iUTAH Response to 2013 Reverse Site Visit Panel

INTRODUCTION

The iUTAH EPSCOR Reverse Site Visit (RSV) was convened on September 25th, 2013 at NSF, Arlington, VA. The RSV Panel's report was submitted to iUTAH on October 28th, 2013. The RSV Panel did a thorough review of the project's Year 1 programs and made many constructive suggestions to the iUTAH Leadership Team. The following report is a response to the four Recommendations made by the RSV Panel. Note that each response is accompanied by an associated timeline for addressing each recommendation.

NSF REVERSE SITE VISIT PANEL RECOMMENDATIONS

1) Demonstrate progress on social science research by designing social science research protocols and instruments before the end of year 2.
2) Show evidence of a tight coupling between social and biophysical sciences through specific initiatives in joint research problems, questions, methodological procedures, and survey instruments.
3) Address lack of groundwater expertise.
4) Develop a precise set of requirements for contributing data and models to the iUTAH web portal.

IUTAH EPSCoR RESPONSES

Recommendation 1 - Demonstrate progress on social science research by designing social science research protocols and instruments before the end of year 2.

The iUTAH Strategic Plan section associated with Research Focus Area 2 (Social and Engineered Systems) established several goals to advance our ability to address social science research questions and couple social with biophysical data in iUTAH study watersheds. Targets for year 1 included:

(a) Identify and collate existing socio-economic data, identify data gaps;
(b) Select study neighborhoods representing a gradient of urban forms; and
(c) Design social science research protocols and instruments.

A brief overview of the first two items and a more detailed review of the broader social science data collection plan, including the development of protocols and instruments, are outlined below.

During our first year, the RFA2 team made significant progress on all three of these goals (and on other related goals outlined in the strategic plan), and we are rapidly converging on a more ambitious coordinated social science research plan that will guide research investments and activity in year 2 and beyond. We welcome the opportunity to expand and clarify details on the specific social science research protocols and instruments employed to date (and planned for the coming year).

To date, our primary accomplishments lie in three areas. First, a series of initial focused research projects were initiated by several iUTAH doctoral students under the mentorship of collaborative teams of RFA2 faculty advisors at the University of Utah and Utah State University. Second, we identified, collected, and organized existing data on diverse biophysical, social and engineered aspects of urban neighborhoods to enable the development of a formal urban typology to guide selection of study sites for future data collection. These social, engineering, and organizational data will also become available to the entire iUTAH project (and the public) through our CI data portal to enable us to address interdisciplinary questions. Third, faculty and graduate students associated with the RFA2 team spent much of year 1 discussing and developing a more ambitious portfolio of coordinated social science data collection activities that will be implemented starting in year 2.

Year 1 Social Science Doctoral Research

In year 1, iUTAH social science doctoral student research provided important initial insights to the drivers of water and land use in the WRMA. To capture the different social and institutional processes occurring at different scales, the RFA2 team targeted the five core PhD social science research fellowships to students working at the household, organizational, landscape, and statewide-level. At the University of Utah**, Philip Stoker**[1] obtained individual monthly water use data on almost 80,000 households from the Salt Lake City public water utility and combined these with data on climate, parcel characteristics, and household structure from several secondary sources to conduct a multivariate statistical analysis of drivers of variation in household water use (addressing RFA2.1 research question #1). At Utah State University, **Ann Armstrong**[2] developed a semi-structured interview protocol (available upon request) and conducted formal interviews with 27 managers and staff of purposively sampled municipal water utilities, canal/irrigation companies, and engineering firms in all three GAMUT watersheds. She also attended and made systematic observations of regular local and statewide meetings of the Utah Stormwater Advisory Committee (USWAC), a coalition of local and state stormwater managers. Ms. Armstrong's work with municipalities and irrigation companies was coordinated with another iUTAH fellow**, Augustina Odame**[3]. Ms. Odame participated in some of the structured interviews and used in-depth information from one local municipality/irrigation company to develop a simple agent-based model that links organizational water system management and individual farmer and household water decisions to changes in climate and water availability. She also developed an econometric model to simulate infrastructure investment decisions of farmers and irrigation companies under conditions of uncertainty. Also at USU, **Enjie Li**[4] gathered historic land use and demographic data to develop a parcel-scale cellular automata model to simulate future patterns of land use change in Cache County, Utah (one of our core GAMUT study areas). The early version of this model simulated the effects of various policy options against a baseline trend scenario. Ms. Li is currently extending this model to cover other regions within the WRMA and to improve the representation of drivers of land use change decision-making. A fourth USU doctoral fellow, **Morey Burham**[5], carried out semi-structured interviews in spring and summer 2013 with regional and state-level water policy makers and water resource management agency staff. The focus of these interviews was to ascertain the most pressing water challenges faced by high-level decision-makers in the state, and to document perceptions of climate change and planned responses to associated changes in water availability.

