Nitrogen & Co-pollutant Research Roadmap Annual Report FY16

Final October, 2016

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Executive Summary

EPA, State and local governments, and numerous stakeholders have made progress to reduce reactive nitrogen (Nr) and co-pollutant (e.g., phosphorus [P], sulfur [S], sediment) loadings that contribute to tropospheric ozone and acid rain, which can result in aquatic ecosystem collapse (via harmful algal blooms, hypoxia, and fish kills); terrestrial biodiversity changes; and degradation of drinking source waters that require costly water treatment. These pollutants continue to be released and discharged at concentrations that cause significant adverse impacts to human health and public welfare and aquatic and terrestrial ecosystems. These impacts will likely be exacerbated in coming years by the pressures of land use change, climate change, and growing resource needs of an increasing human population (Millennium Assessment 2005).

The Nitrogen and Co-pollutant Research Roadmap effort created a cross-Agency team (consisting of Office of Research and Development [ORD], Office of Water [OW], Office of Air and Radiation [OAR], and the Regions) to identify research that informs the development of effective policies needed to successfully implement an integrated and sustainable Nr and co-pollutant management program and improve regulatory programs under the Clean Air Act (CAA), Clean Water Act (CWA), and Safe Drinking Water Act (SDWA). The overarching goal of this cross-Agency effort is to protect human health, public welfare, and ecosystem health through the restoration of air, land, and water quality by integrating Agency research that supports the management of Nr and co-pollutants. The Nitrogen and Co-pollutant Research Roadmap team has moved well-planned research activities that were strongly supported by the Program Offices into several of the current ORD Research Portfolios (Safe and Sustainable Water Resources [SSWR]; Sustainable and Healthy Communities [SHC]; Air, Climate and Energy [ACE]; and Human Health Risk Assessment [HHRA]).

The Flagship Project: Multimedia Nitrogen Modeling for the Mississippi River Basin and Northern Gulf of Mexico generated two 2016 products: 1) a multimedia modeling tool for evaluation of the Mississippi River Basin and northern Gulf of Mexico system and 2) national maps for EnviroAtlas of edge-of-field water quantity and quality under selected climate change scenarios. Other projects include the Narragansett Bay project and projects focused on reducing the impacts of harmful algal blooms (HABs), preparing guidelines for quantifying and reporting water quality model uncertainties, developing P input layers for the EnviroAtlas, conducting atmospheric Nr deposition and critical loads (CL) research (including an online CL Mapper Tool), developing new CL for herbaceous biodiversity, and conducting analyses of the interactive effects of climate change and Nr deposition on forested ecosystems in the northeastern United States.

In addition, the Roadmap effort has enabled ORD support for two cross-EPA Oak Ridge Institute for Science and Education (ORISE) Fellows—one to develop a better understanding of the motivation for farmers to adopt best management practices and support the National Water Quality Benefits project and the other to develop several updates and improvements to the Nr National Inventory—a compiled U.S. Department of Agriculture (USDA)/EPA research database to identify areas of further research collaboration and coordination. This effort is contributing to a three-volume set of reports on species (lichens, trees, and herbaceous species) affected by Nr deposition.

Two very successful scientific workshops resulted from the Nitrogen and Co-pollutant Research Roadmap efforts. One established a collaborative research and management partnership between USDA, U.S. Geological Survey (USGS), and EPA in order to promote sustainable management of Nr. The Air Quality and Ecosystem Services Workshop (2015) identified linkages between atmospheric deposition effects on sensitive natural resources and ecosystem services. Several research efforts that engage partners and external stakeholders are highlighted in this report, including the National Aquatic Resource Surveys, the Centers for Water Research on National Priorities Related to a Systems View of Nutrient Management, and a water sensors project.

The Nitrogen and Co-pollutant Roadmap effort and the research it fosters is in direct response to the EPA's Science Advisory Board (SAB) Integrated Nitrogen Committee (INC) recommendations. The importance of nutrient-related research for the EPA Regions can be seen in the number of ORD/Regional research partnership projects selected for funding by the Regions. A table of FY16 research products from across ORD, OW, OAR, and the EPA Regions highlights areas of active research. Several innovative efforts are also summarized: four nutrient challenges, three visualization challenges, the Cyanobacteria Assessment Network and its use of satellite data, and a New Earth Observations project that collects data from a sensor in geostationary orbit. A cross-Roadmap effort on developing national-scale projections of climate change through 2100 is described as well as the current Integrated Science Assessment (ISA) for nitrous oxides (NOx) and sulfur oxides (SOx) that supports OAR's review of the current secondary national ambient air quality standards.

Organizational challenges related to research integration remain; these include identifying relevant external research and developing a more formal collaborative process. Scientific research challenges include examining the impacts of climate change on Nr and co-pollutant sensitivity, using a systems approach to wildfire and nutrient management, developing ecological response functions, and determining the utility of water quality models across spatial scales.

In "The Year Ahead" section, the ongoing discussions in support of air quality standards (NAAQS), water quality standards (TMDLs) and numeric nutrient criteria are highlighted. A workshop "Cross-EPA Efforts on Reactive Nitrogen and Co-Pollutants: Science to Inform Action" was held in August/September 2016 to foster the implementation of the Roadmap recommendations and discuss ongoing research, develop collaborations, and research areas to emphasize moving forward. This workshop brought together scientists and decision-makers from across the Agency to advance Nr and co-pollutant research that informs science based management, improves cross-EPA collaborations and communication, and identifies alternative approaches to managing Nr in an integrated framework. In addition, a number of upcoming deliverables in FY17 (to be included in the next annual report) and key FY16 publications are highlighted.

The Nitrogen and Co-pollutant Research Roadmap effort has made great strides toward integrating and advancing the research needed to inform program office and regional decisions regarding nutrient management. The continued dedication to integration across EPA and with other Federal Agencies in the future will be essential for developing long-term approaches that manage Nr and co-pollutants.

I. Accomplishments

A. Impacts

The Nitrogen and Co-pollutant Research Roadmap effort created a cross-Agency team (consisting of Office of Research and Development [ORD], Office of Water [OW], Office of Air and Radiation [OAR], and the EPA Regions) to identify research that informs the development of effective policies needed to successfully implement an integrated and sustainable Nr and co-pollutant management program and improve regulatory programs under the Clean Air Act (CAA), Clean Water Act (CWA), and Safe Drinking Water Act (SDWA). The overarching goal of this cross-Agency effort is to protect human health, public welfare, and ecosystem health through the restoration of air, land, and water quality by integrating Agency research that supports the management of N and co-pollutants. The Nitrogen and Co-pollutant Research Roadmap team has moved well-planned research activities that were strongly supported by the Program Offices into several of the current ORD Research Portfolios (Safe and Sustainable Water Resources [SSWR], Sustainable and Healthy Communities [SHC], Air, Climate and Energy [ACE] and Human Health Risk Assessment [HHRA]).

The purpose of this annual report is to highlight ongoing research areas and projects and their associated products (fiscal year [FY] 15-16) and upcoming FY 17 deliverables that will be described in the next annual report. The work described here is not a comprehensive summary of all ongoing Nr and co-pollutant work across the Agency, but provides a snapshot of some key efforts.

i. Roadmap Recommendations Incorporated into the ORD Strategic Research Action Plans

a. Flagship Project: Multimedia Nitrogen Modeling for the Mississippi River Basin and Northern Gulf of Mexico

Excess reactive nitrogen (Nr) in the environment impacts human health and ecosystems across air, land, freshwater, estuarine, and ocean biomes. Thus, the problem of managing Nr crosses traditional media-specific management boundaries. To address this issue and for the purpose of exploring nutrient policy, management, and restoration scenarios, EPA scientists are developing and applying a new multimedia modeling system to track Nr release and movement through the biosphere and assess its impacts to ecosystems and public health. This One Biosphere Modeling System is a collection of models that links air quality, land use, agricultural land management, meteorology, hydrology, coastal ocean hydrodynamics, and ecosystem factors.

One Biosphere Modeling System: Fostering Cross-RAP Collaboration

ACE AIMS-2: Develop an integrated multimedia modeling system ***(ongoing);*** improve the CMAQ model to facilitate linkages with land and water ***(ongoing).***

SSWR 4.02: Develop Mississippi River watershed multi-media scenarios to address nutrient management under alternative land use futures ***(FY16); a***pply to other coastal systems in the Gulf of Mexico, Atlantic, Great Lakes, and Pacific ***(ongoing).***

SSWR 4.03: Link/couple EPIC and SWAT for the Mississippi River watershed to provide upstream P and N loading in response to land use change ***(ongoing).***

SHC 2.61: Develop national-scale air and ecosystem production functions and service estimations from one-environment ***(FY16).***

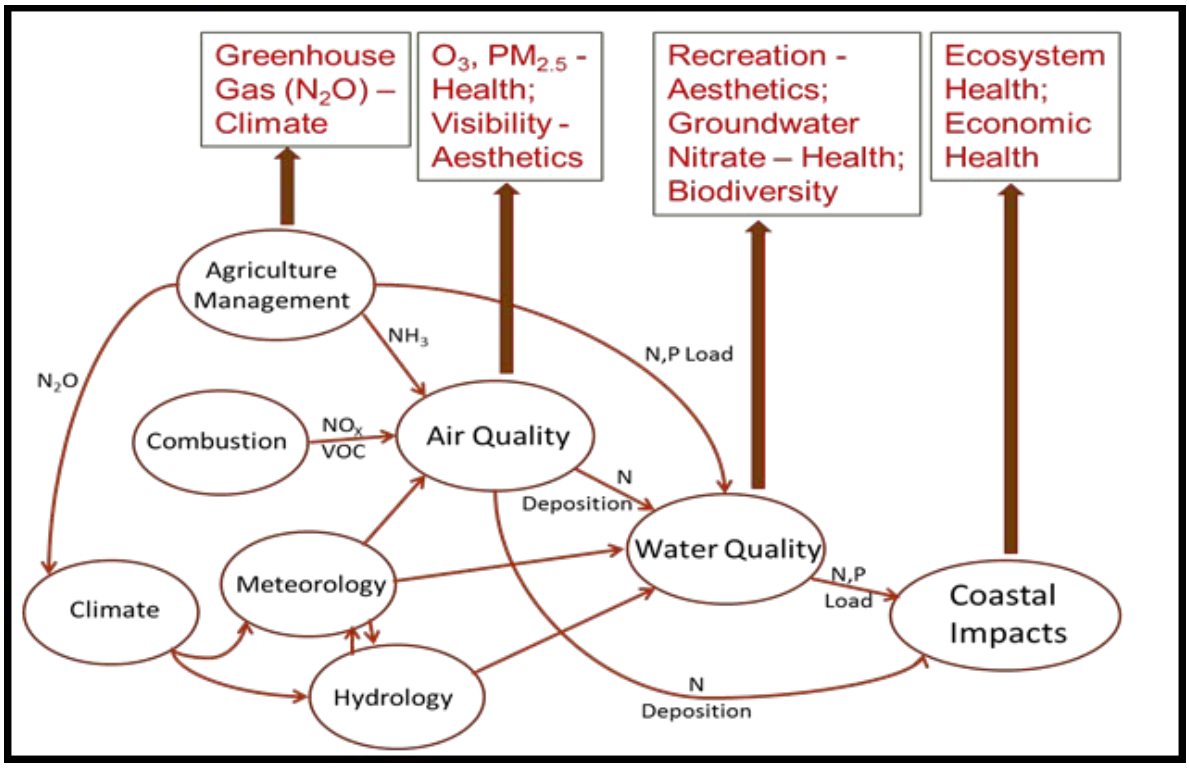
SHC 4.61: Improve quantification of multi-media aspects of the N cascade ***(ongoing).***

Development of the One Biosphere Modeling System was initiated in 2011 in response to a request from the Gulf of Mexico Hypoxia Task Force for tools that could suggest actions to reduce nutrient loads in the Mississippi River Basin and reduce the size of the northern Gulf of Mexico hypoxic zone. Nutrient-related eutrophication and hypoxia in the northern Gulf has been a persistent problem, impairing water quality, ecosystem health, and local/national economic health. This effort develops Mississippi River watershed multimedia scenarios of air quality and deposition, watershed processing, water quantity, and water quality to address nutrient management in alternative climate and land-use futures. The linked/coupled multimedia nature of this work marks an important departure from analyses that typically evaluate individual media impacts. This research explores the explicit connection of regional- to national-scale environmental, social, and economic aspects of the Nr cascade, creating a more complete picture of sustainable options for Nr management by jointly considering air, land, and water quality. Due to the inter-disciplinary nature of the problem, this work integrates efforts from EPA's SSWR, ACE, HHRA, and SHC Strategic Research Action Plans (StRAPs) along with EPA Program offices and external Federal and academic collaborators.

To date, work has progressed on development and integration of the air, land, water, and coastal modeling components (see Figure 1) and the following EPA models:

- Community Multi-Scale Air Quality (CMAQ) model,
- Fertilizer Emission Scenario Tool for CMAQ (FEST-C),
- Coastal General Ecosystem Model (CGEM), and
- Gulf of Mexico Dissolved Oxygen Model (GoMDOM).

Other models that will be integrated into the present modeling system include the Weather Research and Forecasting (WRF) model, the Surface Water Assessment Tool (SWAT), Environmental Policy Integrated Climate Model (EPIC), Nutrient Export from Watersheds (NEWS), and the Navy Coastal Ocean Model (NCOM).



Note: In this figure, the circles contribute information to support the estimation of broad classes of endpoints, examples of which are shown in the boxes.

Figure 1. Conceptual model of linked air, land, water, and coastal multimedia modeling system to explore nutrient policy, management, and restoration scenarios.

In 2016, two Roadmap Products will be delivered:

1. Multimedia modeling tool for evaluation of Mississippi River Basin and northern Gulf of Mexico system and
2. National maps of edge-of-field water quantity and quality under selected climate change scenarios, which will be submitted to EnviroAtlas.

These products are from the SSWR Nutrient Topic Area, project 4.02—Nutrient Threshold Targets and Nutrient Management—and contribute to the SSWR FY19 Output: "Methods, tools, data and scientific analyses to inform prioritization of watersheds for management of nutrients and setting nutrient specific water quality and aquatic life thresholds; and demonstrate and communicate new metrics, management approaches, and use of monitoring data to verify the expected benefits from applying nutrient reduction management practices." The products will consist of a number of manuscripts and databases describing scenario-based predictions of future Mississippi River Basin nutrient loading, climate change, and impacts to hypoxic areas in the northern Gulf (as discussed above). Work planned for 2017–2019 includes expansion of the modeling system to a national scale, continued integration of models and development of scenarios, evaluation of model uncertainties for synthesis of knowledge, and identification of future modeling and observation research.

Below is a list of One Biosphere Modeling System manuscripts.

Fry, B., D. Justic, P. Riekenberg, E. Swenson, R.E. Turner, L. Wang, L. Pride, N.N. Rabalais, J.C. Kurtz, J.C. Lehrter, M.C. Murrell, E.H. Shadwick, and B. Boyd. 2015. Carbon dynamics on the Louisiana continental shelf and cross-shelf feeding of hypoxia. Estuaries and Coasts 38:703-721. DOI: 10.1007/s12237-014-9863-9.

Ko, D.S., R.W. Gould, B. Penta, and J.C. Lehrter. 2016. Impact of satellite remote sensing data on simulations of coastal circulation and hypoxia on the Louisiana continental shelf. Remote Sensing 8: 435. DOI: 10.3390/rs8050435.

Laurent, A., K. Fennel, R. Wilson, J.C. Lehrter, and R. Devereux. 2016. Parameterization of biogeochemical sediment-water fluxes using in-situ measurements and a steady-state diagenetic model. Biogeosciences 13: 77-94. DOI: 10.5194/bg-13-77-2016.

Le, C., J.C. Lehrter, C. Hu, and D. Obenour. 2016. Satellite-based empirical models linking river plume dynamics with hypoxic area and volume. Geophysical Research Letters. DOI: 10.1002/2015GL067521.

Pauer, J.J., T.J. Feist, A.M. Anstead, P.A. DePetro, W. Melendez, J.C. Lehrter, M.C. Murrell, X. Zhang, and D.S. Ko. 2016. A modeling study examining the impact of nutrient boundaries on primary production on the Louisiana continental shelf. Ecological Modelling 328: 136-147.

Yu, L., K. Fennel, A. Laurent, M.C. Murrell, and J.C. Lehrter. 2015. Numerical analysis of the primary processes controlling oxygen dynamics on the Louisiana shelf. Biogeosciences 12: 2063-2076. DOI: 10.5194/bg-12-2063-2015.

Feist, T.J., J.J. Pauer, W. Melendez, J.C. Lehrter, P.A. DePetro, K.R. Rygwelski, and D.S. Ko. Modeling the relative importance of nutrient and carbon loads, boundary fluxes, and sediment fluxes on Gulf of Mexico hypoxia. Environmental Science & Technology. In revision.

Fennel, K., A. Laurent, R. Hetland, D. Justic, D. Ko, J.C. Lehrter, M. Murrell, L. Wang, L. Yu, and W. Zhang. Effects of model physics on hypoxia simulations for the northern Gulf of Mexico: A model inter-comparison. Journal of Geophysical Research: Oceans. In revision.

Lehrter, J.C., D.S. Ko, B. Herchenroder, L. Lowe, B. Penta, B. Jarvis, M.C. Murrell, R.W. Gould, J.D. Hagy, D.F. Yates, R.M. Greene, C. Le, D. Beddick, and R. Devereux. CGEM - 1.0: A coastal general ecosystem model (CGEM) for assessing anthropogenic nutrient loading linkages to eutrophication, hypoxia, acidification, and water clarity. Cleared internal review, in preparation for submission to journal.

Lehrter, J.C., D.S. Ko, L. Lowe, and B. Penta. Predicted effects of climate change on the severity of northern Gulf of Mexico hypoxia. In: Justic et al. (eds.). Modeling Coastal Hypoxia: Numerical simulations of Patterns, Controls, and Effect of Dissolved Oxygen Dynamics. Springer, New York. In review.

Cooter, E.J., J. liames, and D. Schwede. Internal review. A comparison of simulated and field-derived leaf area index (LAI) and canopy height for four forest complexes in the southeastern USA. To be submitted to Ag and Forest Metr.

Garcia, V., E. Cooter, B. Hinckley, M. Murphy, X. Xing, and J. Crooks. Internal review, 06/2016. Examining the Impacts of Increased Corn Production on Ground.

McCrackin, M., E.J. Cooter, R. Dennis, J. Harrison, and J. Compton. Submitted. Export of dissolved inorganic nitrogen by the Mississippi River Basin: a new, monthly model. Journal of Environmental Quality.

Shephard, M.W., C. McLinden, K.E. Cady-Pereira, M. luo, S.G. Mousa, A. Leithead, J. Liggio, R.M. Staebler, A. Akingunola, P. Makar, P. Lehr, J. Zhang, D.K. Henze, D.B. Millet, J.O. Bash, L. Zhu, K.C. Wells, S.L. Capps, S. Chaliyakunnel, M. Gordon, K. Hayden, J.R. Brook, M. Wolde, and S-M. Li. 2015. Tropospheric Emission Spectrometer (TES) satellite validations of ammonia, methanol,

formic acid, and carbon monoxide over the Canadian Oil Sands. Atmos Meas Tech 8: 5189-5211. DOI: 10.5194/amt-8-5189-2015.

b. Ongoing Activities across Research Programs

Example Projects

Narragansett Bay Project

Water quality and ecological conditions in Narragansett Bay have been changing due to a combination of natural and anthropogenic factors affecting contributing watersheds in Massachusetts and Rhode Island, including extensive soil erosion that occurred in the 19th century, climate change, and significant increases in anthropogenic Nr loading that started in the 20th century. Changes in Nr sources and dynamics over thousands of years in Narragansett Bay can be inferred using measurements of stable carbon and N isotopes from clam shells (Oczkowski et. al. 2016a). Concentrations of another chemical tracer, molybdenum (a metal that precipitates out of seawater under low oxygen conditions), are being investigated in dated sediment cores as a chemical proxy for the number of days of estuarine hypoxia, and have helped document important spatially varying trends in hypoxia during the past 100 years. More recent measurements using stable N, carbon, and oxygen isotopic analysis (e.g., from winter flounder [Pruell et al. 2012; Pruell and Taplin, 2015]) have helped to document biochemical changes in the Bay affected by spatial patterns caused by eutrophication. Comparisons of co-variations in water column pH and oxygen are being used to relate variations in Nr loading to observed diurnal and seasonal variations in net ecosystem production in estuarine waters (Oczkowski et al. 2016b). Additional data from an array of moored instrumentation in the Bay helped ORD calibrate linked hydrodynamic data (Environmental Fluid Dynamics Code [EFDC]; Abdelrhman 2015) and water quality models (e.g., Water Quality Analysis Simulation Program [WASP]; Dettmann and Charlestra 2015) of the Narragansett Bay estuary. Nutrient reduction scenarios have been performed with these models, consistent with recent 50% point-source reductions of Nr loading to the Bay. Model calibration results are being shared with the Rhode Island Department of Environmental Management and EPA Region 1. Although additional model validation is needed, results have led to advances in understanding challenges in modeling short-term diurnal net ecosystem production dynamics in stratified and well-mixed portions of the Bay (Nixon et al. 2014) and have helped to identify opportunities for improvements in bio-optical modeling (Thursby et al. 2015) on a range of time scales.

Nutrient loading effects on coastal acidification, hypoxia (Wallace et al. 2014), and the aquatic ecosystem are also being studied in Narragansett Bay. Additional efforts will involve comparison of ORD-modeled results to a National Oceanic and Atmospheric Administration (NOAA)-funded hypoxia project that is making use of alterative models of the Bay with simplified spatial structure and fewer parameters—an analytic approach that may be more suited for formal information-theoretic uncertainty analyses—and use of Bayesian methods for updating model parameters.

Actions during the project period have resulted in declines in organic and pathogen loading, dramatic reductions in effluent Nr concentration and associated increases in estuarine water clarity, and observed decreases in upper bay hypoxia in dry years in Narragansett Bay (Borkman and Smayda 2016); these

actions, however, have required major investments in advanced waste water treatment and combined sewer overflow systems. Research on nutrient-sensitive endpoints including seagrass and some benthic macroinvertebrates and fish (Rashleigh et al. 2015) are being investigated. It has been suggested that a 40% decrease in total N would increase seagrass colonized area from 12% to 63% (Detenbeck and Rego 2015). Results of this research are expected to be helpful to the State of Rhode Island in its efforts to develop numeric nutrient criteria for addressing Nr loading in Narragansett Bay.

Reducing the Impacts of Harmful Algal Blooms

HABs are defined as over accumulations of single-celled phototrophic eukaryotic and prokaryotic microorganisms that have the potential to cause human, environmental, or economic harm through a combination of factors that include the release of toxins, contamination of potable water supplies, disruption of aquatic food webs, aesthetic degradation, and closure or impairment of recreational areas and fisheries. Toxin-producing blooms have been documented in water bodies spanning a range of spatial scales, including Lake Erie (Harke et al. 2016); various lakes in Kansas, Iowa, and Minnesota (Graham et al. 2010); and the Ohio River (Commission and Technical Committee Meeting of the Ohio River Sanitation Commission (October 2015; http://216.68.102.178/commish/2015/octtech/tec10cohioriverhabevent.pptx).

ORD technical support for HABs includes:

- **Analyzing surface water samples from North Dakota, South Dakota, Colorado, and Wyoming in response to a request for assistance.**
- **Analyzing monthly water treatment plant intake samples of nine facilities during the 2015 bloom season and another nine during the 2016 bloom season.**

In an effort to address research gaps in the field of HAB risk management, the SSWR program initiated project 4.01 focused on four areas: management strategies, health and ecological effects, bloom modeling, and development of analytical and monitoring methods. Individual research efforts within these four areas address five of the eight major elements of the Algal Toxin Risk Assessment and Management Strategic Plan (https://www.epa.gov/sites/production/files/2015-11/documents/algal-risk-assessment-strategic-plan-2015.pdf) developed by the Office of Ground Water and Drinking Water (OGWDW) in response to the requirements of Public Law 114-45 (The Drinking Water Protection Act). The five elements in the Strategic Plan that dovetail with the SSWR project are: (1) algal toxins and their human health effects, (2) factors likely to cause HABs, (3) analytical methods, (4) frequency of monitoring, and (5) treatment options. The three remaining elements of the Strategic Plan—health advisories, source water protection practices, and cooperative agreements and technical assistance—are outside the scope of the SSWR project.

Some of the SSWR 4.01 research tasks that link with the Strategic Plan include the following:

- Evaluate the health effects of mammalian oral exposure to cylindrospermopsin (algal toxins and their human health effects);

- Model the impacts of rising temperatures on bloom formation probabilities (factors likely to cause HABs);
- Resolve some of the differences between chromatographic and immunological toxin detection methods (analytical methods);
- Evaluate the impacts of early-stage drinking water treatment on toxin release and degradation (treatment options); and
- Develop a mid-latitude reservoir as a test platform for high-frequency monitoring instrumentation and techniques (frequency of monitoring and factors likely to cause HABs)

SSWR 4.01 anticipates delivering a key product in FY17: "Optimizing the early stages of drinking water treatment in order to mitigate harmful algal bloom risk."

Developing Guidelines for Quantifying and Reporting Water Quality Model Uncertainties

Ecological models are increasingly being used by environmental scientists and managers because they provide data at space and time scales not obtainable in most laboratory or field programs. They also provide causal mechanisms and allow users to analyze numerous potential future scenarios. Despite these benefits, there is little consensus as to the extent ecological models are realistic or provide reliable results that are sufficiently accurate to inform decision-making. Model uncertainties are often not adequately addressed. The Environmental Modeling Community of Practice (E-Mod CoP), facilitated by the Office of the Science Advisor (OSA) and chaired by the Science and Technology Policy Council (STPC), are developing methods for quantifying modeling uncertainties and will test these methods in modeling cases studies (e.g., hypoxia in the Gulf of Mexico, eutrophication in Lake Michigan). Anticipated study deliverables include a technical report on methods to quantify uncertainty in ecological models and peer-reviewed papers describing the application of these methods to Gulf of Mexico and Lake Michigan case studies.

Phosphorus (P) Input Layers for Delivery to EnviroAtlas (www.epa.gov/enviroatlas)

EnviroAtlas has been refined with the addition of four new layers for phosphorus (P) inputs: inorganic P fertilizer applied to farmland, P in manure from concentrated animal feedlots applied to farmland, crop P uptake, and net agricultural P balance. These layers were developed in 2012 and were initially generated for 30 x 30 m pixels and will be scaled to HUC12 watersheds in the EnviroAtlas.

Atmospheric Nr Deposition

OAR, OW, and ORD are collaborating on a national assessment of the impact of Nr air deposition to freshwater streams and lakes by identifying the extent to which waterbodies are impacted by Nr loadings from atmospheric deposition.

Critical Loads

Critical Loads (CL) are used to establish pollution thresholds at which ecological effects first occur. ORD and OAR are collaborating with the Critical Loads of Atmospheric Deposition (CLAD) Science Committee

under the National Atmospheric Deposition Program (NADP) to assemble data, improve the methodologies for calculating CLs, and map CLs for Nr deposition. ORD is also conducting regional and national assessments of the impact of Nr CL exceedances on aquatic and terrestrial endpoints and the modifying effects of climate change on endpoint sensitivity.

Online CL Mapper Tool

ORD has developed a beta-version of an online tool (CL Mapper Tool [CLMT]) for visualizing CL data and conducting simple calculations using the National Critical Loads Database (NCLD; http://nadp.sws.uiuc.edu/committees/clad/db/). The CLMT is an interactive ArcGIS based "front end" to the NCLD. It includes the capacity for users to view and select various atmospheric deposition sources (Total Deposition [TDEP], CMAQ, NADP, or the Intergovernmental Panel on Climate Change [IPCC]) for various years available and for different critical load types (terrestrial acidification, aquatic acidification, herbs, mycorrhizae, forests). Future versions of the tool will incorporate newly available CLs for individual species of trees, lichens, and herbs as well as for herbaceous biodiversity (Simkin et al. 2016).

New Critical Loads for Herbaceous Biodiversity

A large multi-institutional effort led by EPA, U.S. Geological Survey (USGS), U.S. Forest Service (USFS), and several universities recently completed a national-scale analysis of the impacts from N deposition on terrestrial herbaceous species (Simkin et al. 2016). As part of this effort, new estimates for CLs for reductions in herbaceous biodiversity were developed and climatic and soil factors that influence CLs were described. This work also laid the ground work for follow-up research to characterize the vulnerabilities of individual species to N deposition.

