10th Annual Salt Lake County

Watershed Symposium

November 15-16, 2016

10 Years and Counting, Continuing the Conversation

SALT LAKE COUNTY WATERSHED

Watershed Planning & Restoration
Salt Lake County Government Center
2001 South State Street, Suite N3-120, Salt Lake City UT 84190
(385) 468-6600 | www.slco.org/watershed

Welcome

Ten years and counting, and continuing the conversation on water quality and watershed issues in our region. As host of the annual Watershed Symposium, Salt Lake County welcomes its community of water stewards and environmental advocates.

We have a fantastic lineup of speakers and sessions this year, covering a broad range of topics from general interest to technical. And, in honor of our 10th anniversary, we have a wealth of extras planned. First up, we've expanded the Symposium program to co-host a film screening at The City Library and a full-day workshop on green infrastructure. Keep an eye out for a documentary filmmaker who will be on-site both days to capture a "highlight reel" of the Symposium, including interviews with attendees, behind the scenes, and snippets of the presentations!

We are also introducing a **Watershed Steward of the Year** award. This honor will be given to an individual who is recognized as a watershed hero, who provides leadership and inspires the work of others. Nominated by peers, selected by peers, and celebrated with peers at the Watershed Symposium! Be sure to nominate your choice by 12:00pm on November 16, visit the Interactive Corner or the event website. As an added incentive, everyone who participates will be entered into a drawing to win prizes. The award ceremony and drawing will be held during lunch on November 16. We hope to continue this environmentally emblematic recognition in the years to come.

The Watershed Symposium is a free, two-day conference that is made possible through collaboration with numerous individuals and agencies. We want to thank all of the presenters and volunteers for their willingness to share their time and expertise—this event would not be possible without them. We also thank Salt Lake County Council and Mayor Ben McAdams for their continued support. Finally, a big thank you to the Jordan River Commission and Utah Forestry Fire and State Lands for their support of this year's Symposium through the JRC Large Grants Program.

Enjoy!

Salt Lake County Watershed Planning & Restoration

Take the Symposium survey!
We love feedback.
Available at 2016saltlakecountywatershedsympo.sched.org

Contents

Schedule

View the official event schedule & directory online at https://2016saltlakecountywatershedsympo.sched.org/

Create your personalized schedule!

Complete directory of speakers, attendees, moderators, exhibitors, partners, and staff!

TUESDAY November 15, 2016 — Utah Cultural Celebration Center

8:00-9:00	**Check-in/Registration**	
9:00-9:45	**Welcome & Opening Remarks** Deputy Mayor Lori Bays Salt Lake County — GREAT HALL **Keynote–A Decade of Working Together** Jeff Niermeyer	
	Gallery	**Room 104/105**
9:55 - 10:20	**Persistent Urban Impacts on Surface Water Quality in the Wasatch Front** Rachel Gabor University of Utah	**Leaving the Past Behind: Water Supply Forecasting in the Great Basin** W. Paul Miller Colorado Basin River Forecast Center
10:25-10:50	**Water Quality Summary of the Jordan River Watershed** Sandy Wingert Utah Division of Water Quality	**Groundwater Development and Surface Water: Streamflow Depletion** Lynette Brooks USGS Utah Water Science Center
11:00-11:25	**Quantifying Interactions of Climate and Landscape on Water Resources** Andrew Gelderloos University of Utah	**Do Microbes of the Jordan River, Utah, Yo-Yo Diet?** Jennifer Follstad Shah, Michael Navidomskis, Rose Smith University of Utah
11:30-11:55	**Water Losses in SLC During Warm, Dry Years!** Yusuf Jameel University of Utah	**You Can't Play Soccer in a Perennial Bed!** Paul Johnson Utah State University
12:05-12:30	**Starts With a BBQ: Aligning Citizens with Utah Monitoring Needs** Ellen Bailey, Eli Robinson USU Water Quality Extension	**Jordan River Valley & Water Resources Status in the 2040s & 2090s** Krishna Khatri, Court Strong, Martin Buchert University of Utah Nicholas von Stackelberg Utah Division of Water Quality
12:35-1:00	**What Really Inspires Stewardship? A Case Against Scare Tactics** Michelle Mileham, Anne Terry Tracy Aviary	
1:00-2:00	**Lunch** — GREAT HALL	
2:00-2:55	**Poster Session** — GREAT HALL Lynette Brooks, Jennifer Follstad Shah, Rose Smith, Michael Navidomskis, Ramesh Goel, Andrew Gelderloos, Rachel Gabor, Brian Tonetti, Brittany Van Grouw, David Kimberly, Alexis Nelson, Cora Winters, Cynthia Elliott, Mallory Millington, Jake Wood, Arthur Evensen, Eddy Cadet, Annie Young, Marina Astin, Shoeleh Assemi, Scott Olsen, Stacy Henderson, Hanyan Li	
3:05-3:30	**Environmental Dashboard: Tracking the Health of the Wasatch** Joan Degiorgio The Nature Conservancy Marian Hubbard-Rice Salt Lake City Public Utilities	**Diverse Perspectives on Water from the Salt Lake Watershed** Kent Dean Utah State University
3:35-4:00	**Water is for Fighting! Water Right Adjudications in Salt Lake Valley** Blake Bingham Utah Division of Water Rights	**Provo River Delta Restoration: Suckers, Rollerblading, and More!** Melissa Stamp Utah Reclamation Mitigation & Conservation Comm.
4:05-4:30	**Mirage in the Desert: Data Centers, Water Use and Growth** Weston Wood, Darin Mann Utah Rivers Council	**Revealing Intrinsics of Nitrogen Transformation in Green Infrastructure** Ramesh Goel, Aiswarya Rani Pappu University of Utah
7:00-8:45	**Film Screening** — THE CITY LIBRARY, NANCY TESSMAN AUDITORIUM Join us for the Utah debut of **Return of the River**. This film chronicles the largest dam removal project in the history of the United States, and the extraordinary effort to restore an ecosystem and set a river free. **Post-film Q&A with director Jessica Plumb!** Co-hosted with the Utah Film Center	

posters on display in the Great Hall

evening community event!

WEDNESDAY November 16, 2016 — Utah Cultural Celebration Center

8:00-9:00	**Check-in/Registration**	
9:00-9:35	**Opening Remarks** Robert Thompson Salt Lake County Watershed Planning & Restoration — GREAT HALL **Keynote–The Power of Possibility: Birth of a Movement, Rebirth of our Waterways** Marc Yaggi Waterkeeper Alliance	
	Gallery	**Room 104/105**
9:45 - 10:50	**Beyond the Ivory Tower: University-Stakeholder Partnerships for Utah's Water Future** — GREAT HALL **Panelists** Mark Brunson Utah State University/iUTAH EPSCoR R. Ryan Dupont Utah State University Lewis Kogan Salt Lake City Parks and Public Lands Nicholas von Stackelberg Utah Div. Water Quality Court Strong University of Utah Jason Draper Salt Lake City Public Utilities	**Moderators** Michelle Baker Utah State University/iUTAH EPSCoR Chris Keleher Utah Department of Natural Resources
11:00-11:25	**Integrated Water Resource Management Model for Great Salt Lake Watershed: Part 2** Jeff DenBleyker CH2M Laura Vernon Utah Div. Forestry, Fire & State Lands	**Who Pulled the Plug on Utah Lake: An Ecological Primer** Theron Miller Jordan River/Farmington Bay WQ Council David Richards OreoHelix Consulting
11:30-11:55	**The Great Salt Lake: Water Not Wasted** Ashley Kijowski Utah Division of Wildlife Resources	**Utah Lake Water Quality Study** Scott Daly Utah Division of Water Quality
12:05-12:30	**Great Salt Lake, Who Lives Here?** Christopher Bittner Utah Division of Water Quality	**Anthropogenic Impacts on the Utah Lake Ecosystem Using GIS Spatial Analysis** Weihong Wang Utah Valley University
12:35-1:00	**Considering the 3rd Pillar of Water Demand & Conservation: Economics** Gail Blattenberger, Gabriel Lozada Univ. of Utah Zach Frankel Utah Rivers Council	**Utah Lake Eutrophication: Role of Sediment-Water Column Interactions** Ramesh Goel, Anwar Alsanea University of Utah
1:00-2:00	**Lunch** — GREAT HALL **"Watershed Steward of the Year" Award Ceremony & Prize Drawing**	
2:00-2:25	**The Business of Water: Lessons from Coca-Cola Watershed Replenishment** Meagan Knowlton Swire Coca-Cola, USA	**Identifying Contributing Factors to Utah Lake Algal Blooms** Carly Hansen University of Utah
2:30-2:55	**Phased Reclamation at Jordan River, Midvale Utah** Erna Waterman US EPA - Region 8	**Spatiotemporal Variability of Cyanobacterial Harmful Algal Blooms** Jennifer Graham U.S. Geological Survey
3:05-3:30	**The Jordan River…Size Matters** Robert Thompson Salt Lake County Watershed Tom Ward, Lewis Kogan Salt Lake City	**Cyanotoxins and Cell counts: Managing Risk When Cyanobacteria Bloom** Theron Miller Jordan River/Farmington Bay WQ Council
3:35-4:00	**Land Use Changes and Implications for Forest Service Management** Charles Condrat USDA Forest Service	**Birds Provide Insight for Stewardship of Urban Riparian Areas** Cooper Farr Tracy Aviary
4:05-4:30	**Landscape Lab: Merging Science & Design for a Landscape of Learning** Sarah Hinners, Brenda Bowen University of Utah Laura Bandara VODA Landscape + Planning	**Retrofitting Urban Streets to Green Streets: Lessons Learned** William Harris Bio Clean Environmental/Forterra

offered in conjunction with the Symposium

Green Infrastructure Making it Work
Friday, November 18
8:30am-5:00pm

This training will give participants the tools to implement green infrastructure–beyond the basics–through on the ground case studies and experiences from communities across the Wasatch Front, and the globe.

http://jordanrivercommission.com/training/

Co-hosted with Jordan River Commission and Nature Works Alliance

Hosted annually by Salt Lake County Watershed Planning & Restoration
www.slco.org/watershed

SALT LAKE COUNTY WATERSHED

Updated November 11, 2016
(subject to change)

Welcome & Opening Remarks

Lori Bays, Deputy Mayor
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Robert Thompson
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Keynotes

A Decade of Working Together

Jeff Niermeyer
Salt Lake City UT
jeffnier@outlook.com

In the Watershed Symposium inaugural keynote, Niermeyer will focus on the importance of continued collaboration to address the many different issues and interests of many stakeholders that are present in our watersheds, recognizing the value of the 10 years of history of the Salt Lake County Watershed Symposium in this collaboration.

The Power of Possibility: Birth of a Movement, Rebirth of our Waterways

Marc Yaggi
Waterkeeper Alliance, New York NY
myaggi@waterkeeper.org | http://waterkeeper.org/

In this inspirational speech, Yaggi shares a moving story about birth and rebirth, the power of citizen action, and the power of possibility, with a roadmap of how citizens can seize and control the destiny of their communities and waterways around the world. This speech spans from the 1800s to present day in order to paint a picture of our past and foretell a future where engaged citizenry can and must protect their home for future generations.

Plenary Session

Beyond the Ivory Tower: University-Stakeholder Partnerships for Utah's Water Future

Panel:

Mark Brunson
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Jason Draper
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R. Ryan Dupont
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Nicholas von Stackelberg
Utah Division of Water Quality, Salt Lake City UT
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Court Strong
University of Utah, Department of Atmospheric Science, Salt Lake City UT
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Moderators:

Michelle Baker
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Chris Keleher
Utah Department of Natural Resources, Salt Lake City UT
christopherkeleher@utah.gov

This panel, composed of representatives from academia and their non-academic partners, will highlight successful university-stakeholder partnerships covering a range of research, education, and outreach efforts on vital water issues in our state. Using the iUTAH project as an example, panelists will share lessons learned from their successes and failures at bridging the divide between academia and "the real world;" discuss the challenges and rewards of combining practical on-the-ground knowledge, professional expertise, and diverse stakeholder perspectives with basic and applied institutional research; and explore opportunities for new partnerships to advance societally relevant "Science for Utah's Water Future."

