ANNUAL REPORT

July 1, 2006 – June 30, 2007

Submitted by:

The Center for Water and Society Advisory Committee

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Abstract

The Center for Water and Society (CWS) at Michigan Tech was established in June of 2005 under the Sustainable Futures Institute (SFI) to provide the multidisciplinary perspectives and tools to manage water-related problems of local, regional, and international interest.
The following document is a record of the center's accomplishments over its second year of operation and development. The CWS annual report for 2006-2007 is organized by the CWS year in review, conferences and workshops, Degree subcommittee and Seminar & Symposia subcommittee activities, CWS budget analysis, Advisory Committee members and CWS participant roster, affiliated research projects and submitted proposals, and publications and presentations by CWS participants.

1. CWS Mission Statement

The mission of the Center for Water and Society (CWS) at Michigan Tech is to support research, education, and outreach in all disciplines at Michigan Tech related to water issues. The goal is to establish Michigan Tech as a state, regional, national and international leader in these disciplines and, in particular, in interdisciplinary approaches to solving water-related problems. CWS is a "virtual" Research Center. By virtual, we mean that the CWS will not occupy physical space, but is a consortium of people at Michigan Tech whose focal point is water-related activities.

The objectives of the Center for Water and Society are:

- To serve as a focal point for instructional and research activities in water-related fields and water-related outreach activities across the Michigan Tech campus
- To provide an organizational structure that supports continuing growth in water-related fields and outreach activities and encourage interdisciplinary projects
- To promote the visibility of Michigan Tech's water-related research in state, regional, national and international arenas
- To support interdisciplinary graduate and undergraduate education and research in water related fields
- To pursue external funding opportunities to support these objectives and to facilitate the acquisition of external support by faculty participating in CWS.

CWS has 47 participants in 12 units across the Michigan Tech campus (see Appendix1). CWS is governed by a director and advisory committee (see Appendix 2)

2. CWS Year in Review

2.1 CWS 2006 Retreat Survey Results

The CWS retreat was held on June 9, 2006 at McLain State Park on Lake Superior. The goal of the retreat was to reinforce the strategic plan for the center and develop a shared vision for CWS.

We were in consensus about our vision for the Center for Water and Society. We are participants in the center because it has an applied focus on water problem solving through research and education, with an interdisciplinary membership, and a commitment to water-related outreach at MTU and within the larger community. We would like to be known as an excellent source of research, education, and outreach products on water-related problem solving.

After the 2006 retreat, surveys were sent to CWS participants to get additional input on the group's vision, goals, and anticipated commitments for the Center for Water and Society.

As a direct result of the retreat and survey results, CWS led an informal research group composed of faculty members from multiple disciplines across the MTU campus to focus on Great Lakes research. This group then compiled a pre-proposal to the NSF-IGERT program

A second research group meeting is planned for 2007-2008 with the focus on international research and education on water related issues.

2.2 CWS Discussion on Great Lakes Research

The Center for Water & Society discussion on Great Lakes Research was held on October 10, 2006. A summary of the discussion is found in Appendix 3.

Subsequent meetings of this group resulted in the submission of an NSF IGERT pre-proposal for the project, "IGERT: Multi-scale stressors and the sustainability of the Lake Superior basin". The PI is Alex Mayer (GMES), and co-PI's are Noel Urban (CEE), Nancy Auer (BIO), Kathy Halvorsen (SS/SFRES), and Charles Kerfoot (BIO).

2.3. CWS Weekly News email

The Center for Water and Society began a water-related news email which has been submitted to the CWS participants on a weekly basis. The content has consisted of CWS highlights, listings of water-related seminars and graduate defenses, links to water related news articles, and links to new funding opportunities.

2.4 CWS Poster Competition

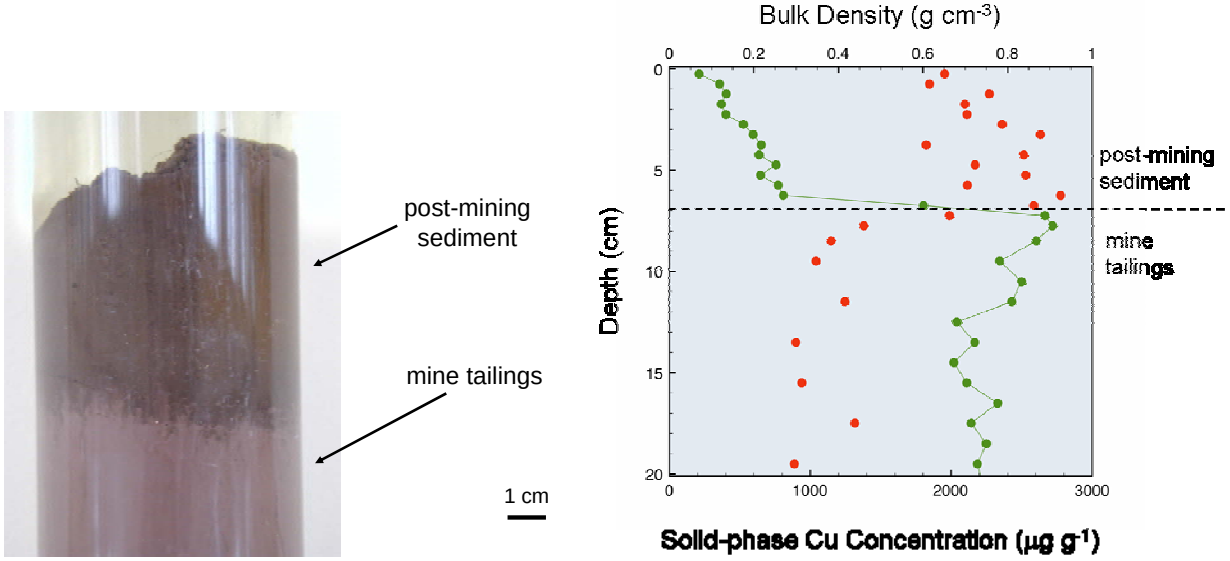
The Center for Water and Society sponsored a special competition held as part of the Graduate Student Council (GSC) Poster Session held on Oct. 13 and 14, 2006. The Center for Water and Society offered cash awards for first, second and third best posters on water-related issues from all university disciplines. This was the first occurrence of another campus organization joining the Graduate Student Council with awards for special interests in the GSC Poster Session.

