EPA-SAB-xx-xxx

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

Subject: Science Advisory Board (SAB) Consideration of the Scientific and Technical Basis of the EPA and Department of the Army's Proposed Rule titled "Revised Definition of Waters of the United States"

Dear Administrator Regan,

As part of its statutory duties, the EPA Science Advisory Board (SAB) may provide advice and comments on the scientific and technical basis of planned EPA actions pursuant to the Environmental Research, Development, and Demonstration Authorization Act of 1978 (ERDDAA). ERDDAA requires the EPA to make available to the SAB proposed criteria documents, standards, limitations, or regulations, together with the relevant scientific and technical information on which the proposed action is based. On the basis of this information, the SAB may provide advice and comments. Thus, the SAB is submitting the attached report on the scientific and technical basis of the proposed rule titled "Revised Definition of Waters of the United States" (Proposed Rule) published in the Federal Register on December 7, 2021 (86 FR 69372). In developing this report, the SAB followed the engagement process for review of science supporting EPA decisions outlined in the memo of February 28, 2022, signed by the Associate Administrator in the Office of Policy, the Deputy Assistant Administrator for Science Policy in the Office of Research and Development, and the Director of the Science Advisory Board Staff Office.

In the Proposed Rule the EPA and the Department of the Army are exercising their discretionary authority to put back in place the pre-2015 definition of "waters of the United States," updated with targeted clarifying changes to reflect consideration of Supreme Court decisions. The agencies have prepared two main supporting documents for the proposed rule: (1) an economic analysis, and (2) a technical support document.

The SAB met by video conference on March 2 and 7, 2022 and elected to review the scientific and technical basis of the Proposed Rule. The SAB discussed providing advice on several topics including: (1) subsurface hydrologic connections, (2) the agencies' economic analysis, (3) climate change science, and (4) environmental justice and potential disproportionate effects of the Proposed Rule. The EPA's Office of Water provided suggested charge questions on these topics to the SAB Staff Office, and on May 31, 2022, and June 2, 2022, a work group took the lead in SAB deliberations at a public video conference on the science supporting the Proposed Rule. The SAB's advice and comments on the science supporting the Proposed Rule are provided in the enclosed report.

The SAB's major recommendations and comments on the science supporting the Proposed Rule are as follows:

- The SAB commends the EPA for its previous work to develop the document titled "Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence" (Connectivity Report) and its recent work to develop the "Technical Support Document for the Proposed Revised Definition of Waters of the United States Rule." Based on the principles of hydrology and the review of the science discussed in these documents, there is more than "speculative or insubstantial" evidence for the effects of "shallow subsurface hydrologic connections" on the chemical, physical, or biological integrity of connected waters.

- The findings and conclusions in Sections II C and D of the Technical Support Document are supported by the available scientific literature. The review of the published literature is thorough and, in general, is technically accurate; papers published since the 2015 Connectivity Report overwhelmingly support the Report's conclusions and, in some cases, strengthen the conclusions.

- The SAB finds that a switch from state-based to radius-based benefit estimates as piloted in Appendix H of the Economic Analysis could potentially improve the agencies' economic analysis, but some caveats should be taken into consideration.

- The agencies' approach to environmental federalism in the Economic Analysis for the Proposed Rule is not consistent with best practices in benefit-cost analysis, and it should be dropped. The agencies should include all states' benefits and costs in the Economic Analysis. This will require adding the omitted states' benefits and costs into all aspects of the analysis (e.g., estimating them in the meta-analysis). This will also make the Economic Analysis consistent with the Environmental Justice and Tribal Impacts Analyses, which appear to include all states.

- EPA's Economic Analysis still undervalues (omits) significant categories of benefits. The SAB recommends that the Economic Analysis discuss and consider incorporating additional wetland benefits, such as the significant values associated with flood protection from the recent economics literature. The SAB finds that future efforts to estimate and include the wide range of omitted benefits would be extremely valuable.

- The explanation in the Economic Analysis for why the U.S. Army Corps of Engineers' permit cost estimates are more appropriate than the Sunding &

Zilberman estimates is reasonable, and the choice appears to be justified. However, additional analyses are recommended to support this approach.

- The text in the preamble of the rule and the Technical Support Document addressing climate change is generally accurate. However it oversimplifies issues of non-stationarity associated with climate change and incorrectly states that storm surges and hurricanes are becoming more frequent. Some suggested changes are recommended to more accurately reflect the science.

- The SAB supports the agency's proposal to allow use of methods other than the traditional rolling 30-year average that are designed to better capture "normal" precipitation in a time of rapidly changing climate.

- The discussion of environmental justice in the Technical Support Document is generally technically sound. However, recommendations are provided to clarify and improve the discussion.

- The agencies' plans to broaden the scope of distributive EJ and tribal analysis are appropriate and promising. Recommendations are provided to further develop the EPA's plans for environmental justice analysis.

The SAB appreciates the opportunity to provide the EPA with advice and comment on the science supporting the Proposed Rule. We look forward to receiving the Agency's response.

Sincerely,

Enclosure

NOTICE

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Science Advisory Board (SAB) Consideration of the Scientific and Technical Basis of the EPA and Department of the Army's Proposed Rule titled "Revised Definition of Waters of the United States"

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

E-EEAC	The External Environmental Economics Advisory Committee
EJ	Environmental Justice
EJSCREEN	Environmental Justice Screening and Mapping Tool
ERDDAA	Environmental Research, Development, and Demonstration Authorization Act of 1978
HUC	Hydrologic Unit Code
IPCC	Intergovernmental Panel on Climate Change
MRIP	Marine Recreational Information Program
NOAA	National Oceanic and Atmospheric Administration
SAB	Science Advisory Board
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WTP	Willingness to Pay

1. INTRODUCTION

As part of its statutory duties, the EPA Science Advisory Board (SAB) may provide advice and comments on the scientific and technical basis of planned EPA actions pursuant to the Environmental Research, Development, and Demonstration Authorization Act of 1978 (ERDDAA). ERDDAA requires the EPA to make available to the SAB proposed criteria documents, standards, limitations, or regulations, together with the relevant scientific and technical information on which the proposed action is based. On the basis of this information, the SAB may provide advice and comments. Thus, the SAB has reviewed the scientific and technical basis of the proposed rule titled "Revised Definition of Waters of the United States" (Proposed Rule) published in the Federal Register on December 7, 2021 (86 FR 69372).

In the Proposed Rule the EPA and the Department of the Army are exercising their discretionary authority to put back in place the pre-2015 definition of "waters of the United States," updated with targeted clarifying changes to reflect consideration of Supreme Court decisions. The agencies have prepared two main supporting documents for the proposed rule: (1) an economic analysis (U.S. EPA and Department of the Army (2021a) (Economic Analysis), and (2) a technical support document (U.S. EPA and Department of the Army (2021b) (Technical Support Document).

The SAB met by video conference on March 2 and 7, 2022 and elected to review the scientific and technical basis of the Proposed Rule. The SAB discussed providing advice on several topics including: (1) subsurface hydrologic connections, (2) the agencies' Economic Analysis, (3) climate change science, and (4) environmental justice and potential disproportionate effects of the Proposed Rule. The EPA's Office of Water provided suggested charge questions on these topics to the SAB Staff Office and on May 31, 2022, and June 2, 2022, a work group took the lead in SAB deliberations at a public video conference on the science supporting the Proposed Rule. Oral and written public comments have been considered throughout the advisory process.

In developing this report, the SAB followed the engagement process for review of science supporting EPA decisions outlined in the memo of February 28, 2022, signed by the Associate Administrator in the Office of Policy, the Deputy Assistant Administrator for Science Policy in the Office of Research and Development, and the Director of the Science Advisory Board Staff Office. All materials and comments related to this report are available at:
https://sab.epa.gov/ords/sab/f?p=114:19:42709640457:::RP,19:P19_ID:973nsert

2. SAB ADVICE AND COMMENTS ON THE PROPOSED RULE

2.1. Topic 1A: Subsurface Connections

2.1.1. Charge Question 1a.

The Agencies' proposal allows for consideration of shallow subsurface hydrologic connections when assessing jurisdiction in two ways. First, the preamble for the proposed rule discusses that the agencies intend to continue their longstanding practice to allow for unbroken shallow subsurface connections to serve as an indicator that a wetland is adjacent (e.g., bordering, contiguous, or neighboring) to a jurisdictional water (see 86 FR 69435 and pp. 184-186 of the Technical Support Document). Second, the proposed rule text includes shallow subsurface flow as a hydrologic factor that can be evaluated as part of a significant nexus analysis (see 86 FR 69430-1 for preamble discussion; 86 FR 69449, 69450 proposing to add 33 CFR 328.3(g)(3) and 40 CFR 120.2(g)(3) to the definition of "waters of the United States"). Please comment on whether considering shallow subsurface hydrologic connections in (1) determining adjacency, and in (2) evaluating whether a water has more than speculative or insubstantial effects on the chemical, physical, or biological integrity of a downstream traditional navigable water, interstate water, or territorial sea is supported by the available science.

The SAB commends the EPA for its previous work to develop the document titled "Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence" (U.S. EPA, 2015) and its recent work to develop the "Technical Support Document for the Proposed Revised Definition of Waters of the United States Rule" (U.S. EPA and Department of the Army, 2021b). The SAB finds that these documents sufficiently cover the basic principles of hydrology and the relevant science to date to address the questions posed.