Breakout Sessions (listed alphabetically by title)

An Integrated Water Resource Management Model for the Great Salt Lake Watershed: Part 2

Jeff DenBleyker
CH2M, Taylorsville UT
jeff.denbleyker@ch2m.com | www.ch2m.com

Laura Vernon
Utah Division of Forestry, Fire & State Lands, Salt Lake City UT
lauravernon@utah.gov

Is Great Salt Lake drying up? How might forecasted population and economic growth in Northern Utah change water levels in the lake? How might an extended drought affect the lake? What does that mean to Great Salt Lake's natural resources, the economic and ecological benefits that are derived from them, and the people who live near its shores? These are all questions the State of Utah has been grappling with that this project hopes to help begin to answer. A recurring challenge for State regulatory and resource agencies is defining and understanding how variable precipitation and water management in Great Salt Lake's watershed can influence the lake's water levels and salinity and subsequently the resources the lake supports. State agencies have not had an effective tool at their disposal that integrates available information to better understand these issues and support sustainable management of Great Salt Lake resources–until now. At last year's Symposium, we discussed the need and objectives for an integrated water resources management model. Since then, the project team has been hard at work developing the model and is nearing completion. This presentation will provide a brief overview of the model objectives but will focus upon how the model was developed and will be used. The model should be ready for use by early 2017. This model will allow State agencies to understand the lake's drivers of change, understand the potential changes and risks Great Salt Lake and its resources may encounter, incorporate these findings into planning efforts, and sustainably manage the lake's economic and ecological resources

Topic(s): Water Quantity/Flow, Climate Change

Anthropogenic Impacts on the Utah Lake Ecosystem using GIS Spatial Analysis

Weihong Wang
Utah Valley University, Orem UT
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Utah Lake is the largest freshwater lake in the United States west of the Mississippi River. Utah Lake and its surrounding wetlands are critical for fish and wildlife resources, flood mitigation, and recreation. However, the ecosystem is under increasing stress due to urban, industrial, and agricultural runoff from an expanding population that now exceeds 500,000 people in Utah Valley. Different types of land use, such as animal farming, mining, and agricultural activities, have impacted Utah Lake water quality significantly. In this project, I propose to use historical images of the Utah Lake ecosystem and available water quality data for Utah Lake to access how land use has changed over time, how these human related activities have affected water quality, and track various pollution sources to Utah Lake. The historical images sourced from Google Earth, Landsat imagery and high resolution LiDAR data will be used to evaluate the land use change around Utah Lake using GIS (Geographic Information System) spatial analysis techniques. In addition, water quality data from previous research projects I was involved in will be used in the mapping process to track water pollution sources to Utah Lake over time. Upon completion of this project, I will be able to: 1) Map how land use and population have changed around Utah Lake since pioneer settlement; 2) Spatially assess the pollution sources to Utah Lake, and 3) Suggest how to change and manage the current land use around Utah Lake in order to protect Utah Lake water quality. This project will provide useful maps and visualizations of spatial information of human impacts on the Utah Lake ecosystem. Utah faces a future that includes population growth and climate change, both of which potentially influence the region's hydrologic system and therefore can affect water availability and quality necessary for human consumption and use. This project will help us to understand how anthropogenic activities have impacted the Utah Lake ecosystem visually, and provide insights for state agencies to implement meaningful water and land-use management plans in the region.

Topic(s): Water Quality

Birds Provide Insight for Stewardship of Urban Riparian Areas

Cooper Farr
Tracy Aviary, Salt Lake City UT
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Our riparian areas are important and complex components of Salt Lake County's urban mosaic, and they provide benefits to both human and animal inhabitants. Multiple streams, creeks, and the Jordan River supply resources, ecosystem services, recreational opportunities, and access to natural spaces for Salt Lake County residents, and these waterbodies also yield critical habitat for our urban bird communities. However, urban riparian areas are heavily impacted by diverse human uses and historic disturbances, which create complex consequences to river and stream health. Since 2011, Tracy Aviary's citizen science program has developed and implemented a series of participatory bird monitoring projects in urban riparian areas throughout the Salt Lake County Watershed. Our projects include diverse objective, partners, stakeholders, and geographic locations, but they all investigate avian use of urban riparian habitat. Patterns of bird occurrence, distribution, and community composition can serve as important indicators of watershed quality and overall ecosystem health, and data we have collected over the years have increased our understanding of local avian ecology, best management practices, and how to balance competing objectives for our region's riparian areas.

Topic(s): Conservation/Restoration

Considering the 3rd Pillar of Water Demand & Conservation: Economics

Zachary Frankel
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Dr. Gail Blattenberger
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News headlines often echo predictions that Utah is running out of water because our population is growing so quickly. Utah water suppliers say there is $32 billion needed for water infrastructure repair and replacement for Utah's growing population amid an aging water delivery system in need of repair. State and local governments are investing in numerous proposed water projects, at times generating significant controversy. But who will pay for these water investments and what, if any, impacts will there be to our water rates? In this workshop, we explore a partnership between a Utah nonprofit organization and a community of academic PhD economists who prepared an economic analysis focusing on the expected water rate increases which would accrue from the largest proposed diversion of the Colorado River: the Lake Powell Pipeline. The workshop examines basic concepts of commodity supply and demand, the elasticity of water rate price upon future water demand and how this information is being used by the public, water suppliers and the State of Utah. We also explore why the economics of water use are so often ignored in water policy and water conservation discussions.

Topic(s): Policy & Law, Water Quantity/Flow, Conservation/Restoration

Cyanotoxins and Cell Counts: Managing Risk When Cyanobacteria Bloom

Theron Miller
Jordan River/Farmington Bay Water Quality Council, Salt Lake City UT
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The recent cyanobacteria bloom on Utah Lake and the accompanying never-ending DWQ and media blitzkrieg has done an effective job in razing public interest and even hysteria in the occurrence of these blooms. This activity has brought out the best and worst of mobilizing agency response and the actual actions that were taken. Lake-side businesses were closed in addition to the hit on ancillary recreational outlets that normally accompanies a summer on Utah Lake. Moreover, these actions stymied our farmers ability to raise valuable local crops and may ultimately affect the farmers' ability to market their goods as the nightly news prattled on and lake closure continued day after day. This Aphanizomenon bloom provides a great example why a more thoughtful, scientific and measured approach to managing human risk is warranted.

Topic(s): Water Quality, Policy & Law

Diverse Perspectives on Water from the Salt Lake Watershed

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Utah is experiencing rapid growth and socio-economic change. When you couple this growth with the fact that Utah is the second driest state in the nation, it is clear that there are a number of critical water resource challenges facing the state. As Utah's major metropolitan area, the Salt Lake Watershed faces these salient water challenges, and better understanding of diverse perspectives on water issues is integral to effective water governance in coming years. This presentation draws on findings from multiple research efforts conducted by the iUTAH water project to ascertain the level of alignment among water related perspectives across different communities, groups, and vantage points. The iUTAH (innovative Urban Transitions and Aridregion Hydro-sustainability) Project is a federally funded effort designed to build capacity to understand Utah's mountain-metro water system and provide key information to decision makers. iUTAH social science research prioritizes the assessment of diverse perspectives on water. Interviews conducted with both professional and public stakeholders illuminate an array of water attitudes and experiences. While there is some common ground, this assessment highlights disconnections that may make setting and implementing local water priorities challenging. A more scientific-oriented discourse was found among professionals who portrayed more complex understanding of water systems. The more abstract discussions of water among public stakeholders who drew upon more personal experiences and observations reveal that public priorities do not always align with the same level of specificity as those articulated by local leaders and resource managers. These findings on how various stakeholders articulate water related issues are key to understanding collaborative potential within and

across the Salt Lake Watershed. Concerns about water supply and infrastructure in light of growing populations and climate change, varying local experiences with water quality incidents and flooding hazards, and maintaining highly-valued water recreation opportunities are all part of water-related discourse across the Salt Lake Watershed.

Topic(s): Conservation/Restoration, Education/Outreach, Water Quantity/Flow

Do Microbes of the Jordan River, Utah, Yo-Yo Diet?

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The Jordan River, a 58-mile, 4th order urban river traversing the Salt Lake Valley from Utah Lake to the Great Salt Lake, suffers from low dissolved oxygen, periods of high water temperature, and loading of organic matter and nutrients. Elevated temperature and abundant energy and nutrients stimulate microbial respiration, which consumes oxygen. We are studying microbial community response to potential variation in temperature and the supply of energy and nutrients at twelve locations along the river in order to better understand whether different management actions are appropriate at certain locations or timepoints. Variation in temperature and resource supply may occur as a result of discharge from point sources (i.e., water reclamation facilities and tributaries) and seasonal change in hydrology or autotroph production. We are measuring water chemistry and quantifying elemental content ratios, stable isotope signatures, and fluorometry of organic matter from the water column and sediments to infer the source of organic matter and its quality. We also are assessing rates of microbial ecoenzyme expression associated with the acquisition of nutrients or carbon to infer whether microbial communities exhibit maximum rates of activity or if they are limited by energy or nutrients. We present preliminary study results summarized after two of our three sampling campaigns, planned for spring, mid-summer, and late fall of 2016. Our sampling efforts occurred before (late May) and during (early August) the harmful algal bloom (HAB) that afflicted the Jordan River this year.

Topic(s): Water Quality

Environmental Dashboard: Tracking the Health of the Wasatch

Marian Hubbard-Rice
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Joan Degiorgio
The Nature Conservancy, Salt Lake City UT
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The Environmental Dashboard will be a tool for the public and decision makers to track the environmental health of the Central Wasatch and evaluate impacts in future planning discussions. It is the intention of the Mountain Accord that the Dashboard is a legacy project and will be updated on a regular basis. It will be scientifically based, data rich, and technically credible. Step I of the Dashboard is in progress and will compile data currently collected throughout the Central Wasatch Mountains in a way that provides a picture of the complete health of the mountain range, as well as a mechanism for measuring the health moving forward. Step II of the Dashboard will include an online connection for people interested in tracking the progress of key indicators. This presentation gives an overview of the development of the Dashboard and where we are today.

Topic(s): Conservation/Restoration, Education/Outreach,

Great Salt Lake, Who Lives Here?

Chris Bittner
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In the 2012 Great Salt Lake Water Quality Strategy, the Utah Division of Water Quality proposed a road map for continued protection of the Lake's water quality. One of the specific goals of the Strategy is the development of numeric criteria, or maximum allowable pollutant concentrations. The first step to develop numeric criteria is to know the specific organisms that comprise the ecosystem to be protected. To help meet this goal, an aquatic life use workshop for Great Salt Lake was held in March, 2015. Scientists who study the Lake were invited to share their data regarding aquatic life surveys on the Lake and that was compiled along with the available data from the published literature. In addition to the specific species data, collocated salinity data was also recorded. Several key data gaps were identified including experimental data regarding salinity tolerances, benthic macroinvertebrates (aka, sediment bugs), and fish populations. The presentation will summarize the results and key data gaps identified. The report and database are available at http://www.deq.utah.gov/locations/G/greatsaltlake/gslwaterquality/index.htm.

Topic(s): Water Quality

Groundwater Development and Surface Water: Streamflow Depletion

Lynette Brooks
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Groundwater and surface-water resources are often connected. Much has been written about the effects of groundwater development on surface water, and new tools are available to simulate and quantify these effects. In this study, a numerical groundwater flow model was used to prepare capture maps to illustrate the connection between groundwater development and surface water. Capture maps show the amount of surface-water depletion caused by a well at any location in the model domain and can be used by water managers to assess the impacts of groundwater development. The first part of this presentation gives a brief synopsis of the source of water to wells and common misconceptions about surface-water depletion. The second part presents the development and analysis of capture maps for a basin dominated by surface-water features. Rather than analyzing depletion in only one river or spring, this work uses one set of capture simulations to determine the effects of groundwater development on 11 segments along two rivers, 30 springs, 13 areas of field drains, and 3 areas of evapotranspiration of groundwater. The presentation concludes with a discussion of the implications of the capture maps and suggestions on how this type of analysis can be used by water managers.