To be considered for the CWS award, students pre-registered their entries with a brief abstract of their poster which declared participation in the CWS competition.

2006 CWS Poster Competition Awards:

The winning posters can be viewed online at
http://www.mtcws.mtu.edu/index_Archived_Events_Oct2006-Oct2007.html.

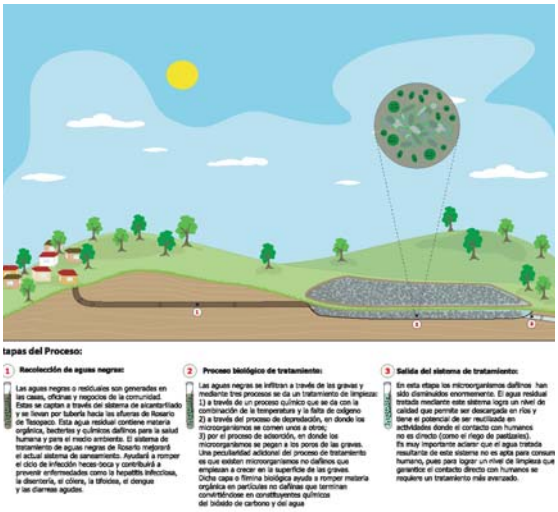
First place: Cory P. McDonald, Engineering – Environmental
"Modeling copper transport in the sediments of Torch Lake, Houghton County, MI"



Second place: Melba D. Apoya-Horton, Biological Sciences
"Movement Modalities As Adaptive Response To Salinity Changes Of The Mudflat Diatom Cylindrotheca closterium (Bacillariophyceae)"

Third place: Andrea Munoz Hernandez, Engineering – Environmental
"Calibration of a water surface model for a basin in a semiarid region: The Rio Yaqui-Basin, Mexico"

GSC Best Overall: Agustin Robles Morua, Engineering – Environmental
"A Collaborative Approach to Improve Sanitation in a Marginalized Rural Community in Mexico" (registered in CWS Poster Competition)



2.5 CWS Graduate travel award

Gerald Greer, Social Sciences, was awarded a CWS graduate student travel award to attend the 13th International Symposium on Society and Resource Management Conference at Park City, UT in June, 2007.

Presentation: "Michigan State Watershed Management Policies and Local Watershed Groups"
Co-authors: Gerald K. Greer, Kathleen E. Halvorsen, Alex S. Mayer, Julia Kalloz.

2.6 CWS Graduate research award

Nancy-Jeanne Bachman, Civil and Environmental Engineering was awarded a CWS graduate research award for her research work.

Project: "Hydrologic Monitoring of an Underdrained Low Impact Development (LID) Stormwater Management System in Gainesville, VA"
Advisors: John S. Gierke and David W. Watkins

2.7 Lake Superior Youth Symposium scholarship

CWS awarded a scholarship for one high school student to attend the 7th Annual Lake Superior Youth Symposium held at Bay Cliff Health Camp in Big Bay, Michigan, May 10-13, 2007.

2.8 World Water Day

World Water Day tents were created and displayed on tables in the U. J. Noblet Forestry Building, the DOW Environmental Sciences & Engineering Building, the J. R. Van Pelt Library, and the Memorial Union Building.

Kathy Halverson made a pledge to WNMU radio and dedicated her pledge to set the Michigan Tech Center for Water & Society as the sponsor for a day of broadcasting for World Water Day.

2.9 Project Cost Share

CWS provided equipment cost share in the amount of $1000 to purchase a CO_2 analyzer for the "REF: Air: A Conduit between Water, Society, and Space" project managed by Noel Urban.

2.10 Conferences and Workshops

Conferences and workshops attended by the CWS Director in support of CWS.

Complex Interacting Systems for a Sustainable Future
NSF Workshop
June 7-8, 2007
Sand Key Beach Sheraton Hotel, Clearwater Beach, Florida

Climate Change in the Great Lakes Region
March 15-16, 2007

Kellogg Conference Center
Michigan State University, East Lansing, MI

Freshwater Ecosystem Sustainability Roundtable
October 4-6, 2006.
The Henry Ford in Dearborn, Michigan

2nd Annual Great Lakes Restoration Conference
September 22-24, 2006
Cleveland, OH

2.11 Degree Subcommittee Activities

(**Members:** Nancy Auer, Kathy Halvorsen, Alex Mayer)

The CWS Degree Subcommittee has developed a list of all current water-related courses offered at MTU, and is working towards a course framework for a minor and a graduate certificate in water study. The course list is posted on the CWS website as a reference for students and instructors (**http://www.mtcws.mtu.edu/education.html**)

The CWS Degree Subcommittee has also developed a formal application which will be used in the competition for graduate student research and travel awards.

