gino Luchetti: Pg B-8: Should note that Rain-on-Snow type events can happen at low revelations. For example, the big snowstorm of X-mas (~mid-90s) and subsequent rapid melt-off in early January caused a huge amount of local flooding.

Response: *We have removed the reference to mid-elevation. The map of areas prone to rain-on-snow events will be used to identify where these key areas are located.*

SR-29 Comment: Time since harvest affects on runoff. *Doug Peters:* Effects of tree harvesting on runoff are gone 6+ years after replanting (2-3 years allowed for replanting so about 6-10 years after harvest).

Response: *We note in the discussion that the increased runoff from tree harvest in rain on snow zones is a temporary phenomenon.*

SR-30 Comment: Is NWI reasonable to use? *Gino Luchetti:* Pg b-9: While helpful and better than not having it, isn't the NWI notorious for it's underestimation of wetlands and if so is it appropriate as a basis of wetland loss?

Response: *We have now acknowledged this in the mapping methods appendix (Appendix H): however, as is pointed out, unless better local data exists, NWI is the best coverage of current wetlands that we have.*

SR-31 Comment: Gradient can be altered by humans. *Peter Skidmore*. Section II. C. Page 18 Third paragraph: gradient is listed as something not altered by humans. This is not accurate. Gradient can and very frequently is substantially altered by humans and severely degrades function and habitat. Channelization increase gradient sometimes by a factor of 2 or more, substantially changing the transport processes at hand.

Response: *Gradient is no longer identified as a control that is not altered by humans.*

Comments on Groundwater

GW-1 Comment: Add groundwater flow to delivery of water. *Tom Winter:* In the introduction to the "delivery of water" section add groundwater as part of the delivery of water to a watershed.

Response. *We have revised this sentence as follows: "the delivery of water to a watershed is controlled primarily by precipitation and groundwater flow patterns."*

GW-2 Comment: Important areas for recharge. *Susan Bolton:* Page 19, Table 3. I find the description of the important areas for recharge confusing. I think you are talking about areas of soils with high infiltration rates that are underlain by permeable geologic material. But that's not what it says.

Tim Beechie: Perhaps 'soils of low water yield' should just be "soils or deposits with high storage capacity".

Response: *We have removed analysis of the soils layer altogether as generally percolation rates are driven by the underlying geology in the Puget Sound region.*

GW-3 Comment: **Below the Surface**. *Tom Winter*: Change "below the "ground" to "below the land surface."

Response. *Change made.*

GW- 4 Comment: Loss of Water. *Tom Winter*: Add "groundwater" to the bullets listed under the "loss of water" section.

Response. *Addition made.*

GW-5 Comment: Effects of precipitation on recharge. *Peter Skidmore:* Groundwater movement: delete "areas with higher rainfall" from the recharge item. Rainfall is not that variable at this scale. Rainfall is variable at the landscape scale, but not at the watershed scale.

Derek Booth: Similarly, will spatial patterns of precipitation ever vary enough over a single study area to significantly affect recharge? Remove areas of higher precipitation – Technically true but I always thought this was a dumb criterion! Where isohyets are steep its topo driven and bedrock is the likely cause; otherwise the change is at a Regional scale beyond the scope of this method.

Response: *While we acknowledge these comments we have opted to include precipitation variability in the assessment of the relative amounts of recharge across a watershed. This decision is partially based on the work of Cox and Kahle (1999) in the Lynden basin of Whatcom County, where the estimated rates of mean annual groundwater recharge in Whatcom County corresponded to the increase in*

precipitation from west to east in the same area. If a jurisdiction feels uncomfortable with this, they can opt to exclude it

GW-6 Comment: Wrong wording. *Susan Bolton:* Page A-16, Mapping methods. -- last line is unclear ' must be used are mapped'?

Response: *The wording has been corrected. .*

GW-7 Comment: Precipitation and deep aquifer flows. *Derek Booth:* Are issues of deep-aquifer flow paths ever going to be relevant at the scales that this method is likely to be applied?

Derek Booth: How/why would the kinds of plans that will rely on your method exert any influence over deep aquifers? (i.e. who cares?)

Response: *As we say in the document, we are focusing this guidance on issues related to the intermediate and local (not very local) flow of groundwater. We think it's unlikely that regional recharge would need to be addressed by land use planning in the Puget Sound region. However, we have included these flow paths in the process diagrams in order to fully describe water flow processes.*

GW-8 Comment: Soils are part of the surface deposit (Appendix B, Movement of Water). *Tom Winter*: Specify that soils are part of surface deposits and that water percolates "through" them and into the surface geologic deposit.

Response: *This change has been made.*

GW-9 Comment: Saturated zones (Appendix B Movement of Water). *Tom Winter*: Clarify that saturated areas are found at the "surface".

Response: *Sentence has been revised to state: saturated areas form on the surface where water can not infiltrate easily."*

GW-10 Comment: Subsurface Storage capacity. *Derek Booth*: How about 'unconfined aquifers'? You might be able to get to this with nothing more than a geologic map.

Derek Booth: Not sure there is adequate technical data to assess this. Delete mapping methods for areas important for storage capacity.

Response: *The guidance has been changed so that subsurface storage is only addressed if sufficient local data exist for identifying deep, permeable deposits.*

GW-11 Comment: Alteration to discharge. *Dick Gersib:* Are humans going to alter groundwater discharge sites? What is the purpose? How are you using this

information? If you're trying to identify gw discharge wetlands to presume certain site functions then this is appropriate (organic soils).

Response: *We now provide more detail in the guidance of how human activities can alter groundwater discharge wetlands and their connectivity to other aquatic ecosystems. This disruption can change the amount and characteristics (for example, temperature) of groundwater that reaches other aquatic areas.*

GW-12 Comment: Discharge. *Derek Booth:* Discuss presence of seeps, wetlands etc... in section on indicators of areas important for discharge

Response: *This has been done*

GW-13 Comment: Trained professional needed. *Dick Gersib:* Groundwater interpretation requires a trained professional (comment made above the general rules on page A-15)

Response: *We have added more detail to the scoping step so that it now clearly identifies that this planning effort will need to be completed with input from a hydrogeologist, hydrologist, or geologist.*

GW-14 Comment: Figure A-1. *Derek Booth:* Blue arrows don't have to curl up!