Topic(s): Water Quantity/Flow, Conservation/Restoration

Identifying Contributing Factors to Utah Lake Algal Blooms

Carly Hansen
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This past summer saw one of the largest toxic algae blooms in the region's recent history spread from Utah Lake and along the entire stretch of the Jordan River. The large amount of biomass and presence of toxins affected local recreation, and several communities who were forced to shut off their secondary water supply which comes from the Jordan River. The magnitude and extent of the bloom led to widespread concern and raised a number of questions including: What caused the bloom? Were there any warning signs? Which areas were affected the most? What were conditions like throughout the water system? In order to address these questions and better understand what happened with this and other blooms in the region, we calibrate several lake-specific models using historical data for chlorophyll-a (an indicator of algal biomass) and satellite-measured reflected radiance from the surface of the lake, and apply the models to the Utah Lake and Great Salt Lake region. We then identify regions of the system which have been historically particularly susceptible to blooms through classification and geospatial statistical techniques. A number of climate factors (including air temperature, wind speed and direction, and precipitation) and lake characteristics, such as lake levels and nutrients are evaluated to determine whether these factors may

have contributed to the large algal bloom of July 2016, as well as past blooms. This application of remote sensing provides valuable opportunities for enhanced visualization and knowledge of the magnitude and extent of blooms in the region. Additionally, an improved understanding of the conditions/factors which cause algal blooms and the locations which are likely to be affected in the future may benefit water quality monitoring and management agencies in the area.

Topic(s): Water Quality

Jordan River Valley & Water Resources Status in the 2040s & 2090s

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One of the major challenges faced by local municipal authorities and regulators in the US is developing a future implementation plan to protect water availability (i.e., water quantity and quality) and attain Total Maximum Daily Load (TMDL) considering uncertain future change drivers including climate change, land use changes, population growth and other water management practices. In this presentation, we consider a case study of the Jordan River and its tributaries, a watershed which encompasses mountainous headwaters that supply water to a highly urbanized valley with irrigation canals, stormwater and treated wastewater return flows. We present our research findings in four areas by a group of multidisciplinary experts on: (a) Climate change and climate variability: what are the major climatic parameters that will have significant changes in their magnitude, and how will these changes in climate impact water resources in the Jordan valley? (b) Land use and land cover changes in Jordan valley: (i) how will land use and land cover change in the valley based on socio-economic drivers? (ii) How land use and land cover will change in the valley if we consider Wasatch Choice 2040 – the shared regional vision established by Wasatch Front communities? (c) Hydrological impact: (i) what will be the impact of the climate change and land use on water availability in creeks that are the major sources of water supply for the valley? (d) Water quality impact: (i) what will be the impact of future climate, land use changes and population growth on nutrient loading and dissolved oxygen levels in different sections of the Jordan River. The results are based on our coupled modeling work: (i) dynamically downscaled regional climate model (Weather Research and Forecasting; WRF) output at 4-km horizontal resolution and hourly time step covering Utah State for 1985 to 2010, and in the decades of 2040s and 2090s; (ii) A probabilistic equilibrium land use model for 2040, and the regional land use vision embodied in in Wasatch Choice 2040; (iv) The HSPF model (Hydrologic Simulation Program-Fortran) - calibrated and validated based on the stream flow data available from 1993 to 2006, and simulated for decades 2040s and 2090s considering the future changes. This body of research is an example of integrated and coupled modeling for watershed science in the face of variability, uncertainty and complexity. This holistic modeling approach and results will be helpful in analyzing water availability and water quality in Jordan River Valley for periods of time to the end of the current century, and will support development of rational watershed plans to protect vulnerable water resources.

Topic(s): Climate Change, Water Quantity/Flow, Water Quality

Land Use Changes and Implications for Forest Service Management

Charles Condrat
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The presentation would show examples of changes in land use using historic aerial photos of Alta/Snowbird, mouth of Little Cottonwood, and perhaps the Draper area. It would show the transition from a rural to urban interface between Forest Service and non-Forest lands and how this affects the way we manage Forest lands.

Topic(s): Conservation/Restoration

Landscape Lab: Merging Science & Design for a Landscape of Learning

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Many so-called sustainable solutions to the challenges of urban systems rely on across-the-board application of a set of "best practices" which are often developed elsewhere and may or may not have been rigorously tested or monitored. Such best practices are probably an improvement over the alternative conventional practices, in that they probably do less ecological damage, however we believe there is a better way to engage in landscape and urban design that tests best practices in situ, and offers the opportunity to innovate and generate knowledge, shortening the time lag between research and application. We present a landscape transformation project, the Landscape Lab, on the University of Utah research campus on Red Butte Creek, that has been developed as a collaborative design project between university research faculty and landscape architects. The goal of this merging of scientific and design processes is to create a landscape that is beautiful and engaging, ecologically revitalized, and that serves to build our pool of understanding about ecological restoration and water management in urban landscapes in our unique climate of northern Utah. We will discuss the unique challenges of this merged process, and the considerable potential it holds for changing the way we shape our built environment. Participants will learn about some of the primary challenges and barriers to creating sustainable urban landscapes in Utah, and opportunities to overcome these by forging new partnerships between different disciplines.

Topic(s): Conservation/Restoration, Green Infrastructure, Water Quantity/Flow

Leaving the Past Behind: Water Supply Forecasting in the Great Basin

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The National Oceanic and Atmospheric Administration's (NOAA's) Colorado Basin River Forecast Center (CBRFC) provides forecasts of water supply conditions to resource managers throughout the Eastern Great Basin regions using Ensemble Streamflow Prediction (ESP) methods that are largely driven by historical observations of temperature and precipitation. Currently, the CBRFC does not incorporate climatic information, such as teleconnections (e.g., the El Niño Southern Oscillation [ENSO]), into the development of its streamflow ensembles; further, as the impacts of climate change are realized, the past may no longer be representative of future conditions. To address these issues, the CBRFC is investigating the incorporation of a Stochastic Weather Generator (SWG) developed by the University of Colorado. Additionally, numerous agencies issue climate outlooks that describe the probability that a region with experience warmer, normal, or cooler conditions with regards to temperature and wetter, normal, or drier conditions with regards to precipitation. Research published by the University of Colorado has shown that a SWG weighted by probabilities related to the ENSO may improve forecast skill in the San Juan River Basin, as well as other regions outside of the Colorado River Basin. In this study, the SWG is applied within the Great Basin and weighted using climate probabilities developed by the National Weather Service's Climate Prediction Center. The ensemble of streamflow events developed using the SWG is then compared to historical ensembles used in the forecast of water supply over the region.

Topic(s): Water Quantity/Flow, Climate Change

Mirage in the Desert: Data Centers, Water Use, & Growth

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Data centers have a history of generating controversy in Utah, particularly in regard to the water and tax benefits that sustain them. In 2014, the Utah Legislature threatened to cut off the NSA Utah Data Center's water supply after public records revealed the data center is using more water than its host town of Bluffdale. This year, after weeks of secrecy over its location, the proposed Facebook data center is slated for West Jordan City where it will enjoy millions of dollars in tax breaks and rely on millions of gallons of water per day. These actions provoke a series of questions this workshop will explore including: Given drought and the high water usage of these data centers, what is the current state of water scarcity in Utah in regard to supply and usage? Do tax policies enable and/or increase their high water consumption? What impacts to our watersheds do these data centers and the practices that sustain them have? We will also examine exactly how much water these data centers use compared to other municipal and agricultural water uses.

Topic(s): Policy & Law, Water Quantity/Flow, Green Infrastructure

Persistent Urban Impacts On Surface Water Quality in the Wasatch Front

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Growing population centers along mountain watersheds put added stress on sensitive hydrologic systems and create water quality impacts downstream. We examined the mountain-to-urban transition in watersheds on Utah's Wasatch Front to identify mechanisms by which urbanization impacts water resources. Rivers in the Wasatch flow from the mountains directly into an urban landscape, where they are subject to channelization, stormwater runoff systems, and urban inputs to water quality from sources such as road salt and fertilizer. As part of an interdisciplinary effort within the iUTAH project, multiple synoptic surveys were performed and a variety of measurements were made, including basic water chemistry along with discharge, water isotopes, and nutrients. Red Butte Creek, a stream in Salt Lake City, does not show significant urban impact to water quality until several kilometers after it enters the city where concentrations of solutes such as chloride and nitrate more than triple in a gaining reach. Groundwater springs discharging to this gaining section demonstrate urban-impacted water chemistry, suggesting that during baseflow a contaminated alluvial aquifer significantly controls stream chemistry. By combining hydrometric and hydrochemical observations we were able to estimate that these groundwater springs were 17-20% urban runoff. We were then able to predict the chemistry of urban runoff that feeds into the alluvial aquifer. Samples collected from storm culverts, roofs, and asphalt during storms had chemistry values within the range of those predicted by the mixing model. This evidence that urbanization affects the water quality of baseflow through impacted groundwater suggests that stormwater mitigation may not be sufficient for protecting urban watersheds, and quantifying these persistent groundwater mediated impacts is necessary to evaluate the success of restoration efforts. By comparing these results from Red Butte Creek with similar studies from other rivers in the Wasatch Front and other alluvial systems, we can quantify how characteristics such as discharge patterns and land-use determine alluvial recharge controls on surface water quality.

Topic(s): Water Quality

Phased Reclamation at the Jordan River, Midvale Utah

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Jordan River riparian restoration was conducted as part of the final remedy for the Midvale Slag Superfund Site. Phase I of the riparian restoration called for the replacement of a damaged and dangerous sheet pile dam that was built to maintain river bank stability for the portion of the Jordan River running adjacent to the Site. The dam reduces bank erosion and prevents the release of buried contaminants into the river and other adjacent properties. A river energy/flow survey of was conducted to develop a two-dimensional model to evaluate the hydraulic characteristics of the river at different stream flows. The model allowed EPA to determine where the highest velocities occurred and indicated areas susceptible to erosion and/or migration of stream flows out of the current channel. The model also provided water-surface elevations throughout the reach for various streamflows and aided in planning where increased cross sectional areas were needed and where to install velocity abatement structures. Information obtained from the model was used to curb the effects of erosion and strengthen the stability of the cap for the Midvale Site. In addition, two doctorate summer interns were hired to conduct detailed soil and weed studies for information used for planning future phased work. Phase 2 of the riparian effort included replacing debris/weeded areas with native plants, and some armoring. This Phase included outreach to the community on a variety of projects including education, building bridge abutments for future pedestrian bridges to be built by the city and developers, weed mitigation, pedestrian trail expansion, and improved river access for recreational use. Additionally, Phase 2 included opening up the river up-stream to slow the flow to reduce potential damage downstream. Phases 4 and 5 were a continuance of earlier phases making adjustments. The reclamation portion of the Superfund work was conducted using Veteran Owned Small Business and Minority Owned Small Business as well as task specific grants to Salt Lake County and the USGS. In short, the work conducted was cost effective using mostly local resources.

Topic(s): Conservation/Restoration, Education/Outreach, Green Infrastructure

Provo River Delta Restoration: Suckers, Rollerblading, and More!

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Although the Provo River is not located within Salt Lake County, it serves as a major drinking water source for Salt Lake County residents. It is also the largest tributary to Utah Lake, which feeds Salt Lake County's largest river. Since European settlement in the 1800's, both Utah Lake and the Provo River have been affected by water development and river management projects involving the construction of dams, water diversions, pipelines, dikes, and pumping systems. These alterations to the river and lake ecosystem have impacted the endangered June sucker (Chasmistes liorus) which occurs naturally only in Utah Lake and spawns primarily in Provo River. As recent water development projects have been planned and constructed, commitments have been made to aid in the recovery of the June sucker. The Provo River Delta Restoration Project (PRDRP) will address several of these commitments by restoring a more natural delta ecosystem essential for a healthy June sucker population. Currently, June sucker recruitment is severely limited in part because of degraded rearing habitat. The PRDRP will redirect the lower 1.5 miles of the lower Provo River channel into a restored delta while still preserving the existing lower river channel as a recreational amenity. The delta restoration will remove artificial levees, re-connect the river and lake with adjacent wetlands, restore natural fluvial processes and ecological conditions, and re-establish and reconnect habitats. Restored rearing habitat will support juvenile June sucker until they are capable of surviving in the larger open water environment of Utah Lake. Another major component of the PRDRP will be to enhance and expand recreation opportunities in the area. Currently, the Provo River Parkway Trail along the lower existing river channel receives heavy recreational use for activities including fishing, rollerblading, jogging, and biking. The PRDRP includes commitments to preserve and enhance the recreation experience along the existing lower river channel by providing minimum instream flows and installing an aeration system to improve water quality. The PRDRP will also develop new trailheads, viewing towers, and additional trails around the restored delta area. These recreation features are being designed in close coordination with numerous stakeholders including Utah County, Provo City, and Utah Lake State Park. The PRDRP is a joint effort of the June Sucker Recovery Implementation Program, the Utah Reclamation Mitigation and Conservation Commission, the U.S. Department of Interior's Central Utah Project Completion Act Office, and the Central Utah Water Conservancy District. A Final Environmental Impact Statement and Record of Decision were published for the project in April and May of 2015, respectively. Currently, property for the project is in the process of being acquired and detailed designs for the delta area and various recreation features are being developed. Project construction is anticipated to begin in 2018. This presentation will familiarize listeners with the PRDRP, highlight the

watershed connections between Provo River and Salt Lake County, and provide insights into the complexities and groundwork involved in implementing large-scale restoration projects.