[1] Doctoral student in the Department of City and Metropolitan Planning.
[2] Doctoral student in the Department of Sociology, Social Work, and Anthropology.
[3] Doctoral student in the Department of Applied Economics.
[4] Doctoral student in the Department of Environment and Society.
[5] Doctoral student in the Department of Environment and Society.

Development of Spatial Datasets to Characterize Urban Neighborhoods

A subset of iUTAH RFA2 faculty and students[6] worked throughout the spring and summer of 2013 to gather existing secondary data at the Census Block Group (CBG) level for urban and urbanizing areas throughout the 10-county WRMA region. CBGs approximate the boundaries of socially-meaningful 'neighborhoods' in most urban settings, and are a level of geography for which extensive socio-demographic data are available.[7] These data included indicators for the following seven metrics:

- ***Land Cover*** (% impervious surface area, % tree cover, NDVI)
- ***Land Use*** (% land area used for residential, commercial/industrial, urban parks and open space, irrigated and non-irrigated agriculture)
- ***Biophysical Context/Micro-climate*** (temperature, precipitation, elevation)
- ***Built Environment*** (population density, housing density, parcel size, block length, intersection density and configuration)
- ***Housing Characteristics*** (% occupied housing units, % detached single family homes, age of housing stock, housing value, diversity of housing types)
- ***Household Characteristics*** (household size, family households, workers per household)
- ***Resident Demographics*** (age, income, poverty, and race/ethnicity)

Throughout the summer and early fall of 2013, the team developed a statistical typology of urban neighborhoods that represent the range of distinctive configurations of these metrics among urban CBGs across the WRMA[8]. We plan to use this typology to identify locations for the collection of systematic social science, engineering, and biophysical data in year 2 (and beyond).

Year 2 Comprehensive Social Science Data Collection Plan

Building on the insights of the initial doctoral student research and the efforts of the urban typology workgroup, all RFA2 social science faculty and graduate students met in mid-August 2013 and developed a comprehensive plan to guide systematic social science data collection in the coming year (and beyond). The plan envisions a **suite of six types of coordinated social science data collection activities** for RFA2. A key goal is to organize social science research methods to facilitate collaboration and interaction with engineering and biophysical colleagues.

The six planned social science data collection activities include:

1. A **household survey** of individual water users (densely sampled from neighborhoods that represent diverse urban forms)
2. Multi-method data collection from **water system managers** (cities, irrigation companies, university campuses)
3. Additional qualitative data collection from **regional and state water decision-makers & stakeholders**
4. Collection of **policy and planning documents** at both local, regional, state and federal scales
5. Collection of secondary data from **government records & remote sensing**
6. Collection of data from various **statewide and regional media** sources on water issues

[6] Led by Jackson-Smith, Buchert, Stoker, Hinners, S. Li, and C. Licon.
[7] From the U.S. Census of Population and American Community Survey.
[8] Details available upon request.

These activities are designed to provide data to address **6 clusters of guiding research questions** that are consistent with the iUTAH strategic plan and support the interests of collaborating iUTAH faculty, postdocs, and graduate students. Each activity will provide input into more than one 'research question' cluster, so a coordinated approach is necessary. These research questions include:

a. What are the drivers of individual water user decisions?
b. What are the drivers of organizational water management decisions?
c. What are social, economic, legal, and institutional drivers and obstacles to the adoption of green stormwater infrastructure?
d. How are state and regional water policy-makers responding to climate change and population growth? What are the emerging areas of vulnerability and how have/will they adapt?
e. How do different urban forms affect water system outcomes (water balance, water quality)?
f. What aspects of local and regional water systems provide important social, economic, and ecosystem values to different constituencies?

Finally, we also plan to utilize **a common approach to sampling units for analysis that allow us to integrate data across scales and methods for future integrated analyses**. Most notably, our household survey data is intended to be combined with independent measures of the local and regional 'context' surrounding each study neighborhood – which requires documentation of biophysical and built environment characteristics, water management organizations, local policies and plans, regional and state policies, etc.

A matrix linking each data collection activity to a research question area is presented in Appendix 1.

The Household Survey Effort

The most significant social science data collection effort in 2013/14 will involve a large-scale survey of households from neighborhoods across the 3 iUTAH study watersheds. The current plan is to gather data from 150 households in 20 selected neighborhoods (or a total sample of 3,000 households) in the spring of 2014. Since CBGs in this area typically include 400-500 households, a sample of 150 households from each neighborhood will allow us to estimate neighborhood-level population characteristics within +/- 6.5%. Collecting data from 20 neighborhoods is the minimum to allow the use of multi-level models that compare the impact of individual and neighborhood scale predictors. The survey will be administered using a drop-off/pick-up methodology using trained field enumerators; this method has been associated with much higher response rates than mail or telephone surveys (typically in the 75-85% range).