The SAB notes that, in some cases, shallow subsurface hydrologic connections can have substantial impacts on chemical, physical, and biological integrity of downstream waters. This holds true for determining adjacency to jurisdictional waters as well. The science is clear, especially given that shallow subsurface flow is a major mechanism for generating runoff in headwaters. As further discussed below, shallow subsurface flow in headwater regions can have substantial impacts on waters of the U.S. and can also substantially impact the integrity of water when it occurs outside of headwaters (e.g., downstream riparian areas).

Based on the principles of hydrology and the review of the science discussed in both U.S. EPA (2015) and U.S. EPA and Department of the Army (2021b), there is more than "speculative or insubstantial" evidence for the effects of "shallow subsurface hydrologic connections" on the chemical, physical, or biological integrity of connected waters. Specifically, the literature reviews show that these subsurface hydrologic connections transport a significant amount of water and constituents to and from open waters, deeper aquifers, and wetlands. This transport varies greatly across time and space; however, if water is shown to be connected (i.e., unbroken), then the transport of constituents is likely, although the impact of this connection depends on how "unbroken" is defined. Unbroken can be defined spatially (either vertically or horizontally) or temporally.

Significance of shallow subsurface hydrologic connections

Scientists have long known that surface water and groundwater are a single resource (Winter et al., 1998). Wetlands and streams are linked by integrated surface water and groundwater flow systems (Rains et al., 2006) that affect local storage of water (Min et al., 2010; McLaughlin et al., 2014; Ali et al., 2017), groundwater recharge (Sinclair, 1977; Wood and Sanford, 1995; Rains, 2011) and the rate at which water flows to downstream waters (Rains et al., 2016).

The scientific literature provides strong empirical support for importance of surface water-shallow groundwater flow dynamics for maintaining the biological, chemical, and physical integrity of jurisdictional waters. Winter et al. (1998) describe that all landscape types have the potential for surface and ground waters to interact in one of three general ways: streams, rivers, lakes or wetlands can gain water from inflow of groundwater, lose water by outflow (including seepage), or both. Other terminology for those interactions includes: (1) Interflow, or the rapid lateral flow in the unsaturated zone of soil and rock that commonly occurs because above a low-permeability layer there are interconnected macropores that intercept and channel rainfall as would a subsurface pipe (e.g., Beven and Germann, 1982) and (2) Saturated Groundwater Flow, where infiltrating rainfall reaches the water table and then flows laterally along with the general flow in the aquifer.

Surface water-shallow groundwater (or local groundwater) interactions can determine the amount of water gained or lost from river networks (e.g., gaining vs. losing streams or rivers) and other surface water bodies, though flow dynamics and contributions to surface water can vary widely over space and time. The subsurface connections are especially important in determining the volume and persistence of water flow within river networks in areas with shallow groundwater tables and/or pervious subsurfaces.

Exchanges between surface water and groundwater also are critical for habitat upon which fish, aquatic plants, and interstitial organisms depend, particularly when surface water flows diminish but subsurface flow is present. For example, surface-subsurface exchanges can moderate water temperature keeping waters suitable for certain fish like salmon that need colder stream temperatures and/or lay eggs within the hyporheic zone. Upwelling subsurface water also supplies stream organisms with nutrients while downwelling stream water provides dissolved oxygen and organic matter to microbes and invertebrates in the hyporheic zone.

The functional significance of the hyporheic zone (i.e., area of sediment and porous space beneath and alongside a stream or riverbed where shallow groundwater and surface water mix), is determined by its activity and connection with the surface water. Generally, the hyporheic zone is one of the key modulators for most metabolic stream/river processes and is a major pathway for chemical transfer (Lewandowski et al., 2019).

Processes within the hyporheic zone can improve water quality by increasing the contact time with reactive environments to better remove nutrients, trace organic compounds, fine suspended particles, and microplastics. At the same time, in systems where surface waters move too quickly for nutrient cycling, the slower flow of subsurface waters allows sufficient time for microbial activity so that nutrients can return to the surface water. Longer residence times also promote dissolved solute retention, which can be later released back into the channel, delaying or attenuating the signals produced by the stream channel. As residence times and hyporheic exchange increases, pollutants also will generally decline.

Research indicates that an evaluation of the hydrological connectivity of geographically isolated wetlands should include consideration of hydrological flowpaths that may occur through spillage or groundwater. The spatial scale at which this connectivity may occur is highly variable; a recent study by Shogren et al. (2019) reported that organic carbon and inorganic nutrient concentrations within Alaskan watersheds was determined by processes operating at scales from 3-30 km^2.

The Appendix to the EPA's Technical Support Document contains reviews of several studies that demonstrate significant connectivity between geographically isolated wetlands and groundwater (e.g., Sampath et al., 2015; Cohen et al., 2016; Ameli and Creed, 2017; Neff and Rosenberry, 2017; Nitzsche et al. 2017; Bam et al., 2020).

Evaluating connectivity through shallow subsurface water

Understanding the nature and significance of interactions of groundwater and subsurface waters with downstream waters is best achieved by viewing systems as part of larger basins, riverscapes and watersheds. Subsurface flows often persist after surface flows wane and, thus, may provide important connectivity functions from ephemeral and intermittent surface waters to downstream waters. It is important to note that bedrock should not be assumed to be impermeable, because groundwater flows through bedrock are important flowpaths that connect hydrologic landscapes over long distances and often across watershed boundaries (e.g., Roses et al., 1996).

The U.S. Geological Survey (USGS) has published reports and tools on groundwater connectivity, including diagrammatic examples of flowpath frameworks (Heath, 1983,1984; Winter et al., 1998). The potential for surface-shallow subsurface exchange may be partly assessed through topography, as the respective altitudes of water tables and surface water bodies can determine flow (e.g., gaining vs. losing streams). Wetlands may be more difficult to characterize than streams and rivers, but wetlands located in depressions usually have interactions with groundwater similar to those found in lakes and streams. Wetlands in coastal areas may be more affected by tidal cycles and shallow water tables. Another approach to determine connectivity to groundwater includes use of environmental tracers, such as major cations and anions, stable isotopes of oxygen or hydrogen, radioactive isotopes (e.g., radon), and water temperature (Winter et al., 1998).

Recommended clarifications regarding consideration of subsurface connections

- The SAB finds that further discussion of anthropogenic impacts (such as groundwater use) on subsurface connections is warranted in EPA's Technical Support Document. For example, groundwater use can change a gaining stream to a losing stream. Surface water connectivity has been discussed in U.S. EPA (2015) and U.S. EPA and Department of the Army (2021b, pages 32 and 39).

- Clarification of EPA's technical support documents is needed to identify specific determinants of the hyporheic zone and create a refined definition of "shallow." It is unclear if specific terms used in the technical support documents differ or are synonymous; examples of these terms are "shallow groundwater," "shallow aquifers," "shallow subsurface," "alluvial aquifer," "shallow water tables," and "shallow groundwater system." Shallow subsurface flow might be a broad, overarching determinant that could spatially include hundreds of miles of subsurface connections in parts of the United States. However, two surface water hydrologic features which abut, are contiguous, or border each other (i.e., adjacent) and have shallow subsurface flow would be significantly connected and greatly impact each other through the flow of constituents (i.e., chemical), maintenance of water flow and depth (i.e., physical) or biological transport. Further examination of the literature may help define shallow subsurface connection.

2.2. Topic 1B. Summary Review of the Scientific Evidence of Connectivity

2.2.1. Charge Question 1b.

In section II.C of the Technical Support Document, the agencies discuss their summary review of the scientific evidence published since EPA's 2015 report, Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence, with a focus on findings relevant to the conclusions of the 2015 report (see pp. 62-89). Please comment on whether the summary review of the scientific evidence is technically accurate and on whether the conclusions and findings in sections II.C and D are supported by the available scientific literature as presented in the document (see pp. 62-90).

The SAB notes that there are sections of the EPA's Technical Support Document that seem to provide less substantive detail than the EPA's previous 2015 Connectivity Report and the relevant text of the SAB review of that document (U.S. EPA SAB, 2014) provided below. However, the findings and conclusions in U.S. EPA and Department of the Army (2021b), sections II C and D, are supported by the available scientific literature as presented. The review of the published literature is thorough and, in general, is technically accurate; papers published since the 2015 Connectivity Report overwhelmingly support the report's conclusions and, in some cases, strengthen the conclusions.[1]

The major findings regarding the connectivity of streams and wetlands to downstream waters that are supported through the first (U.S. EPA, 2015) and updated (U.S. EPA and Department of the Army, 2021b) literature reviews are included in Appendix A of this report.

Relevant text excerpted from the initial SAB review of EPA's Connectivity Report (U.S. EPA SAB, 2014)

> Future efforts to quantify connectivity can be informed by the wide variety of conceptual models and quantitative tools that have been developed to evaluate the connectivity of both surface and subsurface hydrological systems in different settings, including non-floodplain wetlands. The standard approach involves first characterizing the surface and subsurface

[1] One citation not included in the update is: Lewandowski, J. et al. 2019. Is the Hyporheic Zone Relevant beyond the Scientific Community? *Water*. 11(11):2230. https://doi.org/10.3390/w11112230

elements of landscapes. Important elements are climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements can then be integrated to create a flowpath network that describes connectivity (Heath, 1983; ASTM, 1996; Kolm et al., 1996; Winter et al., 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al., 1998). Of course, the approach to quantifying hydrologic connectivity is not identical across systems, and careful attention must be given to identifying the most appropriate techniques (Healy et al., 2007; Bracken et al., 2013) and metrics (Lexartza-Artza and Wainwright, 2009; Ali and Roy, 2010; Wainright et al., 2011; Larsen et al., 2012).

