ANNUAL REPORT


Submitted by:
The Great Lakes Research Center

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GLRC Web page: http://www.mtu.edu/greatlakes/
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1 Introduction

This is the first Great Lakes Research Center (GLRC) annual report commemorating the Center’s first eighteen months of Institute operations and activity at Michigan Technological University. The GLRC operates as a shared use interdisciplinary facility where faculty, staff and graduate students collaborate to identify solutions, new knowledge, and awareness in freshwater research, education and outreach.

The GLRC was built in cooperation with the State of Michigan who provided three-quarters of the $25 million construction costs. The University made significant investment to leverage this partnership by acquiring the lakefront and land where the GLRC resides; through the Strategic Faculty Hiring Initiative in water, adding six new faculty positions to continue advancing the University’s role throughout the Great Lakes and the world; and the develop of a supercomputing facility. The GLRC facility provides 50,000 square feet of office and laboratory space for faculty, research staff and graduate students who support sponsored research and outreach activities. With the addition of “Superior,” the University’s super computer, big data computational and predictive modeling capabilities now allow faculty an opportunity to support investigations in weather modeling, invasive species migration, and other areas of coastal resiliency. Researchers from the GRLC are supporting research in all five of the Great Lakes and across the Laurentian Great Lakes Basin.

2 Mission of the GLRC

Mission: To be a leader in interdisciplinary aquatic science and engineering focused on the Laurentian Great Lakes Basin in its entirety through excellence in research, education and outreach.

Core focus areas of interest:
- Aquatic Ecology and Ecosystem Dynamics
- Marine Engineering and Technology
- Aquatic Resources and Human Dimensions
- Education and Outreach

2.1 GLRC Executive Committee

The GLRC, internal, Executive Committee (GLRC-EC) is composed of four elected members and one member appointed as Director of GLRC Operations by the Vice President for Research (VPR). The four elected members will be selected to each represent the four core focus areas of interest within the Institute:
- Aquatic Ecology and Ecosystem Dynamics
- Aquatic Resources and Human Dimensions
- Marine Engineering and Technology
- Education and Outreach

The director of each joining University-recognized Center will also serve on the Executive Committee. Members will initially be appointed for one, two- or three-year terms, to provide a staggered rotation of members. The primary responsibility of the GLRC-EC is to provide advice to the GLRC Director and to organize participation within each core focus area to better respond to funding and research opportunities.
Current Executive Committee (as of June 2014)

- GLRC Operations – Mike Abbott
- Aquatic Ecology and Ecosystem Dynamics – Amy Marcarelli
- Marine Technology and Engineering – Colleen Mouw
- Aquatic Resources and Human Dimensions – Emma Norman
- Education and Outreach – Marty Auer
- Center for Water and Society – Noel Urban

2.2 GLRC Personnel
The following personnel supported the operations and development of the GLRC facilities and Institute:

Director – Dr. Guy Meadows
Great Lakes Research Center Operations – Mike Abbott
Administrative Support – Cathy Codere, Richelle Schwaller, and Darlene Saari
Marine Coordination – Jamey Anderson
Facilities and Custodial Support – Tom Polkinghorn and Beth Fredricks
Website and Publication Support – Carol Asiala

3 GLRC use of IRAD funds
GLRC IRAD index: E35300

Research Incentive Transfer In ................................................................. 37,540.80

Expenditures ................................................................................................ 2,136.28
  Salaries & Fringes .............................................................................. 401.10
  Inter University Services .................................................................. 107.44
  Supplies ............................................................................................. 27.92
  Travel ............................................................................................... 1,599.82

Balance as of June 30, 2014 .................................................................. 35,404.52

4 GLRC Activities and Accomplishments

4.1 Development of GLRC Web page
The GLRC Web page was redesigned and formatted into the university’s Content Management System format.

http://www.mtu.edu/greatlakes/

4.2 Affiliation of the Center for Water and Society with the GLRC
The members of the Center for Water and Society (CWS) voted to affiliate CWS with the GLRC institute. CWS brings a broader scope of research to the GLRC, which fosters more interdisciplinary and collaborative research among all members. CWS is a partner in education and outreach coordinating many on-campus events to extend awareness and stewardship of fresh water resources.
### 4.3 Research

#### 4.3.1 New Awards (Jan 2013 – July 2014)

1) **Interpreting Ecological Variability using Remotely Observed Optical Properties and Ocean Models**
   - **PI:** Colleen Mouw
   - **Sponsor:** Massachusetts Institute of Technology (Fed Pass through - National Aeronautics Space Administration)
   - 1205053P1: Awarded: 04/29/2013; $64,631 (11/15/2012-11/14/2013)

2) **Abiotic and Biotic Constraints to Survival of Lake Sturgeon Eggs and Age-0 Larvae with Implications for Restoration: Development of Habitat Suitability Models**
   - **PI:** Nancy A. Auer
   - **Sponsor:** US Dept of the Interior, US Fish & Wildlife Service
   - 1206017P1: Awarded: 11/07/2012; $70,568 (09/01/2012-09/01/2017)

3) **Rip Currents in the Great Lakes: Advancing Forecasting Through Perishable Data Recovery and Analysis**
   - **PI:** Guy A. Meadows
   - **Sponsor:** University of Michigan (Federal Pass-through - US Dept of Commerce, National Oceanic & Atmospheric Administration)
   - 1207001P3: Awarded: 10/30/2013; $15,169 (12/19/2012-06/30/2014)
   - 1207001P4: Awarded: 03/19/2014; $26,466 (12/19/2012-06/30/2014)

4) **Connecting Phytoplankton Cell Size to Variability in the Ocean Carbon Sink**
   - **PI:** Colleen Mouw
   - **Sponsor:** University of Wisconsin – Madison, Space Science & Engineering Center (Fed Pass through - National Aeronautics Space Administration)
   - 1207068P1: Awarded: 09/12/2012; $38,669 (08/22/2012-12/02/2015)
   - 1207068P2: Awarded: 01/30/2013; $67,331 (08/22/2012-12/02/2015)