Topic(s): Conservation/Restoration, Water Quality, Water Quantity/Flow

Quantifying Interactions of Climate and Landscape on Water Resources

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Growing populations and a changing climate are creating an uncertain future for water resources in the Western United States, including Salt Lake City and all of Utah. Planning for future population and climate conditions requires quantifying differential sensitivity of hydrologic partitioning to changes in climate. To address this challenge we ask: How do landscape characteristics influence the partitioning of precipitation into streamflow and plant available water along the Wasatch Front? And can historical observations of climate and streamflow provide inferences to the differential sensitivity of local watersheds to changes in climate? The seven watersheds along the Wasatch Front (City Creek, Red Butte, Emigration, Parley's, Millcreek, Big Cottonwood, and Little Cottonwood) provide an excellent research area to answer these questions. These watersheds are not only important to the Salt Lake area, providing over half of its water supply, but also have over 100 years of climate and streamflow response data to study the how the water balance is influenced by landscape. Additionally, there are many landscape differences between the watersheds: ranging in size from 19 km2 to 127 km2, in mean elevation from 1960 m to 2610 m, in mean slope steepness from 20° to 27°, in predominant slope aspect either north-facing or south-facing, in the type of soils present, and in the predominant bedrock geology. Mean annual precipitation (790 mm to 1290 mm) and temperature (3.3°C to 6.9°C) vary primarily as a function of catchment elevation. Between 1900 and 2014 the average annual temperature across all watersheds has increased by 0.91°C, with most of the change occurring during the last fifty years. During the same time there has been no significant change in the amount of annual precipitation. Mean annual streamflow, normalized by catchment area, ranges from 150 mm to 820 mm with annual precipitation explaining between 43%-72% of the annual variability in streamflow. Surprisingly, the remaining variability is not correlated to annual or seasonal temperature even though the catchments have experienced notable warming. Instead, inter-annual variability in streamflow and water yield is significantly related to the rate of snow melt and the amount of subsurface storage in the watershed (derived from winter baseflow) in addition to the amount of annual precipitation. Specifically, higher antecedent baseflow and faster snowmelt both result in a preferential partitioning of precipitation to streamflow. This implies that the effects of a warming climate on the water resources of the seasonally snow dominated watersheds near Salt Lake City can be best understood through the context of the melting snowpack. Further, climate extremes, such as inter-annual drought, may leave a legacy effect on the subsurface storage in some watersheds, causing a delayed streamflow recovery in the years following the drought.

Topic(s): Climate Change, Water Quantity/Flow

Retrofitting Urban Streets to Green Streets: Lessons Learned

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Stormwater planter boxes and biofiltration systems are a sustainable stormwater Best Management Practice option for use in "Green Street" retrofit applications and roadway improvements projects. Applying stormwater flow-through planter boxes that are designed to capture and remove stormwater runoff pollutants conveyed in public streets poses a difficult challenge for many Green Street project designers, landscape architects and civil engineers. Conventional design regimens for stormwater planter box systems typically require large areas of space along sidewalks and curb areas so as to properly convey a design volume of runoff for capture and infiltration inside flow-through biofiltration systems in the public right-of-way. In high-density areas, there are typically little or no opportunities to place stormwater planter box systems along roadways or sidewalks due to existing infrastructure and underground utilities. This presentation provides civil engineers, planners, landscape architects, designers, and project developers with various alternative space-saving solutions to applying smaller, more compact "Green Street" flow-through planter boxes and Tree Box Filters where and when available space is limited in a public roadway or street. Specific project examples using space-saving stormwater planter box systems will be provided along with

detailed information on the proper design, components, installation and costs for applying stormwater planter box systems. Attendees will learn the difference between planter box system types, design and performance criteria as well as limitations for use in public right-of-way retrofit applications. Attendees will walk away with practical guidelines for evaluating candidate sites in conjunction with identifying various choices of planter box types that may or may not be applicable for a particular Green Street retrofit location. Example stormwater planter box projects will be showcased in this presentation with reference to high-density locations at major cities in the USA, including projects located in cities of Portland (OR), Los Angeles, San Diego, Philadelphia, Minneapolis and the San Francisco Bay Area.

Topic(s): Green Infrastructure, Water Quality, Water Quantity/Flow

Revealing Intrinsics of Nitrogen Transformation in Green Infrastructure

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Unmitigated rainfall runoff from the impervious surfaces common to urban infrastructure can lead to many environmental problems. Water quality of the surface runoff is degraded because of deposition of various types of pollutants. This load-magnified stormwater discharge does not meet the required discharge quality standards because high levels of nutrients may result in eutrophication or algal blooms. Eutrophication will lead to excessive plant growth thus lowering water-column oxygen levels. Excess levels of nutrients or build-up of toxins may stimulate growth of algal blooms in receiving waterbodies and thereby killing aquatic biota. Bioretention basins, as stormwater control measures, take advantage of natural environmental processes through incorporation of vegetation and different types of soil media resembling a natural ecosystem. The different layers of soils present in bioretention basins provide an environment favorable for the growth of various microorganisms which help in degrading filtered pollutants like nitrogen and phosphorus. Unfortunately, research has shown that nitrous oxide (N2O) gas which is a potent greenhouse gas is a byproduct of nitrogen removal in soil in both nitrification and denitrification processes. However, very limited research has been done in the direction of understanding the role and abundance of microbial communities involved in the process of nitrogen transformations and contributes to the release of N2O into the atmosphere from bioretention basins. During the study, samples were collected from existing bioretention basins located near the University of Utah Campus. Core samples of soil, and composite effluent and influent stormwater samples were collected from the basins and then transported on ice to the laboratory and subsequently analyzed. The results suggest that the quantitative abundance amoA, atypical NosZ, NirK, and NirS gene in all soil samples collected from the bioretention basins during winter are ranging from 1.7×10^6 to 1.7×10^7copies/gm-soil, 1.2×10^6 to 3.1×10^7copies/g-soil, 2.7×10^6 to 3.9×10^8copies/gm-soil, and 3.4×10^7 to 7.4×10^8copies/gm-soil, respectively. Furthermore, results showed lower amoA, NirS and NosZ gene abundance and no amplification of NirK gene in control basin soil samples. Methods for analyzing phosphorus removal efficiency are being developed. Potential links between emissions of greenhouses gas like N2O and seasonal distribution of microbial communities in bioretention basins with different plant communities are also being observed. Results indicate the presence of AOB strains, Nitrosospira sp. 40KI and Nitrosospira sp. NpAV which have the ability to produce N2O during a nitrifier denitrification process. Moreover, analysis of both winter and summer stormwater samples showed higher concentrations of nitrate in effluent than influent. Further analysis on summer samples and N2Oemissions from each basin are in progress. The purpose of this research is to comprehend the mechanisms involved in biological nitrogen removal, to explore the contribution of various pathways in N2Oemissions, and understanding microbial ecology for developing a better design of bioretention basin in future which will result in reduced emissions of greenhouse gases into the atmosphere.

Topic(s): Green Infrastructure

Spatiotemporal Variability of Cyanobacterial Harmful Algal Blooms

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Cyanobacteria cause a multitude of water-quality concerns, including potential production of taste-and-odor compounds and toxins. Taste-and-odor compounds cause malodorous or unpalatable drinking water and fish, resulting in increased treatment costs and loss of aquacultural and recreational revenue. Cyanotoxins have been implicated in human and animal illness and death in over fifty countries worldwide, including at least 36 U.S. States. The study of cyanobacteria and associated compounds presents several unique challenges. For example, 1) complex mixtures of cyanotoxins and taste-and-odor compounds are common in mixed-assemblage cyanobacterial blooms, 2) spatiotemporal variability is characteristic of blooms, and occurrence of cyanobacteria, cyanotoxins, and taste-and-odor compounds may vary substantially within relatively short distances and periods of time, and 3) relations between spatiotemporal dynamics and environmental conditions are unique to individual systems and are the complex result of the interactions between biological, physicochemical, and hydrologic factors. In the face of these challenges, continuous-water-quality monitors, remote sensing, genetic techniques, and in situ field experiments have supplemented traditional limnological studies. These new approaches have facilitated the development of tools to provide early warning systems for occurrence that guide management and public health decisions.

Topic(s): Water Quality

Starts With a BBQ: Aligning Citizens with Utah Monitoring Needs

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More than 20 of our most dedicated Utah Water Watch volunteers gathered this summer to share the story of why they monitor at the first annual volunteer get-together in Salt Lake City. Now in its fifth year, Utah Water Watch -- Utah's citizen water quality monitoring network – is expanding and adapting its programs, providing volunteers with more advanced monitoring opportunities. We are finding new ways to support our existing network of over 100 volunteers while addressing Utah's unique monitoring needs. In this session, we will show how our volunteers are working with watershed partners and scientists to improve the water quality and safety of Utah's rivers, lakes and streams. We have learned that volunteers want to know how their data is used, so forming these connections between volunteers and scientists is critical to the success of our program. We will be discussing how improvements to the Tier 2 volunteer network and coordination with watershed partners can advance statewide water quality goals. Partners benefit from an extra hand in the field and volunteers learn about local water quality issues while assisting with implementation and monitoring of restoration projects. We will also address our plan to expand lake monitoring, especially for harmful algal blooms and E. coli, to help keep Utah's waters and swimming beaches safe. Volunteers monitor many of the swimming beaches and lakes in many rural areas that are often beyond the reach of state and local agencies. Utah Water Watch is working closely with the Utah Lakes and Reservoirs program as well as partners such as the State Parks in developing our protocol and network.

Topic(s): Water Quality

The Business of Water: Lessons from Coca-Cola Watershed Replenishment

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At Swire Coca-Cola USA, we have seen the sense in conserving natural resources since the very beginning of our business journey. We have a vested business interest in protecting the water resources in the communities in which

we operate; where we produce refreshing Coca-Cola products is where we also distribute and sell them. In order to maintain the most important material for our business—water—we have to work hard to protect natural water sources. One of our major initiatives toward protecting the water resources around us is called the Replenish project. In collaboration with The Coca-Cola Company, we work to implement conservation projects that restore the water supplies of natural water bodies like rivers and wetlands. In 2007, The Coca-Cola Company and all of its bottling partners, including ourselves, set the goal of returning 100% of the water that goes into our finished products back to nature and communities. By the end of 2015, the Coca-Cola system achieved 100% replenishment globally. In Utah, we have worked in the Chalk Creek watershed to improve stream flows by implementing conservation irrigation for a local rancher and by removing a fish migration barrier. Secondly, we work with The Nature Conservancy at Jesse Creek in Idaho to restore a dry section of the stream. Our manufacturing plant in Fruitland, Idaho sources its water from the Jesse Creek watershed. We are also evaluating a third project in the upper Bear River watershed in Wyoming. This project would restore the habitats and passage for local trout by replenishing an estimate of billions of liters to nature. In partnership with The Coca-Cola Company, we've learned that there are several necessary steps to implementing a successful replenishment project. The first step is to map the water. Coca-Cola does this by completing source water vulnerability assessments for our business operating areas. We have completed Source Water Vulnerability Assessments for each of our manufacturing facilities, utilizing the expert knowledge of third-party hydrogeologists. Following these vulnerability assessments, we have also developed Source Water Protection Plans, which work to protect the watersheds in our operating areas. We operate in the western U.S., from Portland to Denver to Phoenix. Our goal is to protect watersheds throughout these areas, some of which have limited water availability. The second lesson that Swire Coca-Cola has learned from Replenish projects is the value of partnerships. We partner with environmental nonprofits, customers such as universities, and other members of the Coca-Cola system. Swire Coca-Cola has partnered with Bonneville Environmental Foundation (BEF), Trout Unlimited, The Nature Conservancy, and Coca-Cola North America on three restoration projects in Utah, Idaho, and Wyoming. Thirdly, to build on the importance of partnership, we have found that active collaboration and engagement in these programs is vital to the success of watershed restoration projects. Collaboration with our partners has allowed us to identify suitable Replenish sites and to successfully implement restoration projects. The Replenish projects at Jesse Creek and Chalk Creek return 275 million liters of water to nature annually.

