Utah EPSCoR
NSF EPSCoR RII Track 1

innovative Urban Transitions and Arid-region Hydro-sustainability (iUTAH)

Strategic Plan for 2012-2017

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1. EXECUTIVE SUMMARY

Introduction

Utah became eligible for the National Science Foundation EPSCoR Program in 2009. At that time, a planning grant was obtained to establish a jurisdiction EPSCoR Office, initiate the development of a State Science and Technology Plan, identify an EPSCoR research area, and form a writing team to produce a viable proposal to NSF. Both the 2009 and 2010 proposals were unsuccessful. The 2011 submission, focusing on Utah's water quantity and quality, especially along the rapidly urbanizing Wasatch Front, was favorably reviewed and awarded (EPS 1208732). The opportunity to build Utah's research infrastructure and develop human capacity around interdisciplinary, water-related research is now possible. To accomplish this, a dispersed, multi-disciplinary team of scientists and educators from across the state with the common vision of integrating research efforts to address the state's pressing water resource needs and sustainable future were brought together. The process of writing the proposal began a transformation of statewide collaboration that has continued to flourish, undoubtedly leading to a sustainable, more successful research and education community. The NSF EPSCoR Track 1 award, starting August 1, 2012, will provide the essential infrastructure necessary to develop a world-class program in interdisciplinary water-related research, modeling and instrumentation. This Strategic Plan outlines the vision of iUTAH and details the path chosen to achieve success.

Strategies for Success

The goals of the Utah RII Track-1 are to create sustainable infrastructure improvements to benefit water – related science and technology throughout the state, increase national research and development competitiveness, and expand our workforce of researchers, educators and practitioners to ensure a vital economy and sustainable future. Infrastructure improvements include:

- *Enhanced research capacity of the biophysical, social and engineered water environment.* This will be accomplished by building state-of-the-art water quality- and quantity- monitoring networks in three focal watersheds that encompass a range of urbanization and future development. In addition, a green infrastructure research facility will be constructed, allowing for new research activities, as well as providing an important educational and outreach facility.

- *Building on Utah's existing strengths in hydrologic modeling and cyber-infrastructure from the CI-WATER and Cyber-infrastructure NSF EPSCoR awards.* This will be accomplished through interdisciplinary modeling approaches that will create new models; link currently disparate models, data and computing approaches; and provide greatly enhanced forecasting capabilities for water managers and stakeholders.

- *Building programs to increase participation of underrepresented groups that include women, Hispanics and Native Americans.* A series of diversity training workshops will be given to all iUTAH participants to provide best practices for recruitment and retention of diverse audiences. iUTAH will also aggressively recruit underrepresented groups for all EPSCoR-related activities and hires.

- *Providing educational opportunities for a scientifically literate Utah workforce citizenry.* iUTAH has a number of programs that target K-12 students and teachers as well as undergraduate students. The programs will provide hands-on activities associated with the instrumented

watersheds and green infrastructure facilities. In addition, iUTAH has partnered with state museums to provide informal science education to literally thousands of Utah residents.

- *Providing societally relevant science and education regarding current and future water resources.* iUTAH has a rigorous external engagement plan in place that will include state, regional, county and local water management agencies and stakeholders. Our participatory modeling activities will provide first-hand knowledge of our enhanced sensor networks, data flows and scenarios modeling capabilities. In turn, our research questions and modeling activities will be directly informed by the needs expressed by our water resource managers and policy makers.

The iUTAH Vision

The vision for iUTAH EPSCoR is to lead the nation in scientific, educational, and innovative solutions for water management and sustainability **through innovative interdisciplinary research and systems-level knowledge of the interactions among water, demand, and climate and development of a state-of-the-art hydroinformatics program that incorporates large data with interdisciplinary modeling and visualization**

The iUTAH Mission

The mission of iUTAH is to enhance collaborative partnerships to better understand how to sustain Utah's water resources by (1) developing novel approaches to integrated research and training, and (2) by expanding the state's economic, educational, and research competitiveness. This will be carried out over the next five years by:

- Enhancing Utah's research capacity and competitiveness in the science of interactions between society and the biophysical environment
- Leading research, training and education in coupled human-natural water resource systems
- Recruiting and training a diverse STEM (Science, Technology, Engineering, and Mathematics) workforce and the next generation of researchers
- Informing policy makers and our citizenry on the interactions between climate, land use, innovative management, and water sustainability
- Providing a lasting human and physical infrastructure comprised of a statewide consortia of researchers, educators and private-sector partners as well as a sustainable sensor and cyberinfrastructure network

Alignment With State Priorities and the Science & Technology Plan

The Utah Science &Technology (S&T) Plan recognizes core statewide competencies in ecology, engineering, and water resources. The environmental sector was formally analyzed in the S&T Plan because of its role in Utah's ability to grow and provide quality of life, infrastructure, resources, and jobs. iUTAH will build upon those strengths and enhance statewide linkages between the research community and urban planners, regulators, businesses, and policy makers. Specifically, iUTAH goals and actions directly align with the Utah S&T Plan by providing opportunities to meet the needs identified below:

- Insufficient linkages between Utah's industry clusters and its institutions of higher education
- Inability to meet industry's needs due to a lack of skilled individuals to fill senior management and other positions
- Lack of water to meet the demand necessitated by future growth and development
- Lack of funding for public-private partnerships to further the growth of an industry cluster; these

bring industry, academic researchers, institutions of higher education, and state government together to pursue development of a particular technology area
- No mechanisms that bring industry and academic researchers together
- Insufficient linkages between education and training programs/students to Utah's industry clusters
- Concern about the quality of STEM education
- Desire to (1) better apply environmental strengths found in ecology and atmospheric sciences and (2) to better assess and develop strategies related to water issues

The Strategic Planning Process

In June 2012, a management team was created that included the Leadership Team of PIs from the 3 research institutions, as well as representatives from the state's primarily undergraduate institutions (PUIs). The Management Team organized statewide groups to create the Research Focus Areas (RFAs) 1,2 and 3, Cyberinfrastructure, Diversity, Workforce Development, and External Engagement teams. Team leads and co-leads were designated who, in turn, led their teams in creating work plans and logic models.

In September 2012, a meet-and-greet was held in Salt Lake City, Utah as the first formal activity of building teams and engaging participating institutions. Participants attended from the major universities and state organizations that expressed interest in participating in iUTAH. The Principal Investigators (PIs) provided participants with an overview of the EPSCoR mission, proposal, and objectives. The iUTAH partner institutions are listed in Appendix 1.

From October 17-19, 2012, a core group of the iUTAH EPSCoR team, including representatives from each of the teams, convened with two facilitators from the American Association for the Advancement of Science (AAAS), two external evaluators, and the NSF EPSCoR program officer to begin the strategic planning process. Activities included working meetings, a brief tour and explanation of the most northern watershed, and a graduate student poster session, in which all 14 first-year iUTAH Graduate Research Fellows presented their activities.

Working sessions were led by the AAAS evaluators and consisted of an overview presentation by each team, followed by a critical review from the AAAS and external evaluators with input from the NSF program officer. An agenda and participant list for these activities are found in Appendix 2 and Appendix 3, respectively. Following the AAAS and NSF meeting, team leads coordinated with their respective teams to discuss the External Assessment Team's reviews and to gather input. The iUTAH team participants and their EPSCoR roles are lists in Appendix 4. On November 16, the first all-hands meeting of iUTAH EPSCoR was held in Salt Lake City, Utah, with more than 70 participants attending either in person or through video conferencing. Breakout sessions and working groups helped develop short- and longer-term metrics and overarching goals for iUTAH. An agenda and participant list for this all-hands meeting are provided in Appendix 5 and Appendix 6, respectively.

Following a request from NSF to modify the strategic plan submitted in December 2012, we held a second all-hands meeting designed to revisit our specific research questions and methods as well as to provide specific milestones and more refined metrics. An agenda and participant list for this second all-hands meeting on March 29, 2013 are provided in Appendix 7 and 8.

The purpose of this document is to define goals, objectives, and metrics for measuring performance and to provide a tool for evaluating progress made from the current baseline during the course of the project. This document will provide a framework around which the iUTAH EPSCoR RII project will operate, manage day-to-day activities, and measure progress and performance. It is also intended to be a living

document in which revisions will reflect lessons learned, the outcomes of scientific discoveries, and changes in state and national policies.

Organizational Structure

Utah EPSCoR was formally established under the State of Utah's Utah Science, Technology and Research Initiative (USTAR). USTAR aims to strengthen Utah's "knowledge economy." In its first six years of operation, USTAR has bolstered the innovation infrastructure of Utah, increased the human capital devoted to research, and demonstrated success in technology commercialization. By encouraging collaboration, USTAR has enabled Utah-based researchers to tackle bigger and more complex projects and to compete for additional funding opportunities. Brookings Institution has called USTAR "a national best practice."

The Utah EPSCoR State Committee is responsible for oversight and coordination of the state's EPSCoR portfolio to ensure synergy with the Utah 2012 Science & Technology Plan.

2. Project Priorities, Strategies, Milestones and Metrics

Project Overview

Many of Utah's challenges are similar to other states in the West where growing populations demand more water and energy resources. Increasing resource demands, coupled with an uncertain and changing climate, represent very real challenges to Utah's economic and environmental sustainability. **iUTAH's sustainability solutions will emerge through innovative interdisciplinary research and systems-level knowledge of the interactions among water, demand, and climate.** iUTAH will examine interactions among and feedbacks from hydroclimate, ecological, and human systems to identify how these systems impact the sustainability of our rapidly expanding Wasatch Front. iUTAH will explore potential adaptive solutions that include alternative water management strategies, urban planning and design, and the use of green infrastructure to enhance and protect ecosystem services.

Proposed research facilities and activities will enhance strengths identified in the Utah S&T Plan. These strengths include active and growing research programs focused on hydrology, ecology, natural resource management, urban planning and design, and water resource engineering. They also fill critical gaps and bring new tools to Utah's colleges and universities necessary for water resources-related environmental science training. By employing a coupled human-natural systems approach, iUTAH will better establish a culture of statewide, multi-institutional, transdisciplinary research.

iUTAH is built on a model that not only enhances transdisciplinary and multi-institutional research, but also facilitates institutional and organizational learning and adaptation through participatory research techniques and the innovative use of stakeholder engagement tools. iUTAH's vision involves enhancing the skills of our current college and university communities while engaging urban and rural students for a more robust and diverse statewide future for STEM education. The iUTAH model will be effective because:

- A synergistic, transdisciplinary, multi-institutional research effort will be more effective for building research capacity than traditional discipline-focused and single-institution efforts.
- The establishment, enhancement, and cooperative sharing of state-of-the-art facilities will increase capacity for leveraging institutional resources and developing partnerships.
- Greater cooperation among academic, non-academic, private sector, and stakeholder communities will build partnerships with lasting impacts on Utah's STEM research enterprise.

iUTAH's Research Focus Areas and associated facilities concentrate on: educating undergraduate and graduates students, mentoring post-doctoral fellows, nurturing junior faculty who will receive research and graduate student support, and engaging senior faculty as role models and mentors. Additionally, faculty from metro/regional universities and community colleges who have traditionally focused on teaching will become important research partners in iUTAH and thus elevate the research capacity of those institutions.