5) **Ocean Basin Impact of Ambient Noise on Marine Mammal Detectability, Distribution, and Acoustic Communication**
   - **PI:** Colleen Mouw
   - **Sponsor:** Pennsylvania State University (Federal Pass-through - US Dept of Defense, Navy)
   - 1207069P1: Awarded: 01/01/2013; $17,945 (08/20/2012 12/31/2014)
   - 1207069P2: Awarded: 03/14/2014; $12,018 (08/20/2012 12/31/2014)

6) **Parameterizing Spectral Characteristics of Optically Active Constituents in Inland Water for Improved Satellite Retrievals**
   - **PI:** Colleen Mouw
   - **Sponsor:** National Aeronautics Space Administration
   - 1208033P1: Awarded: 12/18/2013; $228,117 (12/03/2013-12/02/2016)

7) **Advanced Underwater Sensing**
   - **PI:** Guy A. Meadows
   - **Sponsor:** Enbridge Energy, LP
   - 1210071P1: Awarded: 04/09/2013; $375,249 (04/01/2013-03/31/2016)

8) **Development of Novel Detection and Prediction Algorithms for Microcystis Blooms**
   - **PI:** Colleen Mouw
   - **Sponsor:** University of New Hampshire (Fed Pass through - US Dept of Health & Human Services, National Institutes of Health & National Science Foundation)
9) Monitoring Stream Ecosystem Function Responses to Stamp Sand Stabilization in Tributaries of Lake Superior  
PI: Amy M. Marcarelli  
Co-PI: Casey Huckins  
Sponsor: University of Michigan  
<table>
<thead>
<tr>
<th>Awarded</th>
<th>Amount</th>
<th>Dates</th>
</tr>
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<tbody>
<tr>
<td>1303064P1</td>
<td>08/23/2013</td>
<td>$26,219 (07/01/2013-09/30/2013)</td>
</tr>
<tr>
<td>1303064P2</td>
<td>09/20/2013</td>
<td>$23,736 (09/01/2013-08/31/2014)</td>
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</table>

10) Cayuga Lake Bioassays  
PI: Martin T. Auer  
Sponsor: Upstate Freshwater Institute Inc  
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<th>Amount</th>
<th>Dates</th>
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<tbody>
<tr>
<td>1304044P1</td>
<td>07/10/2013</td>
<td>$47,068 (04/25/2013-12/31/2014)</td>
</tr>
</tbody>
</table>

11) Great Lakes Observing System (GLOS)  
PI: W. Charles Kerfoot  
Co-Pls: Sarah A. Green and Guy A. Meadows  
Sponsor: US Dept of Commerce  
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<tr>
<th>Awarded</th>
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<th>Dates</th>
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</thead>
<tbody>
<tr>
<td>1305004P1</td>
<td>05/23/2013</td>
<td>$13,560 (05/24/2013-08/31/2014)</td>
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<tr>
<td>1305004P2</td>
<td>04/08/2014</td>
<td>$23,664 (05/24/2013-08/31/2014)</td>
</tr>
</tbody>
</table>

12) Phytoplankton Enumeration for Les Cheneaux Water Quality Studies  
PI: Amy M. Marcarelli  
Co-PI: Gary L. Fahnenstiel  
Sponsor: Les Cheneaux Watershed Council  
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<tr>
<th>Awarded</th>
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<th>Dates</th>
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<tr>
<td>1305011P1</td>
<td>06/19/2013</td>
<td>$1,796 (06/01/2013-05/31/2014)</td>
</tr>
<tr>
<td>1305011P2</td>
<td>06/05/2014</td>
<td>$1,796 (06/01/2014-05/31/2015)</td>
</tr>
</tbody>
</table>

13) REF-IE: Putting the "AQ" in the AQUAM Lab  
PI: Guy A. Meadows  
Co-Pls: Michael R. Gretz, Judith Perlinger, Claudio Mazzoleni, Louisa Jane Kramer  
Sponsor: Michigan Technological University  
<table>
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<tr>
<th>Awarded</th>
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<th>Dates</th>
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<tbody>
<tr>
<td>1305020P1</td>
<td>06/30/2013</td>
<td>$20,500 (07/01/2013-08/31/2014)</td>
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</table>

14) Lake Superior Stewardship Initiative  
PI: Joan Schumaker Chadde  
Co-PI: Lloyd Tucker Wescoat  
Sponsor: Copper Country Intermediate School District  
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<th>Awarded</th>
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<th>Dates</th>
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<tbody>
<tr>
<td>1306008P1</td>
<td>08/16/2013</td>
<td>$70,000 (07/01/2013-06/30/2015)</td>
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</tbody>
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15) Lake Superior Stewardship Initiative  
PI: Joan Schumaker Chadde  
Co-PI: Lloyd Tucker Wescoat  
Sponsor: Copper Country Intermediate School District (CCISD)  
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<th>Awarded</th>
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<th>Dates</th>
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<tbody>
<tr>
<td>1306019P1</td>
<td>06/24/2013</td>
<td>$29,223 (06/01/2013-08/30/2013)</td>
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16) Restoring, Retrofitting and Recoupling Michigan’s Great Lakes Shorelands in the Face of Global Climate Disruption  
PI: Guy A. Meadows  
Sponsor: University of Michigan  
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<tr>
<th>Awarded</th>
<th>Amount</th>
<th>Dates</th>
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<tbody>
<tr>
<td>1306023P1</td>
<td>02/03/2014</td>
<td>$25,000 (09/01/2013-08/31/2014)</td>
</tr>
</tbody>
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17) NEORSD Integrated Clean Water Act Planning Evaluation - Stage 1  
PI: Martin T. Auer
Co-PI: David W. Watkins  
Sponsor: Wade Trim  
1306035P1: Awarded: 07/01/2013 $43,087 (09/01/2013-08/31/2014)  

18) Development of Novel Detection and Prediction Algorithms for Microcystis Blooms  
PI: Colleen Mouw  
Sponsor: University of New Hampshire (Fed Pass through - National Science Foundation)  
1307020P1: Awarded: 07/12/2013 $19,031 (03/01/2013-02/28/2014)  
1307020P2: Awarded: 03/12/2014 $21,437 (03/01/2013-02/28/2015)  

