Pendergast, Jim

From: Frithsen, Jeff
Sent: Thursday, April 17, 2014 12:47 PM
To: Stoner, Nancy; Alexander, Laurie; Pendergast, Jim; Kaiser, Russell; Peck, Gregory; Gilinsky, Ellen; Kopocis, Ken
Subject: RE: Feedback on Connectivity report from SAB

Sharing as FYI.... The draft SAB letter to the administrator and the draft executive summary (see attached) provides a good overview of the SAB ad hoc panel's comments on the draft Connectivity report. The ad hoc panel set up workgroups for the charge questions. While their comments within workgroups are fairly consistent, the comments between workgroups are not quite. I assume this will be addressed when they deliver their final draft for the quality review by the chartered SAB.

On the 5th, we should be able to provide an overview of what we heard on the April 28 and May 2 teleconferences with the SAB ad hoc panel.

Jeff

PDF

[redacted]

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-----Original Appointment-----
From: Stoner, Nancy
Sent: Thursday, April 17, 2014 12:40 PM
To: Stoner, Nancy; Frithsen, Jeff; Alexander, Laurie; Pendergast, Jim; Kaiser, Russell; Peck, Gregory; Gilinsky, Ellen; Kopocis, Ken
Subject: Feedback on Connectivity report from SAB
When: Monday, May 05, 2014 4:00 PM-4:45 PM (UTC-05:00) Eastern Time (US & Canada).
Where: 3233 WJC-E Call in 1-866-299-3188 passcode 2025644093

EPA-SAB-14-xxx

The Honorable Gina McCarthy
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: SAB Review of the Draft EPA Report *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence*

Dear Administrator McCarthy:

The EPA's Office of Research and Development (ORD) requested that the Science Advisory Board (SAB) review the draft report titled *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence (September 2013 External Review Draft)* ("Report"). The Report is a review and synthesis of the peer-reviewed literature on the connectivity or isolation of streams and wetlands relative to large water bodies such as rivers, lakes, estuaries, and oceans. The Report was developed by ORD to inform an EPA and U.S. Army Corps of Engineers rulemaking to clarify the jurisdiction of the Clean Water Act.

In response to the EPA's request, the SAB convened an expert panel to review the Report. The Panel was asked to comment on: the clarity and technical accuracy of the Report; whether it includes the most relevant peer reviewed literature; whether the literature has been correctly summarized; and whether the findings and conclusions are supported by the available science. The enclosed report provides the consensus advice and recommendations of the Panel.

The Report is a thorough and technically accurate review of the literature on the connectivity of streams and wetlands to downstream waters. However, the SAB recommends some revisions to improve the clarity of the document, better reflect the scientific evidence, and make it more useful to decision-makers. The SAB disagrees with one of the Report's key conclusions concerning the connectivity of non-floodplain wetlands. Our major comments and recommendations are provided below.

- The Report often treats connectivity as a binary property, either present or absent, rather than as a gradient. In order to make the Report more technically accurate and useful to decision makers, the SAB recommends that the interpretation of connectivity be revised from a dichotomous, categorical distinction (connected versus not connected) to a gradient approach that recognizes variation in the strength, duration and magnitude, and consequences of those connections.

- The Report presents a conceptual framework that describes the hydrologic elements of a watershed and the types of connections that link them. The literature review supporting the framework is technically accurate and clearly presented. However, to strengthen and improve its usefulness, the SAB recommends that the framework be expressed as continuous hydrological (surface and subsurface), chemical, and biological flowpaths that connect watersheds. The water body classification system used in the Report should be mapped onto the flowpath framework to show that continuous phenomena interact across landscape settings. In addition, the SAB recommends that each section of the Report be clearly linked to the framework.

- The SAB recommends that the Report more explicitly address the cumulative and aggregative effects of streams and wetlands on downstream waters. In particular, the Report should contain a discussion of the spatial and temporal scales at which streams and wetlands are functionally aggregated. We also recommend that, throughout the Report, the EPA expand coverage of several important issues including the role of biological connectivity, biogeochemical transformation processes, and the effects of human alteration of connectivity.

- In the Report, the EPA has classified waters and wetlands as either having the potential for "bidirectional" or "unidirectional" hydrologic flows with rivers and lakes. The SAB finds that these terms do not adequately describe the four-dimensional nature of connectivity and recommends that they be replaced with more commonly understood terms that are grounded in the peer-reviewed literature.