2.12 Seminars & Symposia Subcommittee Activities

(**Members:** Noel Urban, Kathy Halvorsen, Chris Anderson, Alex Mayer)

Co-Sponsored seminars and events

David Gallo, Special Projects Coordinator
Woods Hole Oceanographic Institute
September 25-28, 2006.

"Extreme Deep: Exploring the Ends of the Earth—Neptune's Basement"

"Global Water Crisis"

Meetings with Michigan Tech department and centers, toured research facilities, and interacted with teachers and students from local schools

ISSRM 2007
CWS was a supporter of the 13th International Symposium on Society and Resource Management held in Park City, Utah, June 17-21, 2007. The theme of the symposium was "Landscape Continuity and Change - Social Science Perspectives and Interdisciplinary Contributions".

Aboard the Agassiz
CWS co-sponsored community & school programs held on excursions taken on board the Agassiz research vessel which were held during the summer and fall of 2006.

Inconvenient Truth
CWS co-sponsored the free showing of Al Gore's Inconvenient Truth film, which was presented on campus October 29th and 30th, 2006.

3. CWS Budget

CWS Institute O/H Incentive Account

Beginning Balance July 1, 2006 ..... $18,711.99

Research Incentive Transfer In $3,299.57

Expenditures $16,220.79

Balance as of June 30, 2007 ..... $**5,478.13**

4. Research

4.1 New awards 2006-7

New Research Funding 2006-7: $405,327

- ExCit: Expanding Cities-People, Water and Infrastructure
  PI: Alex Mayer
  Sponsor: U.S. Department of Education
  $63,462 (9/2006 – 8/2008, Third Year of Funding)

- Herring Gull BioSentinal Sampling Program Cooperative Agreement .
  PI: Judith Perlinger
  Sponsor: Clemson Univ
  $8,000 (8/2006 – 9/2008)

- Streamside Lake Sturgeon Culture for the Ontonagon River, Michigan
  PI: Nancy Auer
  Sponsor: MI DNR
  $30,394 (10/2006 – 9/2008, First Year of Funding)

- Collaborative Research: The carbon balance of Lake Superior: modeling lake processes and understanding impacts on the regional carbon budget
  PI: Noel Urban
  Sponsor: NSF
  $242,199 (8/2006 - 7/2010)

- Evaluating Riparian Timber Harvesting Guidelines: Phase 3, Result 2 Evaluate Aquatic Habitat Impacts
  PI: Casey Huckins
  Sponsor: U.S. Dept. of Agriculture Forest Service, Northern Research Station
  $22,605 (5/2007 – 6/2009)

- Huron Creek Watershed Management Plan
  PI: Alex Mayer
  Sponsor: MI-EPA
  $38,667 (7/2007 - 12/2008)

4.2 Active Research Projects Affiliated with CWS, 2006-7

Total Research Expenditures 2006-7: $281,571.59
Project Expenditures: $242,603.40
Cost Share Expenditures: $38,968.19

- Sedimentation in Schoharie Reservoir: Temporal Dynamics
  PI: Noel R. Urban
  Sponsor: Upstate Freshwater Institute (pass through funding from NYC Dept. Environmental Protection)
  Project Expenditures: $83,866.25

- TIES - MTU-UNISON Linkage: Training a Core of Water Resource Experts
  PI: Alex S. Mayer
  Sponsor: Association Liaison Office/US Agency for International Development
  Project Expenditures: $2,071.04

  ExCit: Expanding Cities - People, Water and Infrastructure
  PI: Alex S. Mayer
  Sponsor: US Dept. of Education
  Project Expenditures: $37,681.75
  Cost Share Expenditures: $31,618.50

- REF: Air: A Conduit between Water, Society, and Space
  PI: Alex Mayer
  Sponsor: State of Michigan – REF
  Project Expenditures: $49,263.37

- Herring Gull BioSentinal Sampling Program Cooperative Agreement .
  PI: Judith Perlinger
  Sponsor: Clemson Univ
  Project Expenditures: $4,149.82

- Streamside Lake Sturgeon Culture for the Ontonagon River, Michigan
  PI: Nancy Auer
  Sponsor: MI DNR
  Project Expenditures: $17,046.85
  Cost Share Expenditures: $7,349.69

- Collaborative Research: The carbon balance of Lake Superior: modeling lake processes and understanding impacts on the regional carbon budget
  PI: Noel Urban
  Sponsor: NSF
  Project Expenditures: $48,524.32

4.3 Proposals Submitted under CWS, 2006-7

- Regionalization Techniques for Ensemble Streamflow Prediction
  PI: David Watkins
  Sponsor: NOAA
  Requested Amount: $131,360

- Factors Influencing Successful Water Quality Trading Programs
  PI: David Watkins
  co-PI: Barry Solomon
  Sponsor: EPA
  Requested Amount: $135,750

- Bioaccumulation of Hg Released from Mine Tailings on Michigan's Keweenaw Peninsula
  PI: Noel Urban
  co-PI: Judith Perlinger
  co-PI: Charles Kerfoot
  Sponsor: EPA Great Lakes National Program Office
  Requested Amount: $58,924

- PIRE: Risk Perception Analysis and Water Resources Management in Latin America
  PI: David Watkins
  co-PI: Kathy Halverson
  co-PI: Veronica Webster Griffis
  co-PI: James Mihelcic
  co-PI: Alex Mayer
  Sponsor: NSF (Pre-Proposal)

- Herring Gull BioSentinal Sampling Program Cooperative Agreement .
  PI: Judith Perlinger
  co-PI: Noel Urban
  Sponsor: Clemson Univ
  Requested Amount: $8,000