19) Low-Cost Underwater Glider Fleet for Littoral Marine Research  
PI: Nina Mahmoudian  
Sponsor: US Dept of Defense, Navy  
1307024P1: Awarded: 12/12/2013 $70,000 (12/1/2013-12/31/2014)  
1307024P2: Awarded: 02/24/2014 $20,000 (12/1/2013-12/31/2014)  

20) Arresting the Spread of Eurasian Watermilfoil in Lake Superior  
PI: Casey J. Huckins  
Co-PIs: Rodney Chimner, Colin N. Brooks, Amy M. Marcarelli, and Guy A. Meadows  
Sponsor: US Environmental Protection Agency, Great Lakes National Program Office  
1308013P1: Awarded: 02/12/2014 $499,887 (01/01/2014-12/31/2015)  

21) Source Identification of PCBs in Torch Lake  
PI: Martin T. Auer  
Co-PIs: Carol A. MacLennan and Guy A. Meadows  
Sponsor: Michigan Dept of Environmental Quality  
1312044P1: Awarded: 02/07/2014 $199,406 (02/07/2014-12/31/2014)  

22) Impacts of Physical Drivers on Phytoplankton Community Composition in the Bering Sea  
PI: Brice Grunert  
Sponsor: University of Michigan-Michigan Space Grant Consortium  
1311040P1: Awarded: 04/25/2014 $5,000 (05/01/2014-04/30/2015)  

23) Community-Based Research to Understand Lake Superior Coastal Storms Risk and Vulnerability at Au Train MI  
PI: Guy A. Meadows  
Sponsor: Ohio State University  
1312040P1: Awarded: 06/18/2014 $49,976 (06/01/2014-08/31/2014)  

24) National-Scale Efforts Towards Verification and Validation of Observing Technologies  
PI: Guy A. Meadows  
Sponsor: University of Maryland  
1405037P1: Awarded: 06/16/2014 $104,961 (06/01/2014-05/31/2015)  

25) Collaborative Research: Continuation and Enhancement of MPOWIR  
PI: Colleen Mouw  
Sponsor: National Science Foundation  

26) Disclosure Restricted  
PI: Martin T. Auer  
Sponsor: Disclosure Restricted  
1306036P1: Awarded: 10/22/2013 $80,975 (07/01/2013-06/30/2014)  
1306036P2: Awarded: 05/16/2014 $5,875 (07/01/2013-12/31/2014)
4.3.2 Proposals submitted (Jan 2013 – July 2014)

1. **CFIRE-UTC Recompetition**
   PI: Joan Schumaker Chadde
   **Sponsor:** University of Wisconsin-Madison
   1110099P3: Awarded: 09/24/2013 $8,108 (08/01/2013-10/31/2013)

2. **Abiotic and Biotic Constraints to Survival of Lake Sturgeon Eggs and Age-0 Larvae with Implications for Restoration: Development of Habitat Suitability Models**
   PI: Nancy A. Auer
   **Sponsor:** US Dept of the Interior, US Fish & Wildlife Service
   1206017P1: Awarded: 11/07/2012 $70,568 (09/01/2012-09/01/2017)

3. **Rip Currents in the Great Lakes: Advancing Forecasting Through Perishable Data Recovery and Analysis**
   PI: Guy A. Meadows
   **Sponsor:** University of Michigan (Fed Pass through - US Dept of Commerce, National Oceanic & Atmospheric Administration)
   1207001P3: Awarded: 10/30/2013 $15,169 (12/19/2012-12/31/2013)

4. **Parameterizing Spectral Characteristics of Optically Active Constituents in Inland Water for Improved Satellite Retrievals**
   PI: Colleen Mouw
   **Sponsor:** National Aeronautics Space Administration
   1208033P1: Awarded: 12/18/2013 $228,117 (12/03/2013-12/2/2016)

5. **Parameterizing Spectral Characteristics of Optically Active Constituents in Inland Water for Improved Satellite Retrievals**
   PI: Colleen Mouw
   **Sponsor:** National Aeronautics Space Administration
   1208033P2: Awarded: 08/27/2014 $41,494 (07/01/2014-06/30/2015)

6. **Restoration of Sand-impacted Coaster Brook Trout Habitat**
   PI: Casey J. Huckins
   **Sponsor:** National Fish and Wildlife Foundation
   1302028PP: $59,812 (05/01/2013-04/30/2014)

7. **GLOS Open Lakes (Nearshore Buoy Keweenaw Observatory and Glider Support Activities) and Remote Sensing**
   PI: Robert A. Shuchman
   **Sponsor:** University of Michigan
   1302073P3: Awarded: 10/22/2014 $177,179 (06/01/2014-05/31/2015)

8. **Global Change and Ecosystem Stressors in the Great Lakes: Strengthening Environmental Literacy in Underrepresented Teens**
   PI: Martin T. Auer
   **Sponsor:** US Dept of Commerce
   1303016P1: $673,303 (10/01/2013-09/30/2018)

9. **Assessing the Impacts of Sea-ice and Biogeochemical Changes in the Bering Sea on High Arctic Ecosystems Experiencing Rapid Reductions in Sea Ice**
   PI: Colleen Mouw
   **Sponsor:** Lamont-Doherty Earth Observatory of Columbia University
   1303036P1: $349,314 (11/01/2013-10/31/2016)

10. **Modeling the Efficacy of Sediment in Torch Lake Michigan with Sed2K**
    PI: Noel R. Urban
PI: Guy A. Meadows
Sponsor: University of Michigan
1303052P1: $49,572 (06/01/2013-05/31/2015)

12. Spatial Distribution of Stamp Sand Impacts on Benthic Macroinvertebrates Around Gay MI
PI: Nancy A. Auer
Sponsor: Michigan Dept of Environmental Quality
1303056P1: $99,396 (01/02/2014-03/31/2015)

13. Eurasian Watermilfoil Strategic Control Program
PI: Casey J. Huckins
Sponsor: University of Michigan
1303059PP: $471,122 (08/01/2013-07/31/2015)