Analysis of the Interactive Effects from Climate Change and Nitrogen Deposition on Forested Ecosystems in the Northeast

A biogeochemical model (ForSAFE-VEG) using a coupled plant community was used to examine how various scenarios of climate change and atmospheric deposition futures could affect various endpoints of concern (e.g., understory biodiversity, N leaching, acid neutralizing capacity in leachate, and carbon-N sequestration). Mixed deciduous forests were targeted and the model was calibrated from two research stations (Hubbard Brook, NH and Bear Brook, ME). The research produced three publications that (1) described the model setup and calibration (in review); (2) provided modeling results of the calibrated model across the various climate and Nr scenarios (Water Air Soil Pollut (2016) 227:84, DOI 10.1007/s11270-016-2762-x); and (3) ran the calibrated model across a wider geographic area (in prep) to better understand local versus regional vulnerabilities.

b. Cross-ORD ORISE Fellows

Currently, two cross-ORD ORISE Fellows are being funded to work on Nr-related research. The first Fellow started in 2014 and explores nutrient issues and works to develop a better understanding of the motivation for farmers to adopt best management practices. This Fellow also supports the National Water Quality Benefits project (SSWR 3.04) by estimating the water quality benefits to homeowners (hedonic modeling) in Midwestern streams. Potential water quality variables that will be considered in

the hedonic model are nutrients and HABs. In addition to the Midwestern streams study, work has begun to collect housing market data in Cleveland, OH with the idea of examining how combined sewer overflows have affected house prices.

The second Fellow started in 2015 and assisted in developing several updates and improvements to the Nr National Inventory, including: (1) updated biological Nr fixation (BNF) numbers in natural systems (i.e., non-agricultural), (2) updated cultivation-induced BNF numbers from a manuscript by Sobota et al. (in prep) that will be a significant improvement over the older estimates (Herridge et al. 2008), (3) updated atmospheric deposition estimates from TDEP, and (4) added a new line in the Nr Inventory from a previously underappreciated source (rock N weathering [Morford et al. 2016]). The second Fellow is also part of a team of EPA and USFS researchers who are developing a three-volume set of reports on species affected by N deposition (V.1, lichens; V.2, trees; V.3, herbaceous species). The reports are intended for a nontechnical audience to summarize each species in 1–2 pages and are likely to be a central resource for the community of researchers and decision-makers focused on CLs of atmospheric deposition. These reports will be published as USFS General Technical Reports and will describe: (1) the range and abundance of each species; (2) the functional response of species to N deposition (e.g., growth and mortality for trees); (3) the ecology of the species in brief; and (4) a summary of the ecosystem services of that species. This post-doc will lead the development of the second report.

c. Workshops

EPA/USDA/USGS Working Meeting on N and Co-pollutants—June 2014

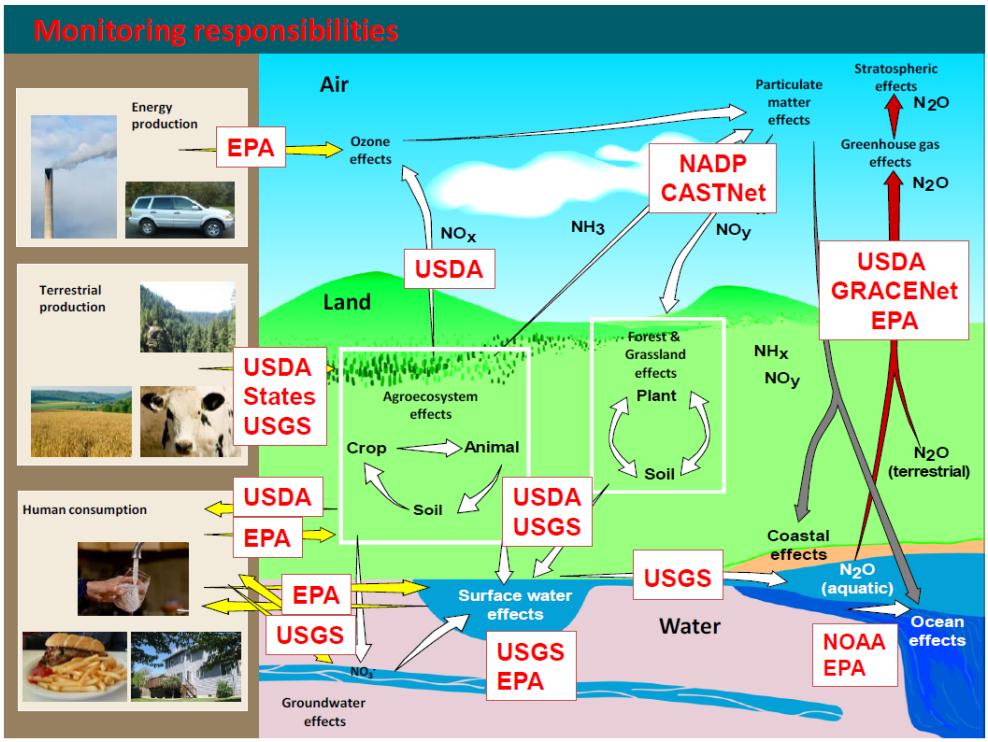
In June 2014, representatives from government, academia, nongovernmental organizations (NGOs), and the private sector participated in a workshop to review the science and management related to Nr and co-pollutants across the U.S. Department of Agriculture (USDA), USGS, and EPA. The purpose of the meeting was to develop a collaborative research and management partnership between these agencies in order to promote sustainable management of Nr. Workshop participants identified research needs in monitoring, policy development, technical solutions, collaboration, communication, and database alignment. Participants agreed that achieving the common goals of improving air and water quality, food security, and human health and welfare will require coordination of research, policies, and management across a variety of Federal agencies. The workshop report was published as an EPA report (U.S. EPA 2015) with interest in future workshops. An additional outgrowth of this workshop was a research initiative to update the U.S. National N inventory. Several important themes that emerged from this meeting are discussed below.

Evaluating Policy Options

Targeted research is needed on the environmental and economic effects of policy options. Conservation practice adoption studies are needed to explore the user response to different incentives, including certification schemes and consumer labeling. Studies on the interactions and trade-offs of different policy options and improved coordination across agencies is essential in policy research.

Monitoring Nr Fluxes and Impacts

While many aspects of the Nr cycle are tracked on a somewhat regular basis (see graphic on the right), a number of the internal components, such as losses from farm fields to air and water, are not well-monitored at the appropriate temporal and spatial scales needed for regular assessment. Rapid and timely assessment of Nr loads to the environment will hinge on the availability of improved field-level information regarding agricultural Nr and co-pollutant use. Integration of field- and watershed-scale Nr data and models across agencies, collaboration on ongoing studies, and better coordination of existing data sets through the National Water Quality Monitoring Council have all been recognized as key opportunities.



Developing Technical Solutions

Review of existing research, standardized data collection, sharing through systematic review, meta-analysis, and improved data planning are important aspects of tackling the Nr problem. Because the drivers and solutions to issues surrounding nutrient-related problems vary by region, regional collaborative centers focused on nutrient management are encouraged through the newly established regional climate hubs and the Long-Term Agro-ecosystem Research (LTAR) network. Key considerations regarding the human dimension of policy implementation include the motivations of the stakeholders involved as well as their available resources and sources of information. Supply-chain perspectives and partnerships and closing the food life cycle will be important new areas of focus.

Improving Communication

Agencies need to work together to develop an effective Nr communication strategy. Nr and co-pollutants are not widely recognized by the public as essential to food production or as significant environmental problems. Communicating the problem and solution options in a clear and concise way

to both policymakers and the public is essential. Improving recognition of the Nr pollution problem might be facilitated by placing a dollar value on Nr externalities and energy costs associated with Nr production. USDA's mission of integrating food production with environmental and human health protection could be supported and reinforced by the missions of both EPA and USGS.

Achieving common goals of improving air and water quality, food security, and human health and welfare will require coordination of research, policies, and management across a variety of Federal agencies. The EPA/USDA/USGS workgroup are working together on a publication from the workshop, and some members of the group are collaborating on related integration efforts through the International Nitrogen Initiative and the post-docs described above. The collaborative relationship between EPA, USGS, and USDA scientists and management will advance Nr research to inform science-based management, improve communications among policymakers and the public, and develop alternative approaches to managing Nr in an integrated framework.

Air Quality and Ecosystem Services (AQES) Workshop, Santa Monica Mountain National Recreation Area, Thousand Oaks, CA February 24–26, 2015

Environmental policy and management decisions must often consider how changes to the environment modify the benefits provided by nature and valued by people. The Air Quality and Ecosystem Services (AQES) workshop assembled a diverse group of 27 scientists, economists, and environmental policy makers from ORD, EPA Program Offices, National Park Service (NPS), USGS, USFS, and university and private entities in order to identify links between existing critical loads for atmospheric deposition and sensitive natural resources, ecosystem services, and the human beneficiaries of ecosystem services. While substantial information on the effects of acidification and eutrophication in aquatic and terrestrial ecosystems has been published, including many CLs, little work had previously been done to establish the ecological production functions needed to connect these air quality effects on plants, animals, soils, and waters to the humans who use or enjoy them. This process is useful because it advances communication of the science by translating air pollution impacts on ecosystems into terms that the public can more easily understand and value. Workshop participants included scientists with expertise in aquatic ecology, water and soil chemistry, plant physiology, modeling of environmental effects of pollution, economics, air quality policy, and natural resource management. The workshop identified clear connections between Nr inputs and terrestrial and aquatic ecosystem services, and provided information about the strength of the science behind these relationships for different ecosystem types. Outputs of this workshop included a report (Blett et al. 2016) and a series of papers to be published in a special issue of the journal *Ecosphere*.

ii. Outreach to Partners and Stakeholders

a. Stakeholder Outreach

National Aquatic Resource Surveys (NARS)

National Aquatic Resource Surveys (NARS) are collaborative programs between EPA (OW and ORD), states, and tribes designed to assess the condition of the nation's coastal waters, lakes and reservoirs, rivers and streams, and wetlands using a statistical survey design (https://www.epa.gov/national-aquatic-resource-surveys). NARS provides critical, nationally-consistent data on the condition of the nation's waters. A suite of biological, chemical, and physical indicators are used to assess biological integrity, trophic state, recreational suitability, and key stressors impacting water quality. Many of these indicators are specific or relevant to Nr and co-pollutant status and impacts. The results are data and information that can be used for trends analysis and water quality decision-making.

Nutrient Centers

The following institutions received grants under the 2013 National Priorities Centers for Water Research on National Priorities Related to a Systems View of Nutrient Management request for applications (RFA) and recently entered year 3:

- Colorado State University: Mazdak Arabi
- University of South Florida: James Mihelcic
- Pennsylvania State University: James Shortle
- Water Environment Research Foundation: Amit Pramanik

The centers have produced several publications and presentations (see Appendix Table 1) and are now conducting demonstration projects, one of the research areas in the RFA. In 2015, the grant kickoff meeting was held at the EPA lab in Narragansett, RI where Center Directors presented their research plans and met ORD, OW, and EPA Region 1 and 4 staff. Toward the end of 2016, each center will conduct an annual review by convening a scientific advisory committee (SAC) for a 1–2 day meeting where each center will receive feedback on current and future research from the respective SAC committees.

Key findings and accomplishments from the Pennsylvania State center included developing an integrated decision support process involving modeling, empirical data, and lessons learned to develop community-based, spatially-explicit, nutrient intervention scenarios for stakeholders in the Chesapeake Bay region. Preliminary modeling has shown that substantial efforts are needed in order to mitigate or reverse the effects of nutrient pollution in the Chesapeake Bay watershed. Although significant decreases in atmospheric deposition of Nr have occurred, largely due to emissions reduction policies, these reductions have stabilized, making additional reductions to the levels needed to meet the Bay's 2025 total maximum daily load (TMDL) goals highly unlikely. The Pennsylvania Integrated Hydrologic Model (PIHM) simulations of groundwater wetting and drainage pathways during storm events in one of the focal watersheds under study was improved to identify critical nutrient source areas (i.e., flow accumulation areas and sections discharging to streams). This information coupled with simulations of Nr movement and crop growth from an agroecosystem model (Cycles) will improve selection of targeting options for best management practice (BMP) placement throughout the sub-watershed. This coupled model has been demonstrated to work in two watersheds.

The University of South Florida (USF) Center developed patent-pending technology for wastewater treatment using a novel reactor design which results in greater reactor efficiency and flexibility by combining several reactors into one reactor. The significance of the invention is that it will drastically improve the performance of wastewater treatment systems for both new systems and retrofits, especially decentralized and onsite systems. Another USF Center project evaluated how scale of implementation impacts the environmental sustainability of wastewater treatment plants (WWTPs). A septic system at the household scale, an advanced water reclamation facility at the community scale, and an advanced water reclamation facility at the city scale were evaluated using three sustainability parameters: embodied energy, carbon footprint, and eutrophication potential. The study found that there are benefits to WWTP centralization in terms of embodied energy and carbon footprint; however, the community scale was shown to have the lowest eutrophication potential. The study also showed that factors such as technology selection, nutrient control practices, and topographical conditions may have a larger impact on environmental sustainability than the scale of implementation.

The Water Environment & Reuse Foundation project focuses on developing process technologies using mainstream deammonification. The Foundation conducted demonstration studies at Hampton Roads Sanitation District and D.C. Water. The study demonstrated that the use of online aeration control resulted in a total inorganic N removal efficiency up to 91% which demonstrates that application of the proposed on-line aeration control is capable of relatively high Nr removal without supplemental carbon and alkalinity addition at a low hydraulic residence time.

Water Sensors

ORD is working with EPA Region 10, Office of Enforcement and Compliance Assurance (OECA), OW, and State, local, and tribal groups to demonstrate the effectiveness of advanced water quality monitoring and associated network design for ambient water quality monitoring. This project is evaluating the use of nearly continuous sampling from water sensors in a network within a watershed to identify trends in nitrate/nitrite and bacterial levels. This project will also result in data posted on the internet in near real-time to increase public awareness of how runoff and land use practices affect water quality over several seasons.

b. Successes in Addressing Emerging Issues and Advisory Committee Recommendations

EPA's Science Advisory Board Integrated Nitrogen Committee (SAB INC) report recommended greater intra-agency and interagency coordination on Nr, which is the foundation of the Nitrogen and Co-pollutant Research Roadmap effort. In response to this call for coordination, the Cross-EPA N team led the interagency workshop, "Meeting on Management Strategies for Reactive Nitrogen and Co-Pollutants," held in June 2014, with a report published in November 2015. The Cross-EPA N team also conducted an intra-agency workshop, "Cross-EPA Efforts on Reactive Nitrogen and Co-Pollutants: Science to Inform Action," held in August 2016.

iii. Current List of Products/Peer-reviewed Publications

Appendix Table 1 provides a summary of the current list of products relating to Nr and co-pollutant research across the Agency. Note that while the lead Office is listed, many of these are cross-Office, cross-Program collaborations. This is not meant to be a complete listing, but it provides a snapshot of how the Agency is responding to and communicating about issues related to Nr and co-pollutants. The table reflects information in ORD's Scientific & Technical Information Clearance System (STICS) from October 1, 2015 through June 30, 2016. This time period spans two research action plans (2011–2014, 2015–2019) so entry formats are not consistent.

Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

High Profile Publications: 11
Peer Reviewed Publications: 99
Book Chapters: 4
Reports (External, Internal, Unpublished): 12
Miscellaneous: 17
Presentations (Oral, Poster): 300+
Policy Review: 8
Regional Projects: 11

Appendix Table 1 quantifies some of the ongoing research and communication efforts that address issues related to nutrient pollution. Of note, there are 11 high-profile publications, 99 additional peer-reviewed publications, over 300 presentations (oral/poster) at scientific conferences both nationally and internationally, 4 book chapters, 12 reports, and 17 'miscellaneous' efforts, such as newsletters, technical factsheets, and data sets. In addition, several manuscripts that underwent policy review (8) and current Regional projects (11) are listed.

a. Recent and On-going Regional/ORD Partnership Projects

The importance of nutrient-related research for the Regions can be seen in the number of ORD/Regional research partnership projects selected for funding by the Regions.

Recent and On-going Regional/ORD Partnership Projects

- **Triple Value Simulation Model for Nutrient-related Water Quality Impairments in Suffolk County, NY (Region 2)**
- **Lake Erie Algal Bloom Study (Region 5)**
- **Fecal Indicators in Response to Nutrients in an Impaired Urban Watershed (Region 4)**
- **Ammonia Monitoring in Northeast Colorado (Region 8)**
- **Nutrient Characterization of Digester Effluents (Region 10)**
- **Partnership to Improve Nutrient Efficiency in the Willamette Valley (Region 10)**
- **Methods for Monitoring Algal Blooms using NextGen qPCR and Microarrays (Region 7)**
- **Nutrient Characterization of Digester Effluents (Region 5)**
- **Tracing Near-Shore Nitrogen through the Ground Water flow, Cape Cod Maine (retained) (Region 1)**
- **Natural Attenuation of Septic-system Nitrogen from Thickly Settled Coastal Zones, Falmouth, Cape Cod, MA (Region 1)**

B. Encouraging Innovation

i. Nutrient-related Open Innovation Prizes

Open innovation to reduce nutrients in waterways is among the Administration's top 100 leadership examples in science, technology, and innovation. Challenging Nutrients is coordinated by the Office of Science and Technology Policy (OSTP)-convened Challenging Nutrients Coalition of Federal agencies (EPA, NOAA, USDA, USGS, and National Institute of Standards and Technology [NIST]), academia, and the private sector.

- **Challenging Nutrients—**Beginning in 2013, a coalition of Federal agencies and other partners have been working together to seek innovative ways to address pollution caused by excess Nr and P in water. A number of activities described below are now underway by the coalition including development of affordable nutrient sensors and associated strategies for their deployment and use.

Challenging Nutrients Logo

  - **Nitrate and Phosphate.** The Nutrient Sensor challenge was launched in 2014 to accelerate development and adoption of affordable, accurate, and reliable sensors for nitrate and orthophosphate in water. Requirements for the sensors were informed through extensive input from users (Federal and State regulators and scientists, academic researchers, sensor developers, and waste water/drinking water sectors) across the United States and for a range of applications. Six sensors are currently undergoing final testing. Awards will be announced in late 2016 and pilot demonstration projects will begin in early 2017 (see http://www.act-us.info/nutrients-challenge/).
  - **Cyanobacteria/Cyanotoxins.** EPA and NOAA are collaborating with the Association of Clean Water Administrators (ACWA), Association for Safe Drinking Water Administrators (ASDWA), National Water Quality Monitoring Council (NWQMC), USGS, and Water Environment Federation (WEF) to accelerate the development of affordable and accurate technology to detect cyanobacteria/cyanotoxins in water. Requirements and preferences for cyanobacteria/cyanotoxin sensors have been developed and summarized in a report. In collaboration with NOAA, efforts to identify specific sensor technologies will begin in 2017 (see https://intranet.ord.epa.gov/p2/sswr/sswr-communication under SSWR Overview and Roadmaps).
  - **Total Nitrogen and Total Phosphorus.** EPA and USGS are collaborating with the ACWA, ASDWA, NWQMC, and WEF to accelerate the development of affordable and accurate technologies to detect total N and total P in water. A report has been developed that summarizes the sensor requirements and preferences from Federal agencies and feedback on efforts of non-Federal organizations (see https://intranet.ord.epa.gov/p2/sswr/sswr-communication under SSWR Overview and Roadmaps).

- **Nutrient Recycling Challenge.** EPA is leading an effort in close collaboration with USDA and pork and dairy producers to develop affordable technologies and approaches to manage and realize the full value of manure as a renewable fertilizer and soil amendment. Phase 1 prizes were awarded by EPA in March 2016,[1] and Phase 2 competition details are in preparation (see https://www.challenge.gov/challenge/nutrient-recycling-challenge/).

- **Visualizing Data about Nutrient Pollution—**EPA ORD has launched two challenges to develop examples of effective public communication, education, and action pertaining to nutrient data visualization challenges.

  - **Visualizing Nutrients Challenge.** This effort is sponsored by USGS, EPA, and Blue Legacy International to develop inventive ways to organize and analyze existing data on nutrient levels in water and was followed by the Visualize Your Water high school challenge. Both of these have been completed, and prizes have been awarded and results are available.[2]

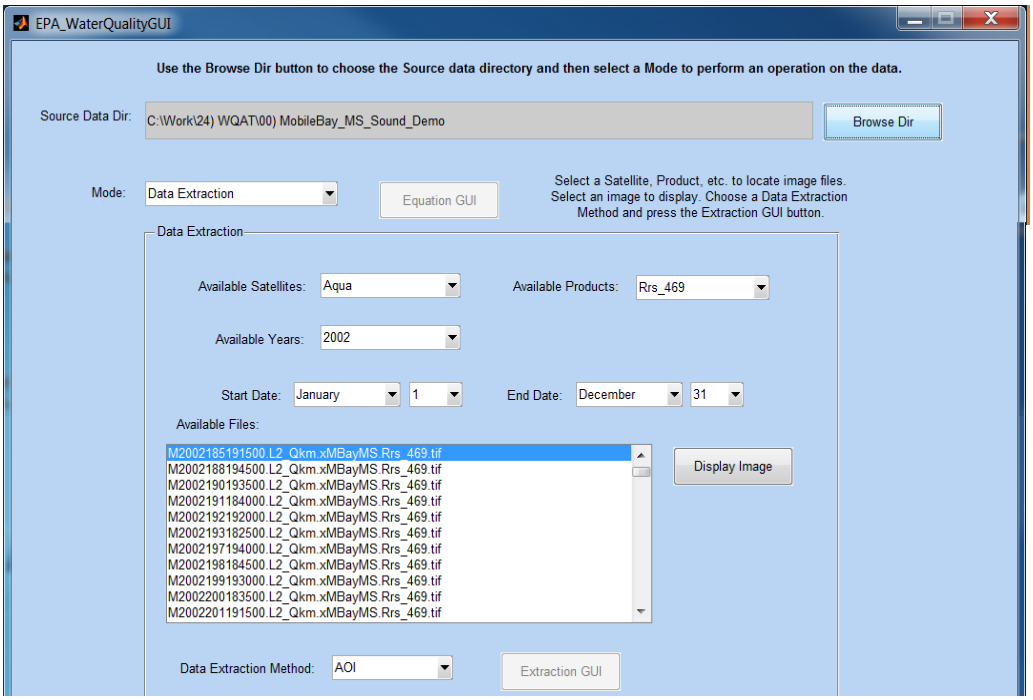
  - **Visualize Your Water**. This event was a 2016 challenge for high school students to develop innovative visualizations about nutrient pollution and equip students with new GIS technology skills while broadening their understanding of their environment and water issues that affect their community. EPA partnered with USGS, Environmental Systems Research Institute (ESRI), WI/MN Sea Grants, Great Lakes Observing System (GLOS), and the Chesapeake Bay Foundation on this effort. Over 100 entrees were received with a grand prize, 2 regional prizes, and 2 honorable mentions (see https://www.challenge.gov/challenge/visualize-your-water/).

ii. Sensor Technology/Satellite Data

Water Quality Assessment Tool (WQAT)

Water quality decision-making could be improved with ready access to the 30-year satellite data time-series for lakes, reservoirs, and coastal systems. ORD developed the Water Quality Assessment Tool (WQAT) for simplified access to remote sensing imagery of indicators of nutrient pollution (see Figure 2). For example, the satellite remote sensing methodology for the State of Florida's numeric nutrient criteria in coastal waters could be reproduced with WQAT. Targeted as a niche tool for water quality management of nutrient pollution, water clarity, and suspended sediments, WQAT is being used as a nutrient management tool by our partners in OW/Office of Science and Technology (OST) through their Nutrient Scientific Technical Exchange Partnership and Support (N-STEPS) programs to provide technical assistance to the States.

[1] https://yosemite.epa.gov/opa/admpress.nsf/0/A0A071CAD98F1CEF85257F85007D21E5
[2] https://www.epa.gov/innovation/visualize-your-water-challenge-winners



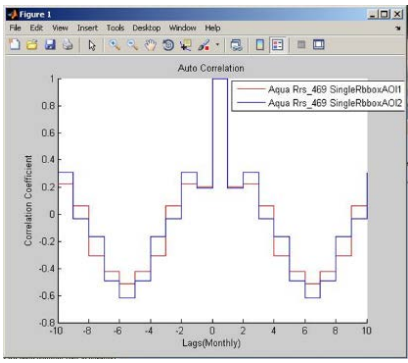


Figure 2. Water Quality Assessment Tool (WQAT) for satellite data (Product 4.01E.1): Screen shots of access to remote sensing data and data analysis.

Cyanobacteria Assessment Network (CyAN)

Few time-series studies of harmful and nuisance algal bloom trends exist to assess frequency, extent, and duration of occurrence. Assessment methods are needed to provide relevant information at local, regional, national, and global scales. These scalable status and trend assessments may permit adaptive management strategies on more relevant timescales. The mission of the Cyanobacteria Assessment Network (CyAN) project is to support the environmental management and public use of U.S. lakes and estuaries. Chlorophyll-a and cyanobacteria concentrations can serve as indicators of increased anthropogenic nutrient stress and as a measure of harmful and nuisance algal blooms. Temperature is also relevant to phytoplankton ecological models and is necessary for quantifying climatic response. This project evaluated validation regression results and statistical distributions for satellite-derived chlorophyll-a, cyanobacteria, and temperature products obtained from current and historical satellite data (MEdium Resolution Imaging Spectrometer [MERIS], Landsat). Assessment methods were developed using historical MERIS data in order to quantify (1) number of cloud-free observations available; (2) number of spatially resolvable water bodies; and (3) frequency of cyanobacteria occurrence in resolvable lakes and reservoirs, including those with surface drinking water intakes (see Figure 3). These inputs were used to derive the spatial extent and rate of change for time-series analysis of cyanobacteria blooms in the states of California, Connecticut, Florida, Massachusetts, New Hampshire, Ohio, Rhode Island, and Vermont.

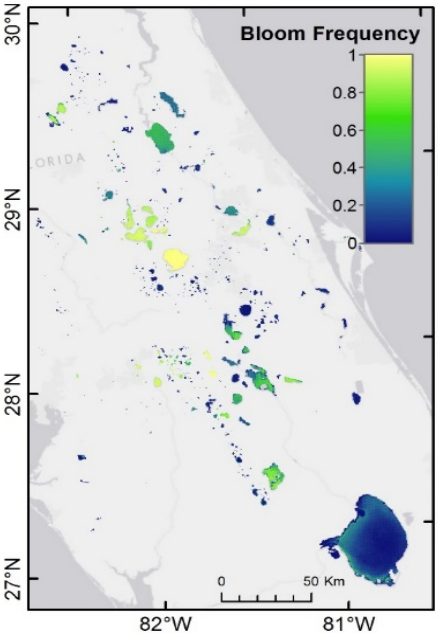
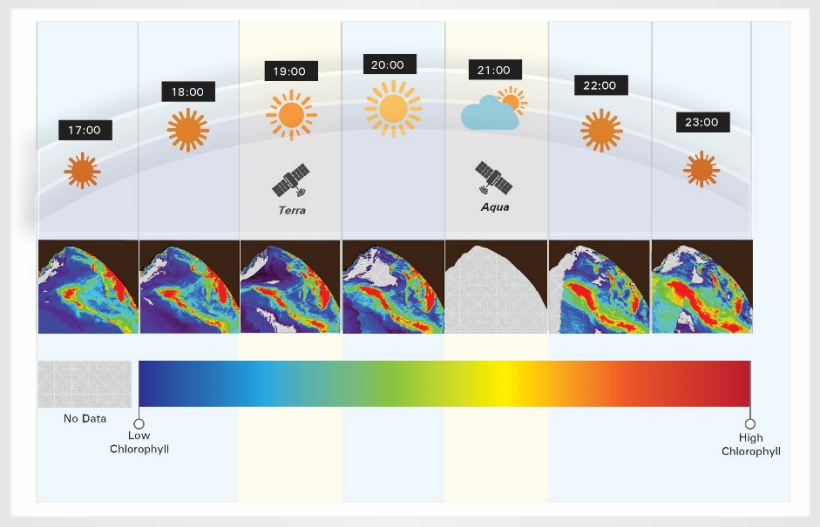


Figure 3. Frequency of cyanobacteria concentrations occurrence observed over the World Health Organization high threshold of 100,000 cells/ml from 2008–2011 in Florida.