Neighborhoods will be sampled from categories developed in the urban typology (described above). To ensure that household survey results can be linked to data streams associated with the iUTAH GAMUT observatory and other RFA1 and RFA3 efforts, neighborhoods that have a direct or indirect hydrologic connection to the three instrumented GAMUT rivers and creeks will prioritized for survey data collection. In addition, neighborhoods that represent instances of other types of 'urban form' not represented in the first group, but that are located within the boundaries of GAMUT watershed host municipalities, will be included. Where possible, 2-3 replicates of several urban neighborhood types will be selected from across our three GAMUT study areas to allow assessment of neighborhood type * watershed context interactions.

The household survey instrument is currently under development, but includes draft sections covering the following topics:

a) Data on indoor and outdoor water behaviors & decision-making factors
b) Inventory of household water appliances and irrigation technology, use of culinary and secondary water systems
c) Sources of information about water use, water resource conditions
d) Awareness of water providers, water prices, local water policy and programs
e) Awareness, use, and valuation of local water bodies and related ecosystem services
f) Awareness, acceptance, and concern about traditional and 'green' stormwater infrastructure in their neighborhood
g) Risk perceptions, policy preferences, and responses to water management scenarios
h) Basic household and respondent demographic characteristics and attitudes

In each study neighborhood, additional contextual data will be systematically collected on the characteristics and policies of local municipal and secondary water provider organizations, the types and locations of engineered public and private stormwater systems, the presence of neighborhood groups and organizations, and the broader spatial positioning of the neighborhood within a larger watershed context. For the subset of study neighborhoods that are located near and/or hydrologically connected to the instrumented urban portions of the three GAMUT rivers and streams (the Logan River, Red Butte Creek, and Middle Provo River) we anticipate combining results of the household survey with the contextual data above to capture the relative impacts of built environments, policy contexts, and individual water user behaviors on measured water system outcomes. A subsample of survey respondents will be approached to participate in coupled social & biophysical data collection (see response to question #3 below).

Stormwater Management Surveys

Building on contacts and relationships built with individual stormwater managers and the Utah Stormwater Advisory Coalition (USWAC) in our first year, we have made arrangements to design and implement two surveys related to stormwater management in Utah. Both surveys are being sponsored by USWAC, so iUTAH expenses will be limited to providing labor and management to implement the survey effort.

The first survey will be sent to stormwater managers at all municipalities in Utah who are currently or expected soon to be subject to EPA MS4 regulations (N=91, including 77 current, and 14 coming under regulations in February 2014). An additional sample of 700 construction companies and commercial/industrial facilities that have acquired stormwater permits in the last 2 years will be drawn. The survey instrument is currently under development in consultation with several iUTAH faculty, postdoctoral fellows, and graduate students (and our USWAC partners), and will be administered as an online web-survey in late January 2014. The goals of the survey are to document the stormwater management policies and practices used in representative municipal and commercial locations, to better understand the challenges faced by organizations as they seek to comply with MS4 regulations, and to gauge the extent to which observed changes in climate and weather have affected their ability to manage stormwater effectively. The iUTAH team will lead in the development of the survey instrument, implementation of the survey, and cleaning and analysis of the results.

A separate brief survey of the general public will be developed to ascertain their awareness of and attitudes toward stormwater management, local and state policies and regulations, public educational programs, and changes in weather and climate conditions. This telephone survey will be implemented

in early spring 2014 by a professional polling firm to be hired by USWAC. The iUTAH contribution will to develop the survey instrument and lead analysis of the data.

Local, Regional and State-Level Policy and Planning Documentation

As noted above, one aspect of the intensive household data collection from 20 neighborhoods across the WRMA is the collection of data on the local water system governance and policy context. As part of that effort, this spring and summer we plan to systematically collect and analyze information about water management organizations that provide water services (and manage storm and wastewater) in each neighborhood, and the organizational linkages or degree of cooperative management that occurs among these organizations. We will also be documenting the structure of local residential and commercial water rates, local stormwater regulations and ordinances, and any additional plans or policies that affect the management and function of the urban water system.

Aside from these local policies, we have plans to continue interviews and collection of policies and planning documents from regional and state water decision-makers. Specific methods and details will depend on our ability to recruit a new doctoral student to work on state/regional policy issues (under the leadership of J. Endter-Wada).

State and Regional Media Content Analysis

Over the next few years, we will collect and analyze data on various aspects of water communication in state and regional media. This will allow us to document how water resource management issues are framed from various vantage points, and highlight perceived vulnerabilities and capacities to respond to change. Our initial efforts are targeting news media, whereas future efforts will assess the communication strategies by governmental and non-governmental entities around water conservation (e.g. Slow-the-Flow Campaign, etc).

In the fall of 2013, we initiated a thorough news media analysis of all six daily papers in Utah (SLC Tribune, Deseret News, Logan's Herald Journal, Ogden's Standard Examiner, Provo's Daily Herald, and St. George's Spectrum). Dr. Courtney Flint is collaborating with Dr. Cathy Bullock to ensure key journalistic parameters are incorporated into data collection, coding, and analysis. Furthermore, this Utah project is coupled with a parallel study led by faculty at Washington State University. This comparative study will help us evaluate how generalizable the Utah findings are across the Intermountain West region.

