

## **RICHARD P. AXLER**

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## **EDUCATION**

PhD 1979 Ecology/Limnology, University of California, Davis  
BA 1970 Physics, Temple University, Philadelphia, Pennsylvania

## **RESEARCH INTERESTS**

Lake and water quality management and restoration; aquatic ecosystem responses to pollutants; nutrient cycling and food web dynamics; web-based environmental education; Lake Superior Basin stormwater impacts and mitigation; constructed treatment wetlands

## **PROFESSIONAL EXPERIENCE**

### **1988 to present**

**Research Associate** (Senior Research Associate since 1999)/Limnologist/Environmental Chemist, Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota Duluth.

- *Administer the Institute's Central Analytical Laboratory (CAL), develop and manage externally funded aquatic research programs designed to assist the state in developing its natural resources in an environmentally sustainable manner. The laboratory has also performed an outreach function by assisting local and regional commercial laboratories, consulting companies (>20), and government agencies with a variety of analyses, by consultation and by collaboration.*

### **1986 to 1988**

**Assistant Director**, Lake Mead Limnological Research Center, Environmental Research Center, University of Nevada, Las Vegas.

- *Project manager, Lake Mead Pre-Fertilization and Fertilization Studies*
- *Senior limnologist assisting with the Lake Mead/Mohave/Havasu Monitoring Program (USBR), Lake Mead Cover Enhancement Project (NV Department of Wildlife), Lake Mead Benthos Project (NOAA); co-taught lab/lecture/field course in limnology 1986 and 1987*

### **1979 to 1986**

**Staff Research Scientist**, Institute of Ecology and Division of Environmental Studies, University of CA, Davis.

- *Project Manager, McLaughlin Gold Mine-Davis Creek Reservoir Study 1984 to 1986. Advised PhD graduate student.*

- *Co-Director, Interagency Tahoe Monitoring Program, 1982 to 1984. Water quality monitoring of Lake Tahoe, CA-NV and Tahoe Basin tributaries (>12 participating local, state and federal agencies; directed 7-10 technical personnel, data analysis and preparation of all reports).*
- *Project Manager, Tahoe Basin Atmospheric Deposition Study, 1983 to 1984. Directed a study of acid and nutrient loading from atmospheric deposition.*
- *Field Director, Research Coordinator, Castle Lake Research Program, 1977 to 1983 (National Science Foundation funded). Designed and conducted experimental, process oriented studies of primary production and nutrient recycling in western, mountain lakes (co-supervised three PhD and three MS students).*
- *Teaching Fellow and Lecturer, 1979 and 1983. Taught lecture/laboratory/field course in Limnology. Guest lecturer in several environmental studies courses every year from 1978-1985.*

## 1982 to 1985

**Consulting Scientist**, to Aqua gene Tech. Ltd., San Diego, CA, a small company applying to monitor and mitigate the impacts of chemical toxicants.

## 1984 to 1985

**Contractor-Ecotoxicology**, Ecotoxicology Group, Division of Biological Sciences, National Research Council of Canada, Ottawa, ON.

- *Established ecotoxicology lab to perform chemical and radioisotope analyses, microbial rate measurements and microcosm experiments; developed generic microcosm test protocols for screening pollutant ecological impacts and risks*

## 1978 to 1986

**Consulting Scientist**, to Ecological Research Associates, Davis, CA. Served as a Senior Scientist or Project Manager for more than 20 projects involving environmental issues. Examples include:

- *Provided reservoir management consultation and critical review of lake/stream monitoring data for Yolo County, CA for use in planning and permitting the McLaughlin Gold Mine, 1984-1987.*
- *Synthesized historical data and developed conceptual models of aquatic ecosystems for the presidentially mandated 1982 Lake Tahoe Environmental Thresholds Study (Tahoe Regional Planning Agency), 1982-1985.*
- *Evaluated artificial lake designs and water quality in 5 lakes in Shoreline Regional Park, Mountain View, CA; developed monitoring program to provide early warning in case of leachate intrusion from an adjacent municipal landfill.*
- *Recommended management methods to mitigate against algal blooms while maintaining cost savings by using reclaimed water and nutrients to irrigate a municipal park, 1981-1984.*

- *Conducted microcosm and mesocosm experiments to assess the effects of nutrient discharges from secondary and tertiary treated domestic wastewater on water quality in Las Vegas Bay, Lake Mead, NV. (EPA funding via Brown and Caldwell Consulting Engineers, Inc), 1980-1981.*
- *Assessed the impacts of sediment dredging on water quality in the Santa Barbara, CA municipal water supply reservoir - Gibraltar Lake, 1980-1981.*
- *Provided technical review of research projects utilizing artificial wetlands to remove inorganic and organic pollutants from wastewater at the Santee Facility of the San Diego Region Water Reclamation Agency, CA, 1980-1986.*
- *Provided consultation regarding the design and/or management of recreational artificial lakes for homeowner's associations, engineering companies, environmental planners and municipalities, 6 projects, 1979-1985.*

## 1975 to 1979

***Dissertation Graduate Research***, Ecology Graduate Group, Division of Environmental Studies, University of CA, Davis, CA.

- *Conducted field and laboratory studies of the dynamics of inorganic nitrogen cycling in subalpine, oligotrophic Castle Lake, CA. Isotope tracer techniques with radioactive N-13 (10 minute half-life) and stable N-15 labeled nitrate and ammonium were used to directly measure the kinetics of microbial N-uptake. Additional nutrient enrichment experiments and physiological assays utilized measurements of short and long term uptake of C-14 labeled carbon dioxide. Conceptual models were developed and contrasted with marine models.*
- *Collaborated in research on food web dynamics and nutrient transformations in subalpine lakes, including Lake Tahoe, CA/NV and Crater Lake, OR.*
- *Maintained a remote mountain laboratory facility for year-round studies and participated in the field and analytical aspects of an intensive, long-term limnological monitoring program.*

## GRANTS/CONTRACTS

(during tenure at the Natural Resources Research Institute : \$ 21.8 million)

*Thrush Lake liming project: chemical analyses.* MN Department of Natural Resources and U.S. Fish and Wildlife Service. \$280,688 (PI w/J.Ameel) (1986-1992)

*Analysis of acid-sensitive lakes and streams.* MN Pollution Control Agency. \$262,175 (PI) (1988-1996)

*Assessment of phytoplankton nutrient deficiency in northern Minnesota acid-sensitive lakes.* MN Pollution Control Agency. \$15,000 (PI) (1989-1991)

*Limnological assessment of six mine pit lakes for aquaculture use.* Iron Range Resources and Rehabilitation Board, Greater Minnesota Corporation, MN Dept of Agriculture, MN Dept of Natural Resources, NRRI. \$168,763 (PI w/M.McDonald) (1989-1991)

*Commercial aquaculture: implications for water quality in mine pit lakes.* Minnesota Technology, Inc. and IRRRB. \$200,000 (PI w/M.McDonald) (1991-1993)

*Biological community of Lake Superior: the land-water interface.* Legislative Commission on Minnesota Resources. \$240,000 (Co-PI w/ 6 others) (1989-1991)

*Analysis of methoprene in MMCD wetlands.* Metropolitan Mosquito Control District. \$103,060 (PI) (1988-1993)

*Baseline limnological study for LTV Steel Mining Company.* \$121,634 (PI), (1992, 1994-1996).

*Limnological consultation and water quality analysis for the Itasca County Lake Monitoring Program.* Itasca County Soil and Water Conservation District. \$34,500 (PI) (1992-2001)

*Baseline limnological assessment for Cyprus Northshore Mining Company.* \$27,052, (PI) (1993-1994)

*St. Louis and Mississippi River sediment assessment (three contracts).* Minnesota Pollution Control Agency. \$366,460, (Co-PI w/ K. Lodge), 1993-1996

*Constructed wetlands in northern Minnesota: Development and demonstration of a novel treatment system for aquacultural wastes.* Minnesota Technology, Inc. and IRRRB. \$216,419. (PI w/S. Bridgham) (1993-1996)

*Use of Hydrothol 191 for reducing total suspended solids in waste stabilization ponds.* Elf ATOChem North America (Agrichemical Division). \$74,214. (PI) (1993-1995)

*Remediation of net-pen aquaculture water quality impacts: Predicted and observed effects of waste collection and fallowing.* Minnesota Sea Grant. \$97,097 (PI w/M.McDonald) (1994-1996)

*Demonstration of the FIS-C aquacultural bioenergetics model for optimizing feeding, estimating waste loads and assessing oxygen demand for two rainbow trout farms.* Minnesota Department of Agriculture. \$43,162 (PI) (1994-1995)

*Limnological consultation and water quality analysis for the Crow Wing County Lake Monitoring Program.* Crow Wing County Soil and Water Conservation District. \$10,000 (PI) (1992-1995)

*Knife Lake restoration project: stream and lake microcosm studies.* Knife Lake Improvement District and Blue Water Science, Inc. \$15,000. (PI) (1994-1995)

*Potential impacts of invading ruffe (*Gymnocephalus cernuus*) on benthic and pelagic systems of the Great Lakes.* National Sea Grant/NOAA. \$1,569,777. (Co-PI w/ C. Richards et al.) (1995-1999)

*On-site treatment systems for domestic wastewater: A field comparison of alternative technologies.* MTI, LCMR, EPRI, \$257,000. (Co-PI w/ B. McCarthy). (1995-1997); overall project involves multiple agencies and collaborators; total budget ~ \$626,000

*Watershed effects on stream-productivity and water quality discharge in Lake Superior tributary streams.* Minnesota Sea Grant, \$224,591. (Co-PI w/ A. Hershey, C. Richards) (1996-1999)

*Use of acousto-optical tunable filters.* (Proprietary). Minnesota Technology, Inc. \$83,525 (Co-PI w/ C. Owen) (1995-1997)

*Alternative individual sewage treatment systems pathogen/nutrient removal development and demonstration.* (Co-PI w/J. Anderson, B. McCarthy, J. Crosby (St. Louis County), P. Weidman (WLSSD), G. Sabel, [MPCA]). LCMR. \$500,000. (1997-1999)

*Sediment toxicity, contaminant concentration and benthic community structure as indicators in the St. Louis River/Duluth-Superior Harbor: A test of EMAP concepts applied to a Great Lakes area of concern.* U.S. EPA GLNPO/MPCA, \$225,000 (Co-PI with C. Richards, J. Crane [MPCA] and S. Lozano [EPA]), (1995-1997)

*Water on the Web (WOW): Monitoring Minnesota's lakes on the Internet.* National Science Foundation. \$656,756 (Co-PI w/ B. Munson, C. Hagley, G.E. Host, M. McDonald and K. Montgomery) (1997-2001)

*Assessing and communicating risk: A partnership to evaluate a superfund site on Leech Lake tribal lands.* EPA Office of Environmental Justice. \$249,781 (Co-PI w/ M. McDonald, C. Richards, J. Gunderson and C. Hagley. In Partnership with Leech Lake Reservation Tribal Council) (1997-2002).

*Alternative On-site treatment systems phase III: assessment of recirculation systems.* (Joint PI with B. McCarthy, in collaboration with St. Louis County Environmental Health Dept. and Western Lake Superior Sanitary District.) Minnesota Technology, Inc. \$234,300 (1997-1999).

*Development of fluorescence-based sensor for determination of optical brighteners: an assessment tool for wastewater contamination of sensitive water resources.* Minnesota Technology, Inc. (proprietary), \$66,765 (Co-PI w/ C. Owen, E. Tokhtuev, and R. Carlson) (1997-1999)

*In situ characteristics of ultraviolet and visible light in Rana pipiens (leopard frog) habitats.* U.S. EPA, \$200,000 (Co-PI. W/ L. Johnson) (1998-2000)

*Development of a UV-probe for the determination of nitrate in groundwater and surface water* [in partnership with Apprise Technologies, Inc]. Minnesota Technology, Inc. Industrial Partnership Fund, \$61,366. (PI) (1998-1999)

*Stormwater study of four urban lakes in Grand Rapids, MN.* Minnesota DNR, \$9,400. (PI w/R. Pierce (Minnesota DNR), R. Reed (Itasca County SWCD) (1998-99)

*LakeAccess: Making water quality data real and relevant for Minnesotans.* U.S. EPA EMPACT. \$425,000 (Co-PI w/ G. Host, C. Hagley, B. Munson collaborating with Hennepin Parks Dept, Minnehaha Creek Watershed Dist and Apprise Technologies, Inc) (1999-2000)

*Pathogen and nutrient removal by constructed wetlands for treatment of single home and small community wastewater flows.* Minnesota Sea Grant. \$80,400 +2 yr GRA, (PI w/R Hicks and-McCarthy) (1998-2001; no cost extension to 2002).