New Earth Observations

The GEOstationary Coastal and Air Pollution Events (GEO-CAPE) satellite workshop was hosted at the EPA Research Triangle Park facility to formulate science questions and applications that can be addressed with a sensor in geostationary orbit. GEO-CAPE would provide high-frequency measurements of coastal regions to help protect ecosystems and enhance economic activity (see Figure **4**). ORD demonstrated potential applications for a new satellite sensor that may integrate into the Pre-Aerosol, Clouds, and ocean Ecosystem (PACE) ocean color mission with a target launch date of 2022. Discussions included scoping of science questions, applications, and technical requirements. The new satellite sensor is proposed to include 100-m high resolution pixels, hyperspectral wavebands, and pointing capability specifically designed for coastal and inland water quality research. ORD also responded to the National Research Council (NRC) requests for information on the next decade of research in earth science and applications that direct U.S. space programs for 2017–2027. EPA identified key challenges for earth science in research and applications related to land, water, and air media. Links were made with EPA science and application targets, satellite derived geophysical variables, and mission

requirements to NRC themes. The Nitrogen and Co-pollutant Research Roadmap served as a critical reference document in EPA's response to the NRC for identifying priority research questions.



Note: In this figure, GEO-CAPE data is simulated to demonstrate movements of phytoplankton blooms in Monterey Bay, California (Salisbury et al. Eos: Earth and Space Science News, In Press). Traditional ocean color satellites provide a single measurement per day. GEO-CAPE would provide multiple measurements and assist to avoid cloud cover (e.g., 21:00).

Figure 4. GEO-CAPE satellite to demonstrate phytoplankton bloom movement in Monterey Bay, CA.

C. Opportunities

i. Cross-Roadmap Interactions

National-Scale Projections of Climate Change under Multiple Scenarios Through 2100

Drought can have wide-reaching regional effects or be localized in scale. ORD is developing hourly projections of climate change across the continental United States within 36 x 36 km cells to examine frequency and severity of drought across multiple spatial and temporal scales. These projections can be used to examine potential changes related to temperature and precipitation extremes and the cascading impacts on sensitive ecosystems. These data address issues at the nexus of three of the four ORD roadmaps for cross-cutting research: Climate Change, Nitrogen & Co-Pollutants, and Environmental Justice. These data can be used to examine changes in nutrient loading to sensitive ecosystems, including the Mississippi River at the Gulf of Mexico and Chesapeake Bay. These data can also be used to develop approaches for creating intensity-duration-frequency curves that reflect potential changes to future climate and anticipate effects of drought on agriculture across the Nation. Lastly, these modeling approaches holistically examine impacts of climate changes on air quality, health, water quantity, and ecosystems using dynamically consistent Agency tools. Products from this effort will include:

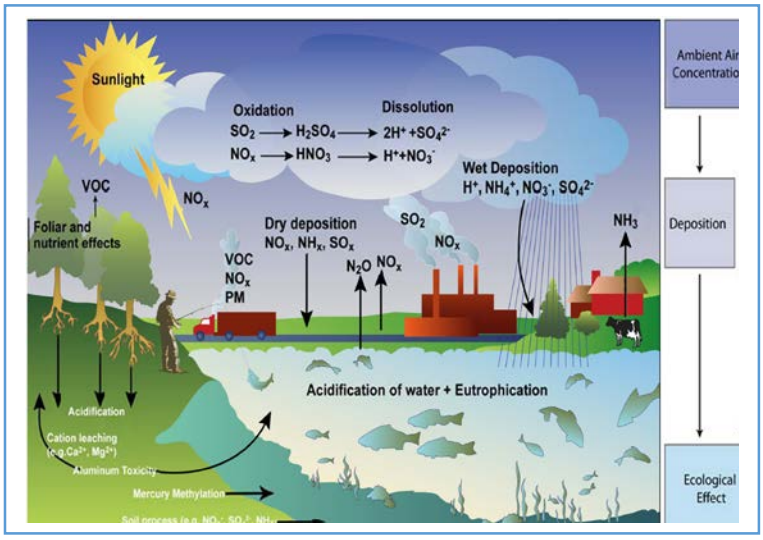
- 4QFY16: Interagency agreement established with USGS Southeast Climate Science Center,
- 4QFY16: Hourly time series of precipitation projections for the contiguous United States (CONUS) through 2100,
- 4QFY17: Demonstrated application of these data under SSWR 4.02B.1-b,
- 2QFY18: Data prepared for public dissemination via EnviroAtlas (*pending additional funds*) https://www.epa.gov/enviroatlas, and
- 4QFY19: Preliminary uncertainty analysis using downscaled projected data.

ii. Changes in the Broader Scientific and Policy Landscapes and Impact on Research Directions

ORD, OAR, and OW have been working collaboratively on Nr air deposition issues to compile new research, conduct analyses, and identify research gaps. Much of this work directly supports OAR's current review of the NOx and SOx Secondary National Ambient Air Quality Standards (NAAQS) for public welfare.

The Integrated Science Assessment (ISA) for NOx and SOx

The Integrated Science Assessment (ISA) (part of the HHRA research program) critically evaluates and integrates the scientific information on the deposition and ecological effects associated with ambient air concentrations of total reactive oxidized N (NOy), ammonia/ammonium (NHx), and SOx, individually and in combination. Discipline areas included are atmospheric science, biogeochemistry, plant and animal physiology, ecotoxicology, population ecology, community ecology, and ecosystem services. The ISA evaluates the evidence for causal relationships between observed ecological outcomes and NOx and SOx exposures using a five-level hierarchy that classifies the weight of evidence for causation. Determination of causality involves the evaluation and integration of evidence across disciplines for major outcome categories: aquatic acidification, terrestrial acidification, aquatic eutrophication, terrestrial eutrophication, S-driven nutrient effects, and gas-phase effects. The goal is to synthesize the current state of knowledge on the most relevant issues pertinent to the review of the secondary NAAQS for NO_X and SO_X, to identify changes in the scientific evidence base since the previous review (2008), and to describe remaining or newly identified uncertainties. In the 2008 ISA, the main effects from Nr deposition were acidification and eutrophication. Acidification from the deposition resulting from current emission levels causes a cascade of effects that harm susceptible aquatic and terrestrial ecosystems, including slower growth and injury to forests and localized extinction of fishes and other aquatic species. In addition to acidification, atmospheric deposition of Nr resulting



from current NOx and NHx emissions along with other non-atmospheric sources (e.g., fertilizers and wastewater) causes a suite of ecological changes within sensitive ecosystems. These include increased primary productivity in most N-limited ecosystems, biodiversity losses, changes in carbon cycling, and eutrophication and HABs in freshwater, estuarine, and ocean ecosystems.

In each NAAQS review, development of the ISA begins with a "call for Information" published in the *Federal Register*. To assist in the development of the current ISA, scientific experts were invited to a kickoff workshop in March 2014 to highlight research published since the publication of the 2008 NOx/SOx ISA. Based on this input, early draft material was developed and evaluated by scientific experts during a workshop held by teleconference August 25–27, 2015. The first draft of the ISA from the current review is targeted for release in 2017 and includes over 1200 new citations (2008- 2015 publications).

iii. Challenges

As indicated by the diversity of EPA Offices, EPA Regions, and ORD Laboratories and Centers, the Nitrogen and Co-pollutant Research Roadmap effort has brought together researchers across organizations to develop a path forward toward a common goal; however, several organizational and scientific research challenges that foster integration still remain, a few of which are highlighted here.

Organizational Challenges

- **Ensure integrative success** of Nr and co-pollutant research housed in multiple tasks, projects, ORD regional air pollution studies (RAPs), and Office and Regional efforts.
- **Identify relevant external research efforts,** including academic, Federal, State, and NGO efforts that address key Nr and co-pollutant management issues.
- **Develop a formal, collaborative process between ORD, Program Offices, and Regions** to discuss how best to provide scientific support or tools for the Program Offices to make local- to national-scale decisions (e.g., NAAQS; numeric nutrient criteria) and for the Regions and States to use in developing prioritized load reductions (including the characterization of changes in ecosystem services). This includes sharing data between models (e.g., spatial and temporal scales, geographic projections) and integrating with social science elements.

Organizational Challenges

- Ensure integrative success
- Identify relevant external research efforts
- Develop a formal, collaborative process between ORD, Program Offices and Regions

Scientific Research Challenges

- Examine climate impacts on nitrogen and co-pollutant sensitivity
- Use a systems approach to wildfire and nutrient management
- Develop ecological exposure response functions
- Determine the utility of water quality models across spatial scales

Scientific Research Challenges

- **Examine climate impacts on Nr and co-pollutant sensitivity** because climate change will undoubtedly alter both temperature and precipitation patterns nationally and regionally. These

factors will greatly affect the sensitivity of ecological systems to the impacts of Nr and co-pollutant (S, P) deposition, discharge, and runoff (e.g., increased HABs and cyanotoxins, low dissolved oxygen [DO], increased fish kills, reduced recreational use, increased drinking water treatment costs, and reduced property values). Also important to consider is how actions to adapt to or mitigate the impacts of climate change could impact Nr emissions and Nr sensitivity due to land use changes. This is a critical environmental, public, and economic health issue to address collaboratively across EPA and other Federal agencies in the near future.

- **Use a systems approach to wildfire and nutrient management.** Managing active wildfires using various fire suppression tactics and mitigating wildfire risk by mechanical thinning or prescribed burns requires a systems approach to evaluate short- versus long-term impacts on air quality (e.g., particulate matter [PM] and polycyclic aromatic hydrocarbon [PAH] exposure) and water quality (e.g., excess nutrient loading). Wildfires are a large source of particulates during the summertime and can significantly impact susceptible human populations. Prescribed burns can release high concentrations of PAHs into the air depending on the temperature of the controlled burn. For years after a wildfire, nutrients may be flushed out of the burned zone and into surface and groundwater. This higher loading requires drinking water treatment plants to treat more Nr and, as a result, more nitrogenous disinfection byproducts (DBPs) are created, which are more harmful than carbonaceous DPBs.
- **Develop ecological exposure-response functions** for many Nr-related impacts and impacts of potential changes in Nr loadings from alternative NOx and SOx standards (OAR secondary NAAQS), regulatory and non-regulatory emissions reduction programs. Exposure-response functions provide support in setting standards to protect ecological endpoints from secondary NAAQS pollutants. They also help to evaluate nonpoint and point source loading reduction programs and the benefits of such programs.
- **Determine the utility of water quality models across spatial scales.** There is a range of both Agency and external models for Nr and co-pollutant source apportionment in water at varying spatial scales (e.g., OW TMDL development). Linking these models to air quality models is also an important development area.

II. The Year Ahead

A. Ongoing Discussions across Research Programs, New Research Gaps

Contributions from ORD, OAR, OW and the Regions in terms of research, science, and policy expertise are essential to designing the goals, research projects, and work plans as well as conducting and using the research, science, and tools to reduce Nr and co-pollutant loading across air, land, and water. OAR, OW, Regional, and ORD researchers and scientists continue to collaborate on the design of investigations, synthesis of data and information, and implementation of tools in existing and innovative management actions and policy design. Simultaneously OW, OAR, and EPA Regions are being encouraged to collaborate to find innovative policy and management approaches, in addition to current regulatory programs, to optimize Nr and co-pollutant reductions by developing voluntary initiatives and

exploring improved ways to link CAA, SDWA, and CWA authorities. One current example is determining how best to coordinate CAA secondary National Ambient Air Quality Standards (NAAQS) reviews with CWA TMDLs to achieve needed Nr reductions that will lead to ecological and human health benefits.

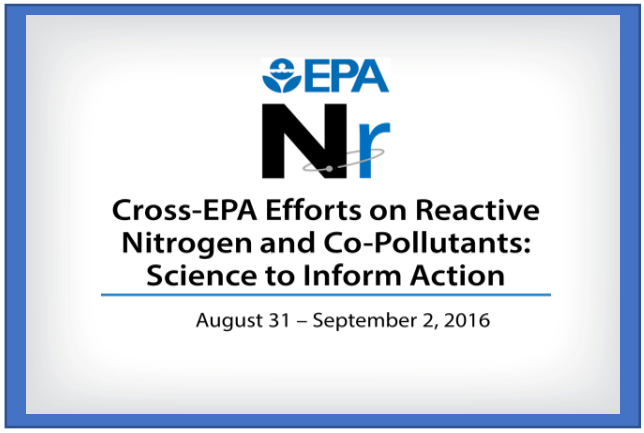
A second current example is related to the development of numeric nutrient criteria. EPA OW/OST is in the process of re-evaluating the current CWA section 304(a) numeric nutrient criteria recommendations for lakes and reservoirs of the continental United States, using stressor response analyses to relate both total N and total P to a variety of assessment endpoints that relate to CWA designated uses (aquatic life, recreation, and source water protection). Data from EPA's NARS National Lakes Surveys (2007 and 2012) are being used for this purpose, along with relevant scientific literature. OST has completed an extramural review of the draft technical support document, and it is currently undergoing review by an EPA Action Development Process (ADP) workgroup (Headquarters, ORD, Regional offices). ORD has either published (Hagy 2015, Alber et al. 2015) or is in the publication process for a number of reports and journal manuscripts initiated under the previous SSWR RAP in support of development of numeric nutrient criteria. These publications address a range of nutrient sensitive endpoints, including seagrasses, seagrass epiphytes, and chlorophyll-a and provide evaluations of successful nutrient management programs for point source and nonpoint source nutrient inputs into coastal regions.

The value of communication across disciplines and EPA offices cannot be overlooked. Continued discussions across offices, ongoing science seminars, annual engagement with the National Program Directors during their planning cycles, and annual face-to-face meetings with scientists and decision-makers across the Agency continue to be important. In the next few years, it is anticipated that this type of effort can and should be extended to the other Federal partners and States (see proposed workshop below on Joint Agency Opportunities in the Science and Management of Nitrogen and Co-Pollutants).

B. Recent and Proposed Workshops

i. Cross-EPA Efforts on Reactive Nitrogen and Co-Pollutants: Science to Inform Action, August 31 - September 2, 2016 RTP NC

Nearly 70 people attended this workshop from across ORD, OW, OAR and the Regions. The program was organized around the N Cascade and included plenary sessions, lightning talks, a poster session, breakout groups, and panel discussions. Everyone agreed that an annual face-to-face meeting across Offices was a huge benefit and should be continued in the future.



The main goal of this workshop is to provide an opportunity for EPA scientists working on similar issues in different Laboratories, Centers, and Offices to meet and build cross-EPA collaborations. This workshop built upon the SAB INC recommendations and the Cross-EPA Nitrogen and Co-pollutant Roadmap for greater intra-

agency interaction to break down media-based or disciplinary barriers and brought together scientists across EPA to share their research. EPA scientists in the SSWR, ACE, SHC, and HHRA research programs working on nutrient research; staff in OW, OAR and the Regions; and NCER Nutrient Centers representatives. This FY16 workshop provided EPA scientists the opportunity to learn about related research and identify areas of coordination and collaboration across EPA. EPA researchers presented their work and focused discussions in particular areas (e.g., systems modeling, water quality trading, ecosystem services, research integration, and communication).

The Cross-EPA N Workshop helped to advance Nr research to inform science based management, improve cross-EPA collaborations and communication, and identify alternative approaches to managing Nr & co-pollutants in an integrated framework.

Key recommendations from the workshop included:

- Quarterly webinars around a specific topic (e.g., areas of research emphasis below)
- Annual face-to-face meeting in conjunction with an EPA meeting or Scientific Conference
- Areas of research emphasis to explore further:
    - Linkages between nutrients and HABs (especially cyanobacteria)
    - Interactions between nutrients and climate, specifically biodiversity and biogeochemical cycle feedbacks between nutrients and climate
    - Integrated approaches that allow decision-makers to make trade-offs (regulatory, voluntary, incentives, markets, etc.)
    - Dose-response functions for ecological endpoints and ecosystem services
    - Measurement Model Fusion: using an integrated approach for data fusion

ii. Proposed workshop–Joint Agency Opportunities in the Science and Management of Reactive Nitrogen and Co-Pollutants (currently unfunded)

This proposed workshop will focus on increasing coordination across agencies and would build upon recent successes in interagency coordination from the White House nutrient challenge, NOAA-EPA-USGS algal bloom monitoring network, Hypoxia Task Force, water quality trading coordination, and EPA-USDA food waste reduction initiatives, EPA-USDA air research, and NADP and partner agencies working on critical loads. Representatives from Federal agencies, academia, industry partners in agriculture, energy and wastewater, and NGOs as well as key partners from the International Nitrogen Initiative, U.S. Global Change Research Program (USGCRP) Biogeochemistry Interagency Working Group, and The National Socio-Environmental Synthesis Center (SESYNC), will be invited to attend. Products will include a workshop summary publication, communication materials, and database of ongoing Agency nutrient-related projects.

C. Highlights of FY17 Deliverables

Some of the upcoming FY 17 deliverables that will be described in the next annual report are highligeted below.

1. ACE FY17 AIMS-2 Output: Improved atmospheric system for Nr and a fully linked multi-media model set for aquatic acidification.
2. One barrier to successful water quality trading (WQT) includes low numbers of willing and able buyers or sellers of nutrient control, referred to as thin markets. SSWR Project 4.03 addresses the feasibility of bringing alternative participants into WQT as one approach to address thin markets. Areas of research include estimating: 1) nutrient reductions (with uncertainty bounds), 2) incentives of alternative participants, and 3) unintended consequences under different management scenarios.
3. The U.S. EPA is looking to improve its ability to value the full range of benefits of rules under the CWA. ORD, Office of Policy (OP), and OW have formed a collaborative team of economists, ecologists, and water quality modelers to develop a national water quality benefits modeling framework that will better inform senior decision-makers and the public. The effort is currently identifying gaps within the body of existing studies—starting with place-based economic and water quality studies—and organizing a workshop.
4. Institutional N footprint website SHC/SSWR FY17: Since 2014, the SHC program has been funding the application of the institutional Nr footprint developed at the University of Virginia for nearly 20 universities, colleges, and research institutions across the United States and Canada. With additional funding from SSWR and the Immediate Office of the Assistant Administrator (IOAA) in 2016, this effort will now merge with the Campus Carbon Calculator housed at the University of New Hampshire http://campuscarbon.com/. This connection will extend the potential application of the Institutional Nitrogen Footprint to over 100 institutions.
5. San Juan, PR Coordinated Case Study (SHC 2.61) is documenting anthropogenic Nr distribution in the San Juan Bay Estuary (Puerto Rico). This work aims to quantify how the clogged Martin Peña Canal, and associated chronic flooding of vulnerable low-lying communities with sewage-enriched water, is impacting both human and estuarine health. This research, along with efforts to look at the sustainability of interwoven urban mangrove stands, is feeding into coupled ecological-human health models designed to aid stakeholder groups and inform restoration decision-making.
6. New critical loads for 89 individual tree species, 100+ individual lichen species, and 100+ individual herb species are being readied for publication and will become available in FY17. These will be pulled into the NCLD and the CL Mapper Tool and will dramatically advance our understanding of which species are/are not vulnerable to atmospheric deposition.
7. Three new working groups are being created under the National Atmospheric Deposition Program, CL Science Committee to advance key areas in CL research and application. Work includes: (1) pulling in new CL data into the NCLD (e.g., trees, herbs, and lichens), (2) quantifying uncertainty for various CLs, and (3) developing an approach and case study(ies) for combining all CLs in a given area to assess overall vulnerability to atmospheric deposition.
8. The First Draft of the ISA for NOx and SOx will be released in FY17 and finalized in FY18.
9. Cross-EPA Efforts on Reactive Nitrogen and Co-Pollutants: Science to Inform Action Workshop. Products and follow up items include: workshop summary, presenations, quarterly cross-Office meetings on specific topics (e.g., linkages between nutrients and HABS, interactions between nutrients and climate), annual face-to-face meetings, and ongoing discussion on areas of research emphasis to evaluate for recommendation in the the 2020-2024 StRAP development process.

10. Challenging Nutrient Pilots—a set of pilot projects utilizing continuous nutrient monitors—will be used to address critical issues pertaining to the monitoring and use of data for decision-making.
11. Methods for monitoring cyanobacteria harmful algal bloom frequency in recreational and drinking water sources with satellites (SSWR 4.03E).
12. A status and trends assessment approach to quantify freshwater cyanobacteria blooms extent using satellite remote sensing data (SSWR 4.03E).

D. FY16 Highlighted Publications

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IV. Acronyms and Abbreviations

ACE	Air Climate and Energy
ACWA	Association of Clean Water Administrators
ADP	Action Development Process
AQES	Air Quality and Ecosystem Services
ASDWA	Association for Safe Drinking Water Administrators
BMP	Best Management Practice
BNF	Biological Nr Fixation
CAA	Clean Air Act
CGEM	Coastal Gulf Ecology Model
CL	Critical Loads
CLAD	Critical Loads of Atmospheric Deposition
CLMT	Critical Loads Mapping Tool
CMAQ	Community Multiscale Air Quality modeling system
CONUS	Contiguous United States
CWA	Clean Water Act
CyAN	Cyanobacteria Assessment Network
DBP	Disinfection Byproduct
DO	Dissolved Oxygen
E-Mod CoP	Environmental Modeling Community of Practice
EFDC	Environmental Fluid Dynamics Code
EPA	Environmental Protection Agency
EPIC	Environmental Policy Integrated Climate
ESRI	Environmental Systems Research Institute
FEST-C	Fertilizer Emission Scenario Tool for CMAQ
FY	Fiscal Year
GEO-CAPE	GEOstationary Coastal and Air Pollution Events
GLOS	Great Lakes Observing System
GoMDOM	Gulf of Mexico Dissolved Oxygen Model
HAB	Harmful Algal Bloom
HHRA	Human Health Risk Assessment
INC	Integrated Nitrogen Committee
IOAA	Immediate Office of the Assistant Administrator
IPCC	Intergovernmental Panel on Climate Change
ISA	Integrated Science Assessment
LTAR	Long-Term Agro-Ecosystem Research
MERIS	MEdium Resolution Imaging Spectrometer
N	Nitrogen
N-STEPS	Nutrient Scientific Technical Exchange Partnership and Support
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NARS	National Aquatic Resource Surveys
NCLD	National Critical Loads Database
NCOM	Navy Coastal Ocean Model
NEWS	Nutrient Export from Watersheds
NGO	Nongovernmental Organization
NH_3	Ammonia

NH_4^+	Ammonium
NH_x	NH_3, NH_4^+
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrogen oxides (NO + NO_2)
NO_y	Total reactive oxidized nitrogen
NPS	National Park Service
NRC	National Research Council
Nr	Reactive nitrogen
NWQMC	National Water Quality Monitoring Council
OAR	Office of Air and Radiation
OECA	Office of Enforcement and Compliance Assurance
OGWDW	Office of Ground Water and Drinking Water
OP	Office of Policy
ORD	Office of Research and Development
ORISE	Oak Ridge Institute for Science and Education
OSA	Office of the Science Advisor
OST	Office of Science and Technology
OSTP	Office of Science and Technology Policy
OW	Office of Water
P	Phosphorus
PACE	Pre-Aerosol, Clouds, and Ocean Ecosystem
PAH	Polycyclic Aromatic Hydrocarbon
PIHM	Pennsylvania Integrated Hydrologic Model
PM	Particulate Matter
RAP	Research Action Plan
RFA	Request for Application
S	Sulfur
SAB INC	Science Advisory Board Integrated Nitrogen Committee
SAB	Science Advisory Board
SAC	Scientific Advisory Committee
SDWA	Safe Drinking Water Act
SESYNC	National Socio-Environmental Synthesis Center
SHC	Safe and Healthy Communities
SOx	Sulfur oxides
SSWR	Safe and Sustainable Water Resources
STICS	Scientific and Technical information Clearance System
StRAP	Strategic Research Action Plan
STPC	Science and Technology Policy Council
SWAT	Soil and Water Assessment Tool
TDEP	Total Deposition
TMDL	Total Maximum Daily Load
USF	University of South Florida
USFS	U.S. Forest Service
USDA	U.S. Department of Agriculture
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey

WASP	Water Quality Analysis Simulation Program
WEF	Water Environment Federation
WQAT	Water Quality Assessment Tool
WQT	Water Quality Trading
WRF	Weather Research and Forecasting Model
WWTP	Wastewater Treatment Plant