14. Evaluating the Role of the Great Lakes Restoration Initiative in Enhancing the Policy Capacity of Lakewide Management Plans (LaMPS)
PI: Hugh S. Gorman
Sponsor: University of Michigan
1303060P1: $48,378 (09/03/2013-08/15/2015)

15. Monitoring Stream Ecosystem Function Responses to Stamp Sand Stabilization in Tributaries of Lake Superior
PI: Amy M. Marcarelli
Co-PI: Casey Huckins
Sponsor: University of Michigan
1303064P1: Awarded: 08/23/2013 $26,219 (09/01/2013-08/31/2014)
1303064P2: Awarded: 09/20/2013 $23,736 (09/01/2013-08/31/2014)

16. Lake Superior Mining Restoration Project: Encroachment of Stamp Sands onto Buffalo Reef
PI: W. Charles Kerfoot
Sponsor: University of Michigan
1303069PP: $475,446 (10/01/2013-09/30/2015)

17. Great Lakes Harmful Algal Bloom Synthesis: Products Prediction and Public Understanding
PI: Colleen Mouw
Sponsor: University of Michigan
1303072PP: $500,000 (10/01/2013-09/30/2015)

18. An Advanced Decision Support System for the Lake Superior LaMP
PI: Martin T. Auer
Sponsor: University of Michigan
1303074PP: $499,397 (10/01/2013-09/30/2015)

19. Learning from Success: How Can Progress At Other AOCs Best Be Transferred To Torch Lake AOC?
PI: Carol A. MacLennan
Sponsor: University of Michigan
1303075P1: $49,983 (08/01/2013-07/31/2015)

20. PCBs in Fish: How Much and How Fast Can AOC Remediation Help?
21. Cayuga Lake Bioassays
PI: Martin T. Auer
Sponsor: Upstate Freshwater Institute Inc.
1304044P1: Awarded: 07/10/2013 $47,068 (04/25/2013-12/31/2014)

22. Great Lakes Observation System
PI: W Charles Kerfoot
Co-Pls: Sarah A. Green and Guy A. Meadows
Sponsor: US Dept of Commerce

PI: Evan S. Kane
Sponsor: National Aeronautics Space Administration
1304052PP: Pre-proposal (01/01/2014-12/31/2016)
1304052P1: $346,885 (01/01/2014-12/31/2016)

24. A Glider for Underwater Outreach Programs Aimed at Inspiring Engaging and Educating Next Generation of Scientists and Engineers
PI: Nina Mahmoudian
Sponsor: US Dept of Defense
1305009PP: $599,890 (10/01/2013-09/30/2016)

25. Phytoplankton Enumeration for Les Cheneaux Water Quality Studies
PI: Amy M. Marcarelli
Co-PI: Gary L. Fahnenstiel
Sponsor: Les Cheneaux Watershed Council
1305011P1: Awarded: 06/19/2013 $1,796 (06/01/2013-05/31/2014)

26. REF-IE: Putting the "AQ" in the AQUAM Lab
PI: Guy A. Meadows
Co-Pls: Michael R. Gretz, Judith Perlinger, Claudio Mazzoleni, and Louisa Jane Kramer
Sponsor: Michigan Technological University
1305020P1: Awarded: 06/30/2013 $20,500 (07/01/2013-08/31/2014)

27. Angler Demographics Cohort Effects and Fisheries Governance
PI: Richelle L. Winkler
Sponsor: Great Lakes Fishery Commission
1305074P1: $122,386 (05/01/2014-09/01/2016)

28. Lake Superior Stewardship Initiative
PI: Joan Schumaker Chadde
Co-PI: Lloyd Tucker Wescoat
Sponsor: Copper Country Intermediate School District (CCISD)
1306008P1: Awarded: 08/16/2013 $70,000 (07/01/2013-06/30/2015)

29. Lake Superior Stewardship Initiative
PI: Joan Schumaker Chadde
Co-PI: Lloyd Tucker Wescoat
Sponsor: Copper Country Intermediate School District  
1306019P1: Awarded: 06/24/2013 $29,223 (06/01/2013-08/30/2013)

30. Restoring, Retrofitting and Recoupling Michigan’s Great Lakes Shorelands in the Face of Global Climate Disruption  
PI: Guy A. Meadows  
Sponsor: University of Michigan  
1306023P1: Awarded: 06/24/2013 $25,000 (09/01/2013-08/31/2014)

31. Wake Modeling  
PI: Guy A. Meadows  
Sponsor: Akela Inc  
1306029P1: $39,100 (01/01/2014-9/30/2014)

32. NEORSD Integrated Clean Water Act Planning Evaluation - Stage 1  
PI: Martin T. Auer  
Co-PI: David W. Watkins  
Sponsor: Wade Trim  
1306035P1: Awarded: 07/01/2013 $43,087 (09/01/2013-08/31/2014)  
1306035P2: Awarded: 03/17/2014 $200,033 (02/01/2014-01/31/2015)

33. Disclosure Restricted  
PI: Martin T. Auer  
1306036P1: Awarded: 10/22/2013 $80,975 (07/01/2013-06/30/2014)  
1306036P2: Awarded: 05/16/2014 $5,875 (07/01/2013-12/31/2014)

34. Integrated Municipal Stormwater and Wastewater Planning -Great Lakes  
PI: Martin T. Auer  
Sponsor: Water Environmental Research Foundation  
1307016PP: $331,290 (01/01/2014-12/31/2015)

35. Development of Novel Detection and Prediction Algorithms for Microcystis Blooms  
PI: Colleen Mouw  
Sponsor: University of New Hampshire (Fed Pass through - National Science Foundation)  
1307020P1: Awarded: 07/12/2013 $19,031 (03/01/2013-02/28/2014)

36. Low-Cost Underwater Glider Fleet for Littoral Marine Research  
PI: Nina Mahmoudian  
Sponsor: US Dept of Defense, Navy  
1307024P1: Awarded: 12/12/2013 $70,000 (12/01/2013-12/31/2014)