- The SAB commends the EPA for the comprehensive literature review in the Report. To make review process more transparent, we recommend that the EPA more clearly describe the approach used to screen, compile, and synthesize the information. The EPA should verify and explicitly state that the Report summarizes those studies that failed to show connectivity along with those that demonstrate connectivity.

- The SAB finds that the review of the literature describing connectivity of headwater streams reflects the pertinent literature and is strongly grounded in current science. The literature review provides strong scientific support for the conclusion that streams exert a strong influence on the character and functioning of downstream waters and that all tributary streams are connected to downstream waters. We recommend that the literature review more thoroughly address hydrologic exchange flows between main channels and off channel areas, the influence of stream temperature on downstream waters, and the movement of biota throughout stream systems to use critical habitats.

- The SAB finds that the literature on the connectivity of waters and wetlands in riparian/floodplain settings has been correctly summarized in the Report. There is strong scientific support for the overall conclusion that riparian and floodplain water bodies and wetlands are highly connected to receiving waters through multiple pathways. However, the SAB recommends that the Report be reorganized to clarify the functional role of floodplains and riparian areas in maintaining the ecological integrity of streams and rivers. We also recommend that the Report more fully reflect the literature on lateral exchange between

floodplains and rivers, and more explicitly discuss how floodplain environments are linked to river systems by means of the flood pulse.

- The SAB finds that the review and synthesis of the literature on the connectivity of non-floodplain ("unidirectional") waters and wetlands is generally thorough, technically accurate, and clearly presented. We recommend including additional information on material flows generated by avian fauna.

- The SAB disagrees with the EPA's conclusion that the literature reviewed did not provide sufficient information to evaluate or generalize about the degree of connectivity (absolute or relative) or the downstream effects of wetlands in unidirectional landscape settings. The SAB finds that the scientific literature does provide information to support a more definitive statement and recommends that the EPA revise the conclusion to better articulate those aspects that are clearly supported by the literature and the issues that still need to be resolved. The SAB also recommends that the Report indicate that over sufficiently long time scales all aquatic habitats are connected to downstream waters through the transfer of water, chemicals or biota, though the magnitude and effects of these connections vary widely across wetlands.

- Finally, the SAB finds that the EPA's Report could be strengthened by careful editing to ensure that it is more clearly organized and written in a consistent style and voice.

The SAB appreciates the opportunity to provide the EPA with advice on this important subject. We look forward to receiving the agency's response.

Sincerely,

NOTICE

This report has been written as part of the activities of the EPA Science Advisory Board (SAB), a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The SAB is structured to provide balanced, expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency and, hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names of commercial products constitute a recommendation for use. Reports of the SAB are posted on the EPA Web site at http://www.epa.gov/sab.

U.S. Environmental Protection Agency
Science Advisory Board
Panel for the Review of the EPA Water Body Connectivity Report

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APPENDIX B: TECHNICAL AND EDITORIAL CORRECTIONS FOR THE FINDINGS AND CONCLUSIONS B-1

1. EXECUTIVE SUMMARY

The National Center for Environmental Assessment in the EPA Office of Research and Development (ORD) has developed a draft report titled *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence (September 2013 External Review Draft).* The draft report (hereafter referred to as the "Report") is a review and synthesis of the peer-reviewed scientific literature on the connectivity or isolation of streams and wetlands relative to large water bodies such as rivers, lakes, estuaries, and oceans. The purpose of the Report is to summarize the current understanding of these connections, the factors that influence them, and the mechanisms by which connected waters affect the function or condition of downstream waters. The Report was developed to inform an EPA and U.S. Army Corps of Engineers rulemaking to clarify the jurisdiction of the Clean Water Act. The Report is a scientific review and, as such, it does not set forth legal standards for Clean Water Act jurisdiction.

The literature review and synthesis in the Report focuses on describing: (1) a conceptual framework that represents the hydrologic elements of a watershed, the types of physical, chemical, and biological connections that link them, and the watershed climatic factors that influence connectivity at various spatial and temporal scales; (2) the downstream connectivity and effects of ephemeral, intermittent, and perennial streams; (3) the downstream connectivity and effects of waters and wetlands in riparian/floodplain settings; and (4) the downstream connectivity and effects of waters and wetlands in non-riparian/non-floodplain settings. Four case studies from the literature are included in the report to illustrate the connectivity of water bodies in different landscape settings and geographic regions.