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Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
High Profile Publications			
ACE 082	Peer Reviewed	Loughlin, D., K. Kaufman, C. Lenox, and B. Hubbell. Analysis of alternative pathways for achieving NOx emission reductions. JOURNAL OF AIR AND WASTE MANAGEMENT. Air & Waste Management Association, Pittsburgh, PA, USA, 69(9): 1083-1093, (2015).	ORD
ACE AIMS-2.2	Peer Reviewed	Cooter, E., J. Compton, and R. Dennis. MONTHLY DISSOLVED INORGANIC NITROGEN EXPORT FROM THE MISSISSIPPI RIVER BASIN: A NEW, LOOSELY COUPLED MULTIMEDIA MODEL. JOURNAL OF ENVIRONMENTAL QUALITY. American Society of Agronomy, MADISON, WI, USA.	ORD
HHRA223	Peer Reviewed	Stingone, J., T. Luben, S. Carmichael, A. Aylsworth, L. Botto, A. Correa, S. Gilboa, P. Langlois, W. Nembhard, J. Richmond-Bryant, G. Shaw, and A. Olshan. Maternal exposure to nitrogen dioxide, intake of methyl nutrients and congenital heart defects in offspring. AMERICAN JOURNAL OF EPIDEMIOLOGY. Johns Hopkins Bloomberg School of Public Health.	ORD
HHRA211	Integrated Science Assessment	U.S. EPA. Integrated Science Assessment for Oxides of Nitrogen - Health Criteria (Second External Review Draft). U.S. Environmental Protection Agency, Washington, DC, USA, 2015.	ORD
HHRA213	Integrated Science Assessment	U.S. EPA. Preamble to the Integrated Science Assessments. U.S. Environmental Protection Agency, Washington, DC, USA, 2016.	ORD
SSWR 2.3C	Peer Reviewed	Hilborn, E., and R. Ward. The Risk of Cyanobacterial Toxins in Dialysate, What do we Know?. Seminars in Dialysis. Wiley-Blackwell Publishing, Hoboken, NJ, USA, 29(1): 15-18, (2016).	ORD
SSWR 2.3D; SHC 3.3.1.1	Report	Compton, J., R. Bruins, C. Clark, N. Dubrovsky, R. Knighton, R. Parry, M. Ribaudo, M. Rozum, and M. Walbridge. Joint Agency Opportunities in the Science and Management of Nitrogen and Co-Pollutants. U.S. Environmental Protection Agency, Washington, DC, USA.	ORD
SSWR 2.3E	Manual	Mayer, P., and J. Compton. Nutrients in Riparian Ecosystems.	ORD
SSWR 5.2C	Internal Report	Latham, M., T. Speth, D. Lytle, and N. Dugan. City of Toledo Drinking Water Ban due to CyanoHAB and Associated Toxins: Action Taken by U.S. EPA's Office of Research and Development Laboratories in Cincinnati. US EPA Office of Research and Development, Washington, DC, USA.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 6.5A	Report	Wainger, L., G. Van Houtven, B. Rashleigh, N. Detenbeck, J. Messer, S. Jordan, and A. Rea. Ecosystem Services Approaches to Restoring a Sustainable Chesapeake Bay and its Tributary Watersheds. US EPA Office of Research and Development, Washington, DC, USA, 2015.	ORD
SSWR4.02C	Peer Reviewed	Gross, C., and J. Hagy. Attributes of Successful Actions to Restore Lakes and Estuaries Degraded by Nutrient Pollution. JOURNAL OF ENVIRONMENTAL MANAGEMENT. Elsevier Science Ltd, New York, NY, USA.	ORD
Peer Reviewed Publications			
ACE 105	Peer Reviewed	Li, Y., B. Schichtel, J. Walker, D. Schwede, X. Chen, C. Lehmann, M. Puchalski, D. Gay, and J. Collett. The Increasing Importance of Deposition of Reduced Nitrogen in the United States. Nature Geoscience. Nature Publishing Group, London, UK.	ORD
ACE 105	Peer Reviewed	Schichtel, B., and J. Walker. Reactive Nitrogen Monitoring Gaps: Issues, Activities and Needs. ENVIRONMENTAL MANAGEMENT. Springer-Verlag, New York, NY, USA.	ORD
ACE 142	Peer Reviewed	Bash, J., J.T. Walker, M.W. Shepard, K.E. Cady-Pereira,, D.K. Henze, D. Schwede, L. Zhu, and E. Cooter. Modeling reactive nitrogen in North America: recent developments, observational needs and future directions. ENVIRONMENTAL MANAGER. Air & Waste Management Association, Pittsburgh, PA, USA, 36-42, (2015).	ORD
ACE 145	Peer Reviewed	Phelan, J., S. Belyazid, C. Clark, P. Jones, and J. Cajka. Assessing the Effects of Climate Change and Air Pollution on Soil Properties and Plant Diversity in Sugar Maple-Beech-Yellow Birch Hardwood Forests in the Northeastern United States: Model Simulations from 1900-2100.	ORD
ACE 145	Peer Reviewed	Belyazid, S., J. Phelan, and C. Clark. Assessing the Effect of Climate Change and Air Pollution on Biogeochemistry and Plant Diversity in Northeastern U.S. hardwood forests: Step 1 Model Setup and Evaluation.	ORD
ACE 158	Peer Reviewed	Miller, D., S. Snow, M. Schladweiler, J. Richards, A. Ghio, A. Ledbetter, and U. Kodavanti. Acute Ozone-Induced Pulmonary and Systemic Metabolic Effects are Diminished in Adrenalectomized Rats. TOXICOLOGICAL SCIENCES. Society of Toxicology, 150(2): 312-22, (2016).	ORD
ACE 167	Peer Reviewed	Hogrefe, C. Introduction to the EM Special Issue on Reactive Nitrogen. EM Magazine. Air and Waste Management Association, Pittsburgh, PA, USA.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
ACE 175	Peer Reviewed	Sutton, M.A., S. Reis, S.N. Riddick, U. Dragosits, E. Nemitz, M.R. Theobald, Y.S. Tang, C.F. Braban, M. Vieno, A.J. Dore, R.F. Mitdhell, S. Wanless, F. Daunt, D. Fowler, T.D. Blackall, C. Milford, C.R. Flechard, B. Loubet, R. Massad, P. Cellier, E. Personne, P.F. Coheur, L. Clarisse, M. van Damme, Y. Ngadi, C. Clebaux, C.A. Skjoth, C. Geels, O. Hertel, R.J. Wickink Kruit, R. Pinder, J. Bash, J. Walker, D. Simpson, L. Horvath, T.H. Misselbrook, A. Bleeker, F. Dentener, and W. de Vries. Towards a climate-dependent paradigm of ammonia emission and deposition. PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY OF LONDON. Royal Society, London, UK, 368(1621): 01666, (2013).	ORD
ACE 035	Peer Reviewed	Farraj, A., F. Malik, N. Coates, L. Walsh, D. Winsett, D. Terrell, L. Thompson, W. Cascio, and M. Hazari. Morning NO2 Exposure Sensitizes Hypertensive Rats to the Cardiovascular Effects of Same Day O3 Exposure in the Afternoon. INHALATION TOXICOLOGY. Informa Healthcare USA, New York, NY, USA, 28(4): 170-179, (2016).	ORD
ACE 045	Peer Reviewed	Mirowsky, J., L. Dailey, and R. Devlin. Differential Expression of pro-inflammatory and oxidative stress mediators induced by nitrogen dioxide and ozone in primary human bronchial epithelial cells. INHALATION TOXICOLOGY. Taylor & Francis, Inc., Philadelphia, PA, USA, 28(8): 374-82, (2016).	ORD
ACE 158	Peer Reviewed	Kodavanti, U. Stretching the Stress Boundary: Linking Air Pollution Health Effects to a Neurohormonal Stress Response. Biochimica et Biophysica Acta. Elsevier Science Ltd, New York, NY, USA.	ORD
ACE 245	Peer Reviewed	Shephard,, M.W., C. McLinden, K.E. Cady-Pereira, M. Luo, S.G. Moussa, A. Leithead, J. Liggio, R.M. Staebler, A. Akingunola, P. Makar, P. Lehr, J. Zhang, D.K. Henze, D.B. Millet, J. Bash, L. Zhu, K.C. Wells, S.L. Capps, S. Chaliyakunnel, M. Gordon, K. Hayden, J.R. Brook, M. Wolde, and S. Li. Tropospheric Emission Spectrometer (TES) satellite observations of ammonia, methanol, formic acid, and carbon monoxide over the Canadian oil sands: validation and model evaluation. Atmospheric Measurement Techniques. Copernicus Publications, Katlenburg-Lindau, GERMANY, 8: 5189-5211, (2015).	ORD
ACE 245	Peer Reviewed	Zhu, L., D. Henze, J. Bash, K. Cady-Pereia, M. Shephard, M. Luo, and S. Capps. Sources and Impacts of Atmospheric NH3: Current Understanding and Frontiers for Modeling, Measurements, and Remote Sensing in North America. Current Pollution Reports. Springer, New York, NY, USA, 1(2): 95-116, (2015).	ORD
ACE 245	Peer Reviewed	Zhu, L., D. Henze, J. Bash, G. Jeong, K. Cady-Pereira, M. Shephard, M. Luo, F. Poulot, and S. Capps. Global evaluation of ammonia bidirectional exchange and livestock diurnal variation schemes. Atmospheric Chemistry and Physics. Copernicus Publications, Katlenburg-Lindau, GERMANY, 15: 12823-12843, (2015).	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
ACE P1	Peer Reviewed	Deemer, B., J. Harrison, S. Li, J. Beaulieu, T. DelSontro, J.A. Vonk, N. Barros, M. dos Santos, S. Powers, and J.F.B. Neto. Eutrophication Increases the Potency of Reservoir Greenhouse Gas Emissions - journal article. Nature Geoscience. Nature Publishing Group, London, UK.	ORD
ACE PEP-3.1	Peer Reviewed	Geron, C., R. Daly, P. Harley, R. Rasmussen, R. Seco, A. Guenther, T. Karl, and L. Gu. Large Drought-Induced Variations in Oak Leaf Volatile Organic Compound Emissions during PINOT NOIR 2012. CHEMOSPHERE. Elsevier Science Ltd, New York, NY, USA, 146: 8-21, (2016).	ORD
HHRA 2.2131	Peer Reviewed	Irvine, I., T. Greaver, J. Phelan, R. Sabo, and G. Van Houtven. Effects of terrestrial acidification on Final Ecosystem Goods and Services: Reducing air pollution may protect snowshoe hares, baseball, and Christmas. Ecosphere. ESA Journals.	ORD
HHRA 2.2131	Peer Reviewed	Richmond-Bryant, J., C. Owen, S. Graham, M. Snyder, S. McDow, M. Oakes, and S. Kimbrough. Estimation of on-road NO2 concentrations, NO2/NOx ratios, and related roadway gradients from near-road monitoring data. ATMOSPHERIC ENVIRONMENT. Elsevier Science Ltd, New York, NY, USA.	ORD
HHRA214	Peer Reviewed	Greaver, T., C. Clark, J. Compton, D. Vallano, L. Band, J. Baron, E. Davidson, L. Liu, J. Lynch, C. Goodale, R. Haeuber, C. Tague, C. Weaver, J. Herrick, and E. Felker-Quinn. Climate change effects on ecosystem response to nitrogen loading. Nature Climate Change. Nature Publishing Group, New York, NY, USA.	ORD
HHRA333	Peer Reviewed	McEwen, A., H. Hsu-Kim, N. Robins, N. Hagan, S. Halabi, O. Barras, D. Richter, and J. Vandenberg. Residential metal contamination and potential health risks of exposure in adobe brick houses in Potosi, Bolivia. SCIENCE OF THE TOTAL ENVIRONMENT. Elsevier BV, AMSTERDAM, NETHERLANDS, 562: 237-246, (2016).	ORD
N/A - Not Applicable	Peer Reviewed	Nowlan, c., X. Lu, J. Leitch, K. Chance, G. Bonzales Abad, C. Lu, P. Zoogman, J. Cole, T. Delker, W. Good, F. Murcray, L. Ruppert, D. Soo, M. Follette-Cook, S. Janz, M. Kowalewski, C. Loughner, K. Pickering, J. Herman, M. Beaver, R. Long, J. Szykman, L. Judd, P. Kelley, W. Luke, X. Ren, and J. Al-Saadi. Nitrogen Dioxide Observations from the Geostationary Trace Gas and Aerosol Sensor Optimization (GeoTASO) Airborne Instrument: Retrieval Algorithm and Measurements During DISCOVER-AQ Texas 2013. Atmospheric Measurement Techniques. Copernicus Publications, Katlenburg-Lindau, GERMANY.	ORD
N/A - Not Applicable	Peer Reviewed	Clark, C., M. Bell, C. Davis, J. Compton, T. Blett, E. Davidson, M. Fenn, L. Geiser, and L. Jones. Nitrogen-induced terrestrial eutrophication: Cascading effects and impacts on ecosystem services.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
N/A - Not Applicable	Peer Reviewed	Sabo, R., S. Scanga, G. Lawrence, D. Nelson, K. Eschelman, G. Zabala, A. Alinea, and C. Schimer. Watershed-scale changes in terrestrial N cycling during a period of reduced acid deposition.	ORD
N/A - Not Applicable	Peer Reviewed	Grizzle, R., K. Ward, C. Peter, M. Cantwell, D. Katz, and J. Sullivan. Growth, morphometrics and nutrient content of farmed eastern oysters, Crassostrea virginica (Gmelin), in New Hampshire, USA (5/11/16 STILL EARLY VIEW ONLINE AS OF 2/10/16, NOT YET INCLUDED IN AN ISSUE). Aquaculture Research. John Wiley & Sons, Inc., Hoboken, NJ, USA.	ORD
N/A - Not Applicable	Peer Reviewed	LeDuc, S., X. Zhang, C. Clark, and C. Izaurralde. Cellulosic feedstock production on Conservation Reserve Program land: potential yields and environmental effects.	ORD
N/A - Not Applicable	Peer Reviewed	Yu, L., K. Fennel, A. Laurent, M. Murrell, and J. Lehrter. Numerical analysis of the primary processes controlling oxygen dynamics on the Louisiana shelf. Biogeosciences. Copernicus Publications, Katlenburg-Lindau, GERMANY, 12: 2063-2076, (2015).	ORD
N/A - Not Applicable	Peer Reviewed	Ball, B., Y. Carrillo, and M. Molina. The influence of litter composition across the litter:soil interface on mass loss, nitrogen dynamics and the decomposer community. SOIL BIOLOGY AND BIOCHEMISTRY. Elsevier Science Ltd, New York, NY, USA, 69: 71-82, (2014).	ORD
N/A - Not Applicable	Peer Reviewed	Meyers, L., A. Nahlik, and E.S. DeKeyser. Relationship between the natural abundance of soil nitrogen isotopes and condition in North Dakota wetlands. ECOLOGICAL INDICATORS. Elsevier Science Ltd, New York, NY, USA, 60: 394-401, (2016).	ORD
N/A - Not Applicable	Peer Reviewed	Munns, Jr., W.R., and A.W. Rea. Ecosystem Services: Value Is in the Eye of the Beholder. Integrated Environmental Assessment and Management. Allen Press, Inc., Lawrence, KS, USA, 11(2): 332-333, (2015).	ORD
N/A - Not Applicable	Peer Reviewed	Hellwinckel, C., C. Clark, M. Langholtz, L. Eaton, and P. Morefield. Impact of the Renewable Fuels Standard on U.S. Conservation Reserve Program Enrollment and Conversion. GCB Bioenergy. John Wiley & Sons, Inc., Hoboken, NJ, USA, 8(1): 245-256, (2016).	ORD
N/A - Not Applicable	Peer Reviewed	Grear, J. Translating biological responses from pCO2 beaker experiments into ecological predictions (5/25/16 UNDER REVIEW WITH POPULATION ECOLOGY). Population Ecology. Springer International Publishing AG, Cham (ZG), SWITZERLAND.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
N/A - Not Applicable	Peer Reviewed	Perakis, S., A. Tepley, and J. Compton. Disturbance and topography shape nitrogen availability and delta 15N over long-term forest succession. ECOSYSTEMS. Springer, New York, NY, USA, 16, (2015).	ORD
SHC	Peer Reviewed	Lane, C., B. Autrey, T. Jicha, L. Lehto, C. Elonen, and L. Seifert-Monson. Denitrification potential in geographically isolated wetlands of North Carolina and Florida, USA. WETLANDS. The Society of Wetland Scientists, McLean, VA, USA, 35(1): 459-471, (2015).	ORD
SHC 1.62.1	Peer Reviewed	Wu, J., and L. Jackson. Association of land use and its change with beach closure in the United States, 2004-2013. ENVIRONMENTAL INTERNATIONAL. Pergamon Press Ltd., New York, NY, USA.	ORD
SHC 2.1.2.5	Peer Reviewed	Gabriel, M., C. Knightes, E. Cooter, and R. Dennis. Evaluating relative sensitivity of SWAT-simulated nitrogen discharge to projected climate and land cover changes for two watersheds in North Carolina, USA. Hydrological Processes. John Wiley & Sons, Ltd., Indianapolis, IN, USA, online, (2015).	ORD
SHC 2.1.2.5	Peer Reviewed	Gabriel, M., C. Knightes, E. Cooter, and R. Dennis. The Impacts of Different Meteorology Data Sets on Nitrogen Fate and Transport in the SWAT Watershed Model. ENVIRONMENTAL MODELING AND ASSESSMENT. Baltzer Science Publishers BV, Bussum, NETHERLANDS, 19(4): 301-314, (2014).	ORD
SHC 3.1.1.2	Peer Reviewed	Weber, J., K. Goyne, T. Luxton, and A. Thompson. Phosphate treatment of lead contaminated soil: effects on water quality, plant uptake and lead speciation. Elizabeth Guertal, E. Charles Brummer, and Andrew Sharpley. JOURNAL OF ENVIRONMENTAL QUALITY. American Society of Agronomy, MADISON, WI, USA, 44(4): 1127-1136, (2015).	ORD
SHC 3.3.1.10	Peer Reviewed	Jorgensen, E. Nitrogen Sustainability; Impediments to Action and Communication. Journal of Environmental Sustainability. Rochester Institute of Technology (RIT) Scholarship Publishing Studio, Rochester, NY, USA.	ORD
SHC 3.3.1.3	Peer Reviewed	Pardo, L., T. Blett, C. Clark, and L. Geiser. Impacts of nitrogen pollution on terrestrial ecosystems in the US.	ORD
SHC 3.3.1.3	Peer Reviewed	Simkin, S., C. Clark, W. Bowman, E. Allen, J. Belnap, and L. Pardo. Conditional vulnerability of plant diversity to atmospheric nitrogen deposition across the United States. PNAS (PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES). National Academy of Sciences, WASHINGTON, DC, USA, 113(15): 4086-4091, (2016).	ORD
SHC 3.3.1.5	Peer Reviewed	Yuan, Y., and L. Chiang. Sensitivity Analysis of SWAT Nitrogen Simulations with and without In-Stream Processes. AGRONOMY JOURNAL. American Society of Agronomy, MADISON, WI, USA, 61(7): 969-987, (2015).	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SHC 4.61.1	Peer Reviewed	Stevens, C., C. Clark, S. Simkin, W. Bowman, E. Allen, and M. Brooks. Increases in invasive plant species under atmospheric nitrogen deposition.	ORD
SSWR 1.1A	Peer Reviewed	Omernik, J., S. Paulsen, M. Weber, and G. Griffith. Regional patterns of total nitrogen concentrations in the National Rivers and Streams Assessment. JOURNAL OF SOIL AND WATER CONSERVATION. Soil and Water Conservation Society, 71(3): 167-181, (2016).	ORD
SSWR 1.1B	Peer Reviewed	Scown, M., M. McManus, J. Carson, and C. Nietch. Improving predictive models of in-stream phosphorus based on nationally-available spatial data coverages in a Southwestern Ohio watershed. PLoS ONE. Public Library of Science, San Francisco, CA, USA.	ORD
SSWR 1.1B; SSWR 2.3A	Peer Reviewed	Smucker, N.J., A. Kuhn, M.A. Charpentier, C.J. Cruz-Quinones, C.M. Elonen, S.B. Whorley, T.M. Jicha, J.R. Serbst, B.H. Hill, J.D. Wehr, and J. Lake. Quantifying Urban Watershed Stressor Gradients and Evaluating How Different Land Cover Datasets Affect Stream Management. ENVIRONMENTAL MANAGEMENT. Springer-Verlag, New York, NY, USA, 57(3): 683-695, (2016).	ORD
SSWR 1.1D	Peer Reviewed	Moorhead, D., R. Sinsabaugh, B. Hill, and M. Weintraub. Vector analysis of ecoenzyme activities reveal constraints on coupled C, N and P dynamics. SOIL BIOLOGY AND BIOCHEMISTRY. Elsevier Science Ltd, New York, NY, USA, 93: 1-7, (2016).	ORD
SSWR 1.2C	Peer Reviewed	Golden, H., C. Lane, A. Prues, and E. D'Amico. Multiple Landscape and Riparian Factors Influence Aquatic Nutrients and Biological Condition in a Mixed Land Cover Watershed. JAWRA. American Water Resources Association, Middleburg, VA, USA.	ORD
SSWR 2.3A	Peer Reviewed	Shafer, D., T. Swannack, C. Saltus, J. Kaldy, and A. Davis. Development and validation of a habitat suitability model for the non-indigenous seagrass Zostera japonica in North America OF THE INTRODUCED SEAGRASS ZOSTERA JAPONICA. Management of Biological Invasions. Regional Euro-Asian Biological Invasions Centre, Helsinki, FINLAND, 7(2): 141-155, (2016).	ORD
SSWR 2.3A; SSWR 4.2B	Peer Reviewed	Parr, T., N. Smucker, C. Bentsen, and M. Neale. Potential roles of past, present, and future urbanization characteristics in producing varied stream responses. Freshwater Science. The Society for Freshwater Science, Springfield, IL, 35(1): 436-443, (2016).	ORD
SSWR 2.3A; SSWR 4.2B	Peer Reviewed	Hale, R., M. Scoggins, N. Smucker, and A. Suchy. Effects of climate on the expression of the urban stream syndrome. Freshwater Science. The Society for Freshwater Science, Springfield, IL, 35(1): 421-428, (2016).	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 2.3C	Peer Reviewed	Loftin, K., J. Graham, E. Hilborn, S. Lehmann, M. Meyer, J. Dietze, and C. Griffith. Cyanotoxins in Inland Lakes of the United States: Occurrence and Potential Recreational Health Risks in the EPA National Lakes Assessment 2007. Harmful Algae. Elsevier B.V., Amsterdam, NETHERLANDS.	ORD
SSWR 2.3C	Peer Reviewed	Hollister, J., B. Milstead, and B. Kreakie. Modeling lake trophic state: a random forest approach. Ecosphere. ESA Journals, 7(3): e01321, (2016).	ORD
SSWR 2.3E	Peer Reviewed	Newcomer-Johnson, T., S. Kaushal, P. Mayer, R. Smith, and G. Sivirichi. Nutrient Retention in Restored Streams and Floodplains: A Review and Synthesis. WATER. MDPI AG, Basel, SWITZERLAND, 8(4): 116, (2016).	ORD
SSWR 2.3E	Peer Reviewed	Pennino, M., S. Kaushal, P. Mayer, R. Utz, and C. Cooper. Stream restoration and sanitary infrastructure alter sources and fluxes of water, carbon, and nutrients in urban watersheds. HYDROLOGY AND EARTH SYSTEM SCIENCES. EGS, 12: 13149-13196, (2015).	ORD
SSWR 2.3E	Peer Reviewed	Kaushal, S., W. McDowell, W. Wollheim, T. Newcomer Johnson, P. Mayer, K. Belt, and M. Pennino. Urban Evolution: the Role of Water. WATER. MDPI AG, Basel, SWITZERLAND, 7: 4063-4087, (2015).	ORD
SSWR 2.3E	Peer Reviewed	Yang, G., and E. Best. Spatial optimization of watershed management practices for nitrogen load reduction using a modeling-optimization framework. JOURNAL OF ENVIRONMENTAL MANAGEMENT. Elsevier Science Ltd, New York, NY, USA, 161: 252-260, (2015).	ORD
SSWR 4.2A	Peer Reviewed	Brown, R., and M. Borst. Nutrient Infiltrate Concentrations from Three Permeable Pavement Types. JOURNAL OF ENVIRONMENTAL MANAGEMENT. Elsevier Science Ltd, New York, NY, USA, 164: 74-85, (2015).	ORD
SSWR 5.1A	Peer Reviewed	Wood, A., T. Hawkins, X. Xue, N. Ashbolt, J. Garland, and M. Blackhurst. Cost-Effectiveness of Nitrogen Mitigation by Alternative Household Wastewater Management Technologies. JOURNAL OF ENVIRONMENTAL MANAGEMENT. Elsevier Science Ltd, New York, NY, USA, 150(3): 344-354, (2014).	ORD
SSWR 5.1B	Peer Reviewed	Nadagouda, M., C. Han, D. Dionysiou, and L. Wang. An innovative zinc oxide-coated zeolite adsorbent for removal of humic acid. JOURNAL OF HAZARDOUS MATERIALS. Elsevier Science Ltd, New York, NY, USA, 313: 283-290, (2016).	ORD
SSWR 5.1B	Peer Reviewed	Nadagouda, M., J. Lalley, and C. Han. Titanium Dioxide-Based Antibacterial Surfaces for Drinking Water Disinfection - journal article. Current Opinion in Chemical Engineering. Elsevier BV, AMSTERDAM, NETHERLANDS.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 5.1B	Peer Reviewed	Nadagouda, M., T. Speth, J. Garland, C. Han, and J. Lalley. Enhanced Removal of Phosphate Using Calcium and Magnesium-Modified Ferrites - journal article. RSC Advances. RSC Publishing, Cambridge, UK.	ORD
SSWR 5.2E	Peer Reviewed	Kapoor, V., M. Elk, and X. Li. Inhibitory effect of cyanide on wastewater nitrification determined using SOUR and RNA-based gene-specific assays - journal article. ENVIRONMENTAL SCIENCE & TECHNOLOGY. American Chemical Society, Washington, DC, USA.	ORD
SSWR 5.2E	Peer Reviewed	Kapoor, V., M. Elk, X. Li, C. Impellitteri, and J. Santodomingo. Effects of Cr(III) and CR(VI) on nitrification inhibition as determined by SOUR, function-specific gene expression and 16S rRNA sequence analysis of wastewater nitrifying enrichments. CHEMOSPHERE. Elsevier Science Ltd, New York, NY, USA, 147: 361-367, (2016).	ORD
SSWR 5.2E	Peer Reviewed	Kapoor, V., X. Li, M. Elk, K. Chandran, C. Impellitteri, and J. Santodomingo. Transcriptional and physiological responses of nitrifying bacteria to heavy metal inhibition. ENVIRONMENTAL SCIENCE & TECHNOLOGY. American Chemical Society, Washington, DC, USA, 49: 13454-13462, (2015).	ORD
SSWR 5.2E	Peer Reviewed	Li, X., V. Kapoor, C. Impellitteri, and K. Chandran. Measuring nitrification inhibition in wastewater treatment systems: current state of science and fundamental research needs. CRITICAL REVIEWS IN ENVIRONMENTAL SCIENCE AND TECHNOLOGY. CRC Press LLC, Boca Raton, FL, USA, 46(3): 249-289, (2016).	ORD
SSWR 5.2E	Peer Reviewed	Kapoor, V., X. Li, K. Chandran, C. Impellitteri, and J. Santodomingo. Effect of copper on nitrification activity as measured by RNA- and DNA-based function-specific assays - journal. APPLIED AND ENVIRONMENTAL MICROBIOLOGY. American Society for Microbiology, Washington, DC, USA.	ORD
SSWR 6.1A	Peer Reviewed	Oczkowski, A., T. Gumbley, B. Carter, R. Carmichael, and A. Humphries. Establishing an Anthropogenic Nitrogen Baseline Using Native American Shell Middens. Frontiers in Marine Science. Frontiers, Lausanne, SWITZERLAND, 79, (2016).	ORD
SSWR 6.1A	Peer Reviewed	Oczkowski, A., C. Hunt, K. Miller, C. Oviatt, S. Nixon, and L. Smith. Comparing Measures of Estuarine Ecosystem Production in a Temperate New England Estuary (6/6/16 ONLINE, PENDING FINAL). Estuaries and Coasts. Estuarine Research Federation, Port Republic, MD, USA.	ORD
SSWR 6.1A	Peer Reviewed	Pruell, R., and B. Taplin. Carbon and nitrogen isotope ratios of juvenile winter flounder as indicators of inputs to estuarine systems. MARINE POLLUTION BULLETIN. Elsevier Science Ltd, New York, NY, USA, 101(2): 624-631, (2015).	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 6.1B	Peer Reviewed	Gledhill, D., M. White, J. Salisbury, H. Thomas, I. Mlsna, M. Liebman, B. Mook, J. Grear, A. Candelmo, R.C. Chambers, C. Gobler, C. Hunt, A. King, N. Price, S. Signorini, E. Stancioff, C. Stymiest, R. Wahle, J. Waller, N. Rebuck, Z. Wang, T. Capson, J.R. Morrison, S. Cooley, and S. Doney. Ocean and Coastal Acidification off New England and Nova Scotia. OCEANOGRAPHY. Oceanography Society, Rockville, MD, USA, 28(2): 182-197, (2015).	ORD
SSWR 6.1B	Peer Reviewed	Wallace, R., H. Baumann, J. Grear, R. Aller, and C. Gobler. Coastal ocean acidification: The other eutrophication problem. Estuarine Coastal and Shelf Science. Elsevier Science Ltd, New York, NY, USA, 148: 1-13, (2014).	ORD
SSWR 6.1B	Peer Reviewed	Grear, J. Phytoplankton community response to carbon dioxide enrichment in winter incubation experiments (5/25/16 STILL UNDER REVISION).	ORD
SSWR 6.2B	Peer Reviewed	Humphries, A., S. AYVAZIAN, J. CAREY, B. Hancock, S. Grabbert, D. J. COBB, C. J. STROBEL, AND R. Fulweiler. Directly measured denitrification reveals oyster aquaculture and restored oyster reefs remove nitrogen at comparable high rates. Frontiers in Marine Science. Frontiers, Lausanne, Switzerland, 3(74):doi: 10.3389/fmars.2016.00074, (2016).	ORD
SSWR3.01G	Peer Reviewed	Lane, C., and B. Autrey. Sediment Accretion and Accumulation of P, N, and C in Depressional Wetlands in Three Ecoregions of the United States. WETLANDS. The Society of Wetland Scientists, McLean, VA, USA.	ORD
SSWR4.01C	Peer Reviewed	Hollister, J., and B. Kreakie. Associations between Chlorophyll a and various microcystin-LR health advisory concentrations. F1000 Research. Faculty of 1000, London, UK, 5: 151, (2016).	ORD
SSWR4.02B	Peer Reviewed	Keith, D., R. Lunetta, and B. Schaeffer. Optical Models for Remote Sensing of Colored Dissolved Organic Matter Absorption and Salinity in New England, Middle Atlantic and Gulf Coast Estuaries USA. Remote Sensing. MDPI AG, Basel, SWITZERLAND, 8(4): 283, (2016).	ORD
SSWR4.03A	Peer Reviewed	Duan, S., T. Newcomer-Johnson, and S. Kaushal. Phosphorus retention in stormwater control structures and restored streams across streamflow in urban and suburban watersheds. WATER. MDPI AG, Basel, SWITZERLAND.	ORD
SSWR4.03B	Peer Reviewed	Heberling, M., H. Thurston, and C. Nietch. Addressing thin water quality trading markets: A proposal to explore non-traditional participation. Applied Economic Perspectives and Policy. Oxford University Press, Cary, NC, USA.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03D	Peer Reviewed	Liu, T., R. Bruins, and M. Heberling. Factors influencing farmers' adoption of best management practices: A review and synthesis.	ORD
SSWR4.03B	Peer Reviewed	Heberling, M., C. Nietch, H. Thurston, M. Elovitz, K. Birkenhauer, S. Panguluri, B. Ramakrishnan, E. Heiser, T. Neyer. 2015. Comparing Drinking Water Treatment Costs to Source Water Protection Costs Using Time Series Analysis. Water Resources Research 51, 8741–8756, doi:10.1002/2014WR016422.	ORD
SSWR4.03E Nutrient Center USF	Peer Reviewed	Kuwayama, Y., H. Kamen, (in review) What Drives the Reuse of Municipal Wastewater? A County-Level Analysis of Florida. Submitted to Land Economics.	ORD
SSWR4.03E Nutrient Center USF	Peer Reviewed	Lynn, T.J., S. Ergas, M. Nachabe, (in review) Effect of Hydrodynamic Dispersion in Denitrifying Wood-Chip Stormwater Biofilters, Journal of Sustainable Water in the Built Environment – ASCE.	ORD
SSWR4.03E Nutrient Center USF	Peer Reviewed	Lynn, T.J., D. Yeh, S. Ergas, Performance of Denitrifying Stormwater Biofilters Under Intermittent Conditions, Environmental Engineering Science, 32(9): 796-805.	ORD
SSWR4.03E Nutrient Center USF	Peer Reviewed	Wang, R., J. Zimmerman. Economic and Environmental Assessment of Office Building Rainwater Harvesting Systems in Various U.S. Cities. Environmental Science and Technology, 49 (3): 1768-1778.	ORD
SSWR4.03E Nutrient Center USF	Peer Reviewed	Cornejo, P., Qiong Zhang, and J. Mihelcic, J. (2016) How Does Scale of Implementation Impact the Environmental Sustainability of Wastewater Treatment Integrated with Resource Recovery? Environmental Science & Technology 2016 50 (13), 6680-6689	ORD
SSWR4.03E Nutrient Center WERF	Peer Reviewed	Regmi, P., B. Holgate, M. Fredericks, B. Miller, S. Wett, C. Murthy Bott, Optimization of a mainstream nitritation-denitritation process and anammox polishing. Water Science and Technology. (2015).	ORD
SSWR4.03E Nutrient Center WERF	Peer Reviewed	Regmi, P., R. Bunce, M. Miller, H Park, H., K. Chandran, B. Wett., S. Murthy, and C. Bott, Ammonia-based intermittent aeration control optimized for short-cut nitrogen removal. Biotechnology and Bioengineering,	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center WERF	Peer Reviewed	Ziels, R.M., D.A.C. Beck, M. Marti, M., H.L. Gough, H.D. Stensel, B.H. Svensson (2015) Monitoring the dynamics of Syntrophic β-oxidizing bacteria during anaerobic degradation of oleic acid, FEMS Microbiology Ecology, (91), 4, 5-28.	ORD
SSWR4.03E Nutrient Center WERF	Peer Reviewed	Regmi, P., B. Holgate, M. Miller, H. Park, K. Chandran, B. Wett, S Murthy, and C. Bott, (2015). Nitrogen polishing in a fully anoxic anammox MBBR treating mainstream nitritation-denitritation effluent. Biotechnology and Bioengineering.	ORD
SSWR4.03E Nutrient Center PSU	Peer Reviewed	Williams MR, AR Buda, HA Elliott, J Hamlett, EW Boyer, and JP Schmidt. (2014). Groundwater Flow Path Dynamics and Nitrogen Transport Potential in the Riparian Zone of an Agricultural Headwater Catchment. Journal of Hydrology. DOI:10.1016/j.jhydrol.2014.02.033.	ORD
SSWR4.03E Nutrient Center PSU	Peer Reviewed	Leonard, L. and C. Duffy. 2014. Automating Data-Model Workflows at a Level 12 HUC Scale: Watershed Modeling in a Distributed Computing Environment. Environmental Modelling & Software 6:174–90. doi:10.1016/j.envsoft.2014.07.015.	ORD
SSWR4.03E Nutrient Center PSU	Peer Reviewed	Sebestyen SD, J Shanley, EW Boyer, C Kendall, and D Doctor. (2014). Coupled hydrological and biogeochemical processes controlling variability of nitrogen species in streamflow during autumn in an upland forest. Water Resources Research, DOI: 10.1002/2013WR013670.	ORD
SSWR4.03E Nutrient Center PSU	Peer Reviewed	Williams MR, AR Buda, HA Elliott, J Hamlett, EW Boyer, and JP Schmidt. (2014). Groundwater Flow Path Dynamics and Nitrogen Transport Potential in the Riparian Zone of an Agricultural Headwater Catchment. Journal of Hydrology. DOI:10.1016/j.jhydrol.2014.02.033.	ORD
SSWR4.03E Nutrient Center CSU	Peer Reviewed	Weirich, Scott R., JoAnn Silverstein, and Balaji Rajagopalan. "Resilience of secondary wastewater treatment plants: prior performance is predictive of future process failure and recovery time." Environmental Engineering Science 32.3 (2015): 222-231.	ORD
	Peer Reviewed	Pulchalski, M.A., C.M. Rogers, R. Baumgardner, K.P. Mishoe, G. Price, M.J. Smith, N. Watkins, C.M. Lehmann. A statistical comparison of active and passive ammonia measurements collected at Clean Air Status and Trends Network (CASTNET) sites. Environ. Sci. Process Impacts 2015 Feb:17(2):358-69. DOI 10.1039/c4em00531g	OAR