37. Collaborative Research: Continuation and Enhancement of MPOWIR  
PI: Colleen Mouw  
Sponsor: National Science Foundation  
1308008P1: Awarded: 01/29/2014 $82,739 (04/01/2014-03/31/2018)

38. Collaborative Research: Physical Implications of Optical Changes in Lake Michigan Due to Invasive Mussels  
PI: Colleen Mouw  
Sponsor: National Science Foundation  
1308011P1: $440,563 (03/01/2014-02/28/2018)

39. Arresting the Spread of Eurasian Watermilfoil in Lake Superior  
PI: Casey J. Huckins  
Co-PIs: Rodney Chimner, Colin N. Brooks, Amy M. Marcarelli, and Guy A. Meadows
Sponsor: US Environmental Protection Agency, Great Lakes National Program Office  
1308013P1:  Awarded: 02/12/2014  $499,887 (01/01/2014-12/31/2015)

40. Keweenaw Stamp Sands Ecosystem Restoration Project  
PI: W. Charles Kerfoot  
Sponsor: US Environmental Protection Agency  
1308014P1:  $99,916 (11/01/2013-10/31/2015)

41. Impacts of Physical Drivers on Phytoplankton Community Composition in the Bering Sea  
PI: Brice Grunert  
Sponsor: University of Michigan-Michigan Space Grant Consortium  
1311040P1:  Awarded: 04/25/2014  $5,000 (05/01/2014-04/30/2015)

42. Physical Drivers of Phytoplankton in Lake Superior  
PI: Colleen Mouw  
Sponsor: University of Michigan-Michigan Space Grant Consortium  
1311044P1:  $5,000 (05/01/2014-04/30/2015)

43. After School Engineering & Technology Classes for Grades 1-6  
PI: Joan Schumaker Chadde  
Sponsor: University of Michigan-Michigan Space Grant Consortium  
1311068P1:  $10,000 (05/01/2014-04/30/2015)

44. Great Lakes Observatory for Biodiversity and Ecosystem Science (GLOBES)  
PI: Guy A. Meadows  
Sponsor: US Dept of Commerce  
1311085P1:  $9,330,716 (06/01/2014-05/31/2019)

45. Ocean Acidification: Collaborative Research: Great Lakes Ocean Acidification  
PI: Noel R. Urban  
Sponsor: National Science Foundation  
1312001P1:  $407,640 (10/01/2014-09/30/2018)

PI: Robert A. Shuchman  
Sponsor: Ohio State University  
1312038P1:  $179,371 (05/12/2014-05/11/2016)

PI: Richelle L. Winkler  
Sponsor: US Environmental Protection Agency  
1312039P1:  Awarded: 08/07/2014  $14,490 (08/15/2014-08/14/2015)

48. Community-Based Research to Understand Lake Superior Coastal Storms Risk and Vulnerability at Au Train MI  
PI: Guy A. Meadows  
Sponsor: Ohio State University  
1312040PP:  Pre-proposal (05/12/2014-05/11/2016)  
1312040P1:  Awarded: 06/18/2014  $49,976 (05/12/2014-05/11/2016)

49. Source Identification of PCBs in Torch Lake  
PI: Martin T. Auer  
Co-PIs: Carol A. MacLennan, Guy A. Meadows  
Sponsor: Michigan Dept of Environmental Quality
50. **NRI: Co-Robots to Engage Next Generation of Students in STEM Learning**  
   **PI:** Nina Mahmoudian  
   **Sponsor:** National Science Foundation  
   **1401050P1:** Awarded: 08/21/2014 $359,652 (09/01/2014-08/31/2017)

51. **Preliminary Proposal: Mechanistic Linkages between In-Stream Fine Sediment and Fluvial Fish**  
   **PI:** Casey J. Huckins  
   **Sponsor:** National Science Foundation  
   **1401061PP:** Pre-proposal (01/01/2015-12/31/2017)

52. **Standard Research Grant: Toxic Mobilizations: Contaminants and Iron Mining Histories in the Lake Superior Basin**  
   **PI:** Nancy E. Langston  
   **Sponsor:** National Science Foundation  
   **1401083P1:** Awarded: 07/28/2014 $236,069 (09/01/2014-08/31/2017)

53. **Defining the Great Lakes Observatory for Biodiversity and Ecosystem/Economic Sustainability**  
   **PI:** Guy A. Meadows  
   **Sponsor:** Great Lakes Protection Fund  
   **1402002PP:** $193,233 (08/01/2014-01/31/2016)

54. **Integration of Commons Concepts and Indigenous Philosophies in Great Lakes K12 Outreach**  
   **PI:** Martin T. Auer  
   **Sponsor:** US Environmental Protection Agency  
   **1402009P1:** $131,527 (09/01/2014-08/31/2015)

55. **Physical Controls of Phytoplankton Community Structure in the Bering Sea**  
   **PI:** Colleen Mouw  
   **Sponsor:** National Aeronautics Space Administration  
   **1402019P1:** $30,000 (09/01/2014-08/31/2015)

56. **Operational Transition of a Reliable Autonomous Real-Time Observation System for Advancing Water Quality Monitoring and Assessment in the Great Lakes Region**  
   **PI:** Colleen Mouw  
   **Sponsor:** University of New Hampshire  
   **1402030P1:** $312,313 (12/01/2014-11/30/2017)

57. **ITEST Strategies: Glider for Underwater Problem-solving and Promotion of Interest in Engineering (GUPPIE)**  
   **PI:** Nina Mahmoudian  
   **Sponsor:** National Science Foundation  
   **1402031P1:** $717,882 (09/01/2014-08/31/2017)

58. **Advancing an Ice-Capable Sensor Equipped (ISE) Cabled and Mobile Observing Technologies for Ice-Bound Seas**  
   **PI:** Guy A. Meadows  
   **Sponsor:** US Dept of Commerce  
   **1402068P1:** $2,849,247 (09/01/2014-08/31/2017)

59. **Collaborative Research: Underwater Distributed Antenna Systems: Fundamental Limits and Practical Designs**
60. Develop and Verify Habitat Suitability Models for Early-life Lake Sturgeon
PI: Nancy A. Auer
Sponsor: US Dept of the Interior
1403015P1: $147,354 (08/15/2014-05/01/2017)