Response: *Corrected by including one arrow going horizontal.*

GW-15 Comment: Incomplete sentence. *Susan Bolton:* Page B-12 C.i., second sentence, 'Loss… 'is an incomplete sentence.

Response: *Corrected*

GW-16 Comment: Identify large groundwater users. *Derek Booth:* Page B-11 State your principle (i.e. look for big groundwater users in your area of interest) and then cite your i, ii, and iii as examples of how a local implementation of your method might move forward. Currently, it reads as a prescription for these 3 areas (and no guidance for anywhere else). [Better (and more useful) to describe a more generic rationale (i.e. look for the big GW using activities in a region) and then give these as examples rather than as categories.}

Response: *This has been clarified and will be done now using locally available data, rather than regional generalizations.*

GW-17 Comment: Baseflow analysis. *Derek Booth:* Page B-12. A local planner can't be expected to do this statistical analysis – let alone interpret the data.

Response: *This is now done only with local data and only if a hydrologist working on the team feels it is warranted. The need for working with a hydrologist is clarified in the scoping step.*

GW-18 Comment: Groundwater – shift pumping from movement to loss. *Dick Gersib:* It's tough to affect this (movement) much…

Response: *We have kept this in clarified that it is lateral and vertical subsurface movement of water that is affected by pumping. Also, in the 'loss of water' section, we have only included components that result in the permanent removal of water from a watershed.*

GW-19 Comment: Additional recharge alterations. *Derek Booth:* Leaky pipes and irrigation change recharge locations

Response: *We added this into the alteration table for the movement of water.*

GW-20 Comment: "X" watershed transfers of water. *Janet Carroll:* Groundwater Movement: Also in the "Loss" row, what about discharge as a loss or removal of water from one watershed to another for use as the water supply or using in sewage treatment?

Response: *We have now included this in the alterations table for the loss of water.*

GW-21 Comment: Step 2: How to deal with gw contributing areas of different size than watershed? *Janet Carroll:* Page 28. How would a groundwater contributing area that is smaller than the surface water contributing area affect the analysis?

Response: Response: *In discussing this with our hydrologist we could not see a situation where the gw contributing area would be smaller than surface water contributing area for the Puget lowlands under unaltered conditions. This may occur in a higher altitude mountainous watershed where exposed bedrock was present for a significant portion of the watershed. If the extent of the contributing area for ground and surface water are different, you would conduct the analysis for the larger area, in this case the surface watershed. In Step 2 we have tried to provide clearer guidance on this.*

GW-22 Comment: Groundwater flow paths. *Dick Gersib:* ***Page 45 –*** While you emphasized the need for looking at groundwater flow paths and the need to expand the surface catchment area for analysis, it seems like this concept has been ignored in the Drayton Harbor analysis and interpretation. It appears as if all maps are analyzing only the surface catchment area in later steps.

Response: *We have attempted to address this by indicating the groundwater flow does indeed cross the watershed boundaries between the watersheds for Dakota and California Creeks but they are included within a single catchment area (See*

figure II-1). We hope to develop more detailed examples of this principle in our workshops that will present this guidance.

Comments on Sediment

S-1 Comment: Soil erosion should be surface erosion. *Tim Beechie:* Soil erosion is a general term that includes mass wasting as one of the main processes. Perhaps this refers to surface erosion?

Response: *We have changed this so that soil erosion is now surface erosion.*

S-2 Comment: Additional areas for sediment removal. *Derek Booth:* All wetlands and all lakes.

Response: *We have included depressional wetlands and lakes.*

S-3 Comment: Table 4 - Sediment – suggested rewording. *Tim Beechie:* For loss of soils, perhaps it is better stated as 'transport capacity' rather than 'water velocity'. There's more to transport than just velocity.

Peter Skidmore: Also, I think "Stream energy" may be a more important control than velocity. Velocity alone does not determine transport, though it is well correlated. Stream energy may be better correlated.

Response: *We have changed this to transport capacity.*

S-4 Comment: Channel armoring as an alteration to sediment inputs. *Peter Skidmore:* Channel armoring and channelization are human alterations of the in channel erosion that are rampant and detrimental to both sediment flux as well as habitat.

Derek Booth: Channelized flow and increased surface flow also increases soil erosion.

Response: *We have added channelization as an indicator of this; local data could be used to identify channel armoring.*

S-5 Comment: Sediment – mass wasting. *Dick Gersib:* Add in unstable slopes on glacial deposits as an important area for surface erosion and the human alteration is forest clearing/development on >30% slope.

Response: *Comment noted. Since this was based on observations by WSDOT experts and could not be directly supported by studies in Puget Sound, we decided not to include it in our guidance. Planners could look at the rationale used by WSDOT and decide if they feel comfortable with it.*

S-6 Comment: Mass wasting- vegetation. *Derek Booth:* Mass wasting areas also altered by surface water concentrations and vegetation removal.

Response: *Both of these have been added to the guidance.*

S-7 Comment: Lower streamflow not remove sediment – just defer it (relates to surface r/o or streamflow issue). *Susan Bolton:* Page A-5 - Loss section, water velocity -- this control has always been a little confusing to me. Under relationships you indicate that areas with longer retention time remove more sediment. This is true if you are talking about surface runoff, but not really true if you are talking about streamflow. Yes if the streamflow is lower velocity you will settle the sediment out of the water column, but it then becomes a problem for the channel bed and hasn't really been removed from the system. Again, this may stem from my uncertainly over whether you just mean surface runoff or are including streamflow.

Response: *We have clarified this by providing for storage of sediment in depressional wetlands, floodplains and depositional channels under the movement component for this process.*

S-8 Comment: Importance of floodplains to sediment storage. *Derek Booth:* I doubt floodplains settle out a significant percentage of a fine sediment load, even during an overbank flood and certainly not for all the sub-overbank flows that typically transport the majority of sediment (e.g., p. A-19).