The Report also can draw on examples related to water quantity and quality modeling (Appel and Reilly, 1994; Sun et al., 1997; Harbaugh, 2005; Parkhurst et al., 2010; Cunningham and Schalk, 2011), integrated surface water groundwater modeling (Markstrom et al., 2008; Ely and Kahle, 2012; Huntington and Niswonger, 2012; Woolfenden and Nishikawa, 2014), sediment transport modeling (Nelson et al., 2003; McDonald et al., 2005), and watershed and biological/habitat/landscape modeling (Kinzel et al., 1999, 2005; Hunt et al., 2013). Approaches have also been developed to quantify linkages due to groundwater movement and storage (Heath, 1983) and the effects of “flood pulses” (Kolm et al., 1998). Likewise, the role of chemical movement and storage to groundwater systems in floodplains has been quantified by flow and transport modeling (Winter et al., 1998; Markstrom et al., 2008; Woolfenden and Nishikawa, 2014) as well as with steady-state and transient analyses that simulate temporal changes (Appel and Reilly, 1994; Winter et al., 1998; Nelson et al., 2003; Conaway and Moran 2004; Harbaugh 2005; McDonald et al. 2005; Markstrom et al. 2008; Huntington and Niswonger, 2012).

A growing number of studies are using graph-theory-based indices of connectivity to better understand aquatic systems. These studies should be considered in developing the discussion of approaches to quantify connectivity. For example, Van Looy et al. (2013) used the Integral Index of Connectivity to quantify connectivity and habitat availability in a dendritic river network across varying spatial scales. Wainwright et al. (2011) demonstrated how responses of river systems to vegetation removal, runoff, and erosion were better predicted by measures of structural and functional connectivity. Other metrics integrate hydrological and ecological connectivity using the Directional Connectivity Index and connectivity-orientation curves, which effectively quantified physical-biological feedbacks in the Everglades (Larsen et al., 2012). Malvadkar et al. (2014) recently examined numerous metrics drawn from graph-theory, including Betweenness Centrality, Integral Index of Connectivity, Coincidence Probability, Eigenvector Centrality, Probability of Connectivity, and Influx Potential.

Connectivity also can be described using six metrics commonly used in hydrology and disturbance ecology – frequency, magnitude, timing, duration, rate of change, and predictability (e.g., Resh et al., 1988; Poff, 1992; Poff et al., 1997). These can be defined in hydrological, chemical, or biological terms. For example, in hydrological terms, frequency describes how often a flow of a particular magnitude occurs, magnitude is the amount of water moving past a fixed location per unit time, duration is a measure of how long such a flow persists, and the rate of change is how quickly one flow gives way to another. These first five metrics comprise the components of the natural flow regime (Poff et al., 1997). The last metric, predictability, takes all of these into account (e.g., predictability of a given flow can be indicated by the presence or absence of flow-dependent biota).

The temporal and spatial predictability of connectivity is especially important to quantify when assessing potential for downgradient effects in systems without permanent or continuous flowpaths (e.g., Poff and Ward, 1989; Lytle and Poff, 2004; Poff et al., 2006). Predictability refers to the regularity at which certain flows occur. Some mechanisms of connectivity are predictable (e.g., migration of anadromous fish and waterfowl, spring flood pulses and late summer low flows, seasonal peaks of aquatic insect emergence), whereas others are less so (e.g., flood events from storms, short-term and/or stochastic movement of organisms, nutrient spiraling dynamics). Predictable events can profoundly shape systems. For example, sequential and predictable seasonal flooding and drying events over an annual cycle are formative processes of physical, chemical, and biological attributes of streams in Mediterranean biomes, including parts of the western United States (Gasith and Resh, 1999). Large seasonal waterfowl migrations can move nutrients, plants (seeds), and invertebrates between wetlands and downgradient waters (e.g., Figuerola et al., 2003; Green et al., 2008). A predictability axis could be folded into the current "gradient of connectivity" framework suggested by the SAB -- Figure 3 in Section 3.7.3 of U.S. EPA SAB (2014).

<u>Text and figures in EPA (2015) illustrating surface-subsurface water interactions</u>

The SAB notes that the EPA report "Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence" (U.S. EPA, 2015) contains helpful text and figures related to surface-subsurface water interaction. The text and figures from U.S. EPA (2015) are provided below.

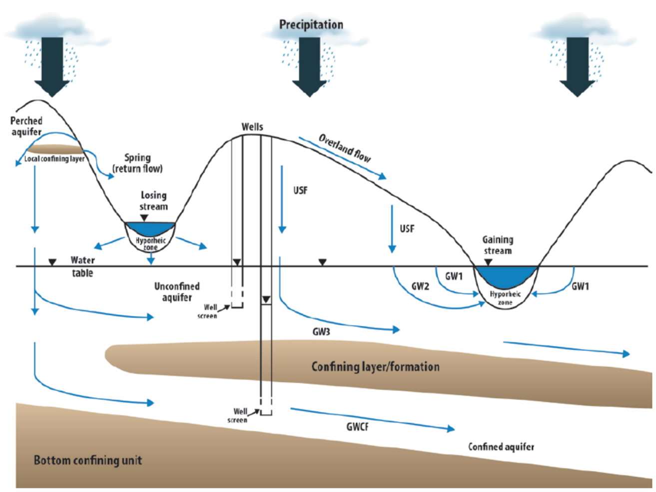

Figure 3-5. Cross-section showing major hydrologic flowpaths in a stream-watershed system regional in scale. USF = unsaturated flow, GW = groundwater flowpath (saturated flow); GW1, GW2, and GW3 = groundwater flowpaths on varying depth and length. GW1 represents local groundwater and GW3 represents regional groundwater. GWCF = groundwater flowpath in confined aquifer.

Flowpaths within river basins (Bencala et al., 2011) are commonly grouped into three categories - see Figure 3-5 from U.S. EPA (2015):

- **Local groundwater flow system** (also referred to as **shallow groundwater**), groundwater flows from a water table high to an adjacent lowland or surface water (Winter and LaBaugh, 2003). Local groundwater flow is the most dynamic of groundwater flow systems, so local groundwater has the greatest interchange with surface waters.

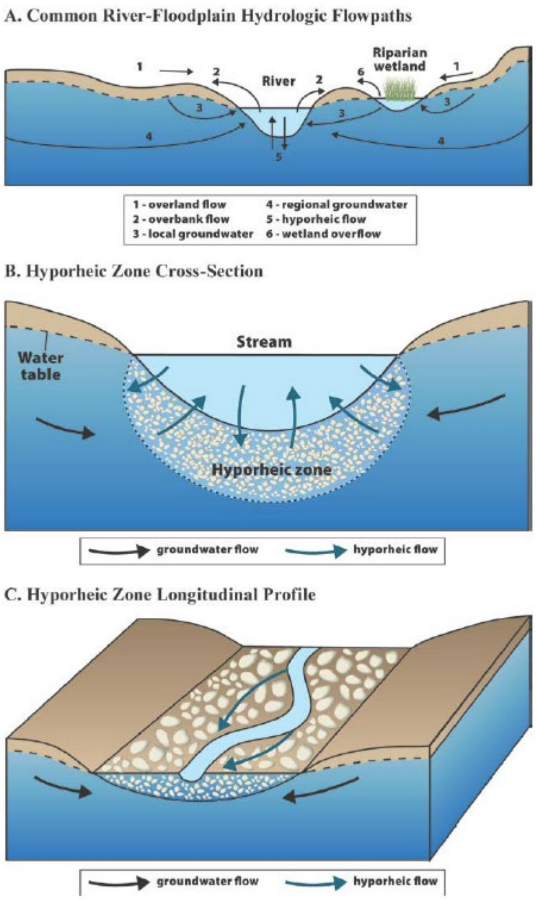

Figure 3-6. Hyporheic zone flows. (A) Common hydrologic flowpaths by which water flows between drainage basins and river networks. (B) and (C) The three-dimensional process of hyporheic flow, or the movement of water from a river or stream to adjacent alluvium and then back to the river or stream.

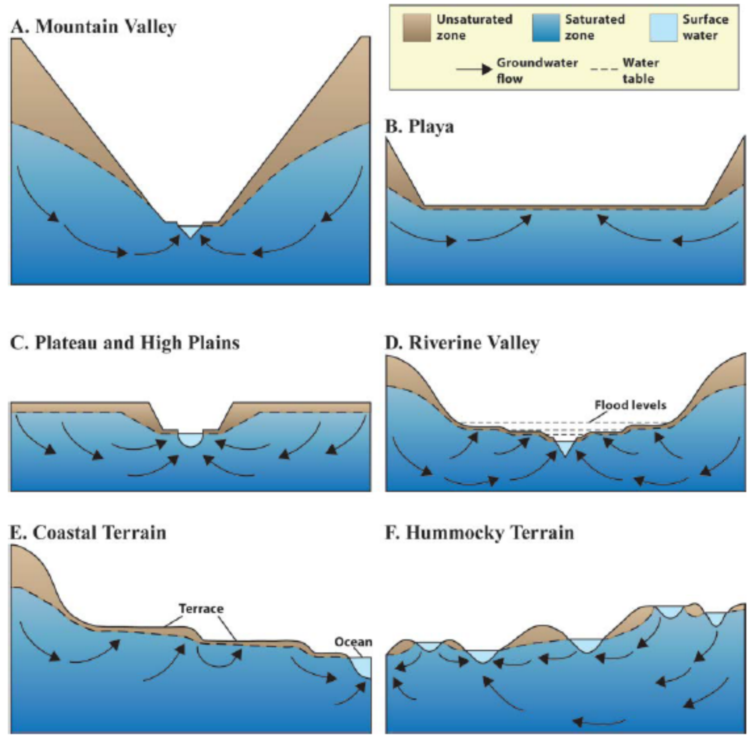

Figure 3-16. Generalized hydrologic landscape forms. (A) Mountain Valley: narrow uplands and lowlands separated by a large steep valley side; (B) Playa: large broad lowland separated from narrow uplands by steeper valleys sides (playas and basins of interior drainage); (C) Plateau and High Plains: small narrow lowlands separated from broad uplands by steeper valley sides; (D) Riverine Valley: small fundamental landscape units nested inside broader fundamental landscape unit; (E) Coastal Terrain: small fundamental landscape units nested inside broader fundamental landscape unit (coastal plain with terraces and scarps); and (F) Hummocky Terrain: small fundamental landscape units superimposed randomly on larger fundamental landscape unit. A fundamental hydrologic landscape unit is defined by land-surface form, geology, and climate.