- A Modified Relaxed Eddy Accumulator for Measurement of Persistent Bioaccumulative Toxicant Fluxes in Coastal/Estuarine Areas
  PI: Judith Perlinger
  Sponsor: CICEET Univ of NH
  Requested Amount: $ 475,873

- Optimal Identification of Climate Signals and Conditioning of Ensemble Streamflow Prediction Forecasts
  PI: Dave Watkins
  co-PI: Veronica Griffis
  Sponsor: US Dept of Commerce
  Requested Amount: $245,655

- Streamside Lake Sturgeon Culture for the Ontonagon River, Michigan
  PI: Nancy Auer
  Sponsor: MI DNR
  Requested Amount: $64,240

- Monitoring Biodiversity: An Illustrated Atlas to the Larval Fishes of the Great Lakes Basin
  PI: Nancy Auer
  Sponsor: NSF
  Requested Amount: $445,797

- Enhanced Natural Recovery of Hg-Contaminated Sediments by Nitrate Augmentation
  PI: Martin Auer
  co-PI: Noel Urban
  co-PI: Gilbert Lewis
  Sponsor: NIH
  Requested Amount: $911,125

- Society, Sustainability, and N: A History of Society's Changing Knowledge of and Interaction with the Nitrogen Cycle
  PI: Hugh Gorman
  Sponsor: NSF
  Requested Amount: $134,541

- The Calumet Watershed, Lake Superior Basin: An observatory to assess impacts of change in the hydrologic cycle and land use on biogeochemical processes
  PI: Robert Stottlemeyer
  co-PI: Alex Mayer
  co-PI: David Toczydlowski
  Sponsor: NSF
  Requested Amount: $2,739,067

- Development of a Stream Management Guide to Enhance Great lakes Coastal Habitats
  PI: Joan Chadde
  co-PI: Casey Huckins
  co-PI: Alex Mayer
  Sponsor: U.S. Fish & Wildlife Service
  Requested Amount: $19,997

- Assessment of groundwater influence on coaster brook trout spawning habitat using non-invasive methods in the Salmon Trout River, Upper Peninsula of Michigan
  PI: Alex Mayer
  Sponsor: U.S. Fish & Wildlife Service's Coastal Program - Great Lakes
  Requested Amount: $19,617

- Collaborative Research: Modeling and Analyzing the Use, Efficiency, Value and Governance of Water as a Material in the Great Lakes Region Through an Integrated Approach
  PI: Alex Mayer
  co-PI: James Mihelcic
  co-PI: David Watkins
  co-PI: Qiong (Jane) Zhang
  Sponsor: NSF
  Requested Amount: $1,078,322

- Assessment of groundwater influence on coaster brook trout spawning habitat using non-invasive methods in the Salmon Trout River, Upper Peninsula of Michigan
  PI: Alex Mayer
  Sponsor: Huron Mountain Wildlife Foundation
  Requested Amount: $20,869

- Collaborative Research: Modeling of the lower food web in Lake Superior
  PI: Noel Urban
  co-PI: Marty Auer
  Sponsor: NSF
  Requested Amount: $517,552

- Disappearing Diporeia: Testing the Food Limitation Hypothesis
  PI: Marty Auer
  co-PI: Nancy Auer
  co-PI: Noel Urban
  Sponsor: EPA Great Lakes Nat'l Prog Office
  Requested Amount: $285,460

- Disappearing Diporeia: Testing the Food Limitation Hypothesis
  PI: Marty Auer
  co-PI: Nancy Auer
  co-PI: Noel Urban
  Sponsor: Great Lakes Fishery Commission
  Requested Amount: $285,460

- Disappearing Diporeia: Testing the Food Limitation Hypothesis
  PI: Marty Auer
  co-PI: Nancy Auer
  co-PI: Noel Urban
  Sponsor: Great Lakes Fishery Trust
  Requested Amount: $285,460

- IGERT: Multi-scale stressors and the sustainability of the Lake Superior basin
  PI: Alex Mayer
  co-PI: Noel Urban
  co-PI: Nancy Auer
  co-PI: Kathy Halvorsen
  co-PI: Charles Kerfoot
  Sponsor: NSF IGERT (pre-proposal)

- Sustainable Development for Rural Communities: Social, Health, Economic, and Environmental Advances
  PI: Alex Mayer
  co-PI: Blair Orr
  co-PI: Carol MacLennan
  co-PI: Jim Mihelcic
  co-PI: David Watkins
  Sponsor: US Dept. of Education NA Mobility Program
  Requested Amount: $199,966

- Evaluating Riparian Timber Harvesting Guidelines: Phase 3, Result 2 Evaluate Aquatic Habitat Impacts
  PI: Casey Huckins
  Sponsor: U.S. Dept. of Agriculture Forest Service, Northern Research Station
  Requested Amount: $22,605

- Global Watershed: Integrating Rural and Global Perspectives with Research and Technological Advances
  PI: Alex Mayer
  co-PI: Linda Nagel
  co-PI: Casey Huckins
  co-PI: Bradley Baltensperger
  Sponsor: NSF GK12
  Requested Amount: $2,287,782

5. Publications by CWS Participants, 2006-7

Publications are ordered by CWS author or co-author and include journal articles, books, and chapters in books that are published, in press, forthcoming, or accepted. Items which are in press, forthcoming, or accepted will be counted as published with complete references in the next CWS Annual Report.

5.1 Published journal articles, books, and book chapters

1. Oyadomari, J.K. and **N. A. Auer**, Page Proofs 4/9/2007, Influence of Rearing Temperature and Feeding Regime on Otolith Increment Deposition in Larval Cisco, Transactions of the American Fisheries Society.