Derek Booth: P. A-19 discussion of floodplains: Problematic. For all sub-bankful flows, there is no floodplain "settling" but still plenty of opportunity for soil erosion and transport. I think I'd omit this area (for sediment storage importance).

Response: *We have removed the statement that floodplains settle fine sediment: settlement of fine sediment is now specifically limited to depressional wetlands. We have continued to include floodplains as key areas for sediment storage based on work by Buffington et al. 2003. For "sub-bankful flows we have now identified them as "in-channel erosion" as a component of sediment delivery.*

S-9 Comment: Where to get Shaw Johnson output. *Susan Bolton:* Page A-19 B, mapping methods: text implies that the output for Shaw Johnson is available but does not say where to access it. – If it is available, can you indicate how to get it, if not, maybe be clearer about the fact that the user has to run the model themselves?

Response: *The use of the Shaw Johnson model output is now described more clearly in the Appendix H, Mapping Methods including a web site where it can be downloaded.*

S-10 Comment: No need to identify areas next to streams for soil erosion. *Derek Booth:* disagree with this. Stream erosion cares little for soil erodibility. It's

overland flow erosion for which this is important (e.g. King County 'erosion hazard' maps). (next category down in table)

Response: *Our guidance now specifies that it's surface erosion that is controlled by the erodibility of soils. A specific component for in-channel erosion has been created, not bank erosion in the stream channel.*

S-11 Comment: Shaw Johnson. *Derek Booth:* OK for forested areas on bedrock; are criteria in categories mapped column defensible?

Response: *While it is true that the Shaw Johnston model has not be tested outside of forested areas, Laura Vaugeois of DNR (phone conversation 1/26/06) indicates that the slope stability portion of the Shaw Johnson model was calibrated using the range of surficial geology types and precipitation that occur throughout Western Washington. Therefore, we believe that this suggests that the model has utility in predicting shallow landslides on other surficial geology types for the full range of precipitation that occurs in Western Washington.*

S-12 Comment: Depressional wetlands subset of floodplains. *Joanne Schuett-Hames:* In C. i. (page A-19), depressional wetlands as described are a subset of ii. Floodplains.

Response: *We have maintained a distinction between these two terms. Depressional wetlands are a subset of floodplains but they also occur elsewhere on the landscape; similarly, not all floodplains are depressional wetlands.*

S-13 Comment: New construction section not clear. *Susan Bolton:* Page B-13- New construction bullet- lines 7 and 8 are not clear- rewrite for clarity.

Derek Booth: If this is going to be a contentious issue, then this is not adequately referenced. Take a look at MD and Delaware sediment control ordinances – there's probably a lot to work with there.

Response: *This discussion has been rewritten. We added additional documentation from the Issaquah area on the effect of construction and land clearing on surface erosion and the delivery of sediment. We could not locate information on the Maryland and Delaware sediment control ordinances.*

S-14 Comment: Add urbanization. *Derek Booth:* Add urban land cover as source of erosion of fine sediments.

Derek Booth: Note that in urban areas, the primary input of soil appears to be channel erosion from increased discharge (Trimble 1997; Nelson and Booth, 2002).

Response: *This is now included.*

S-15 Comment: Roads within 200' of stream. *Derek Booth:* (Page B-14). This sounds very risky. Surely it depends entirely on topo and the road drainage system. Maybe check Leslie Reid's Ph.D. thesis (UW)??

Doug Peters: This does not address the conveyance in road ditches into an area adjacent to streams. Topography affects transport distance and carrying capacity.

Response: *We have chosen to use the 200' guideline as a general indicator at a watershed scale based on the analysis presented in the Forest Practices Watershed Analysis Manual, Appendix B Erosion. On page B-9 for "roads erosion" it is stated that: "sediment delivery to channels only occurs: 1) when ditches or culverts drain near the channels (within 200 ft.). Within this zone, the sediment delivery ratio is 100%) (Burroughs and King,1989). 2) Within a 200-foot buffer distance from the stream at other locations, delivery is based on the probability of downslope sediment transport. Outside the buffer zone, sediment supply to streams is assumed to be inconsequential because of the low probability of delivery (Ketcheson and Megahan unpublished reports (Burroughs and King 1989)." Because local topography and position of a road have a lot to do with how effectively roads transport sediment to stream channels and other aquatic ecosystems we encourage planners using this method to consider other local data if available.*

S-16 Comment: Dams. *Derek Booth:* Truth is, for sediment removal, this is a <u>good</u> thing. Bad for others, to be sure, but if you are stingy with the obvious your credibility is compromised overall.

Response: *We have tried to resolve this issue by restructuring the format of the appendices in the final document. The final appendices now present the indicators of unaltered conditions together with the indicators of alteration. While it true that the guidance makes a basic assumption that unaltered processes are important to protecting the structure and function of aquatic ecosystems, we leave interpretation of the results of the characterization to the team of experts that would apply these methods. So in the example of the sediment removal by dams, the indicator states that "the presence of dams can alter the dynamics of sediment movement within a fluvial system by removing sediment from the water column above the dam." If the analysis team was conducting the assessment within an urbanized watershed that had local problems associated with transport of phosphorous and pathogens (i.e. they absorb to sediment), and aquatic habitat was substantially altered below the dam, then the reduction of sediment delivery would be an important benefit to the community. We believe that the method is transparent enough to allow this type of analysis and is definitely provided for and encouraged in step 1 (define the purpose of the analysis).*

S-17 Comment: Logging as indicator of sediment source. *Janet Carol:* <u>Sediment delivery and removal</u>. How about Logging as an indicator of process alteration in the contributing area.