Modified from Winter (2001).

- **Intermediate groundwater flow system** is one in which groundwater flows from a water table high to a lowland that is not immediately adjacent to the water table high.

- **Regional groundwater** (also referred to as deep groundwater) originates from precipitation in distant upland recharge areas and moves over long distances, through deep regional-scale aquifers, to river networks - see Figure 3-5 from U.S. EPA (2015). These deep and long flow systems result in longer contact times between groundwater and subsurface materials than do local systems. Eventually, deep regional flow systems also discharge to surface waters in the lower portions of river networks where they influence surface water conditions.

<u>Recommended clarification of EPA's literature review</u>

- No literature review will include every piece of relevant work; however, it is not clear that the EPA's literature search included papers in which connections, ancillary to the original "abstract worthy" findings, are identified and quantified. The SAB notes that reviewing just the paper title and abstract would make it difficult to find such papers and decide whether they support or refute a position. The SAB also notes that it would also be helpful to indicate how many studies were included from research and monitoring outside of the United States (U.S. EPA and Department of the Army, 2021b, pg 70).

- With regard to the text on page 73 in U.S. EPA and Department of Army (2021b), the SAB notes that additional review would probably show the benefits of ephemerals to be similar to wetlands during periods of their hydrographs. In addition, literature would provide more details on sinks and lags of more chemical constituents than those listed in both ephemerals and wetlands.

- With regard to the text on pages 37, 77, and 78 in U.S. EPA and Department of the Army (2021b), the SAB notes that more research should be highlighted when discussing the aggregation of functions to exemplify impacts. While this is an important point to make, highlighting individual ephemeral or wetland benefits is just as pertinent to this work. If this is going to be part of the discussion, review and further explanation of any work on the point at which aggregated ephemerals and wetlands no longer have a discernable impact on downstream systems is warranted.

- As previously noted, further discussion of anthropogenic impacts (such as groundwater use) on subsurface connections is warranted in the EPA's Technical Support Document.

2.3. Topic 2: Economic Analysis

2.3.1. Charge Question 2a.

The Economic Analysis estimates benefits with a "state-based" approach (Section III.C) while also providing an alternate "radius-based" approach (Appendix H). Please comment on the appropriateness of these approaches in capturing total willingness to pay over the market extent in the context of this proposed rule. In particular, please provide comment on the range of radii presented in the radius-based approach in Appendix H.

The SAB finds that a switch from state-based to radius-based benefit estimates as piloted in Appendix H could potentially improve the agencies' economic analysis. The radius-based approach has several advantages compared to the state-based approach, namely that it allows for interstate impacts and better captures heterogeneity in local population demographics. The radius-based approach allows the baseline wetland acreage in the analysis to vary at the census tract level, which is a significant improvement on the prior state-based approach that assumed a uniform baseline wetland acreage. Cutting off benefits at state boundaries is not consistent with economic theory and is hard to justify as a valid extent-of-the-market assumption (Keiser et al., 2020). As the EPA has indicated, it also leads to problems in projecting local vs. non-local benefits using the "local" indicator from the meta-analysis of wetland values.

The SAB notes, however, that a radius-based approach would ideally account for patterns of local and regional visitation, which recent work shows is a very important consideration for ambient water quality valuation (Kuwayama et al., 2022). Given the likely importance of recreational benefits to total willingness to pay (WTP) for avoided loss of wetland acreage, a radius-based approach that is naïve with respect to the origin of typical visitors to wetland sites may substantially underestimate benefits, as it does for surface water quality in Kuwayama et al. (2022). For example, on p. 172 of Appendix H of the Economic Analysis, the text states that "local wetlands are the most proximate and from which households presumably derive the most benefits." This is not likely to be true in areas where the most important wetlands for recreational purposes are non-local. In the two pilot states (Georgia and Rhode Island), coastal wetlands may be surveyed in the National Oceanic and Atmospheric Administration's (NOAA) Marine Recreational Information Program (MRIP) data. These data generally include recreator zip codes, so if enough wetland sites are surveyed, it would be possible to account for recreation behavior in a radius-based approach to see if this makes a difference in the estimates. If visitation patterns or other behaviors affecting valuation cannot be incorporated into the analysis, it would be helpful to discuss this as a potential drawback of the agencies' approach.

Finally, it is unclear from the discussion in Appendix H how the radius-based approach will be adjusted in cases where affected wetlands cross international borders. The agencies should explain this briefly in any revised documentation of their approach.

<u>Recommendations regarding radius-based benefit estimates</u>

- Although the SAB finds that the radius-based approach in Appendix H of the Economic Analysis is a reasonable alternative, the following caveats should be taken into consideration. The radius-based approach does not capture the following potential groups of individuals that may benefit from changes in wetlands:

    1) Individuals that are outside of the radii and still have use value for the wetlands. This could be an important category of missing benefits for wetlands that impact iconic bodies of water or draw a large number of visitors from great distances away. However, for many wetlands, this may not be a major concern since the largest radius considered (200 miles) likely captures most use value for a particular site.

    2) Individuals that are outside of the radii and have non-use value for the wetlands. It is difficult to know the precise value that individuals outside these radii have for any particular wetland. While the value for any particular wetland may be low, if these values are aggregated over many individuals, these lost benefits could be large. This is an uncertain, but important, category of missing benefits.

    3) Individuals that are outside of the radii considered, but are impacted by the connectivity of the wetland to another area of value. These impacts could accrue through use or non-use channels. This could include downstream flood impacts, habitat for migratory birds, drinking water impacts, or diffuse environmental impacts that are otherwise difficult to measure. This is also an uncertain, but important, category of missing benefits.

- It seems that the analysis derived the range of the local and outer radii from studies in the meta-analysis. While this is a generally reasonable strategy, the SAB notes that the meta-analysis is based on eight states and two Canadian provinces. The analysis notes that the radii approach better aligns with EPA methods for valuing surface water quality. The SAB suggests that the EPA consider finding some guidance on the appropriate range of radii from surface water quality valuation studies using a more comparable sample of states.

- It is not clear why EPA conducted sensitivity analyses in which the local variable was zeroed out. If this was for illustrative purposes, that seems fine, but it does not seem to be an approach that should be used for calculating benefits.

- The SAB understands EPA's concern that the studies from the meta-analysis were not designed to study the extent of the market. However, it would be useful to know the extent of the market from these studies and how it compares to EPA's sample radii.

- The range of the radii considered seems appropriate. However, the SAB recommends that the EPA conduct a thorough review of the literature and present information on extent of the market from prior wetland studies.

2.3.2. Charge Question 2b.

The agencies took a different approach to environmental federalism in the Economic Analysis for the proposed rule in comparison to the analysis for the Navigable Waters Protection Rule. Please comment on whether the approach to characterizing states discretely in the Economic Analysis for the proposed rule is appropriate (Chapter II and Section III.C). Please provide comment on the exclusion of Canadian studies from the meta-data and setting the baseline wetlands acreage to 10,000 in the sensitivity analysis (Appendix E) associated with the assessment of states' costs and benefits.

The SAB finds that the agencies' approach to environmental federalism in the Economic Analysis for the proposed rule is not consistent with best practices in benefit-cost analysis, and it should be dropped. It appears that the Economic Analysis for the Navigable Waters Protection Rule was the first regulatory benefit-cost analysis to use this approach, in which the agencies omit from the analysis a group of states based on predictions about what those states may do in response to a proposed rule. The agencies assume that many states kept more stringent jurisdictional definitions under the Navigable Waters Protection Rule, but data are insufficient to support this assumption. As noted in two peer-reviewed publications (Keiser et al., 2021, Keiser et al., 2022) and one report prepared by the External Environmental Economics Advisory Committee (E-EEAC) (Keiser et al., 2020), this approach conflicts with EPA's *Guidelines for Preparing Economic Analyses*, and it also incorporates incorrect information into the agencies' benefit and cost estimates.

The Navigable Waters Protection Rule Economic Analysis set a poor precedent by including the federalism analysis, and the current Economic Analysis provides an opportunity to correct that error. In the Navigable Waters Protection Rule, the Economic Analysis reported both estimates including all states' benefits and costs, as well as estimates from the "federalism scenarios." The current rule's Economic Analysis omits the "all states" analysis entirely, which makes it more difficult to determine how much bias is introduced when states are dropped from the analysis based on predictions about their future regulatory choices.

