

# Alabama Water Institute Strategic Plan 2021-2026



Delivering Hydrologic Solutions for a Changing World

## Introduction

The creation of the Alabama Water Institute (AWI) demonstrated the commitment of the University of Alabama to be a premier research and education institution around water-related issues. AWI's goal is to become a world-class interdisciplinary water research institute that develops path-breaking, holistic, and environmentally friendly solutions to ensure people and ecological systems in our community, state, nation and around the world are water secure with access to clean water and are resilient to extreme events. The University of Alabama is leading many efforts to enhance water quantity and quality management capabilities and ecological integrity, much of it focused through AWI's current six affiliated centers:

- 1) Center for Complex Hydrosystems Research
- 2) Center for Freshwater Studies
- 3) Center for Sedimentary Basin Studies
- 4) Center for Water Quality Research
- 5) Remote Sensing Center
- 6) Global Water Security Initiative/Center

Researchers at these centers support the campus in efforts to promote water research in areas of remote sensing, biodiversity of aquatic systems, water quality, water and wastewater treatment, groundwater assessment, flood and drought forecasting, hydro-informatics, and disaster planning and management. AWI partners with many agencies including NOAA, U.S. Geological Survey, Army Corps of Engineers, NASA, National Science Foundation, U.S. Fish and Wildlife Service, Alabama Department of Conservation and Natural Resources, and the Alabama Geological Survey. With these relationships, AWI will make existing centers better by encouraging effective multi-disciplinary collaboration and looking for opportunities to develop new water related centers.

## Mission Statement

*To both carry out cutting edge and applied research and to train the next generation of scientists to provide actionable, novel solutions for a more water-secure world*

## Vision

*To be internationally recognized as a world-class, multidisciplinary water research institute that provides interdisciplinary knowledge and solutions for critical water problems and issues*

## Why is Water Research Important?

Water is essential for all aspects of life – drinking, agriculture, ecological sustainment, power generation and industrial production. Because water is foundational to our society, it is imperative adequate quality of water is accessible to all users while maintaining biodiverse ecosystems. Alarmingly, around the world (including our nation and states like Alabama), hundreds of millions of people still live without access to enough quality of water or their water supplies are threatened by floods, droughts or infrastructure failures daily. With increased water demand to satisfy a larger population and uncertainty posed by variations and changes in the physical environment, many communities around the world are already experiencing water crises

that are becoming even more detrimental to society, worsening the impacts of disease and poverty, exacerbating food and energy insecurity, declining ecological diversity, undermining economic growth, and fostering insecurity. There is a growing consensus that these types of water-related crises are going to become more widespread in the coming decades due to increasing water demand and decreasing water availability and quality. Water mitigation and adaptation require holistic science and data-based solutions.

The University of Alabama is in a unique position, as an R-1 research institution, to address these challenges to contribute to a healthier, safer and more prosperous world. AWI will serve as an incubator and facilitator for novel science that will foster science-informed policymaking and policy-informed research and development. Through these exchanges, we will build a research program that will lead the nation and globe in building a more secure world that would allow societies to better manage risks and become more resilient to future water disruptions.

### **AWI Research Goals within the University of Alabama**

AWI's primary goal is to fulfill the University of Alabama's mission of advancing the intellectual, social and economic condition of people at the state, national and world levels through the creation, translation and dissemination of knowledge, with an emphasis on developing quality research programs.

Over the course of the next five years, we will endeavor to meet the University's strategic goal of increasing productivity and innovation in research, scholarship and creative activities that impact economic and societal development. Additionally, AWI will work to advance the Office for Research & Economic Development's (ORED) 2019-2024 Strategic Plan themes of:

- 1) **Research Environment** -- AWI will promote cross-disciplinary, collaborative water research efforts and enhance strategic communications with campus and external stakeholders.
- 2) **Alabama Research Institutes** -- AWI will encourage collaboration within existing institutes and centers; look toward development of new water-related centers; and foster water-related research for Alabama's rural and underserved communities.
- 3) **Transformative Initiatives** -- AWI will seek research partnerships with other research universities, both domestic and international and will establish an external advisory board.
- 4) **Translating Intellectual Property** -- AWI will encourage faculty and students to pursue patents, commercialization and licensing of their research.
- 5) **Economic and Business Engagement** -- AWI will encourage faculty and students to pursue startups, business partnerships, and community use of their research.