2. **Auer, N.A.** and E.A. Baker, 2007, Assessment of Lake Sturgeon Spawning Stocks Using Fixed-location, Split-beam Sonar Technology, Journal of Applied Ichthyology, Vol 23:113-121.

3. Duan, Jennifer G.; **Barkdoll, Brian**; French, Richard, 2006, "Lodging velocity for an emergent aquatic plant in open channels", American Society of Civil Engineers *Journal of Hydraulic Engineering*, v 132, n 10, October 2006, p 1015-1020.

4. Melville, Bruce; van Ballegooy, Sjoerd; Coleman, Stephen; **Barkdoll, Brian**, 2006, "Scour countermeasures for wing-wall abutments", American Society of Civil Engineers *Journal of Hydraulic Engineering*, v 132, n 6, June 2006, p 563-574.

5. Melville, Bruce; van Ballegooy, Sjoerd ; Coleman, Stephen ; and **Barkdoll, Brian**, 2006, "Countermeasure Toe Protection at Spill-Through Abutments", American Society of Civil Engineers *Journal of Hydraulic Engineering*, Vol. 132, No. 3, March 2006, pp. 235-245.

6. Li, Hua; **Barkdoll, Brian D**.; Kuhnle, Roger; Alonso, Carlos, 2006, "Parallel walls as an abutment scour countermeasure", American Society of Civil Engineers *Journal of Hydraulic Engineering*, v 132, n 5, May 2006, p 510-520.

7. Korkut, Recep; Martinez, Emilio J.; Morales, Reinaldo; Ettema, Robert; and **Barkdoll, Brian**, 2007, "Geobag Performance as Scour Countermeasure for Bridge Abutments", American Society of Civil Engineers *Journal of Hydraulic Engineering*, Vol. 133, No. 4, April 2007, pp. 431-439.

8. Duan, J., Chen, and **Barkdoll, B.** (*In Press*) "Surface-Based Fractional Transport of Sediment", American Society of Civil Engineers *Journal of Hydraulic Engineering.*

9. Morey, E.R., J. Thacher, and **W.S. Breffle**. 2006. Using angler characteristics and attitudinal data to identify environmental preference classes: a latent-class model. Environmental and Resource Economics 34(1):91-115.

10. Morey, E.R. and **W.S. Breffle**. 2006. Valuing a change in a fishing site without collecting characteristics data on all fishing sites: a complete but minimal approach. The American Journal of Agricultural Economics 88(1):150-161.

11. Blake, A., **Campbell, G. A.** , 2007, "Conflict over flying fish: The dispute between Trinidad & Tobago and Barbados", *Marine Policy, 31*(3), pp. 327-335.

12. Rosemier, J., **D. Flaspohler**. 2006. Island-specific ecological release of small mammals in Lake Michigan and potential consequences for ground-nesting birds. George Wright Forum 23:24-32.

13. **Flaspohler, D.J.**, and C. Meine. 2006. Planning for Wildness: Aldo Leopold's Report on Huron Mountain Club. Journal of Forestry 104:32-42. Featured cover photo from this paper.

14. .Sherman, H. M., **J. S. Gierke**, C. P. Anderson, "Controls on Spatial Variability of Uranium in Sandstone Aquifers," *Ground Water Monitoring & Remediation, 27*(2), 106-118, 2007. doi:10.1111/j.1745-6592.2007.00142.x

15. Van Antwerp, D. J., R. W. Falta, **J. S. Gierke**, "Numerical Simulation of Field Scale Contaminant Mass Transfer During Air, Sparging," *Vadose Zone Journal* (in press).

16. **Griffis, V.W.** and J.R. Stedinger, "Evolution of Flood Frequency Analysis with Bulletin 17," Journal of Hydrologic Engineering, ASCE, 12 (3), 283-297 (2007).

17. **Griffis, V.W.** and J.R. Stedinger, "The Log-Pearson Type 3 Distribution and its Application in Flood Frequency Analysis, 1. Distribution Characteristics," Journal of Hydrologic Engineering, ASCE, (in press), (2007).

18. **Griffis, V.W.** and J.R. Stedinger, "The Log-Pearson Type 3 Distribution and its Application in Flood Frequency Analysis, 2. Parameter Estimation Methods," Journal of Hydrologic Engineering, ASCE, (in press), (2007).

19. **Griffis, V.W.** and J.R. Stedinger, "The Use of GLS Regression in Regional Hydrologic Analyses," Journal of Hydrology, (accepted for publication), (2007).

20. **Huckins, C.J**., and E.A. Baker, *in press*, "Migrations and biological characteristics of adfluvial coaster brook trout in a south shore Lake Superior tributary", Transactions of the American Fisheries Society.

21. **Huckins, C.J.**, and E.A. Baker, K.D. Fausch, and J.B.K. Leonard, *in press*, "Ecology and life history of coaster brook trout *Salvelinus fontinalis* and potential bottlenecks in their rehabilitation", North American Journal of Fish Management.

22. Webster, C., **C. Huckins**, and J. Shields, *in revision*, "Spatial distribution of riparian zone coarse woody debris in a managed northern temperate watershed", American Midland Naturalist.

23. **Kerfoot, W. Charles**, **Judith Wells Budd**, **Sarah A. Green**, James B. Cotner, Bopaiah Biddanda, David J. Schwab, and Henry A. Varderploeg, *in press*, "Doughnut in the desert: a late winter production pulse in Southern Lake Michigan", Limnology and Oceanography.

24. Churchill, J.H. and **W.C. Kerfoot**, 2007, "The impact of surface heat flux and wind on thermal stratification in Portage Lake, Michigan", JGLR. 33(1):143-155.