Pilot investigations and protocol development for data collection methodologies as well as coding and analysis are nearly completed. All water-related print news articles will be acquired using online archives and key word searches. Undergraduate and graduate research assistants will be involved with coding and inter-coder reliability will be assessed statistically. Once coded, the water news media will be analyzed to address research questions including:

- What are the dominant water resource issues or vulnerabilities covered in the print news media?
- Are there variations in the coverage of water issues, either in terms of volume, themes, or tone across the six state newspapers?
- Are local water issues receiving differential coverage or attention across the various news sources and geographic circulation areas?

- Are there particular upstream-downstream relationships articulated in the print news media that would inform water management scenarios or planning efforts?
- What is the network of stakeholders related to water resources as articulated in the print news media?
- Are their particular stakeholders who are deemed through coverage in the print news media to bear more responsibility for water management and risk mitigation or blame for vulnerabilities and problems?

Timeline to Address Design of Social Science Research Protocols:

Ongoing:

1. Develop statistical typology of urban neighborhoods that represent the range of distinctive configurations of urban CBGs across the WRMA[9]; Completed December 2013
2. Use this typology to identify locations for the collection of systematic social science, engineering, and biophysical data: Completed January 2014

Year 2 Activities:

1. A **household survey** of individual water users (densely sampled from neighborhoods that represent diverse urban forms); Survey instrument completed January 2014; Fieldwork data collection initiated March 2014; Completed June 2014
2. Multi-method data collection from **water system managers** (cities, irrigation companies, university campuses) – USWAC survey completed March 2014; qualitative data collection ongoing March – July 2014.
3. Additional qualitative data collection from **regional and state water decision-makers & stakeholders – Ongoing – January 2014-July 2014**
4. Collection of **policy and planning documents** at both the local, regional, state and federal scales – Complete by July 2014.
5. Collection of secondary data from **government records & remote sensing – Collect water use data at parcel scale from municipalities in study neighborhoods (May-July 2014); collaborate with RFA1/RFA3 to determine optimal remote sensing methods to estimate ET**
6. Collection of data from various **statewide and regional media** sources on water issues – Complete May 2014

Recommendation 2 - Show evidence of a tight coupling between social and biophysical sciences through specific initiatives in joint research problems, questions, methodological procedures, and survey instruments.

Research Focus Area 3 of iUtah is intended to link the activities and results of RFA 1 (biophysical science) and RFA 2 (social and engineering science) to gain an understanding of the coupled human-natural water system. The RFA3 work plan includes three focused efforts: (a) coordination of primary data collection on both social and biophysical aspects of water systems; (b) development of formal coupled process models that integrate hydrology, ecology and socio-economic systems; and (c) and engagement

[9] Details available upon request.

with decision-makers and stakeholders to develop visualization and scenario planning tools for water management.

All three foci are guided by an overarching common conceptual framework which is being used to both guide and generate questions and hypotheses about how these components interact and shape the development of coupled systems models (below). The framework was initially developed and proposed by the participants in RFA3, and was then presented to all iUtah participants for their feedback. We are now engaged in a series of small working groups (led by postdoctoral associate Rebecca Hale) across the disciplines and campuses to further refine the framework and discuss the resulting questions and hypotheses in more detail.