*Development of a low-cost optical based probe for detection of red-tide blooms.* National Science Foundation- SBIR. \$23,548. (PI; subcontract to Apprise Technologies, Inc) (1999 - 2001)

*On-site sewage treatment alternatives: performance, outreach and demonstration.* Legislative Commission for Minnesota Resources. (Co-PI w/J. Anderson (UM-St Paul), B. McCarthy, R. Axler, D. Gustafson (UMTC), R. Hicks (UMD-Biology), J. Crosby (St. Louis County); Pete Weidman (WLSSD); coordinated through Project Manager G. Sabel, Minnesota Pollution Control Agency. \$550,000 (NRRI=\$350,000;+\$374,024 match), (1999-2001)

*Development of an inexpensive data logging ultraviolet (UV-B) dosimeter for environmental and human health monitoring.* Minnesota Technologies, Inc. \$52,311. (PI); Industrial partner: Apprise Technologies, Inc. (A. Skirda) (1999-2001)

*Limnological re-sampling of Chisholm area mine pit lakes with reference to former aquaculture impacts.* Minnesota Pollution Control Agency. \$25,000 (PI) (1999-2000)

*Managing urban runoff using real-time, community-based monitoring to improve lake water quality.* U.S. EPA-EMPACT program. \$400,000. (Co-PI w/G. Host, C. Hagley, B. Munson, B. Liukkonen, J. Barten (Suburban Hennepin Regional Park District), G. Spiotta (Minnehaha Creek Watershed District), J. Teirney (city of Plymouth, L. Gunderson (Bassett Creek Water Management Commission), and C. Owen (Apprise Technologies, Inc.) (2000-2002)

*Great Lakes diatom indicators in the estuarine environment research program.* \$906,229. J. Kingston (PI) with R. Axler, E. Stoermer, J. Johansen, G. Sgro, R. Kreis, and Jo Thompson. To EPA-Star Program (component of omnibus proposal below)

*Development of environmental indicators of condition, integrity, and sustainability in the Great Lakes basin.* \$6,000,000. U.S. EPA STAR program. (Co-PI w/ G. Niemi, J. Hanowski, G. Host, L. Johnson, C. Johnston, J. Kingston, R. Regal, C. Richards, D. Swackhamer (all U of MN); R. Howe, U. of Wisconsin-Green Bay; B. Bedford, C. Smith, Cornell University; J. Ciborowski, U. of Windsor, Canada; J. Johansen, G. Sgro, John Carroll University, Ohio; D. Mladenoff, J. Zedler, U. of Wisconsin-Madison; E. Stoermer, U. of Michigan; U.S. EPA ORD Cooperators: S. Bradbury, G. Ankley, J. Brazner, P. Cook, N. Detenbeck, S. Diamond, J. Kelly, R. Kreis, M. Moffett, Mid-Continent Ecology Division-Duluth, MN and Grosse Ile, MI. (2001-2006)

*Training water science technicians for the future - a national on-line curriculum using advanced technologies and real-time data.* National Science Foundation Advanced Technological Education program. \$800,000 (\$600,000 to UMD and \$200,000 to Lake Superior College) (Co-PI w/ B. Munson, C. Hagley, G. Host, C. Richards, G. Merrick - [UMD-Education, NRRI, Sea Grant, LSC]) (2001-2005)

*DuluthStreams: Community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes:* U.S. EPA-EMPACT Program. \$352,000. U.S. EPA EMPACT. (PI w/ G. Host, C. Hagley, B. Munson, C. Richards; collaboration between U. of MN and city of Duluth (PI M. Lonsdale), WLSSD, Great Lakes Aquarium, and MPCA; 2001-2004.

Implementation of a performance-based code for onsite wastewater treatment in northern Minnesota. PI- replacing B. McCarthy (now at MPCA) and R. Otis (Ayres Assoc, Madison, WI). EPA Water Quality Cooperative Agreement administered by IRRRB (M. Pospeck). \$225,000 (EPA Grant) plus \$35,000 County/IRRRB match. 7/02 - 4/05.

*Managed onsite wastewater treatment systems in the Lake Superior basin: outreach and education.* \$32,253 (+ in-kind NRRI + WLSSD match of \$41,000. Minnesota's Lake Superior Coastal Program, MDNR (NOAA Prime). PI (replacing B. McCarthy). 10/02-12/04.

*Monitoring diatom algae in northeastern Minnesota: a tool for measuring past and present water quality in lakes.* Itasca County Soil and Water Conservation District and Minnesota DNR. \$184,468. Co-PI w/J. Kingston. 2001-2003.

*Limnological assistance to Itasca County, MN for lake protection tools for Itasca County.* Itasca County Soil and Water Conservation District. \$20,000. PI. 2001-2003.

*Development and analysis of multi-scale ecological stressor and response data for the St. Louis River estuary.* PI: G Host, R. Axler. NOAA/Minnesota Sea Grant. \$90,000 + 2 Yr GRA (~ \$60,000). 7/03-2/06.

*Flash flood: interactive animations of stormwater and wastewater flows in Duluth's urban watersheds.* \$2,000. UMD Visualization and Digital Imaging Lab. PI. R. Axler, J. Schomberg, G. Host. 06/04-12/04.

*DuluthStreams.org: regionalizing surface water education and outreach.* \$45,580 (total project = \$102,850). Minnesota Lake Superior Coastal Program (MDNR-NOAA prime). Partnered w/UMD Facilities Management, WLSSD, cities of Hermantown and Proctor, MN and Superior, WI. PI R. Axler, Co-PIs M. Lonsdale, C. Hagley, J. Schomberg, G. Host. 10/04-3/06.

*MinnesotaBeaches.org: Lake Superior beach monitoring and notification program website development and hosting.* \$12,500. (Co PI with G. Host). MPCA. 5/04 - 12/05. Renewed for \$3200 website maintenance, development and hosting for 7/06-6/07.

*DuluthStreams: community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes.* Services contract with city of Duluth for 2005. \$24,000, PI. 1/05-12/05.

*DuluthStreams heads north: making North Shore stream data make sense to citizens and local officials.* Minnesota Lake Superior Coastal Program (MDNR, NOAA prime) PIs Axler, Host, Schomberg, Hagley (collaborators J. Anderson, J. Mayasich, M. Lonsdale, W. Seidel) 8/05-12/06. Total award = \$95,619 + match = \$96,676 total project = \$192,952.

*Itasca County lake vulnerability-II.* \$10,413. Minnesota DNR. (PI). 4/04- 6/05.

*Assessment and development of water quality monitoring protocols for park units in the National Park Service Great Lakes Network.* Great Lakes inventory and monitoring network and NPS Cooperative Ecosystem Studies Unit. 8/03-9/05. \$36,650. PI (w/G. Host and J. Mayasich).

*Monitoring water quality in lakes within the National Park Service Great Lakes network.* \$25,849. National Parks Services Great Lakes Inventory and Monitoring Network and National Park Service Cooperative Ecosystem Studies Unit. 7/04-12/05. PI (w/J. Mayasich, E. Ruzycki).

*Omnibus monitoring protocols and framework.* National Parks Services Great Lakes Inventory and Monitoring Network and National Park Service Cooperative Ecosystem Studies Unit. 7/04-12/05. \$67,000 Co-PI (PI-G. Host).

*Development of a North Shore conservation design toolkit II.* \$10,000 addendum for FY05/06. Minnesota Office of Environmental Assistance/MPCA Storm Water Pollution Prevention Program. PI. R. Axler, C. Hagley, J. Schomberg. 07/05-06/06.

*Assessing the condition of Great Rivers using benthic and planktonic algal indicators.* \$839,999. EPA. E. Reavie (PI), L. Johnson and R. Axler. 06/05-05/10.

*Interactive animation and visualization tool for exploring Lake Superior beach monitoring program bacteria data.* \$5,000 (total project \$10,463). Minnesota Lake Superior Coastal Program. R. Axler, G. Host and H. Bauman (MPCA). 6/05-12/05.

*Hg monitoring and load estimation for Duluth streams.* \$16,000 from Western Lake Superior Sanitary District of analytical support to cover low level total and methyl-Hg analyses from Duluth area and North Shore Lake Superior streams event-based sampling. This is a collaborative effort with WLSSD involving an augmentation of the G. Host / R. Axler Sea Grant project to supplement E. Ruzycki's MS thesis with a Hg load component.

*Mitigating disturbance in tributary streams of Lake Superior.* \$35,000. PI L. Johnson (Co-PI w/G. Host, D. Breneman). National Fish and Wildlife Foundation 4/06-3/07.

*DuluthStreams/LakeSuperiorStreams* project: community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes. \$40,000 (PI) Services contract w/ city of Duluth for 2006 and 2007. 1/06- 12/07.



*MinnesotaBeaches.org*: Lake Superior beach monitoring and notification program website development and hosting. \$3,200 (Co-PI with G. Host). MPCA. 7/06-6/07.

*Stormwater planning initiative project-stormwater management planning guide website featuring ARC IMS website tool*. \$16,770 (total project with request for \$4,800 from the University of Minnesota Center for Community and Regional Research and \$4,255 from the Minnesota DNR Minnesota Lake Superior Coastal Program. Co-PI w/ G. Host, C. Hale, J. Schomberg, and J. Geissler. 7/06-6/07

*Minnesota: Western Lake Superior watersheds (mitigating disturbance in tributary streams of Lake Superior by identifying sources of thermal stress and sedimentation)*. \$98,217 (Match-\$122,684) U.S. EPA/GLNPO. EPA-GLNPO. L. Johnson (PI), V.Brady, G. Host, R. Axler, D. Breneman. 10/05-9/07. [partially funded]

*Weber Stream Restoration Initiative (WSRI)* – co-PI w/D. Breneman, L.Johnson, G.Host and V.Brady. 12/04- indefinite. \$250,000 private endowment for seed. Coordinating collaborative stream water quality effort between NRRI, Sea Grant, City of Duluth, MPCA-Duluth and S.St. Louis SWCD. Prepared Annual Reports for 2009 and 2010; website management; proposals for additional assessment work by NRRI, MPCA (Magner) and UMD-Geology (Gran) and potential for Amity Watershed to become a Minnesota Sentinel Watershed. ([www.lakesuperiorstreams.org/weber](http://www.lakesuperiorstreams.org/weber)).

*MinnesotaBeaches.org: Lake Superior Beach Monitoring and Notification Program website development and hosting*. \$25,000. (Co PI with G.Host). MPCA. 12/07 - 12/09.

*Predicting the impacts of development on Lake Superior North Shore streams using high resolution GIS spatial data*. Minnesota Sea Grant (NOAA). \$135,122. Co-PI w/L. Johnson, T. Hollenhorst and D. Breneman. 2/07-1/09. Extended to 12/10.

*Volunteer assisted water quality/biological monitoring of North Shore Superior streams*. \$229,533. MPCA Legacy Act Surface Water Assessment Program. PI w/V.Brady and D. Breneman. 4/08 – 6/10.

*Data for discovery and decision-making: LakeSuperiorStreams.org*. \$89,862 (+ \$103,400 Match). Minnesota's Lake Superior Coastal Program (NOAA/MDNR). PI with G. Host, C.Hagley and J. Schomberg. 10/08 – 6/10.

*Minnesota's water resources: climate change impacts- Part 1*. L. Johnson (PI). Project partners: Richard Axler, University of Minnesota Duluth; Virginia Card, Metropolitan State University; Raymond Newman, University of Minnesota, Heinz Stefan, University of Minnesota; Patrick Welle, Bemidji State University; Peter Ciborowski, MPCA; Don Pereira, Minnesota DNR; Kurt Rusterholz, Minnesota DNR; Edward Swain, MPCA; Bruce Wilson, MPCA; David Wright, Minnesota DNR; Jim Zandlo, Minnesota DNR. \$250,000. MN -LCCMR. 7/06-6/08

*Duluth Residential Stormwater Reduction Demonstration project for Lake Superior tributaries.* C.Kleist, V. Brady, J.Schomberg, R.Axler. MPCA 319 program grant (U.S. EPA pass-through MPCA). Cash award (total): \$167K (121K to NRRI; + equal in-kind match). 10/08 - 12/11.