25. **Kerfoot, W.C.**, 2006, "The Baltic Eubosmina radiation: sensitivity to invertebrate predators (induction) and observations on genetic differences", Arch. Hydrobiol. 167(1-4): 147-168.

26. **MacLennan, C.**, **Walck, C. L.**, *in press*, "Mining and Ranching on the Landscape of Southwestern New Mexico, 1850-2005", in L Cliggett and C. Pool, eds. *Economies and the Transformation of Landscape.* Alta Mira Press.

27. **MacLennan, C.**, *in press*, "Wai—Indigenous Water, Industrial Water", *Organizations and the Environment.*

28. **Mayer, A.S.**, May, W., Lukkarila, C. and J. Diehl, "Estimation of Fault Zone Conductance by Calibration of a Regional Groundwater Flow Model – Desert Hot Springs, California," *Hydrogeology Journal*, 2007, DOI 10.1007/s10040-007-0158-0.

29. **Mayer, A.S.** and K.L. Endres, "Simultaneous Optimization of Contaminant Source and Plume Remediation," *Journal of Contaminant Hydrology*, 2007, DOI 10.1016/j.jconhyd.2006.11.009.

30. **Mayer, A.S.**, Endres, K.L. and **D.W. Hand**, *in press*, "Groundwater Treatment Modeling in the Optimal Design of Pump-and-Treat Groundwater Remediation Systems," *Journal of EnvironmentalEngineering,* 2007.

31. Bau, D. and **A.S. Mayer**, "Data-worth Analysis for Multi-Objective Optimal Design of Pump-and-Treat Remediation Systems, "*Advances in Water Resources,* in press, 2007, DOI 10.1016/j.advwatres.2007.02.008.

32. Ilija, M., **Mayer, A.S.**, and **B.D. Solomon**, *accepted*, "Economic Valuation of Environmental Services Sustained by Water Flows in the Yaqui River Delta," *Ecological Economics*, 2007.

33. Ahrens, BT and **JR Mihelcic**, "Making Wastewater Construction Projects Sustainable in Urban, Rural, and Peri-Urban Areas," *Journal of Engineering for Sustainable Development: Energy, Environment, Health*, 1(1): 13-32, 2006.

34. Fry, L, **J.R. Mihelcic**, **D.W. Watkins, Jr.** "Improving Public Health by Improving Water Supply: Results from Springbox Projects in Cameroon," *Journal of Engineering for Sustainable Development: Energy, Environment, Health*, 1(1):33-42, 2006.

35. Hokanson, D. R., **Q. Zhang**, J. R. Cowden, A. M. Troschinetz, **J. R. Mihelcic**, and D. M. Johnson. "Challenges to Implementing Drinking Water Technologies in Developing World Countries," *Environmental Engineer: Applied Research and Practice*, Vol. I, Winter, 2007, in Environmental Engineer, the Magazine of the American Academy of Environmental Engineers, Vol. 43, No. 1, pp. 31-38, 2007.

36. McConville, J.R., and **J.R. Mihelcic,** "Adapting Life Cycle Thinking Tools to Evaluate Project Sustainability in International Water and Sanitation Development Work," *Environmental Engineering Science*, in press, 2007.

37. **Mihelcic, J.R.** J.B. Zimmerman, A. Ramaswami, **"**Integrating Developed and Developing World Knowledge into Global Discussions and Strategies for Sustainability Part 1: Science and Technology," *Environmental Science & Technology*, 41(10); 3415 - 3421, 2007.

38. Ramaswami, R., J.B. Zimmerman, **J.R. Mihelcic**, "Integrating Developed and Developing World Knowledge into Global Discussions and Strategies for Sustainability Part 2: Economics and Governance," *Environmental Science & Technology*, 41(10): 3422 - 3430, 2007.

39. Muga, H.E. and **J.R. Mihelcic**, "Sustainability of Wastewater Treatment Technologies," *Journal of Environmental Management*, in press, 2007.

40. Rowe, M.D., **Perlinger, J.A.**, and **Urban, N.R.**, "Modeling contaminant behavior in Lake Superior: A comparison of PCBs, PBDEs, and mercury", In State of Lake Superior, Ecovision World Monograph Series, M. Munawar (Ed.), Taylor & Francis Publ., London, UK, in press.

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42. **Solomon, B.D.** C.M. Corey and **K.E. Halvorsen**, 2007, "Safe minimum standard analysis of the Florida manatee", in J. Gowdy and J.D. Erickson, eds. *Frontiers in Environmental Valuation and Policy* (Northampton, MA: Edward Elgar).

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5.3 Presentations

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2. **Auer, N. A.**, "Rapid assessment of lake sturgeon spawning stocks using fixed-location , split-beam sonar technology", American Fisheries Society, Lake Placid, New York, September 2006.

3. **Auer, N. A.**, Two-day workshop on Larval Fish identification, American Fisheries Society, Lake Placid, New York, September 2006.

4. **Auer, N. A.**, "Coral Reefs", guest lecture in Oceanography Class, Michigan Technological University, April 2007.