Response: *We have included the removal of forest vegetation, if it occurs on erodible soils or mass wasting hazard areas, as an indicator that sediment delivery may be altered.*

Comments on Phosphorus

P-1 Comment: P removal more complex than just water velocity. *Alison Aldous:* Factors that influence P removal. In addition to long residence time, other characteristics such as wetland surface area, vegetation type, wetland type, and presence of periphyton determine the potential for P removal. For example, a wetland with emergent vegetation, a large surface area, and significant periphyton has the greatest P removal capacity.

Alison Aldous: N and P sequestration within the ecosystem are controlled by biological processes as well as geophysical processes ones. These elements can be buried with organic matter, either via plant or microbial uptake.

Response: *In our revision, we have presented a more complete picture of how phosphorus can be stored or removed from a watershed. Appendix D (Phosphorous and toxin delivery, movement, and loss) diagrams the "biotic uptake and decomposition by identifying "biotic cover and composition" as a control of this component of the movement of phosphorous. Though we were unable to identify reliable indicators (short of a site scale assessment of wetlands) at the watershed scale for this component, planners are encouraged to map these areas if local data should make it possible. For the movement of Nitrogen (Appendix E), headwater streams were identified as an indicator of key areas for the biotic uptake and decomposition of nitrogen.*

P-2 Comment: Mineral soils have greater capacity for absorbing P than organic. *Alison Aldous:* mineral soils have greater P sorption capacity than organic soils

Alison Aldous: The dominant geophysical mechanism of P sorption to soils is with mineral soils, and this is the principal sink for P. In lower pH freshwater ecosystems, Fe (and also Al to some extent) hydroxides form complexes with PO4. In freshwater ecosystems with neutral to basic pH, the P is precipitated with Ca as CaPO4. Although P also forms complexes with organic soils, this is secondary. In fact, humic acids such as those produced by highly organic soils can sorb Al, Fe, and Ca, which prevents their sorption with P. Clays high in Fe and Al oxides are probably best at P retention. For two good reviews on this topic, see Walbridge & Struthers 1993 and Frossard et al. 1995.

Response: *We have corrected this error.*

P-3 Comment: Add areas of sediment removal to important areas for phosphorus removal. *Tom Hruby:* p.A-6- to bottom of table add…"areas of sediment removal" (80% of P is bound to sediment).

Response: *The link between sediment delivery and movement and phosphorus delivery and movement is now explicit in the tables associated with identifying key areas for phosphorus delivery, movement and loss.*

P-4 Comment: Lakes. *Derek Booth:* Add lakes for P removal.

Response: *All areas that store sediment are now included explicitly in the phosphorus delivery, movement and loss discussion; however, the mapping and analysis of these areas only occurs under the sediment process.*

P-5 Comment: Areas for reducing water velocity and adsorption should be combined. *Derek Booth:* Seems redundant to identify these two areas separately.

Response: *These are not always the same areas, although the areas important for adsorption are a subset of those important for sedimentation. For example, floodplains are identified as storage areas for sediment (lower velocity), but not all areas in the floodplain may be important for adsorption (i.e. depressional wetlands with clay or organic soils). Maintaining the distinction is important since different processes are active (e.g. also phosphorous, pathogen movement) and therefore planning for these areas may be different.*

P-6 Comment: Phosphorus delivery alteration should include other things. *Alison Aldous:* Human alteration of P input should also include runoff in general from feedlots, and leaching from human wastewater if storm drains are not separate from wastewater drains and wastewater goes untreated during storm events.

Derek Booth: Increased soil erosion increases P loads.

Response: *These are both included now.*

P-7 Comment: Saturated soils release P. *Doug Peters:* I read some research a few years back which indicated soils can be saturated to the point the P can be released without soil movement (erosion). Especially on soils receiving animal manure repeatedly.

Response: *This is correct. Richardson (1985) states that the phosphorus adsorption capacity of a wetland can be saturated in a few years if low quantities of aluminum and iron or calcium are present. We have revised the guidance to note that application of manure can result in a buildup of phosphorous levels in soils and the subsequent increase in phosphorous in storm runoff.*
Richardson, C.J. 1985. Mechanisms controlling phosphorus retention capacity in freshwater wetlands. Science 228:1424-1427.

Comments on Nutrients - General

N-1 Comment: Not clear why 'natural loads' for nutrients and toxins (not clear that this is unaltered conditions). *Allison Aldous:* The inputs of N and P are attributed to "natural sources". I don't understand this since the quantities of N and P entering and leaving the system have been largely modified by human activities and are probably dominated by agricultural and sub/urban activities. Same for toxin delivery and removal

Dick Gersib: Add in artificial sources for P, N and Toxins and cattle for pathogens

Response: *The section of the document where these two comments appeared was trying to identify the sources of N and P and toxins under* ***natural, unaltered*** *conditions. The artificial sources of P, N, Toxins and Pathogens are now clearly included under the alterations section of each process.*

N-2 Comment: Table 4 - Need to include fertilizers as input of nutrients. *Tim Beechie:* Phosphorous and nitrogen – fertilizers would seem to be an important source in ag lands (which cover a huge part of the state).

Response: *Fertilizers are included now.*

N-3 Comment: Nutrient loads as indicators of process alteration. *Susan Bolton:* You refer to indicators of phosphorus, nitrogen and sediment as 'loads'. Do you really have access to load information or do you have actual concentration information? This may also stem from my confusion between surface runoff and streamflow.

Allison Aldous: I'm reluctant to think that measuring P or N loads (as indicators of process alteration) is a good approach since it is hard to interpret concentration data unless they are really high. In my experience, there is so much temporal and spatial variation in nutrient concentration data that it's hard to tease apart what factor(s) are controlling that variation.

Response: *We no longer refer to areas as "important for" nutrient, pathogen or sediment loading. Additionally, we do not use nutrient loading data as indicators of process alterations. Instead, land use activities are used as watershed scale indicators of increased inputs or delivery of nutrients, pathogens or sediment.*

Comments on Nitrogen

N-4 Comment: Overall. *Arthur Gold (comments received in Dec. 15, 2005 phone call):* Revised Appendix E was well researched and well-informed and is a good application of his research.