One illustrative example demonstrates the downsides of the approach the agencies have taken. The State of Florida is listed in Table II-1 of the Economic Analysis as one that currently regulates waters more broadly than the proposed rule requires, for both Clean Water Section 404 and surface waters. Thus, no benefits and costs are estimated for Florida in the scenario that compares the current rule to the Navigable Waters Protection Rule baseline. However, Florida (which became the third state to acquire Section 404 permitting authority under the Clean Water Act in 2021) has stated publicly and in correspondence to the EPA that it will continue to apply the Navigable Waters Protection Rule jurisdictional guidelines, rather than return to the pre-2015 guidance (Northey, 2022). Thus, the agencies categorized Florida incorrectly – a return to pre-2015 guidance would likely result in avoided wetland loss relative to the Navigable Waters Protection Rule, no matter what information was used by the agencies to classify that state in Table II-1.

This case highlights the difficulty of trying to predict how states will react to a change in a federal rule, and it is one important reason that EPA's *Guidelines for Preparing Economic Analyses* states clearly that this kind of speculation should not be incorporated into an analysis. It also introduces error into the agencies' estimates. According to Appendix D, Tables D-6 and D-4, of the Economic Analysis, Florida's annualized national benefits from replacing the Navigable Waters Protection Rule with the pre-2015 guidance represent 55-60% of the total national benefits, and only 12-14% of the total national costs of the proposed rule, when all states' benefits and costs are considered (as they should be). Thus, dropping Florida from the analysis significantly reduces the net benefits of the proposed rule (at least in the case of this single state).

As Keiser et al. (2021, 2020) point out, Florida is not the only state that is mis-classified. In fact, the agencies point out that, since the original state classifications were done for the Navigable Waters Protection Rule Economic Analysis, Ohio and Indiana had to be dropped from the list of those states that were presumed to have zero benefits and costs due to their regulations on the books at the time. The dynamics of these kinds of state changes provide another reason that the agencies should avoid speculating on future state behavior in their Economic Analysis.

An additional drawback of characterizing states discretely when using the state-based approach is the omission of inter-state impacts. For example, Table II-1 of the Economic Analysis shows that both Michigan and Pennsylvania regulate waters more broadly than the proposed rule, but Ohio and Indiana do not. Since these states share borders, an improvement in waters in directly affected states (Ohio and Indiana) may yield environmental benefits in states that already regulate more broadly (Michigan and Pennsylvania), and these benefits would be omitted.

On page 47 of the Economic Analysis for the proposed rule, the agencies write that the federalism approach was "necessary because of the deregulatory nature of the Navigable Waters Protection Rule." Also on p. 47, the agencies note that they are returning to a "traditional approach," while, in fact, they are following the same process. The SAB questions why deregulation is fundamentally different from a regulatory approach, or in the case of the proposed rule, a re-regulatory approach, in the appropriate approach to state responses. In the current rule, the agencies are re-regulating, but continuing to use the federalism approach that was described as only necessary with *de*regulation.

Finally, the SAB notes that the maps in the Tribal Impacts Analysis (Figures V-1 and V-2) include all states. The same may be true for the Environmental Justice Analysis in Section IV. Dropping 23 states from the Economic Analysis because the agencies anticipate zero benefits and costs in those states is inconsistent with including wetland losses in those same 23 states in the EJ and Tribal Impacts Analyses. Relevant to the comments above, the SAB notes that Figure V-1 shows large impacts (not zero impacts) on wetland acreage in Florida, Minnesota, and other states dropped from the Economic Analysis (compare Figures V-1 and V-2 to Figure III-1).

<u>Exclusion of Canadian studies from the meta-data and setting the baseline wetlands acreage to 10,000 in the sensitivity analysis</u>

The SAB finds that it is appropriate to exclude the Canadian studies for a sensitivity analysis associated with the assessment of states' costs and benefits, but it also seems appropriate to include these studies in the main analysis if the study locations and local populations are similar (as EPA argues). It is not clear why EPA returns to using the 10,000 baseline acreage for all states in this same robustness analysis. This does not seem appropriate and makes it more difficult to understand the impact of the Canadian studies on the final benefit estimates. Does the sensitivity analysis use a uniform baseline wetland acreage in order to compare to the previous Navigable Waters Protection Rule analysis? Since baseline acreage impacts WTP, it seems that allowing for heterogeneous baseline acreage would be more appropriate if there is available data.

<u>Recommendations regarding the approach to environmental federalism and the sensitivity analysis</u>

- The SAB recommends that the agencies include all states' benefits and costs in the Economic Analysis and drop the federalism piece of the analysis altogether. This will require adding the omitted states' benefits and costs into all aspects of the analysis (e.g., estimating them in the meta-analysis), and it will also make the Economic Analysis consistent with the Tribal Impacts and Environmental Justice Analyses.

- It is appropriate to exclude the Canadian studies for a sensitivity analysis, but it also seems appropriate to include them in the main analysis if the study locations and local populations are similar (as EPA argues).

- It is not clear why EPA returns to using the 10,000 baseline acreage for all states in the robustness analysis. This does not seem appropriate and makes it more difficult to understand the impact of the Canadian studies on the final benefit estimates. Since baseline acreage impacts WTP, it seems that allowing for heterogeneous baseline acreage would be more appropriate if data are available.

2.3.3. Charge Question 2c.

Please comment on whether in the Economic Analysis the agencies have adequately addressed criticisms that benefits of wetland and stream protection have been drastically underestimated or *non-monetized in the economic analyses for previous rulemakings revising the definition of "waters of the United States." Please comment on the appropriateness of how the agencies assessed water quality benefits associated with upstream and downstream connectivity (see Section III.C).*

The SAB finds that the agencies have responded to most of the suggestions for revisions to the wetlands benefit meta-analysis first used in the Economic Analysis of the Navigable Waters Protection Rule. The Agencies have also done a much better job explaining some of the reasoning for listing but not estimating some other benefits of the proposed rule (e.g., intermittent/ephemeral stream protection).

The meta-analysis draws from stated preference studies to estimate WTP for changes in wetland acreage, a reasonable strategy to quantify non-market economic values. However, it would be useful to clarify the types of wetland services that are being captured by the applied WTP estimates and whether these are use and/or non-use values. Based on the discussion in the proposed rule and the Technical Support Document, wetlands have broad functions that range from ecological and recreational services to flood mitigation and water purification. While the Economic Analysis states that the benefits are likely to be an underestimate, a better understanding of the types of services valued in the WTP estimates might help one qualitatively gauge the extent of the underestimate.

A related issue is that WTP benefits measures depend on the available information set. If people were unaware of certain (or the extent of) wetland functions at the time of the studies in the meta-analysis (the publication years range from 1991 – 2013), then these values would be omitted from the WTP estimates. The agencies note that limiting affected populations to state residents may understate benefits of the proposed rule, given upstream and downstream connectivity of wetlands. The agencies' plan to pursue a radius-based approach to better account for this seems reasonable.

The SAB finds that the agencies' analysis still undervalues (omits) significant categories of benefits. The agencies admit this fact and note they, "do not include the changes to water quality inside ephemeral and intermittent streams, downstream water quality and flood avoidance outside of the vicinity of wetlands, and additional services provided by wetlands such as carbon sequestration" (page 82). They also do not value any benefits to programs outside of Section 404 of the Clean Water Act. The connectivity of wetlands to other downstream areas are not adequately measured either. The SAB recognizes that incorporating additional wetland benefit estimates into the Economic Analysis for the current rule would be challenging, and would require careful thinking about potential double-counting given the stated preference approaches supporting the meta-analysis. The agencies may want to consult recent work by Taylor and Druckenmiller (2022), which suggests significant wetland values associated with flood protection. The SAB recommends that the Economic Analysis discuss potential flood prevention benefits from that study and others, and that the agencies consider the possibility of incorporating such estimates in this rule or future rules.

<u>Recommendations to improve the wetlands benefit meta-analysis</u>

- The agencies should clarify the types of wetland services that are being captured by the applied WTP estimates and whether these are use and/or non-use values. While the Economic Analysis states that the benefits are likely to be an underestimate, a better understanding of the types of services valued in the WTP estimates might help one qualitatively gauge the extent of the underestimate.

- A paper published in the April 2022 issue of the *American Economic Review* (Taylor and Druckenmiller, 2022) makes it much easier to estimate one omitted category of wetland benefits – avoided flood damages – which are very unlikely to be included in the estimates currently used in the meta-analysis. The agencies should discuss these new estimates of wetland benefits in the Economic Analysis for the proposed rule, and consider the possibility of incorporating them.

2.3.4. Charge Question 2d.

The agencies requested public comment in the Economic Analysis for the proposed rule on whether the costs in Sunding & Zilberman (2002) should be considered for analyzing this proposed rule (see Section III.C.3, p. 85). Please comment on whether it is appropriate or not for the agencies to use Sunding & Zilberman (2002) to supplement the primary cost approach in the Economic Analysis.

The discussion on p. 85 of the Economic Analysis explains very briefly why the agencies chose to use their own primary cost approach, rather than using the Section 404 individual and general permits cost estimates from Sunding and Zilberman (2002). The SAB finds that the explanation of why the Sunding and Zilberman permit cost values are less appropriate than those in the U.S. Army Corps of Engineers' analysis is reasonable. The agencies noted that the Corps permit cost analysis was based on a "typical project" that affected up to three acres of land (pg. 76). The SAB provides the following recommendations for additional work to support the agencies' approach.

<u>Recommendations regarding the permit cost approach in the Economic Analysis</u>

- The agencies should consider undertaking a sensitivity analysis to vary the "typical project" assumption.

- In order to make a recommendation on the use of Sunding and Zilberman (2002), the agencies should consider how the permitting process has changed, if at all, since the study period (early 2000s) and whether the process is similar.