5. J. Diaz and **B. Barkdoll**, "Comparison of Wastewater Treatment in Developed and Developing Countries", *Proceedings of the 2006 World Environmental and Water Resources Congress,* American Society of Civil Engineers, *May 21-25, 2006, Omaha, Nebraska.*

6. L. Garcilaso, W. Gaines, and **B. Barkdoll**, "Eco-Efficiency Analysis of Existing Industrial Wastewater Treatment: How to Include the External Costs to the Environment", *Proceedings of the 2006 World Environmental and Water Resources Congress,* American Society of Civil Engineers, *May 21-25, 2006, Omaha, Nebraska.*

7. **B. D. Barkdoll**, B. W. Melville, and R. Ettema, "A Review of Bridge Abutment Scour Countermeasures", *Proceedings of the 2006 World Environmental and Water Resources Congress,* American Society of Civil Engineers*, May 21-25, 2006, Omaha, Nebraska.*

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9. **Barkdoll, B. D.**, Melville, B. W. and. Ettema, R, "Design of Bridge Abutment Scour Countermeasures", *Proceedings of the International Conference on Scour and Erosion,* American Society of Civil Engineers, Amsterdam, Netherlands, Oct 31-Nov 4, 2006.

10. Hemme, Susan R., **Sarah A. Green**, and **W. Charles Kerfoot**, "Metallothionein in zooplankton as a biomarker of copper stress on an ecosystem", American Society for Limnology and Oceanography, Victoria, B.C., 2006.

11. **Hugh S. Gorman**, "The Houston Ship Channel and the Changing Landscape of Industrial Pollution" in *An Environmental History Of Houston and the Gulf Coast*, ed. Martin V. Melosi and Joseph Pratt (University of Pittsburgh Press, 2007): 52-68.

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14. **Huckins, C.J**., "Coasters 101", Great Waters Institute for Jouronalism and Natural Resources, Marquette, MI, July 2006.

15. **Huckins, C.J.**, "Fish and macroinvertebrate survey in the Eagle River Watershed", Copper Country Chapter of Trout Unlimited, Houghton, MI, November 2006.

16. **Huckings, C.J**., "Fishes in the forest: effects of forest management on stream communities", Xi Sigma Pi National Forestry Honor Society Symposium: Wildlife and Forests: the Role of Management, Michigan Technological University, Houghton, MI, April 2007.

17. **Kerfoot, W. Charles**, **Judith Wells Budd**, **Sarah A. Green**, Matthew Julius, and David J. Schwab, "Doughnut in the desert: vertical structure of a winter production pulse", American Society for Limnology and Oceanography, Victoria, B.C., 2006.

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19. **Urban, N.R.**, C.P. McDonald, and **W.C. Kerfoot**, "Environmental mobilization of mercury from mine tailings", Mercury Conference, University of Wisconsin.

20. **MacLennan, C.,** "New Alliances: Environment, Labor, and 21st Century Mining in the Lake Superior Basin", American Anthropological Association Annual Meetings. San Jose, CA. November 2006.

21. **Mayer, A.S.**, "Modeling the Rio Yaqui basin, Mexico: Optimization of water resource allocation," short course on watershed management, University of Havana, Cuba, 6/06

22. **Mayer, A.S.**,Garcia Ruiz, J.-L., "Training a New Generation of Water Resource Experts," Presented paper, Higher Education in Development/USAID Meeting, Washington DC, 8/06

23. **Mayer, A.S.**," Watershed Management," short course on watershed management, College of Sonora, Mexico, 10/06

24. **Mayer, A.S.**," Crecimiento de Ciudades: la Población, el Agua y su Infraestructura," Presented paper, North American Mobility Program Conference, Guanajuato, Mexico, 10/06

25. Munoz-Hernandez, A., **Mayer, A.S.**, "Calibration and uncertainty of a surface water model for a large basin in a semiarid region: The Rio Yaqui-Basin, Mexico,"Presented paper, American Geophysical Union Fall Meeting, San Francisco, CA, 12/06

26. **Mayer, A.S.**, "Watershed Studies at Michigan Tech," short course on watershed management, College of Sonora, Mexico, 4/07

27. **Mayer, A.S.**," Integrated Economic-Environmental-Hydrologic Modeling of the Rio Yaqui Basin, Sonora, Mexico," Invited seminar, University of Illinois, 5/07

28. Fry, L., **J.R. Mihelcic**, and **D.W. Watkins, Jr.** "Improving Public Health by Improving Groundwater Supply: Results from Springbox Projects in Cameroon." National Ground Water Association Summit, April 2006.

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37. McDonald CP, **Urban NR**, 2006, "Modeling Copper Transport in the Sediments of Torch Lake, Houghton County, MI", 49th Internat. Assoc. Great Lakes Res., Windsor, ONT, 5/2006.

Appendix 1: CWS Participants

Biological Sciences
Nancy A. Auer
Susan T. Bagley
Casey J. Huckins
Charles W. Kerfoot

Chemistry
Sarah A. Green

Civil & Environmental Engineering
Martin T. Auer
C. Robert Baillod
Brian D. Barkdoll
Kristine L. Bradof
Veronica Griffis
David W. Hand
Neil J. Hutzler
Alex S. Mayer
James R. Mihelcic
Judith A. Perlinger
Noel R. Urban
David W. Watkins
Qiong Zhang

Educational Opportunity
Christine S. Anderson

Fine Arts
Mary Ann Beckwith

Geological & Mining Eng. & Science
Gregg J. Bluth
Judith R. Budd
Suzanne J. Beske-Diehl
John S. Gierke
Alex S. Mayer
Wayne D. Pennington

Humanities
R. Craig Waddell

Mechanical Engineering
John W. Sutherland

School of Business & Economics
William S. Breffle
Gary Campbell
Thomas E. Merz
Christa L. Walck

School of Forest Resources & Environmental Science
David J. Flaspohler
Margaret R. Gale
Kathleen E. Halvorsen
Martin F. Jurgensen
Linda M. Nagel
Blair D. Orr
Tom G. Pypker
James M. Schmierer