*Restoring impaired Lake Superior tributaries: stormwater BMP evaluation, education and outreach.* R. Axler (PI) and D. Breneman. MPCA 319 program grant. \$103,553 (Match \$104,376). US EPA 319/MPCA. 10/07–12/11 (actual start 2/08).

*Minnesota's water resources: climate change impacts- Part 2.* L. Johnson (PI). Project partners: Richard Axler, University of Minnesota Duluth; Virginia Card, Metropolitan State University; Raymond Newman, University of Minnesota, Heinz Stefan, University of Minnesota; Patrick Welle, Bemidji State University; Peter Ciborowski, MPCA; Don Pereira, Minnesota DNR; Kurt Rusterholz, Minnesota DNR; Edward Swain, MPCA; Bruce Wilson, MPCA; David Wright, Minnesota DNR; Jim Zandlo, Minnesota DNR. \$300,000. Minnesota LCCMR. 7/07-6/10.

*DuluthStreams/LakeSuperiorStreams Project:* Community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes. \$40,000 (PI) Services contract w/ City of Duluth for 2009 and 2010. 1/1/09 to 12/31/10. Authorized by Public Works and approved by City Council.

*Weather and Water: Combining Broadcast Meteorology And Stream Data Animations To Protect Lake Superior's Streams.* \$ 42,218 (+ \$31,000 for GRA). MN Sea Grant/NOAA .Co-PI w/G.Host. 7/09-12/11. Project Collaborators G. Kessler, J. Edmondson, Broadcast Meteorologists, Northlands News Center, KBJR-TV, Duluth, MN; K. Eckman, Water Resources Center, UM-Twin Cities. Key Partners: Superior Regional Stormwater Protection Team.

*Pumped Hydro Energy Storage (PHES) Using Abandoned Mine Pits on the Mesabi Iron Range of Minnesota.* \$250,000. co-PI w/D.Fosnacht (PI, NRRI), S. Hauck (NRRI), J. Marr (SAFL), N. Johnson (Civil Eng-UMD), E. Wilson (Humphrey Inst-UM), G.Hudak (NRRI), C. Carranza-Torres (Civil Eng-UMD), J.Gulliver (SAFL-UM), M. Pollak (Humphrey Inst-UM). 7/10-10/11 (\$70,000 for Axler related component personnel, water chemistry analysis, and travel).

*Low impact development on the North Shore: Lessons learned.* Minnesota's Lake Superior Coastal program (NOAA/MDNR). \$74,573 (direct) In-kind \$106,188; Total project \$181,761. PI with J.Schomberg, and G.Host. 7/10 – 12/11.

*Minnesota Lake Superior Beach Monitoring and Notification Program: Beach Season 2010.* \$57,751. Minnesota Pollution Control Agency. 8/10-10/10.

*DuluthStreams:* Community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes. Services contract with City of Duluth for 2011-13. \$20,000/yr. PI. 1/011- 12/13. [3 yr Contract approved by City Council]

*Establishing a monitoring network in the St. Louis Estuary.* \$172,089 (~\$33K for NRRI-UMD). R. Axler co-PI w/PI J.Austin (LLO-UMD). Part of a 5 AOC proposal submitted by overall Project Manager Jennifer Read (Michigan State U.) to EPA-GLRI: "GLOS Enhanced Tributary

Monitoring to Support AOCs and LaMPs". 9/10-12/12.

*GLIC-GLEI II indicator testing and refinement Great Lakes Environmental Indicators-2.* \$1,682,986. EPA-GLRI. Co-PI (R.Axler 4%) w/PI L.Johnson, G.Niemi, E.Reavie, V.Brady, and G.Host. 7/10-6/13.

*Minnesota Lake Superior Beach Monitoring and Notification Program : Beach Season 2011.* \$5,000. Minnesota Dept of Health. 5/11-11/11. [www.MNBeaches.org](http://www.MNBeaches.org) web site operation and maintenance as service contract.

*GLOS Enterprise Architecture Project.* Limnotech, Inc. ~ \$35,000. PI L.Johnson w/E. Reavie and R.Axler. 7/10-6/11.

*St. Louis River Watershed streams & lakes: Water quality/biological monitoring.* (SWA-SLR) \$302,067. MPCA, PI w/D.Breneman, V.Brady, L.Johnson. 5/09-6/11. MN Pollution Control Agency Surface Water Assessment Grant.

*Center for Global Great Lakes Data Analysis, Synthesis and Modeling.* \$600,000. U. of MN Institute on the Environment Discovery Grants Program. Co-PI w/R. Hecky, S. Colman and G. Host. 7/09-6/12 (~ \$96,783 to NRRI-UMD). No cost extension until 6/13.

*Stressor gradients and spatial narratives of the St. Louis River Estuary.* \$239,581 (+. MN Sea Grant Special (NOAA) co-PI w/G.Host, C.Hagley, J.Schomberg, and A.Drewes (Bemidji State U.) – combined with \$239,986. WI Sea Grant Omnibus. co-PI w/J.Sibernagel, M.Wagler, D.Hart, N.Danz, and J.Schuldt. 7/10- 6/12. No cost extension until 12/2013. Total project \$479,567.

*Global Great Lakes Data Management and Visualization: Enhancing Utilization of Lake Victoria Fisheries Information for Decision Support.* \$29,900 (+\$28,411 in-kind match). University of Minnesota International Collaborative Seed Grants with a focus on Africa or Water in the World. Co-PI R.Axler with R.Hecky (LLO PI), O.C. Mkumbo (Lake Victoria Fisheries Organization); G.Host (NRRI) and N.E. Dobiesz (LLO). 5/10-8/11 (+no cost ext. to 6/13).

*Superior Basin Lakes Monitoring 2011-12.* \$16,283. MPCA Surface Water Assessment Grant (SWAG). 4/11- 6/13.

*Amity Creek Restoration Project.* \$843,616 total and \$488,493 to NRRI. PI R. Axler (~8%/yr) w/Project Manager B.Story (MPCA), D.Breneman, G.Host, V. Brady (NRRI-UMD), J.Schomberg (Sea Grant-UMD); and R.Boheim (S.St. Louis SWCD). 7/10-6/14. Funded by EPA via MPCA subcontract.

*Mahnomen: A comparative analysis of isolated inland wild rice lakes"* . \$27,260. Research collaboration with Leech Lake Tribal College, Department of Math and Sciences (S.Glidden), the Leech Lake Band of Ojibwe (LLBO) Department of Resource Management (DRM), and the U. of Minnesota Extension Service (S.Nordrum, Cass Lake, MN) – limnological consultation and water quality analyses (USDA-CSREES prime; 7/10-6/12).

*Amity Restoration Assessment: Water quality, fish, bugs, people.* \$64,555 (+\$64,555 Match) Total project \$129,110. PI R.Axler with G.Host. Minnesota's Lake Superior Coastal Program (NOAA/MDNR). 8/11-12/12.

*Establishing a monitoring network in the St. Louis Estuary.* \$106,189. R. Axler co-PI w/PI J.Austin (LLO-UMD). Continuation of a 5 AOC proposal submitted by overall Project Manager Tom Johengen, U. of Michigan from GLRI: "GLOS Enhanced Tributary Monitoring to Support AOCs and LaMPs". (Continuing operation of Lake Superior monitoring observational efforts as part of the Great Lakes Observing System). 7/10-11/13.

*A Web 2.0 guide to coastal resources, hazards and habitats.* Total project \$64,240 (\$32,058 grant + In-kind \$32,182. Co-PI w/ PI G.Host. Minnesota's Lake Superior Coastal program (NOAA/MDNR). 9/11 – 12/12.

*Event-based stream sampling in northeastern Minnesota.* \$151,419. PI R. Axler. Minnesota Pollution Control Agency. 3/12 – 6/14.

*Watershed Pollutant Load Monitoring Network (WPLMN; aka Event-based stream sampling in northeastern Minnesota).* PI R. Axler, co-PI E.Ruzycki. \$126,727 for 1/15/2014 thru 3/31/2016. Minnesota Pollution Control Agency. Contract further amended to include an additional \$135,061 for the period 1/15/2016 thru 6/30/2018 (w/PI Elaine Ruzycki, co-PIs Richard Axler and Jerry Henneck.

*Northshore Superior periphyton surveillance.* \$44,077 (+\$44,077 Match). E.Ruzycki and R.Axler. MN's L. Superior Coastal Program (NOAA/MDNR), 9/12 -12/13.

*Developing Land Intensity Data for the St. Louis River Estuary in Minnesota and Wisconsin.* \$50,000. D. Hart (PI), with L. Johnson, G. Host, and R. Axler. NOAA National Sea Grant Office and NOAA Coastal Services Center. (\$5,426 to NRRI) 2012-2013.

*St. Louis County Rainy River Headwater Lakes Assessment ("Ely Lakes").* PI E.Ruzycki, co-PI J.Henneck & R.Axler. \$17,131. MN Pollution Control Agency. 3/24/14 - 6/30/16.

*DuluthStreams: Community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes.* Services contract with City of Duluth for 2014-16. \$60,000. PI. 1/014 12/16. [3 yr contract renewal approved by City Council w/Duluth Public Works Department]

*North Shore Superior Lake and Stream Water Assessment.* PI E.Ruzycki, co-PI J.Henneck & R.Axler. \$73,330 (amended) MN Pollution Control Agency. MN Pollution Control Agency. 4/1/13 - 6/30/15.

*North Shore Superior Lake and Stream Water Assessment 2013.* MN Pollution Control Agency \$76,443. PI E. Ruzycki, Co-PI R. Axler. 4/13 – 6/15.

*Weather, Water, and People.* R.Axler, PI. \$28,373 (+\$29,003 Match). PI R. Axler. Minnesota's Lake Superior Coastal Program. 9/13-12/14.

*Minnesota Lake Superior Beach Monitoring and Notification Program: Beach Seasons 2011-2015.* \$49,000. PI R. Axler. Minnesota Dept of Health. 5/11-11/15. <http://www.MNBeaches.org> web site operation and maintenance as service contract.

*Taking Stock of Coastal Communities.* \$28,287 (+ 28,300 in-kind match). PIs J.Schomberg and K.Eckman w/Co-PI R.Axler. MN's Lake Superior Coastal Progr. (NOAA/MDNR). 8/13-12/14.

*St. Louis River Area of Concern (SLRAOC) Paleolimnology.* \$298,787. PI E.Reavie, co-PIs R.Axler and L.Allinger,. MPCA. 11/2013 10/2015.

*Long-term aquatic conditions to inform delisting efforts on the St. Louis River.* PI E.Reavie, co-PI R.Axler. MN Sea grant/NOAA. \$106,183 (+\$31,856 match+ 2 yr GRA \$86,000). 7/14 -6/16.  
*Cloquet Watershed Lake and Stream Water Assessment (plus Trout Lake).* Co-PI w/PI E.Ruzycki. \$54,000. 3/15/2015-3/15/2017. Minnesota Pollution Control Agency

*Hinckley Region Surface lake and stream water assessment (aka SWAG 2016/17 - 3/15/2016-1/15/2018; \$56,002.* Minnesota Pollution Control Agency.

*Establishing a monitoring network in the St. Louis Estuary.* \$172,089 (~\$33K for NRRI-UMD for final Year 5). R. Axler co-PI w/PI J.Austin (LLO-UMD). Part of a 5 AOC proposal submitted by overall Project Manager Jennifer Read (Michigan State U.) to EPA-GLRI: "GLOS Enhanced Tributary Monitoring to Support AOCs and LaMPs". 9/10-10/15.

*Duluth Streams Urban Watershed Restoration & Protection (WRAP): Phase I.* PI J.Schomberg and co-PI R. Axler. Minnesota Pollution Control Agency. \$154,038. 7/14-12/31/16.