61. Assessing Beach Habitat for Piping Plover Across Upper Lake Michigan and Lower Lake Superior in the Face of Changing Environmental Stress
PI: Guy A. Meadows
Sponsor: US Dept of the Interior
1403054P1: $89,820 (07/01/2014-06/30/2015)

62. Lake Superior Stewardship Initiative
PI: Joan Schumaker Chadde
Sponsor: Copper Country Intermediate School District
1404005P1: Awarded: 04/09/2014 $13,560 (09/01/2013-08/01/2014)

PI: Zhaohui Wang
Sponsor: National Science Foundation
1404006P1: $319,509 (10/01/2014-09/30/2016)

64. REF-RS: Development of a Hydrodynamic Modeling System for Lake Superior and its Application to Optimal Design of a Lake Superior Observing Network
PI: Pengfei Xue
Sponsor: Michigan Technological University
1405014P1: Awarded: 05/01/2014 $20,000 (07/01/2014-08/31/2015)

65. National-Scale Efforts Towards Verification and Validation of Observing Technologies
PI: Guy A. Meadows
Sponsor: University of Maryland
1405037P1: Awarded: 06/16/2014 $104,961 (06/01/2014-05/31/2015)

66. Angler Demographics: An Age-period-cohort Analysis
PI: Richelle L. Winkler
Sponsor: Great Lakes Fishery Commission
1405065P1: Awarded: 02/19/2015 $127,031 (05/01/2015-08/31/2017)

4.3.3 Publications of the GLRC
The GLRC is tracking the peer-reviewed literature published by researchers associated with the GLRC. Each publication is given a sequential number, and the following statement will be included in the Acknowledgements section of each paper: “This is Contribution No. _ of the Great Lakes Research Center at Michigan Tech.” As of June 2014, we are at contribution number 10 with 8 published documents.


4.4 Research Vessels/Equipment

4.4.1 Visiting Ship from NOAA-GLERL
The National Oceanic and Atmospheric Administration (NOAA) Great Lakes Environmental Research Laboratory (GLERL) ship, the research vessel (R/V) Storm, visited the GLRC for three weeks in July and August 2013 to further the long-term partnership of GLRC and NOAA/GLERL in the Long Term Monitoring Program for Lake Superior. The R/V Storm was made available for use by the GLRC scientists, which strengthened collaborations with NOAA scientists. A 2014 visit was also initiated.

4.4.2 Visiting Ship from USGS
The USGS ship, the R/V Sturgeon, also visited campus for a week during the summer of 2013 to strengthen collaborations with USGS fisheries scientists. USGS has offered free “piggy back” time aboard their Lake Superior vessel or if demand is sufficient, again bring R/V Sturgeon to Lake Superior.

4.4.3 Acquisition of S/V Osprey
The VPR has also provided funding for a new small, covered survey vessel for the GLRC. The S/V Osprey arrived in the first week of May 2014. It is a very lightly used, 2005, Osprey 24’ long cabin vessel, on a heavy-duty trailer, compatible with the GLRC ¾ ton truck. The vessel is powered by a 320 HP Volvo I/O drive, has a small galley and an enclosed toilet.

A tentative use charge of $350/day has been established for Osprey use. The GLRC will provide an operator for all Osprey use.
4.4.4 Acoustic Doppler Current Profiler
A NorTek Acoustic Doppler Current Profiler (AWAC-ADCP) was deployed over the past winter off South Entry for wave, current, and ice monitoring, optimized for sensing in 25 meters water depth and less, internal and real-time recording. This was sponsored through a joint DOE program with the University of Michigan.

4.4.5 Acquisition of IVER 3
The fully Autonomous Underwater Vehicle (AUV), IVER 3, s offer the ability to survey, explore, and collect data without requiring input from an operator. By controlling their movement themselves, AUVs give researchers a new way to study the Great Lakes—with no need for human control. The IVER 3 is truly a first-of-its-kind AUV, proudly displaying serial number 001 as confirmation. With this brand-new equipment, GLRC researchers have access to a host of new technologies, including:

- High-resolution, forward-looking video/still digital camera
- LED lighting
- EdgeTech 2505 digital side-scan and mapping sonar
- Acoustic Doppler current profiler and velocity log

The IVER 3’s sonar system uses the full range of EdgeTech side-scan sonar frequencies (100–1,600 kHz), making it the most versatile sonar imaging system available. The ultra-high-resolution EdgeTech sonar provides unrivaled imaging resolution and full three-dimensional mapping capabilities.

IVER 3’s more-than-300-foot-depth diving capabilities coupled with its 12 hours of operating time provides unsurpassed underwater survey capabilities to Center researchers—and a winning combination for the Great Lakes.

4.5 Seminars

4.5.1 Brown-bag lunch series
The GLRC and CWS jointly hosted a Water Brown-bag Lunch Series from January 15 through April 2, 2014, meeting on every other Wednesday.

The intent of the series was to promote broad, interdisciplinary conversation and collegial friendships among faculty, staff, and graduate students at Michigan Tech who share an interest in water. Each meeting was launched by a speaker with a short (15-20 minutes) accessible presentation to spark a lively discussion. Presentation topics were selected from the presenter’s current research or potential interdisciplinary research ideas.

One of our most important goals is to build a true community of colleagues in a number of different disciplines who all share a special interest in water. The success of the series is bringing researchers of different disciplines together as colleagues and friends.

Series Organizers: Nancy Langston, Guy Meadows, Noel Urban, and Emma Norma

Presentations:
JAN 15: Nancy Langston (Social Sciences)
JAN 29: Noel Urban (Civil and Environmental Engineering)
4.6 Education and Outreach Activities

4.6.1 Teacher Institutes
The following K-12 Summer Teacher Institutes were conducted with the assistance of Joan Schumaker Chadde, Lloyd Wescoat, and many GLRC faculty and students. Topical Institutes included:

- Great Lakes Watershed Investigations
- Great Lakes Maritime
- Global Change
- Geology of the U.P.
- Forestry

4.6.2 Water Festival
The Fall 2013 Water Festival targeted students from Grades 9-11 and offered students the opportunity to engage in standards-based experiences taught by Michigan Tech scientists, students, and community experts involved in Great Lakes and STEM career fields. Participation included 300 high school students with many Michigan Tech faculty and student presenters.