Topic(s): Conservation/Restoration, Education/Outreach

The Great Salt Lake: Water Not Wasted

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This presentation covers a variety of important issues surrounding Great Salt Lake and the water that feeds it. It covers the purpose of the Great Salt Lake Ecosystem Program (GSLEP) and demonstrates how we accomplish managing and conserving the avian and aquatic communities of Great Salt Lake. Participants in this talk can expect to learn about the brine shrimp harvest industry and how it is managed by GSLEP. They will learn about the life history of brine shrimp and why they are so important. Participants will also learn about how the millions of birds, people that use the lake for recreation, industries and quality of life in the Salt Lake valley will be affected by lowering lake levels. They will learn about the watershed and why it is very important to continue to allow water to reach Great Salt Lake.

Topic(s): Education/Outreach, Conservation/Restoration, Climate Change

The Jordan River...Size Matters

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The Jordan River has changed in size, shape and function over the past century. In that same time span, the river's ability to convey water, sediment and process pollutants has also changed. Is there a significant nexus between the morphological divergence and the river's water quality degradation? This presentation will explore the possible nexus and a pilot program to test this hypothesis and implement the Jordan River TMDL.

Topic(s): Conservation/Restoration, Water Quality, Water Quantity/Flow

Utah Lake Eutrophication: Role of Sediment-Water Column Interactions

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Utah Lake is the largest natural freshwater lake in the western United States in terms of surface area with a maximum length and width of 24 and 13 miles, and has a surface area of roughly 375 km2 (145 square miles). It is a shallow lake with an average depth of approximately 9-10 feet during normal reservoir operating conditions with a storage capacity of 902,400 acre feet (Psomas & SWCA, 2007). The lake is managed as a reservoir to have a minimum surface elevation of 4,489 feet above sea level to maintain a consistent shoreline. Utah Lake is considered hypereutrophic in terms of trophic status and experiences extreme algal blooms in the late summer and fall throughout the lake (Psomas & SWCA, 2007). Low dissolved oxygen, or anoxic, events have not been observed in Utah Lake and this is attributed to the shallow lake being well mixed and wind induced reaeration. There is an increasing concern about the role of nutrients, especially phosphorus, in contributing to Utah Lake water quality. This has led to a lots of debate about sources and sinks of phosphorus in Utah Lake among the local community. Phosphorus is a tricky nutrient whose fate is primarily pH dependent. In this EPA and UDWQ funded research, we closely looked at P in the sediments and looked at its speciation, sediment minerology and potential of release under changed DO and pH conditions. More recently, we have collected five more sediment cores from the Utah Lake and are in the process of evaluating parameters which will be useful for Utah Lake modeling efforts let by the University of Utah and Utah DWQ. Water column samples collected show the correlation between nutrients, chlorophyll a, and cyanotoxin with water quality and lake bottom sediments. Majority of phosphorus in Utah Lake sediments is calcite bound which can only be immobilized under low pH conditions. We also developed an in-house toxin measurement method based on high performance liquid chromatography. The samples collected and analyzed did not show toxin concentrations above world health organization's prescribed limits. The sediments were a source of dissolved N and P while the water column was a sink, and once again this was associated with plankton bioassimilation. The sediments in Utah Lake proper were similar in terms of %TS and roughly 37% of the VS were organic carbon, and are composed primarily of carbonate and clay minerals which are easily resuspended. The high carbonate content, elevated ambient pH, and alkalinity provide a pathway for abiotic P precipitation. In-situ sediment oxygen demand measurements revealed that the Utah Lake water column is responsible for the majority of the ambient oxygen demand, not SOD, and was associated with phytoplankton respiration and decay.

Topic(s): Water Quality, Water Quality, Education/Outreach

Utah Lake Water Quality Study

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The Division of Water Quality is conducting a two-phased water quality study on Utah Lake to determine the role of excess nutrients on impairments to the aquatic life and recreational beneficial uses and to determine appropriate nutrient endpoints. An initial water quality investigation was completed in 2007 and subsequently put on hold

to evaluation the relationship between in-lake water quality and ongoing ecological management strategies. This presentation will provide an overview of the project, progress to date, overview of ongoing research, and a discussion of the next steps. DWQ initiated Phase 1 of the Utah Lake study in 2015 in response to nutrient related impairments identified in DWQ's Integrated Report and in response to harmful algal bloom events on Utah Lake in recent years. Phase 1 of the study consists of four work elements led by DWQ staff and representative stakeholder subcommittees. Phase 1 work elements include: 1) Stakeholder Outreach and Public Involvement; 2) Data and Information Management; 3) Beneficial Use Assessment; 4) Bulk Load Analysis; and 5) Model Selection and Development. DWQ anticipates completing the majority of the Phase 1 work elements in 2016 and launching a Phase 2 study to identify appropriate nutrient management scenarios. Phase 2 will further investigate water quality conditions in Utah Lake and will result in one of three alternatives: 1) Total Maximum Daily Load; 2) Site Specific Nutrient Criteria; or 3) Use Attainability Analysis. The water quality model developed in Phase 1 will serve as the primary tool to evaluate the water quality and ecological responses expected from a reduction of nutrient inputs and the carp removal effort. This will require additional research to better understanding of the unique biological, physical, and chemical interactions in the Utah Lake system. DWQ and stakeholders will continue to work collaboratively throughout this study to develop scientifically defensible recommendation for meeting Utah Lake beneficial uses.

Topic(s): Water Quality

Water is for Fighting! Water Right Adjudications in Salt Lake Valley

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As competing demands over water resources within the Salt Lake Valley continue to grow, the urgency for clarity and certainty in the realm of water rights likewise becomes more critical. Having evolved over time--commensurate with the history of Utah--present-day water rights take many shapes and forms. Consequently, questions of supplemental relationships, pre-statutory rights, forfeiture, and Federal Reserve rights often cloud the overall water rights picture. The General Adjudication process addresses these issues utilizing a unique combination of historical research, "boots-on-the-ground" investigations, and legal proceedings--ultimately providing the public with a clear delineation of the water rights within the Utah Lake and Jordan River watershed.

Topic(s): Policy & Law

Water Losses in SLC During Warm, Dry Years!

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Water is a critical resource for human development, economic well-being, and sustainability. Growing population and expanding agricultural activities have made water extraction for anthropogenic use a major flux in the hydrological cycle. In order to successfully meet the rising demands, water managers have resorted to over-exploitation of regional surface water resources, large scale inter-basin transfer, and extraction from subsurface aquifers making sustainable water management practices a major challenge, thus endangering water availability for our future generations.The severity of these effects, and the need to better understand connections between climate, water extraction, water use, and water use impacts, is strongest in areas of climatic aridity and substantial land-use change, such as the rapidly urbanizing areas of Utah. To understand these connections, we collected and analyzed stable isotopic ratios of more than 800 urban tap water samples in a series of semiannual water surveys (spring and fall, 2013 to 2015) across the Salt Lake Valley (SLV) of northern Utah. We observed strong and structured spatiotemporal variation in tap water isotopic compositions across the region which we attribute to complex distribution systems, varying water management practices and multiple sources used across the valley. Isotopic mass balance indicated significant inter- and intra-annual variability in water losses within the distribution network due to evaporation from surface water resources supplying the SLV. Our calculation suggests that evaporative losses from the SLV water supply increased from 1 - 1.5% of the total water flux in 2013 to 4 - 6% in 2015. Using yearly water consumption data for the SLV obtained from the Utah Division of Water Rights, these values translate into > 4 million gallons of

evaporative loss per day in 2015. This enhanced loss to the atmosphere would equate to $2.25 million of revenue loss in 2015 (calculated at current rates of $1.16 per unit within Salt Lake City; 1 unit = 748 gallons) if translated into reduced extractions, or significant ecological impacts if extraction remained unchanged. Our isotopic assessment highlights aspects of the municipal water systems supplying the SLV that are germane to planning for and understanding these future water resource challenges. Our calculations show significant increase in evaporative losses within the system over the three-year sampling period, likely attributable to the atypically warm and dry weather that persisted throughout the study. Given that majority of municipal water used within the SLV is currently sourced from surface water and the proposed development of water resources to satisfy future demands associated with population growth focuses primarily on surface water systems of the Central Utah Project and Bear River, SLV communities are and will continue to have strong exposure to changes in evaporative losses from these systems.

Topic(s): Climate Change, Water Quantity/Flow, Education/Outreach

Water Quality Summary of the Jordan River Watershed

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The Jordan River watershed is part of the Great Salt Lake Basin draining from Utah Lake and terminating at the Great Salt Lake 51 miles to the north. Major water uses in the area include municipal and industrial uses, agriculture, irrigation, and recreation. Much of the water in the watershed is diverted for consumptive uses supporting a population of over a million residents. Tributaries to the Jordan River from both the east and west are situated within a complex network of diversions, return flows, and stormwater discharges resulting in a variety of water quality concerns. This presentation will provide an overview of these water quality concerns along with ongoing remediation efforts, such as Total Maximum Daily Loads (TMDLs) and watershed plans, to restore their beneficial uses. While past management of the watershed focused on water development and flood control programs, future management will need to concentrate efforts on the continual need to develop and preserve high levels of water quality in the Jordan River watershed.

Topic(s): Water Quality, Water Quality, Water Quality

What Really Inspires Stewardship? A Case Against Scare Tactics

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Have you encountered someone who cares about the environment but thinks the issues are too big for them to do anything about? Recent research indicates that this type of attitude may stem from being exposed to serious environmental issues at a young age; for instance, a five year old learning an animal might die from entanglement in litter. Whether you consider yourself an educator or not, most of us interact with the public in various forums and have the opportunity to help curb this issue. In recent years a movement has developed that encourages educators to consider age appropriate messages and shy away from messages of fear, instead focusing on messages of positive behavior change. In this session we will present David Sobel's idea of "ecophobia" and how it informs Tracy Aviary's education programs. We will discuss appropriate topics for different age groups and ask audience members to share ideas for how this concept might affect their work or programming.

Topic(s): Education/Outreach, Environmental Justice

Who Pulled the Plug on Utah Lake: An Ecological Primer

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Utah Lake was perhaps the most ecologically diverse, productive, and awe inspiring lake in the western USA, prior to Mormon settlement in the late 1800's. Bonneville cutthroat trout and twelve other fish species thrived by the millions. More species of freshwater mollusks called Utah Lake home than anywhere in western North America. Birds, wildlife, and Native Americans thrived. By most accounts, without the incredible bounty that Utah Lake provided, the recently established LDS community likely would have perished. All this abruptly changed at the hands of progress and Utah Lake underwent what is known as a 'catastrophic ecosystem shift'. Although Utah Lake continues to be highly productive and is sanctuary for thousands of birds; its native fauna has all but disappeared and its waters are now primarily comprised of taxa such as cyanobacteria, algae, zooplankton, worms, midges, and carp. Urbanization is rampant along the shores of Utah Lake, its tributaries run dry for most of the year, and there is no longer a natural connection between Utah Lake and the Jordan River downstream. Utah Lake will never return to what it once was and its time is running out. Utah Lake's fate is now being decided by political forces that may or may not have its best interests in mind. Citizens need to have a basic understanding of Utah Lake's incredible ecology and the ecosystem services it provides free of charge to help make informed decisions and to provide guidance to their elected officials and water managers. This presentation will give a brief history of Utah Lake and then focus on its present ecology and food web dynamics including the misunderstood and vastly under appreciated role of mollusks, midges, plankton, and worms.

Topic(s): Conservation/Restoration, Water Quality, Climate Change

You Can't Play Soccer in a Perennial Bed!