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
	Peer Reviewed	Qingtao Zhou & Charles T. Driscoll & Stephen E. Moore & Matt A. Kulp & James R. Renfro & John S. Schwartz & Meijun Cai & Jason A. Lynch. 2015 Developing Critical Loads of Nitrate and Sulfate Deposition to Watersheds of the Great Smoky Mountains National Park, USA. Water Air Soil Pollut 226:255. DOI 10.1007/s11270-015-2502-7	OAR
	Peer Reviewed	Influence of solid noise barriers on near-road and on-road air quality. Baldauf, R., Isakor, V., Deshmokh, P., Venkatram, A., Yang, B., Max Zhang, K. Atmos. Environ. 129 (2016) 265-276.	OAR
	Peer Reviewed	Modeling the impact of solid noise barriers on near road air quality. Venkatram, A., Isakor, V., Deshmokh, P., and Baldauf, R. Atmos. Environ. 141 (2016) 462-469.	OAR
Book Chapters			
ACE 142	Book Chapter	Bash, J., C. Flechard, R. Massad, M. Sutton, R. Wichink Kruit, S. Gernermont, P. Cellier, L. Horvath, B. Grosz, J. Drouet, M. Adon, and M. Theobald. Modelling the Air-Surface Exchange of Ammonia from the Field to Global Scale. Chapter 5, Review and Integration of Biosphere-Atmosphere Modelling of Reactive Trace Gases and Volatile Aerosols. Springer Netherlands, Dordrecht, NETHERLANDS, 153-161, (2015).	ORD
SSWR 2.3A	Book Chapter	Caffrey, J., and M. Murrell. An historical perspective on eutrophication in the Pensacola Bay Estuary, FL, USA. Aquatic nutrient biogeochemistry and microbial ecology: A dual perspective.	ORD
SSWR 2.3D	Book Chapter	Lehrter, J., and D. Ko. Predicted effects of climate change on the severity of northern Gulf of Mexico hypoxia. Modeling Coastal Hypoxia: Numerical Simulations of Patterns, Controls, and Effects of Dissolved Oxygen Dynamics. Springer, New York, NY, USA.	ORD
SSWR 5.1B	Book Chapter	Nadagouda, M., C. Han, E. Sahle-Demessie, D. Dionysiou, A. Shah, S. Nawaz, L. Rahman, N.B. McGuinness, S.C. Pillai, and D.C. H. Catalysis for Environmental Applications - book chapter. Catalysis for Environmental Applications.	ORD
Reports (External, Internal, Unpublished)			
ACE 143	Report	Williams, R., A. Kaufman, T. Hanley, J. Rice, and S. Garvey. Evaluation of Elm and Speck Sensors. U.S. Environmental Protection Agency, Washington, DC, USA, 2015.	ORD
ACE 146	Unpublished Report	Beaver, M., K.G. Kronmiller, and R. Long. Data intercomparison of Cavity Attenuated Phase Shift (CAPS), Cavity Ring-Down Spectroscopy (CRDS), and FRM systems.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
ACE 213	Internal Report	Takkellapati, S., D. Ferguson, S. Cosper, and D. Waage. ACE 213 Rotary Kiln Gasification of Solid Wastes. U.S. Environmental Protection Agency, Washington, DC, USA.	ORD
N/A - Not Applicable	Report	Williams, R., T. Barzyk, and A. Kaufman. Citizen Science Air Monitor (CSAM) Operating Procedures. U.S. Environmental Protection Agency, Washington, DC, USA, 2015.	ORD
N/A - Not Applicable	Internal Report	Kuhn, A., G. Thursby, J. LiVolsi, T. Jicha, C. Elonen, L. Coiro, D. Borsay, and J. Bishop. Surface Water Monitoring Results for Newport RI Drinking Water Reservoirs. U.S. Environmental Protection Agency, Washington, DC, USA.	ORD
SHC 2.61.4	Report	Jewhurst, S., and M. Mazzotta. Economic Tools for Managing Nitrogen in Coastal Watersheds. U.S. Environmental Protection Agency, Washington, DC, USA, 2016.	ORD
SHC 3.3.1.1	Report	Detenbeck, N., and S. Rego. Predictive Seagrass Habitat Model. U.S. Environmental Protection Agency, Washington, DC, USA, 2015.	ORD
SSWR 2.3A	Report	Hagy, J. Science Supporting Numeric Nutrient Criteria for Lakes and Their Watersheds: A Synopsis of Research Completed for the US Environmental Protection Agency. U.S. Environmental Protection Agency, Washington, DC, USA, 2016.	ORD
SSWR 2.3D; SHC 3.3.1.1	Report	Compton, J., R. Bruins, C. Clark, N. Dubrovsky, R. Knighton, R. Parry, M. Ribaudo, M. Rozum, and M. Walbridge. Joint Agency Opportunities in the Science and Management of Nitrogen and Co-Pollutants. U.S. Environmental Protection Agency, Washington, DC, USA.	ORD
SSWR 6.1A	Internal Report	Chintala, M., S. Ayvazian, W. Boothman, G. Cicchetti, L. Coiro, J. Copeland, J. Grear, S. Hale, J. King, A. Kuhn, J. Nye, M. Pelletier, R. Pruell, B. Rashleigh, S. Robinson, K. Rocha, S. Southworth, B. Taplin, H. Walker, and E. Watson. Trend analysis of stressors and ecological responses, particularly nutrients, in the Narragansett Bay Watershed. U.S. Environmental Protection Agency, Washington, DC, USA.	ORD
SSWR 6.1B	Report	Rashleigh, B., H. Walker, T. Gleason, M. Abdelrhman, L. Charlestra, E. Dettmann, P. Pelletier, S. Hale, G. Thursby, N. Detenbeck, D. Keith, S. Rego, S. Robinson, J. Grear, S. Ayvazian, and M. Mazzotta. Quantitative Models Describing Past and Current Nutrient Fluxes and Associated Ecosystem Level Responses in the Narragansett Bay Ecosystem. U.S. Environmental Protection Agency, Washington, DC, USA, 2015.	ORD
SSWR 6.1B	Internal Report	Dettmann, E., and L. Charlestra. Calibration of the USEPA's Water Quality Analysis Simulation Program (WASP) for use in Narragansett Bay: Status Report. U.S. Environmental Protection Agency, Washington, DC, USA.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
Miscellaneous Products			
ACE 017	Paper in Non-EPA Proceedings	Loughlin, D., K. Kaufman, and A. Macpherson. Marginal abatement cost curve for NOx incorporating controls, renewable electricity, energy efficiency and fuel switching. In Proceedings, A&WMA 2015 Annual Conference & Exhibition, Raleigh, NC, USA, 06/22/2015 - 06/25/2015. US Environmental Protection Agency, Cincinnati, OH, USA, (2015).	ORD
ACE 146	Technical Fact Sheet	Beaver, M. Data Intercomparison of Cavity Attenuated Phase Shift (CAPS), Cavity Ring-Down Spectroscopy (CRDS), and FRM Systems (ACE 146). US EPA Office of Research and Development, Washington, DC, USA, 2013.	ORD
ACE 064	Summary	Walker, J. Improved methods for quantifying nitrogen, sulfur, and ozone concentrations and air-surface exchange fluxes. U.S. Environmental Protection Agency, Washington, DC, USA.	ORD
ACE 221	Paper in Non-EPA Proceedings	Kosusko, M., P. Bhave, A. Zubrow, Y. Hsu, J. Dorn, and F. Divita. EPA's SPECIATE 4.4 Database - Development and Uses. In Proceedings, Air & Waste Management Association 2015 Annual Conference and Exhibition, Raleigh, NC, USA, 06/21/2015 - 06/25/2015.	ORD
N/A - Not Applicable	Newsletter Article	U.S. EPA. Commuting Decathlon. In: It All Starts with Science, U.S. Environmental Protection Agency, Washington, DC, USA, n/a, (2015).	ORD
N/A - Not Applicable	Paper in Non-EPA Proceedings	Kosusko, M., S. Chilingaryan, P. Green, M. Cohen, and F. Mitloehner. Mechanisms for Nitrogen Oxide Formation during Ensiling of Dairy Feeds. In Proceedings, Air & Waste Management Association 2015 Annual Conference and Exhibition, Raleigh, NC, USA, 06/21/2015 - 06/25/2015. US Environmental Protection Agency, Cincinnati, OH, USA, 2015.	ORD
SHC 1.2.1.2	Technical Fact Sheet	Dennis, R. New national CMAQ multi-pollutant scenarios based on new transport rule and new ozone standards. US EPA Office of Research and Development, Washington, DC, USA, 2013.	ORD
SHC 3.3.1.1	Dataset	Detenbeck, N. Nitrogen Source and Loading Data for EPA Estuary Data Mapper. U.S. Environmental Protection Agency, Washington, DC, USA, 2014.	ORD
SHC 3.3.1.10	Dataset	Copeland, M., and K. Forshay. Yakima Data Report: 2013 - present. U.S. Environmental Protection Agency, Washington, DC, USA, 2015.	ORD
SHC 3.3.1.2	Extramural Document	Compton, J. Status of the World's Soil Resources Report, Intergovernmental Technical Panel on Soils. Food and Agriculture Organization of the United Nations (FAO), Rome, ITALY, 2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SHC 3.3.1.2	Extramural Document	Leach, A., A. Majidi, J. Galloway, and A. Greene. How to Calculate Your Institution's Nitrogen Footprint. University of Virginia, Charlottesville, VA, USA, 2015.	ORD
SHC 3.3.1.2	Non-Peer Reviewed	Compton, J., D. Landers, and D. Sobota. Connecting nitrogen deposition and Final Ecosystem Goods and Services for air quality standards review. EM Magazine. Air and Waste Management Association, Pittsburgh, PA, USA, July 21-27, (2015).	ORD
SSWR 1.1B	Newsletter Article	Latimer, J., and C. Tilburg. ESIP and EPA team up to develop watershed-estuary connections in the Northeast. In: ESIP Journal, Gulf of Maine Council on the Marine Environment & Global Program of Action Coalition, Boscawen, NH, USA, 1, (2015).	ORD
SSWR 5.2D	Summary	Dugan, N., and L. Rosenblum. Control of Contaminants of Emerging Concern, Oxidized Inorganic Compounds and Ammonia by Anaerobic and Aerobic Biological Drinking Water Treatment Processes. U.S. Environmental Protection Agency, Washington, DC, USA, 2015.	ORD
SSWR 6.1A	Technical Fact Sheet	Tenbrink, M., G. Foley, J. Hunter, H. Walker, and R. Eric. NARRAGANSETT-3VS MODEL OVERVIEW (Information Sheet). US EPA Office of Research and Development, Washington, DC, USA, 2016.	ORD
SSWR3.02A	Manual	Kim, K., K. Wolfe, M. Galvin, G. Whelan, and R. Parmar. SDMProjectBuilder: SWAT Setup for Nutrient Fate and Transport. US EPA Office of Research and Development, Washington, DC, USA, 2016.	ORD
SSWR3.02B	Manual	Wolfe, K., M. Galvin, G. Whelan, R. Parmar, and K. Kim. SDMProjectBuilder: SWAT Simulation and Calibration for Nutrient Fate and Transport.	ORD
ACE 008	Presentation	Schwede, D., D. Luecken, and J. Walker. Improvements to the treatment of organic nitrogen chemistry & deposition in CMAQ. Presented at 2015 American Meteorological Society Meeting, Phoenix, AZ, USA, 01/05/2015 - 01/09/2015.	ORD
ACE 008	Presentation	Schwede, D., and D. Luecken. Improvements to the characterization of organic nitrogen chemistry and deposition in CMAQ. Presented at National Atmospheric Deposition Program Fall 2014 Scientific Symposium, Chapel Hill, NC, USA, 10/27/2014 - 10/29/2014.	ORD
ACE 008	Presentation	Schwede, D., D. Luecken, J. Walker, G. Pouliot, and W. Appel. Improvements to the characterization of organic nitrogen chemistry and deposition in CMAQ (CMAS Presentation). Presented at Community Modeling & Analysis CMAS, Chapel Hill, NC, USA, 10/27/2014 - 10/29/2014.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
ACE 017	Presentation	Loughlin, D., K. Kaufman, A. Macpherson, and B. Keaveny. Marginal abatement cost curves for NOx that account for renewable electricity, energy efficiency, and fuel switching. To be presented at A&WMA 108th Annual Conference & Exhibition, Raleigh, NC, USA, 06/22/2015 - 06/25/2015.	ORD
ACE 032	Poster	Long, T., R. Snow, and R. Baldauf. Using Extractive FTIR to Measure N2O from Medium Heavy-Duty Diesel Vehicles. To be presented at AWMA, Raleigh, NC, USA, 06/22/2015 - 06/25/2015.	ORD
ACE 082	Abstract	Gamas, J., D. Loughlin, and R. Dodder. Insights into future air quality: a multipollutant analysis of future scenarios using the MARKAL model. Presented at 14th Annual CMAS Conference, Chapel Hill, NC, USA, 10/05/2015 - 10/07/2015.	ORD
ACE 082	Presentation	Gamas, J., D. Loughlin, R. Dodder, and B. Hubbell. Insights into future air quality: Analysis of future emissions scenarios using the MARKAL model. Presented at 2015 CMAS Conference, Chapel Hill, NC, USA, 10/05/2015 - 10/07/2015.	ORD
ACE 082	Poster	Loughlin, D., C. Lenox, and R. Dodder. Energy, environmental and climate assessment with the EPA MARKAL energy system modeling framework. Presented at Health Effects Institute 2015 Annual Conference, Philadelphia, PA, USA, 05/03/2015 - 05/05/2015.	ORD
ACE 105	Presentation	Leytem, A., and J. Walker. USDA-EPA Collaborative Ammonia Research. To be presented at USDA Agricultural Air Quality Task Force, Arlington, VA, USA, 04/07/2016 - 04/07/2016.	ORD
ACE 105	Presentation	Walker, J. Measurement and modeling of the contribution of ammonia to total nitrogen deposition from canopy to regional scale. To be presented at Invited Seminar - College of Charleston, Charleston, SC, USA, 03/03/2016 - 03/03/2016.	ORD
ACE 105	Poster	Duman, T., J. Walker, J. Bash, K. Gannam, C. Huang, K. Andrey, and G. Katul. Estimating sources, sinks and fluxes of reactive atmospheric compounds within a forest canopy. Presented at 2015 American Geophysical Union, San Francisco, CA, USA, 12/14/2015 - 12/18/2015.	ORD
ACE 110	Abstract	Loughlin, D., C. Nolte, S. Smith, and J. West. Application of an Integrated Assessment Model with state-level resolution for examining strategies for addressing air, climate and energy goals. Presented at 14th Annual CMAS Conference, Chapel Hill, NC, USA, 10/05/2015 - 10/07/2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
ACE 119	Abstract	Kodavanti, U., M. Schladweiler, A. Ledbetter, M. McGee, J. Richards, D. Andrews, D.B. Miller, A. Henriquez, and S. Snow. Systemic Metabolic Impairment and Lung Injury Following Acrolein Inhalation. Presented at Society of Toxicology Meeting, New Orleans, LA, USA, 03/13/2016 - 03/17/2016.	ORD
ACE 119	Abstract	Snow, S., H. Tong, D.B. Miller, M. Schladweiler, J. Richards, D. Andrews, and U. Kodavanti. Coconut, Fish, and Olive Oil-Rich Diets Modify Ozone-Induced Metabolic Effects. Presented at Society of Toxicology Meeting, New Orelans, LA, USA, 03/13/2016 - 03/17/2016.	ORD
ACE 119	Abstract	Henriquez, A., S. Snow, D. Miller, and U. Kodavanti. Evaluation of autophagy as a mechanism involved in air pollutant-induced pulmonary injury. Presented at Keystone Symposia on Molecular and Cellular Biology: Autophagy (E6), Breckenridge, CO, USA, 06/19/2015 - 06/24/2015.	ORD
ACE 137	Presentation	Morefield, P. Global Change Explorer: Overview and Updates. Presented at 2015 EPA GIS Workshop, Raleigh, NC, USA, 03/03/2015 - 02/05/2015.	ORD
ACE 143	Abstract	Lunden, M., N. Staubach, D. Herzl, P. Solomon, M. Beaver, and S. Kaushik. Air Pollution Measurements Employing Multiple Mobile Platforms in Denver, CO, Summer 2014. Presented at AAAR 34th Annual Conference, Minneapolis, MN, USA, 10/12/2015 - 10/16/2015.	ORD
ACE 143	Presentation	Williams, R. Next Generation Air Monitoring, presentation at Workshop on Campus-Community Partnerships. Presented at Workshop on Campus-Community Partnerships, San Francisco, CA, USA, 07/23/2015 - 07/23/2015.	ORD
ACE 145; SHC 3.3.1.3	Abstract	Clark, C. Synthesis of recent advances in critical loads research on impacts from atmospheric nitrogen deposition on terrestrial plant communities.	ORD
ACE 145; SHC 3.3.1.3	Presentation	Clark, C. Synthesis of recent advances in critical loads research on impacts from atmospheric nitrogen deposition on terrestrial plant communities.	ORD
ACE 174	Presentation	Pye, H., D. Luecken, D. Schwede, and K. Baker. Towards mechanistic representations of SOA from BVOC + NO3 reactions. Presented at Workshop on Nitrate Radicals & BVOC's, Atlanta, GA, USA, 06/23/2015 - 06/24/2015.	ORD
ACE 174	Presentation	Pye, H., D. Luecken, D. Schwede, K. Baker, B. Hutzell, and S. Budisulistorini. SOA from BVOCs in the Southeastern United States. Presented at Southeast Atmosphere Study (SAS) in the Southeastern US, Princeton, NJ, USA, 06/08/2015 - 06/08/2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
ACE 207	Abstract	Zavala, J., J. Krug, S. Warren, T. Krantz, C. King, S. Gavett, M. Lewandowski, B. Lonneman, T. Kleindienst, M. Meier, M. Higuchi, I. Gilmour, and D. DeMarini. Two Simulated-Smog Atmospheres with Different Chemical Compositions Produce Contrasting Mutagenicity in Salmonella. Presented at Society of Toxicology, New Orleans, LA, USA, 03/13/2016 - 03/17/2016.	ORD
ACE 207	Abstract	DeMarini, D. Are There Human Germ-Cell Mutagens? We May Know Soon. Presented at Genetics and Environmental Mutagenesis Society, RTP, NC, USA, 10/28/2015 - 10/28/2015.	ORD
HHRA211	Presentation	Brown, J. Nitrogen dioxide exposure and airway responsiveness in individuals with asthma-2. Presented at ACE Connections (biweekly call), RTP, NC, USA, 05/06/2015 - 05/06/2015.	ORD
HHRA211	Presentation	Patel, M. Overview of the Integrated Science Assessment for Oxides of Nitrogen - Health Criteria. Presented at Meeting with visiting scientists from Japan, RTP, NC, USA, 10/07/2014 - 10/07/2014.	ORD
HHRA331	Presentation	Richmond-Bryant, J. Work-in-Progress: The Influence of Meteorological Variables on the Near Road Gradient. Presented at Near Road Scientist to Scientist Monthly Meeting, RTP, NC, USA, 04/16/2015 - 04/16/2015.	ORD
SHC 2.61.1	Abstract	Hopkins, A., and T. DeWitt. Macrofaunal community response to extreme concentrations of green macroalgae in a naturally eutrophic estuary. Presented at Coastal & Estuarine Research Federation 2015, Portland, OR, USA, 11/08/2015 - 11/13/2015.	ORD
SHC 2.61.1	Abstract	Lewis, N., and T. DeWitt. Effect of Green Macroalgal Blooms on the Survival, Growth, and Behavior of Cockles in Pacific NW Estuaries. Presented at Coastal & Estuarine Research Federation, Portland, OR, USA, 11/08/2015 - 11/13/2015.	ORD
SHC 2.61.1	Abstract	Oczkowski, A., C. Wigand, A. Hanson, and E. Huertas. How a clogged canal affects ecological and human health in a tropical urban wetland ecosystem. Presented at Coastal & Estuarine Research Federation (CERF) 23rd Biennial Conference, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SHC 2.61.3	Abstract	Marois, D., T. DeWitt, and J. Stecher. A dynamic nitrogen budget model of a Pacific Northwest salt marsh. To be presented at 2016 American Water Resources Association Summer Specialty Conference, Sacramento, CA, USA, 07/11/2016 - 07/13/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR6.02A	Abstract	Nadagouda, M., G. Varshney, E. Martin, C. Soryong, and N. Kesav. Phosphate Removal and Recovery using Drinking Water Plant Waste Residuals - abstract. Presented at ACS Central Regional Meeting 2016, Covington, KY, OH, USA, 05/18/2016 - 05/21/2016.	ORD
ACE 008	Presentation	Schwede, D., D. Luecken, J. Walker, and G. Pouliot. Improvements to the Characterization of Organic Nitrogen Chemistry. Presented at National Atmospheric Deposition Program Fall 2014 Scientific Symposium, Indiana, IN, USA, 10/22/2014 - 10/23/2014.	ORD
ACE 017	Abstract	Loughlin, D., K. Kaufman, B. Keaveny, and A. Macpherson. Regional and sectoral marginal abatement cost curves for NOx incorporating controls, renewable electricity, energy efficiency and fuel switching. Presented at 14th Annual CMAS Conference, Chapel Hill, NC, USA, 10/05/2015 - 10/07/2015.	ORD
ACE 035	Abstract	Farraj, A., F. Malik, N. Coates, L. Walsh, D. Winsett, D. Terrell, L. Thompson, and M. Hazari. Morning NO2 Exposure Sensitizes Hypertensive Rats to the Cardiovascular Effects of O3 Exposure in the Afternoon. Presented at Society of Toxicology, San Diego, CA, USA, 03/22/2015 - 03/26/2015.	ORD
ACE 057	Presentation	Schwede, D., and G. Lear. Status of Total Deposition (TDEP) Maps & Future Plans. Presented at National Atmospheric Deposition Program Total Deposition Science Committee, Monaray, CA, USA, 04/13/2015 - 04/13/2015.	ORD
ACE 057	Presentation	Dennis, R., and K. Foley. Characteristics of New CMAQ Deposition Series of 2002 to 2011 for Critical Loads. Presented at 2014 NADP Annual Meeting and Scientific Symposium, Indianapolis, IN, USA, 10/21/2014 - 10/24/2014.	ORD
ACE 060	Poster	Long, T., R. Snow, and R. Baldauf. Using Extractive FTIR to Measure N2O from Medium Heavy-Duty Diesel Vehicles. To be presented at AWMA, Raleigh, NC, USA, 06/23/2015 - 06/25/2015.	ORD
ACE 061	Presentation	Julius, S., T. Johnson, G. Shenk, L. Linker, E. Molina, J. Fischbach, and R. Lempert. Using Robust Decision Making to Address Climate Change Uncertainties in Water Quality Management. To be presented at AWRA-NCR, Washington, DC, USA, 04/10/2015 - 04/10/2015.	ORD
ACE 070	Presentation	Liu, S., J. Xue, and F. Chen. Development and application of traffic density-based parameters for studying near-road air pollutant exposure. To be presented at ISES 2016, Utrecht, NA, NETHERLANDS, 10/09/2016 - 10/13/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
ACE 094	Abstract	DeMarini, D. Cooking with Fire: Mutagenicity and Chemical Analysis of Emissions from Cookstoves. Presented at 38th Annual Meeting of the UK Environmental Mutagen Society (UKEMS), Plymouth, NA, UK, 07/12/2015 - 07/15/2015.	ORD
ACE 105	Presentation	Walker, J. Measurement and modeling of the contribution of ammonia to total nitrogen deposition from canopy to regional scale. Presented at American Meteorological Society, phoenix, AZ, USA, 01/04/2015 - 01/08/2015.	ORD
ACE 105	Presentation	Walker, J., D. Schwede, J. Bash, and C. Oishi. Comparison of Aerodynamic Resistance Parameterizations and Implications for Dry Deposition Modeling. Presented at National Atmospheric Deposition Program, Indianapolis, IN, USA, 10/22/2014 - 10/24/2014.	ORD
ACE 111	Presentation	Bhander, G., and J. Chang. Greenhouse Gas Mitigation Options Database (GMOD) and Tool. Presented at ACLCA, Vancouver, WC, CANADA, 10/06/2015 - 10/08/2015.	ORD
ACE 119	Abstract	Henriquez, A., D. Miller, S. Snow, M. Schladweiler, and U. Kodavanti. Ozone-Induced Pulmonary Injury and Inflammation are Modulated by Adrenal-Derived Stress Hormones. Presented at Society of Toxicology, New Orleans, LA, USA, 03/13/2016 - 03/17/2016.	ORD
ACE 119	Abstract	Schladweiler, M., S. Snow, H. Tong, V. Bass, J. Richards, R. Jaskot, and U. Kodavanti. Ozone-Induced Pulmonary Injury and Vascular Contractility are Differentially Impacted by Coconut, Fish, and Olive Oil-Rich Diets. Presented at Society of Toxicology Meeting, New Orleans, LA, USA, 03/13/2016 - 03/17/2016.	ORD
ACE 137	Presentation	Clark, C. Development of an Interactive Online Critical Loads Tool for Decision makers and the Public. To be presented at National Atmospheric Deposition Program Spring 2015 Meeting, Pacific Grove, CA, USA, 04/13/2015 - 04/16/2015.	ORD
ACE 145; SHC 3.3.1.3	Presentation	Clark, C. Synthesis of critical loads research for the U.S.: State-of-the-science under current and changing climate and a roadmap forward.	ORD
ACE 145; SHC 3.3.1.3	Presentation	Clark, C., S. Simkin, L. Pardo, L. Geiser, K. Horn, and Q. Thomas. Overview of recent progress on critical loads in the U.S.: Focus on terrestrial herbs, lichen, and trees. To be presented at ICP & M, Zagreb, NA, CROATIA, 04/20/2015 - 04/24/2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
ACE 158	Abstract	Miller, D.B., M. Schladweiler, S. Snow, J. Richards, D. Andrews, A. Ghio, A. Ledbetter, and U. Kodavanti. Acute Ozone-Induced Pulmonary and Systemic Metabolic Effects are Diminished in Adrenalectomized Rats. Presented at Society of Toxicology, New Orleans, LA, USA, 03/13/2016 - 03/17/2016.	ORD
ACE 207	Abstract	Zavala, J., J. Krug, S. Warren, T. Krantz, C. King, S. Gavett, M. Lewandowski, B. Lonneman, T. Kleindienst, M. Meier, M. Higuchi, I. Gilmour, and D. DeMarini. Two Simulated-Smog Atmospheres with Different Chemical Compositions Produce Contrasting Mutagenicity in Salmonella. Presented at Genetics and Environmental Mutagenesis Society (GEMS), RTP, NC, USA, 10/28/2015 - 10/28/2015.	ORD
ACE 207	Abstract	Zavala, J., A. Ledbetter, P. White, D. DeMarini, I. Gilmour, and M. Higuchi. Critical Evaluation of Air-Liquid Interface Exposure Devices for In Vitro Assessment of Atmospheric Pollutants. Presented at Environmental Mutagenesis and Genomics Society (EMGS), New Orleans, LA, USA, 09/26/2015 - 09/30/2015.	ORD
ACE 245	Abstract	Duvall, R., R. Long, M. Beaver, K. Kronmiller, and M. Wheeler. Evaluation of Small Sensors in Citizen Science-Based Ambient Networks. Presented at Air & Waste Management Association 108th Annual Conference & Exhibition, Raleigh, NC, USA, 06/22/2015 - 06/25/2015.	ORD
ACE 245	Abstract	Duvall, R., R. Long, and M. Beaver. Evaluation of Small Sensors for Criteria Pollutants in Citizen Science-Based Ambient Networks. Presented at Air and Waste Management Association 108th Annual Conference and Exhibition, Raleigh, NC, USA, 06/22/2015 - 06/25/2015.	ORD
ACE AIMS-1.5	Presentation	Pye, H., D. Luecken, and L. Xu. SOA Modeling for Regulatory Assessment: Motivation for Mechanistic SOA. Presented at International Aerosol Modeling Algorithms Conference, Davis, CA, USA, 12/09/2015 - 12/11/2015.	ORD
ACE AIMS-1.5	Poster	Pye, H., D. Luecken, and L. Xu. Predicting SOA from organic nitrates in the southeastern United States. Presented at American Geophysical Union AGU Fall Meeting, San Francisco, CA, USA, 12/14/2015 - 12/18/2015.	ORD
ACE AIMS-2.2	Presentation	Cooter, E., L. Ran, and J. Bash. Response of a One-Biosphere Nutrient Modeling System to Regional Land Use and Management Change. Presented at International Society for Ecological Modelling (ISEM) Global Conf., Baltimore, MD, USA, 05/08/2016 - 05/12/2016.	ORD
ACE AIMS-2.2	Presentation	Lear, G., and D. Schwede. A Hybrid Approach for Estimating Total Deposition in the United States. Presented at 2015 Acid Rain Conference, Rochester, NY, USA, 10/19/2015 - 10/23/2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
ACE CIVA-1.4	Abstract	Baublitz, C., B. Henderson, D. Loughlin, C. Nolte, D. Henze, and H. Lee. Climate Strategy Impact on Nitrogen Deposition in the USA. Presented at A&WMA's 109th Annual Conference & Exhibition, New Orleans, LA, USA, 06/20/2016 - 06/23/2016.	ORD
ACE CIVA-1.4	Presentation	Loughlin, D., C. Nolte, W. Shi, Y. Ou, S. Smith, and C. Ledna. The GLIMPSE project: Exploring strategies for meeting energy, environmental and climate objectives. Presented at Seminars: Tsinghua University, Shanghai Academy of Environmental Studies, Beijing and Shanghai, NA, CHINA, 06/10/2016 - 06/13/2016.	ORD
ACE CIVA-1.4	Presentation	Loughlin, D., C. Nolte, W. Shi, Y. Ou, S. Smith, and C. Ledna. The Global Change Assessment Model: A potential component of ABaCAS?. Presented at 4th Air Benefit and Cost and Attainment Assessment Conference (ABaCAS 2016), Shanghai, NA, CHINA, 06/14/2016 - 06/16/2016.	ORD
ACE CIVA-1.4	Presentation	Loughlin, D. Computing and Systems Applied in Support of Coordinated Energy, Environmental, and Climate Planning. Presented at Computing and Systems Graduate Research Symposium, Raleigh, NC, USA, 04/22/2016 - 04/22/2016.	ORD
ACE CIVA-1.4	Presentation	Loughlin, D., C. Nolte, C. Lenox, G. Bhander, W. Shi, Y. Ou, S. Babaee, S. Smith, J. McLeod, C. Ledna, and J. West. Modeling U.S. air pollutant emissions and controls in GCAM-USA. Presented at JGCRI 2015 Integrated Assessment Workshop, College Park, MD, USA, 12/01/2015 - 12/04/2015.	ORD
ACE CIVA-1.4	Poster	Ou, Y., J. West, C. Nolte, and D. Loughlin. Exploring Air-Climate-Energy Impacts with GCAM-USA. To be presented at UNC-Chapel Hill Climate Change Symposium, Chapel Hill, NC, USA, 04/22/2016 - 04/22/2016.	ORD
ACE CIVA-1.5; SHC 4.61.4	Presentation	Clark, C. CLAD Topics for 2016 Spring Meeting. Presented at National Atmospheric Deposition Program, Madison, WI, USA, 04/25/2016 - 04/26/2016.	ORD
ACE PEP-3.1	Abstract	Chen, X., and J. Walker. Evaluation of gas and particle concentrations of water soluble inorganic compounds by a semi-continuous Monitor for Aerosols and Gases in Ambient Air (MARGA).	ORD
ACE SEM-1.1	Abstract	Babaee, S., and D. Loughlin. The potential role of natural gas power plants with carbon capture and storage as a bridge to a low-carbon future. To be presented at 34th USAEE/IAEE North America Conference, Tulsa, OK, USA, 10/23/2016 - 10/26/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
CSS 7.1.3	Presentation	Snyder, M., G. Small, and C. Pringle. Diet-switching by Omnivorous Freshwater Shrimp Diminishes Differences in Nutrient Recycling Rates and Body Stoichiometry Across a Food Quality Gradient. Presented at Southeastern Division of the American Fisheries Society Spring Meeting, Savannah, GA, USA, 01/29/2015 - 02/01/2015.	ORD
HHRA 2.2112	Presentation	Hines, E. Integrated Science Assessment (ISA) for Oxides of Nitrogen - Health Criteria?(Second External Review Draft), Briefing for Children's Health Protection Advisory Committee (CHPAC). Presented at CHPAC Briefing, Washington, DC, DC, USA, 11/13/2015 - 11/13/2015.	ORD
HHRA 2.2131	Presentation	Greaver, T., E. Felker-Quinn, and A. Talhelm. Effects of Temperature, Precipitation and Nitrogen on Carbon Cycling. Presented at Acid Rain 2015, Rochester, NY, USA, 10/19/2015 - 10/23/2015.	ORD
HHRA 2.2131	Poster	Maxwell, A., R. Housego, A. Benson, M. Lassiter, and T. Greaver. Ecotoxicological Dose-Response Relationships from the Aquatic Acidification Literature. Presented at National Leadership in Training Organization, RTP, NC, USA, 05/26/2016 - 05/26/2016.	ORD
HHRA 2.2131	Poster	Maxwell, A., R. Housego, A. Benson, M. Lassiter, and T. Greaver. Ecotoxicological Dose-Response Relationships from the Aquatic Acidification Literature Poster. Presented at Acid Rain 2015, Rochester, NY, USA, 10/19/2015 - 10/23/2015.	ORD
HHRA 2.2131	Poster	Lassiter, M., M. Deerhake, E. Sullivan, and T. Greaver. Evidence of Eutrophication of Estuarine/Marine and Freshwater Systems Reviewed in the United States Environmental Protection Agency's Integrated Science Assessment for Oxides of Nitrogen and Sulfur. Presented at Acid Rain 2015, Rochester, NY, USA, 10/19/2015 - 10/23/2015.	ORD
HHRA211	Presentation	Painter, K. Document Classification for Environmental Risk Assessment. To be presented at Lunch and Learn Seminar, RTP, NC, USA, 07/14/2015 - 07/14/2015.	ORD
HHRA211	Presentation	Patel, M. Overview of the Draft Integrated Science Assessment (ISA) for Oxides of Nitrogen - Health Criteria. To be presented at ACE Connections (biweekly call), NA, NA, USA, 04/01/2015 - 04/01/2015.	ORD
HHRA214	Abstract	Maxwell, A., A. Ross, and J. Pinto. Comparison of NTN Deposition Data for National Park Sites to the CMAQ Model. To be presented at Intl Acid Rain Conference, Rochester, NY, USA, 10/19/2015 - 10/23/2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
HHRA214	Abstract	Lassiter, M., M. Deerhake, E. Sullivan, J. Herrick, and T. Greaver. Eutrophication of Estuarine/Marine and Freshwater Systems in the United States Environmental Protection Agency's Integrated Science Assessment for Oxides of Nitrogen and Sulfur. To be presented at Acid Rain 2015, Rochester, NY, USA, 10/19/2015 - 10/23/2015.	ORD
HHRA214	Abstract	Greaver, T., and E. Felker-Quinn. Temperature, Precipitation and Nitrogen effects on the Terrestrial Carbon Cycle. To be presented at Acid Rain 2015, Rodchester, NY, USA, 10/19/2015 - 10/23/2015.	ORD
HHRA214	Abstract	Lassiter, M., T. Greaver, A. Maxwell, and R. Housego. Ecotoxicological Dose-Response Relationships from the Aquatic Acidification Literature. To be presented at National Atmospheric Deposition Program, Rochester, NY, USA, 10/19/2015 - 10/23/2015.	ORD
N/A - Not Applicable	Abstract	Martin, R., and S. Moseman-Valtierra. Greenhouse gas emission response to global change may be limited by vegetation community shifts. Presented at Society of Wetland Scientists (SWS) Annual Meeting, Corpus Christi, TX, USA, 06/01/2016 - 06/03/2016.	ORD
N/A - Not Applicable	Abstract	Schofield, K., and M. Bennett. Moving from published research results to policy decisions with the help of conceptual model diagrams. To be presented at Society for Freshwater Science, Sacramento, CA, USA, 05/21/2016 - 05/26/2016.	ORD
N/A - Not Applicable	Abstract	Felker-Quinn, E., R. Housego, A. Maxwell, and M. Gooding Lassiter. Exploring links between Bromus invasion, anthropogenic nitrogen enrichment, and wildfires using systematic review and meta-analysis. To be presented at Ecological Society of American Annual Meeting, Baltimore, MD, USA, 08/09/2015 - 08/14/2015.	ORD
N/A - Not Applicable	Presentation	Kosusko, M., S. Chilingaryan, P.G. Greene, M. Cohen, and F. Mitloehner. Mechanisms for Formation of Oxides of Nitrogen during Ensiling of Dairy Feeds. Presented at Air & Waste Management Association 2015 Annual, Raleigh, NC, USA, 06/21/2015 - 06/25/2015.	ORD
N/A - Not Applicable	Presentation	Lowrance, R. The Ground Water and Ecosystems Restoration Division. Presented at invited talk, Stillwater, OK, USA, 03/11/2015 - 03/12/2015.	ORD
N/A - Not Applicable	Presentation	Johnson, J. Centers for Water Research on National Priorities Related to a Systems View of Nutrient Management: Kickoff Workshop. Presented at National Priorities Nutrient Management Kickoff Workshop, Narragansett, RI, USA, 01/21/2015 - 01/21/2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
N/A - Not Applicable	Presentation	Felker-Quinn, E., and T. Greaver. Quantitative review of nitrogen addition to wetlands. Presented at 45th Annual Air Pollution Workshop, Portland, OR, USA, 06/25/2013 - 06/27/2013.	ORD
N/A - Not Applicable	Poster	Farrar, L., and M. Latham. EPA's Safe and Sustainable Water Resources Research Program. To be presented at 2015 BOSC SSWR Subcommittee Review, Cincinnati, OH, USA, 08/27/2015 - 08/28/2015.	ORD
N/A - Not Applicable	Poster	Golden, H., and J. Hagy. Thresholds and Targeting Actions Research. To be presented at 2015 BOSC SSWR Subcommittee Review, Cincinnati, OH, USA, 08/27/2015 - 08/28/2015.	ORD
N/A - Not Applicable	Poster	Felker-Quinn, E., M. Lassiter, A. Maxwell, R. Housego, and b. young. Links between plant invasion, anthropogenic nitrogen enrichment and wildfires: a systematic review. Presented at American Geophysical Union, San Francisco, CA, USA, 12/15/2014 - 12/19/2014.	ORD
N/A - Not Applicable	Poster	Felker-Quinn, E., K. Siporin, and T. Greaver. Quantitative review of plant biomass and nutrient concentration shows that plant response to N loading varies by wetland type. Presented at Ecological Society of America, Minneapolis, MN, USA, 08/05/2013 - 08/09/2013.	ORD
SHC	Abstract	Johnston, J. International Society for Ecological Modelling (ISEM) Conference Session Title: Modeling of ecosystem services for improved decision making. Presented at International Society for Ecological Modelling (ISEM) Conference, Towson, MD, USA, 05/08/2016 - 05/12/2016.	ORD
SHC 1.1.1.3	Poster	Heilke, I., M. Tenbrink, T. Stockton, and B. Dyson. System Sketch Poster. Presented at New Partners for Smart Growth Technology Fair, Baltimore, MD, USA, 01/29/2015 - 01/31/2015.	ORD
SHC 1.1.2.3	Poster	Washburn, E., and L. O'Fallon. Exposure Science 21: Meeting the Needs of Citizen Scientists. Presented at National Environmental Monitoring Conference (NEMC) 2015, Chicago, IL, USA, 07/13/2015 - 07/17/2015.	ORD
SHC 2.1.2.4	Presentation	Stecher, J., T. DeWitt, and P. Clinton. WATER LEVEL AND OXYGEN DELIVERY/UTILIZATION IN POROUS SALT MARSH SEDIMENTS. Presented at Coastal and Estuarine Research Federation, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SHC 2.1.2.5	Presentation	Johnston, J., C. Barber, K. Wolfe, M. Galvin, M. Cyterski, and R. Parmar. A Watershed-based spatially-explicit demonstration of an Integrated Environmental Modeling Framework for Ecosystem Services in the Coal River Basin (WV, USA). Presented at Fifth Interagency Conference on Research in the Watersheds, Charleston, SC, USA, 03/02/2015 - 03/06/2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SHC 2.1.3.2	Abstract	Russell, M., R. Fulford, J. Nestlerode, D. Dantin, J. Rogers, and J. Harvey. The search for habitat specific coefficients for the spatial assessment of ecosystem services. Presented at CERF, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SHC 2.1.4.1	Abstract	Rogers, J., and M. Russell. Tampa Bay Water Clarity Model (TBWCM): As a Predictive Tool. Presented at 2016 Ocean Sciences Meeting, New Orleans, LA, USA, 02/21/2016 - 02/26/2016.	ORD
SHC 2.1.4.4	Presentation	Hoffman, J., G. Peterson, A. Cotter, M. Sierszen, A. Trebitz, and J.R. Kelly. Energy and nutrient flows connecting coastal wetland food webs to land and lake. Presented at IAGLR Conference, Burlington, VT, USA, 05/25/2015 - 05/29/2015.	ORD
SHC 2.61.1	Abstract	Dantin, D., J. Harvey, R. Fulford, M. Russell, A. Almario, I. Krauss, and K. Murphy. Benthic incubation chambers for estimating nitrogen flux at the sediment water interface. Presented at CERF 2015, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SHC 2.61.3	Abstract	Moon, J., K.J. Naithani, J. Stecher, T. DeWitt, A. Nahlik, M.S. Fennessy, and R. Regutti. Modeling the Effects of Climate Change on Spatio-Temporal Dynamics of Denitrification in an Oregon Salt Marsh. Presented at Society of Wetland Scientists Annual Meeting, Corpus Christi, TX, USA, 05/31/2016 - 06/04/2016.	ORD
SHC 2.61.3	Abstract	Michael, L., J. Moon, A. Nahlik, S. Fennessy, T. DeWitt, J. Stecher, and K.J. Naithani. Spatial variability in denitrification rates in an Oregon tidal salt marsh. Presented at Society of Wetland Scientists Annual Meeting, Corpus Christi, TX, USA, 05/31/2016 - 06/04/2016.	ORD
SHC 2.61.3	Abstract	Regutti, R., J. Moon, T. DeWitt, and J. Stecher. Identifying important spatial and temporal scales and patterns of soil properties in a tidal saltmarsh situated in a mixed red alder and Douglas fir watershed. Presented at Society of Wetland Scientists, Corpus Christi, TX, USA, 05/31/2016 - 06/04/2016.	ORD
SHC 2.61.3	Abstract	Moon, J., H. Stecher, T. DeWitt, A. Nahlik, M. Fennessy, L. Michael, R. Regutti, B. Mckane and K. Naithani. Understanding the Spatio-Temporal Dynamics of Denitrification in an Oregon Salt Marsh. Initiator: Ted DeWitt,ord/nheerl/wed/pceb.	ORD
SHC 3.3.1.1	Abstract	Detenbeck, N., A. Morrison, R. Abele, T. Plessel, V. Zoltay, M. Tenbrink, and S. Rego. Data access and decision tools for coastal water resources management (MEETING JULY 11-13, 2016). To be presented at American Water Resources Association (AWRA) Summer Specialty Conference: GIS and Water Resources IX, Sacramento, CA, USA, 07/11/2016 - 07/13/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SHC 3.3.1.1	Abstract	Metson, G., J. Compton, D. Cordrell, J. Harrison, and D. Iwaniec. Shaping Future Phosphorus Management Pathways by Understanding the Past and Present. Presented at American, San Francisco, CA, USA, 12/13/2015 - 12/18/2015.	ORD
SHC 3.3.1.1	Abstract	Detenbeck, N., T. Plessel, and M. Tenbrink. Estuary Data Mapper: A virtual portal to coastal data informing environmental management decisions. Presented at Coastal GeoTools 2015, Charleston, SC, USA, 03/30/2015 - 04/02/2015.	ORD
SHC 3.3.1.10	Presentation	Forshay, K. Biogeochemistry in River Floodplain Nitrogen Management. Presented at Seminar ECU chemistry students and staff, Ada, OK, USA, 11/06/2015 - 11/06/2015.	ORD
SHC 3.3.1.11	Abstract	Raposa, K. Nonlinear responses of coastal salt marshes to nutrient additions and sea level rise. Presented at Coastal & Estuarine Research Federation (CERF) 23rd Biennial Conference, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SHC 3.3.1.2	Abstract	Bellmore, R., J. Compton, M. Weber, R. Hill, D. Thornbrugh, and R. Brooks. Effects of Nitrogen Inputs and Watershed Characteristics on Summer Stream Nitrogen Concentrations: A National-Scale Analysis. Presented at American Geophysical Union, San Francisco, CA, USA, 12/13/2015 - 12/18/2015.	ORD
SHC 3.3.1.2	Abstract	Pearlstein, S., J. Compton, A. Eldridge, A. Henning, J. Selker, R. Brooks, and D. Schmitz. Is it working? A look at the changing nutrient practices in the Southern Willamette Valley's Groundwater Management Area. Presented at Southern Willamette Valley Groundwater Management Area Website, Corvallis, OR, USA, 05/01/2015 - 05/01/2015.	ORD
SHC 3.3.1.3	Abstract	Pardo, L., T. Greaver, and T. Blett. Synthesis of critical loads research for the U.S.: State-of-the-science and a roadmap forward. To be presented at Ecological Society of America, Baltimore, MD, USA, 08/09/2015 - 08/14/2015.	ORD
SHC 3.3.1.3	Presentation	Clark, C., S. Simkin, L. Pardo, L. Geiser, K. Horn, Q. Thomas, J. Phelan, T. Blett, C. O'Dea, and J. Lynch. Overview for OAQPS for projects in the pipeline for the secondary NAAQS review.	ORD
SHC 3.3.1.3	Presentation	Clark, C. Challenges and recommendations on assessing and interpreting critical loads.	ORD
SHC 3.3.1.3	Presentation	Clark, C. Development of an Interactive Online Critical Loads Tool for Decision makers and the Public.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SHC 3.3.1.3	Presentation	Clark, C., S. Simkin, W. Bowman, and E. Allen. National meta-analysis of impacts from nitrogen deposition on terrestrial plant biodiversity: ?Overview and updates. To be presented at National Atmospheric Deposition Program Spring 2015 Meeting, Pacific Grove, CA, USA, 04/13/2015 - 04/16/2015.	ORD
SHC 3.3.1.5	Presentation	Arnold, C., and Q. Kellogg. N-Sink - An online decision support tool to look at nitrogen pollution in a slightly different but potentially useful way. Presented at EPA Region 1, NA, NA, USA, 07/23/2015 - 07/23/2015.	ORD
SHC 3.3.1.8	Poster	Hale, S. Eutrophication and Hypoxia Degrade Ecosystem Functions and Services of Narragansett Bay Benthic Communities. Presented at Coastal and Estuarine Research Federation, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SHC 3.63.2	Abstract	Olszyk, D., M.G. Johnson, T. Shiroyama, J.M. Novak, K.B. Cantrell, and D.W. Watts. Carrot, Corn, Lettuce and Soybean Nutrient Contents are Affected by Biochar. To be presented at Biochar 2016: The Synergy of Science and Industry: Biochar's Connection to Ecology, Soil, Food, and Energy, Corvallis, OR, USA, 08/22/2016 - 08/25/2016.	ORD
SHC 4.61.1	Abstract	Detenbeck, N., and S. Rego. A geospatial modelling approach to predict seagrass habitat recovery under multiple stressor regimes. Presented at Coastal and Estuarine Research Foundation (CERF) 23rd Biennial Conference, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SHC 4.61.1	Abstract	Rego, S., and N. Detenbeck. Geospatial interface and model for predicting potential seagrass habitat. Presented at New England Association of Environmental Biologists (NEAEB), Bartlett, NH, USA, 03/18/2015 - 03/20/2015.	ORD
SHC 4.61.4	Abstract	Compton, J. Cost of nitrogen use in the US. Presented at True Cost of American Food, San Francisco, CA, USA, 04/14/2016 - 04/17/2016.	ORD
SHC 4.61.4	Abstract	Compton, J., D. Sobota, and J. Lin. Ecosystem services impacts associated with environmental reactive nitrogen release in the United States. To be presented at International Nitrogen Initiative, Melbourne, AUSTRALIA, 12/04/2016 - 12/10/2016.	ORD
SHC 4.61.4	Abstract	Baron, J., S. Bittman, R. Shiebley, J. Compton, C. Snyder, and D. Wise. Canadian-US Demonstration Project Towards an International Nitrogen Assessment System. To be presented at International Nitrogen Initiative, Melbourne, AUSTRALIA, 12/04/2016 - 12/10/2016.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SHC 4.61.4	Abstract	Metson, G., J. Lin, J. Harrison, and J. Compton. Influences of climate and land use on contemporary anthropogenic watershed phosphorus input and riverine export across the United States. To be presented at Sustainable Phosphorus Summit, Kunming, NA, CHINA, 08/08/2016 - 08/14/2016.	ORD
SHC 4.61.4	Abstract	Bellmore, R., B. Trelstad, M. Strong, and J. Compton. Institutional Nitrogen Footprint: A Case Study at Oregon State University. To be presented at AASHE, Baltimore, MD, USA, 10/09/2016 - 10/12/2016.	ORD
SHC 4.61.4	Poster	Forshay, K., C. Arnold, Q. Kellogg, and A. Gold. N-Sink: A decision support tool under development with EPA. Presented at Region 7 Tools Café, Lenexa, KS, USA, 12/09/2015 - 12/09/2015.	ORD
SSWR 1.1A	Presentation	Pelletier, P., M. Gutierrez, R. Mckinney, and S. Guberman. Assessing the impacts of salinity and nutrient stress to Ruppia maritima and Zostera marina. Presented at Coastal & Estuarine Research Federation (CERF) 23rd Biennial Conference, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SSWR 1.1A	Presentation	Hoffman, J., J.R. Kelly, G. Peterson, A. Cotter, M. Starry, and M. Sierszen. Water quality conditions and food web structure in Chequamegon Bay. Presented at Chequamegon Bay Research Symposium, Asland, WI, USA, 04/14/2015 - 04/14/2015.	ORD
SSWR 1.1B	Abstract	Whorley, S., N. Smucker, A. Kuhn, and J. Wehr. Urbanization alters fatty acid concentrations of stream food webs in the Narragansett Bay watershed. Presented at Society for Freshwater Science, Sacramento, CA, USA, 05/21/2016 - 05/26/2016.	ORD
SSWR 1.1B	Presentation	McManus, M., M. Scown, J. Carson, and C. Nietch. Lessons from comparing national and local covariates: Effects on instream spatial predictions of total phosphorus -Presentation. To be presented at American Water Resources Specialty Conference IX: GIS and Water Resources, Sacramento, CA, USA, 07/11/2016 - 07/13/2016.	ORD
SSWR 1.1B	Presentation	Pelletier, M., M. Gutierrez, R. Mckinney, and C. Slocum. IMPACTS OF salinity and nutrient stress to Ruppia maritima and Zostera marina: a mesocosm experiment. Presented at New England Estuarine Research Society (NEERS) Spring Meeting, Bristol, RI, USA, 04/16/2015 - 04/18/2015.	ORD
SSWR 1.1B	Presentation	Smucker, N., A. Kuhn, M. Charpentier, C. Cruz, C. Elonen, B. Hill, J. Lake, and J. Serbst. Developing Ecological Indicators for Nutrients and Urban Impacts to Streams in Coastal Watersheds. Presented at Society for Freshwater Science Annual Meeting, Milwaukee, WI, USA, 05/17/2015 - 05/22/2015.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 1.1B	Presentation	Christensen, J., M. Nash, J. Compton, J. Wigington, and S. Griffith. Connecting Seasonal Riparian Buffer Metrics and Nitrogen Concentrations in a Pulse-Driven Agricultural System. To be presented at SFS (Society for Freshwater Science) Meeting, Milwaukee, WI, USA, 05/17/2015 - 05/21/2015.	ORD