N-5 Comment: Nitrogen fixation primarily by microbial community (inputs). *Allison Aldous:* Nitrogen input – nitrogen fixation occurs primarily via the microbial community, with plants secondary. Nitrogen is also carried in surface and groundwater.

Response: *The final guidance now shows fixation by "biota" which includes both plants and the microbial community. It is also noted that nitrogen is present in both surface and groundwater (i.e. sections on "movement" and "loss" of nitrogen).*

N-6 Comment: Denitrification occurs in more than just seasonal wetlands; organic soils in acidic conditions not primary area for denitrification. *Allison Aldous:* Denitrification requires an oxic-anoxic interface in the soil plus a supply of organic matter. Thus hyporheic areas, the edges of wetlands (not just seasonal), and riparian wetlands are places where denitrification is highest. These habitats typically don't have organic soils, but rather they have pockets of organic matter, such as alluvial floodplain deposits. Denitrification in highly organic soils is often very low for a number of reasons, including suppression of microbial activity in acidic environments, low C quality as a microbial substrate, and low nutrient availability in highly organic soils (Groffman 1994).

Derek Booth: In principle this makes sense, but I'd sure like to see a systematic test of this methodology before believing it. So what kinds of wetlands *aren't* important? Perennial wetlands with mineral soils, right? Do any exist? If not, why go to all this effort?

Tom Hruby: p. A-22, B. Please note I would not emphasize hyporheic without organic soils; hyporheic zone only accounts for ~10% loss N in a watershed; 80-90% is wetlands & organic soils.

Tom Hruby: p.A-7- to denitrification, last box under relationship of important areas to controls, add …"need organic soils."

Response: *These comments, and advice from Noel Gurwick, led us to review much of the recent literature on this subject and to speak with the lead authors of several of the studies. We have now included depressional wetlands (as all of them have a seasonal fringe where denitrification can occur) and areas with shallow groundwater moving into riparian areas that are likely to have buried organic deposits. Therefore, instead of identifying the entire "hyporheic zone" as an important area for denitrification, we have refined it to identify specific areas*

within it that undertake denitrification. Additionally, we have excluded any depressional wetlands with highly acidic soils from being important for denitrification.

N-7 Comment: Headwater streams do not have much opportunity for N removal. *Allison Aldous:* I don't understand the comment about small headwater streams being important for N retention (p. A-24). If they are headwater streams, they won't have much of the N generated within the watershed.

Derek Booth: I don't know the reference, but is small the key to the process (i.e. did they emphasize 'small' streams because that's the only place this works or because they're most at risk but are nonetheless important because of their aggregate length)? Do these processes not happen in big rivers?

Joanne Schuett-Hames: It sounds like there are 'small to mid size streams' and that headwater streams are a portion of this much larger group of streams. Change title from 'small headwater streams' to 'small to mid-sized streams' on page A-24.

Response: *According to Peterson et al. (2001) small streams make up 85% of the total stream network and play a large role in nitrogen transformation and retention. They can remove (temporarily) more than 50% of the nitrogen input for a watershed. These N transformation processes are somewhat different from those that occur in large rivers, in that assimilation by biota plays a major role in the removal of N and removal occurs over a relatively short distance. Peterson defines small streams as 10 meters or less in width. Our mapping methods identify these streams as being "3rd order or less." These small stream networks are not only located in the inland, mountainous portions of Puget Sound watersheds but also in lowland terraces. These terraces contain small streams which are often within agricultural areas that are generating large N loads.*

N-8 Comment: Mapping for hyporheic – why is it different than for other processes. *Derek Booth:* Why is this identification (mapping methods) any different than that used for surface water and for sediment trapping?

Response*: We have completely revised the important areas for the delivery, movement and loss of nitrogen. Hyporheic areas are no longer mapped. Instead, specific areas such as depressional wetlands and riparian areas with a consistent supply of groundwater (i.e. nitrogen sinks) are mapped.*

N-9 Comment: Mapping of riparian areas with shallow groundwater. *Derek Booth:* Accuracy of STATSGO/SSURGO: Why? What is STATSGO and SSURGO?

Response: *STATSGO is a regional planning-level soil database (1:250,000) developed by the Natural Resources Conservation Service (NRCS). A greater degree of accuracy, however, can be obtained with the NRCS SSURGO soils database (ranges from 1:12,000 to 1:63,360) which is based on county level soil*

surveys. We use the SSURGO data base in our mapping methods because it allows identification of hydric soils. Areas of hydric soils can then be used, in conjunction with topography (areas of less than 2% slope) to identify and map depressional wetlands. STATSGO is used to obtain soil erodibility, or 'k factor', for surface erosion.

N-10 Comment: Not all natural riparian corridors consisted of conifers. *Susan Bolton:* Page B-18, section iii. I'm not convinced that intact corridors consist primarily of conifers. Streams are naturally disturbed systems and consist of a mosaic of conifer and deciduous species depending on the time since last disturbance. Ideas about how 'evil' red alder is are beginning to be changed by new studies.

Response: *Comment noted. This section has been removed.*

N-11 Comment: Lightning? *Janet Carroll:* Nitrogen delivery and removal. Can you put in a little explanation for the "Lightning" – not many people will know how lightning fixes nitrogen. I had to look it up on the internet.

Response: *In the discussion of the delivery, movement and storage of nitrogen we now explain this aspect of the process in more detail.*

N-12 Comment: FEMA is coarse floodplain indicator; improved mapping. *Doug Peters:* Current floodplain mapping effort being initiated. Can this improve data and access?