- Sunding and Zilberman (2002) estimate a statistical relationship in their paper that allows them to model permit cost for individual and "nationwide" permits. However, the results of this statistical relationship are not provided in the paper. If this relationship is the basis for determining projected costs, then the equation that was estimated, the parameter estimates, and standard errors should be provided.

- On p. 85 of the Economic Analysis, the text states that it is "likely" that the high estimates in Sunding and Zilberman (2002) are attributable to large permits covering multiple features – permits that would likely still be needed even if one or more waters covered would move from non-jurisdictional under the Navigable Waters Protection Rule to jurisdictional under the proposed rule. The agencies should check with the authors of that study to confirm this hunch, if it is not evident from the paper alone. This would make a more persuasive argument.

- The approach taken in the Economic Analysis, using the highest estimate for the "high" category and the lowest estimate for the "low" category of costs, does not seem ideal, whether the agencies are using the Sunding and Zilberman (2002) estimates, or their own estimates. If the highest end of the range in Sunding and Zilberman represents an outlier, then one would not expect it to be comparable to the highest end of the range in the agencies' estimates (whether that is an outlier or not). It might be better to take the 5th and 95th percentile values, or even the 25th and 75th percentile values, and use those for the low and high cost estimates, rather than using the most extreme values in the distribution for that purpose. If the agencies take that approach, the results may not differ as much from the Sunding and Zilberman approach. Even if the agencies do not switch the approach altogether, they might consider including a sentence or two in the text on p. 85 making this point.

2.4. <u>Topic 3: Climate Change</u>

2.4.1. Charge Question 3a.

The preamble of the proposed rule discusses how the significant nexus standard allows for the agencies to consider the functions of streams, wetlands, and open waters that support the resilience of the chemical, physical, or biological integrity of traditional navigable waters, interstate waters, or the territorial seas (foundational waters) to climate change (see 86 FR 69394). Please comment on the extent to which this section of the preamble is technically accurate.

The SAB finds that, in general, the preamble language referenced in the charge question is accurate. However, the language oversimplifies issues of non-stationarity associated with climate change. Specifically, the examples cited in the preamble focus on monotonic climate changes (i.e., places becoming either wetter or drier) and do not consider that some places are becoming both wetter and drier as the envelope of hydroclimatic variability widens, which is to say as climate variability becomes more extreme (e.g., p. 153 of the Technical Support Document). The preamble is not incorrect, the language is simply not complete in the sense that it misses some of the nuances of non-stationarity.

The preamble also states that "Coastal wetlands can also help buffer storm surges, which are becoming more frequent due to climate change." The SAB notes that stronger and higher storm surges are indeed occurring and projected to continue due to both sea-level rise and more intense storms, but it is not clear there is evidence that storm surges are becoming more frequent. Such a conclusion is not found in the Intergovernmental Panel on Climate Change's (IPCC's) Sixth Assessment Report (AR6) from Working Group I (IPCC, 2022), for example. Extreme storm surges are becoming more frequent, but not all storm surges.

2.4.2. Charge Question 3b.

The Technical Support Document for the proposed rule discusses climate change in two respects. First, the agencies summarize the impact of climate change on water resources to the extent that they would affect the chemical, physical, or biological integrity of traditional navigable waters, interstate waters, or the territorial seas (see section III.C., pp. 153-155). Please comment on the extent to which that section of the document accurately summarizes how climate change is projected *to impact water resources and explains the importance of considering functions of streams and wetlands that can mitigate for effects of climate change in a significant nexus analysis. Second, the agencies assert that the Navigable Waters Protection Rule's standard for "typical year" does not accurately consider climate change in its evaluation of precipitation "normalcy." (see section III.B.iii.c, pp. 132-134). Please comment on whether that section of the document is technically accurate in its assessment of the inconsistencies of the Navigable Waters Protection Rule with respect to climate science.*

The SAB finds that the summary in the Technical Support Document of climate change impacts to water resources is technically accurate.[2] The Technical Support Document highlights one of the major challenges to decision-makers, which is the declining relevance of a "typical year" approach to assessing hydrologic connectivity. This is especially true in places where hydrologic conditions are becoming more extreme instead of simply wetter or drier. The SAB agrees that going back to the significant nexus standard likely offers the flexibility to account for growing hydrologic extremes.

The Technical Support Document states that: "Coastal wetlands can also help buffer inlands from storm surges and slow winds from tropical storms and hurricanes, which are becoming more frequent due to climate change" (U.S. EPA and Department of the Army, 2021a). The SAB notes that the IPCC's Sixth Assessment Report (AR6) published earlier this year states that "There is *low confidence* in observed recent changes in the total number of extratropical cyclones over both hemispheres. The proportion of tropical cyclones which are intense is expected to increase (*high confidence*) but the total global number of tropical cyclones is expected to decrease or remain unchanged (*medium confidence*)." Therefore the text on page 154 of the Technical Support Document should be revised as follows: "…hurricanes, of which the most intense are becoming more common due to climate change." to more accurately reflect the science. Again aside from this one item, the description of how climate change is likely to affect water supplies seems to align well with the science community's conclusions.

The agencies assert that the Navigable Waters Protection Rule's standard for "typical year" does not accurately consider climate change in its evaluation of precipitation "normalcy." As discussed above, it is accurate to point out this problematic issue with the Navigable Waters Protection Rule as the climate is now changing so rapidly that averages over the prior 30-yr period often do not reflect current conditions. While the World Meteorological Organization has long used a 30-yr window as a standard measure of "climate," that definition was created many decades ago before climate change took on the more rapid pace seen over recent decades. Current conditions now frequently depart from their prior 30-yr averages, and they can be reliably estimated when recent changes have been fairly regular or steady. An example is temperature rise that leads to current climate conditions being substantially warmer than the average over the previous 30 years, as used in, e.g., the IPCC's Special Report on 1.5C for global mean surface temperature estimates (i.e. the 30-yr average centered on the 2017 value was used for 'current' rather than the 1987-2017 average because the change was a fairly regular quasi-monotonic increase through 2017 and thus the following 15 years could be reasonably estimated based on extrapolation). Another example is NOAA's 15-year seasonal average of total precipitation, as noted in

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[2] The last paragraph of Section C reads "flashy hydrology" but the intended phrase should probably be "flashy streams."

the rule, which could be used under the revised standard along with similar methods designed to better capture precipitation in a changing climate.

2.5. Topic 4: Environmental Justice

2.5.1. Charge Question 4a.

The agencies discussed environmental justice in both the Technical Support Document (Section III.D, pp. 155-156) and the Economic Analysis (Section IV). Section V of the Economic Analysis contains the tribal impact analysis. Please comment on the extent to which these documents are technically accurate in their discussions of environmental justice, burdens, and overburdened communities.

The SAB finds that the discussion of environmental justice in the Technical Support Document is generally technically sound. The Technical Support Document (Section III.D, pp. 155-156) presents an introduction to the environmental justice (EJ) implications of the Navigable Waters Protection Rule. This section provides an effective and useful overview of the disproportionate impacts of Navigable Waters Protection Rule on socially disadvantaged population groups. The Economic Analysis (Section IV) provides a screening assessment of the impacts of changes due to the proposed rule for populations of concern, using the secondary baseline of the Navigable Waters Protection Rule. This EJ analysis is distributional in scope and focuses on the potential spatial impacts of the proposed rule using two Environmental Justice Screening and Mapping Tool (EJSCREEN) environmental indicators and seven socio-demographic variables relevant to EJ, based on comparing their values across multiple Hydrologic Unit Code (HUC-12) watershed change (wetland area and affected waters) scenarios. The methodology is generally sound and results are explained with sufficient clarity, although more rigorous analyses may be necessary to determine the extent to which socially-disadvantaged and tribal communities are disproportionately impacted by the proposed rule. There are several issues that require further clarification and consideration. These issues and related recommendations are listed below.

Recommendations to improve the discussion of environmental justice issues in the Technical Support Document and Economic Analysis

- It is unclear how the scenarios associated with both Wetland Area Changes and Changes to Affected Areas (used in Tables IV-1, IV-2, IV-3, IV-4 and Figures V1, V2) were developed or derived, and why the watershed change-related measures were classified into these four specific categories. This justification is important because the results of the EJ analysis presented here could be influenced by how values of Wetland Area Changes and/or Changes to Affected Areas are classified. If the scenarios used for this EJ analysis were based on information included in another document on the proposed rule, it should be referenced here. A definition of HUC-12 watershed boundaries could also be included, since not everyone may be familiar with this USGS terminology.

- The Economic Analysis does not contain a detailed analysis of the 96 HUC-12 watersheds that had wetland changes of greater than 50 acres (4^{th} category in the tables) under the new regulation. Given the large overrepresentation of minority and low income populations in these HUCs, the Economic

Analysis needs to investigate further before it can draw definitive conclusions about the environmental justice implications of the regulation. These HUCs represent only a small fraction of the U.S., but these kinds of screenings are meant to reveal just these kinds of disparities that warrant further investigation. It appears that these HUCs were concentrated along the Gulf of Mexico near the Mississippi River Delta. Wetland gains in these areas may be associated with post-Hurricane Katrina restoration of coastal and estuarine wetlands to protect coastal communities.