4.6.3 Green Film Series and Monthly Lectures
Monthly showing of films on environmental topic to audiences of ~100 composed of Michigan Tech students and faculty and local community members. This series was co-sponsored by CWS, the Keweenaw Land Trust, and the Keweenaw Universalist Unitarian Fellowship. Five films were shown in 2013 (listed below); each was followed by a discussion moderated by MTU faculty or community members.

Lectures:
NOV – Thomas Power, University of Montana
   *The Economic Anomaly of Mining: Treasure and Tears*
DEC – Chelsea Schelly, Social Sciences, Michigan Tech
   *Technology, Nature & Society: Seeing the Social in the Material of Everyday Life*

Films:
JAN – *River Planet*
FEB – *Tiny: a movie about living small*
MAR – *Gasland*
APR – *Thin Ice*
MAY – *GMO OMG*

4.6.4 10th Biennial Lake Superior Youth Symposium
The Lake Superior Youth Symposium is held in different locations around Lake Superior every two years for students and teachers in Grades 8-12 in Michigan, Minnesota, Wisconsin, and Ontario. The 10th Biennial Lake Superior Youth Symposium was held at Michigan Tech in May 2013, hosting over 200 students, teaching them about Lake Superior and the Great Lakes
watersheds through hands-on activities and to prepare them to bring their experiences back to their classrooms and communities.

4.6.5 Ride the Waves with GM
The General Motors (GM) Ride the Waves program supported participation in 48 student excursions and 9 community excursions focusing on the following topics: Aquatic Food Web & Lab Investigation; Mine Waste Remediation & Torch Lake Restoration; Investigate “the Lake” with a Remotely Operated Vehicle; and the Lake Superior Ring of Fire.

4.7 Director Activities in Support of GLRC

During the first eighteen months of GLRC operations, Director Guy Meadows lead the following initiatives to help advance the Institute’s capabilities within the Great Lakes region.

The Marine Research Assets Facility (MRAF) and the Geospatial Research Facility (GRF) were established within the GLRC to support the development of shared use marine assets with direct access to Lake Superior and digital geospatial data and analysis. Facilities designated as Core University facilities are eligible to propose and receive annual supplemental support from the University to further research activities. Section 5.3 and 5.4 of this report highlight the shared use equipment available to researchers through the GLRC and the MRAF. The GRF includes a 12 computer workstation classroom (B003) equipped to teach advanced geospatial information system (GIS) courses through an interactive and cooperative learning environment. Available software includes ArcGIS, Google Earth Pro, Stat Transfer and the Adobe Creative Suite. The GRF includes a newly established Remote Sensing Laboratory (room 316) to support geospatial research and skilled technician support to aid in research investigations.

Another major initiative for this period was the establishment of the Great Lakes Observatory for Biodiversity and Ecosystem Science (GLOBES). GLOBES was established to support a more systematic, coordinated and sustainable network for quantifying and tracking biodiversity in the Great Lakes. The GRLC along with partnering institutions the University of Windsor and the University of Victoria, seek to support a bottom-mounted cabled-observatory to provide continuous assessment of physical and biological variables and well as supporting a fleet of mobile autonomous vehicles for on-going monitoring and data collection. GLOBES objectives include:

- Identify a baseline of biological, physical, chemical and ecological parameters
- Forecast spatial and temporal patterns of algae production, food web basal resources, fish stocks and species distributions
- Document and forecast the effects of climate change
- Develop and apply indicators of lake ecological conditions
- Restore native species and their habitats in a deliberate and strategic manner

4.8 GLRC Memberships in External Organizations

- National Association of Marine Laboratories
- University-National Oceanographic Laboratory System (UNOLS)
- Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI)
4.9 GLRC News Features

The following news stories, highlighting faculty, staff, graduate students and activities of the GLRC, were published by the University’s Marketing and Communication office.

Sarah Green Named Jefferson Science Fellow (March 29, 2013)
Kerfoot to Receive 2013 Research Award (April 26, 2013)
Michigan Tech Researchers Receive Two Great Lakes Restoration Grants (March 27, 2015)
Students and Teachers Gather at Tech to Learn about Lake Superior (May 14, 2013)
Great Lakes Research Center: One Year Old and Growing (June 4, 2013)
SURFing for the Summer (August 14, 2013)
New Satellite Maps Track Harmful Algal Blooms in Great Lakes (September 5, 2013)
Message in a Bottle: “Hello, fellow traveler.” (October 14, 2013)
Iver 3 Charts New Waters (October 17, 2013)
Science is Spelled Excitement during STEM Awareness Month (October 31, 2013)
Supercomputer Helps Model Lakes, Oceans and Much More (November 26, 2013)
Michigan tech Appoints Two New Robbins Chairs (December 19, 2013)
Nancy Auer’s Sturgeon Book Among Michigan’s Most Notable for 2014 (January 8, 2014)
One-Celled Plants Key to Understanding Changes in the Great Lakes (February 11, 2014)
Toward Smarter Underwater Drones (May 29, 2014)
5  Space and Facilities Requirements

The Great Lakes Research Center building

5.1  Laboratories

Aquatic Ecology and Ecosystem Dynamics

<table>
<thead>
<tr>
<th>Lab</th>
<th>Contact</th>
<th>Location</th>
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<tbody>
<tr>
<td>Analytical Laboratory for Great Lakes Exploration</td>
<td>Michael Gretz</td>
<td>GLRC 219, 223</td>
</tr>
<tr>
<td>Aquatic Chemistry Lab</td>
<td>Colleen Mouw</td>
<td>GLRC 207</td>
</tr>
<tr>
<td>Aquatic Ecology Lab</td>
<td>Nancy Auer, Casey Huckins</td>
<td>GLRC 113, 117</td>
</tr>
<tr>
<td>Ecosystem Processes Lab</td>
<td>Martin Auer</td>
<td>GLRC 304</td>
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<tr>
<td>Invasive Species Lab</td>
<td>Charles Kerfoot</td>
<td>GLRC 103</td>
</tr>
<tr>
<td>Primary Productivity and Plankton Ecology Lab</td>
<td>Gary Fahnenstiel</td>
<td>GLRC 217</td>
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<tr>
<td>Sediments Lab</td>
<td>Noel Urban</td>
<td>GLRC 203</td>
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Atmospheric