Response: *This will be very useful when completed. Until it exists though, planners will need to use the best data that they have locally to identify historic floodplains. This may or may not be the SSHIAP data layer that we outline in our methods. For the largest river systems, we no longer suggest using the FEMA floodplain but rather delineating floodplains manually. The valleys are so clear on a DEM that it seemed easier than going using a FEMA floodplain which does not provide a relatively accurate depiction of the historic floodplain.*

N-13 Comment: Denitrification – Additional Research *Arthur Gold (comments received in Dec. 15, 2005 phone call):* The Role of Riparian Forests. Consider new research conducted by Richard Lowrance et al. (citation is Environmental Management, 1997, 687-712 - entitled Water quality functions of riparian forests in Chesapeake Bay watershed). It looks at geomorphic settings and how different types of riparian zones work for P and N; uses STATSGO. Also consider Dorothy Kellogg's recently completed dissertation (his student) on denitrification processes in riparian zones. Kellogg found that evapotranspiration of plants in areas with high water tables winds up not only drawing down the water table but changing the whole groundwater flow path so that deeper groundwater moves towards the surface. This means that deeper groundwater has more likelihood of interacting with buried C deposits where denitrification occurs. People can argue over how

common the buried C deposits are but no one would argue that once the groundwater gets near the surface that denitrification will occur. He suggested that in WA where we have a functional drought each summer (no rain to provide water for ET), this shift in the groundwater gradient and movement of deeper groundwater upwards is likely pretty important.

Response: *Thank you for the additional references. This information reinforces the importance of considering the movement of nitrate-N in groundwater. Once we have further evaluated this research we will consider including indicators in future versions, for alteration of the movement of groundwater and denitrification by changes in natural land cover in riparian zones.*

N-14 Comment: Floods are key to creating buried deposits *Arthur Gold* (comments *received in Dec. 15, 2005 phone call*)*:* Big floods are really important for creating conditions for the buried organic deposits. Have found organic deposits down to 3m in depth as long as they were near the stream (See Kellogg et al 2005). Where there are broad flat floodplains the buried deposits are within 10 to 30 meters of the stream.

Response: *This work has been incorporated into the guidance*.

N-15 Comment: Don't just look at alterations immediately adjacent to stream. *Arthur Gold (comments received in Dec. 15, 2005 phone call).* Concerned that looking at alterations only immediately adjacent to a stream (3 to 8m) does not consider alterations further away from the stream that intercept or change the movement of groundwater so that it doesn't move through those areas with buried organic deposits. Flow paths are changed and the denitrification areas are short-circuited.

Response: *Comments incorporated. The revised guidance considers alterations within the floodplain which intercept shallow groundwater flow into riparian areas. This includes the filling of depressional wetlands, ditching and channelization.*

N-16 Comment: Reducing N loads at a landscape scale. *Philippe Vidon (comment received in Dec. 15 2005 phone call).* If you're interested in reducing N loads at a landscape scale or concentrations in a water body such as Puget Sound, the important thing is to focus on where there are large fluxes of nitrogen. Because of this one might not worry about areas that are locally high in nitrate concentrations for a short period of time but rather places that have large fluxes when looked at over a year. You want to remove the maximum volume of NO3. The landscape position that they described in their paper basically identifies places where there is more likely to be a large flux, over a year, of nitrate laden water into the riparian zone where denitrification can occur. The things that drive this are 1) the size of the upland aquifer, to have enough water to supply movement into the riparian area and 2) the gradient between the upland and the riparian area or floodplain, to create a hydraulic gradient that allows the gw to move into areas where denitrification could

occur. The greatest denitrification they saw occurred in riparian zones with large inputs (large upland aquifers and steep gradients between the upland and the riparian areas). They describe the gradient as having 'concave slopes'.

Response: *Based on these comments and associated research, the revised guidance has incorporated methods and indicators for identifying areas with large fluxes of nitrogen that move into riparian areas.*

N-17 Comment: Width of floodplain negates the effect of seeps on denitrification *Philippe Vidon (comment received in Dec. 15 2005 phone call).* In the Gold study in Rhode Island they found seeps just on the till, but in Ontario Vidon and Hill found seeps also on the outwash (at all 8 sites). The gist of this is that it doesn't matter if you have seeps, in terms of denitrification, if the floodplain/riparian zone is wide enough to allow the water to reinfiltrate and move into riparian soils where it is likely to denitrify.

Response: *Comment noted. We have included riparian areas as key areas for denitrification but have not specified a threshold width. We believe that this level of detail will have to be developed by a water quality expert and hydrologist with specific knowledge of local conditions.*

N-18 Comment: Denitrification also occurs at depth in hydric soils. *Philippe Vidon (comment received in Dec. 15 2005 phone call*). In their Ontario study they found soils at the surface not meeting the technical definition of hydric and they did not see the redoximorphic features that are required for a soil to be classified as hydric. The water table wasn't high enough. But denitrification did occur at depth where the soils were hydric.

Response: *Thank you for the clarification. The revised methods now consider both shallow subsurface and deeper subsurface denitrification processes.*

N-19 Comment: Importance of monitoring. *Philippe Vidon (comment received in Dec. 15 2005 phone call*). He also thought it would fantastic to do some monitoring do evaluate the effectiveness of applying these ideas to planning and whether they really do reduce the nitrate loads in the water bodies. He suggested contacting a university researcher to see if they would take it on. He would love to but he's in Indiana!

Response: *We are hoping to conduct a pilot project that both applies these methods to a local planning process and monitors the results.*

N-20 Comment: Delivery of nitrogen (Final draft of Appendix E, Section 1.1) *Noel Gurwick:* This is accurate if you are considering only 'natural' ecosystems, but at this point in time a lot of nitrogen becomes available through industrial fixation (fertilizer production) and subsequent addition of this fertilizer to agricultural fields.

Response: *We have now identified the Haber-Bosch process and mining of phosphate deposits and the burning of fossil fuels to be sources of nitrogen (Section 3.1.1).*

Noel Gurwick: There are a number of more recent references, e.g. Galloway et al. 2004. Nitrogen cycles: past, present, and future. Biogeochemistry. 70(2):153.

Response: *Thank you for the reference. Galloway et al. 2004 is now used in the nitrogen sources section (3.1.1).*

.

N-21 Comment: Terrestrial and marine ecosystems? *Noel Gurwick:* It would help to say if you are considering only terrestrial or terrestrial + marine ecosystems, as this has a large influence on the per hectare calculation. For the early 1990, Galloway et al. (2004) estimate BNF (terr)~107, BNF (marine)~121 Tg N / yr. These estimates exclude industrial fixation (also presented in their table 1).