The EPA asked the SAB to review the Report and comment on: the clarity and technical accuracy of the document; whether it includes the most relevant peer reviewed literature; whether the literature has been correctly summarized; and whether the findings and conclusions in the Report are supported by the available science. This Executive Summary highlights the findings and recommendations of the SAB in response to the charge questions provided in Appendix A.

Overall Clarity and Technical Accuracy of the Report

The SAB was asked to provide its overall impressions of the clarity and accuracy of the Report. The SAB generally finds that the Report is an extensive review of the literature on the connectivity of streams and wetlands to downstream waters that is both thorough and technically accurate. However, the Report could be strengthened by careful editing to ensure that it is more clearly organized and written in a consistent style and voice. Some terms and definitions are not used consistently in all parts of the document. The SAB recommends that the conceptual framework describing the hydrologic elements of a watershed and the connections that link them be used to integrate the entire Report. Each section of the document should be clearly linked to this framework. In addition, the key points in each chapter of the Report should be clearly stated at end of the chapter, and a succinct table summarizing all of the key findings of the Report should be included in the executive summary.

The Report is a science, not policy document, but it was written to support the EPA's efforts to clarify the jurisdiction of the Clean Water Act. The SAB finds that the report could be more useful to decision-makers if it brought more clarity to the interpretation of connectivity, especially with respect to: (1) quantification of the degree, magnitude, or consequences of connectivity, and (2) the cumulative or aggregate effects of streams and wetlands on downstream waters. The Report often treats connectivity as

a binary property, either present or absent, rather than as a gradient. The SAB recommends that the interpretation of connectivity be revised from a dichotomous, categorical distinction (connected versus not connected) to a gradient approach that recognizes variation in the strength, duration and magnitude and effect of those connections. The SAB also recommends that the Report more explicitly address the cumulative effects of streams and wetlands on downstream waters, particularly the spatial and temporal scales at which streams and wetlands are functionally aggregated.

The literature review in the Report could be strengthened by more clearly describing the approach used to screen, compile, and synthesize the information and by including additional references provided by the SAB. The EPA should confirm and state that studies failing to show connectivity were cited in the Report along with those that demonstrate connectivity. The SAB finds that the case studies in the Report provide helpful illustrations of the connectivity of streams and wetlands in certain geographic areas to downstream waters, but the relevance of the case studies would be more apparent if the Report explained how they were selected and also presented them more succinctly in text boxes throughout the document.

Clarity and Technical Accuracy of the Conceptual Framework in the Report

The SAB was asked to comment on the clarity and technical accuracy of the conceptual framework of watershed structure and function presented in the Report. The literature review supporting the conceptual framework is thorough and technically accurate but the SAB recommends some revisions to improve the clarity, accuracy, and usefulness of the framework. Connectivity should be defined at the beginning of the Report and the SAB recommends that this definition include connections within and among entire watersheds and underlying aquifers. The EPA should clearly state in the Report what are considered “waters” and “wetlands” and how they are distinct from the federal regulatory definition.

The SAB recommends that the conceptual framework in the Report be expressed as continuous hydrological (surface and subsurface), chemical, and biological flowpaths connecting watersheds. The framework should also illustrate the importance of climate, geology, and relief on flow and transport and highlight the four-dimensional nature of connectivity. In the Report, the EPA discusses connectivity within a classification system based on discrete landscape settings (i.e., rivers and streams; waters and wetlands in riparian/floodplain settings; and waters and wetlands in non-riparian/non-floodplain settings). The SAB recommends that this classification system be mapped onto the flowpath framework to show that continuous phenomena interact across these discrete landscape settings. There should be more emphasis in the conceptual framework on the importance of groundwater connectivity and biological connectivity. Additional layers of complexity also should be included in the conceptual framework to reflect important issues such as spatial and temporal scales and human alteration of the hydrological landscape.