## Strategic Assumptions and Implications to AWI Research

- 1) ***Our integrated world will continue to change at a rapid pace.*** Real-time research with an adaptive management focus necessary to balance natural and human systems.
- 2) ***Information access will require data and information to be easily accessible and understood.*** Information should clearly articulate the societal benefits and address the “so what” question to each receiver of information.
- 3) ***Science and technology will continue to advance.*** Computing power and storage capacity will increase and will be available at a relatively lower cost; forecast models will continue to improve, big data will be available through remote sensing sensors; data processing will involve cloud computing, artificial intelligence/machine learning and web services.
- 4) ***Our primary stakeholders will be a diverse group of researchers and practitioners in academia, private industry, local and state authorities, federal laboratories, and policy decision makers.*** We need to be creative and focus on integrating the right scientific data into decision making processes to minimize environmental impacts.

## Global Trends Affecting AWI Research

There are five overarching global trends that will shape our water future: (1) human population will continue to increase in the foreseeable future, especially in vulnerable parts of the world, thus posting new water challenges, (2) a societal perception that fresh water is limitless, (3) variations in the physical environment (e.g., land use land cover, weather, biodiversity, etc.) will continue to impact water availability and quality, (4) an integrated global economy will expand the demand for water, and (5) impacts of the changes of weather and climate that will impact vulnerable communities and the ecological environment.

## AWI Strategic Research Themes

Because we live in a complex world, humans believe the future generations will discover solutions that do not have to be addressed today and can be left for tomorrow. Our vision is that with the right research focus, AWI will be at the center of research to address the “wicked” problems of today and tomorrow. The following key research themes were developed to address the above challenges, build on available resources and talents, and reflect the interdisciplinary water research vision within the University:

### **1) Modeling and Remote Sensing**

***Objective/Vision: Develop and improve modeling and remote sensors to broaden research in water resource management, hazard assessments and communications.***

The United States is the leader in generating ground-based and satellite-based information on water and the environment and processing them using hydrological models to include processing with machine learning. The University of Alabama will continue to develop and improve water modeling and remote sensing applications that will provide value-added prediction products that can serve the public and meet decision-making requirements. Accurate and timely water predictions are vital to water resources planning and provides the ability to anticipate conditions

that can save lives and reduce costs. To meet the **Modeling and Remote Sensing** theme, AWI will pursue research in many areas, for example:

- a) ***Next generation hydrological models***
- b) ***Remote sensing of water dynamics/ecology and development of novel sensor(s)***
- c) ***Groundwater modeling and aquifer sustainability assessments***
- d) ***Water quantity and quality modeling in response to (short- and long-term) changes in the physical environment***

## **2) Integrated Water Resource Assessment**

***Objective/Vision: Develop basic understanding needed to inform programs and policies to reduce impact on water quantity, water quality, threatened and endangered species, health and ecosystem function.***

According to the United Nations, approximately 2.1 billion people (27% of global population) lack access to safely managed drinking water and 4.5 billion people (59 percent) lack properly managed sanitation. Coupled with poor hygiene, these factors are the leading cause of disease and death. Disease and water collection place a significant drag on economies because the population is left with little excess capacity to economically produce. Furthermore, the world's water ecosystems facilitate the replenishment and purification of water resources that are essential to human health and well-being. Research in the protection and management of water and ecological resources are critical to avoid major economic losses and ensure sustainable drinking water supplies are available that could positively impact communities like Alabama and the South's rural and vulnerable population. To meet the **Integrated Water Resource Assessment** theme, AWI will pursue research in many areas, for example:

- a) ***Drinking water treatment***
- b) ***Low cost sewage treatment***
- c) ***Water quality and health conditions monitoring and modeling***
- d) ***Ecosystem function management***

## **3) Management of Water Hazards**

***Objective/Vision: Develop and improve predictive tools that reduce risk and increase resilience of agricultural, industrial, public water supplies and natural ecosystems to stressors.***

Flooding and droughts are the two most frequent and expensive weather threats that our nation and the world faces. According to NOAA, 90% of all natural disasters in the U.S. involve flooding that affect households and crops. These hazards are the result of spring thaws, hurricanes, tropical storms, high tide flooding, heavy rains, levees and dams breaking, and flash floods. NOAA

has estimated the average cost of drought is \$9.4 billion per event and flooding amounts is \$4.6 billion per event. From 1980-2019, drought cost the U.S. \$249.7 billion in damages and inland flooding was \$146.5 billion.