SSWR 1.1C	Presentation	Kreis, R. The Great Lakes Water Quality Agreement with an emphasis on annex 4 nutrients -and Lake Erie. Presented at Lake Erie Conference, Toledo, OH, USA, 03/20/2015 - 03/20/2015.	ORD
SSWR 1.2B	Presentation	Heberling, M., and C. Nietch. Addressing thin markets: Considering non-traditional participants. Presented at National Workshop on Water Quality Markets, Lincoln, NE, USA, 09/15/2015 - 09/17/2015.	ORD
SSWR 1.2B	Presentation	Heberling, M., C. Nietch, and H. Thurston. Understanding a drinking water utility's incentive to protect source water: A case study in Ohio. Presented at IWA International Conference on Water Efficiency and Performance Assessment of Water Services, Cincinnati, OH, USA, 04/20/2015 - 04/24/2015.	ORD
SSWR 1.2C	Poster	Golden, H., C. Lane, A. Prues, and E. D'Amico. Multiple Landscape Factors Affect the Resilience of a Mixed Land Cover Watershed. To be presented at American Geophysical Union 2015 Fall Meeting, San Francisco, CA, USA, 12/14/2015 - 12/18/2015.	ORD
SSWR 2.3A	Abstract	Nelson, W. Seagrass epiphytes as a nutrient stressor indicator: approaches towards development of threshold values. Presented at Northwest Algal & Seagrass Symposium, Coupeville, WA, USA, 05/06/2016 - 05/08/2016.	ORD
SSWR 2.3A	Abstract	Brown, C., J. Kaldy, P. Fong, T. MochonCollura, and P. Clinton. Stable Isotope Identification of Nitrogen Sources for United States (U.S.) Pacific Coast Estuaries. Presented at 2016 Ocean Sciences, New Orleans, LA, USA, 02/21/2016 - 02/26/2016.	ORD
SSWR 2.3A	Abstract	Keith, D., G. Thursby, and S. Rego. Hyperspectral Remote Sensing of New England Coastal Waters to Predict Seagrass Distribution. Presented at American Geophysical Union (AGU) Ocean Sciences Meeting, New Orleans, LA, USA, 02/21/2016 - 02/26/2016.	ORD
SSWR 2.3A	Abstract	Lehrter, J., and C. Le. Relating watershed nutrient loads to satellite derived estuarine water quality. Presented at AGU Fall Meeting, San Francisco, CA, USA, 12/14/2015 - 12/18/2015.	ORD
SSWR 2.3A	Abstract	Sutula, M., R. Kudela, J. Hagy, M. Berg, S. Bricker, J. Cloern, R. Dugdale, L. Harding, and D. Senn. Scientific Basis for Assessment of Nutrient Impacts on San Francisco Bay. Presented at CERF 2015, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 2.3A	Abstract	Nelson, W. Seagrass epiphytes: useful indicator, potential biological criterion, or forlorn hope?. Presented at CERF 2015, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SSWR 2.3A	Abstract	Kaldy, J., M. Frazier, K. Caudle, C. Brown, and W. Nelson. Variable primary producer responses to nutrient and temperature manipulations in mesocosms: temperature usually trumps nutrient effects. Presented at Coastal Estuarine Research Federation, Portland, OR, USA, 11/08/2015 - 11/13/2015.	ORD
SSWR 2.3A	Abstract	White, C., C. Brown, and T. MochonCollura. Cross-system comparison of factors influencing chlorophyll-a concentration in Oregon estuaries. Presented at Coastal and Estuarine Research Federation, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SSWR 2.3A	Abstract	Green, L., C. White, and C. Brown. Opening the black box: evaluation of nutrient nonpoint source management for estuarine watersheds. Presented at Coastal and Estuarine Research Federation, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SSWR 2.3A	Abstract	Keith, D., G. Thursby, and S. Rego. An Approach to Developing Numeric Nutrient Criteria for the Coastal Waters of the Northeast Using the Hyperspectral Imager for the Coastal Ocean (HICO). Presented at International Space Station Research and Development Conference, Boston, MA, USA, 07/07/2015 - 07/09/2015.	ORD
SSWR 2.3A	Abstract	Friedman, S., K. Houghton, J. James, and F. Genthner. Analysis of 16S Sediment Microbial Communities from a Southern California Wastewater-Treatment Discharge Field. Presented at American Society for Microbiology General Meeting, New Orleans, LA, USA, 05/30/2015 - 06/02/2015.	ORD
SSWR 2.3A	Abstract	Clinton, P., C. Brown, and W. Nelson. What's Upstream? GIS's critical role in developing nutrient reference conditions for estuaries - April 2, 2015. Presented at Costal GeoTools 2015, North Charleston, SC, USA, 03/30/2015 - 04/02/2015.	ORD
SSWR 2.3A	Presentation	Green, L., C. White, and C. Brown. Opening the black box: Evaluation of nutrient nonpoint source management for estuarine watersheds. Presented at 10th National Monitoring Conference, Tampa, FL, USA, 05/02/2016 - 05/06/2016.	ORD
SSWR 2.3A	Poster	James, J., K. Houghton, S. Friedman, R. Devereux, and F. Genthner. Functional Characteristics of Bacterial Communities in Periphyton Colonized in Tampa Bay Estuaries Receiving Runoff from Different Landscapes. Presented at American Society for Microbiology General Meeting, New Orleans, LA, USA, 05/30/2015 - 06/02/2015.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 2.3C	Presentation	Santodomingo, J. Molecular Characterization of cyanobacterial blooms. Presented at Water Conference, Chapel Hill, NC, USA, 05/17/2016 - 05/19/2016.	ORD
SSWR 2.3C	Presentation	Loftin, K., J. Graham, E. Hilborn, S. Lehmann, M. Meyer, and C. Griffith. Cyanotoxins in inland lakes of the continental United States: Photic Zone Occurrence and potential recreational health risks in the 2007 Survey of the Nation's lakes. To be presented at Eighth Symposium on Harmful Algae in the U.S., Long Beach, CA, USA, 11/15/2015 - 11/19/2015.	ORD
SSWR 2.3C	Presentation	Hilborn, E. The cyanobacteria toxins, microcystins; emerging risks to human health. Presented at Pathology 527: Emerging Issues and Research on Harmful Cyanobacterial Algal Blooms: Impact on Populations, Ecosystems, and Water, Urbana, IL, USA, 02/27/2015 - 02/27/2015.	ORD
SSWR 2.3C	Poster	Nojavan, F., B. Kreakie, and J. Hollister. A Bayesian Multilevel Model for Microcystin Prediction in Lakes of the Continental United States. Presented at Society For Freshwater Science Annual Meeting, Milwaukee, WI, USA, 05/17/2015 - 05/21/2015.	ORD
SSWR 2.3D	Abstract	Lehrter, J., D. Ko, L. Lowe, B. Jarvis, and C. Le. Application of the coastal generalized ecosystem model (CGEM) to assess the impacts of a potential future climate scenario on northern Gulf of Mexico hypoxia. Presented at 2015 Aquatic Sciences Meeting, Grenada, NA, SPAIN, 02/22/2015 - 02/27/2015.	ORD
SSWR 2.3E	Abstract	Kalin, L., M. Hantush, S. Isik, A. Sharifi, and M. Rezaeianzadeh. A New Physically-based Wetland Nutrient Cycling Model: WetQual. To be presented at EcoSummit 2016, Ecological Sustainability: Engineering Change, Montpellier, NA, FRANCE, 08/29/2016 - 09/01/2016.	ORD
SSWR 2.3E	Abstract	Ramesh, R., L. Kalin, M. Rezaeianzadeh, M. Hantush, and C. Anderson. How Does Urbanization Affect Headwater Wetland Functioning and Ultimately Coastal Water Quality? - A Case Study in Baldwin County, AL. Presented at EWRI World Environmental & Water Resources Congress 2016, West Palm Beach, FL, USA, 05/22/2016 - 05/26/2016.	ORD
SSWR 2.3E	Abstract	Kalin, L., M. Rezaeianzadeh, M. Hantush, C. Mo, and A. Sharifi. Graphical User Interface for the Wetland Water Quality Model (WetQual). Presented at EWRI World Environmental & Water Resources Congress 2016, West Palm Beach, FL, USA, 05/22/2016 - 05/26/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 2.3E	Presentation	Ramesh, R., L. Kalin, M. Hantush, and A. Sharifi. Assessing Climate Change Impacts on the Functioning of a Restored Wetland. Presented at World Environment & Water Resources Congress 2015, Austin, TX, USA, 05/17/2015 - 05/21/2015.	ORD
SSWR 2.3E	Presentation	Sharifi, A., M. Hantush, and L. Kalin. Modeling Nitrogen Dynamics in Wetland Soils and Water Under Saturated and Unsaturated Wetland Conditions. Presented at World Environment & Water Resources Congress 2015, Austin, TX, USA, 05/17/2015 - 05/21/2015.	ORD
SSWR 2.3E	Presentation	Mayer, P., M. Audie, R. Brooks, K. Forshay, J. Hartranft, D. Merritts, R. Walter, and J. Weitzman. Effects of legacy sediment removal on hydrology and biogeochemistry in a first order stream in Pennsylvania, USA. Presented at Ecological Society of America, Baltimore, MD, USA, 08/09/2015 - 08/14/2015.	ORD
SSWR 5.1A	Abstract	Ma, C., and A. Gonzalez. Nutrient recovery from municipal wastewater for sustainable food production systems: An alternative to traditional fertilizers. Presented at 2nd International Conference on Global Food Security, Ithaca, NY, USA, 10/11/2015 - 10/14/2015.	ORD
SSWR 5.1A	Abstract	Gonzalez, A., C. Ma, X. Xue, J. Garland, and J. Cashdollar. The Implications of Nutrient Recovery from Municipal Wastewater to the Urban Water System Sustainability. Presented at IWA Efficient2015-PI2015, Cincinnati, OH, USA, 04/20/2015 - 04/24/2015.	ORD
SSWR 5.1A	Presentation	Gonzalez-Meja, A., and C. Ma. Nutrient recovery from municipal wastewater for sustainable food production systems: An alternative to traditional fertilizers. Presented at 9th Biennial Emergy Research Conference, Gainesville, FL, USA, 01/07/2016 - 01/09/2016.	ORD
SSWR 5.1A	Presentation	Gonzalez, A., C. Ma, J. Garland, and J. Cashdollar. Nutrient recovery from municipal wastewater for sustainable food production systems: An alternative to traditional fertilizers. Presented at 2nd International Conference on Global Food Security, Ithaca, NY, USA, 10/11/2015 - 10/14/2015.	ORD
SSWR 5.1B	Abstract	Nadagouda, M., T. Speth, J. Garland, C. Han, X. Li, J. Lalley, and D.D. Dionysiou. Phosphate Remediation and Recovery from Lake Water using Modified Iron Oxide-based Adsorbents - abstract. Presented at AWWA, Logan, UT, USA, 09/16/2015 - 09/18/2015.	ORD
SSWR 5.1B	Presentation	Kapoor, V., M. Elk, X. Li, and C. Impellitteri. Chromium toxicity to nitrifying bacteria: implications to wastewater treatment. To be presented at ACS National Conference, San Diego, CA, USA, 03/13/2016 - 03/16/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 5.1B	Presentation	Nadagouda, M., J. Lalley, X. Li, and C. Han. Cerium and lanthanum-modified, magnetically separable nano-catalysts for water treatment. To be presented at Pacichem, Honolulu, HI, USA, 12/15/2015 - 12/20/2015.	ORD
SSWR 5.1B	Poster	Kapoor, V., M. Elk, X. Li, C. Impellitteri, and K. Chandran. Effect of heavy metals on nitrification activity as measured by RNA- and DNA-based function-specific assays. To be presented at ACS National Meeting, San Diego, CA, USA, 03/13/2016 - 03/17/2016.	ORD
SSWR 5.1B	Poster	Nadagouda, M., J. Lalley, X. Li, C. Han, and D. Dionysioub. Phosphate Remediation and Recovery from Lake Water using Modified Iron Oxide-based Adsorbents. Presented at WQTC 2015, Salt Lake City, UT, USA, 11/15/2015 - 11/19/2015.	ORD
SSWR 5.1B	Poster	Lalley, J., C. Han, M. Nadagouda, and D. Dionysiou. Phosphate Remediation and Recovery using Iron Oxide-based Adsorbents. Presented at Poster Graduate Forum, Cincinnati, OH, USA, 03/06/2015 - 03/06/2015.	ORD
SSWR 5.2C	Presentation	Dugan, N., T. Sanan, S. Smith, and D. Lytle. Cyanobacteria, Toxins and Indicators: Field Monitoring, Treatment Facility Monitoring and Treatment Studies. Presented at US EPA Region 8 Harmful Algal Bloom Workshop, Rapid City, SD, USA, 09/30/2015 - 10/01/2015.	ORD
SSWR 5.2C	Presentation	Dugan, N., T. Sanan, S. Smith, R. Marsh, H. Mash, and D. Lytle. Cyanobacteria, Toxins and Indicators: Full-Scale Monitoring & Bench-Scale Treatment Studies. Presented at US Environmental Protection Agency Small Systems Workshop, Cincinnati, OH, USA, 08/25/2015 - 08/27/2015.	ORD
SSWR 5.2C	Presentation	Dugan, N., T. Sanan, S. Smith, R. Marsh, H. Mash, and D. Lytle. Cyanobacteria, Toxins and Indicators: Full-Scale Monitoring & Bench-Scale Treatment Studies. Presented at USEPA Area Wide Optimization Program National Meeting, Cincinnati, OH, USA, 07/22/2015 - 07/22/2015.	ORD
SSWR 5.2C	Presentation	Dugan, N., T. Sanan, S. Smith, R. Marshall, H. Mash, and D. Lytle. USEPA Research Update - presentation, 3/24/15. Presented at Ohio EPA Regional HAB Meeting, Avon Lake, OH, USA, 03/24/2015 - 03/24/2015.	ORD
SSWR 5.2C	Presentation	Speth, T., N. Dugan, J. Allen, D. Lytle, H. Mash, T. Sanan, J. Shoemaker, J. Garland, and M. Latham. Formation and Control of Cyanobacterial Toxins. Presented at 11th CECIA IAUPR Biennial Symposium on Potable Water Issues in Puerto Rico, Bayamon, NA, PUERTO RICO, 02/12/2015 - 02/14/2015.	ORD
SSWR 5.2E	Poster	Kapoor, V., X. Li, C. Impellitteri, and J. Santodomingo. Applying Molecular Tools for Monitoring Inhibition of Nitrification by Heavy Metals. Presented at WEFTEC 2015, Chicago, IL, USA, 09/26/2015 - 09/30/2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 5.5E	Abstract	Revetta, R., C. Bennett-Stamper, D. King, K. Schrantz, S. Pfaller, J. Pressman, D. Wahman, and V. Gomez-Alvarez. Comparison of Microbial Communities in a Simulated Chloraminated Drinking Water Distribution System Subjected to Episodes of Nitrification. Presented at American Society for Microbiology, New Orleans, LA, USA, 05/30/2015 - 06/02/2015.	ORD
SSWR 6.1A	Abstract	Boothman, W., and L. Coiro. Modern history of hypoxia in Narragansett Bay: the geochemical record (MEETING NOVEMBER 6-10, 2016). To be presented at Society of Environmental Toxicology and Chemistry (SETAC) North America 37th Annual Meeting, Orlando, FL, USA, 11/06/2016 - 11/10/2016.	ORD
SSWR 6.1A	Abstract	Grear, J., T. Rynearson, A. Montalbano, B. Govenar, and S. Menden-Deuer. PCO2 effects on species composition and growth of an estuarine phytoplankton community. Presented at Association for the Sciences of Limnology and Oceanography (ASLO) Ocean Sciences Meeting, New Orleans, LA, USA, 02/21/2016 - 02/26/2016.	ORD
SSWR 6.1A	Abstract	Chintala, M., S. Ayvazian, W. Boothman, G. Cicchetti, L. Coiro, S. Hale, A. Kuhn, J. Nye, P. Pelletier, B. Rashleigh, S. Robinson, and K. Rocha. Trend analysis of stressors and ecological responses, particularly nutrients, in the Narragansett Bay Watershed. Presented at Coastal & Estuarine Research Federation (CERF) 23rd Biennial Conference, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SSWR 6.1A	Abstract	Nye, J., S. Ayvazian, and B. Rashleigh. Analysis of Trends in Fish Assemblages in Narragansett Bay, RI/MA. Presented at Northeast Fish & Wildlife Conference, Newport, RI, USA, 04/19/2015 - 04/21/2015.	ORD
SSWR 6.1A	Poster	Pruell, R., and B. Taplin. Temporal trends in nitrogen isotope ratios of winter flounder collected from Rhode Island coastal systems. Presented at Coastal & Estuarine Federation (CERF) 23rd Biennial Conference, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SSWR 6.1A	Poster	Nye, J., S. Ayvazian, and B. Rashleigh. The influence of climate, nutrient loading and predation on spatial and temporal changes in fish assemblages in Narragansett Bay. Presented at American Fisheries Society 145th Annual Meeting, Portland, OR, USA, 08/16/2015 - 08/20/2015.	ORD
SSWR 6.1B	Abstract	Rashleigh, B., H. Walker, T. Gleason, M. Abdelrhman, L. Charlestra, E. Dettmann, P. Pelletier, S. Hale, G. Thursby, N. Detenbeck, D. Keith, S. Rego, S. Robinson, J. Grear, S. Ayvazian, and M. Mazzotta. Quantitative Models for the Narragansett Bay Estuary, Rhode Island/Massachusetts, USA. Presented at International Society for Ecological Modelling (ISEM), Baltimore, MD, USA, 05/08/2016 - 05/12/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR 6.1B	Abstract	Grear, J., T. Rynearson, A. Montalbano, B. Govenar, and S. Menden-Deuer. Phytoplankton community response to carbon dioxide enrichment in winter incubation experiments. Presented at Coastal and Estuarine Research Federation (CERF) 23rd Biennial Conference, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SSWR 6.2B	Abstract	Ayvazian, S., A. Humphries, and R. Fulweiler. The role of oyster restoration and aquaculture in nitrogen removal within a Rhode Island estuary. Presented at Coastal & Estuarine Research Federation (CERF) 23rd Biennial Conference, Portland, OR, USA, 11/08/2015 - 11/12/2015.	ORD
SSWR 6.2B	Abstract	Humphries, A., S. Ayvazian, J. Carey, and R. Fulweiler. The role of oyster restoration and aquaculture in nutrient cycling within a Rhode Island estuary. Presented at International Oyster Sympsium, Falmouth, MA, USA, 10/21/2015 - 10/23/2015.	ORD
SSWR 7.1B	Abstract	Pacella, S., C. Brown, M. Young, and R. Labiosa. Sources of nutrients to nearshore areas of a eutrophic estuary: Implications for nutrient-enhanced acidification in Puget Sound. Presented at 2016 Ocean Sciences Meeting, New Orleans, LA, USA, 02/21/2016 - 02/26/2016.	ORD
SSWR 7.1B	Poster	Burke, R., R. Mckinley, K. Mcneal, J. Martin, and M. Parsons. Sediment Pore Water Ammonium and Phosphate Concentrations in Choctawhatchee Bay as Determined by the Diffusive Equilibration in Thin Films (DET) Technique. Presented at 10th National Water Quality Monitoring Conference, Tampa, FL, USA, 05/02/2016 - 05/06/2016.	ORD
SSWR2.3A	Poster	Houghton, K., F. Genthner, J. James, S. Friedman, and R. Devereux. Taxonomic Characterization of Bacterial Communities in Periphyton Colonized in Tampa Bay Estuaries Receiving Runoff from Different Landscapes. Presented at American Society for Microbiology General Meeting, New Orleans, LA, USA, 05/30/2015 - 06/02/2015.	ORD
SSWR3.01B	Abstract	Barnhart, B., M. Bostian, R. Fare, S. Grosskopf, G. Whittaker, E. Sinha, A. Michalak, and M. Papenfus. Agricultural production and nutrient runoff in the Corn Belt: Assessing dynamic environmental performance. To be presented at North American Productivity Workshop IX, Quebec City, NA, CANADA, 06/15/2016 - 06/18/2016.	ORD
SSWR3.04A	Abstract	Merrill, N., J. Bousquin, M. Mazzotta, and K. Mulvaney. Regional Demand Models for Water-Based Recreation: Combining Aggregate and Individual-Level Choice Data. Presented at The Northeast Agricultural and Resource Economics Association Annual Meeting, Bar Harbor, ME, USA, 06/19/2016 - 06/21/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR3.04B	Abstract	Barnhart, B., M. Bostian, M. Papenfus, G. Whittaker, P. Mayer, R. Fare, and S. Grosskopf. Optimal Allocation of Restoration Practices Using Indexes for Stream Health. To be presented at INFORMS, Nashville, TN, USA, 11/13/2016 - 11/16/2016.	ORD
SSWR4.01A	Presentation	Dugan, N. Responding to Harmful Algal Blooms: Treatment Optimization. Presented at EPA Office of Research and Development / Office of Water Small Systems Webinar Series, Cincinnati, OH, USA, 05/31/2016 - 05/31/2016.	ORD
SSWR4.01A	Presentation	Dugan, N., S. Smith, T. Sanan, G. Abulikemu, and D. Lytle. Impacts of Early-Stage Drinking Water Treatment on Cyanobacterial Toxin Release and Degradation. To be presented at Region 5 Harmful Algal Bloom Clean Water Act/Safe Drinking Water Act Workshop and Public Meeting, Chicago, IL, USA, 04/27/2016 - 04/29/2016.	ORD
SSWR4.01A	Presentation	Dugan, N. Harmful Algal Blooms. Presented at Thomas More College: Environmental Topics (ENV 215), Crestview Hills, KY, USA, 02/29/2016 - 02/29/2016.	ORD
SSWR4.01A	Presentation	Dugan, N., T. Sanan, S. Smith, and D. Lytle. Cyanobacteria, Toxins and Indicators: Field Monitoring, Treatment Facility Monitoring and Treatment Studies. Presented at University of Cincinnati Graduate Research Seminar, Cincinnati, OH, USA, 10/09/2015 - 10/09/2015.	ORD
SSWR4.01A	Poster	Rea, A., M. Reiley, and R. Waite. EPA Nitrogen and Co-Pollutant Roadmap. Presented at 2015 BOSC SSWR Subcommittee Review, Cincinnati, OH, USA, 08/27/2015 - 08/28/2015.	ORD
SSWR4.01B	Abstract	Hilborn, E. Human Health Effects Associated with Exposure to Toxic Cyanobacteria. Presented at Water Microbiology, Chapel Hill, NC, USA, 05/17/2016 - 05/19/2016.	ORD
SSWR4.01E	Abstract	Hilborn, E., W. Krueger, R. Stumpf, B. Schaeffer, E. Sams, and T. Wade. Great Lake beach-goer behavior during a retrospectively detected bloom of cyanobacteria. To be presented at International Conference Toxic Cyanobacteria, Wuhan, NA, CHINA, 10/22/2016 - 10/28/2016.	ORD
SSWR4.01E	Abstract	Schaeffer, B. Using Remote Sensing for Water Quality Monitoring in Lakes and Reservoirs. To be presented at EPA Numeric Nutrient Criteria Webnair Series, Durham, NC, USA, 09/21/2016 - 09/21/2016.	ORD
SSWR4.01E	Abstract	Hilborn, E., W. Krueger, B. Schaeffer, R. Stumpf, E. Sams, and T. Wade. Beach-goer behavior during a retrospectively detected algal bloom at a Great Lakes beach. Presented at 2016 Recreational Water Conference, New Orleans, LA, USA, 04/12/2016 - 04/15/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.02A	Abstract	McManus, M., M. Scown, J. Carson, and C. Nietch. Lessons from comparing national and local watershed covariates: effects on instream spatial predictions of total phosphorus. To be presented at American Water Resources Association Summer Specialty Conference: GIS and Water Resources IX, Sacramento, CA, USA, 07/11/2016 - 07/13/2016.	ORD
SSWR4.02A	Abstract	McManus, M., and D. Isaak. Use of National GIS Data and Stream Monitoring Measurements for Spatially-Explicit Watershed and Stream Network Analysis. To be presented at American Water Resources Association Summer Specialty Conference: GIS and Water Resources IX, Sacramento, CA, USA, 07/11/2016 - 07/13/2016.	ORD
SSWR4.02A	Presentation	Mitchell, R., A. Pollard, L. Yuan, and E. Pilgrim. Comparing metagenomic and morphological periphyton assemblage data to major environmental gradients: A pilot study from the National Rivers and Stream Assessment. Presented at Society of Freshwater Science 2016 Annual Meeting, Sacramento, CA, USA, 05/22/2016 - 05/26/2016.	ORD
SSWR4.02B	Abstract	Rackley, J., R. Devereux, J. Rogers, M. Machavaram, and M. Mills. Watershed delineation and nitrogen source analysis for Bayou Chico, an urban watershed in northwest Florida. To be presented at 2016 American Water Resources Association Annual Conference, Orlando, FL, USA, 11/13/2016 - 11/17/2016.	ORD
SSWR4.02B	Presentation	Lee, S., E. Rosi-Marshall, A. Reisinger, J. Kelly, M. Rojas, and S. Kaushal. Effects of urban chemical stressors on stream biofilms. To be presented at Society for Freshwater Science, Sacramento, CA, USA, 05/21/2016 - 05/26/2016.	ORD
SSWR4.02C	Abstract	Pearlstein, S., J. Compton, A. Eldridge, A. Henning, R. Brooks, J. Selker, and D. Schmitz. Is it working? A look at the changing nutrient practices in the Southern Willamette Valley's Groundwater Management Area. To be presented at Soil and Water Conservation Society Meetings, Louisville, KY, USA, 07/24/2016 - 07/27/2016.	ORD
SSWR4.03B	Poster	Nietch, C., M. Heberling, M. Elovitz, J. Beaulieu, J. Allen, and J. Young. A Watershed Cooperative Addresses Short and Long-Term Perspectives for the Management of Harmful Algae at a Southwestern Ohio Drinking Water Reservoir. Presented at Society of Environmental Toxicology and Chemistry North America 36th Annual Meeting, Salt Lake City, UT, USA, 11/01/2015 - 11/05/2015.	ORD
SSWR4.03C	Abstract	Lin, J., S. Pearlstein, J. Compton, W. Matthews, and S. Leibowitz. Nitrogen Balance and Use Efficiency in the Calapooia River Watershed, Oregon, United States. To be presented at International Nitrogen Initiative, Melbourne, AUSTRALIA, 12/04/2016 - 12/10/2016.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03C	Abstract	Lin, J., J. Compton, and S. Leibowitz. Modeling and assessing nitrogen delivery in the Calapooia River Watershed, and the impact of small streams delivery on downstream watershed. To be presented at Soil and Water Conservation Society meetings, Louisville, KY, USA, 07/24/2016 - 07/27/2016.	ORD
SSWR4.03C	Presentation	Yuan, Y. Watershed Simulation of Nutrient Processes. Presented at ISCMEM Mtg, Davis, CA, USA, 10/27/2015 - 10/29/2015.	ORD
SSWR6.01A	Presentation	Nadagouda, M. Green Chemistry and Environmental Remediation. Presented at ACS Meeting, Cincinnati, OH, USA, 03/30/2016 - 03/30/2016.	ORD
SSWR6.01A	Poster	Nadagouda, M., and E. Martin. Phosphate Removal and Recovery using Drinking Water Plant Waste Residuals. Presented at ACS Meeting, Kentucky, OH, USA, 05/18/2016 - 05/21/2016.	ORD
SSWR6.03C	Poster	Nadagouda, M., c. Han, G. Varshney, and N. Kesav. Resource Recovery and Reuse: Recycled Magnetically Separable Iron-based Catalysts for Phosphate Recovery and Arsenic Removal. Presented at ACS Meeting, San Diego, CA, USA, 03/13/2016 - 03/17/2016.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Regan, Claire, S. Yetter, T. Veith, A. Collick, and R. Brooks. Nutrient/Sediment Runoff and Ecological Condition: Linking the SWAT-VSA Model with Empirical Measures. Maryland Water Monitoring Conference, North Linthicum, MD, November 21, 2014. Poster presentation.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Boyer EW. Water Quality in Catchments of the Northeastern USA: Toward Understanding Impacts of Atmospheric Deposition and Climatic Variability. Department of Earth Sciences Seminar Series, Uppsala University, December 3, 2014.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	DeWalle, D, E. Boyer, and A. Buda. Relationship Between Long-term Atmospheric Wet Deposition and Stream Chemistry in Mid-Appalachian Forest Catchments. American Geophysical Union, San Francisco, CA, December 2014.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Campbell JL, M. Vadeboncoeur, H Asbjornsen, M. Green, M. Adams, and E. Boyer. Evaluating Biological and Physical Drivers of Evapotranspiration Trends at Northeastern US Watersheds. Fifth Interagency Conference on Research in the Watersheds in Charleston, SC, March 2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center PSU	Presentation	Brooks, R., S. Yetter, M. Nassry, J. Bishop, H. Ingram, C. Regan, T. Mazurczyk. The Art and Science of Translating Ecological Indicators to Ecosystem Services in Riparian Systems. Society of Wetland Scientists Annual Meeting, Providence, RI, May 31 – June 4, 2015. Oral presentation	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Boyer EW. Water Quality in Catchments of the Northeastern USA: Toward Understanding Impacts of Atmospheric Deposition and Climatic Variability. Cornell University, Department of Agricultural and Biological Engineering, Soil & Water Seminar Series, April 13, 2015.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Bryant RB, A. Buda, S. Tzilkowski, E. Boyer, M. King, L. Kibet, A. Allen, and E. May. Terrestrial Sources of Urea to Water in a Mixed Land Use Watershed: Implications for Nitrogen Management. 2nd International Interdisciplinary Conference on Land Use and Water Quality: Agricultural Production and the Environment. Vienna, Austria, September 2015.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Boyer EW. Atmospheric Deposition in Pennsylvania. Pennsylvania Department of Environmental Protection, Air Quality Technical Advisory Committee, Harrisburg, Pennsylvania, August 2015.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Shortle, J. Water Quality and Agriculture: Policies to Harmonize Food Production with Protection of Aquatic Ecosystems and Ecosystem Services. Invited presentation for the University of Illinois.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	J. Shortle. Improving the Efficiency and Effectiveness of Agri-Environmental Policies. Invited presentation for the PA Department of Environmental Protection Chesapeake Bay Agricultural Advisory Committee. Harrisburg, PA, June 18, 2015.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Shortle, J. Endogenous Risk and Non-Point Uncertainty Trading Ratios. Energy and Environmental Economics Seminar Series, Penn State University, University Park, PA, November 11, 2015.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Shortle, J. Innovating Public Policy to Address Nutrient Pollution from Agriculture. Columbia Water Center American Water Webinar Series. November 12, 2015.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center PSU	Presentation	Buda AR, S. Tzilkowski, L. Kibet, R. Bryant, E. Boyer, A. Allen, P. Kleinman, and E. May. Terrestrial sources of urea to water in a mixed land use watershed: exploring the roles of current and past nitrogen management. Joint Aquatic Sciences Meeting, Portland, OR, May 2014.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Boyer, E, J Grimm, K Eklof, L Iavorivska, P Drohan, J Bennett, and C Grant. Effects of climatic variability and land use on atmospheric deposition, with implications for water quality in forested catchments of the Northeastern United States. UCOWR/NIWR/CUAHSI Conference on Water Systems, Science, and Society Under Global Change. Medford, MA June 2014.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Reed, BC and E. Boyer. Water Quality of Three Forest Streams in Pennsylvania Impacted by Atmospheric Deposition. UCOWR/NIWR/CUAHSI Conference on Water Systems, Science, and Society Under Global Change. Medford, MA, June 2014.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Shortle, J. Improving the Efficiency and Effectiveness of Agri-Environmental Policies. Invited presentation for the PA Department of Environmental Protection Chesapeake Bay Agricultural Advisory Committee. Harrisburg, PA, June 18, 2015 Water Quality Trading. Penn State Extension Water Resources Seminar Series, May 27, 2015.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	DeWalle, D, E. Boyer, and AR Buda. Relationship Between Long-term Atmospheric Wet Deposition and Stream Chemistry in Mid-Appalachian Forest Catchments. American Geophysical Union, San Francisco, CA, December 2014.	ORD
SSWR4.03E Nutrient Center PSU	Poster	Shortle, J: The CNS poster (titled 'Center for Integrated Multi-Scale Nutrient Pollution Solutions) was presented at the Mid-Atlantic Regional Water Conference (October 2015, Shepardstown, WV) and at the Penn State Institutes of Energy and the Environment annual BBQ.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Regan, C., S. Yetter, T. Veith, A. Collick, and R. Brooks. Nutrient/Sediment Runoff and Ecological Condition: Linking the SWAT-VSA Model with Empirical Measures. Maryland Water Monitoring Conference, North Linthicum, MD, November 21, 2014. Poster presentation.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Boyer EW. Water Quality in Catchments of the Northeastern USA: Toward Understanding Impacts of Atmospheric Deposition and Climatic Variability. Department of Earth Sciences Seminar Series, Uppsala University, December 3, 2014.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center PSU	Presentation	DeWalle, D, E. Boyer, and A. Buda. Relationship Between Long-term Atmospheric Wet Deposition and Stream Chemistry in Mid-Appalachian Forest Catchments. American Geophysical Union, San Francisco, CA, December 2014.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Campbell JL, M. Vadeboncoeur, H. Asbjornsen, M. Green, M. Adams, and E. Boyer. Evaluating Biological and Physical Drivers of Evapotranspiration Trends at Northeastern US Watersheds. Fifth Interagency Conference on Research in the Watersheds in Charleston, SC, March 2015.	ORD
SSWR4.03E Nutrient Center PSU	Presentation	Shortle, J. Water Quality and Agriculture: Policies to Harmonize Food Production with Protection of Aquatic Ecosystems and Ecosystem Services. Invited presentation for the University of Illinois Institute for Sustainability, Energy, and Environment 2015 CONGRESS: Water Planet, Water Crisis? Meeting the World's Water-Food-Energy Needs Sustainably. Champaign-Urbana, IL, September 15, 2015.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Fredericks, D., K., Regmi, P., Miller, M., Bott, C. Optimization of an Intermittently Aerated BNR Pilot for Higher N Removal Efficiency. Proc. WEFTEC, Sept. 26-30, 2015, Chicago, IL.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Godwin, J., M. Miller, S. Klaus, P. Regmi, B. Wett, S. Murthy, C. Bott. Impact of Limited Organic Carbon Addition on Nitrogen Removal in a Mainstream Polishing Anammox Moving Bed Biofilm Reactor. Proc. WEFTEC, Sept. 26-30, 2015, Chicago, IL.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Holgate, R., P. Regmi, M. Miller, C. Bott. Anammox Polishing in Mainstream Wastewater Treatment to Meet Stringent Ammonia and Total Nitrogen Limits. Proc WEFTEC Sept. 26-30, 2015, Chicago, IL.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Sadowski, M., P. Regmi, S. Murthy, B. Wett, C. B. Bott. Comparison of Aeration Strategies for Optimization of Nitrogen Removal in an A/B Process: DO, ABAC, and AVN Control. Proc. WEFTEC, Sept. 26-30, 2015, Chicago, IL.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Miller, M., P. Regmi, S. Murthy, B. Wett, C. B. Bott. Combining high-rate activated sludge and shortcut nitrogen removal for efficient carbon and energy utilization. Proc. WEF/IWA Residual and Biosolids Conference 2015: The Next Generation of Science, Technology, and Management, June 8-10, Washington DC.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center WERF	Presentation	Optimizing Adsorption-style High Rate Activated Sludge for BNR and Energy Recovery. Proceedings of the IWA Specialist Conference, Global Challenges: Sustainable Wastewater Treatment and Resource Recovery, Kathmandu, Nepal. October 29, 2014.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	On-Line Sensors For The Control And Optimization of an Adsorption-Style HRAS Pilot Study. Proceedings of the IWA World Water Congress & Exhibition, Lisbon, Portugal. September 22, 2014.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Mainstream NOB Out-selection for Nitrite-shunt and Deammonification. Proceedings of the IWA World Water Congress & Exhibition, Lisbon, Portugal. September 24, 2014.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Feasibility Of Using A UV/Vis Spectral Sensor For Carbon-Based Control of an Adsorption-Style HRAS Process. Proceedings of the Virginia AWWA/VWEA Join Annual Meeting, Hampton, Virginia. September 9, 2014.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Assessment of NOB out-selection in an intermittently aerated nitritation-denitritation process with subsequent anammox polishing. Proceedings of the Virginia AWWA/VWEA Join Annual Meeting, Hampton, Virginia. September 9, 2014.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	New Approach to Physically Separate Solid Retention Time Based on Function: Mainstream Deammonification Case Study. IWA Specialist Conference - Global Challenges: Sustainable Wastewater Treatment and Resource Recovery, Kathmandu, Nepal, 26-30 October 2014.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Carbon-nitrogen-energy Nexus Governs Technology Decision for Resource-efficient Sewage Treatment. IWA Specialist Conference - Global Challenges: Sustainable Wastewater Treatment and Resource Recovery, Kathmandu, Nepal, 26-30 October 20.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	From Nitrite Shunt to Mainstream Deammonification Strategy: Pilot-Scale Demonstration. WEFTEC 2014, New Orleans, 28-30 September 2014.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Balancing Denitrification and Anammox Activities During Mainstream Deammonification: Influence of COD Input and Aeration Regime. WEFTEC 2014, New Orleans, 28-30 September 2014.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center WERF	Presentation	Mainstream Deammonification – Process Fundamentals and Research, IWA-WEF Water Energy conference, Washington, DC, June 8th, 2015.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Mark Miller. Pushing the Limits of Adsorption-Style High Rate Activated Sludge to Maximize Carbon Capture. Proc. WaterJAM Sept. 14 - 17, 2015, Virginia Beach, VA.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Michael Sadowski. Comparison of Aeration Strategies for Optimization of Nitrogen Removal in an A/B Process: DO, ABAC, and AVN Control. Proc. WaterJAM Sept. 14 - 17, 2015, Virginia Beach, VA.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Johnnie Godwin. Impact of Limited Organic Carbon Addition on Nitrogen Removal in a Mainstream Anammox Moving Bed Biofilm Reactor. Proc. WaterJAM Sept. 14 - 17, 2015, Virginia Beach, VA.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Ziels, R., A. Karlsson, J. Ejlertsson, S. Yekta, A., Bjorn, H. Stensel, and B. Svensson. Importance of syntrophic long-chain fatty acid-degrading bacteria during anaerobic codigestion fats, oils, and grease with municipal wastewater sludge, 89th Annual WEFTEC Conference Proceedings, Sept., 2015.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Richard, L., Enhanced Removal of Nutrients from Urban Runoff with Novel Unit-Process Capture, Treatment, and Recharge Systems, AWWA Sustainable Water Management Conference; Portland, Oregon; March 17, 2015.	ORD
SSWR4.03E Nutrient Center WERF	Presentation	Charbonnet, J., J. Grebel, D. Sedlak, Manganese Oxide Geomedia and its Regeneration for Passive Treatment of Urban Stormwater Contaminants" Poster presentation. AEESP Research and Education Conference, Environmental Engineering and Science: At the Nexus. June 13, 2015. Publications.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Rodriguez-Gonzalez, K. Payne, M. Trotz, S. Ergas, Hybrid Adsorption and Biological Treatment Systems (HABiTs) for Onsite Wastewater Treatment. Proceedings of the 88th Annual Meeting Water Environment Federation (WEFTEC 15), Chicago, IL, Sept. 26-30, 2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center USF	Presentation	Payne, K., L. Krayzelova, J. Cunningham, L. Rodriguez-Gonzalez, L. Trotz, S. Ergas, Mathematical Modeling of Adsorption and Mixotrophic Denitrification in a Tire-Sulfur Hybrid Adsorption Denitrification (T-SHAD) bioreactor, Proceedings of the 88th Annual Meeting Water Environment Federation (WEFTEC 15), Chicago, IL, Sept. 26-30, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Ergas, S., L. Krayzelova, L. Rodriguez-Gonzalez, K. Payne, M. Trotz, Hybrid Adsorption Biological Treatment Systems (HABiTS) for Improved Nitrogen Removal in Onsite Wastewater Treatment, Proc. Water Environment Federation Nutrients Symposium, San Jose, CA. July 26-28, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Ergas, S., Hybrid Adsorption Biological Treatment Systems (HABiTS) with Sulfur Oxidizing Denitrification, Department of Biotechnology, Delft Technological University (TU Delft), Delft, the Netherlands. September 3, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Rodriguez-Gonzalez, L., K. Payne, D. Trotz, S. Ergas, Hybrid Adsorption and Biological Treatment Systems (HABiTS) for onsite wastewater treatment. Proc. 88th Annual Meeting Water Environment Federation (WEFTEC 15), Chicago, IL. September 26-30, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Ergas, S.J. (2015) Hybrid Adsorption Biological Treatment Systems (HABiTS) for Improved Nitrogen Removal in Onsite Wastewater Treatment, Department of Environmental Engineering and Water Technology, UNESCO-IHE Institute for Water Education, Delft, the Netherlands. October 16, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Ergas, S. Hybrid Adsorption Biological Treatment Systems (HABiTS) for Improved Nitrogen Removal in Onsite Wastewater Treatment, Department of Civil & Environmental Engineering, Carnegie Mellon University, Pittsburgh PA. November 14, 2014.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Lopez, E, R. Locicero, T. Lynn, S. Ergas, F. Barton, J.Mihelcic, J. P., M. Trotz,How Concepts of Stormwater and Nutrient Management can Build Non-Traditional Workforce Capacity in an Urban Community. Association of Environmental Engineering & Science Professionals (AEESP), New Haven CT. June 13-16, 2015.	ORD
SSWR4.03E Nutrient Center USF	Dissertation	Lopez, E. Modified Bioretention Systems for Management of Nitrogen in Stormwater: Field Performance and Modeling Studies. Doctoral Dissertation Proposal Defense, Department of Civil & Environmental Engineering, University of South Florida, Tampa, FL. November 18, 2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center USF	Presentation	Orner, K. Net-Energy-Positive Nutrient Removal and Recovery from Digester Effluent. University of South Florida EWRE Seminar, Tampa, FL. November 4, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Ozcan, O., A. Prieto, H. Jean, R. Bair, D. Yeh, Phototrophic Membrane Bioreactor (PMBR) for the Management of Nutrients in Domestic Wastewater. Association of Environmental Engineering & Science Professionals (AEESP), New Haven CT. June 15, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Ozcan, O., H. Jean, R. Bair, A. Prieto, M. Pickett, D. Yeh Phototrophic Membrane Bioreactor (PMBR) for the Management of Nutrients in Domestic Wastewater. Water Environment Federation Nutrients Symposium, San Jose, CA. July 28, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Payne, K., L. Rodriguez-Gonzalez, S. Tong, J. Cunningham, M. Trotz, S. Ergas, Mathematical Modeling of HABiTS for Enhanced Nitrogen Removal. American Institute of Chemical Engineers Annual Meeting, Salt Lake City, Utah. November 8, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Rodriguez-Gonzalez, L., K. Payne, M. Trotz, D. Anderson, S. Ergas, Hybrid Adsorption and Biological Treatment systems (HABiTS) for Onsite Wastewater Treatment, Proc. NEHA Annual Educational Conference, Orlando, FL. July 13-15, 2015.	ORD
SSWR4.03E Nutrient Center USF	Thesis	Dick, G. Direct Membrane Filtration of Domestic Wastewater: Implications for Coupling with Anaerobic Membrane Bioreactor (DF-AnMBR) for Wastewater Resource Recovery. M.S. Thesis, University of South Florida, Tampa, FL.	ORD
SSWR4.03E Nutrient Center USF	Thesis	Butcher, M. "Diffuse Nutrient Pollution from Residential Catchments" (2014). Graduate Theses and Dissertations. http://scholarcommons.usf.edu/etd/5194.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Rodriguez-Gonzalez, L., K. Payne, M. Trotz, S. Ergas, Hybrid Adsorption and Biological Treatment Systems (HABiTs) for Onsite Wastewater Treatment. 88th Annual Meeting Water Environment Federation (WEFTEC 15), Chicago, IL, Sept. 26-30, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Rodriguez-Gonzalez, L., K. Payne, M. Trotz, D. Anderson, S. Ergas, Hybrid Adsorption and Biological Treatment Systems (HABiTs) for Onsite Wastewater Treatment. National Environmental Health Association (NEHA) 2015 Annual Educational Conference, Orlando, Florida, July 13-15, 2015.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center USF	Presentation	Santana, M., Q. Zhang, J. Mihelcic, The Effect of Sprawl and Smart Growth on The Embodied Energy and Carbon Footprint of Water Supply, 2015 Sustainable Water Management Conference, Portland, Oregon, March 15-18, 2015.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Rodriguez-Gonzalez, L.C., K. Payne, M. Trotz, S. Ergas, S.J. Hybrid Adsorption and Biological Treatment Systems (HABiTs) for onsite wastewater treatment. 24th Annual Southwest Florida Water Resources Conference, Fort Myers, Florida, February 6, 2015.	ORD
SSWR4.03E Nutrient Center USF	Poster	Ray, H., T. Boyer, How we can improve the waterless urine systems for water conservation? Poster presented at 2014 Florida Section of AWWA Fall Conference, Orlando, FL, December 2, 2014.	ORD
SSWR4.03E Nutrient Center USF	Poster	Saetta, D., T. Boyer, Improving waterless urinals for nutrient recovery and source water protection. Poster presented at 2014 Florida Section of AWWA Fall Conference, Orlando, FL, December 2, 2014.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Ergas, S.J. Hybrid Adsorption Biological Treatment Systems (HABiTS) for Improved Nitrogen Removal in Onsite Wastewater Treatment, Department of Civil & Environmental Engineering, Carnegie Mellon University, Pittsburgh PA, November 14, 2014.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Maraida Balaguer-Barbosa, Nancy Diaz-Elsayed, Pablo K. Cornejo, and Qiong Zhang, An Evaluation of the Energy and Greenhouse Gas Emissions of Onsite Wastewater Treatment Systems, poster presentation at Society of Hispanic Professional Engineers (SHPE) 2014 Conference, Detroit, Michigan, November 5-9, 2014.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Cornejo, P.K., Zhang, Q., Mihelcic, J.R. How does scale of implementation impact embodied energy and carbon footprint of water reuse systems?, Water Environment Federation Technical Exhibition and Conference (WEFTEC), New Orleans, LA, Sept. 27 – Oct. 1, 2014.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Butcher, M., Mihelcic, J.R. Diffuse release of nutrients from residential lawn management, Florida Lake Management Society (FLMS) 25th Annual Technical Symposium, Stuart, FL, June 16-19, 2014.	ORD
SSWR4.03E Nutrient Center USF	Presentation	Mihelcic, J.R. An overview of the new EPA National Research Center for Reinventing Aging Infrastructure for Nutrient Management (RAINmgt), Florida Lake Management Society (FLMS) 25th Annual Technical Symposium, Stuart, FL, June 16-19, 2014.	ORD