Social Sciences
Hugh Gorman
Carol A. MacLennan
Patrick E. Martin
Susan R. Martin
Timothy Scarlett
Bruce E. Seely
Barry D. Solomon
Kathleen E. Halvorsen

Western UP Center for Science, Mathematics & Environmental Education
Joan F. Schumaker Chadde

Appendix 2: CWS Advisory Committee

Director Alex S. Mayer asmayer@mtu.edu	Geological & Mining Engineering & Science
Administrative Assistant Carol J. Asiala cjasiala@mtu.edu	Geological & Mining Engineering & Science

Advisory Committee

Christine S. Anderson csanders@mtu.edu	Educational Opportunity
Nancy A. Auer naauer@mtu.edu	Biological Sciences
Mary Ann Beckwith mabeckwi@mtu.edu	Fine Arts
Gary A. Campbell gacampbe@mtu.edu	School of Business & Economics
John S. Gierke jsgierke@mtu.edu	Geological & Mining Engineering & Science
Sarah A. Green sgreen@mtu.edu	Chemistry
Kathy Halvorsen kehalvor@mtu.edu	Social Sciences
Tom Pypker tgpypker@mtu.edu	School of Forest Resources & Environmental Science
John Sutherland jwsuther@mtu.edu	Mechanical Engineering-Engineering Mechanics
Joan F. Schumaker-Chadde jchadde@mtu.edu	Western Upper Peninsula Center for Science, Mathematics & Environmental Education
Noel R. Urban nurban@mtu.edu	Civil & Environmental Engineering
R. Craig Waddell cwaddell@mtu.edu	Humanities

Appendix 3. Great Lakes Research

Center for Water & Society discussion on Great Lakes Research, held on October 10, 2006

Attendees of CWS Great Lakes Research Discussion:

Marty Auer	Jeff Henquinet	Carol MacLennan
Nancy Auer	Casey Huckins	Judith A. Perlinger
Stacey Cotey	Neil Hutzler	Noel R. Urban
John Gierke	Charles Kerfoot	
Kathy Halvorsen	Alex Mayer	

1. Great Lakes restoration
    - Great Lakes Regional Collaboration: http://www.glrc.us/
    - Prescription for Great Lakes Ecosystem Protection and Restoration (Avoiding the Tipping Point of Irreversible Changes) http://restorethelakes.org/PrescriptionforGreatLakes.pdf
    - Should we join the Healing Our Waters Coalition http://www.restorethelakes.org/about.html

2. Making connections with Altarum
    - Tech Topics news item on Michigan Tech acquisition of Altarum Environmental and Emerging Technologies Division (EETD) http://www.admin.mtu.edu/urel/news/media_relations/516/
    - Web site for Environmental and Emerging Technologies Division (EETD) http://www.altarum.org/eetd/index.htm

3. Investigate funding and collaborative research opportunities associated with Great Lakes monitoring networks
    - NEON program http://www.neoninc.org/
    - NSF "CLEANER" program http://www.nsf.gov/pubs/2005/nsf05549/nsf05549.htm
    - CUAHSI http://www.cuahsi.org/index.html
    - GLOS – Great Lakes Observing System, Regional Interest Group http://glos.us/
    - There is a Great Lakes Research advisory committee;
    - Integrated Atmospheric Deposition Network http://www.epa.gov/glnpo/monitoring/air/iadn/iadn.html;
    - UMD Large Lakes Observatory http://www.d.umn.edu/llo/

4. Ballast water/Exotic species: potential research topics
    - disinfection technology
    - modeling of dispersal of exotic species and subsequent ecosystem impacts
    - authority of institutions to enforce ballast rules
    - social considerations for preventing small-scale introduction of exotic species (e.g. edible fish markets, bait shops,...)

5. Gay/Keweenaw Bay stamp sands research ideas
    - remediation design
    - modeling of sediment transport, ecosystem impacts in support of remediation
    - Army Corps of Engineers connection
    - Great Lakes Legacy Act funds for research in support of remediation
    - social aspects of stamp sands and remediation

6. Focus on Lake Superior vs. Great Lakes
    - We have tremendous expertise on Lake Superior and will continue research on Lake Superior. However, we should be able to promote/position ourselves as having expertise that can be applied to all of the Great Lakes.

7. Modeling
    - Since many of us have expertise on modeling- surface and groundwater flow, chemical fate and transport, food web modeling, general numerical methods, etc., we should be able to promote ourselves as being able to model many of the phenomena that are important to Great Lakes.
    - If we integrated this modeling expertise, we could develop models capable of simulating relevant processes from watersheds to the open water.
    - These models could be used to predict the combined effects of climate change and land use change on the Great Lakes.
    - These models could be used to support decisions on how best to restore the Great Lakes.
    - Outputs from these models could be used to guide policy-makers (and policy-makers should be involved in model development).
    - Various aspects of models will need to be validated

8. Notre Dame is in the UP...
    - University of Notre Dame Environmental Research Center http://www.nd.edu/~underc/east/research/

9. Snow and ice
    - Our location is well suited for research on snow and ice as drivers for ecosystem behavior.
    - Climate change is expected to have impacts (or is already impacting) temporal and spatial patterns of snow and ice- how will this impact (or how is this impacting) ecosystems.

10. Critical areas of expertise needed at Michigan Tech to further contribute to Great Lakes research.
    - Hydrodynamicist would contribute to understanding of physical processes in open lakes and near shore areas.
    - Meteorologist would contribute to understanding effects of climate change on the Great Lakes and would connect with hydrodynamicist.
    - CWS could “lobby” for faculty positions to be filled by scientists with this expertise, but perhaps should be done as part of a larger research thrust proposal.