In the conceptual framework, the EPA has classified waters and wetlands based on their potential to have bidirectional or unidirectional hydrologic flows with rivers and lakes. Some unidirectional wetlands are also called “geographically isolated wetlands.” However, the terms “bidirectional” and “unidirectional” do not adequately describe the four-dimensional nature of connectivity and therefore should be replaced with more commonly understood terms that are grounded in the peer-reviewed literature. The term “geographically isolated wetlands” is misleading because all waters and wetlands are connected at sufficiently long time scales. The Report should explain that the term “geographically

isolated" does not imply functional isolation. In addition, the SAB recommends that a summary and synthesis of the conceptual framework be added to the end of Chapter 3 of the Report.

Literature on Connectivity and Effects of Ephemeral, Intermittent, and Perennial Streams

The Report contains an excellent review of the scientific literature describing the connectivity of headwater streams to downstream waters. Nevertheless, further discussion of the literature on several specific topics is warranted. The review should be expanded to include more complete discussion of temporal dynamics of connectivity as well as the processes involved in hydrologic exchange flows between main channels and off channel areas. The discussion of naturally occurring chemical constituents, contaminants, contaminant transformation processes, and the influence of stream temperature on downstream connectivity also should be expanded. In addition, the Report should more thoroughly document the evidence that the biological integrity of headwater streams and downstream waters is affected by the movement of biota throughout the lotic system. Other important topics that should be further discussed include: the consequences of human alteration of headwater streams; aggregate and cumulative effects of headwater streams on downstream waters; the effects of streamside vegetation on stream ecosystems; the importance of food-webs from riparian areas to stream ecosystems; and the degree or strength of downstream connections.

Findings and Conclusions Concerning Ephemeral, Intermittent, and Perennial Streams

The Report concludes that streams exert a strong influence on the character and functioning of downstream waters and that all tributary streams are physically, chemically, and biologically connected to downstream waters. While strong scientific support has been provided for these conclusions and related findings, the conclusions and findings should be quantified whenever possible, related to the four dimensions of connectivity, and give more attention to biogeochemical transformations and biological connections. In addition, some hydrologic aspects of connectivity require additional detail. These include descriptions of key linkages and exchanges in tributary streams, such as groundwater-surface water interactions, as well as the role of transition areas between uplands and headwaters. Likewise, the Report should explain how hydrologic connectivity sustains aquifers, particularly in alluvial systems in the southwest and in karst systems in the eastern U.S. The EPA should also consider summarizing and displaying the conclusions in the Report in matrix form with brief characterizations of the temporal and spatial scales over which given functions or phenomena occur. Articulating the rationale for choosing the specific the case studies would help ensure that the keys points are well illustrated.

Literature on Waters and Wetlands in Riparian/Floodplain Settings

The literature on the connectivity and downstream effects of waters and wetlands in riparian/floodplain settings has been correctly summarized and characterized in the Report. The literature review substantiates the conclusion that floodplains, riparian areas, and waters and wetlands in riparian/floodplain settings support the hydrological, chemical, and biological integrity of downstream waters. However, additional emphasis of certain topics, and in some cases review of more recent and diverse literature, is needed in the Report. The review of the literature on riparian and floodplain wetlands should be reorganized to clarify the functional role of floodplains and riparian areas in maintaining the ecological integrity of streams and rivers. The SAB recommends that the Report discuss the functional role of floodplains and wetlands in the entire landscape setting. The term "bidirectional wetlands" should therefore be replaced with the term "waters and wetlands in riparian/floodplain

settings" to reflect landscape position. The review should more fully reflect the literature on lateral exchange between floodplains and rivers followed by downstream transport. In addition, an integrated discussion of the functional attributes of floodplains as habitats should be included in the review.

Other topics should also be emphasized. The Report should more explicitly discuss how floodplain environments are intimately linked to river systems by means of the flood pulse. In this regard, the importance of the short duration high intensity and long duration low intensity events should be compared and contrasted. The Report should also review additional literature on: channel migration zones (which demonstrate the variable nature of connectivity of floodplains); the importance of sediment movement, erosion and deposition; lateral connections that create a diversity of habitats supporting a wide array of species; and human impacts on connectivity. In addition, the Report requires a more recent and diverse review of the biogeochemical implications of exchange flow, including the literature on the role of wetlands and floodplains as sources, sinks, and transformers of nutrients and other chemical contaminants. The SAB also recommends that the examples used in the Report be broadened to make it more representative of the U.S. In particular, studies on peatlands in floodplain settings and forested wetlands, including bottomland hardwoods, should be incorporated.