All of iUTAH's research, cyberinfrastructure, diversity, external engagement, and workforce development activities are aimed at implementing the overall iUTAH vision and mission as stated above. iUTAH's integrated research and education activities are outlined below.

2.1 Project Priority: Research

Research Focus Area 1 – Biophysical Ecohydrologic System

Team Leads: Zach Aanderud (BYU), Dave Bowling (UU)

Team Participants: Michelle Baker (USU), Gabe Bowen (UU), Paul Brooks (UU), Greg Carling (BYU), Rick Gill (BYU), Jeff Horsburgh (USU), Jiming Jin (USU), Amber Jones (USU), Scott Jones (USU), Beth Neilson (USU), Sam St. Clair (BYU), Court Strong (UU), Suzanne Walther (UVU), Simon Wang (USU)

Overall Goal: The goal of Research Focus Area 1 (RFA1) is to improve Utah's capacity to monitor and understand the ecologic/climatic/hydrologic (hereafter ecohydrologic) system of the Wasatch Range Metropolitan Area (WRMA). This goal will be achieved by improving watershed-scale measurement capacities. This instrumentation will be used to conduct research aimed at gaining a better understanding of the biophysical processes that influence Utah's water resources.

Major Activities: Design, **construct** and **operat**e an ecohydrologic observatory: the Gradients Along Mountain to Urban Transitions network (GAMUT). GAMUT will measure aspects of water inputs, outputs, and quality along mountain-to-urban gradients in three watersheds that share common water sources (winter-derived precipitation), but differ in the human and biophysical nature of land-use transitions. GAMUT will allow for real-time monitoring of meteorological variables, snow accumulation and melt, soil moisture, surface water flow, and surface water quality. **Site selection** will build on and complement existing monitoring stations. Once GAMUT is functioning, research activities will be phased in to address research questions. GAMUT will provide data to answer the general and specific questions listed above. RFA1's goal is to provide an infrastructure platform and integrated **long-term data sets** to make Utah more successful in future large project grants.

Objectives:

- Improve capacity to measure WRMA ecohydrologic system on the mountain-to-urban gradient
- Enhance capacity to understand ecohydrologic processes in the WRMA as they relate to water resource availability now and in the future

Research Focus Area 1.1- Water Balance: Determine the water cycle processes most important for the water balance **a**long mountain-to-urban gradients *(Court Strong, Team Lead)*

1) Determine the sizes of the major components of the water budget (precipitation, evapotranspiration, runoff) and how do these components change along mountain-to-urban gradients
2) Determine controls on evapotranspiration in mountain and urban landscapes
3) Determine the exchanges between surface water and ground water in stream channels during base flow

Research Focus Area 1.2-Water Quality: Determine drivers of water quality *(Zachary Aanderud, Team Lead)*

1) Determine the spatial and temporal variability of biogeochemical transformations that affect water quality
2) Determine the relationship between snowpack chemistry and runoff chemistry
3) Determine the major nitrogen sources and loading rates to Wasatch Range Metropolitan Area watersheds and streams and how they vary along mountain-to-urban gradients
4) Determine the *Escherichia coli* sources across the mountain-to-urban gradient and how do they relate to water quality indices and the overall microbial community structure in streams

Research Focus Area 1.3- Climate and Land Use Change: Determine how availability of and demand for mountain water resources will likely change as a result of climate and land use change *(Jiming Jin, Team Lead)*

1) Determine how the sizes of the major components of the water budget change across our mountain-to-urban gradients and into the future due to projected land and water use
2) Reduce the uncertainty in regional climate models through down scaling model outputs at the Wasatch Range scale
3) Determine how the size of precipitation variability relative to components of evapotranspiration vary across our mountain-to-urban gradients

Strategic actions to be implemented:

- Design a GAMUT observatory
    - define fundamental sensor units
    - identify vendors for instrumentation
    - identify locations for instrument installation
    - design telemetry for integration of sensor data into the iUTAH Data Federation
- Coordinate with resource managers on placement and parameter sensors to ensure that GAMUT complements existing monitoring infrastructure while addressing existing monitoring gaps and avoiding unnecessary redundancy
- Build GAMUT observatory
    - recruit and hire three technicians
    - purchase and test instrumentation
    - negotiate memorandums of understanding with property owners for access to site locations
    - install instrumentation
    - develop standard operating procedures (SOPs) for instrument operation and maintenance
- Develop data collection and sample analysis plans
- Engage graduate students in watershed instrumentation plans and mentor students in writing successful fellowship applications
- Propose research themes/potential projects for undergraduate research fellows and match identified undergraduates to research mentors
- Add instrumentation to GAMUT to allow monitoring of ecohydrologic processes at finer spatial scales in support of research identified by Focus Area 2, including mobile sensor units
- Bring on additional faculty members in vegetation phenology, ecohydrology and climate modeling to enhance research on vegetation and climate modeling scenarios
- Conduct research and monitoring in three watersheds to be used in additional proposals
- Submit interdisciplinary proposals and papers

Research Focus Area 1 – Biophysical Ecohydrologic System: Milestones

Strategic Priority Area		Year 1	Year 2	Year 3	Year 4	Year 5
Research Focus Area 1 - Biophysical Ecohydrologic System	RFA1.1Water Balance	1. Design instrumentation 2. Select sites 3. Purchase aquatic sensors 4. Purchase weather stations 5. Collect and summarize existing data sets 6. Coordinate with water quality team	1. Install instrumentation in at least 2 watersheds 2. Establish rating curves at 12 sites 3. Snow pack data collected 4. Climate data collected 5. Soil moisture data collected 6. Sapflux measurements commence	1. Validate rating curves 2. Install remaining instrumentation 3. Continue data collection 4. 1st papers published	1. Continue data collection 2. Validate rating curves 3. Finalize water balance models 4. Publish long-term data sets	1. Continue data collection 2. Validate rating curves 3. All datasets archived 4. Create data repository 5. Publish finalized water yield models for all watersheds
	RFA 1.2 Water Quality	1. Design instruments 2. Select sites 3. Purchase aquatic sensors 4. Collect and summarize existing data sets 5. Coordinate with water balance team	1. Install instrumentation in at least 2 watersheds 2. Surface water chemistry collected 3. Snow pack chemistry collected	1. Install remaining instrumentation 2. 1st papers published 3. Collect data to understand surface/ groundwater exchange 4. Surface water chemistry collected	1. Continue data collection 2. Publish datasets	1. Continue data collection 2. Stream datasets 3. Create data repository 4. Publish finalized water quality models for all three watersheds
	RFA 1.3 Climate and Land Use Change	1. Collate existing climate models 2. Collate existing land cover information	1. Down-scaled models developed 2. Model parameters identified 3. Existing models validated	1. iUTAH data incorporated into developed climate models 2. Water yield – climate models modified	1. Collaborate with RFA 3 modelers to inform land-use scenarios models 2. Climate change scenarios models developed 3. Publish datasets	1. Collaborate with RFA 3 to publish final coupled land-use, climate change models 2. Collaborate with RFA 3 to publish scenarios models for 5, 10 and 15 year futures

Research Focus Area 1 – Biophysical Ecohydrologic System: Metrics

Strategic Priority Area	Metrics	Baseline (as of Aug 1, 2012)	5-Year Target
Research Focus Area 1: Biophysical Ecohydrologic System	# of GAMUT design meetings/workshops	1	5-10 yearly in years 1 and 2
	Hire & train watershed technicians	0	3 in year 1
	Install aquatic instrumentation	0	2 watersheds in years 1 and 2 1 watershed by year 3
	Install terrestrial instrumentation	2 existing snotel sites	2 watersheds in years 1 and 2 1 watershed in year 3
	Mobile sensor units built and deployed	0	3 in years 2 and 3
	Hydrology data sets available	3 USGS stations	3-5 in years 2, 3 and 4
	Nutrient chemistry data sets available	0	3-5 in years 2, 3 and 4
	Presentations	0	10-15 annually
	Peer-reviewed publications	0	3-6 annually beginning in year 3
	Popular press publications	0	2-5 annually beginning in year 2
	Collaborative proposals	EPSCoR CI-WATER and RII	3-5 annually
	Publish datasets	0	5-10 in years 4 and 5

Research Focus Area 2 – Social and Engineered Systems

Team Leads: Doug Jackson-Smith (USU), Christine Pomeroy (UU)

Team Participants: Daniel Bedford (WSU), Paul Brooks (UU), Martin Buchert (UU), Steve Burian (UU), Ryan Dupont (USU); Eric Edwards (USU), Joanna Endter-Wada (USU), Courtney Flint (USU), Joanna Ganning (UU), Ryan Jensen (BYU), Sarah Hinners (UU), Shujuan Li (USU), Carlos Licon (USU), Carla Trentelman (WSU), Bo Yang (USU)

Overall Goals: The goals of Research Focus Area 2 (RFA2) are to: (a) improve the capacity of Utah's science community to gather and analyze social and engineering system data on coupled water systems; (b) understand the interactions between urban form, environmental change, built water infrastructure, and decision-making in terms of water use; and (c) model the impact of alternative infrastructure designs and policy options on water use behaviors, the water cycle, water quality, and interconnected social and environmental systems.

Major Activities: Systematic data will be gathered on the urban built environment, water use behaviors and decisions, and institutional contexts across the urbanization gradient in the larger WRMA, with particular focus on areas within the three GAMUT watershed observatories. We will coordinate with RFAs 1 and 3 and Cyberinfrastructure to **co-locate data collection** to facilitate the **development of models** for coupled system dynamics. Education, Outreach, Diversity, and RFA teams will work closely to engage in collaborative discussions with water **stakeholders and decision-makers** and to train the next generation of social and engineering scientists. Collaborating with water system stakeholders and decision-makers will ensure that the data and models being developed are realistic and useful to resource managers and policy makers.