Response: *The guidance deals with freshwater terrestrial systems, which is stated in the introduction. We will include the updated "Galloway" nitrogen estimates in the next version of the guidance.*

N-22 Comment: Movement of nitrogen (final draft section 1.2) *Noel Gurwick:* "Movement" implies transport, and the key point here would be that nitrate is much more mobile than ammonium.

Response: *In section 1.1, Delivery of Nitrogen, we now state that "nitrate is generally more mobile than is ammonium."*

Noel Gurwick: Second paragraph, first sentence. Add " from one form to another".

Response: *We have re-written this and the next sentence to make it clear that we are referring to the transformation of ammonium to nitrate.*

Noel Gurwick: Second Paragraph. N can also be converted to N2 gas through the anaerobic oxidation of ammonia and nitrite (anammox). This process may occur at ecologically significant rates in some ecosystems. See, e.g., Rysgaard et al. (2004). Denitrification and anammox activity in Arctic marine sediments. Limnology and Oceanography 49(5):1493.

Response: *Thank you for this information. We now include the annamox process under section "1.3 Loss of Nitrogen" in the revised guidance*

Noel Gurwick: Second Paragraph. I read Grimm et al. a little differently. They state clearly that the rate of nitrification in temperate forests is limited mainly by NH4+ supply. They also note that C:N ratio "has been proposed as an indicator" of nitrification rates in forest soils, but that's different from saying that C:N ratio controls nitrification rates.

Response: *We revised this sentence in the final and removed the reference to C:N ratios controlling the rate of nitrification.*

N-23 Comment: Loss of Nitrogen (Final Draft - Section 1.3) *Noel Gurwick*: First Paragraph. Removal can also occur through plant uptake and subsequent harvesting and transport (e.g., on a truck). In human-dominated watersheds, terms like this need to be considered in a budget.

Response: *We have clarified this sentence in the final guidance by stating that ammonium removal "under natural conditions" occurs through volatization and denitrification.*

Noel Gurwick: Second paragraph, volatization. This is also important in places where excessive manure production occurs (e.g., North Carolina hog 'farms.') In such cases, volatilized N may redeposit within the same watershed or may be deposited in adjacent watersheds.

Response: *In section 3.1.1 of the final guidance, we have identified feedlots and dairies as sources of nitrogen (also assuming that volatization can play a role through re-deposition.*

Noel Gurwick. (Paragraph 3, #3). One reason some active sites may not receive much NO3- is that considerable denitrification can occur in microsites within surface soils. Even though these soils may not be saturated, respiration rates are so high (because carbon availability is so high) that considerable N removal can occur there.

Response: *Comment noted. Because this denitrification process occurs at microsites we were not sure how to identify them at a landscape scale. We will wait to include these as key areas until we identify better indicators.*

N-24 Comment: Movement of nitrogen, biotic uptake and decomposition (section2.2 final draft) *Noel Gurwick:* Might be worth an extra sentence or two explaining the time scale over which this assimilation occurs and the consequences for that N over longer time scales.

Response: *Comment noted. We will develop this additional explanation with you for future versions.*

N-25 Comment: Loss of nitrogen, denitrification (section 2.3.1) *Noel Gurwick:*. Wetlands. I think Alison's suggestion is that measured rates are low, and I agree with that point. However, if N inputs were to increase dramatically, these systems likely would be very important sites of denitrification. Certainly lots of available C + anoxia + high NO3- concentrations often yields high denitrification rates.

Response: *Thank you for the clarification. Wetlands are identified as key areas of denitrification, especially if they are located in areas of high nitrogen flux*
.

Noel Gurwick: Streams. I think this is an overstatement. If I'm remembering correctly, the LINX study – about which Peterson et al. (2001) report -- did not measure denitrification. They were able to infer N removal from the water column but did not measure denitrification directly. Removal could mean assimilation into biota, which has very different implications than denitrification.

LINX II attempted to measure denitrification and the results are just now becoming available. The results I've seen suggest that denitrification becomes important when N loading rates to streams are high, but not when they are low. You could check this. It's possible Peterson et al. (2001) were able to draw some strong inferences by combining available data with modeling, but be careful.

Response: *We have removed this paragraph from the denitrification section and moved it to "biotic uptake and decomposition (section 2.2.1).*

Noel Gurwick: Riparian areas with shallow hydric alluvium or hydric outwash conditions, second bullet "Hydric alluvial and outwash deposits both support greater denitrification rates." I would have to go back and look at the papers to see if this is an accurate representation of their conclusions, but buried channel deposits occur quite deep and in at least one site we have measured high denitrification rates at depth.

Response: *We reviewed the Rosenblatt et al, 2001, Gold et al. 2001 and Kellogg et al. 2005 papers again and concluded that these researchers were confident that denitrification occurred in shallow hydric soils but the results were not conclusive for denitrification in deeper hydric soils. Vidon and Hill 2004, however, did find that denitrification occurred at depth (see comment above by Phillipe Vidon – Denitrification also occurs at depth in hydric soils). We may need to clarify that denitrification occurs at depth in the next version of this appendix.*

Comments on Toxins

T-1 Comment: Toxin section needs rewording. *Tim Beechie:* Toxins: the 'additional sources' are actually just new toxins. The sources are human activities like fertilizing, spraying, driving cars, etc.

Derek Booth: Development to replace list of toxins.

Response: *The new sources of toxins have now been listed, rather than the actual toxins themselves. We use various land uses as indicators that toxin inputs are likely to be high.*

T-2 Comment: No natural sources of toxins. *Tim Beechie:* Aren't most toxins anthropogenic? Not sure what natural sources of toxins would be?

Response: *We now state that naturally occurring toxins such as copper, lead, zinc, mercury, cadmium and nickel occur in relatively low levels in Puget Sound lowland streams since bedrock type does not influence metal concentrations*

Comments on Pathogens

PA-1 Comment: Human addition of pathogens not alteration of natural process. *Tim Beechie:* Human alteration of pathogens seems misplaced here. It is not an alteration of wildlife inputs as the table would suggest. It is simply another source altogether.