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Turfgrasses are unique plants in how they grow, how they are managed, what people expect of them, and especially how they are used in urban landscapes. Most people are not aware of their role, but turf is very important to the sustainability and quality of life in urban areas throughout the world. While often misunderstood, people come in contact with turfgrasses constantly, providing recreation and cultural benefits including improved physical and mental health. As living plant systems, turfgrasses are highly adaptable, do not require the inputs many people believe (especially water), and protect and build soils. Their role in urban areas in many ways is increasing in importance with heavier use and higher demands. In this presentation, we will discuss the unique roles that turfgrasses play in urban landscapes, that literally no other type of plant can deliver. We will also discuss the diversity of grasses that could be used, several misconceptions about their management, and summarize attributes that make them an important component of sustainable water-conserving landscapes.

Topic(s): Conservation/Restoration, Green Infrastructure, Education/Outreach

Posters (listed alphabetically by title)

All About Cyanobacteria and Cyanotoxins

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Experienced with population growth, landuse changes and more point and non-point pollution loads in, Utah Lake is now considered to be hypereutrophic and experiences more frequent algal bloom. Algal bloom is a rapid increase

of algae in water body. Among them, the blue green algae (or cyanobacteria) is mostly concerned with their ability to outcompete other groups of algae and release cyanotoxins in the water. Several common cyanobacteria genera in fresh water include Microcystis, Anabaena, Cylindrospermopsis, and Aphanizonmenon. During this summer, Aphanizonmenon dominated in Utah Lake with high concentrations of microcystins (one of cyanotoxins) detected, whereas the causes of its dominance and community change were unclear to us. Our study will reveal the current problems by detecting the seasonal dynamics of cyanobacteria, the condition for their flourish, and determine the potential cyanotoxin-producing strains using mcyA, anaC, and other functional genes.

Topic(s): Water Quality, Climate Change

Climate Change Effects on Eutrophication in Jordan River

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The Jordan River is a 51 mile long freshwater stream in Utah that provides drinking water to more than 50% of Utah's population. The various point and nonpoint sources introduce an excess of nutrients into the river. This excess induces eutrophication that results in an inhabitable environment for aquatic life is expected to be exacerbated due to climate change. Adaptive measures must be evaluated based on predictions of climate variation impacts on eutrophication and ecosystem processes in the Jordan River. A Water Quality Assessment Simulation Program (WASP) model was created to analyze the data results acquired from a Total Maximum Daily Load (TMDL) study conducted on the Jordan River. Eutrophication is modeled based on levels of phosphates and nitrates from point and nonpoint sources, temperature, and solar radiation. It will simulate the growth of phytoplankton and periphyton in the river. This model will be applied to assess how water quality in the Jordan River is affected by variations in timing and intensity of spring snowmelt and runoff during drought in the valley and the resulting effects on eutrophication in the river.

Topic(s): Water Quality, Climate Change

Groundwater Development and Surface Water: Streamflow Depletion

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Groundwater and surface-water resources are often connected. Much has been written about the effects of groundwater development on surface water, and new tools are available to simulate and quantify these effects. In this study, a numerical groundwater flow model was used to prepare capture maps to illustrate the connection between groundwater development and surface water. Capture maps show the amount of surface-water depletion caused by a well at any location in the model domain and can be used by water managers to assess the impacts of groundwater development. The first part of this presentation gives a brief synopsis of the source of water to wells and common misconceptions about surface-water depletion. The second part presents the development and analysis of capture maps for a basin dominated by surface-water features. Rather than analyzing depletion in only one river or spring, this work uses one set of capture simulations to determine the effects of groundwater development on 11 segments along two rivers, 30 springs, 13 areas of field drains, and 3 areas of evapotranspiration of groundwater. The presentation concludes with a discussion of the implications of the capture maps and suggestions on how this type of analysis can be used by water managers.

Topic(s): Water Quantity/Flow, Conservation/Restoration

H2O-Yeah! Getting Families Excited About Wetlands and Watersheds

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Located in Salt Lake City's Liberty Park, Tracy Aviary inspires curiosity and caring for birds and nature through education and conservation. Here in Utah, where water is a critically important resource, fulfilling this mission includes getting people excited about our watersheds! Tracy Aviary provides watershed education through a diverse suite of programs, utilizing a variety of approaches to engage participants. Intended to get people connected to nature and invested in their watershed, these programs range from formal to very informal interactions with guests and Salt Lake residents, both on- and off-grounds. Join Tracy Aviary educators in discovering how diversifying education programs can inspire caring for water and dive into results from a recent evaluation project of Tracy Aviary's watershed programs.

Topic(s): Education/Outreach

Impact of Phragmites Australis Control on Utah Lake Water Quality

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Phragmites australis (common reed) is an invasive species that has some negative ascetic traits in Utah Lake. The Division of Natural Resources is combating Phragmites australis by indiscriminately spraying herbicides and smashing the roots and remaining rhizomes into the lake sediment. Phragmites australis is known to sequester trace metals in their roots and rhizomes. We hypothesize that this method of removal of the common reed will have an adverse impact on water quality in Utah Lake due to the release of trace metals from their roots and rhizomes during decomposition. Phragmites australis, sediment and water samples will be collected from sixteen sites selected at random surrounding Utah Lake, including both treated and untreated areas for a period of 5 months. Five replicate samples will be taken at each site. The samples will be processed in UVU Environmental laboratory, microwave digested in concentrated HNO3 using EPA Method 3015 and analyzed with the ICP-OES to measure their trace metal (As, Cd, Cr, Ni, Co, Pb and Cu) content. The rate of release of trace elements will be determined for each site and compared with non-treated areas. An increase in trace metal concentration in the sediment and water over time will indicate a negative impact on Utah lake water quality. To determine factors which may potentially impact trace metal concentration in the lake water and sediment, pH, redox reaction, particle size distribution and organic matter contents will be measured. Results from each sites will be compared and potential reasons for any variations observed will be discussed.

Topic(s): Water Quality

Quantify Controls on Stormwater Quality in Red Butte Creek

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Utah's predicted population growth, urbanization, and climate change will create unique challenges for water resources managers. As demand for water resources increases and supplies become more variable, it is critical to understand how land use and runoff affects water quality. To address this challenge, we collected stormwater samples and discharge measurements throughout 2015 and 2016 from a range of individual land cover types as well as four stormwater culverts that drain into Red Butte Creek at the University of Utah campus in Salt Lake City, Utah.

Surprisingly, analysis of 52 storm events from 2015 demonstrated that between 0% and 67% storm outflow recharges groundwater in this section of Red Butte Creek and indicating that urbanization impacts local groundwater quality as well as surface runoff. The recharge volume is positively correlated with total outflow from each storm drain (R2 = 0.99) as well as the duration of storm outflow (R2 =0.71). Analysis of nutrient concentrations in stormwater samples taken at stormwater culverts during Fall 2015 and Spring/Summer 2016 determined concentrations of total nitrogen and potassium vary little, with averages of 2 mg N/L (±0.3 mg/L) and 3.6 mg K/L (±0.1 mg/L) respectively. Total organic carbon concentrations are 4 to 5 times higher in summer and fall (13.2 and 18.6 mg C/L) than during this spring runoff season (3.8 mg/L). However, stormwater collected Summer 2016 had nitrite levels of 1.4 mg/L NO2-N, exceeding the EPA maximum contaminant levels of 1 mg/L NO2-N. Our results indicate that stormwater entering Red Butte Creek recharges local groundwater. Urban runoff nutrient concentrations vary seasonally and peak during the dry summer season. Implementation of green infrastructure to mitigate these water quality concerns needs to recognize the dual impacts of storm runoff on both surface and ground water.

Topic(s): Water Quality, Green Infrastructure

Quantifying Interactions of Climate and Landscape on Water Resources

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Growing populations and a changing climate are creating an uncertain future for water resources in the Western United States, including Salt Lake City and all of Utah. Planning for future population and climate conditions requires quantifying differential sensitivity of hydrologic partitioning to changes in climate. To address this challenge we ask: How do landscape characteristics influence the partitioning of precipitation into streamflow and plant available water along the Wasatch Front? And can historical observations of climate and streamflow provide inferences to the differential sensitivity of local watersheds to changes in climate? The seven watersheds along the Wasatch Front (City Creek, Red Butte, Emigration, Parley's, Millcreek, Big Cottonwood, and Little Cottonwood) provide an excellent research area to answer these questions. These watersheds are not only important to the Salt Lake area, providing over half of its water supply, but also have over 100 years of climate and streamflow response data to study the how the water balance is influenced by landscape. Additionally, there are many landscape differences between the watersheds: ranging in size from 19 km2 to 127 km2, in mean elevation from 1960 m to 2610 m, in mean slope steepness from 20° to 27°, in predominant slope aspect either north-facing or south-facing, in the type of soils present, and in the predominant bedrock geology. Mean annual precipitation (790 mm to 1290 mm) and temperature (3.3°C to 6.9°C) vary primarily as a function of catchment elevation. Between 1900 and 2014 the average annual temperature across all watersheds has increased by 0.91°C, with most of the change occurring during the last fifty years. During the same time there has been no significant change in the amount of annual precipitation. Mean annual streamflow, normalized by catchment area, ranges from 150 mm to 820 mm with annual precipitation explaining between 43%-72% of the annual variability in streamflow. Surprisingly, the remaining variability is not correlated to annual or seasonal temperature even though the catchments have experienced notable warming. Instead, inter-annual variability in streamflow and water yield is significantly related to the rate of snow melt and the amount of subsurface storage in the watershed (derived from winter baseflow) in addition to the amount of annual precipitation. Specifically, higher antecedent baseflow and faster snowmelt both result in a preferential partitioning of precipitation to streamflow. This implies that the effects of a warming climate on the water resources of the seasonally snow dominated watersheds near Salt Lake City can be best understood through the context of the melting snowpack. Further, climate extremes, such as inter-annual drought, may leave a legacy effect on the subsurface storage in some watersheds, causing a delayed streamflow recovery in the years following the drought.

Topic(s): Climate Change, Water Quantity/Flow

Solid-liquid Separation of Dairy Waste Effluent

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Dairy farms use large amounts of water during milking and pasteurization processes, producing waste that contains manure, flush water, and polluted runoff. The effluents include dissolved sugars, proteins, fats, and possibly residues of additives. Dairy waste effluents have high levels of BOD, COD, and TSS loads and need to be pre-treated before being discharged to natural or municipal water systems. The effluents can be treated also in order to produce water with acceptable quality for irrigation or livestock drinking water. One challenge in dairy wastewater treatment is to reduce the amount of total suspended solids that cannot be separated by normal screening or press systems. Such colloidal matter can be separated by means of coagulation or flocculation using polymers or coagulants and can then be separated by various methods such as filtration or pressing. Flocculation of colloids using polymers can be costly, as the flocculation rate can vary with factors such as polymer composition, charge, concentration and effluent composition. A thorough optimization process can reduce the cost of waste management in a farm drastically.Our presentation will include information on how polymers can be used for flocculation of dairy wastewater effluent as well as optimizing a cost effective flocculation step. Methods of solid/liquid separation, including the Imessa HUBSTM system will be discussed as well.

Topic(s): Water Quality

Sources and Cycling of Nitrogen in the Jordan River

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The Jordan River is a eutrophic stream that begins in Utah Lake and flows north to the Great Salt Lake. An overabundance of nutrients and organic matter has lead to algae blooms and depleted oxygen levels in the river, which threaten in-stream ecosystems as well as the wetland ecosystems of the Great Salt Lake directly downstream. Among the nutrients involved in the eutrophication problem is nitrogen (N). The Jordan River has a multitude of sources contributing to its nitrogen load. Among these are four wastewater treatment plants, which discharge effluent into the river system. In order to quantify the spatial variability in nitrogen forms and loads, we sampled the Jordan River in 22 locations during late May and early August 2016 for dissolved, particulate, and sediment-bound nitrogen. This included an extensive survey of water and sediment sampling above and below each of four water reclamation facilities, effluent samples from each facility, and an intensively sampled (every ~2km) reach extending from downstream of the Surplus Canal to North 20th St. Early results have shown significant variation between the facilities' contributions to the Jordan River and likely reflects the variability in technology utilized at each facility. While the average particulate organic matter concentration is much lower in the contributing effluents than the river itself (4.1 mg/L compared to 78.7 mg/L), water reclamation facilities are contributing significantly higher dissolved N concentrations than found in the river and may significantly increase N loading in the Jordan River. Data from one sampling date in late-May shows that the river just upstream of the Surplus Canal diversion had an approximate N load of 4.6 metric tons N per day, while three upstream treatment facilities (plus Millcreek in conjunction with one effluent outfall) have combined for an approximate load of 4.42 metric tons N per day, suggesting a significant portion of the Jordan's nitrogen load is derived from wastewater. Early results from the intensive sample region have shown increasing NH4+ concentrations trending along the flowpath, although TDN does not increase substantially over the same stretch. Forthcoming isotope analysis will offer more insight into the sources and predominant N processes along the Jordan River and will enhance our understanding of wastewater impacts.