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<tbody>
<tr>
<td>Air Quality and Meteorology (AQUAM) Lab</td>
<td>Judith Perlinger, Simon Carn</td>
<td>GLRC 304</td>
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Marine Engineering and Technology

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<tr>
<th>Lab</th>
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<tbody>
<tr>
<td>Marine Engineering Lab</td>
<td>Guy Meadows</td>
<td>GLRC B001</td>
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<tr>
<td>Vessel Deployment Center</td>
<td>Guy Meadows</td>
<td>GLRC B006</td>
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Computational

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<tr>
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<tbody>
<tr>
<td>Computational Research Center</td>
<td>Warren Perger</td>
<td>GLRC 105</td>
</tr>
<tr>
<td>Remote Sensing and Coastal Instrumentation Lab</td>
<td>Guy Meadows, Colleen Mouw</td>
<td>GLRC 316</td>
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Education and Outreach

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<tr>
<th>Lab</th>
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<tr>
<td>Environmental Education Lab</td>
<td>Joan Schumaker Chadde</td>
<td>GLRC 104</td>
</tr>
<tr>
<td>Limnology Lab</td>
<td>Martin Auer, Noel Urban</td>
<td>GLRC 102</td>
</tr>
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Flex Labs

GLRC 111, 217, and 302 are available to accommodate a variety of short to mid-term uses. Requests for use should be addressed to Cathy Codere (cmbanfield@mtu.edu). Currently GLRC 217 is currently in use by Gary Fahnenstiel as the Primary Productivity and Plankton Ecology Lab.
5.2 Offices & Conference Rooms
The Great Lakes Research Center operated at capacity. Available office space was fully utilized by faculty and graduate students. The building houses a number of conference rooms that provide meeting space with state-of-the-art technology for group engagement. Room sizes accommodate six to ninety attendees. The largest conference room, GLRC 202, was frequently used by other on-campus groups for meetings, workshops, seminars, socials and catered events.

5.3 Vessels – Surface and Subsurface
The GLRC owns and operates a variety of surface and subsurface vessels. These vessels are operated by trained staff and students who support the research, education and outreach mission of the Institute.

**Surface Vessel Fleet**

**R/V Agassiz:** Custom built for Michigan Tech in 2002, the 36-foot, aluminum-hulled *R/V Agassiz* has a top cruising speed of 30 mph and a cruising distance of over 250 miles. With an array of on-board scientific equipment, heated pilot house, and electronic navigation tools, the *R/V Agassiz* offers students and educators of all ages a state-of-the-art floating laboratory that can access even the most remote parts of Lake Superior. The *R/V Agassiz* is operated by a licensed captain and can carry 19 additional passengers.

**SV Osprey:** 24-foot boat with a 320hp inboard/outboard motor with fuel capacity of 150 gallons.

**SV Polar:** 22-foot boat with a 150hp outboard motor with fuel capacity of 80 gallons.

**SV Husky Traveler:** instrumental in validating satellite-derived data in the lower Great Lakes. The *SV Husky Traveler* resides in the Lower Peninsula—close to the [Michigan Tech Research Institute](#) in Ann Arbor, Michigan. The *SV Husky Traveler* is 17-foot boat with a 90hp outboard motor with fuel capacity of 40 gallons.

**Remotely Operated Vehicles (ROVs)**

**Outland 1000:** The GLRC maintains and operates two Outland 1000 ROVs. These vehicles can dive to depths of more than 1,000 feet. Both are fully equipped with a collection of sampling tools, including:

- Scanning imaging sonar
- One-function articulated arm for selective sampling
- Two color (and one black-and-white) low-light video cameras
- Flood lights

The Outland 1000 ROVs are designed for light-to-medium work tasks and selective sampling. One vehicle, with 1,000 feet of tether, is designated for use on the *R/V Agassiz* while the other is available for remote applications and carries a 500-foot retractable cable reel. An additional 1,000-foot cable is also available for very deep dives.
VideoRay ROV: The light-duty VideoRay ROV is capable of acquiring underwater video with lighting at up to 250 feet of depth. This technology gives researchers an underwater eye—perfect for exploring the depths of the Keweenaw Waterway or deeper areas of the Great Lakes.

Autonomous Underwater Vehicle (AUV)

IVER 3: The IVER 3 is truly a first-of-its-kind AUV, proudly displaying serial number 001 to confirm it. With this brand-new equipment, GLRC researchers have access to a host of new technologies, including:

- High-resolution, forward-looking video/still digital camera
- LED lighting
- EdgeTech 2505 digital side scan and mapping sonar
- Acoustic Doppler current profiler and velocity log

The IVER 3’s sonar system uses the full range of EdgeTech side-scan sonar frequencies (100–1,600 kHz), making it the most versatile sonar imaging system available. The ultra-high-resolution EdgeTech sonar provides unrivaled imaging resolution and full three-dimensional mapping capabilities.

IVER 3’s more-than-300-foot-depth diving capabilities coupled with its 12 hours of operating time provides unsurpassed underwater survey capabilities to Center researchers—and a winning combination for the Great Lakes.

6 Future Plans/Goals

During the next fiscal year (July 1, 2014 – June 30, 2015), the GLRC will work towards the following plans/goals:

1. Continue to grow faculty engagement with the Institute
2. Increase the number and value of externally sponsored awards
3. Further develop the Core facilities through equipment acquisition and capabilities (staffing) while increasing member use
4. Conduct formal strategic planning to establish new goals for growth and Institute self-sustainability
5. Contribute towards regional freshwater science and research to address challenges and identify solutions. This includes continuing to be an advocate for the Great Lakes through new and on-going relationships and leadership.