Objectives:

- Ensure that research activities are relevant to decision-makers
- Improve capacity of Utah scientists to study human dimensions of water systems
- Improve capacity of Utah scientists to study the impacts of gray and green water infrastructure systems
- Ensure that social and engineering data can answer research questions
- Improve iUTAH's capacity to collect intensive data about water use, water decision-making, and stormwater runoff
- Improve iUTAH's knowledge of the built water infrastructure across the WRMA
- Improve iUTAH's capacity to use information about water behaviors and built infrastructure in coupled models of urban water system outcomes

Research Focus Area 2.1 – Water and Land Use: Determine the current drivers of water and land use management in the region *(Doug Jackson-Smith, Team Lead)*

1) Quantify the most important drivers of water use behavior of households, farmers/irrigators and local water management organizations (e.g., attitudes, perceptions, social networks, institutions, and climate)
2) Determine the most appropriate scale to model patterns of water use (households, neighborhoods, cities, regions)
3) Determine the effectiveness of existing policies, regulations, and public initiatives designed to shape water use in the WRMA

Research Focus Area 2.2 – Urban Form: Determine how urban form interacts with water availability *(Courtney Flint, Team Lead)*

1) Determine which aspects of urban form (e.g., built water infrastructure, lot size, land cover, policy) most affect water outcomes (water use, water quality, timing & location of flows)
2) Develop sampling protocols and tools that best measure changes in urban form across time and space
3) Determine what the most pressing future water use issues we need to be equipped to address

Research Focus Area 2.3 – Built Systems: Provide methodologies and tools to design our built systems to enhance water sustainability *(Christine Pomeroy, Team Lead)*

1) Quantify how implementations of Green Infrastructure (GI) impact hydrologic processes (water pathways; water quantity and quality)
2) Determine the best GI designs to enhance sustainability and how we upscale the results of experimental observations to neighborhood, city and landscape scales
3) Determine the major barriers and paths to implementation of GI

Strategic Actions to be implemented:

- Team Building
    - Facilitate cross-disciplinary and cross-campus collaborations among social scientists, planners, and engineers in Utah
- Systematic Data Collection
    - Identify urban sites for intensive data collection
    - Assess and build an archive of existing social and engineering data in selected study sites
    - Develop appropriate methods and instruments to document drivers of variation in water use behaviors
    - Collect new primary data on water behavior and drivers of water decision-making among individuals, households, and organizations in study sites
    - Implement ongoing monitoring of significant changes in population, land use, water infrastructure, and water use
    - Design and construct a Biogeochemistry of Urban Green Infrastructure facility (iBUGI)
    - Develop a methodological approach to incorporate distributed GI sites with work at iBUGI facility
    - Coordinate with RFA 1 to choose common sites and develop protocols for colocation of social, engineering, and biophysical data collection and monitoring activities
- Contribute to Coupled Systems Models
    - Define sustainability outcome metrics for culinary, irrigation, and stormwater
    - Evaluate alternative modeling approaches for simulating impacts of built infrastructure on sustainability outcomes
    - Develop empirical models that predict variation in water use behaviors and outcomes under different built, policy, and climatic environments
    - Collect primary data and use models to assess impacts of alternative built infrastructure designs on water cycle and water quality under a range of climate scenarios
    - Bring social and engineering data and models to contribute to RFA3 coupled systems model development efforts
- Collaborative Engagement
    - Coordinate with RFA 3 and Education, Outreach, and Diversity teams to organize stakeholder interactions
    - Develop partnerships with local water system managers to coordinate data monitoring plans and to share data
    - Work with the Education, Outreach, and Diversity teams and stakeholders to clarify water management challenges and assess appropriateness of research design
- Training the next generation
    - Train graduate and undergraduate students in methods to study the social and engineering dimensions of water systems

Research Focus Area 2 – Social and Engineered Systems: Milestones

Strategic Priority Area		Year 1	Year 2	Year 3	Year 4	Year 5
Research Focus Area 2 - Social & Engineered Systems	Research Focus Area 2.1 - Water & Land Use	1. Hold first cross-campus and stake holder collaborative meetings 2. Identify and collate existing socio-economic data sets; identify data gaps 3. Provide input into RFA1-GAMUT design 4. Design social science research protocols and instruments 5. Choose study neighborhoods	1. Expand stakeholder partnerships to all study watersheds and neighborhoods 2. Collect data on drivers of water and land use behaviors 3. Carry out first multivariate analysis of drivers of water use 4. Submit first collaborative research grant 5. Publish first dataset 6. Develop social science content for Summer Institute 7. Assist in development of social science and human subjects elements of data management policies 8. Integrate human dimensions of water systems into conceptual framework of coupled water system	1. Develop first analysis that links data collected by RFA1 and RFA2 teams 2. Transfer initial findings from RFA2 work to RFA3 coupled systems modeling teams 3. First published peer reviewed paper 4. Coordinate with local neighborhood organizations to review HH survey results 5. Conduct key informant interviews in WRMA communities to assess interactional capacity and water programming 6. Expand Utah Water iPad Survey project with new collaborators 7. Develop templates for social science data collection and management plans, metadata reporting	1. Work with partners to identify ways to incorporate RFA2 research results into ongoing water system planning efforts	1. Document impacts of RFA2 research on stakeholder decisions 2. Identify new research questions and data needs to address emergent scientific and policy goals 3. Receive first major collaborative research grant award

	Research Focus Area 2.2 - Urban Form	1. Identify existing datasets to categorize urban forms 2. Generate urban typology for census block groups 3. Select study neighborhoods representing gradient of urban forms 4. Work with partners and stakeholders in watersheds to identify existing data and data gaps 5. Work with RFA1 team to design instrumentation strategies to capture impacts of urban form on water flows	1. Collaborate with RFA1 to initiate co-located social, engineering, and biophysical measurements in selected neighborhoods 2. Expand partnerships with stakeholders to cover all study areas 3. Make first research presentations 4. Submit first paper 5. Contribute to first submitted collaborative grant 6. Publish first dataset	1. Review work with partners and stakeholders in study areas to ensure research addresses local questions and interests of diverse communities 2. Publish first paper 3. Incorporate first results of urban form analysis into RFA3 couple systems modeling exercises 4. Submit collaborative proposal to link urban typology to biophysical outcomes 5. Finish installation of new urban instruments	1. Work with RFA3 team to simulate impacts of alternative urban growth scenarios on water and ecological outcomes	1. Document impact of improved knowledge on stakeholder decisions about urban design, growth management and water sustainability. 2. Receive first major collaborative grant

	Research Focus Area 2.3 - Built Systems	1. Design Green Infrastructure Research facility (GIRF) 2. Identify and collate existing models for assessing impacts of built infrastructure on water sustainability 3. Identify data and equipment needs 4. Assess and synthesize existing research on impacts of GI on hydrology, water quality, and ecology 5. Develop content for Summer Institute	1. Design approach for extended GI research network 2. Develop first stormwater models for GAMUT areas 3. Involve first undergraduate iUTAH fellows 4. Make first presentation on GI research 5. Contribute to first submission of collaborative grant 6. Publish first dataset	1. Analyze first data from GIRF experiment 2. Construct and begin research at GIRF 3. Instrument 1 new GI project in collaboration with municipalities and universities 4. Publish first research paper 5. Develop improved model for simulating surface runoff in diverse built/urban contexts 6. Incorporate results of GI research into urban hydrologic models	1. Develop improved models to simulate GI at neighborhood or landscape scale 2. Integrate consideration s of GI options into RFA3 coupled models	1. Document impact of GI research on stakeholder decisions about GI planning and implement-ation. 2. Receive first major collaborative grant

Research Focus Area 2 – Social and Engineered Systems – Metrics

Strategic Priority Area	Metrics	Baseline (as of Aug 1, 2012)	5-Year Target (total)
Research Focus Area 2 - Social & Engineered Systems	Number of RFA2 or subgroup planning meetings	0	3-10 annually
	Number of Stakeholder engagement meetings	0	2-5 annually in years 2-5
	Number of urban form neighborhood typologies	0	1 annually in years 2-4
	Number of social science data collection protocols & instruments	0	2-3 annually in years 2-5
	Number of new RFA2 datasets that document social and engineered aspects of study areas	0	3-5 annually
	Number of new Green Infrastructure Research Facilities (GIRF)	0	1 completed in year 4

	Number of GIRF facility design and management meetings	0	5-10 in years 1-2
	Synoptic sampling campaign of urban influence on water outcomes	0	1 annual in years 3-5
	Number of RFA2 research presentations	0	5-8 annually in years 2-5
	Number of RFA2 peer-reviewed publications	0	3-5 annually in years 3-5
	Popular press publications on RFA2 work	0	2-3 annually in years 3-5
	Number of new collaborative proposals with RFA2 contributions	0	1-2 annually in years 2-5
	Number of RFA2 team members working with RFA3 on coupled models & participatory engagement	0	3-5 annually

Research Focus Area 3 – Coupled Human-Natural Systems

Team Leads: Sarah Null (USU), Court Strong (UU)

Team Participants: Martin Buchert (UU), Tony Castranova (USU**),** Reid Ewing (UU), Joanna Ganning (UU), Sarah Hinners (UU), Jeff Horsburgh (USU), Doug Jackson-Smith (USU), Ryan Jensen (BYU), Carols Licon (USU), David Rosenberg (USU), Bo Yang (USU)

Overall Goals: The goals of Research Focus Area 3 (RFA3) are describe the water system as a whole, by defining and including the linkages between biophysical and social dynamics, using results from RFAs 1 and 2 and to Facilitate interactions with stakeholders and linkages among disparate datasets and models to improve capacity to study the complexity of local water issues.

Major Activities: Activities in this focus area will draw on data and results from RFAs 1 and 2 as well as other ongoing work to study the linkages between the natural and human-engineered water system. Focus will be on activities that **create centralized datasets** across the social and natural sciences, **couple modeling activities**, **parameterize and validate models**, and provide **model and data visualization** for a variety of audiences.

Objectives:

- Identify, categorize, and centralize relevant datasets and models
- Link disparate models and datasets
- Integrate results from RFAs 1 and 2
- Enhance capacity for interdisciplinary research and training
- Provide participatory modeling tools for researchers, teachers, students, and stakeholders interested in water sustainability
- Enhance data/model visualization capacity

Research Focus Area 3.1 – Interdisciplinary Models: Couple specific models representing hydrology, ecology, and human systems to ensure efficient exchange of inputs and outputs at appropriate spatial and temporal scales (*David Rosenberg, Sarah Null, Team Leads*)

1) Identify and compile the models currently in use by Utah researchers and stakeholders to understand and manage water resources, and what are their inputs, outputs, and spatiotemporal domains
2) Create the best access mechanisms for providing data to coupled models so that we can automate the transformation of data into the appropriate formats
3) Incorporate human behaviors and decisions into dynamic coupled systems models

Research Focus Area 3.2 – Coupling Research: Coupling Ecohydrology, social science and engineering research *(Court Strong, Team Lead)*

1) Quantify the important and/or irreversible thresholds and non-linearities in the coupled water system
2) Quantify the tradeoffs in potential solutions to water sustainability problems
3) Create and enhance decision support and planning tools to better capture mechanistic and coupled human-natural processes in the water system

Research Focus Area 3.3 – Scenario Planning and Visualization: Provide mechanisms and media so that iUTAH model and data products can be presented and visualized to best enhance communication, learning, and experimentation among faculty, students, and stakeholders *(Sarah Hinners, Team Lead)*

1) Produce tools and information content to disseminate iUTAH findings to all relevant stakeholders
2) Integrate/couple interdisciplinary models in a way that facilitates collaboration among researchers and contributions from stakeholders and non-specialists
3) Facilitating "in reach" of off-campus partners into iUTAH research and solicit model scenarios and tools from relevant stakeholders

Strategic Actions to be implemented:

- Define and parameterize the coupled water system
- Develop a working conceptual model of the major water pools and fluxes within the study domain and identify key processes and relationships that constitute the coupled human-water system
- Integrate the activities in RFAs 1 and 2 and determine whether additional processes, relationships, and datasets are necessary to understand the system as a whole
- Work with the Cyberinfrastructure group to create a data inventory to identify key datasets important to an iUTAH data inventory and eventual data archive and clearinghouse
- Working with the Cyberinfrastructure group, create a model inventory to identify relevant social and biophysical component models for iUTAH currently used by iUTAH partners
- Continue to specify and implement the areas where ongoing activities can be relatively easily linked to improve the representation of water processes in modeling studies that are already underway
- Facilitate interactions among individual scientists and science teams working at Utah universities to identify opportunities for data sharing, model improvements, and future collaborative research efforts
- Develop a working group to consider the scenarios to be studied in RFA3 that include understanding how to represent future land use change and decision-making, developing common scenarios across all modeling activities, and maximizing inclusion of stakeholders in the development of scenarios
- Link models that individually represent specific aspects of the system such as hydrologic-, climate-, ecological-, and agent-based models of decision-making
- Build an iUTAH visualization lab

Research Focus Area 3 – Coupled Human-Natural Systems: Milestones

Strategic Priority Area		Year 1	Year 2	Year 3	Year 4	Year 5
Research Focus Area 3 - Coupled Human-Natural Systems	RFA 3.1 - Interdisciplinary modeling	1. Develop inventory of existing data and models 2. Develop collaborative modeling team through workshop series	1. Develop conceptual model of coupled human-water system 2. Explore linkages with other models such as ET^{+} 3. Couple existing water models	1. Publish conceptual and model development 2. Develop and evaluate methods for model coupling 3. Continue model coupling	1. Populate models with GAMUT and other iUTAH collected data 2. Dissemination of results 3. Continue model coupling	1. Dissemination of results and model products 2. Publish model coupling methods and results
	RFA 3.2 – Coupling Research	1. Begin to identify components of human-natural water systems and how they relate 2. Establish collaborative teams across campuses 3. Engage stakeholders in establishing questions and priorities in coupled water research	1. Establish common scenarios of change 2. Develop stakeholder-responsive, coupled water system research	1. Integrate RFA1 and RFA2 through synthesis of biophysical data with social and engineering science 2. Collaborative publication and dissemination of results 3. Entrain stakeholders into coupled modeling workshops	1. Continue integration of RFAs 1 and 2 2. Publication and dissemination of results 3. Participatory data collection and modeling to test adaptation and mitigation strategies	1. Publication and dissemination of results 2. Evaluation of scenarios of change and adaptation/mitigation strategies

	RFA 3.3 – Scenarios Modeling and Visualization	1. Build collaborations with stakeholders 2. Build collaborations with EOD team 3. Development of team for building interactive model products and tools	1. Assess stakeholder needs for visualization and research products 2. Assessment of student, diversity, and public outreach needs for visualization and research products 3. Establish target for interactive products and tools	1. Development of stakeholder responsive products 2. Development of student, diversity, and outreach oriented products 3. Development of visualization capacity for project-wide apps, web applications, and interactive tools	1. Dissemination of products and tools 2. New round of stakeholder workshops 3. Continued development of apps, web applications, and interactive tools based on user feedback	1. Publication and dissemination of results 2. Introduce stakeholders to live web-based visualizations through classroom use and presentation to state agencies 3. Assess usage of web-based visualizations through analytics

Research Focus Area 3 – Coupled Human-Natural Systems: Metrics

Strategic Priority Area	Metrics	Baseline (as of Aug 1, 2012)	5-Year Target
Research Focus Area 3 - Coupled Human-Natural Systems	Collaborative team meetings/workshops	1	5-8 annually
	Model inventory meetings	0	2-3 annually
	Interdisciplinary model development workshops	0	1-2 annually
	Stakeholder engagement meetings	0	1-3 annually
	Stakeholder products	0	1-3 in years 3-5
	Model inventory	1 as addendum to RII proposal	Updated annually
	Scenarios Modeling Workshops	0	2-3 annually in years 3-5
	Visualization Outreach Activities	0	3-5 annually in years 4-5
	Presentations	0	1-5 annually
	Peer-reviewed publications	0	2-3 annually in years 3-5

	Popular press publications	0	1-2 annually in years 3-5
	Collaborative proposals	0	1-2 annually

2.2 Project Priority: Cyberinfrastructure

Team Leads: Jeff Horsburgh (USU), Court Strong (UU)

Team Participants: Stephanie Reeder (USU), Matt Lorimer (USU), Amber Jones (USU), Pabitra Dash (USU), Anthony Castronova (USU), Christine Pomeroy (UU)

Overall Goals: The goals of the Cyberinfrastructure (CI) Team are to increase capacity for data collection, organization, management, sharing, and synthesis to higher-level products and increase capacity for integration of data and models.

Major Activities: The iUTAH Modeling and Data Federation (MDF) will be built as a distributed facility that will coordinate across Utah universities and support the full data life cycle. iUTAH's MDF will **increase capacity for data collection, organization, management, sharing, and synthesis** to higher-level products and **integration with the proposed models**. For example, data organization, archival, and publication will primarily be supported at Utah State University, but will coordinate data storage resources with the University of Utah for redundancy and for High Performance Computing support. iUTAH will leverage development of enhanced optical network connectivity and computational resources through the Utah Education Network and the recent EPSCoR RII C2 award, and the recent Utah/Wyoming EPSCoR CI-WATER award. In addition, CI activities will be essential to providing **online resources** for graduate and undergraduate courses and information across all Utah institutions. These CI products will include **data, visualizations, and access** to models for K-12, policy makers and the general public in collaboration with RFA3.

Objectives:

- Develop infrastructure to support data collection and management activities of iUTAH facilities and researchers
- Identify, prioritize, and facilitate access to external datasets needed by iUTAH researchers
- Enable iUTAH researchers to share and access data using standard formats, protocols, and services
- Support iUTAH participants in discovering and accessing iUTAH and relevant external data
- Support iUTAH researchers in identifying and prioritizing modeling needs, selection and development of model coupling approaches, and access to computational resources
- Provide online resources for citizens, K-12, undergraduate, and graduate students throughout Utah

CyberInfrastructure Area 1 – Data System: Produce a data system architecture that optimally supports data sharing and collaboration across a diverse team of interdisciplinary scientists *(Jeff Horsburgh, Team Lead)*

1) Design and deploy a hardware architecture for hosting required web applications and data services and to facilitate linkage to high performance computing resources where needed
2) Produce data models, formats, and encoding standards that will enable iUTAH to store and manage heterogeneous data from researchers and partners working across focus areas, including streaming sensor data, remote sensing and geospatial datasets, and social science datasets
3) Provide data discovery and access services and interfaces that mediate across differing formats and semantics and enable iUTAH researchers and partners to discover, access, and interpret iUTAH data resources and the data resources of partner organizations
4) Enable and increase collaborative research and sharing of data and models through the innovative use of CI
5) Engage with the iUTAH iVL and work collaboratively to develop innovative visualizations of iUTAH datasets and research products.

CyberInfrastructure Area 2 – Monitoring Data: Design the cyberinfrastructure that enables standardized data collection and management for a network of aquatic and terrestrial monitoring sites managed by a consortium of disparate organizations. Integrate data from a green infrastructure research facility and social science data collected as part of RFA2 *(Jeff Horsburgh, Team Lead)*

1) Develop software to support streaming sensor data management and quality control. Investigate procedures for automated quality control of aquatic sensor and terrestrial data streams that differentiate between artificial (resulting from errors and malfunctions in the monitoring system) and real (resulting from real environmental events) anomalies in sensor data streams
2) In collaboration with iUTAH researchers, produce the design, approach, and algorithms for adaptive sampling protocols that modify the frequency of data collection in response to events in the monitored system (e.g., it's raining at a weather station, the water level and turbidity are rising in the stream so we need to increase the frequency of data collection in the stream to capture the effects of the storm)
3) Develop software to support management and tracking of monitoring network physical infrastructure (equipment) and logging of field actions
4) Provide access to, and visualizations of raw and quality controlled sensor data streams (as well as a variety of other types of data) to audiences ranging from K-12 to University researchers
5) Develop software, databases, and workflows for integrating data derived from samples collected at continuous monitoring sites and other experimental facilities
6) Provide flexible and configurable data connectivity to the Green Infrastructure Research Facility to support the variety of experimentation and data collection efforts that will occur there
7) Develop new methods for storing, visualizing, and analyzing social science datasets

CyberInfrastructure Area 3 – Technical Approaches for Coupled Modeling and Integration of Data and Models: Design and implement software and data/model integration approaches to support coupling of multidisciplinary water system models. *(Anthony Castronova, Jeff Horsburgh, Team Leads)*

1) Investigate techniques for overcoming technical challenges in coupling models, including computational challenges and spatial/temporal mismatches at coupled model boundaries
2) Develop software to support coupling of water system models, including integration of model driving datasets and simple visualizations of model inputs and outputs
3) Participate in development of coupled modeling case study and scenario development

Strategic actions to be implemented:

- Hire a CI Team consisting of a programmer/analyst, system administrator, data manager, and student programmers and technicians
- Design and deploy a virtual server architecture to host the iUTAH MDF
- Design and deploy a large storage infrastructure in collaboration with CI-WATER to provide storage resources for data, modeling, and CI system redundancy
- Coordinate with RFA1-RFA3 researchers to identify CI needs
- Assist iUTAH research facilities with telemetry system design and data communication from remote sites
- Develop databases, web services, and software CI for managing datasets from iUTAH facilities
- Develop and conduct a survey to assist iUTAH researchers in identifying planned and existing data
- Develop and conduct a survey to assist iUTAH researchers in identifying existing models relevant to iUTAH
- Lead delivery of a graduate level course in Hydroinformatics across the USU, BYU, and UofU campuses in collaboration with CI-WATER
- Develop relationships and collaborations with existing agencies, data providers, and existing CI projects
- Select and develop standard data and metadata formats for iUTAH
- Select and develop standard data access services and mechanisms for iUTAH
- Develop a searchable data repository and metadata catalog for iUTAH data resources to support data upload, discovery, and retrieval
- Coordinate to leverage CI-WATER EPSCoR Track 2 modeling services and results to provide better linkages to models and computational resources
- Provide support for formal data publication and archival via CUAHSI HIS, DataONE, and/or other partner repositories
- Leverage the work of the NSF-funded HydroShare project to provide collaborative data and model sharing capabilities for iUTAH
- Develop software for model coupling and integration of datasets with water system models
- Work closely with the Education, Outreach, and Diversity team to provide online iUTAH products for Utah citizens, policy makers, resource managers, as well as K-16, undergraduate and graduate students throughout Utah
- Conduct original CI research to be used in additional proposals
- Submit interdisciplinary proposals and peer reviewed journal publications