*Rip current forecasting from real-time imaging and modeling.* MN Sea Grant Subaward from WI Sea Grant (PI Chin Wu, UW-Madison, co-PIs J.Schomberg, G.Host, R.Axler, UM-Duluth) \$25,126. 10/14- 9/16.

*Duluth Area Watersheds Protection Framework.* \$79,000 (+ 1:1 match). PI w/ co-PI J. Schomberg and J.Henneck. NOAA/MDNR MN's L.Superior Coastal Program. 3/16 – 6/17.

*St. Louis River AOC Data Visualization.* \$7,500 (+1:1 Match). PI NOAA/MDNR MN's L.Superior Coastal Program. 3/16 – 9/17.

*Management of NRRI Central Analytical Laborator.* Director since 1988. The Laboratory is MN Dept. of Health certified for various "conventional" EPA Clean Water Act and Safe Drinking Water Act water quality parameters specializing in low level nutrients for limnological studies of unproductive Great Lakes water resources (annual services income ~\$35-85,000/yr).

## PROFESSIONAL ACTIVITIES

### Organizations

- American Society for Limnology and Oceanography (ASLO)
- International Society for Limnology (SIL)
- Water Environment Federation (WEF)
- Central States Water Pollution Control Association
- North American Lake Management Society (NALMS)
- International Association of Great Lakes Research (IAGLR)
- Minnesota Lakes Association (MLA) and Minnesota Waters

### Teaching

- Teaching Assistant, Limnology, University of CA, Davis, 1977
- Teaching Fellow, Field and Laboratory Limnology, University of CA, Davis, 1979
- Lecturer, Limnology, University of CA, Davis, 1983
- Guest Lecturer and co-instructor, Limnology/Aquatic Ecology, University of Nevada-Las Vegas, 1986-1987
- Lecturer, Envirovet Course (U. of Illinois/UMD/UWS), 1991-1993, 1994, 1996, 1998
- Instructor, Aquatic Microbial Ecology, Biology 5900, UMD, spring 1995 (w/L. Shannon)
- Instructor, Water Pollution Biology, Biology 5871, UMD, spring 1995, (w/L. Shannon)
- Co-Instructor, Limnology, Geol/Biol/Limnol 5001, UMD, fall 1996 (w/T. Johnson, E. Brown)
- Instructor, Tools for Managing Lakes and Streams, Biology 5772, UMD, winter 1996/97 w/C. Richards)
- Instructor, Limnology, Geol/Biol/Limnol 5002, UMD, winter 1996 to 1998 (w/E. Brown)
- Instructor, Water Pollution Biology, Biol 5871, UMD, spring 1997 (w/J. Schuldt)
- Senior Member of UMD Biology Graduate Faculty (1989-present) and Integrated Biological Sciences graduate faculty (2005 to present)
- Senior Member of UM/UMD Water Resources Science Graduate Faculty (1995-present)
- External Thesis Reviewer - Lakehead University, Thunder Bay, ON Canada (MS Biol, 2001)
- External Thesis Reviewer - Murdoch University, Western Australia (PhD, 2001)
- Graduate Thesis Advisor- Chemistry (1 student), UMD
- Graduate Thesis Advisor- Biology/IBS (5 students), UMD
- Graduate Thesis Advisor- Water Resources Science (4 students), UMD
- Graduate Thesis committees- Chair (8); Member (31), UMD
- Guest Lecturer, Microbial Ecology (Biol 5677): 2 lecture/labs per course, UMD, 1990, 1992-99, 2001
- Guest Lecturer, Graduate Wetlands Ecology, UMD, 1994,
- Guest Lecturer, Water Resources Management, Geography 5440, spring 1997.
- Guest Lecturer, Managing Lakes and Streams, Biology 5678, winter/spring 2000, 2002, 2004
- UMD UROP (Undergraduate Research Opportunities Program) sponsor (C. Radosevich [1991], T. Martin [1996], P. Peterson [1996, 1997], C.Knudsen [2014], S.McMillian [2016])

- Sponsor for Gustavus Adolphus College student intern, Chemistry, summer 1994
- Sponsor for MacAlaster College student intern, Biology, summer 1998.
- Sponsor for 2 U. Wisconsin-Madison student interns 2014
- Graduate independent study (2 credits), UMD
- Undergraduate independent study (2 credits, 1993, 1995, 1996), UMD
- McNair Undergraduate Fellow, A. Moynan 2016
- Undergraduate Laboratory Assistant support (37 students), UMD
- Guest Lecturer (3-4/semester), Wetlands Ecology (BIOL 5870), Fall 2005, 2007, 2009, 2011, 2013, 2015
- Guest Lecturer (2/semester), Stream Ecology (BIOL 5833), Spring 2011, 2013
- IBS 8030 Research Club (Seminar) co-taught w/G.Trachte in Fall 2011-15.

### **Graduate students and postdocs advised**

Advisor: C.Rose, S.Yokom, J. Pundsack, D.Nordman, M.Olson, E.Ruzycki, A.Crouse, W.Bartsch Committee: J.Aaronson, P.Aas, D.Anderson, E.Alexson, L.Baily, B.Black, J.Bostrum, G.Bly, T.Connor, A. Deweese, J.Erickson, A.Fisher, M.Gearhiser, B.Keough, W.Ksoll, D.Hansen, S.Hoeheisel, J.J.Nemec-Thomas, J. Magyar-Jasperson, C.Johnson, F.Kazuba, G.Neitzel, R.Mars, K. McNaughton, J.Milan-Olker, K.Olson, D. Ongaro, R.Oster, K.Rezanka, J.Schwalbe, T.Sprague, D.Weaver, M.Wick, A.Fisher-Wold, A. Wold, P.Zigah; Post Doc: J.Schuldt.

### **Committees**

- Member, Graduate Program and Admissions Committee, Graduate Biology Faculty, University of Minnesota Duluth (1993-2002); Integrated Biological Sciences 2007-2010.
- Member, Graduate Admissions Committee, Water Resources Science Graduate Faculty, University of Minnesota-TC/Duluth (1997-2001); WRS Executive Committee 2003- 2010.
- Member, Environmental Restoration Theme Team for the Great Lakes Regional Water Program (USDA/CSREES Region 5; 2005-2009).
- Member, Lake Superior Freshwater Estuary Site Selection Team for National Estuarine Research Reserve proposal to NOAA (2007-2010)
- Member, Research and Education Technical Advisory Committees for the St. Louis River Estuary N.E.R.R. (2010-present)
- Member, Lake Superior Binational Forum, 2013-2015.
- Member, Flute Reed River Watershed Partnership, Cook County, MN. Collaborating via consultation, development of website section on [www.lakesuperiorstreams.org](http://www.lakesuperiorstreams.org), and review of materials and reports. 2007 - present.
- Member, Miller Creek Temperature TMDL Technical Advisory Group 2007-2011
- Member, Poplar River Turbidity TMDL Technical Advisory Group 2006-2011
- Member, Technical Advisory Committee for MDNR's Canisteo Pit Lake water level project 2007-2011 (review of plans, data, and monitoring designs in 2010-11)
- Member, University of Minnesota Duluth Stormwater Steering Committee (2004-present)
- Member, University of Minnesota Duluth Sustainability Technical Advisory Committee (2010-present)
- Member, Western Lake Superior Regional Stormwater Protection Team (2003-present)

- Member, Lake Superior Beach Monitoring Program Technical Committee (2002-present)
- Member, Jessie Lake, Itasca County, Minnesota TMDL Study (2005-present)
- Member, first national peer review panel for Tahoe Regional Planning Agency –Tahoe Thresholds Program, coordinated by Tahoe Science Council, U. of Nevada-Reno. 3/2012
- Member, Science Advisory Board, Great Lakes Aquarium, Duluth, MN (2001-2002)
- Member, Technical Research Advisory Committee, North Central Region Aquaculture Center (USDA sponsored) (1993-1996; 1997-2001)
- Member, Ecology Committee, Water Environment Federation (1995-1999)
- Member, Northern Counties Wastewater Technical Committee, formerly Alternative On-Site Waste Treatment Technical Committee, Arrowhead Region of N. Minnesota (1994-2008)
- Member, Grand Lake Constructed Wetland Treatment System/NERCC Steering Committee, NRRI/WLSSD/St. Louis County/Minnesota Power/ MPCA (1996-2003)
- Member, Itasca County Lake Vulnerability Steering Committee Study (1999-2006)
- Member, Minnesota Pollution Control Agency Aquaculture Rules Advisory Committee (1989- 1992)
- Member, Water Quality Technical Advisory Committee, St. Louis River/Duluth-Superior Harbor Remedial Action Plan (1990-1993)
- Member, Crater Lake National Park (OR) Scientific Advisory Panel (1982-1985)
- Technical Advisor, Task Committee on Aquatic Habitat and Sediment Transport, American Society of Civil Engineers (1985-1986)
- Panel Member, Research Coordinating Committee on the Fate of Agrochemical Residues in Food and the Environment (United Nations FAO/IAEA, 1980-1983)
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## Reviewer

*Grant proposal reviewer* for the National Science Foundation (Ecosystems, Ecology, Biocomplexity), Minnesota Technology, Inc., Minnesota Water Resources Research Center, NY Sea Grant, Ohio Sea Grant, State of Connecticut Long Island Sound Research Fund, State of Maine Water Resources Institute, American Public Health Association, U.S. Dept of Energy (Office of Energy Research), U.S.-Israel Binational Research and Development Fund, U. of MN WRC, Iron Range Resources and Rehabilitation Board, North Central Region Aquaculture Center (USDA), Bureau of Reclamation, U.S. DOE, N. Central Region Aquaculture Center / USDA, CICEET, New York Sea Grant, Western Regional Aquaculture Center/USDA, Canada-National Research Council, Maine Water Resources Initiative; U.S. Civilian Research and Development Foundation; EPA Environmental Decision Making Grant Proposal Panelist; NOAA CICEET Environmental Technology Grant Proposal Panelist. •

*Manuscript reviewer* for Limnology and Oceanography, Lake and Reservoir Management, Freshwater Biology, Hydrobiologia, Archives fur Hydrobiologia, J. of Phycology, American Naturalist, J. Plankton Research, Canadian J. Fisheries and Aquatic Sciences, Wetlands, U.S. Geological Survey, Hydrobiologia, J. of Environmental Quality, Ecological Engineering, Water Science and Technology, J. Great Lakes Res, GNLPO-SOLEC, USGS Water Quality Methods, Compass Books, N. American Lake Management Society, Canadian Biosystems Engineering, EPA-EMPACT Technology Transfer Manuals, Wiley- Interscience, several book chapters, USGS Methodology (Simultaneous persulfate TN-TP), Oceanography, N. Central Region



Aquaculture Center/USDA, Environmental Monitoring and Assessment, Water Science and Technology, Environmental Management, EPA- SOLEC; Aquaculture; Biogeochemistry, Environmental Management, EPA-MED, AAAS, New York SERDA.