Findings and Conclusions Concerning Waters and Wetlands in Riparian/Floodplain Settings

The findings and conclusions concerning waters and wetlands in riparian/floodplain settings are discussed in Section 1.4.2 of the Report. There is strong scientific support for the overall conclusion that riparian and floodplain water bodies and wetlands are highly connected to downstream waters through physical, chemical, and biological pathways. However, additional literature would bolster the findings and conclusions in Section 1.4.2 of the Report. A broad discussion of floodplain systems is warranted, including an explanation of the floodplain areas that can and cannot be classified as wetlands. The discussion of the findings and conclusions should further address a number of other issues including: the temporal dimension of connectivity of waters and wetlands in riparian/floodplain settings; the role of these waters and wetlands in storing and transforming chemical constituents; the role of biological connectivity, the effects of human alteration of connectivity; and the importance of considering aggregate/cumulative downstream effects of these waters and wetlands. In addition, the SAB recommends that the conclusions be more empirically and/or specifically described (e.g., indicating the percentage of studies that supported a conclusion) and that consistent terminology be used throughout the report to describe riparian and floodplain wetlands.

Literature on Waters and Wetlands with the Potential for Unidirectional Hydrologic Flows to Rivers and Lakes

In general, the EPA's review and synthesis of the literature on the downstream connectivity and effects of wetlands and open waters with the potential for unidirectional connectivity is thorough, technically accurate, and clearly presented. The SAB recommends that the EPA consider adding some additional publications on biological connections and "geographically isolated" wetlands. Inclusion of publications that analyze material flows generated by birds is important. The term "unidirectional wetlands" as used in the report is misleading because it implies one-way hydrologic flows when, in fact, connectivity can have many spatial and temporal dimensions. The SAB recommends that the terms "unidirectional" and "geographically isolated" waters and wetlands be replaced in the report with the term "non-floodplain waters and wetlands." The SAB also recommends that the EPA frame the discussion about the temporal and spatial scales, types, and gradients of various connections between and among floodplain wetlands

and non-floodplain wetlands and downstream waters by considering the magnitude, duration and frequency of surface and subsurface connections. The magnitude, frequency, and durations of the connections should be specified to the degree possible from the literature, with acknowledgment that all aquatic habitats are connected to downstream waters over sufficiently long time scales. In addition, the Report should discuss the importance of assessing wetland connectivity and connectivity pathways in terms of aggregated wetland complexes and the legacy effects of human disturbances.

Findings and Conclusions Concerning Waters and Wetlands with the Potential for Unidirectional Hydrologic Flows to Rivers and Lakes

The SAB disagrees with the EPA's overall conclusion in Section 1.4.3 of the Report indicating that "The literature we reviewed does not provide sufficient information to evaluate or generalize about the degree of connectivity (absolute or relative) or the downstream effects of wetlands in unidirectional landscape settings." To the contrary, the SAB finds that the scientific literature does provide information to support a more definitive statement (i.e., numerous functions of unidirectional wetlands have been shown to benefit downstream water quality) and recommends that the EPA revise the conclusion to focus on aspects that are clearly supported by the literature and the issues that still need to be resolved. The SAB also recommends that the EPA's conclusions concerning "unidirectional" wetlands explicitly recognize connectivity as a gradient rather than a dichotomous categorical variable and highlight the fact that there are multiple mechanisms resulting in connectivity that occur over gradients of space and time. The following text should be included in these conclusions: *Over sufficiently long time scales all aquatic habitats are connected to downstream waters through the transfer of water, chemicals or biota, though the magnitude and effects of these connections vary widely among wetlands.*

The SAB recommends several revisions to improve the findings concerning "unidirectional" waters and wetlands. Reference to specific studies should be removed as the findings are intended to summarize general themes arising from a broad synthesis of the diverse literature. The key findings should be more explicitly presented and clearly explained in the text of the Report. In addition, the key findings should include: the biological functions and biological connectivity of unidirectional wetlands, differences between natural and manmade wetlands, the importance of spatial proximity as a determinant of connectivity, and the importance of cumulative or aggregate impacts of unidirectional wetlands.