CyberInfrastructure Milestones

Strategic Priority Area	Year 1	Year 2	Year 3	Year 4	Year 5
Cyberinfrastructure	1. CI staff hired with ongoing support and training throughout 2. Virtualization infrastructure for hosting the iUTAH Modeling & Data Federation designed and deployed 3. Databases and software to support managing streaming sensor data from GAMUT deployed 4. Assist in design of telemetry to iUTAH field sites 5. CI needs of RFA1-RFA3 identified through collaboration 6. Hydroinformatics course offered in collaboration with CI-WATER 7. Collaborate to leverage CI-WATER and RII C2 Cyberconnectivity EPSCoR Awards	1. Large storage infrastructure for iUTAH designed and deployed in collaboration with CI-WATER 2. Open software development repositories established for all iUTAH CI software products 3. Initial release of software tools for managing quality control of streaming sensor data 4. Initial release of data repository, catalog & data discovery interface 5. Initial release of iUTAH MDF website 6. iUTAH data policy developed and documented 7. Development of partnerships with external data providers and consumers (ongoing throughout) 8. Collaborations with CI-WATER developed to provide models with access to national datasets 9. Additional servers and	1. Datasets from GAMUT discoverable and accessible through iUTAH MDF website 2. External datasets discoverable & accessible through iUTAH MDF website 3. Initial release of functionality for depositing user datasets into the iUTAH MDF repository for publication, archival, and sharing 4. Initial release of monitoring equipment and field activity management database and website 5. Initial release of coupled modeling software 6. Explore data curation with CUAHSI HIS, DataONE, HydroShare, and University Libraries 7. Initial release of social science data visualization software 8. Additional storage added to virtualization infrastructure	1. New proposals for CI-related research developed 2. Data from iUTAH facilities (GAMUT, GIRF) discoverable, accessible, and citable in iUTAH MDF 3. Data repository, catalog, and data discovery interfaces complete 4. Software tools for managing streaming sensor data refined and revised based on user input 5. Initial release of iUTAH MDF client web service interfaces 6. Support for model coupling & execution on HPC 7. Develop partnership(s) with CUAHSI HIS, HydroShare, DataONE, and/or	1. New proposals for CI-related research developed 2. All iUTAH MDF software tools released via open source code repositories 3. Presentations given at national meetings 4. Peer reviewed papers about iUTAH CI published 5. Curate published iUTAH data sets within a long-term data repository such as CUAHSI HIS, DataONE and/or HydroShare 6. Coupled modeling software revised based on user feedback and use cases 7. Final release of iUTAH MDF client web service interfaces 8. Additional storage added to virtualization

Strategic Priority Area	Year 1	Year 2	Year 3	Year 4	Year 5
		storage added to virtualization infrastructure		university libraries for long term archival of iUTAH datasets 8. Additional servers and storage added to virtualization infrastructure	infrastructure

CyberInfrastructure Metrics

Strategic Priority Area	Metrics	Baseline (as of Aug 1, 2012)	5-Year Target
Cyberinfrastructure	Supported CI staff	0	3 annually
	Trained student programmers	0	1-2 annually
	Virtual host servers	0	1-2 added annually
	Data storage supporting virtualization infrastructure	0	250 TB
	Disk capacity of large storage infrastructure (in collaboration with CI-WATER)	0	1 PB
	Datasets from external partners accessible through iUTAH MDF	0	5-8 annually
	Number of registered users of the Modeling & Data Federation	0	5-10 added annually
	Number of downloads of iUTAH datasets	0	5-10 annually
	Presentations about iUTAH MDF and CI	0	3-5 annually
	Peer reviewed publications	0	2-3 annually in years 3-5
	Hydroinformatics course offerings (# of semesters)	0	1 annually
	Grad students trained in Hydroinformatics course	0	15-25 annually
	Number of new CI-related proposals	0	2-5 annually in years 2-5
	Number of new proposals from iUTAH researchers that cite the iUTAH MDF in their data management plans	0	2-3 annually

2.3 Project Priority: Diversity Enhancement

Team Leads: Mark Brunson (USU), Ellen Burns (USU)

Team Participants: Adrienne Andrews (WSU), Nancy Bo Flood (Navajo Nation), Sue Dintelman (Pleiades, Inc.), Carla Endres (USU-Eastern,) Shana Geffeney (USU-Uintah), Marian Howe-Taylor (SLCC), Shalini Kesar (SUU), Becky Monhardt (Loras College) Herm Olsen (J.D), Madlyn Runburg (NHMU), Anne Wairepo (UVU)

Overall Goal: The goal of Diversity Enhancement (DE) is to increase the individual, disciplinary, institutional, and geographic diversity of the STEM enterprise in Utah to address the water sustainability issues facing Utah and the Mountain West.

Major Activities: Diversity enhancement will be integrated into all iUTAH activities with an emphasis on creating opportunities for women, rural audiences, Hispanic Americans, and Native Americans. iUTAH will use the watershed observatories, green infrastructure facilities and scenarios modeling to engage students and teachers from diverse populations in discussions of water sustainability issues with cultural relevance to their communities.

Objectives:

1. Enhance the diversity of iUTAH team members
2. Train iUTAH team members in the best practices for implementing culturally aware educational activities
3. Strategically recruit and retain groups underrepresented in STEM for all iUTAH activities

Strategic Actions to be implemented:

- Diversify the iUTAH team by inviting members of underrepresented groups with relevant skills and interests to join the RFAs and/or EOD teams
- Host seminars and dialogs that connect iUTAH scientists with diverse audiences and bring diverse institutions, leaders, and communities into iUTAH science, education, and outreach
- Use the established networks of iUTAH partners to engage students, teachers, researchers, and public participants from diverse groups in iUTAH activities
- Host a conference about culturally appropriate teaching and elements of effective diverse education related to water, watersheds, and ecosystems for the iUTAH teams
- Create a workbook of cultural knowledge readings for the relevant cultural groups
- Conduct diversity training workshops for the iUTAH teams
- Target recruitment efforts to diverse audiences for all iUTAH opportunities and engagement events
- Recruit teacher and students participants from grades K-12 with emphasis on communities with underserved populations, including Title I schools and rural communities, for NHMU's TLO program
- Provide improved support networks for the retention of diverse groups, especially women, rural audiences, Hispanic Americans, and Native Americans

Diversity Enhancement Milestones

Strategic Priority Area		Year 1	Year 2	Year 3	Year 4	Year 5
Diversity Enhancement	2.3.1 Diversify iUTAH team members	1. Establish statewide Diversity Enhancement Team (DET) 2. Create statewide partnerships 3.	1. Recruit diversity specialists from partner institutions 2. Conduct first seminar & dialog program 3. Formative assessment of DET activities	1. Expand and diversify DET team 2. Increase diversity of iUTAH leadership 3. Conduct seminar & dialog program	1. Expand and diversify DET team 2. Conduct seminar & dialog program	1. Summative assessment of DET activities

	2.3.2 Train iUTAH teams in effective diverse education	1. Hold first Diversity conference with focus on Native Americans 2. Produce best-practices handbook for iUTAH personnel	1. Conduct diversity-training workshop for iUTAH participants 2. Update best practices handbook	1. Conduct diversity training workshop for new iUTAH participants 2. Update best practices handbook	3. Hold second Diversity conference with focus on Hispanic Americans 4. Update best practices handbook	1. Conduct diversity training workshop for new iUTAH participants
	2.3.3 recruit and retain groups underrepresented in STEM	1. Develop Spanish language & other culturally effective iUTAH materials 2. Faculty and students attend SACNAS	1. Design museum programs for target populations 2. Partner with WFD and EE to recruit & retain URMs 3. Establish near-peer mentors program for women and URMs 4. Attend SACNAS	1. Train near-peer mentors 2. Solicit new ideas for recruitment & retention programs 3. Develop recruitment and retention plans for target populations 4. Attend SACNAS	1. Train near-peer mentors 2. Implement new recruitment and retention programs for target populations 3. Attend SACNAS	1. Train near-peer mentors 2. Implement recruitment and retention programs for target populations

Diversity Enhancement Metrics

Strategic Priority Area	Metrics	Baseline (as of Aug 1, 2012)	5-Year Target
Diversity Enhancement	1. Cultural awareness and teaching techniques conference – S. Utah, N. Utah	0	1 yearly in Year 1 and 3
	2. Cultural awareness handbook/best practices	0	Annually review and update
	3. Diversity training workshops	Institutional only	1 yearly in years 2-5
	4. Museum programs for specific target populations	NHMU but not water related	Up to 2 annually
	5. Increase diversity of iUTAH leadership	0 URM	Add 1-2 yearly in years 2-5
	6. Recruit & retain URMs & women in all iUTAH opportunities	0	Up to 25% participants from URM or female audiences

2.4 Project Priority: Workforce Development (WFD)

Team Leads: Mark Brunson (USU), Ellen Burns (USU)

Team Participants: Scott Bates (USU), Dan Bedford (WSU), Jen Ciaccio (Dixie), Boyd Edwards (USU-Uintah Basin), Richard Gill (BYU), Danny Horns (UVU), Nancy Huntly (USU), Chris Keleher (UDNR), Mary Jane Keleher (SLCC), Molly Malone (UU),, David Matty (Weber State U), Nancy Mesner (USU), Lucas Moyer-Horner (UU), Bill O'Neill (Dixie), Bob Ramsey (Canyon Concepts), Kevin Rhodes (Campbell Scientific), Madlyn Runburg (NHMU), Louisa Stark (GSLC/UU), Carla Trentelman (WSU), Sarah Young (Utah Office Education)

Overall Goal: Enhance the STEM (Science, Technology, Engineering, and Mathematics) workforce in Utah by developing programs for a diverse range of learners that inspire students to choose STEM careers, promoting the retention of students in STEM degrees, and enhancing the success of faculty in STEM disciplines. A strong STEM workforce is critical to building and sustaining research capacity and economic growth.

Major Activities: Integrated research and education activities are planned for K-6 students, middle school and high school students and teachers, undergraduates at community colleges, primarily undergraduate institutions (PUIs), and the major research universities, graduate students**,** postdoctoral fellows, and early career faculty and established faculty. These experiences will be directly related to iUTAH's research questions, so the focus will be on the watershed observatories and other iUTAH

facilities developed. Guiding principles for iUTAH's workforce development plan include integrating research and education, providing near-peer mentoring, encouraging diversity, and creating public-private partnerships. Annual assessments by the External Advisory Board and External Assessment Team will be formative assessments, which will be used to modify or change future activities as advised.