## Awards

- Regents Fellowship, University of CA, 1973
- Jastro-Shields Scholarship, University of CA, 1976
- Water on the Web- U. of Minnesota 1999 Technology Enhanced Learning-Innovation Award June 8, 1999. (w/B. Munson, C. Hagley, G. Host and C. Owen)
- Water on the Web - National Extension Year 2000 Gold Award Web Page in recognition of a Web page that is an outstanding extension natural resources educational material (from the Association of Natural Resource Extension Professionals, June 2000 (to Hagley w/B. Munson, R. Axler, G. Host and G. Merrick)
- Water on the Web and LakeAccess projects team- North American Lake Management Society Year 2000 Technical Excellence Award in Education and Outreach (to R. Axler and C. Owen w/B. Munson, C. Hagley, G. Host and G. Merrick)
- Water on the Web - Sea Grant Great Lakes Network Program Leaders Superior Program Award. September 2001 (to B. Munson, R. Axler, C. Hagley, G. Host and G. Merrick)
- Alternative Onsite Wastewater Treatment Program- Certificate of Recognition from the Commissioner of the Minnesota Department of Health, Nov 2002.
- Alternative Onsite Wastewater Treatment Program - Clean Water Partners for the 21st Century Award from U.S. EPA to the Northern County Wastewater Technical Committee (10 counties) for taking extraordinary steps to protect the nation's watersheds. April 2003. This award formally recognizes the Northern Counties Wastewater Technical Committee's collective efforts in the region since 1994 to improve all aspects of the onsite wastewater treatment industry. November 2002.
- DuluthStreams.org - Environmental Leadership Award for Education and Outreach at the 4th Annual Road Salt Symposium, March 30, 2005 in St. Cloud, MN. (Freshwater Society, Minnesota Local Technical Assistance Program and Fortin Consulting).
- DuluthStreams.org received the 2004 Environmental Stewardship Award for Media from the St. Louis River Citizens Action Committee. January 2005. Superior, WI.
- DuluthStreams received an APEX award of excellence from Communications Concepts, Inc. in the special purpose video and electronic publications category. July 19, 2004.
- Water on the Web - finalist The Best Web-Based Outreach Effort -- 2005 by the NOAA National Sea Grant Network. June 6, 2005.
- Water on the Web - 2005 MERLOT Award for Exemplary Online Learning Resources. MERLOT Classics 2005. Ceremony at MERLOT International Conf., Nashville, Tennessee, July 25-28, 2005 (Multimedia Educational Resource for Learning and Online Teaching).
- DuluthStreams.org - Environmental Leadership Award for Education and Outreach at the 4th Annual Road Salt Symposium, Mar 30, 2005, St. Cloud, MN. (Freshwater Society, Minnesota Local Technical Assistance Program and Fortin Consulting).
- LakeSuperiorStreams.org project (formerly called DuluthStreams.org)- 2005 Technical Excellence Award in recognition of Outstanding Research in Stream and Lake Restoration, Protection and Management from the North American Lake Management Society (NALMS)

at the Annual NALMS International Symposium Lake Effects: Exploring the Relationship between People and Water held in Madison, WI, Nov 9-11, 2005.

- LakeSuperiorStreams.org- Great Lakes Information Network Site of the Month for Dec 2005.
- LakeSuperiorStreams.org was nominated by the U.S. EPA-MED Lab for the 2006 State of the Lakes (SOLEC) Success Stories Award for Community Education.
- LakeSuperiorStreams.org was a finalist (of 3) for the 2007 Minnesota Environmental Initiative Award for Environmental Education (<http://www.mn-ei.org/awards/finalistswinners.html>)
- LakeSuperiorStreams.org received the 2007 Lake Superior Binational Program - Environmental Stewardship and Education Award.
- Weber Stream Restoration Initiative received the 2009 St. Louis River Alliance Milton Pelletier Environmental Stewardship Award ( Organization)
- Weber Stream Restoration Initiative received the 2010 Lake Superior Binational Program Environmental Stewardship Award.
- Western Lake Superior Regional Stormwater Protection Team (RSPT) was selected as the 2012 recipient of the Water Environment Federation (WEF) Public Education Award (member)
- Weber Stream Restoration Initiative (WSRI) received the 2013 Partnership of the Year award from the Minnesota Environmental Initiative and was also a finalist in the Natural Resource Protection and Restoration category.

## **RELEVANT WEBSITES** (see Awards above)

Water on the Web (Co-Principal Investigator):

**<http://waterontheweb.org>**

LakeAccess (Co-Principal Investigator):

**<http://lakeaccess.org>**

Alternative On-Site Wastewater Treatment (PI and Co-Principal Investigator):

**<http://septic.coafes.umn.edu/Research/index.html>**

(much of the NRRI research is described and/or downloadable from this website.)

DuluthStreams & LakeSuperiorStreams (Principal Investigator) (DS evolved LSS in 2005)

**<http://duluthstreams.org>**    **<http://lakesuperiorstreams.org>**

Minnesota Beaches (Co-Principal Investigator)

**<http://mnbeaches.org>**        **<http://minnesotabeaches.org>**

Saint Louis River Estuary (Co-Principal Investigator)

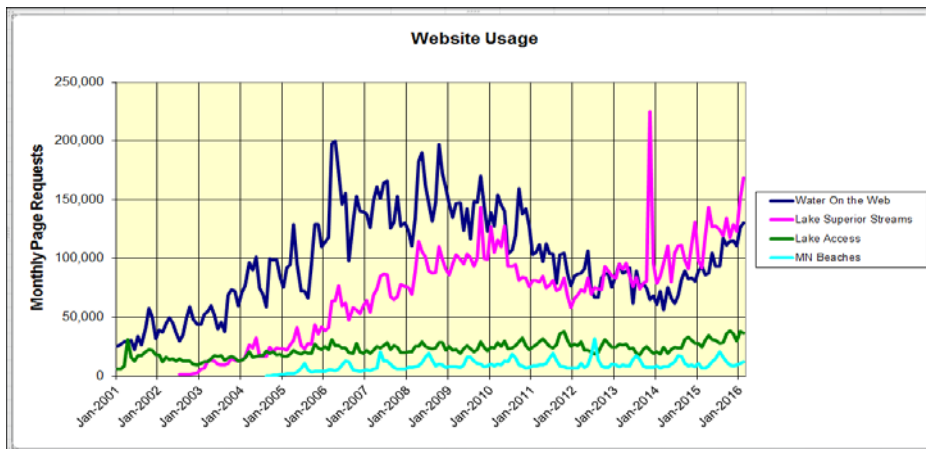
**<http://www.stlouisriverestuary.org>** (in development at **<http://stlre.pebbleonline.com/>**)

Park Point, Western Lake Superior Beach Information  
<http://www.ParkPointBeach.org>

Global Great Lakes  
<http://www.globalgreatlakes.org>

**4. Relevant Websites** - Of the websites listed below only [www.lakesuperiorstreams.org](http://www.lakesuperiorstreams.org), [www.mnbeaches.org](http://www.mnbeaches.org), [www.globalgreatlakes.org](http://www.globalgreatlakes.org), [www.stlouisriverestuary.org](http://www.stlouisriverestuary.org) (in development at <http://stlre.pebbleonline.com/>) are dynamic and continue to be improved. The websites are heavily reviewed by colleagues and agency staff affiliated with the projects and via citizens, students, faculty, consultants and agency users that provide feedback. *Water on the Web* was peer-reviewed by a National Advisory Panel comprised of academic, agency and private sector scientists and engineers, community college faculty, and university administrators. The Water Science curriculum was also reviewed and class tested by groups of 12-20 college teachers in 5 regions of the U.S, as well as by a professional educational curriculum evaluator who developed formal evaluation survey tools. The WOW limnology (lake) sections are used by the U.S. EPA’s on-line Watershed Academy curriculum as its *Lake Ecology Primer*

Overall website usage stats based on the analytical software described below shows continued high use of the oldest 3 websites, but declines for both LSS and WOW. However, these data are somewhat suspect because the seasonal patterns for both WOW and LSS have always reflected peaks in fall and spring attributable to student and teacher use during the school academic year, while the recent patterns have “flattened out.” A current summary of mean monthly page requests, a metric thought to best describe information downloaded from the websites is shown below and summary website descriptions follow.



[WaterontheWeb.org](http://www.WaterontheWeb.org) has had a pattern of growth that finally seemed to decrease to ~110- 130,000 page requests/month and ~0.5-0.8 million overall requests (“hits”) per month during Fall –Winter 2015/16. Since January 2001

**Water On the Web -- Usage Since 2001**

**General Summary**

The General Summary provides a quick overview of the general statistics for the entire web site during the report time frame.

General Summary	
1. Successful server requests	174,812,532 Requests
2. Successful requests for pages	17,727,450 Requests for pages
3. Failed requests	1,819,985 Requests
4. Redirected requests	722,883 Requests
5. Distinct files requested	37,164 Files
6. Distinct hosts served	1,964,113 Hosts
7. Total data transferred	1.969 TB

This report was generated on March 16, 2016 16:49.  
 Report time frame January 1, 2001 00:29 to February 29, 2016 23:59.

WOW has received ~175 Million successful server requests and ~ 18 Million successful requests for pages As time permits we continue editing portions of the websites to make them more “search friendly”.

**[LakeAccess.org](http://LakeAccess.org)**

This website has maintained slight growth since its last changes in 2004 and recorded ~0.4-0.9 Million “hits”/mo and ~35,000 page requests/mo in Fall/Winter 2015/16. The website has generated >60 Million Successful server requests and ~ 4 Million Successful requests for pages since September 2000.

- **[www.MNBeaches.org](http://www.MNBeaches.org)**

[www.MNBeaches.org](http://www.MNBeaches.org) usage has been consistent over its life reflecting a limited local audience. We expect it to show some growth from year-to-year due to more vigorous outreach and marketing campaign by the MN Department of Health which assumed responsibility from the MPCA beginning in 2011 and because of additional rip current, beach water temperature, and webcam information now reported on the [ParkPointBeach.org](http://ParkPointBeach.org) website. Summertime usage in 2015 ranged from 15~20,000 successful page requests which is roughly the same as it’s been used over the past 7 years.

[www.parkpointbeach.org](http://www.parkpointbeach.org) was funded by a GLRI-NOAA grant to MN Sea Grant, MI Sea Grant, and WI Sea Grant (J.Schomberg, PI). Both websites will be adapted to facilitate their use on smart phones in summer 2012. It’s summertime monthly use in 2015 ranged from ~ 10-40,000 page requests

**LakeAccess.org -- Usage Since Sep-2000**

**General Summary**

The General Summary provides a quick overview of the general statistics for the entire web site during the report time frame.

General Summary	
1. Successful server requests	59,736,644 Requests
2. Successful requests for pages	4,086,607 Requests for pages
3. Failed requests	1,096,688 Requests
4. Redirected requests	7,790 Requests
5. Distinct files requested	22,712 Files
6. Distinct hosts served	999,787 Hosts
7. Total data transferred	228.348 GB

This report was generated on March 16, 2016 16:33.  
Report time frame September 27, 2000 08:10 to February 29, 2016 23:59.

**MNBeaches.org -- Usage Since 2004**

**General Summary**

The General Summary provides a quick overview of the general statistics for the entire web site during the report time frame.

General Summary	
1. Successful server requests	6,891,798 Requests
2. Successful requests for pages	1,254,641 Requests for pages
3. Failed requests	442,393 Requests
4. Redirected requests	9,402 Requests
5. Distinct files requested	2,683 Files
6. Distinct hosts served	203,124 Hosts
7. Total data transferred	47.503 GB

This report was generated on March 16, 2016 17:31.  
Report time frame August 2, 2004 05:59 to February 29, 2016 23:53.

**ParkPointBeach.org -- Usage Since 2012**

**General Summary**

The General Summary provides a quick overview of the general statistics for the entire web site during the report time frame.

General Summary	
1. Successful server requests	5,283,797 Requests
2. Successful requests for pages	297,758 Requests for pages
3. Failed requests	232,062 Requests
4. Redirected requests	79 Requests
5. Distinct files requested	35,218 Files
6. Distinct hosts served	63,412 Hosts
7. Total data transferred	75.329 GB

This report was generated on March 16, 2016 17:36.  
Report time frame June 14, 2012 14:14 to February 29, 2016 23:31.

- [www.LakeSuperiorStreams.org](http://www.LakeSuperiorStreams.org)

This website remains the core of our present effort as an active community education website and also for the continued improvement of its data interface, its ability to allow for exploratory plotting and analysis of parameters from different data sources. It spawned the [www.globalgreatlakes.org](http://www.globalgreatlakes.org) website suite of data analysis and visualization tools (2009) which will allow fisheries managers across the Great Lakes to generate SOLEC reports, DNR reports, GLFC reports, and more importantly allow for interactive comparisons of detailed fisheries data (by species), water quality data, and physical (temp, wave height, air temp, wind speed, etc) data.

*DuluthStreams/LakeSuperiorStreams*

(LSS) continues to expand to encompass more and more surface water resource and pollution prevention issues in the region as well as a broader area than just the City of Duluth. Data collection and analysis are ongoing from 5 trout streams and the WLSSD discharge; the Poplar River was dropped in Aug 2008 due to a funding cut but a new station was installed on Miller Creek at Lake Superior College with LSC funding for the hardware and some

logistical help. LSS.org has now been enhanced by importing 2 more years (2007, 2008) of Miller data from 2 sites from its TMDL temperature study and now includes 3 years of intensive water quality, temperature and flow data from the Knife River from 2005-2007 that was collected during its turbidity TMDL study. We have also imported historic St. Louis River bacteria and water quality data via a current Coastal Program grant, 6 years of nearshore Lake Superior temperature profile data (via J.Austin, LLO-UMD), and 12 years of wastewater treatment plant discharge data from WLSSD.