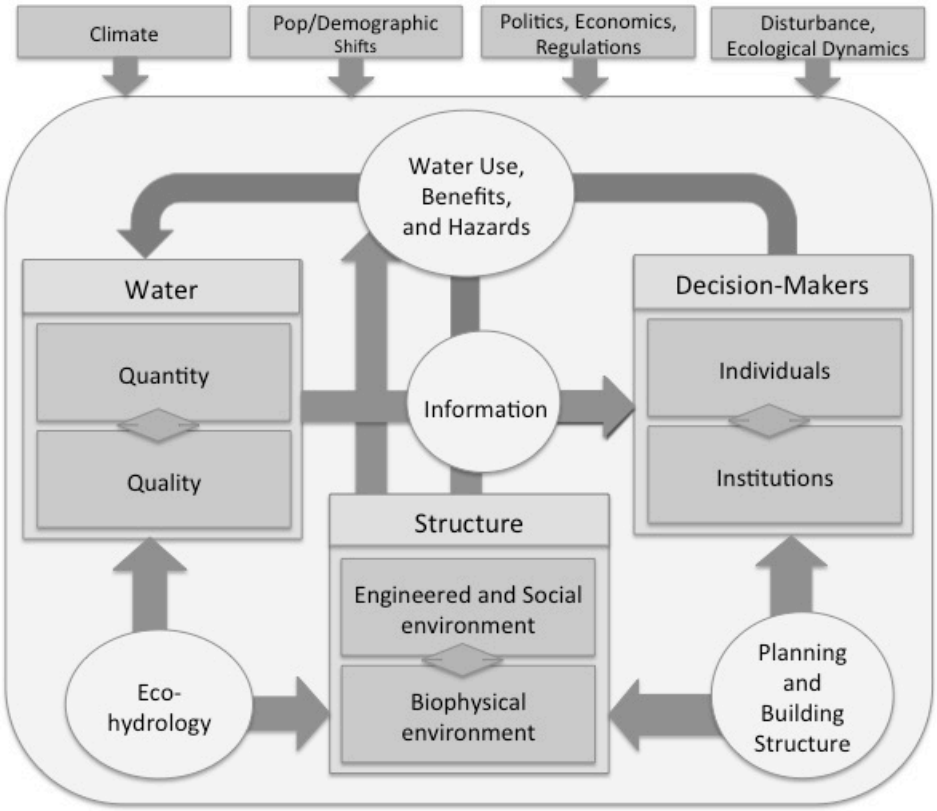


Figure 1: Current Conceptual Model of iUTAH Coupled Biophysical-Social System

Our year 2 process for joint methodology and data collection across the disciplines focuses on coupling social science data with information generated by a network of fixed and mobile instrumentation of hydrologic and ecological parameters within the three GAMUT watershed observatories, our ecohydrological monitoring network. In year 1, we focused on site selection and permitting of fixed GAMUT aquatic and climate stations in or near the three core rivers along the mountain to urban gradient in each watershed. In year 2, we have allocated funds for additional fixed and mobile instrumentation that will be deployed to capture the impacts of different neighborhoods on water quality and water budgets in the urban areas. Neighborhoods are being selected by RFA2 based on a statistical neighborhood typology derived from their combined biophysical and sociodemographic characteristics that we hypothesize influence water processes (described above). RFAs 1 and 2 put out a

joint call for proposals for biophysical instrumentation to be deployed in these neighborhoods. We are currently reviewing these proposals for different types of instrumentation that will capture biophysical variables of interest to both social and natural scientists. In addition, the RFA2 survey instruments are being developed in collaboration with a broad group of scientists across the social and natural sciences interested in social data collection at the household to institutional scales. The survey instruments are still in development as the RFA2 participants receive feedback from researchers in the other disciplines. Hence, both our biophysical and social data collection are being jointly designed across the disciplines in year 2 of our project.

The RFA2 surveys will be conducted in ~3000 households across the study region. We will use stratified random sampling to select a small subset of these households in each watershed and neighborhood type to conduct intensive biophysical sampling coupled with followup interviews in each household. We will measure: 1) household water consumption, 2) outdoor evapotranspiration, microclimate, and soil moisture, 3) outdoor landscaping vegetation types and cover, and 4) outdoor landscape management practices. The iUtah cyberinfrastructure group is developing flow meters to monitor household water consumption for this study. In addition, we will deploy the mobile instrumentation from RFA1 to measure evapotranspiration and microclimate. RFA2 personnel will develop interview questions targeted at outdoor landscaping choices, preferences, and management. This activity is jointly designed by all three RFA's as an integrating activity to understand the coupled human-natural water system in the urbanized watersheds.

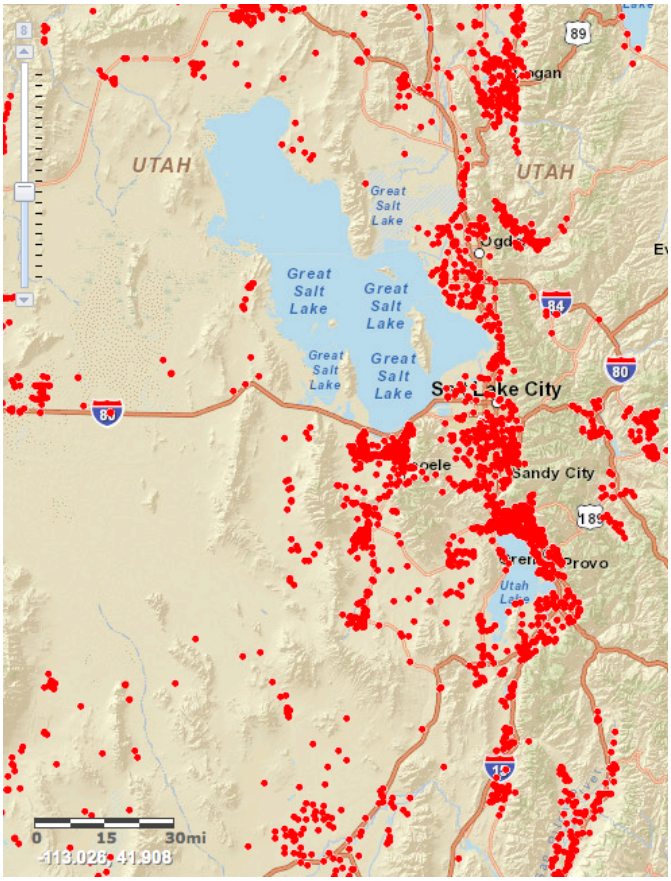
Timeline to Address Coupling of Biophysical Social Science Activities:

1. Finalize plan for and purchase additional urban instrumentation equipment – complete by January 2014
2. Install new fixed instrumentation sites – complete by June 2014
3. Initiate use of mobile instrumentation – April 2014
4. Identify parcels/neighborhoods based on household survey responses for intensive coupled data collection: June 2014
5. Instrument selected households to capture water consumption, outdoor evapotranspiration, micro climate, soil moisture, outdoor vegetation types, and landscape management practices – initiate June 2014, complete by October 2014

Recommendation 3 - Address lack of groundwater expertise.

iUTAH does engage in groundwater research, but made a decision not to invest in physical research infrastructure to instrument groundwater wells, choosing instead to invest in instrumentation for surface water and climate variables. This is because the USGS and other agencies already operate a number of “active” groundwater wells in the Wasatch Range Metropolitan Area (Figure 2). While these wells are not instrumented with real-time data sensors, this system has information useful for water-balance models such as those being developed by the EPSCoR Track-II CI-WATER project. As the research efforts of the CI-WATER award come to a close, iUTAH will engage those faculty interested in applying similar models to the WMRA. Toward that end, **in Year 2, we will organize a workshop among WY EPSCoR, CI-WATER, and iUTAH to identify research synergies and activities that can strengthen our**

understanding of groundwater in iUTAH. Specific aims of the workshop will be to identify gaps in data and understanding of the local ground-water system, and form a research team to write a proposal to the NSF Integrated Earth Systems panel in fall 2014. For those faculty not currently engaged in iUTAH, we hope to attract them to the project using innovation funds available in years 2-3.



One of our recently hired postdocs, Steven Hall (UU), is carrying out research aimed at understanding linkages between the terrestrial and aquatic systems through surface and groundwater flows. He has instrumented several flowpaths in the Red Butte GAMUT with shallow groundwater wells and zero-tension lysimeters, with the aim of measuring nitrogen transport and transformations.

iUTAH graduate students also are engaged in groundwater-related research. In year 1, iUTAH supported Scott Christensen at BYU (advisor Norm Jones) who worked on a program for web-based storage and visualization of groundwater data as part of CI-WATER. In year 2, BYU graduate student Tim Goodsell (advisor Greg Carling) is instrumenting hyporheic flowpaths along the middle Provo River to understand transport and fate of trace metals.

Figure 2. Location of active groundwater sites in the USGS National Water Information System

In Year 3, Bethany Neilson (USU Department of Civil and Environmental Engineering) will recruit a PhD student interested in groundwater-surface water interactions with the aim of measuring gross gains and losses of water along each study watershed. Such information will assist in better interpreting water quality data at GAMUT stations, and will inform water balance models being developed by Court Strong and Steve Burian (UU). Additional graduate students are conducting groundwater-related research. For example UU graduate student Carolina Gomez-Navarro (advisor Diane Pataki) has collected stem water to identify contribution of groundwater to urban plant growth. Similarly, David Bowling (UU) has a new graduate student who is not currently supported by iUTAH but who is interested in water acquisition by plants and may become engaged in similar iUTAH research.

Tap Water Analysis (integrating water losses from input to user's faucet)

In addition to the above activities, we are also measuring sources of urban residential culinary water including: (a) groundwater, (b) river water from nearby montane sources (may or may not have been impounded by a reservoir), or (c) inter-basin transfers (after being impounded by a reservoir).

With limited exception, little is known about:

- "What are the "elevation" recharge regions that contribute to our drinking waters in each of the three watersheds?"
- "What is the "evaporative" history of that drinking water prior to delivery at the consumer's tap?

Tap water collections from May 2013 revealed quite large variations in the isotope ratios of tap water in municipalities of each of the three watersheds. While it seems likely that the montane surface waters supplying each watershed were similar, the evaporation history of water before that tap water was delivered to the consumer was quite different. Some consumers have tap waters that exhibit none to very limited evaporative enrichment, whereas the majority of consumers have water supplies that are evaporated to differing degrees before supplied to the consumer. Some locations within the Cache Valley are supplied with tap waters that show no history of evaporative exposure, whereas most, if not all, tap waters in the Salt Lake Valley reflect different degrees of evaporation prior to delivery to individual households.

The fall tap water sample set greatly advances our preliminary understanding, based on the spring survey, of municipal water isotope ratios in the Salt Lake Valley and their relationship to water sources and distribution in the Valley. Targeted sampling in the fall increased the spatial resolution of our dataset in areas where the spring samples suggested isotopic, and likely water supply, 'discontinuities'. The clearest example existed in the northwest corner of the Salt Lake Valley, in and around the city of Magna, where the most anomalous tap water ratios were documented. Our fall data show that the boundaries of this anomaly are discrete, but do not coincide with known municipality or water management district boundaries, suggesting cross-district water transfer in this region.