The University's research expertise is positioned to improve our nation and Alabama's resilience to drought and flood events. Through research, we can improve the resilience of communities and society by facilitating the planning and responses of how humans and systems handle failures gracefully in order to continue basic operations after a catastrophic event. To meet the **Management of Water Hazards** theme, AWI will pursue research in many areas, for example:

- a) ***Management of coastal flooding***
- b) ***Flood and drought forecasting***
- c) ***Impacts of water hazards on natural environment (e.g. forests, crops, aquatic habitats and species, etc.) and built environment (e.g. roads, buildings, etc.)***
- d) ***Development of predictive tools for management of species and ecosystems***

#### **4) Water Security and Risk Communication**

**Objective/Vision:** Create research opportunities to communicate water, science and risks impacts on society.

Water intelligence, at a fine temporal scale, is key to delivering location-specific and precise solutions. Clear and unambiguous communication is also crucial for helping local, regional and federal levels understand the importance of water cooperation, planning, and use of water resources. Many institutions fail at this seemingly simple task because of the complexity of the issue and the inability to easily distill the information to be consumed by various levels of expertise. To meet the **Water Security and Risk Communication** theme, AWI will to pursue research in many areas, for example:

- a) ***Effective public communication, including educational outreach, of science and risk information***
- b) ***Water footprint and water security analysis***

## AWI Strategies and Metrics of Success

- 1) **Serve Alabama, regional, national and global partners**
  - a) Facilitate local, national, and international partnerships with industry, government, business, and communities to translate University of Alabama water research to impact
    - i. **Goal:** Increase the number of local, national, and international partners working with AWI researchers
    - ii. **Goal:** Increase external investment from partners working with AWI researchers
  - b) Provide peer-reviewed publications, commercial and operational products and expert knowledge with emphasis on policy, planning and operations aligned with the AWI research themes
    - i. **Goal:** Increase the number of commercial and operational products for internal and external use that receive AWI assistance
    - ii. **Goal:** Increase the total number of water-related peer-review publications by UA researchers that received AWI assistance
  - c) Form and promote interdisciplinary teams with diverse leadership and representation to obtain and execute large research grants from state, national and international funders
    - i. **Goal:** Increase the total water portfolio at UA in terms of grants and contracts submitted by UA and awarded to UA that receive AWI assistance
- 2) **Expand the water research, development and innovation portfolio**
  - a) Provide funding support for collaborative and extramural funded research that involves University faculty, researchers, students and centers and incorporates the strategic themes outlined in this strategic plan
    - i. **Goal:** Increase the number and diversity of AWI affiliates that have been supported by AWI funding
  - b) Facilitate interdisciplinary cooperation within the University of Alabama
    - i. **Goal:** Increase the number of multi-PI cross-unit proposals submitted by UA researchers giving credit to AWI
  - c) Encourage the use of UA data and research resources and dissemination platforms for translating water research to actionable products
    - i. **Goal:** Increase the number of AWI affiliates using UA resources for research
- 3) **Communicate AWI's impact and future opportunities for engagement to stakeholders**
  - a) Actively engage the UA community of researchers
    - i. **Goal:** Increase the number of AWI affiliated members
    - ii. **Goal:** Increase the participation of UA community in AWI activities

- b) Support the training of UA students to be the future scientists and leaders, especially from rural and underserved communities
  - i. **Goal:** Increase the number of UA students involved in AWI sponsored education and research activities
- c) Cultivate relationships with the *external* community including state and federal legislative, corporate, government, research, and K-12 educational stakeholders
  - i. **Goal:** Increase the number of external contacts in the AWI network
- d) Enhance the local, national, and international reputation of AWI affiliated research
  - i. **Goal:** Increase the number of external stakeholders exposed to UA researchers through AWI sponsored activities
- e) Involve external stakeholders in advisory roles to support UA water research
  - i. **Goal:** Establish an External Advisory Board to solicit guidance and feedback

## CONCLUSION

As outlined in the 2017 United States Global Water Strategy, the U.S. should be the leader in understanding water insecurity affecting all facets of life. The U.S. Strategy implores both public and private institutions to strive for a water secure world that can sustain enough water quantity and quality to meet human, economic and ecosystem needs. Implementation of AWI's strategic plan would lay the foundation for The University of Alabama to be a global leader in state, regional, national and international water issues. AWI can guide the shift in understanding, valuing and managing water for our nation and the global community to address all water related challenges in the future and shape our world for a better tomorrow.