**NEW for 2016** – A new NOAA/MDNR grant will allow us to install telecommunications equipment on 3 new trout streams in 2016: Lower Miller Creek, Merritt Creek, and Keane Creek. We are also continuing to pursue obtaining a telecommunications permit from MNDOT for the GLOS Blatnik Bridge station in the lower St. Louis River.

Website usage in the region is expected to grow as we continue to important new intensive, real-time data streams from collaborative projects with the Large Lakes Observatory, and the St. Louis River Estuary N.E.R.R. consortium (sensor data from 5 deepwater buoys, 1 western arm buoy, and 3-4 new St. Louis River Estuary buoys that began in 2012).

DS/LSS has received critical review and guidance via its original Partnership and via the Superior Regional Stormwater Protection Team (RSPT, see awards) that the project helped found. In 2005/2006 it was partially re-designed and re-named [lakesuperiorstreams.org](http://lakesuperiorstreams.org) to include the larger region around Duluth including sections for South Shore communities and

**LakeSuperiorStreams.org -- Usage Since 2002**

**General Summary**

The General Summary provides a quick overview of the general statistics for the entire web site during the report time frame.

General Summary		
1.	Successful server requests	49,063,058 Requests
2.	Successful requests for pages	11,730,051 Requests for pages
3.	Failed requests	622,131 Requests
4.	Redirected requests	20,126 Requests
5.	Distinct files requested	27,359 Files
6.	Distinct hosts served	1,811,267 Hosts
7.	Total data transferred	994.871 GB

This report was generated on March 16, 2016 16:15.  
Report time frame March 22, 2002 20:38 to February 29, 2016 23:59.

streams. It also now includes a Site Design Toolkit section for contractors and developers, as well as planners, realtors and home-owners. We continue to add features that are relevant to a wide variety of audiences with the focus in 2011 being the incorporation of an on-line atlas of Low Impact Design best management practices for reducing and cleaning stormwater runoff. From March 2002 through February 2016 it received >49 Million requests and ~12 Million successful page requests with a bit of a growth spurt since 2013. Additional website usage statistics have been generated since 2003 via software shown below.



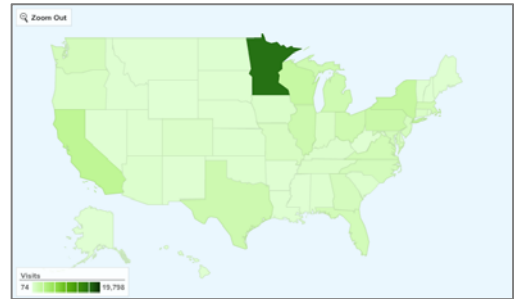
[Analog 6.0](#)



[Report Magic 2.21](#)

In May 2007 we also began using *Google Analytics* software to track usage of the main pages on the website. *Analytics* uses internal and third-party data to derive visitors' locations from their IP addresses, which gives us a general idea of our users' geographical distribution:

- In 2011 there were users in 173 countries.
- US users accounted for 78.5% of these visits.
- The distribution by state is quite consistent – MN is ~30% of US visits, WI is ~5%, and the other Great Lakes states are usually in the top 10, each at about 3% of the US visitors.
- Europe/Asia visits increased from 8% of all visits in 2007 to 12% in 2011.

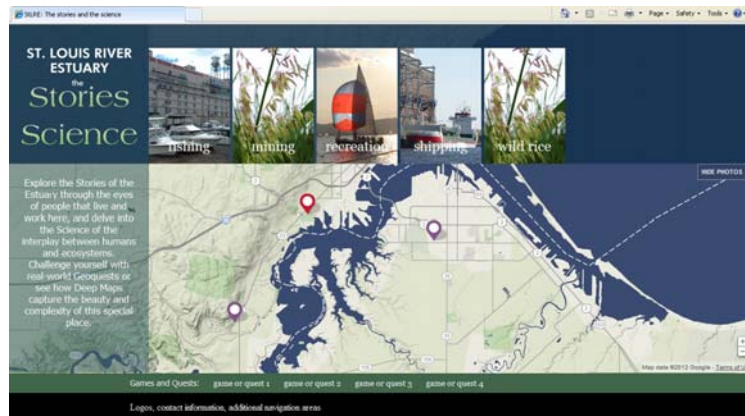


- [www.globalgreatlakes.org](http://www.globalgreatlakes.org) remains in development since funding ended in 2014 (PI R.Hecky at LLO-UMD).



- [www.stlouisriverestuary.org](http://www.stlouisriverestuary.org)

This project, funded jointly by MN and WI Sea Grant is dynamic and has now been supported for the past 2 years via grants from the MPCA and WDNR as a vehicle for informing the public about the progress of the St. Louis River AOC restoration.





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### **Papers/Reports In draft** (submission optimistically expected by Jun 2017)

Axler, R., A. Crouse, N. Will, and G. Host. Weather, Water, and People: Combining broadcast meteorology and water quality data animations to protect Lake Superior Basin waters. *J. of Extension Education*.

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- Axler, R., C. Rose and C. Tikkanen. 1993. Phytoplankton nutrient deficiency as related to atmospheric nitrogen deposition in northern Minnesota acid-sensitive lakes. Sixty-first annual meeting of the Minnesota Academy of Science.
- Axler, R., C. Tikkanen, C. Larsen, P. Aas and M. McDonald. 1993. Water quality impacts of net-pen salmonid aquaculture on mine pit lakes. American Society of Limnology and Oceanography annual meeting, Edmonton, AL, Canada.
- Axler, R., C. Larsen, C. Tikkanen, M. McDonald, P. Aas and S. Yokom. 1994. Water quality issues associated with aquaculture: a case study in mine pit lakes. 14th International Symposium of the North American Lake Management Society, Orlando, FL.
- Axler, R., C.Owen, J.Ameel, Julia Schlotec, E. Ruzycki, Jerry Henneck and Kent Johnson. 1995. MPCA annual Wastewater Operations Seminar, St. Paul, MN, March 1995.
- Axler, R., C. Owen, J. Ameel and E. Ruzycki. Effects of the herbicide Hydrothol 191 (amine salt of endothall; liquid) on algae in eutrophic ponds: phytotoxicity and persistence of endothall. Presented at 14th Annual International Symposium of the North American Lake Management Society, Orlando, FL, November 1994. Abstract
- Axler, R., C. Rose, and C. Tikkanen. Phytoplankton nutrient deficiency as related to atmospheric nitrogen deposition in northern Minnesota acid-sensitive lakes. Minnesota Water '94, Minneapolis, MN, April, 1994. Poster/Abstract
- Axler, R., C. Larsen, C. Rose, and C. Owen. Primary productivity in western Lake Superior. Conference on Ecosystem Management Strategies for the Lake Superior Region, Duluth, MN, May 16-18, 1994.
- Axler, R., C. Larsen, C. Tikkanen, S. Yokom, M. McDonald and P. Aas. Aquaculture impacts on water quality: a case study in mine pit lakes. Sigma Xi poster meeting, University of Minnesota Duluth. Feb 13-17, 1995.
- Axler, R.P., S. Bridgham, C. Tikkanen, J. Henneck, A. Bamford and M. McDonald. Constructed wetlands in northern Minnesota for treatment of aquaculture wastes. Abstract for Society for Wetland Scientists 16th annual meeting, May 28-June 2, 1995, Boston, MA.

- Axler, R. et al. Environmental impacts of aquaculture: environmental and regulatory perspectives. Invited speaker for seminar series Integrated Aquatic Resource Management, Bemidji State University, Bemidji, MN. April 25, 1995
- Axler, R. et al. Methods for characterizing aquacultural waste effluents. Biology department seminar, Bemidji State University, Bemidji, MN. April 26, 1995.
- Axler, R. B. McCarthy, J. Crosby, P. Wiedman, S. Monson-Geerts, J. Henneck and D. Nordman. On-site treatment systems for domestic wastewater: A field comparison of alternative technologies. Minnesota Lakes Association. Duluth, MN. May 3-4, 1996.
- Axler, R. and J.E. Reuter. Competition for nitrate between phytoplankton and periphyton: An integration of whole-lake and mesocosm N15 experiments with a long-term data set from an oligotrophic lake. Annual meeting of the American Society of Limnology and Oceanography, Reno, NV, June 12-16, 1996.
- Axler, R. et al. Real versus perceived environmental impacts of aquaculture on mine pit lakes in northeastern Minnesota. Presentation to Minnesota Sea Grant Advisory Board, Duluth, MN, August 1996.
- Axler, R.P., J. Henneck, S. Bridgham, C. Tikkanen, D. Nordman, A. Bamford, and M.E. McDonald. Constructed wetlands in northern Minnesota for treatment of aquaculture wastes. North American Lake Management Society, annual meeting, Minneapolis, MN, Nov 11-15, 1996.
- Munson, B., R.P. Axler, C.A. Hagley, G. Host, K. Montgomery and C.J. Owen. Water on the Web: monitoring Minnesota's lakes on the Internet. National Science Foundation Advanced Technology Education Program and the American Association of Community Colleges in Washington, DC, November 21-23, 1997.
- Axler, R., B. McCarthy, J. Crosby and P. Weidman. 1997. Alternative on-site treatment systems for wastewater treatment: A demonstration and research project for Minnesota. Minnesota Lakes Association Meeting, Duluth, MN, May 3-5, 1997.
- Axler, R. et al. Real versus perceived environmental impacts of aquaculture on mine pit lakes in northeastern Minnesota. May 1997. Presentation to Minnesota Sea Grant advisory board, Duluth, MN.
- Munson, B., R.P. Axler, C. Hagley, G. Host, G. Merrick and C.J. Owen. Water on the Web: Integrating real-time data into educational curricula over the Internet. Water on the Web: monitoring Minnesota's lakes on the Internet. National Science Foundation Advanced Technology Education Program and the American Association of Community Colleges in Washington, DC, November 21-23, 1998.
- Peterson, G.S., R.P. Axler, K.B. Lodge, J.A. Schuldt and J.L. Crane. Evaluation of a

fluorometric screening method for predicting total PAH concentrations in contaminated sediments. Annual meeting of the Society for Environmental Toxicology and Chemistry, November 15-19, 1998, Charlotte, NC.

Axler et al. Performance of alternative treatment systems in northern Minnesota. Minnesota Water 1998. Minneapolis, MN. May 1998.

Peterson, G.S., R.P. Axler, J.A. Schuldt, and C. Richards. Mesocosm studies of ruffe (*Gymnocephalus cernus*) in the St. Louis River system: effects on primary production and water column and sediment nutrient dynamics. Ninth International Zebra Mussel and Aquatic Nuisance Species Conference, Duluth, MN, April 26-30, 1999

Axler, R., B. Munson, C. Hagley, G. Host, G. Merrick, K. Montgomery, and C. Owen. Water on the web: monitoring Minnesota's lakes on the Internet. Annual meeting of the North American Benthological Society, Duluth, MN. May 1999.

Ruzycki, E.M. R.P. Axler, A.P. Wold, and A.E. Hershey. Epilithon nutrient limitation in streams of forested, urban, and wetland watersheds along the North Shore of Lake Superior. Presented at the annual meeting of the North American Benthological Society, Duluth, MN, May 1999.

Host, G., Axler, R., B. Munson, C. Hagley, G. Merrick, K. Montgomery, and C. Owen. Water on the web: monitoring Minnesota's lakes on the Internet. Presented at TechFest, University of Minnesota Duluth, March 19-20, 1999.

Axler, R.P., B. Munson, C.A. Hagley, G. Host, G. Merrick, K. Montgomery, and C.J. Owen. Water on the Web: monitoring Minnesota's lakes on the Internet, poster/website demo presented at the annual meeting of the American Society of Limnology and Oceanography, Santa Fe, NM, Feb 1-5, 1999.

Axler, R. and G. Host. Water on the Web. Seminar presented at the Natural Resources Research Institute, University of Minnesota Duluth, January 5, 1999.