Appendix Table 1. Summary of Products Related to Aspects of Nitrogen and Co-pollutant Research

Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center USF	Poster	Balaguer-Barbosa, M., N. Diaz-Elsayed, P. Cornejo, Q. Zhang, Q. A Comparison of Energy and Greenhouse Gas Emissions of Conventional and Advanced Onsite Wastewater Treatment Systems. Emerging Research National (ERN) Conference in STEM, Washington, D.C. February 19-21, 2015.	ORD
SSWR4.03E Nutrient Center USF	Poster	Balaguer-Barbosa, M., N. Diaz-Elsayed, P. Cornejo, Q. Zhang, A Comparison of Energy and Greenhouse Gas Emissions of Conventional and Advanced Onsite Wastewater Treatment Systems. Society of Hispanic Professional Engineers (SHPE) Conference, Detroit, MI. November 5-9, 2015.	ORD
SSWR4.03E Nutrient Center USF	Poster	Orner, K., J. Cunningham, Net-Energy-Positive Nutrient Removal and Recovery from Digester Effluent. University of South Florida Research Day, Tampa, FL., 2015. Orner, K., D Cunningham, D. Saetta, T. Boyer, O. Ozcan, D. Yeh, Sewershed-Scale Nutrient Management. Association of Environmental Engineering & Science Professionals (AEESP), New Haven CT. June 13-16, 2015.	ORD
SSWR4.03E Nutrient Center USF	Poster	Reed, M., W. Isaacs, M. Trotz, Green Infrastructure and Engineering with K-12 for Nitrogen Management. Symposium on Nutrient Management in the Urban Water Sector, Tampa, FL. November 13, 2015.	ORD
SSWR4.03E Nutrient Center USF	Poster	Rodriguez-Gonzalez, L., K. Payne, M. Trotz, S. Ergas, Hybrid Adsorption and Biological Treatment Systems (HABiTs) for onsite wastewater treatment. AWRA Student Research Poster Contest at the 24th Annual Southwest Florida Water Resources Conference in Fort Myers FL. February 6, 2015.	ORD
SSWR4.03E Nutrient Center USF	Poster	Rodriguez-Gonzalez, L., K. Payne, M. Trotz, S. Ergas, Hybrid Adsorption and Biological Treatment Systems (HABiTs) for onsite wastewater treatment. Symposium on Nutrient Management in the Urban Water Sector, Tampa, FL. November 13, 2015.	ORD
SSWR4.03E Nutrient Center USF	Poster	Saetta, D., T. Boyer, "Manipulation of urea hydrolysis during urine source separation for complete phosphorus recovery." Florida Section of the American Water Works Association (FSAWWA). 2015.	ORD
SSWR4.03E Nutrient Center USF	Poster	Tong S., L. Rodriguez-Gonzalez, K. Payne, C. Feng, S. Ergas Comparison of particulate pyrite autotrophic denitrification (PPAD) and sulfur oxidizing denitrification (SOD) in wastewater treatment. Symposium Nutrient Management in the Urban Water Sector, Tampa, FL. November 13, 2015.	ORD