The new data also allow us to characterize seasonal isotopic variation across the sampled system, and infer hydrological and management practices that are reflected in this variation. Across most of the Valley tap water ratios remained remarkably stable between seasons, and the dominant difference was a modest decrease in deuterium excess values at ~2/3 of the sample sites. This pattern is consistent with either increased use of, or more likely increased seasonal evaporative losses from, surface water reservoirs supplying water to these sites. A modest number of sites exhibit substantial changes in isotope parameters between seasons, suggesting that managers made major changes in the blend of water from isotopically distinct sources used at these sites.

Timeline for groundwater research:

Ongoing:

1. Analysis and interpretation of tap water isotope data
2. Data collection and analysis on hill-slope flow path

Year 2 Activities:

1. March 2014 – host workshop focused on groundwater (WY EPSCoR, CI-WATER and iUTAH)
2. May 2014 – successfully recruit graduate student to work with Beth Neilson on sw/gw exchange
3. Summer 2014- BYU Student Tim Goodsell completes first field season of sw/gw interaction in Provo River
4. Summer 2014 – UU Post doc Steven Hall completes first field season of N transformation along hill-slope to stream flow paths in Red Butte

Recommendation 4 - Develop a precise set of requirements for contributing data and models to the iUTAH web portal.

Consistent with our proposed Cyberinfrastructure (CI) Plan, we focused in Year 1 on creating the physical computing infrastructure to host the iUTAH Modeling and Data Federation, staffing the CI team, and developing software infrastructure to support data collection in the GAMUT network. We also began inventorying existing datasets and models of interest as well as those that are planned for collection/creation to assist us in identifying requirements for the more general data sharing, data publication, and modeling needs of the different RFAs. These inventories, along with additional communication with the RFA teams, have enabled the CI team to begin scoping the required data sharing and publication software tools for implementation in subsequent project years.

Now that we have more information about the types, quantities, and breadth of data (Appendix 2) to be collected by iUTAH participants, one of the major tasks to be accomplished by the CI team during Year 2 is to draft more specific data management plans for iUTAH facilities such as GAMUT and GIRF, along with policy that addresses not only data created within iUTAH facilities, but also related and derived datasets being created by iUTAH investigators and students.

With regard to primary data collection within iUTAH facilities, our vision is to create high-quality, publicly available data products that are openly available via the iUTAH Modeling & Data Federation website. As an example, the CI team has been working with the RFA1 team to develop the detailed data management plan, workflow, and policy surrounding data created by the GAMUT network. We have made progress for the GAMUT network and anticipate similar efforts as plans for the GIRF and GIRN solidify and move forward. These plans will formalize the specifications and requirements for data to be contributed to the iUTAH Modeling & Data Federation from the iUTAH facilities.

In addition to primary data products produced by iUTAH facilities, however, we also plan to provide data sharing and publication systems within which iUTAH participants can share and publish related and/or derived data products and models. These datasets and models may be products derived from primary datasets collected within iUTAH facilities, but they may also be products derived from outside data sources. While we do not wish to overly constrain what is contributed for sharing and publication by iUTAH participants, we will implement policies that ensure that contributed datasets are relevant, are described with appropriate metadata, and are published using appropriate data and metadata standards.

To this end, we have recently formed an iUTAH data policy committee with representation across RFAs, project leadership, and iUTAH institutions that will assist in developing and maintaining policy related to iUTAH Cyberinfrastructure, datasets, and models. This committee will review the detailed data management plans for iUTAH facilities and will also assist in the development and review of appropriate policies related to non-facility data and models. We anticipate that it will take significant time to develop and agree upon detailed data management plans and policy across the new iUTAH collaboration. We also anticipated as we move forward with the iUTAH project these policies may need to change in response to the needs of iUTAH participants.

Timeline for Developing Requirements for Contributing Data and Models to the iUTAH Modeling & Data Federation:

Ongoing:

1. Formation of iUTAH Data Policy Committee (complete)
2. Formalize the specifications and requirements for data to be contributed to the iUTAH Modeling & Data Federation from the GAMUT network:
    a. Development of strategies for standardization of programming, data collection, and data management across GAMUT sites and watersheds (complete)
    b. Identification of data products to be created by GAMUT (January 2013)
    c. Specification of GAMUT data products that will be contributed to and openly published on the Modeling & Data Federation website (January 2013)
    d. Design of data management, quality assurance, and quality control procedures to be followed for GAMUT data (March 2013)
    e. Specification of time frames within which primary data products from GAMUT will be made available (January 2013)

Year 2 Activities:

1. Draft data policy for non-facility related datasets, including:
    a. Policy and recommendations for assuring compliance with Federal and State privacy regulations
    b. Requirements and procedures for creating metadata
    c. Procedures for uploading and publishing datasets and/or models
    d. Timelines for publication of metadata and data funded by iUTAH
    e. Expectations of data contributors
    f. Data use agreement
    g. Guidelines for citing objects published within the iUTAH Modeling & Data Federation
2. Develop data management plans and policies for additional iUTAH facilities (GIRF and GIRN) as they come online
3. Review existing data policy and revise as needed to support the needs of the iUTAH collaboration (ongoing)