Objectives:

1. Promote and maintain a **STEM workforce** focused on water sustainability
2. Develop **public-private partnerships**
3. Conduct formative **assessment** of programs and modify future activities

Strategic Actions to be implemented:

- Create an annual Summer Institute where teams of K12 students and teachers will spend one week working with iUTAH researchers (undergraduates, graduate students, and faculty) at the watershed observatories or other iUTAH facilities.
- Provide summer research experiences for undergraduates to work jointly with iUTAH scientists and graduate students, with special emphasis on recruiting from primarily undergraduate institutions and those with high enrollment of diverse groups
- Provide competitive research fellowships for graduate students to work with iUTAH researchers on interdisciplinary research projects, including both the natural and social sciences
- Match students through the iUTAH traineeship program to provide real-world job experiences that integrate the knowledge and theory learned in the classroom with practical application of skills in a professional setting
- Employ an interdisciplinary post-doctoral fellowship program that allows fellows to work with an iUTAH research team while spending significant time with at least two mentors from different disciplines and institutions
- Offer research awards for faculty at PUIs and for early career faculty to work with iUTAH researchers on one of the three RFAs. Awardees will be mentored by established faculty and encouraged to submit NSF proposals based on their research fellowship
- Facilities developed by iUTAH, including the instrumented watersheds, green infrastructure research facility & network, and participatory modeling platform will provide the nexus for K12, undergraduates, faculty and stakeholders to interact with researchers.
- Host an annual iUTAH Symposium after the Summer Institute to bring together all iUTAH participants, as well as our External Advisory and Assessment Teams. The Symposium will include presentations by participating students (from all levels of education), teachers, researchers, and other partners, as well as discussions among the participants about future plans for iUTAH, including lessons learned from the previous year's activities.

Workforce Development Milestones

Strategic Priority Area		Year 1	Year 2	Year 3	Year 4	Year 5
Workforce Development	2.4.1 STEM Workforce	1. Recruit members statewide to WFD team 2. Plan Summer Institute (SI) #1 3. Recruit students, teachers, and researchers for SI #1 4. Develop and implement iFellows undergraduate research program 5. Recruit and hire graduate research fellows 6. Develop cross-campus graduate training course 7. Recruit and hire postdoctoral scholars 8. Develop Research Catalyst Grant (RCG) program and review process 9. Recruit PUI faculty for RCGs 10. Review and fund RCGs 11. Recruit and hire targeted iUTAH faculty	1. Expand and diversify WFD team 2. Develop near-peer mentoring program 3. Train near-peer mentors 4. Create K12 curriculum materials from SI#1 5. Implement Summer Institute #2 6. Recruit and hire undergraduate iFellows 7. Recruit and hire graduate research fellows 8. Offer cross-campus hydroinformatics class 9. Recruit and hire postdoctoral scholars 10. Recruit and fund PUI faculty RCGs	1. Expand and diversify WFD team 2. Train near-peer mentors 3. Integrate SI curriculum materials into K12 classrooms 4. Implement Summer Institute #3 5. Create SI curriculum repository 6. Recruit and hire undergraduate iFellows 7. Recruit and hire graduate research fellows 8. Recruit and hire postdoctoral scholars 9. Recruit and fund PUI faculty RCGs	1. Train-near peer mentors 2. Create and deposit curriculum materials from SIs 3. Implement Summer Institute #4 4. Recruit and hire undergraduate iFellows 5. Recruit and hire graduate research fellows 6. Recruit and hire postdoctoral scholars 7. Recruit and fund PUI faculty RCGs	1. Train-near peer mentors 2. Create and deposit curriculum materials from SI 3. Recruit and hire undergraduate iFellows 4. Recruit and hire graduate research fellows 5. Recruit and hire postdoctoral scholars 6. Recruit and fund PUI faculty RCGs

	2.4.2 Public-private Partnerships	1. Recruit agency and private industry partners for iUTAH internship program 2. Develop undergraduate internship program 3. Recruit and hire iUTAH interns	1. Recruit additional agency and private industry partners as internship sponsors 2. Recruit and hire iUTAH interns	1. Recruit additional agency and private industry partners as internship sponsors 2. Recruit and hire iUTAH trainees	1. Recruit additional agency and private industry partners as internship sponsors 2. Recruit and hire iUTAH trainees	1. Recruit additional agency and private industry partners as internship sponsors 2. Recruit and hire iUTAH trainees
	2.4.3 Assessment	1. Develop survey to assess iUTAH collaborations 2. Plan iUTAH symposium for all participants and assessment teams 3. Conduct year-end iUTAH Symposium	1. Formative assessment of WFD activities 2. Modify activities based on assessment results 3. Conduct year-end iUTAH Symposium	1. Survey participants to assess iUTAH collaborations 2. Modify activities based on assessment results 3. Conduct year-end iUTAH Symposium	1. Formative assessment of WFD activities 2. Modify activities based on assessment results 3. Conduct year-end iUTAH Symposium	1. Summative assessment of WFD activities 2. Conduct year-end iUTAH Symposium

Workforce Development Metrics

Strategic Priority Area	Metrics	Baseline (as of Aug 1, 2012)	5-Year Target
Workforce Development	Summer Institute - High school students	0	9 yearly in years 1-4
	Summer Institute - High school teachers	0	9 yearly in years 1-4
	Summer Institute - Undergraduate students	0	9 yearly in years 1-4
	Summer Institute - Graduate students	0	6 yearly in years 1-4
	K-12 curricula materials	0	1 yearly in years 2-5
	Undergraduate research fellows (iFellows)	0	Up to 14 iFellows annually (50% PUI, 25% URM or women)
	Faculty iFellows mentors	0	Up to 14 annually
	Graduate research fellows	0	Up to 15 annually
	Online courses across iUTAH Institutions for Graduate Fellows	0	At least 1 annually

	Post-doctoral researchers	0	3 yearly in years 2 and 4
	PUI Faculty Research Catalyst awards	0	Up to 5 annually
	Faculty hires	0	2 in year 1
	Internship sponsors – private & public organizations	0	Up to 10 in years 1-2
	Undergraduate trainees	0	Up to 10 in years 3-5
	iUTAH Symposium and Assessment	0	1 annually

2.5 Project Priority: External Engagement (EE)

Team Leads: Mark Brunson (USU), Ellen Eiriksson (USU)

Team Participants: Brenda Bowen (UU), Kerry Bringhurst (Utah Public Radio), Marcy DeMillion (National Park Service), Jacqualine Grant (SUU), Brian Greene (USU), Maura Hahenberger (SLCC), Sarah Hinners (UU), Laura Hunter (UEN), Kristina Kaly (Salt Lake County School District), Chris Keleher (UDNR), Becky Menlove (NHMU/UU), Nancy Mesner (USU), Ken O'Brien (Salt Lake County School District), Heather Paulsen (Thanksgiving Point), Jennifer Pemberton (Utah Public Radio), Jackie Pendleton (Living Planet Aquarium), Madlyn Runburg(NHMU/UU), Katie Smith (Leonardo Museum), Sam St. Clair (BYU)

Overall Goal: The goal of External Engagement (EE) is to design and implement programs to enhance the development of a diverse, well-prepared STEM workforce and a more scientifically literate public in the state of Utah. iUTAH will use data and results from the RFAs to engage the public in discussions about water sustainability issues throughout the western United States.

Major Activities: The EE plan includes outreach, communication, and dissemination activities to translate iUTAH efforts to diverse audiences in order to engage key stakeholders and the general public in the results and outputs from iUTAH research. EE partners will bring together researchers, educators, students, stakeholders, and policy makers to design and develop EE activities. Mixed methods will be used for both collaboration and evaluation of these efforts. Workforce Development and Diversity Enhancement goals will also be incorporated into the EE work. Our Annual Assessment will be used to modify or change activities as indicated.

Objectives:

1. Provide participatory iUTAH-related research experiences for **K-12 students and teachers**
2. Engage **public audiences and stakeholders** in face-to-face activities designed to build connections with iUTAH researchers
3. Disseminate iUTAH project information, research outcomes, educational materials, and participation opportunities through a dynamic **communications strategy**
4. Incorporate **assessment** outcomes into future programming efforts

Strategic Actions to be implemented:

- Develop museum partnerships across Utah to provide interactive experiences for K-12 students

and teachers

- Integrate iUTAH research and facilities into existing museum programs
- Engage K12 students and their teachers in NHMU's Taking Learning Outdoors program and the Leonardo's Water Workshops
- Align Utah Water Watch's (UWW) Citizen Science program to support relevant aspects of iUTAH research areas
- Engage relevant Utah stakeholders in shaping research directions
- Recruit additional partners with complementary work to expand iUTAH engagement activities
- Establish an iUTAH communications' strategy for the diverse set of iUTAH audiences, both within and outside of the project
- Develop an iUTAH website and complementary social media presence
- Integrate iUTAH project evaluation results into future years' plans

External Engagement Milestones

Strategic Priority Area		Year 1	Year 2	Year 3	Year 4	Year 5
External Engagement	2.5.1 K-12 students and teachers	1. Build diverse statewide EE team. 2. Tailor the NHMU Taking Learning Outdoors (TLO) program to iUTAH 3. Partner with Leonardo Museum's water workshops 4. Partner with Utah Water Watch (UWW) school rain barrel project	1. Expand and diversify EE team 2. Integrate iUTAH results into museum and citizen science programs 3. Recruit and engage new NHMU & Leonardo cohorts 4. Conduct UWW K12 programs at iUTAH watersheds 5. Solicit ideas for new K12 engagement events 6. Formative assessment of K12 activities	1. Expand EE team 2. Recruit and engage K12 cohorts for museum programs 3. Conduct UWW K12 programs at iUTAH watersheds 4. Fund new K12 engagement events. 5. Engage new museum partners statewide	1. Expand EE team 2. Recruit and engage K12 cohorts for museum programs 3. Recruit and fund new K12 engagement events. 4. Engage K12 students and teachers at Green Infrastructure Facility (GIRF)	1. Recruit and engage K12 cohorts for museum programs 2. Conduct UWW K12 programs at iUTAH facilities 3. Summative assessment of K12 activities

	2.5.2 Public Audiences and Stakeholders	1. Partner with Utah Water Watch (UWW) citizen science projects at iUTAH watersheds 2. Partner with USU Science Unwrapped to present water issues in the West 3. Convene meeting between water resources managers and iUTAH researchers 4. Arrange public screening of WATERSHED	1. Incorporate iUTAH results into UWW 2. Conduct UWW program at iUTAH watersheds 3. Expand stakeholders engaged with iUTAH 4. Solicit ideas for additional public engagement programs	1. Conduct UWW program at iUTAH watersheds 2. Expand stakeholders engaged with iUTAH 3. Fund new public engagement events.	1. Conduct citizen science program at Green Infrastructure Facility (GIRF) 2. Conduct UWW program at iUTAH watersheds 3. Recruit and fund new public engagement events.	1. Recruit and engage public audiences for museum programs 2. Conduct citizen science programs at iUTAH facilities 3. Summative assessment of public engagement activities
	2.5.3 Communications Strategy	1. Form communications team 2. Design, build and launch iUTAH website 3. Design and implement social media strategy 4. Host Becoming the Messenger workshop 5. Develop iUTAH messages 6. Produce bi-monthly newsletter 7. Explore and purchase tools for remote team communications, e.g., Go-to-meeting	1. Expand and diversify communications team 2. Develop website as data entry portal for participants 3. Expand social media following 4. Refine iUTAH messages and videos 5. Produce and expand audience for bi-monthly newsletter 6. Produce glossy highlights publication 7. Evaluate and refine communication tools	1. Expand communications team 2. Develop website as primary communications resource for participants 3. Revise and augment iUTAH website 4. Expand and diversify social media following 5. Produce and expand audience for newsletter 6. Evaluate and refine communication tools	1. Revise and augment iUTAH website 2. Expand and diversify social media following 3. Refine iUTAH messages and videos 4. Produce and expand audience for newsletter 5. Produce glossy highlights 6. Evaluate and refine communication tools	1. Revise and augment iUTAH website 2. Expand and diversify social media following 3. Evaluate and refine inter-team communication tools
	2.5.4 Assessment	1. Develop assessment plan and instruments	1. Conduct formative assessment of EE activities	1. Modify activities based on assessment results	1. Modify activities based on assessment	1. Conduct summative assessment of EE activities