Response: *We now term human pathogen inputs as 'Additional sources of pathogens' and included it in the section on alterations to pathogen delivery process.*

PA-2 Comment: Areas of sediment removal important areas for pathogen removal. *Tom Hruby:* p.A-8- to bottom of table add…."areas of sediment removal"

Derek Booth: Duplicates much/all of the sedimentation discussion, no? Keep only what's pathogen-specific (e.g. 1st 2 paragraphs) but dump a restatement of mapping methods.

Response: *We have streamlined the discussion, removed redundant text and mapping methods, and maintained a link between the movement of pathogens and sediment sections of the methods.*

PA-3 Comment: Cattle. *Dick Gersib:* Add cattle as an alteration factor.

Response: *This has been added.*

Comments on Large Woody Debris

LW-1 Comment: Add entrainment. *Peter Skidmore:* Large woody debris, page 20: add "re-entrainment" to the list of inputs (erosion, mass wasting, windthrow, and re-entrainment). This occurs in unconfined channels.

Peter Skidmore: Large woody debris (page 24): Add re-entrainment to major controls of process. Snag removal and channelization are human alterations, and straightline hydrography is an indicator.

Response: *We have added storage of LWD within the stream network to the movement component of this process which would include the process of re-entrainment (See figure G-1 in published guidance). Inputs are defined wood that comes from outside of the stream system such as bank erosion, mass wasting and windthrow.*

LW-2 Comment: Add floodplains. *Peter Skidmore:* For streambank erosion, add "Floodplains" to the important areas, and delete "where mass wasting is unlikely".

Response: *Floodplains are now included by the identification of unconfined reaches through the use of SSHIAP data . We have deleted all of the 'where mass wasting" or streambank erosion are "unlikely" statements.*

LW-3 Comment: Needs refinement. *Derek Booth:* This seems ill-developed, particularly given the wealth of published info on the subject.

Response: *We have revised this section based on input from other reviewers. Review by experts on LWB indicated we have captured the key factors that control the delivery, movement, and loss of large woody debris to aquatic ecosystems (see comment LW-5 and 11 by Tim Beechie).*

LW-4 Comment: Not all natural landscape forested. *Susan Bolton:* Page A-27, section A. This discussion is assuming a forested landscape. Not all landscapes are naturally forested. In line 1- maybe change it to read 'In unconfined channels in forested landscapes, … the amount '

Response: *Comment noted. If regional data is available to indicate that natural conditions were not forested then this information should be used.*

LW-5 Comment: Indicators adequate. *Tim Beechie:* Appendix A. The indicators chosen for wood delivery are adequate. (Remainder of appendix not reviewed.)

Response: *Comment noted.*

LW-6 Comment: Is 30m DEM adequate for windthrow areas? *Derek Booth:* (Do we even need DEM on there?)

Response: *A 10 m DEM is available for the state, which is what we used, but in retrospect, no DEM analysis is needed here and it has been deleted.*

LW-7 Comment: Mapping methods for streambank erosion. *Derek Booth:* Reads funny. Presence/absence of mass wasting should *a priori* affect rates of streambank erosion and wood delivery, only the relative contribution of LWD. If you had a dry cleaner discharging to a stream, would you eliminate it as a source of toxins if someone built a plant just downstream?

Response: *The methods now allow for one place to be important in multiple ways for the delivery of LWD to aquatic ecosystems. This eliminates having placed a priority on one delivery mechanism over another at a given site.*

LW-8 Comment: Mass Wasting - Applicability of studies on sources of wood. *Dick Gersib:* Page A-27, 3 stream system studies – Were these studies in mountainous bedrock areas? If so, they likely function differently than glaciated areas.

Response: *You are correct in noting that these studies are in areas that are non-glaciated. We know, however, that the process of mass wasting does occur in the Puget lowlands and that this process affects lowland streams that flow to Puget Sound. It is the process of mass wasting that supplies the LWD which does not depend on whether it occurs in non-glaciated areas. Further, DNR provides data layers on their Forest Practices web site which identify areas of mass wasting. Therefore, we believe that it is appropriate to use these studies.*

LW-9 Comment: Use site potential tree height as distance from channel. *Gino Lucchetti:* Pg A-9: Why 100 ft buffer as your criteria? I would suggest NOT using specific numbers as they then tend to become "gospel" and instead use the Site Potential Tree Height SPTH concept (perhaps 1 SPTH for LWD inputs), which is more ecologically based and avoids using distances prescriptively.

Response: *We recognize your concern but have continued to use the 100' buffer, while more clearly indicating that this is based upon the SPTH for western WA, as a guideline. Our primary rationale for continuing to use the number is that it is easier for people to use when conducting a watershed scale analysis that is "rapid." A SPTH is more appropriate at the site level restoration planning stage.*

LW-10 Comment: Streambank erosion and windthrow same areas? *Joanne Schuett-Hames:* don't these (streambank erosion and windthrow) end up being the same areas, just different processes?

Response: *There is overlap for these two processes. However, the streambank erosion process does not occur (i.e. to a significant level) on smaller, steeper streams where windthrow does occur. So both these areas should be initially mapped.*

LW-11 Comment: Indicators adequate. *Tim Beechie:* Appendix B. The indicators chosen for human impairment of wood delivery are also adequate. (Remainder of appendix not reviewed.)

Response: *Comment noted.*

LW-12 Comment: Landuses used for mapping may have stream buffer. *Joanne Schuett-Hames*: Page B-28. Specified land cover types, although not forest land use, may include a stream buffer … (for windthrow mapping).

Response: *This is a good point and one that highlights the need, as we state in the guidance, to evaluate these findings at a site scale before making site level recommendations. From a watershed perspective, regionally available data will help identify priority areas for restoration and protection. Refinement with locally available data will make that prioritization more accurate and refinement with site level data will allow for specific restoration recommendations to be made.*