

STRENGTHENING THE SCIENTIFIC FOUNDATION FOR THE CLEAN WATER ACT THROUGH FEDERAL PARTNERSHIP AND TRANSDISCIPLINARY COLLABORATION

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Abstract—The U.S. Environmental Protection Agency's Office of Research and Development (EPA/ORD) released a report, titled *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence*, that summarizes more than 1,200 studies from the peer-reviewed scientific literature on the structural and functional connectivity of streams and wetlands to downstream waters such as rivers, lakes, reservoirs and estuaries (<https://www.federalregister.gov/articles/2015/01/15/2015-00339/connectivity-of-streams-and-wetlands-to-downstream-waters-a-review-and-synthesis-of-the-scientific>). The evidence reviewed in this report spans many decades of research into aquatic ecosystems and watershed processes. It provides a scientific basis for the Clean Water Rule, which clarifies the definition of "waters of the United States" under the Clean Water Act and went into effect on 28 August 2015. As a technical review, the ORD report does not consider or set forth legal standards for CWA jurisdiction. Rather, it summarizes current scientific understanding of the hydrologic, chemical, and biological connections by which small or temporary streams, nontidal wetlands, and open-waters, singly or in aggregate, affect the integrity of waters protected by the Clean Water Act. It is the result of a multi-year collaboration by scientists working across disciplinary and organizational boundaries to synthesize the best available science in response to evolving policy needs.

INTRODUCTION

The objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Supreme Court decisions in SWANCC (2001) and Rapanos (2006) raised questions about the scope of the CWA, and motivated new research into the connectivity of waters. In January 2015 the EPA ORD published a report (US EPA, 2015) to inform rulemaking by EPA and the U.S. Army Corps of Engineers on the definition of "waters of the United States" under the Clean Water Act (CWA). As a technical document, this report does not consider or propose legal standards or policy options for CWA jurisdiction. Rather, it evaluates, summarizes, and synthesizes the available peer-reviewed scientific literature to address questions about the physical, chemical, and biological connectivity and downstream effects of three categories of waters: ephemeral, intermittent, and perennial streams; riparian or floodplain wetlands and open waters; and wetlands and open waters in non-floodplain settings.

METHODS

This report is the product of a transdisciplinary collaboration of scientists in the EPA ORD National Center for Environmental Assessment, National Health and Environmental Effects Research Laboratory, National Exposure Research Laboratory, and the United States Department of Agriculture's Agricultural Research Service. The authors reviewed and evaluated a large body of evidence from peer-reviewed sources that were published or in press by December 2014, including original research by scientists in federal agencies. The review synthesizes a total of 1,355 publications, which included 1,150 peer-reviewed journal articles, 120 scientific books or chapters, and 50 Federal reports. Following internal review by EPA and U.S. Army Corps of Engineers operational staff, drafts of the report were externally peer-reviewed by scientists in government, academic, nonprofit, and private industry organizations at three different levels: a peer consultation with 11 topic experts in February 2011, a contractor-led panel review by 11 independent peer reviewers in January 2012, and a review by the EPA Science Advisory Board (SAB), which

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Citation for proceedings: Stringer, Christina E.; Krauss, Ken W.; Latimer, James S., eds. 2016. Headwaters to estuaries: advances in watershed science and management—Proceedings of the Fifth Interagency Conference on Research in the Watersheds. March 2-5, 2015, North Charleston, South Carolina. e-Gen. Tech. Rep. SRS-211. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 302 p.

convened public meetings of a 27-member panel in 2013 and 2014. The level of peer review exceeded standards established by OMB (2004). All peer-review panels included Federal partners, who also provided comments during Interagency review. In addition, 133,100 comments from the public were received through the docket (Docket No. EPA-HQ-OA-2013-0582). Comments from all sources were considered and used to improve the clarity and scientific rigor of the document.

CONCLUSIONS

The final report contains five major conclusions, summarized here:

1. The scientific literature unequivocally demonstrates that streams, regardless of their size or frequency of flow, are connected to downstream waters and strongly influence their function.
2. The scientific literature clearly shows that wetlands and open waters in riparian areas (transitional areas between terrestrial and aquatic ecosystems) and floodplains are physically, chemically, and biologically integrated with rivers via functions that improve downstream water quality. These systems act as effective buffers to protect downstream waters from pollution and are essential components of river food webs.
3. There is ample evidence that many wetlands and open waters located outside of riparian areas and floodplains, even when lacking surface water connections, provide physical, chemical, and biological functions that could affect the integrity of downstream waters. Some potential benefits of these wetlands are due to their isolation rather than their connectivity. Evaluations of the connectivity and effects of individual wetlands or groups of wetlands are possible through case-by-case analysis.
4. Variations in the degree of connectivity are determined by the physical, chemical and biological environment, and by human activities. These variations support a range of stream and wetland functions that affect the integrity and sustainability of downstream waters.
5. The literature strongly supports the conclusion that the incremental contributions of individual streams and wetlands are cumulative across entire watersheds, and their effects on downstream waters should be evaluated within the context of other streams and wetlands in that watershed.

ACKNOWLEDGMENTS

This report was funded through the EPA ORD. It has been subjected to Agency review and approved for publication. We are indebted to the report co-authors and the many national experts who reviewed the drafts, provided comments and additions, and helped us in our effort to synthesize the best available science in response to evolving policy needs.

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United States Department of Agriculture

Proceedings of the Fifth Interagency Conference on Research in the Watersheds

Headwaters to Estuaries: Advances in Watershed Science and Management

March 2-5, 2015, North Charleston, South Carolina



Forest Service
Research & Development
Southern Research Station
e-General Technical Report SRS-211

Cover art prepared by James R. Douglas of the U.S. Geological Survey,
South Atlantic Water Science Center.

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Papers published in these proceedings were submitted by authors in electronic media. Some editing was done to ensure a consistent format. Authors are responsible for content and accuracy of their individual papers and the quality of illustrative materials.

January 2016

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Asheville, NC 28804



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