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
SSWR4.03E Nutrient Center USF	Poster	Tong S., L. Rodriguez-Gonzalez, M. Henderson, C. Feng, S. Ergas Particulate pyrite autotrophic denitrification (PPAD) for remediation of nitrate-contaminated groundwater (H32E-06). American Geophysical Union (AGU) Fall Meeting, San Francisco, CA. December 16, 2015.	ORD
SSWR4.03E Nutrient Center CSU	Presentation	Lammers, R., B. Bledsoe, and D. Baker, Uncertainty and sensitivity in bank stability modeling: implications for estimating phosphorus loading. 35th Annual American Geophysical Union Hydrology Days, Fort Collins, CO, March 23-25, 2015.	ORD
SSWR4.03E Nutrient Center CSU	Presentation	Johnson, J., J. Page, and W. Hunt, Evaluation of a Simple Retrofit to Improve Bioretention Efficiencies. American Society of Agricultural and Biological Engineering International Conference, New Orleans, LA, July 29, 2015.	ORD
SSWR4.03E Nutrient Center CSU	Presentation	Suchetana, B., B. Rajagopalan, and J. Silverstein, A Hierarchical Modeling Approach to Evaluate Spatial and Temporal Variability of Wastewater Effluent BOD, TSS and Ammonia. Environmental Science & Technology submitted. 2015	ORD
SSWR4.03E Nutrient Center CSU	Thesis	Lammers, R., Uncertainty and sensitivity in a bank stability model: implications for estimating phosphorus loading. Master's Thesis, Colorado State University. 2015.	ORD
	Presentation	Oliver, J. National numeric nutrient criteria program update. RTAG—Dallas TX 4/6/.	OW/R6
	Presentation	Oliver, J. Research and other activities related Harmful Alga Blooms (HABs) NOAA's Ecological Forecasting Conference – College Park, MD 4/26/2016.	OW
	Presentation	Oliver, J. Homeward Bound: Taking a water sample over the horizon into public policy and aquatic resource management. ASLO Santa Fe, NM 7/7/2016.	OW
	Presentation	Alers-Garcia, J. National Numeric Nutrient Criteria Program: Overview and Updates. RTAG – Dallas, TX 4/6/2016	OW/R2
	Presentation	Yuan, L. Combining regional and local data to improve Environmental decision making. Society of Freshwater Science, Annual Meeting, Sacramento, CA, May 23, 2016.	OW
	Poster	Kaufman, G. Communication ecological importance in a risk-based world: Linking numeric nutrient criteria to waterbody expectations. Ocean Science Meeting, New Orleans LA, February 26, 2016.	OW/OST

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
	Presentation	National Numeric Nutrient Criteria Program: Program Update New England Interstate Water Pollution Control Commission - Nutrient Criteria Workgroup May, 2016.	OW/OST
	Presentation	Kaufman, G. Using Assessment Endpoints to Link Management Goals to Environmental Results. New England Groundwater Meeting, October 2015.	OW/OST
	Presentation	Lynch, J.A. 2015. How Critical Loads are being developed and used around the U.S. Workshop - Sulfur and Nitrogen Monitoring and CL Meeting Minnow Brook Lodge – Blue Mountain Lake, NY.	OAR
	Presentation & Abstract	Lynch, J.A. and C. Funk. 2015. National Surface Water Assessment of Critical Loads Across the U.S. NADP Fall Meeting and Scientific Symposium and the 9th International Conference on Acid Deposition. Rochester, New York, Oct. 19-23, 2015.	OAR
	Presentation & Abstract	Funk, C. 2015. Surface water quality trends from EPA's LTM Network. NADP Fall Meeting and Scientific Symposium and the 9th International Conference on Acid Deposition. Rochester, New York, Oct. 19-23, 2015.	OAR
	Presentation & Abstract	Lynch, J.A., Rice, K.C., Scanlon, T.M., Cosby D. J. 2015. Decreased Atmospheric Sulfur Deposition across the Southeastern U.S. When will watershed release stored Sulfate. NADP Fall Meeting and Scientific Symposium and the 9th International Conference on Acid Deposition. Rochester, New York, Oct. 19-23, 2015.	OAR
	Presentation & Abstract	Funk, C., Nelson, E., Schmeltz, D., Haeuber, R. 2015. Demonstrating the Effectiveness of Utility SO2 and NOx Emission Reductions Using an Integrated Clean Air Act Regulatory and Monitoring Strategy. NADP Fall Meeting and Scientific Symposium and the 9th International Conference on Acid Deposition. Rochester, New York, Oct. 19-23, 2015.	OAR
Policy Review			
	Manuscript	The Nitrogen Cascade and Unintended Consequences in Conservation	OW
	Manuscript	Nutrient Dynamics in Riparian Ecosystems	OW
	Manuscript	Do housing prices reflect water quality impairments? Evidence from Puget Sound	OW
	Manuscript	Review and Synthesis of Potential Climate Change Effects on Nutrients	OW
	Manuscript	Monthly Dissolved Inorganic Nitrogen Export from the Mississippi River Basin: A New, Loosely Coupled Multimedia Model	OW

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Research Program Area; Task ID	Product Subtype	Citation	Program Office/ Region[1]
	Manuscript	Predicted effects of climate change on the severity of northern Gulf of Mexico hypoxia	OW
	Manuscript	Attributes of successful actions to restore lakes and estuaries degraded by nutrient pollution	OW
	Manuscript	Modeling the relative importance of nutrient and carbon loads, boundary fluxes and sediment fluxes on Gulf of Mexico hypoxia	OW
Regional Projects			
	Complete 2016	Groundwater in the shallow coastal waters of the Northeast	Region 1
	2017	Tracing Near-Shore Nitrogen through the Groundwater-Flow System in the Subterranean Estuary at a Coastal Saltwater Pond, Falmouth, Cape Cod, MA	Region 1
		Use of Triple Value Simulation Model for Nutrient-Related Water Quality Impairments in Suffolk County, NY	Regions 1&2
		Lake Erie Algal Bloom Study	Region 5
		Fecal Indicators in Response to Nutrients in an Impaired Urban Watershed	Region 4
		Ammonia Monitoring in Northeast Colorado	Region 8
		Partnership to Improve Nutrient Efficiency in the Willamette Valley	Region 10
		Methods for Monitoring Algal Blooms using NextGen qPCR and Microarrays	Region 7
		Nutrient Characterization of Digester Effluents	Region 5
		Tracing Near-Shore Nitrogen through the Ground Water flow, Cape Cod Maine (retained)	Region 1
		Natural Attenuation of Septic-system Nitrogen from Thickly Settled Coastal Zones, Falmouth, Cape Cod, MA	Region 1

[1]**Note**: While the lead Office is listed, many of these are cross-Office, cross-Program collaborations.