Topic(s): Water Quality

Spatial Impacts on Local Perceptions of the Jordan River Corridor

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The Jordan River, which flows through the west side of Salt Lake City, is considered by some to be a natural amenity that can improve the quality of life in communities. Efforts have been made to turn the stream into a recreation area. It is not known the extent to which local residents benefit from those efforts. In order to give valuable information to the Salt Lake City Parks Department, our study explores how proximity to the Jordan River may affect local concerns and perceptions about certain aspects of the Jordan River. The goal was to get opinions from community members who would not normally be heard. We distributed a questionnaire using iPads through public intercept methods. Surveys were available in both English and Spanish. To be able to spatially analyze different questions on the survey, it asks respondents their proximity to the Jordan River. With this information, we were able to see whether or not proximity affects perceptions people have about the river. We found evidence that proximity to the Jordan River has a relationship with how people perceive that the river affects the quality of life in their neighborhood, as well as a relationship with how frequently people visit the Jordan River and surrounding parks. Other variables also affect people's perceptions of the river, including the neighborhood lived in, frequency of visitation, and gender.

Topic(s): Environmental Justice

The Seven Canyons Trust Story: Uncovering Lost Urban Waters

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Due to the urbanization of the Salt Lake valley at the turn of the 20th century, many of our valley's hydrologic resources were buried underground, replaced with asphalt and concrete. Lost were the ecosystem services these creeks provided in retaining nutrients, replenishing groundwater, and mitigating flooding. Lost were the natural, open spaces and wildlife corridors. Lost were the sounds of running water and the songs of birds, who relied on these riparian areas. However, a new paradigm is emerging. Communities across the globe, from Berkeley California to Zurich, Switzerland, are turning towards the daylighting, or uncovering, of these lost urban waters. The Seven Canyons Trust is creating momentum for this movement locally, working to daylight over 21 miles of buried creeks throughout the Salt Lake valley. Starting at the ecological and cultural significant confluence of three underground urban waters, Red Butte, Emigration, and Parley's Creeks, and the Jordan River, this organization seeks to restore the seven green veins that will once again connect ecosystems, and communities, from the Wasatch Mountains to the Jordan River. With a century-long vision, the Seven Canyons Trust hopes to restore the beauty and health of the hydrology of the Salt Lake Valley, paying homage to the creeks that helped sustain settlement in our valley named after water.

Topic(s): Conservation/Restoration, Green Infrastructure, Environmental Justice

Utah Water Institutions and Policy Boundaries

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Water policies in Utah, as with all states in the United States, are complex and are handled by many different agencies. Each agency, or water institution, is given administrative responsibility for implementing certain aspects of local, state, and federal water laws and policies. Water institutions have policy boundaries within which their decision making has influence, and the policy boundaries of various agencies do not necessarily match other agencies' policy boundaries. This project aims to visually display the geographic domains of different water institutions, explain their role in regard to water policies, and illustrate the need for boundary-spanning activities within the complex water governance structure within Utah.

Topic(s): Policy & Law, Education/Outreach

Water Quality and Invertebrate Abundance Within Wasatch Streams

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In recent years, there has been a more immediate need to understand the impacts of anthropogenic activities on our freshwater systems. The streams along the Wasatch front act as a continuum in usage, access, and habitat type, all of which contributes to the amount, fate, and distribution of contaminants within the system. The objective of this research was to understand how endpoints, such macroinvertebrate diversity and abundance, as well as water quality, differ within and among Wasatch front streams. During late spring and early summer of 2016, City Creek, Emigration Creek, Parleys Creek, and Mill Creek were surveyed. To survey macroinvertebrates passively, Hester-Dendy artificial substrate samplers will be deployed and allowed to colonize for a 6-week duration, beginning in late May. In transects with stream depths less than two feet, surber samplers were employed. Basic water quality data included temperature, pH, dissolved oxygen, conductivity, and turbidity, all of which were recorded on a weekly basis. One liter water samples were also collected and for analysis of pesticides and other contaminants of concern. Preliminary analysis suggests an overall significant shift in invertebrate community structure from up stream to the more urban down stream. Additionally, a strong negative correlation was observed between many abiotic parameters and proximity to urbanized landscapes. Among streams, Mill Creek and City Creek have higher species diversity than the other streams and are characterized by cooler in-stream temperatures and greater canopy cover. As the human population within Salt Lake City continue to increase, it is very important that we understand our impact on local natural resources. This study, and those like it, will aid future management decisions and help increase responsible public use practices.

Topic(s): Water Quality, Conservation/Restoration

Bios

Anwar Alsanea Anwar is a graduate student at the department of Civil and Environmental Engineering at the University of Utah.

Shoeleh Assemi President, Imessa Research LLC.

Marina Astin Marina Astin is an educator at Tracy Aviary. She graduated from Brigham Young University with a B.S. in Biology and a minor in Environmental Science. As an intern at Tracy Aviary she was introduced to environmental education. Marina works with Tracy Aviary's Nature in the City program, providing fun, educational activities to get families outdoors exploring nature. She has especially loved getting to explore Salt Lake's river and streams.

Ellen Bailey Ellen Bailey is program coordinator for USU Water Quality Extension, providing outreach and engaging teachers, students and citizens to become stewards of their water. She received a Biology Degree from University of Dayton and MS in Soil and Water Science from University of Florida. While collecting biological and water quality data in Florida for nine years was an excellent experience, she enjoys working in Utah to protect our water resources.

Michelle Baker Michelle Baker is a Professor of Biology and an Associate of the Ecology Center at Utah State University. She is also the iUTAH Project Director and Principal Investigator. She holds a B.S. in Biology from Lafayette College and Ph.D. in Biology from the University of New Mexico. Dr. Baker spent a year in Toulouse France on a postdoctoral fellowship before joining the faculty at Utah State University in 1999. Dr. Baker is an ecosystem ecologist whose research program focuses on hydrological and biogeochemical processes that control water quality in streams.

Laura Bandara An award-winning landscape designer, Laura Bandara has engaged in a wide range of design and planning work from the iconic scale of Pearl Harbor, Hawai'i to the city block scale of Salt Lake's Regent Street. Emerging from a background in political science and landscape architecture, her work explores the intersections of ecology and culture, past and future, everyday and extraordinary.

Lori Bays Lori first joined Mayor McAdams' team as director of the Human Services Department in 2013, and was promoted to Deputy Mayor and Chief Administrative Officer in September 2015. Lori has more than 16 years of experience in local government and Health and Human Services. Prior to joining Salt Lake County, Lori was a Health and Human Services Agency Executive for San Diego County. Before that, she served as Director of the Office of Public Guardian for the State of Utah. Earlier in her career, Lori worked for a non-profit serving at-risk youth. She holds a master's degree in Clinical Psychology and is a licensed therapist.

Blake Bingham Blake Bingham is the Adjudication Program Manager at the Utah Division of Water Rights. He joined the State Engineer's Office in July 201. Mr. Bingham's current responsibilities include management and supervision of the Division's water rights general adjudication proceedings throughout the State of Utah. He is currently supervising fourteen separate adjudications located in the Utah Lake/Jordan River, Uintah Basin, Bear River, and Virgin River systems. He also works closely with the Utah Attorney General's office in an effort to resolve objections which have been filed on previous proposed determinations throughout Utah. Mr. Bingham earned his B.S. in Civil Engineering from the College of Engineering at Utah State University in 2003. He is a registered Professional Engineer in the State of Utah and currently serves on the Command Staff of the 204th Maneuver Enhancement Brigade in the Utah Army National Guard as the Executive Officer.

Christopher Bittner Mr. Bittner has over 20 years of applying environmental toxicology to both human and ecological risk assessments. Currently, Mr. Bittner is the Standards Coordinator for Utah and is Chairperson of the Utah Water Quality Standards Workgroup. The water quality Standards are the foundation for protecting water quality in Utah.

Gail Blattenberger Gail Blattenberger, longtime professor of economics at the University of Utah, has devoted her life to three causes — peace, poverty, and the environment. Her lifetime commitment to those causes has earned her the Gandhi Peace Award presented annually by the Gandhi Peace Alliance. Blattenberger became a professor in the economics department at the University of Utah in 1997. She taught econometrics, environmental economics and macroeconomics. She officially retired in 2012 but continues as an active professor emeritus and retains an office at the university. Much of her academic focus has been concerned with problems of extreme economic inequality and the lack of economic consideration of environmental destruction.

Brenda Bowen Brenda is an interdisciplinary geoscientist who received a B.S. and M.S. in Earth Science from the University of California, Santa Cruz and a Ph.D. in Geology from the University of Utah where her doctoral research focused on the history of fluid flow in the Navajo Sandstone. She worked as a Postdoctoral Research Associate at Central Michigan University studying the geochemical evolution of acidic brines in southern Western Australia, and then began a position as a faculty member in the Department of Earth, Atmospheric, and Planetary Sciences at Purdue University. She returned to Utah as a faculty member in the department of Geology and Geophysics in 2012. Dr. Bowen has over 35 publications that focus on how changing environmental conditions influence the composition of sediments, authigenic minerals, and fluids in both modern dynamic surface systems and ancient lithified strata. Current projects are focused on geologic CO2 sequestration, structural diagenesis and fluid flow, links between biology, geochemistry, sedimentology, and human activities in extreme environments including the Bonnevile Salt Flats. In addition to her geologic research and teaching, Dr. Bowen is also the Director of the interdisciplinary Global Change and Sustainability Center at the University of Utah where she is actively working to develop interdisciplinary academic programs that address critical issues related to understanding global change and creating sustainable solutions.

Lynette Brooks Lynette Brooks, PE, has a Masters Degree in Civil Engineering and has been a hydrologist with the USGS for 28 years. In that time, she has been part of 10 hydrologic studies of Utah valleys and the Great Basin carbonate and alluvial aquifer system, which covers an area of about 110,000 square miles. She has completed or is currently working on a total of 8 groundwater modelling projects in support of those studies.

Mark Brunson Professor, Department of Environment and Society, Utah State University, and Director for Education, Outreach and Diversity, iUTAH EPSCoR

Martin Buchert Martin Buchert has a Master's degree in Geography from the University of Hawai'i at Manōa and subsequently studied ecology and remote sensing at Utah State University (no degree). Following school, Martin

spent four years in the private sector as a NEPA Planner with H.W. Lochner, during which time he joined the University of Utah's City and Metropolitan Planning Department as Assistant Adjunct Professor, where he continues to teach GIS courses in Urban Planning and Urban Ecology. He is currently a Senior Research Analyst with the University of Utah's Global Change and Sustainability Center. His research background is in landscape ecology, particularly remote sensing and modeling of land use/land cover change. His recent work has focused on modeling and analysis of ecosystem services in urban landscapes including urban agricultural potential, habitat connectivity, open space inventories and conservation planning, accessibility analysis for urban parks, and ongoing studies of parcel-scale urban carbon emissions and urban water usage.

Eddy Cadet Eddy is an Associate Professor in the Department of Earth Science at UVU. He started at UVU (formerly UVSC) in 1993. Eddy specializes in teaching Introduction to Environmental Health, Occupational Worker Safety, Hazardous Materials and Emergency Response, Hazardous Materials Regulations, Environmental Toxicology, Resource Conservation and Recovery, Site Investigation, Landuse Planning, Environmental Compliance, and Environmental Management.

Charles Condrat Charles R. Condrat is the Uinta-Wasatch-Cache National Forest Soil and Water Program Manager and has worked as a Forest Hydrologist on National Forests in northern Utah since 1991. Before this, as a consultant he worked in surface and groundwater assessments and worked seasonally as a forest technician, land surveyor, and fire fighter. He has assessed environmental effects to soil and water resources on a wide variety of projects including timber harvest, grazing, recreation, oil & gas exploration and development, pipelines, powerlines, and mining. He has developed and implemented water quality monitoring plans for streams and lakes on the National Forest in cooperation with State and local entities.