External Engagement Metrics

Strategic Priority Area	Metrics	Baseline (as of Aug 1, 2012)	5-Year Target
External Engagement	Museum partners	0	At least 2 annually
	Museum partnerships K-12 students	0	Up to 200 annually
	Museum partnerships K-12 teachers	0	Up to 30 annually
	Citizen science K-12 students	0	Up to 500 annually
	Citizen science K-12 teachers	0	Up to 30 annually
	Citizen science general public, stakeholders	0	Up to 100 annually
	Stakeholder engagement events	0	2 annually
	Newsletter (bi-monthly)	0	At least 6 annually
	Website	0	Up to 1000 unique visitors per month
	Social media (Facebook, Twitter, Instagram, etc.)	0	Up to 100 new followers annually
	Drupal reporting system	0	All iUTAH participants

2.6 Project Priority: Project Management

Management Team (Leadership team in bold): Zach Aanderud (BYU), Adrianne Andrews (WSU), **Michelle Baker** (USU), Dan Bedford (WSU), Frank Black (Westminster), Jeff Broadbent (USU), **Mark Brunson** (USU), Ellen Burns (USU), **James Ehleringer** (UU), Joanna Endter-Wada (USU), Richard Gill (BYU), Tami Goetz (GOED), Fred Govedich (SUU), Daniel Horns (UVU), **Jeff Horsburgh (USU), Doug Jackson-Smith** (USU), Amber Jones (USU), Chris Keleher (UDNR), **Andreas Leidolf (USU)**, Sarah Null (USU), Christine Pomeroy (UU), Madlyn Runburg (NHMU), **Court Strong** (UU)

Utah NSF EPSCoR fully recognizes that a successful project of this magnitude and complexity depends on the strong leadership of the PIs and management team with sufficient staff and expertise to develop, implement, and oversee it. This RII project uses a multi-level organizational structure (see Figure below) to provide effective programmatic and administrative oversight for successful implementation.

The ***iUTAH Management Team (MT)*** will ensure coordination and integration among iUTAH activities. The MT consists of two members from the Leadership Team (described below) plus the co-leads of each EOD and CI team, co-leads of the research focus areas, and representatives from the PUIs. The MT

members were chosen to span a diversity of institutions, disciplines, gender, and rank. The MT holds monthly meetings either in person or through video conferencing via GoToMeeting to ensure regular communication and coordination, as well as to vet any proposed changes in activities and/or budgets.

The MT is responsible for:

- addressing evolving policies and procedures
- strengthening the research focus and integration
- addressing research team progress and funding allocations
- monitoring the new hire processes
- reviewing evaluation and assessment recommendations
- revising the iUTAH Strategic Plan
- overseeing overall risk management practices

The iUTAH Leadership Team (LT) includes the coversheet principal investigators who have fiduciary responsibility for the project. The LT is responsible for allocating funds as described in the project budget and implementing policies, procedures, and project activities as defined by the MT and as outlined in the strategic plan.

The iUTAH EPSCoR Assistant Director and Project Administrator (Andreas Leidolf) is responsible for day-to-day program oversight, administration, implementation, and integration of project components. He works in tandem with the iUTAH Research Project Director and PI (Michelle Baker). Both share supporting program and administrative staff in the iUTAH office.

Facilities developed by iUTAH, including the instrumented watersheds (GAMUT), green infrastructure research facility (GIRF), and participatory modeling platform will provide the nexus for K-12, undergraduates, faculty and stakeholders to interact with researchers. They will also provide intersection opportunities for interdisciplinary interactions among researchers.

Project Management Milestones

Strategic Priority Area	Year 1	Year 2	Year 3	Year 4	Year 5
Project Management	1. Project management implemented through GoToMeeting, Dropbox and Basecamp 2. Hire Business Manager, PA and EOD coordinator 3. Weekly EPSCoR staff meetings 4. Meetings of Leadership (biweekly) and Management (monthly) Teams 5. Biannual all-hands meeting 6. External Advisory Board (EAB) meeting 7. External Assessment Team (EAT) meeting	1. Weekly staff meeting 2. Biweekly Leadership team meetings 3. Biannual all-hands meeting 4. Annual EAB & EAT meeting 5. Annual symposium held 6. NSF reverse site visit 7. Broaden academic partnership base	1. Weekly staff meetings 2. Biweekly Leadership Team meetings 3. Biannual all-hands meeting 4. Annual EAB & EAT meetings 5. Annual symposium held 6. Broaden state & local government base	1. Weekly staff meetings 2. Biweekly Leadership Team meetings 3. Biannual all-hands meetings 4. Annual EAB & EAT meetings 5. Annual symposium held 6. NSF reverse site visit 7. Broaden private partnerships	1. Weekly staff meetings 2. Biweekly Leadership Team meetings 3. Biannual all-hands meetings 4. Annual EAB & EAT meetings 5. Annual symposium held 6. Oversee all data and modeling repository activities 7. Write final report

Project Management Metrics

Strategic Priority Area	Metrics	Baseline (as of Aug 1, 2012)	5-Year Target
Project Management Leadership & Management teams	iUTAH staff hires	0	4
	iUTAH weekly staff meetings	0	225
	Biweekly Leadership team meeting	0	100
	Monthly Management team meeting	0	50
	iUTAH annual symposium & retreat	0	5
	External Advisory Board meeting, annually	0	5

	NSF Reverse Site visit	0	2
	New partners	0	10

3. Risk Mitigation and Succession Plan

For any project of this magnitude and complexity there are a series of impediments that might diminish success. The most significant potential threats to fully reaching the goals of iUTAH are outlined below, along with strategies to minimize potential negative impacts.

1. General Risks: Utah has 14 institutions of higher education distributed over a very large geographic area. One of the most formidable challenges will be to provide venues and activities that allow all interested parties to participate.

> Likelihood: While there is little risk that our offices and video conferencing software and facilities will be available, there is a MODERATE risk that the institutions located in S. Utah are likely to feel disenfranchised.
>
> Mitigation: It is imperative that state-of-the-art video conferencing opportunities are provided statewide and that all meetings, workshops, and other functions are held in a variety of locations. To this end, iUTAH EPSCoR will employ a distributed management model where the main EPSCoR Office and staff will be housed at the Logan USTAR facility, and a satellite office and meeting venue will be housed at the University of Utah. Licensing will be maintained for web conferencing technologies to facilitate meetings. Coordination of distributed meetings for larger groups using interactive video conferencing technology is available through the Utah Education Network.

2. Instrument Deployment Risk: Due to dependence on a number of resource agencies for data collection and permits for instrumentation placement, it is imperative that a strong working relationship be generated with stakeholders early in the project.

> Likelihood: Because of the large amount of Federal, State, local municipality and private lands involved, there is a HIGH risk that permitting issues will result in site selection changes as well as increasing time to deployment.
>
> Mitigation: In order to effectively engage Utah resource managers with respect to climate change, human impacts, and water resource availability, information will be exchanged regularly between the various groups from inception through the duration of the project. This will include modifying data collection, dissemination and general information as supplied by resource managers and policy makers. We have already received permits for much of the Red Butte upper watershed and will used existing sites on the Little Bear River with prior permits.

3. Data Collection Risk: iUTAH project personnel have strong track records in deploying, operating, and managing diffuse sensor and tower networks. It will be necessary to employ a strong team of field technicians for the long-term maintenance and operations of these networks and instrumentation. Some challenges with the long-term viability of our sensors due to extreme weather conditions and vandalism are anticipated. Our snotel and weather station sites are large, permanent fixtures that are not vulnerable to the issues above. Our hydrologic sensor networks as well as our water quality instrumentation, however, are vulnerable.

Likelihood: There is HIGH risk that some of our aquatic sensors will malfunction, be vandalized or be lost by extreme hydrologic events.

Mitigation: These threats will be strongly considered in deployment design and instrumentation placement. In addition, backup sensors will be purchased (within reasonable budgetary discretion) so that lost or stolen instruments can be quickly replaced.

4. Data Management Risks: iUTAH's CI team has a long history of collecting, storing, managing, and disseminating remotely collected data from sensor and tower networks. Still, the complex terrain and remote nature of many of the proposed sites will pose certain challenges to keeping data streaming into the storage facilities.

Likelihood: There is a HIGH likelihood that we will have disruptions of data streaming.

Mitigation: Continuous monitoring of transmissions from data collection sites will be required to minimize downtime and potential data gaps. Another challenge will be supporting storage, archival, discovery, and access to the diverse datasets that will be assembled by iUTAH partners working across disciplines; some by iUTAH researchers while others will be assembled from existing external sources. The cyberinfrastructure systems that have been proposed and will be implemented will be designed specifically for this purpose.

5. Data Dissemination Risks: An additional challenge will be the need for a "cultural change" in how data are managed and made available. The Data Management Plan from the original iUTAH proposal and the verbiage in subcontracts to iUTAH partners make it clear that iUTAH participants are required to make any primary data created by this project available to other project participants and stakeholders as soon as possible. It is anticipated that with the collection of social science datasets containing sensitive information, the assembly of data from existing external sources, and the creation of derivative data products by iUTAH researchers, a detailed data management policy will be required. It is anticipated that implementation of this policy may be difficult and will require conscious effort by the Project Administrator, Leadership Team, Cyberinfrastructure Team, and individual iUTAH researchers.

Likelihood: There is HIGH risk that some of our collaborators and participants will be reluctant to share their datasets in a timely fashion.

Mitigation: We have added language to all subawards that provides specific requirements for data sharing including the production of meta-data. The Leadership Teams receive monthly updates from our cyberinfrastructure team regarding data uploads and completeness of metadata.

7. Data Modeling and Analysis: Perhaps iUTAH's greatest potential and challenge will be its ability to generate truly integrated models that cross disciplines and data types. It will be essential to produce working, interdisciplinary models to provide both a framework for cutting-edge science and a vehicle for communicating the complex information to the necessary stakeholders and the public.

Likelihood: There is LOW risk that we will be unable to generate the interdisciplinary models necessary to understand the complex water sustainability questions we seek to answer.