Munson, B., R.P. Axler, C.A. Hagley, G. Host, G. Merrick and C.J. Owen. Water on the Web (WOW): integrating real-time data into educational curricula over the Internet. Water on the Web: monitoring Minnesota's lakes on the Internet. National Science Foundation Advanced Technology Education Program and the American Association of Community Colleges in Washington, DC, November 21-23, 1998.

Axler, R.P., J. Henneck, J. Pundsack, R. Hicks, B. McCarthy, D. Nordman and S. Monson-Geerts, J. Crosby and P. Weidman. Cold climate performance of constructed wetlands for removing pathogens and nutrients from domestic wastewater in northern Minnesota. In Proceedings of the Third National Workshop on Constructed Wetlands/BMPs for Nutrient Reduction and Coastal Water Protection, June 10-11, 1999, New Orleans, LA.

- Axler, R.P., J. Henneck, D. Nordman, B. McCarthy, and S. Monson-Geerts. 1999. Operation and maintenance experiences with constructed wetlands in Minnesota. In Proceedings for the National On-Site Wastewater Recycling Association 8<sup>th</sup> annual conference, November 3-6, 1999 Jekyll Island, Georgia.
- Peterson, G.S., L.B. Johnson, R.P. Axler, E.M. Ruzycki, L.P. Anderson, and S.A. Diamond. In *situ* characterization of ultraviolet light in *Rana pipiens* (Leopard Frog) habitats. annual meeting of the Society for Environmental Toxicology and Chemistry, November 1999, Philadelphia, PA.
- Axler, R., B. McCarthy, J. Henneck, S. Monson-Geerts, D. Nordman, J. Crosby and P. Weidman. Cold climate comparison of alternative onsite treatment technologies for removing pathogens and nutrients from domestic wastewater in northern Minnesota. annual meeting of the North American Lake Management Society, Reno, NV, Dec 1-5, 1999.
- Axler, R. B. Munson, C. Hagley, G. Host, G. Merrick and C. Owen. Water on the Web: monitoring Minnesota's lakes on the Internet. annual meeting of the North American Lake Management Society, Reno, NV, Dec 1-5, 1999.
- Axler, R., C. Hagley and S. Hutchins. Water on the Web Lecture/Lab, Lake Ecology Workshop, Itasca Community College and MN Dept. of Natural Resources, Grand Rapids, MN, March 30, 2000.
- Host, G., R. Axler, B. Munson, and C. Hagley. Water on the web (WOW): Monitoring Minnesota's lakes on the Internet. Presented at TechFest, University of Minnesota Duluth, March 19-20, 1999 and March 10, 2000.
- Hagley, C.A., R.P. Axler, G. Host, B.H. Munson, G. Merrick, C.J. Owen, B.L. Liukkonen, and J. Barten, Water on the Web and LakeAccess: students and community members monitoring Minnesota rivers and lakes over the Internet. Second National Extension Natural Resources Conference, sponsored by the USDA Cooperative Research, Education, and Extension Service Natural Resources and Environment and the Association of Natural Resources Extension Professionals, Stateline, NV, May 16-18, 2000.
- Owen, C.J., R. Race, G. Host, R. Axler, B. Munson, C. Hagley. Low-cost profiling systems for marine and freshwater applications. Woods Hole Oceanographic Institution/Office of Naval Research / Marine Technology Society sponsored Oceanographic Buoy Workshop 2000 seminar. May 9-11, 2000.
- Monson-Geerts, S., B. McCarthy, R. Axler and J. Henneck. Performance of peat filters in the treatment of domestic wastewater in northern Minnesota, USA. Quebec 2000 Millennium Wetland Event, International Peat Association Symposium, Quebec City, QC, Canada, August 6-12, 2000.
- Axler, R., J. Henneck, B. McCarthy, J. Pundsack and R. Hicks. Cold climate performance of SSF

constructed wetlands for septic tank effluent in Minnesota. Poster presented at Wetland technology for water treatment, Special Symposium of the International Society of Ecologists, Millennium Wetland Event, Quebec City, QC, Canada, Aug 6-12, 2000.

Host, G. E., R. P. Axler, J. Barten, C. A. Hagley, B. Liukkonen, B. Munson, C. J. Owen and G. Spiotta. LakeAccess EMPACT project: Advanced remote sampling and data visualization tools for delivering and interpreting real-time water quality information on urban lake systems. EPA National Environmental Monitoring Technology Conference, Boston, MA, Sept 19-20, 2000.

Axler, R., J. Barten, B. Munson, C. Hagley, G. Host, G. Merrick and C. Owen. Water on the web (WOW): monitoring Minnesota's lakes on the Internet and LakeAccess: community members monitoring Minnesota lakes over the Internet. Annual meeting of the North American Lake Management Society, Miami, FL, Nov 2000.

Axler, R., G. Host and C. Hagley (Minnesota Sea Grant) presented the seminar Water on the Web and LakeAccess: monitoring Minnesota lakes over the Internet to the UMD Department of Biology, November 3, 2000.

Axler, R., J. Henneck and B. McCarthy. 2000. Residential subsurface flow treatment wetlands in northern Minnesota. 7<sup>th</sup> International Conference on Wetland Systems for Water Pollution Control, Nov. 11-16, 2000, Lake Buena Vista, FL.

Axler, R., B. Munson, G. Host, C. Hagley, G. Merrick, C. Owen, B. Liukkonen, and J. Barten. Water on the web and LakeAccess: students and community members monitoring Minnesota lakes over the Internet. 62nd Annual Midwest Fish and Wildlife Conference, Minneapolis, MN, Dec 3-6, 2000.

Axler, R.P., J.R. Henneck and M.E. McDonald. Mine pit aquaculture in Minnesota: perspectives on the environmental and regulatory issues, 1988-1999. 62nd Midwest Fish and Wildlife Annual Conference in Minneapolis, MN, Dec. 3-6, 2000. Special Symposium on Environmental Strategies for Aquaculture (invited speaker / panelist)

Hagley, C.A., R.P. Axler, G.E. Host, B.H. Munson, G.W. Merrick, J.M. Barten, and C.J. Owen. 2001. Using live data to teach about water - Water on the Web (WOW) and LakeAccess. Presented at the American Society of Limnology and Oceanography national meeting, Feb 12-16, 2001, Albuquerque, NM.

Henneck, J., R. Axler, B. McCarthy, S. Monson-Geerts, S. Heger Christopherson, J. Anderson and J. Crosby. 2001. Onsite treatment of septic tank effluent in Minnesota using SSF constructed wetlands: performance, costs and maintenance. Proceedings of Ninth National Symposium on Individual and Small Community Sewage Systems, Fort Worth, TX, 2001, March 11-14, 2001. American Society of Agricultural Engineers, St. Joseph, Michigan.

Monson-Geerts, S., B. McCarthy, R. Axler, J. Henneck, S. Heger, J. Crosby and M. Guite. 2001.



Performance of peat filters in the treatment of domestic wastewater in Minnesota. Ninth National Symposium on Individual and Small Community Sewage Systems, Fort Worth, TX, March 11-14, 2001. American Society of Agricultural Engineers, St. Joseph, MI.

Axler, R. Pathogen and nutrient removal by constructed wetlands for treatment of single home and small community wastewater flows in cold climates. April 19, 2001. Presentation to Minnesota Sea Grant Advisory Board, Duluth.

Kingston, J.C., G. Sgro, J.R. Johansen, K.S. Domzal, E.F. Stoermer and R.P. Axler. Diatom indicators of water quality for the coastal zone of the Laurentian Great Lakes. American Assoc. Limnology and Oceanography Annual Conference, Salt Lake City, UT. June 2002.

Munson, B., R. Axler, C. Hagley, G. Host, G. Merrick and C. Richards. 2002. Training water science technicians for the future - a national on-line curriculum using advanced technologies and real-time data. ATE Principal Investigators Conference, Assessing the Impact, October 24-26, 2002 hosted by the American Association of Community Colleges in collaboration with the National Science Foundation. Washington, DC.

Munson, B., R. Axler, C. Hagley, G. Host, G. Merrick and C. Richards. 2003. Training water science technicians for the future -a national on-line curriculum using advanced technologies and real-time data. ATE Principal Investigators Conference, Assessing the Impact, October 22-24, 2003 hosted by the American Association of Community Colleges in collaboration with the National Science Foundation. Washington, DC.

Axler, R., C.Hagley, G. Host, B.Munson, G. Merrick and C.Richards. DuluthStreams: Automated sensing and data visualization for understanding urban stormwater issues. National Science Foundation workshop. Frontiers in Assessing and Monitoring the Environment poster, August 11-12, 2003. Minneapolis, MN.

Host, G., R. Axler, C. Hagley, B. Munson, G. Merrick and C. Richards. Internet-based remote sensing and visualizations of water quality information: education applications for specialists and citizens. National Science Foundation workshop. Frontiers in Assessing and Monitoring the Environment. August 11-12, 2003. Minneapolis, MN.

Axler, R. Two talks for the Minnesota Sea Grant National Program assessment team in Duluth, Sep 15-16, 2003: Cold climate performance of alternative, on-site domestic wastewater treatment systems and DuluthStreams.org: stormwater education using automated monitoring and advanced data visualization tools.

Lonsdale, M., R. Axler, C. Hagley, G. Host, C. Richards and B. Munson. 2003. DuluthStreams: community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes. Urban storm water: enhancing programs at the local level, February 17-20, 2003, Chicago, IL; Chicago Botanic Garden and U.S. EPA.

Johnson, J., J. Barten, G. Host, R. Axler, B. Liukkonen and C.Hagley. 2003. *LakeAccess*: effects

of lawn fertilizer phosphorus on runoff from urban watersheds. Society for Conservation Biology annual meeting, Duluth, MN, June 28-July 2, 2003.

Kingston, J., D. Engstrom, E. Swain, E. Stoermer, J. Johansen, G. Sgro, K. Yanko, A. Kireta and R. Axler. Paleolimnological assessment of ecosystem condition in Great Lakes drowned river mouths. Society for Conservation Biology annual meeting, Duluth, MN Jun 28-Jul 2, 2003.

Hagley, C., R. Axler, G. Host, G. Merrick, B. Munson and C. Richards. 2003. Water on the web: training water science technicians with an online, data-rich curriculum. Society for Conservation Biology annual meeting, Duluth, MN June 28-July 2, 2003.

Axler, R., M. Lonsdale, C. Hagley, G. Host, B. Munson and C. Richards. 2003. DuluthStreams: community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes. Society for Conservation Biology annual meeting, Duluth, MN June 28-July 2, 2003.

Johnson, J., J. Barten, G. Host, R. Axler, B. Liukkonen, and C. Hagley. 2003. LakeAccess: effects of lawn fertilizer phosphorus on runoff from urban watersheds. Society for Conservation Biology annual meeting, Duluth, MN June 28-July 2, 2003.

Kingston, J., D. Engstrom, E. Swain, E. Stoermer, J. Johansen, G. Sgro, K. Yanko, A. Kireta and R. Axler. 2003. Paleolimnological assessment of ecosystem condition in Great Lakes drowned river mouths. (Abstract) Society for Conservation Biology annual meeting, Duluth, MN June 28-July 2, 2003. (poster not displayed because of illness)

Axler, R., E. Ruzycki, J. Reed, J. Henneck, N. Will and G. Host; M. Lonsdale (city of Duluth, MN); C. Hagley, J. Schomberg, C. Richards and B. Munson (Minnesota Sea Grant). DuluthStreams.org: web-based delivery of automated data using advanced data visualization techniques for understanding urban stormwater and water quality issues. Minnesota Water 2004 in Minneapolis, March 23-24, 2004.

Johnson, J. and J. Barten (Three Rivers Park District); George Host and Rich Axler; Barb Liukkonen (Minnesota Sea Grant). Restricting the use of phosphorus fertilizer to improve water quality: an urban watershed experiment (LakeAccess.org). Minnesota Water 2004 in Minneapolis, March 23-24, 2004.

Hagley, C., B. Munson and C. Richards (Minnesota Sea Grant; R. Axler, G. Host, E. Ruzycki, J. Reed and N. Will; G. Merrick (Lake Superior College). The new Water-on-the-Web (WOW): a two semester water resource management course on the web. Minnesota Water 2004 in Minneapolis, March 23-24, 2004.