APPENDIX

Appendix 1: Activity * Research Questions Cluster

TABLE 1: Activity * RQ Cluster

	RESEARCH QUESTION CLUSTERS *(domains of social science concepts in italics)*					
DATA COLLECTION ACTIVITY	**Understanding individual water use & decisions**	**Understanding water org mgt & decisions**	**Drivers & obstacles to SW mgt and GI**	**Water Policy & Planning Process**	**Linking urban form / context to ecohydrology outcomes**	**Social values assoc w/ diff water outcomes**
Household surveys	**MAJOR focus** *Attitudes, perceptions, behaviors, social structure & networks*	Minor focus *Attitudes,, perceptions, soc networks, institutional / org factors*	Minor focus *Attitudes, perceptions*		Minor focus *Attitudes, perceptions*	**MAJOR focus** *Attitudes, perceptions, social networks*
Structured data collection from **local water mgt orgs** (KI; possible FG and/or SWAC survey?)	Minor focus *Social networks, Institutional / org factors*	**MAJOR focus** *Attitudes, perceptions, networks, Inst / org factors, built enviro*	**MAJOR focus** *Attitudes, perceptions, networks, inst / org factors*		**MAJOR focus** *Attitudes, perceptions, inst / org factors; built environment*	Minor focus *Attitudes & perceptions*
Structured data collection from **regional/state actors** (KI; possible FG)	Minor focus (e.g. CUP, JWCD)		Minor focus *Attitudes, perceptions, social structure*	**MAJOR focus** *Attitudes, perceptions, social structure*		**MAJOR focus** *Attitudes, perceptions, social networks*
Policy & planning documents (local, regional, state scale)	Minor focus *Law, policy, planning*	Minor focus *Law, policy, planning*	**MAJOR focus** *Law, policy, planning*	**MAJOR focus** *Law, policy, planning*	Minor focus *Law, policy, planning*	Minor focus *Law, policy and planning*
Secondary data from govt records; remote sensing, etc.	Minor focus *Built and biophysical environment*	Minor focus *Built and biophysical environment*	Minor focus *Built and biophysical environment*		**MAJOR focus** *Built and biophysical environment*	
Data on water issues from public & social **media sources**	Minor focus *Attitudes, perceptions, Inst/org factors*	**MAJOR focus** *Soc networks, Inst/ org factors*	Minor focus *Attitudes, perceptions, Inst/Org factors*	Minor focus *Law, policy, planning*		**MAJOR focus** *Attitudes, perceptions, social networks*

Appendix 2: Activity * Research Questions Cluster

Type I - Primary iUTAH Datasets. These include raw sensor data from iUTAH facilities, baseline sampling efforts across iUTAH facilities and sites, and in general datasets collected by iUTAH for the community of iUTAH participants.

1. Metadata for all Type I datasets will be created and submitted within one month of the onset of data collection
2. Automated data streams from iUTAH facilities will be made available in near real time.
3. Quality controlled and derived data products from iUTAH facilities will be published within one year of data collection.
4. All other primary datasets will be published as they become available (e.g., as soon as results are created).

Type II - Datasets for which monetary or material support was provided by iUTAH, but that are created by a specific investigator, student, or iUTAH group to support a particular research question or goal.

1. Metadata for all Type II datasets will be created and submitted within one month of the onset of data creation.
2. Finalized data will be submitted within one year of the completion of data creation activities. Students collecting data must submit their finalized data as a condition of their thesis/dissertation defense.
3. For long running data creation activities (i.e., efforts that last longer than one year), the following will be required:
    a. The initial metadata description will be updated at least once per year.
    b. Preliminary data will be submitted at least every 6 months. Preliminary data will not be released until the dataset is finalized.
    c. Finalized data will be submitted within 2 years of collection or by the end of the project, whichever comes first.

Type III - Type I and Type II datasets that are subject to Institutional Review Board (IRB) restrictions having personally identifiable information or information about human subjects/participants.

1. A plan for collection and release of Type III data should be submitted and approved by the iUTAH Data Policy Committee. The plan should include details of how the data will be anonymized and/or aggregated to a level that is acceptable for distribution to a wide audience of iUTAH participants.
2. Type III datasets will be subject to time requirements described above for Type I and Type II datasets. However, they may require the additional step of anonymization or aggregation as provided by the plan specified in number 1.

Type IV - Datasets procured by iUTAH or iUTAH participants supported by iUTAH that are subject to licensing, copyright, or data use restrictions/agreements from the data source that prohibit general distribution of the data.

1. Metadata for all Type IV datasets will be created and submitted within one month of the onset of data procurement/creation.

2. Type IV datasets will be published as soon as possible (within one month) and to the greatest extent allowable by the licensing, copyright, and/or data use agreements under which they were created/procured.
3. Some Type IV datasets may be permanently restricted.