- The EJ analysis of proposed rule changes was based on the comparing the percentage of individuals in specific socio-demographic categories (e.g., minority, low-income, less-educated, etc.) residing within relevant HUC-12 watersheds to their corresponding national percentage, as indicated in Tables IV-1 to IV-4. While this is easy to understand and interpret, it may not represent the most effective or reliable approach for measuring disproportionate effects with respect to the baseline (no change) scenario. A more appropriate approach would be to be estimate and compare the percentage of each socio-demographic variable inside the area defined by each set of watersheds to the area outside these watersheds (rest of the U.S.), as suggested in several published EJ studies (Harner et al. 2002; Chakraborty 2006). Using the overall U.S. percentage for comparison leads to double-counting of communities within HUC-12 watersheds, since the national percentage for any variable includes areas both inside and outside these watersheds. The percentage difference or ratio of percentages (inside vs. outside watersheds) for each wetland area and affected waters change scenario should provide a more accurate metric for comparison with other change scenarios, as well as the Navigable Waters Protection Rule baseline (no change).

- For discussion of EJ in the Economic Analysis, it may be more appropriate to use state-level sociodemographic averages as a comparison rather than the national average. First, national averages may mask considerable heterogeneity across geographic regions that may make the comparison inappropriate (Federal Interagency Working Group on Environmental Justice & NEPA Committee 2016). For example, in Table IV-1, the % minority in the Wetland Area Change category of >0.5-1 is 43.6% and is compared to a national average of 39.2%. If areas with changes of >0.5-1 acres are systematically located in regions with lower (higher) minority shares as compared to the national average of 39%, then this comparison would under- (over-) state the extent of disproportionate exposure. Second, a state-level comparison may better match the regulatory level at which permitting decisions are made. Third, state-level comparisons would be more consistent with prior EPA analyses that use both national and state-level comparisons, e.g., EPA's 2015 Steam Electric Rule (80 FR 67838). Comparison to state-level demographics may complicate the analysis in cases where a watershed crosses state boundaries and may require combining the demographics characteristics across multiple states.

- Aggregating all individuals who do not identify as *non-Hispanic White* into a single "Minority" category for EJ analysis is a bit problematic and assumes the EJ consequences of proposed rule changes to be identical for all racial/ethnic minority subgroups. This limitation was acknowledged in the paragraph on the agencies' future plans (Economic Analysis: page 97). However, it was unclear if the Minority category used in this screening analysis also includes individuals belonging to an American Indian Tribe. Since these two variables appear in separate columns in all tables (Economic Analysis: Section IV), it would be useful to clarify if they overlap. A danger of not-aggregating may be that no subgroup would reach a critical threshold to be considered an EJ community.

- An appropriate statistical test (e.g., two-sample *Z*-tests of proportions) could be included to determine if any of the observed percentage differences from the national average are significantly different from zero. The inferences drawn from the tables in Section IV of the Economic Analysis (e.g., page 94: "socioeconomic characteristics for HUC-12s experiencing wetland area changes and changes to affected waters due to the proposed rule are similar to national averages") are not supported by any statistical tests.

- Socio-demographic characteristics of HUC-12 watersheds were estimated using the proportion of the area of census tract or block group boundaries that intersect with HUC-12s. The limitations of this approach have been documented in Section IV.B (page 97), but alternative approaches that potentially address the tenuous assumption (i.e., uniform distribution of all population groups across space) and related inaccuracies are not discussed. Multiple geographic information systems (GIS)-based areal interpolation techniques have been introduced and employed in recent years, such as geometric or population-weighted centroid containment, 50 percent areal containment, and dasymetric mapping techniques. Most of these techniques are likely to yield a more accurate estimate of the actual population within watershed boundaries compared to the approach utilized here, and should be considered for future analysis.

- For the Tribal Impact Analysis (Economic Analysis: Section V), the map-based qualitative assessment of the overlap between tribal areas and proposed changes in wetland area (Figure V-1) and affected waters (Figure V-2) is useful, but could be more effective if tables were included to summarize the areal extent of overlap with tribal areas for each watershed change scenario. The nature or degree of adverse impact associated with these proposed changes is difficult to evaluate only on the basis of a national-scale map and without any quantitative measures.

- The discussion of "behavioral and cultural characteristics" in the rule is limited based on Indigenous peoples' relationships to water. More than thirty tribes listed in the compendium of state and tribal regulatory practices (EA Supplement) have specific statements of cultural or spiritual significance of water built into their regulatory frameworks. These statements, along with existing research (e.g., Anderson et al., 2019) emphasize that Indigenous peoples are impacted by degradation of waters in ways that include but also supersede exposure to pollution in water or bioaccumulated in fish tissues. For example, recent work by Van Horne et al. (2021) highlights some of the cultural and religious uses of surface water by Diné people that were affected (or perceived to be affected) following the 2015 Gold King Mine disaster. Disconnection from these kinds of cultural and spiritual uses of water can have negative impacts on Indigenous peoples' health and wellbeing (King et al., 2009), and these impacts are not well captured by the current language of the proposed rule.

2.5.2. Charge Question 4b.

Please comment on the appropriateness of the agencies' plans for the environmental justice analysis (Economic Analysis, Section IV.A, p. 97) and the tribal impact analysis (Economical Analysis, Section V, pp. 99-100) for the final rule.

The SAB finds that the agencies' plans to broaden the scope of distributive EJ and tribal analysis are appropriate and promising, and seek to address several limitations of the EJ and tribal impact analysis presented in Sections IV and V of the Economic Analysis. These plans include consideration of additional environmental risk indicators, the use of illustrative case studies for more detailed assessments of downstream effects of wetland area changes, and disaggregation of 'Minority' individuals into relevant racial/ethnic subcategories. The SAB provides the following recommendations to further develop the plans.

Recommendations to further develop plans for environmental justice analysis

- The SAB strongly supports the inclusion of air pollution exposure and other environmental indicators available in EJSCREEN for conducting a more comprehensive exposure assessment. However, it is also important to examine other environmental risks that are particularly relevant in rural areas affected by the proposed watershed changes. For example, data on concentrated animal feeding operations and pesticide drift, drinking water infrastructure and availability, surface or groundwater quality, mining activities, and underground storage tanks should be considered in future plans.

- Illustrative case studies for more detailed assessments should attempt to include *colonias*, which are low-income immigrant communities in the U.S.-Mexico border region. In addition to inadequate infrastructure and housing, the defining characteristics of *colonias*, they are often burdened by stressors such as contaminated drinking water and limited access to clean water. Additionally, these communities are often located near hazardous land uses or near arroyos prone to seasonal flash flooding.

- The population and socio-demographic characteristics of HUC-12 watersheds should be calculated on the basis of more cutting-edge and reliable areal interpolation techniques that provide more accurate estimates, as mentioned previously (see comments in response to Charge Question 4a).

- The analyses and plans presented here focus exclusively on distributional EJ, or documenting social disparities associated with the spatial distribution of the impacts. However, the EPA's definition of EJ also emphasizes "meaningful involvement of all people" and "equal access to the decision-making process." The agencies' plans thus need to consider participatory and procedural EJ issues, in addition to distributional EJ.

- For the proposed case studies to examine downstream effects, it would be useful to clarify the criteria that will be used to select case studies.

- The current EJ analysis shows the sociodemographic characteristics by changes in the affected waters or wetland area. It would be useful to show the distribution of impacts in terms of a dollar value of benefits. For example, if net benefits can be broken down by geography, one could then relate average benefits to the sociodemographic characteristics in that location. This would be more consistent with the economic analysis carried out in Section III.C. In addition, it may be worth highlighting here that wetland values could be heterogeneous by group (see last recommendation for

Charge Question 4a) such that even equal exposures to changes in wetland acreage across two groups may not translate into the same monetized impacts.

- The tribal impact analysis appears to be only a visual inspection of two superimposed map layers, as mentioned in one of our recommendations for Charge Question 4a. The inspection identifies between two and four states where tribal lands are likely to be impacted. It is unclear that this approach provides the precision needed to evaluate the impacts to tribal nations. At minimum, it would be helpful to place all HUC-12s into two groups based on whether or not they intersect tribal lands. This forms the basis for a Wilcoxon Rank-Sum and/or Two-Sample Kolmogorov-Smirnov test to determine whether or not changes are significantly different for tribal and non-tribal areas. As a first cut, it is probably fine to place straddling HUCs into both groups (i.e., double count), but a more sophisticated approach could area-weight the HUCs and split straddling HUCs as needed. An alternative approach, which may prove more useful to tribal nations, would compute changes for each tribal area and show in comparison to the surrounding state(s). This way, tribal nations could understand whether changes to their waters are regionally consistent.

- As noted in the SAB's response to Charge Question 2b, Figure V-1 in the Tribal Impact Analysis indicates substantial effects on wetland acreage in many states for which the Economic Analysis includes zero effect (e.g., Florida, Minnesota), on the basis of predicting state responses to the rule. If the agencies revise the Economic Analysis to include all states, as the SAB has strongly recommended, this inconsistency will be addressed by that change. Either way, the state impacts included in the Environmental Justice and Tribal Impact Analyses should match those estimated and monetized in the Economic Analysis.

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APPENDIX A: Major Findings Supported by EPA Documents, (U.S. EPA, 2015) and Updated (U.S. EPA and Department of the Army, 2021b) Literature Review

<u>Ephemeral, Intermittent, and Perennial Streams</u>

EPA 2015

- Streams are hydrologically connected to downstream waters via channels that convey surface and subsurface water either year-round (i.e., perennial flow), weekly to seasonally (i.e., intermittent flow), or only in direct response to precipitation (i.e., ephemeral flow).
- Headwaters convey water into local storage compartments such as ponds, shallow aquifers, or stream banks, and into regional and alluvial aquifers.
- Infrequent, high-magnitude events are especially important for transmitting materials from headwater streams in most river networks.
- There is strong evidence that headwater streams function as nitrogen sources (via export) and sinks (via uptake and transformation) for river networks.
- Headwaters provide habitat that is critical for completion of one or more life-cycle stages of many aquatic and semiaquatic species capable of moving throughout river networks.
- Human alterations affect the frequency, duration, magnitude, timing, and rate of change of connections between headwater streams, including ephemeral and intermittent streams, and downstream waters.