Reavie, E.D., Kireta, A., Sgro, G.V., Johansen, J.R., Kingston, J.C., Axler, R.A., Stoermer, E.F. Diatom indicators of environmental condition in Great Lakes coastal ecosystems. Estuarine and Great Lakes Coastal Initiative program (EaGLE) annual meeting, Duluth, MN, 30 September-1 October 2004.

- Sgro, G.V., Reavie, E.D., Kireta, A., Johansen, J.R., Kingston, J.C., Axler, R.A., Stoermer, E.F. Diatom indicators of environmental condition in Great Lakes coastal ecosystems. John Carroll University biology seminar, University Heights, OH, 27 September 2004.
- Sgro G.V., Yanko, K.S., Johansen, J.R., Kingston, J.C., Kireta, A., Axler, R.A. A comparison between core sample and grab sample diatom data for nearshore sites in the Great Lakes. Forty-seventh annual conference on Great Lakes Research, Waterloo, ON, 24-28 May 2004.
- Sjerven, G., G. Host, J. Schomberg and R. Axler. 2004. Exploring the DuluthStreams Website. Session 21, 14th annual MN GIS/LIS conference and workshops in St. Cloud, MN, October 4-6, 2004.
- Hagley, C., R. Axler, G. Host, and N. Will. DuluthStreams: web-based delivery of real-time stormwater and water quality automated data using user-friendly data visualization tools making data come alive for decision-makers, for display and presentation during the symposium, Best Education Practices (BEP) for Water Outreach Professionals: Defining BEPs, Refining Resources and Recommending Future Actions. U. of Wisconsin-Madison. June 2-4, 2004.
- Olker, J.H., L.B. Johnson, R.P. Axler, and C.M. Johnson. 2004. Ultraviolet-B radiation dose to wood frogs (*Rana sylvatica*) in northern Minnesota vernal pools. Annual meeting of the North American Benthological Society, Vancouver, BC, Canada. June 6-10, 2004
- Host, G., R. Axler, B. Munson, C. Hagley, and C. Richards. Remote underwater sensing technology and data visualization. In Future of Open Water Observation Technology for the Great Lakes workshop, sponsored by the National Oceanic Atmospheric Administration and the International Joint Commission, Arbor, MI, Nov 30-Dec 3, 2004.
- Axler, R. 2004. Using time-relevant, intensive lake and stream data for training technicians and educating citizens, students, resource agencies and decision-makers. In Sensors for Environmental Observatories, National Science Foundation Environmental Engineering Directorate sponsored workshop, U. of Washington, Seattle, Nov 30-Dec 2, 2004. [Co-authors: G. Host, N. Will, E. Ruzycski, J. Reed, J. Henneck and G. Sjerven; C. Hagley, J. Schomberg and C. Richards (Minnesota Sea Grant); B. Munson (UMD Education); C. Owen (Apprise Technologies, Inc); M. Lonsdale, T. Carlson, (city of Duluth); J. Barten, J. Johnson and B. Vlach (Three Rivers Park District, formerly Hennepin Parks)].
- Munson, B., R. Axler, C. Hagley, G. Host, G. Merrick and C. Richards. Model inquiry lessons through water quality investigations. Presented at the annual conference for the Association for the Education of Teachers in Science, Colorado Springs, CO. Jan 2005.
- Hagley, C.A. Axler, R.P., Host, G., Munson, B., Richards, C., and E. Ruzycski. Water on the Web: lake and stream data-rich teaching resources. American Society of Limnology and Oceanography 2005 Aquatic Sciences Meeting. Feb 20-25, 2005, Salt Lake City, UT.

Axler, R., E. Ruzycski and T. Carlson. DuluthStreams: visualization and interpretation of road salt runoff into Duluth urban trout streams using *in situ* sensors and advanced data visualization tools. Fourth annual Road Salt Symposium, March 30, 2005 in St. Cloud, MN. (Freshwater Society, MN Local Technical Assistance Program and Fortin Consulting).

Munson, B., R. Axler, C. Hagley, G. Host, G. Merrick and C. Richards. Inquiry, data, and the Internet. Institute of Ecosystem Studies, Millbrook, NY, (invited speaker). Apr 2005.

Axler, R., Lonsdale, M., Hagley, C., Reed, J., Host, G., Schomberg, J., Richards, C., and Munson, B. DuluthStreams: web-based delivery of real-time stormwater and water quality automated data using user-friendly data visualization tools. Making data come alive for decision-makers. International Association of Great Lakes Research 2005 annual meeting: Great Lakes Ecosystem Forecasting-Improving Understanding and Prediction, May 23-27, 2005, Ann Arbor, MI.

Reavie, E.D., Sgro G.V., Kireta A., Johansen J.R., Kingston J.C., Axler R.A. New diatom-based tools to assess environmental disturbance in Great Lakes coastal ecosystems. Forty-eighth annual conference on Great Lakes Research, Ann Arbor, MI, 23-27 May 2005.

Kireta A., Reavie, E.D., Sgro G.V., Johansen J.R., Kingston J.C., Axler R.A. Importance of geomorphic characteristics in developing diatom models in the near-shore Great Lakes. Forty-eighth annual conference on Great Lakes Research, Ann Arbor, MI, 23-27 May 2005.

Sgro G.V., Reavie, E.D., Johansen J.R., Kingston J.C., Kireta A., Axler R.A., Ferguson, M.J. Comparison of benthic diatom indices of habitat quality in the Laurentian Great Lakes. Forty-eighth annual conference on Great Lakes Research, Ann Arbor, MI, 23-27 May 2005.

Ruzycski et al. LakeSuperiorStreams.org project. Poster at First Annual Regional Stormwater Protection Team Water Festival, Jun 4, 2005, Duluth, MN.

Hagley, C.A., Axler, R.P., Host, G., Munson, B., Richards, C., Ruzycski, E., and N. Will. Water on the Web: an award-winning educational web site featuring real-world lake and river data. Nat. Sea Grant Week 2005: Rising to Tomorrow's Coastal Challenges. Jun 3-8, Camden, ME.

Axler, R. Minnesota lakes and streams research highlights: web animations and remote sensors for managing water quality. NRRI 20th Anniversary Program. Sep 22, 2005. Duluth, MN

Axler, R., C. Hagley, B. Munson and G. Host. Water on the Web: lake and stream data-rich teaching resources. USDA-CSREES Tribal Water Quality Facilitation Grant Summit, Oct 17-19, 2005, Polson, MT.

Hagley, C., B. Munson, R. Axler, G. Host, C. Richards, E. Ruzycski, N. Will, J. Reed and G. Merrick. Water on the web: lake and stream data-rich teaching resources. Minnesota Water

2005, Minneapolis, MN. October 2005.

Ruzycki, E., J. Reed, R. Axler, G. Host, N. Will, J. Henneck, M. Lonsdale, C. Hagley, J. Schomberg, C. Richards and B. Munson. DuluthStreams: community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes. Minnesota Water 2005, Minneapolis, MN. October 2005.

Axler, R., M. Lonsdale, G. Host, J. Reed, E. Ruzycki, C. Hagley, J. Schomberg, C. Richards and B. Munson. DuluthStreams to LakeSuperiorStreams: making stormwater and stream data come alive for citizens, students, resource agencies and decision-makers. Minnesota Water 2005, Minneapolis, MN. October 2005.

Hagley, C. Axler, E. Ruzycki, G. Host, J. Schomberg, M. Lonsdale. DuluthStreams: community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes. Self-Sustaining Solutions for Streams, Wetlands and Watersheds, Sep 12-15, 2005, St. Paul MN.

Axler, R., and M. Lonsdale. Delivery of real-time water quality data from trout streams using advanced visualization tools over the Internet for addressing phase II stormwater education requirements and pollutant tracking: DuluthStreams.org. American Public Works Association, International Public Works Congress and Exposition. Sep 11-14, 2005 Minneapolis, MN.

Jereczek, J.C., E. Ruzycki and R. Axler. Lake protection tools for Itasca County, MN: assessment of WILMS and MNLEAP water quality predictions. Twenty-fifth International Symposium. Lake Effects: Exploring the Relationship between People and Water, North American Lake Management Society, Nov 9-11, 2005. Madison, WI.

Johnson, J., J. Barten (Three Rivers Park District); G. Host and R. Axler; B. Liukkonen (Minnesota Sea Grant). Restricting the use of phosphorus fertilizer to improve water quality: an urban watershed experiment (LakeAccess.org). NALMS 2005: 25th International Symposium. Lake Effects: Exploring the Relationship between People and Water, North American Lake Management Society, Nov 9-11, Madison, WI.

Axler, R., M. Lonsdale, G. Host, J. Reed, E. Ruzycki, C. Hagley, J. Schomberg, C. Richards and B. Munson. DuluthStreams to LakeSuperiorStreams: making stormwater and stream data come alive for limnologists, citizens, students, teachers, resource agencies and decision-makers. NALMS 2005: 25th International Symposium. Lake Effects: Exploring the Relationship between People and Water, North American Lake Management Society, Nov 9-11, Madison, WI.

Ruzycki, E.R., R.P. Axler, G. Host, J.R. Henneck and N. Will. Estimating sediment and nutrient loads in three Western Lake Superior streams: Continuous turbidity monitoring versus spot sampling and modeling. NALMS 2005: 25th International Symposium. Lake Effects: Exploring the Relationship between People and Water, North American Lake Management

Society, Nov 9-11, Madison, WI. Best student poster (\$200 cash award)

Hagley, C.A., Axler, R.P. Host, G.E. Munson, B., Richards, C., Ruzycki, E. Water on the Web: continuous lake monitoring data improve student, teacher, and manager understanding of lake variability and function. NALMS 2005: 25th International Symposium. Lake Effects: Exploring the Relationship between People and Water, North American Lake Management Society, Nov 9-11, 2005. Madison, WI.

Reavie, E.D., A.R. Kireta, J.C. Kingston, R.P. Axler, G.V. Sgro, E.F. Stoermer. New diatom based tools to assess environmental disturbance in Great Lakes coastal ecosystems. Eighteenth North American Diatom Symposium, Mobile, AL, Nov 2005.

Sgro, G.V., E. D. Reavie, A.R. Kireta, J.C. Kingston, R.P. Axler, M.J. Ferguson, E.F. Stoermer. Comparison of benthic diatom indices of habitat quality in the Laurentian Great Lakes. Eighteenth North American Diatom Symposium, Mobile, AL, Nov 2005.

Kireta, A.R., E.D. Reavie, R.P. Axler, J.C. Kingston, G.V. Sgro. Importance of geomorphic characteristics and lake in developing diatom models in the near-shore Great Lakes. Eighteenth North American Diatom Symposium, Mobile, AL, Nov 2005.

Ruzycki, E., R. Axler, G. Host and J. Henneck. Preliminary results of exploratory data analysis of the National Park Service Great Lakes Network water quality data. Fifth annual Western Great Lakes Research Conference, Mar 22-23, 2006 in Ashland, WI.

Axler, R., M. Lonsdale, C. Hagley, G. Host, J. Reed, J. Schomberg, N. Will, E. Ruzycki, J. Henneck, T. Carlson and J. Walker and B. Munson. LakeSuperiorStreams.org: using real-time data to make stormwater, stream and WLSSD data come alive. First annual Western Lake Superior Sanitary District Science Symposium for WLSSD board of directors and staff, Jan 21, 2006, Duluth, MN.

Axler, R. and M. Lonsdale. LakeSuperiorStreams.org project. Duluth Water Science Community Freshwater Folks seminar series. Minnesota Pollution Control Agency, Duluth, MN Apr 5, 2006.

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- Johnson, L. and R. Axler. Measuring the effectiveness of the TMDL process. Minnesota Impaired Waters Symposium, Water Resources Center, U. of MN-St. Paul, MN Feb 11-12, 2008 and subsequent preparation of a Final report (F.Sleeper and B.Wilson, U of MN-WRC PIs).
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- Axler, R.P., N.Will, and G.Host. Application of Interactive Data Visualization Tools from Lake Superior and other Minnesota, U.S. Lakes and Rivers to Lake Victoria, East Africa. Workshop on Enhancing Data Management, Visualization And Modeling Capabilities In Support of Lake Victoria Fisheries Victoria Fisheries Organization Summit, Sep 13-17, 2010. Jinja, Uganda.
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