Mitigation: The modeling and CI teams are already meeting regularly to provide a list of available disciplinary models and to design a platform for model integration. The first call for PhD students and post-docs is heavily aimed at interdisciplinary modeling activities. By providing critical mass

early, the hope is to jump-start modeling efforts and progress.

8. Necessary Personnel: One of largest challenges will be to bolster social sciences expertise. While iUTAH has some of the best water-oriented social scientists in the country, they are few in number and spatially dispersed.

   Likelihood: There is HIGH risk that we lack some of the necessary social sciences expertise necessary to understand the complex water issues we seek to understand.

   Mitigation: We have already successfully hired a world-class Associate Professor in water resources social sciences and engaged two new social scientists from Weber State. We continue to look for collaborators across the country that will bolster our social sciences capabilities.

Succession Plan

At every level there are at least two co-directors who oversee the daily and project-wide activities for each research, CI, and EOD focus. Michelle Baker oversees the project, having comprehensive knowledge of the entire project and its history. Additional PIs who were part of the proposal and project development from its inception make up the remaining Leadership Team; any one of those individuals could easily step into the Project Director's role if needed. Two EPSCoR faculty hires have been made; both are likely candidates to be trained for leadership positions within the Utah EPSCoR program.

4. Evaluation and Assessment Plan

The proposed Evaluation and Assessment Plan will include review and evaluation of iUTAH activities by a diverse group of independent, external experts during the award period. Reports prepared by these reviewers will be conveyed to the NSF EPSCoR Office in a timely manner. The project management team, in collaboration with the external evaluators and external advisory board, will continually monitor progress toward the goals of the strategic plan. Recommendations from the evaluation teams will be used to inform plans for subsequent years of iUTAH activities. The iUTAH evaluation and assessment plan will involve a four-pronged approach by independent evaluators, including an Education and Outreach consultant, a Collaboration and Networking consultant, a team from the AAAS Research Competitiveness Program, and members of the External Advisory Board.

Education, Outreach and Diversity (EOD)
Jacque Ewing-Taylor (U. Nevada-Reno, NV EPSCoR) will conduct a comprehensive evaluation that measures the goals and objectives of the iUTAH education and outreach activities. The evaluation component will employ a mixed-method approach, relying on surveys, questionnaires, observations, interviews, and external reviews to assess the quality, efficacy, and value of the proposed work and the ultimate return on NSF's investment. Dr. Ewing-Taylor will ground evaluation activities in the intended outcomes of the project, focusing on several key questions. These questions include: to what extent and how does this project help develop Utah's workforce, engage K-12 teachers and students, engage undergraduate and graduate students in partner universities and colleges, and result in increased public engagement in issues related to water in the arid west. Annual evaluations will provide recommendations that will be used to shape future iUTAH events.

Collaboration and Networking

Alan Porter from Georgia Institute of Technology will assess iUTAH impacts on collaboration and statewide networking. Dr. Porter is a leader in the emerging field of "scientometrics" and will conduct bibliometric analyses to determine the linkages among researchers in Utah. He will analyze the publication and citation patterns of researchers at all Utah institutions to identify the level of interconnectedness prior to the iUTAH award and in Year 4 of the award. This analysis will indicate the connections between institutions, disciplines, and individuals that were stimulated by the iUTAH activities. Results of the Year 4 analyses will be used to form plans for Year 5 and beyond.

AAAS Assessment

Dr. Mark Milutinovich, Program Director of the AAAS Research Competitiveness Service, will lead a review by an AAAS external scientific advisory board. The AAAS Research Competitiveness Service will recruit and lead a panel of experts to evaluate the scientific, programmatic, and administrative aspects of iUTAH. There will be one AAAS staff-only strategic planning visit (Year 1) and two panels in Years 2 and 4 to prepare iUTAH for NSF site visits and inform plans for the following years. The AAAS panels will provide recommendations on scientific directions, management activities, supporting infrastructure and policies, and the evaluation process itself, if any or all need to be modified for the program to have the best chance of success.

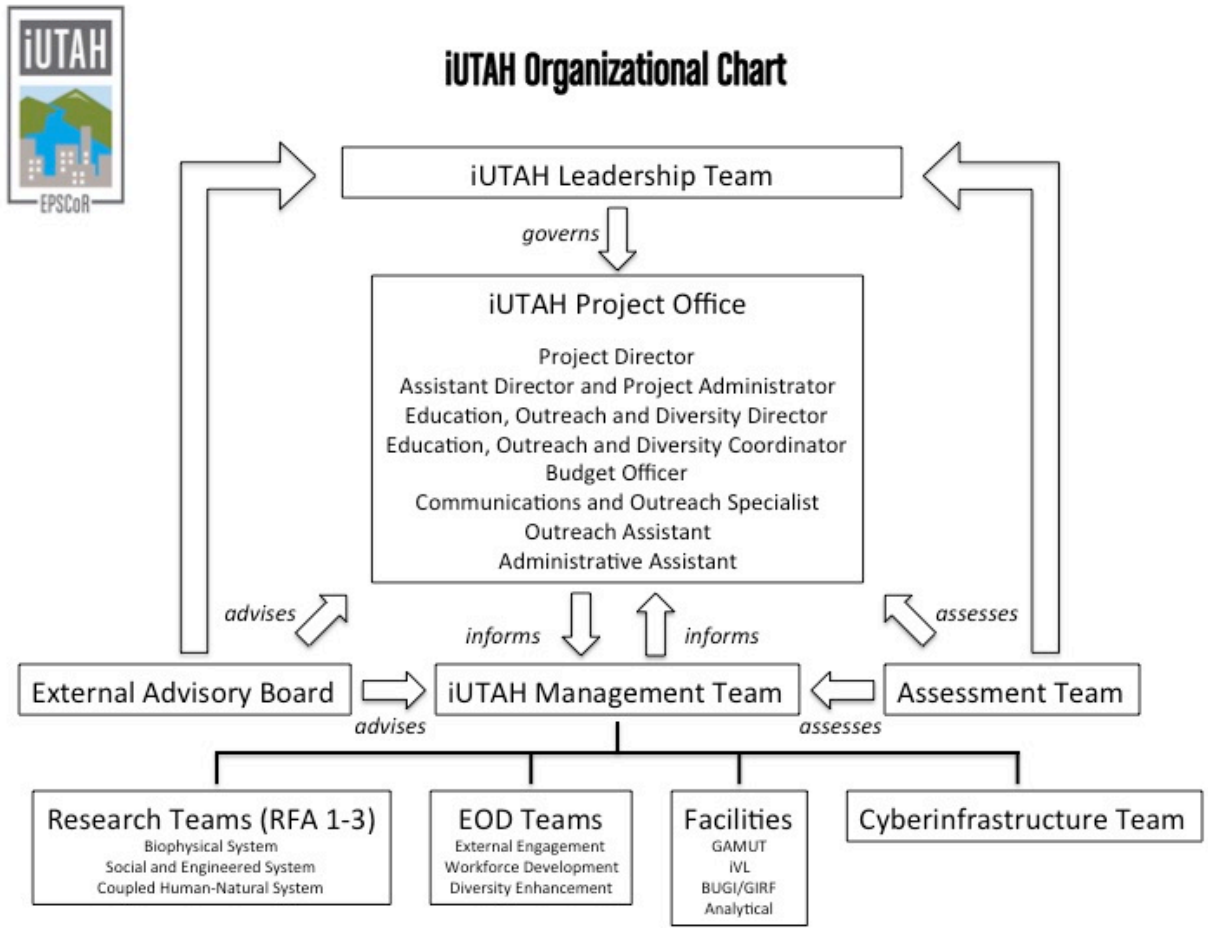
External Advisory Board

iUTAH's External Advisory Board will meet annually in conjunction with the annual iUTAH Symposium to advise the Project Director's Office and the Leadership and Management Teams on the effectiveness of its activities to enhance research, education, diversity, workforce development, and external engagement capacities. Their recommendations will be discussed with the MT, the External Assessment team, NSF and made available on iUTAH's website. The External Advisory Board will also provide forward-looking advice and vision for the future directions of the iUTAH research areas and best practices for EOD activities.

Glossary

AAAS		American Association for the Advancement of Science
BYU		Brigham Young University
CI		Cyberinfrastructure
CI-WATER		Cyberinfrastructure to Advance High Performance Water Resource Modeling
CNH		Coupled Natural and Human
CUAHSI		Consortium of Universities for the Advancement of Hydrologic Sciences
CUWCD		Central Utah Water Conservancy District
CZO		Critical Zone Observatories
DET		Diversity Enhancement Team
Dixie		Dixie State College
EAB		External Advisory Board
EAT		External Assessment Team
EE		External Engagement
EOD		Education, Outreach and Diversity
ESR		Environmental Situation Room
EPSCoR		Experimental Program to Stimulate Cooperative Research
GAMUT		Gradients Along Mountain to Urban Transitions
GOED		Governor's Office of Economic Development
GSLC		Genetics Science Learning Center
HAO		Hillyard, Anderson and Olsen
iUTAH		*innovative* Urban Transitions and Aridregion Hydro-sustainability
LTER		Long Term Ecological Research
NGO		Non Governmental Organization
NHMU		Natural History Museum of Utah
MSP		Math and Science Partnership
MT		Management Team
NSF		National Science Foundation
PUI		Primarily Undergraduate Institution
REU		Research Experience for Undergraduates
RFA1		Research Focus Area 1
RFA2		Research Focus Area 2
RFA3		Research Focus Area 3
S&T		Science and Technology
SEC		State EPSCoR Committee
SEES		Science, Engineering, and Education for Sustainability
SEO		State EPSCoR Office
SES		Social-Ecological-Systems
SI^2		Software Infrastructure for Sustained Innovation

SLCC	Salt Lake Community College
STEM	Science, Technology, Engineering, and Mathematics
SUU	Southern Utah University
UEN	Utah Education Network
ULTRA	Urban Long Term Research Area
USDA NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
USHE	Utah System of Higher Education
USOE	Utah State Office of Education
USTAR	Utah Science Technology and Research Initiative
USU	Utah State University
UU	University of Utah
UVU	Utah Valley University
UWEP	Utah Women and Education Project
West	Westminster College
WDT	Workforce Development Team
WRMA	Wasatch Range Metropolitan Area
WSC	Water Sustainability and Climate
WSU	Weber State University


iUTAH
EPSCoR
iUTAH Organizational Chart
iUTAH Leadership Team
governs
iUTAH Project Office
Project Director
Assistant Director and Project Administrator
Education, Outreach and Diversity Director
Education, Outreach and Diversity Coordinator
Budget Officer
Communications and Outreach Specialist
Outreach Assistant
Administrative Assistant
advises
informs
informs
assesses
External Advisory Board
advises
iUTAH Management Team
assesses
Assessment Team
Research Teams (RFA 1-3)
Biophysical System
Social and Engineered System
Coupled Human-Natural System
EOD Teams
External Engagement
Workforce Development
Diversity Enhancement
Facilities
GAMUT
iVL
BUGI/GIRF
Analytical
Cyberinfrastructure Team