EPA 2021

- Scientific evidence unequivocally demonstrates that streams, including ephemeral, intermittent, and perennial streams and rivers are physically, chemically, and biologically connected to downstream rivers via channels and associated alluvial deposits.
- Ephemeral, intermittent, and perennial stream networks are hydrologically connected to downstream systems, from the source area of headwaters to the flowing waters connected downgradient, to their terminus at endorheic lakes or estuarine systems.
- Flow response in headwater streams from precipitation varies regionally, affected by transmission, evaporation, transpiration, and groundwater recharge.
- The spatial and temporal distribution of river network connectivity is a primary nonlinear control on the network's precipitation-runoff response.
- The dynamism of headwater networks.
- The dynamic nature of headwater streams and downgradient connectivity is well-supported in the literature – headwater streams are neither spatially nor temporally invariant but rather dynamic systems that expand, contract, fragment, and reconnect across predictable spatial and temporal scales.
- Headwater streams without apparent surface flow often have complex and abundant hyporheic flow that maintains a downgradient hydrological connection, supports characteristic surface flows, and maintains habitats.
- Many organisms use and connect the entirety of the stream network, including ephemeral, intermittent, and perennial reaches.

- Headwater streams are biogeochemical reactors within hydrologic networks, transforming and sequestering materials affecting downgradient physical and chemical characteristics and concentrations along the full aquatic network.
- Headwater streams function as both sinks and sources of carbon, nitrogen, dissolved organic matter, and sediment in flowing hydrologic networks.
- Research has shown that headwater stream systems can readily remove, and headwater biogeochemical processing rates are most efficient at low flows.
- Biogeochemical dynamics in headwater stream systems that are longitudinally, laterally, and vertically expanding, contracting, and mixing with groundwater or hyporheic flow for thousands of meters affects downgradient systems.
- It is evident that flow variability emerging from ephemeral, intermittent, and perennial stream network storage and their source areas is asynchronously connected over time and space and maintains an adaptive downgradient system, resilient to watershed-scale perturbations.

<u>Riparian/Floodplains/Open waters</u>

EPA 2015

- Riparian areas and floodplains connect upland and aquatic environments through both surface and subsurface hydrologic flowpaths. These areas are therefore uniquely situated in watersheds to receive and process waters that pass over densely vegetated areas and through subsurface zones before the waters reach streams and rivers.
- Riparian/floodplain wetlands can reduce flood peaks by storing and desynchronizing floodwaters. They can also maintain river baseflows by recharging alluvial aquifers.
- Riparian areas and floodplains store large amounts of sediment and organic matter from upstream and from upland areas.
- Ecosystem function within a river system is driven in part by biological connectivity that links diverse biological communities with the river system. Movements of organisms that connect aquatic habitats and their populations, even across different watersheds, are important for the survival of individuals, populations, and species and for the functioning of the river ecosystem.

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- Floodplain wetlands and open waters are physically, chemically, and biologically integrated with rivers via functions that improve downstream water quality.
- Floodplain wetlands and open waters are integrated with streams and rivers through surface and groundwater interactions and exchanges.
- Floodplain wetlands and open waters are intimately connected to riverine food webs.
- Floodplain wetlands and open waters are important habitats.
- Floodplain wetlands and open waters also exert significant controls on downgradient stream temperature, impacting in-stream refugia.
- Flow through floodplain wetlands and open waters slows river flows, desynchronizing floodwaters and mitigating flood magnitude effects.
- Physical, chemical, and biological connectivity and effects by floodplain wetlands and open waters were found abundantly in the screened scientific literature that was reviewed.

<u>Non-floodplain Wetlands/Open waters</u>

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- Water storage by wetlands well outside of riparian or floodplain areas can affect streamflow.
- Non-floodplain wetlands act as sinks and transformers for various pollutants, especially nutrients, which at excess levels can adversely impact human and ecosystem health.
- Non-floodplain wetlands provide unique and important habitats for many species, both common and rare.
- Biological connections are likely to occur between most non-floodplain wetlands and downstream waters through either direct or stepping-stone movement of amphibians, invertebrates, reptiles, mammals, and seeds of aquatic plants, including colonization by invasive species.
- Spatial proximity is one important determinant of the magnitude, frequency and duration of connections between wetlands and streams that will ultimately influence the fluxes of water, materials and biota between wetlands and downstream waters. However, proximity alone is not sufficient to determine connectivity, due to local variation in factors such as slope and permeability.
- The cumulative influence of many individual wetlands within watersheds can strongly affect the spatial scale, magnitude, frequency, and duration of hydrologic, biological and chemical fluxes or transfers of water and materials to downstream waters. Because of their aggregated influence, any evaluation of changes to individual wetlands should be considered in the context of past and predicted changes (e.g., from climate change) to other wetlands within the same watershed.
- Non-floodplain wetlands can be hydrologically connected directly to river networks through natural or constructed channels, nonchannelized surface flows, or subsurface flows, the latter of which can travel long distances to affect downstream waters.
- Non-floodplain wetlands occur along a gradient of hydrologic connectivity-isolation with respect to river networks, lakes, or marine/estuarine water bodies.
- Caution should be used in interpreting connectivity for wetlands that have been designated as “geographically isolated” because (1) the term can be applied broadly to a heterogeneous group of wetlands, which can include wetlands that are not actually geographically isolated; (2) wetlands with permanent channels could be miscategorized as geographically isolated if the designation is based on maps or imagery with inadequate spatial resolution, obscured views, etc.; and (3) wetland complexes could have connections to downstream waters through stream channels even if individual wetlands within the complex are geographically isolated.

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- Wetlands and open waters located outside of riparian areas and floodplains (i.e., non-floodplain wetlands and open waters), even when lacking surface water connections, provide numerous functions that can affect the integrity of downstream waters.
- It is evident that non-floodplain wetlands – individually and in the aggregate – are connected to and can affect the physical, chemical, and biological conditions and characteristics of downgradient waters (e.g., streams, rivers, and lakes).
- Non-floodplain wetlands, particularly when analyzed in the aggregate, are connected to and can exert a substantive and important influence on the integrity of downstream waters through notable functions affecting downgradient systems including hydrological lag and storage

functions (i.e., affecting baseflow and stormflows/flood-hazards in stream systems) and biogeochemical functions (i.e., microbial, physical, or chemical functions transforming compounds, such as denitrification, carbon mineralization, and phosphorus sequestration).

- Biota connect streams and non-floodplain wetlands, as part of the landscape-scale "freshwater ecosystem mosaic," through the lateral active or passive movements of organisms and propagules.
- Non-floodplain wetlands are the flow-generating origins of many downgradient systems. By providing water to downgradient systems, non-floodplain wetlands maintain and affect the physical, chemical, and biological integrity of those systems.
- In contrast to their flow-generating properties, non-floodplain wetlands can also act as flow-dampening systems, attenuating surface flow through storage functions and providing watershed-scale resilience to hydrologic disturbances.
- Non-floodplain wetlands and open waters are frequently connected to their local and regional aquifers, and hence to the stream networks, through groundwater flows.
- Non-floodplain wetlands are bioreactors performing important sink and transformation functions affecting downgradient waters, which is well-supported in the literature.
- Storage, sequestration, and processing within non-floodplain wetlands and open waters are substantive.
- Non-floodplain wetlands and open waters substantively affect downgradient streams, rivers, lakes, and other aquatic systems through variable connections which support diverse functions that improve downstream waters. Non-floodplain wetlands and open waters exist along physical, biogeochemical, and biological connectivity continuums that affect downstream waters at all points along those continuums.

<u>Degrees/Determinants of Connectivity</u>

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- The surface-water and groundwater flowpaths (hereafter, hydrologic flowpaths), along which water and materials are transported and transformed, determine variations in the degree of physical and chemical connectivity.
- Gradients of biological connectivity (i.e., the active or passive movements of organisms through water or air and over land that connect populations) are determined primarily by species assemblages, and by features of the landscape (e.g., climate, geology, terrain) that facilitate or impede the movement of organisms.
- Pathways for chemical transport and transformation largely follow hydrologic flowpaths, but sometimes follow biological pathways (e.g., nutrient transport from wetlands to coastal waters by migrating waterfowl, upstream transport of marine-derived nutrients by spawning of anadromous fish, uptake and removal of nutrients by emerging stream insects).
- Human activities alter naturally occurring gradients of physical, chemical, and biological connectivity by modifying the frequency, duration, magnitude, timing, and rate of change of fluxes, exchanges, and transformations.

<u>Cumulative Effects</u>

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- Structurally and functionally, stream-channel networks and the watersheds they drain are fundamentally cumulative in how they are formed and maintained.
- Connectivity between streams and rivers provides opportunities for materials, including nutrients and chemical contaminants, to be transformed chemically as they are transported downstream.
- Cumulative effects across a watershed must be considered when quantifying the frequency, duration, and magnitude of connectivity, to evaluate the downstream effects of streams and wetlands.
- The combination of diverse habitat types and abundant food resources cumulatively makes floodplains important foraging, hunting, and breeding sites for fish, aquatic life stages of amphibians, and aquatic invertebrates.