Scott Daly Scott Daly is the Utah Lake Watershed Coordinator for the Utah Division of Water Quality's Watershed Protection Section. In this role he is involved in a diverse range of activities related to Utah Lake including scientific water quality studies, watershed planning, nonpoint source water quality improvement project implementation, water quality monitoring, and coordination with stakeholders representing many state, local, and private interests. Prior to his role in Utah Lake, Scott coordinated watershed planning and implementation programs in the Sevier River, Beaver River, and Cedar watershed areas. Scott has also worked in the consulting field developing Total Maximum Daily Loads and Watershed Management Plans to address a broad range of water quality impairments in more than a half dozen states.

Kent Dean My name is Kent Taylor Dean and I grew up in Riverton, Utah. I am attending graduate school at Utah State University in the Sociology department. I love the outdoors and try and spend as much time as I can camping and traveling.

Joan Degiorgio Joan Degiorgio has been working in the field of natural resources planning for over 30 years. These years have included planning positions with the State of Utah, U.S. Forest Service, private consulting, and the Utah Mitigation Commission. She is a Utah native raised on a farm in Weber County, with a law degree from the University of Utah. She has also been an adjunct professor at the University of Utah teaching a public land and planning course. For the past 12 years she has been working for the Nature Conservancy responsible for identifying and managing projects in Northern Utah that preserve sensitive landscapes and species. These include the Uinta Basin and Bear River where she has assembled a team of public and private partners to develop and implement science-driven landscape plans that include a climate change element.

Jeff DenBleyker Jeff has been a project manager and water resources engineer at CH2M in Salt Lake City since 1996. He has led a wide variety of permitting, investigation, and design projects covering water quality, hydrology, ecotoxicology, the assessment and restoration of streams and wetlands, and constructed treatment wetlands. Jeff's focus is helping form solutions that integrate science with the people and uses that are affected. Jeff led the State's effort to develop site-specific numeric criteria for selenium for GSL, has been involved with efforts to develop nutrient water quality standards for GSL, and is the State's project manager the GSL Integrated Water Resources Management Model.

Jason Draper Engineer, Salt Lake City Public Utilities

R. Ryan Dupont Dr. Dupont has more than 30 years of experience teaching and conducting applied and basic research in environmental engineering at the Utah Water Research Laboratory at Utah State University. His main research areas have addressed soil and groundwater bioremediation, field remediation technology demonstration and treatment system performance verification, and more recently, stormwater management via green

infrastructure. He currently is PI for a recently EPA-funded project looking at the use of GI for distributed stormwater harvesting to extend water supplies in arid western basins.

Cynthia Elliott Cynthia Elliott is an undergraduate student, studying Geography at Weber State University. Her love for the earth was brought out as a 4th grader in Southern California, when her class went for a week long science field-trip in the mountains to learn about ecosystems. She loves learning about weather and climates, rocks and minerals, ecosystems, art, music, and statistics. Cynthia plans on applying for graduate school in the near future. When she is not trying to remember how to classify clouds and rocks, she enjoys casual reading, a refreshing jog outside, and Lord of the Rings marathons with her family.

Arthur Evensen Undergraduate research assistant working under the mentorship and supervision of Dr. Eddy Cadet, PhD

Cooper Farr Cooper leads the Conservation Science Program at Tracy Aviary, which contributes to bird conservation efforts by increasing knowledge about birds and their habitats. The Conservation Science Program supports conservation and field research projects in our home state of Utah, and in other places throughout North, South, and Central America. We provide a range of citizen science opportunities to allow a broad and diverse community of people to become involved in conservation work, and we focus our research efforts on identified local, national, and international bird conservation priorities.

Zach Frankel Zach Frankel is the founder and Executive Director of the Utah Rivers Council. Zach started the organization in 1995 after he received his B.S. in Biology at the University of Utah. Zach has been working on water education and conservation across the American West for over 25 years. He successfully defeated a proposed dam on the Diamond Fork River in 1997 and authored Utah's first water conservation legislation, the Utah Water Conservation Plan Act, which was passed in 1998 by the Utah State Legislature. Zach also wrote legislation passed by the Utah Legislature in 2002 that amended the Bear River Development Act by removing two proposed dams from being constructed on the Bear River. Zach is an avid outdoorsman who enjoys paddling, hiking, backcountry skiing and cycling.

Rachel Gabor Rachel Gabor is a postdoctoral research fellow with iUTAH at the University of Utah. She studies the hydrology and biogeochemistry of watersheds and is currently focused on understanding how urban systems impact water quality.

Andrew Gelderloos Andrew Gelderloos is a master's student studying water resources in the Department of Geology and Geophysics at the University of Utah. His research seeks to understand climate and landscape interactions that influence partitioning of precipitation in seasonally snow dominated watersheds in order to understand watershed sensitivity to future climate change and water supply demands.

Ramesh Goel Dr. Ramesh Goel is an associate professor of Environmental Engineering at the University of Utah. He obtained his PhD from South Carolina and post doctoral training form the University of Wisconsin, Madison. He was a visiting professor at EAWAG aquatic institute in Switzerland. He is currently serving as an associate editor of Water Research and Water Environment Research

Jennifer Graham Jennifer Graham, PhD, has been a research hydrologist with the U.S. Geological Survey in Lawrence, Kansas since 2006. Since 1997, Jennifer's research has focused on the effects of anthropogenic influence on aquatic ecosystems. She also is a nationally recognized expert in cyanobacteria and associated nuisance compounds. For the past seventeen years she has conducted research on environmental factors influencing the occurrence of cyanotoxins in the United States. She has conducted both regional and single system studies at a variety of spatiotemporal scales.

Brittany Van Grouw Brittany is a Master's student under Dr. Michael Barber at the University of Utah. While finishing her thesis, she is working part time as a Water/Wastewater Engineer at AECOM. She moved out to Utah from the east coast two years ago and is continually enthused with learning more about water in Utah.

Carly Hansen Carly is a PhD Candidate in Civil and Environmental Engineering at the University of Utah, working in the Urban Water Research Group under the direction of Dr. Steven Burian.

William Harris William Harris has been active in the environmental industry for over 25 years with an extensive and diversified background in stormwater management and treatment technologies. Mr. Harris has successfully introduced a variety of new and innovative stormwater treatment systems and products for use in private, public and industrial sector markets throughout the USA. In addition, Mr. Harris has extensive knowledge in regulatory

compliance measures including Low Impact Development (LID) principles and practices. Mr. Harris is a graduate of San Francisco State University with a certification in Environmental Assessment and Remediation from the University of California, Davis. Mr. Harris is also the President of the Stormwater Equipment Manufacturers Association (SWEMA).

Stacy Henderson Stacy is a Geology major attending SLCC/ Westminster. She plans to get her Bachelor's degree in Geology and Master's degree in Hydrology/Hydrogeology. Over the summer she interned with iUtah in their policy/ environment research focus area. She is interested in water use and conservation. In her free time she likes to mountain bike, hike, and camp with her dogs and husband.

Sarah Hinners Sarah Hinners, PhD is a landscape and urban ecologist on the faculty of the Department of City and Metropolitan Planning at the University of Utah, and the Acting Director of the Ecological Planning Center. She has a degree in Geography and Environmental Studies from McGill University in Montreal, and a PhD in Ecology from the University of Colorado at Boulder. She focuses her efforts as a researcher, educator, and community member on building strong, relevant, cutting-edge connections between research disciplines, particularly in the sciences, social sciences and engineering, and the practice of urban planning and design, to build cities that are resilient, healthy, and beautiful places to live.

Marian Hubbard-Rice Marian Hubbard-Rice is the Water Quality & Treatment Administrator for Salt Lake City Public Utilities. Before joining Salt Lake City, Marian was the Watershed Section Manager for Salt Lake County Watershed Planning & Restoration. She holds a Bachelor of Science in Biology and MPA in Natural Resource Management from University of Utah. She is currently working on a Ph.D. at University of Utah focusing on the energy-water nexus, which includes water quality analysis, BMP assessments, environmental policy, environmental justice, and an analysis of energy and environmental laws.

Yusuf Jameel Yusuf Jameel is a PhD candidate working with Dr. Gabe Bowen, at the department of Geology and Geophysics, University of Utah studying urban and natural water systems. He has been analyzing the connections between human population, climate, water extraction, water use, and water use impacts, in regions of climatic aridity and extensive land-use change, such as rapidly urbanizing areas across the western United States of America (USA). Using stable isotopes of water, he has developed methods to connect municipal water to its climatic source, calculate evaporative losses from regional water systems and characterize their spatiotemporal patterns across the water districts within the region. His work aims to increase our understanding of the interactions between climate, water supplies, consumptive uses and the hydrological cycle in the intermountain west. He is also working on quantifying the inorganic carbon budget (DIC) of the major rivers in the Great Salt Lake (GSL) basin using geochemical tracers, and understanding the variation in DIC among and within the rivers with respect to varying degrees of urbanization, land cover land used (LCLU) and agricultural practices along the rivers.

Paul Johnson Paul Johnson been studying turfgrasses his entire career, starting as an assistant golf course superintendent, and then in research at the University of Minnesota where he earned his PhD, at the University of Nebraska, and for the last 18 yrs. at Utah State University. His research and teaching with these little plants has been focused on understanding their biology and ecology. That knowledge has been applied to plant breeding efforts in bluegrasses, buffalograss, wheatgrass plus collection and evaluation of numerous turfgrass species for adaptation in the Intermountain West. Paul also applies that knowledge to improve management practices of turfgrasses for best plant and soil health, lowest inputs, and greatest benefits to the users. He is currently Professor and Department Head of the Department of Plants, Soils and Climate and a member of the Center for Water Efficient Landscaping.

Chris Keleher As Deputy Director of the Recovery Programs Office at DNR, I am responsible for administering the Endangered Species Mitigation Fund - a fund created by the Utah Legislature to aid in the recovery of species listed under the Endangered Species Act, and to conserve non-listed native species in an effort to avoid additional federal listings. My professional background includes work in conservation, research and management in fish biology and aquatic ecology.

Krishna Khatri Dr. Krishna Khatri is a Research Assistant Professor at the Department of Civil and Environmental Engineering, University of Utah. Krishna received his PhD in Water Resources Engineering (in the area of risk and uncertainty analysis) from Delft Technical University, Netherlands; MSc in Integrated Urban Water Engineering from UNESCO-IHE, Netherlands; MPA in development study and BE in Civil Engineering from Tribhuvan University, Nepal. He has more than 15 years of experience working with governmental organizations, consultancies, and higher education institutions in Nepal, UK, Netherlands, and USA. His main areas of expertise and interests include hydrological modeling; sustainable water resources and urban infrastructure system; risk and uncertainty analysis; and application of soft computing techniques for system modeling; and decision making under risk and uncertainty.

He has been working for iUTAH project to develop innovative frameworks, new methodology, and system models to analyze important interactions and interdependences within and among natural, built, and social systems, in order to enhance the resilience and sustainability of water resources and water infrastructure systems in Utah.

Ashley Kijowski I am a Wildlife Biologist at the Great Salt Lake Ecosystem Program (GSLEP) within the Utah Division of Wildlife Resources (UDWR). Here my duties are to develop research questions, prepare study design and conduct research in regards to the Great Salt Lake ecosystem. At GSLEP, we focus on managing the commercial brine shrimp fishery to ensure parity among harvesters and control the harvest to make certain the ecosystem needs are met. I began working at GSLEP in December of 2013. Before moving to Utah, I worked for the University of Wisconsin-Stout as a Crew Leader for an NSF funded grant aimed at studying the metacommunity theory in both permanent and ephemeral wetland habitats. I earned a BS from Illinois State University in Biology and Environmental Science and an MS from the University of South Dakota in Ecology with a focus on invertebrate community ecology and conservation.

David Kimberly Dr. David A. Kimberly is an Assistant Professor of Biology at Westminster College. With a background in environmental toxicology, a central goal of his research is to understand the role anthropogenic (human caused) stressors play in shaping components of natural ecosystems. Specifically, he considers anthropogenic stress in a larger context of stress in general and to examine interactive effects such as predators, climate change, habitat alteration, and contaminants. Three main themes that permeate his current research interests: ecotoxicology of reptiles and amphibians, ecotoxicology of freshwater systems, and evolutionary responses to environmental stressors. Students in his lab study a variety of topics, from the trophic transfer of mercury throughout biota on Antelope Island to the impacts of contamination on aquatic macroinvertebrate communities along the Wasatch front.

Meagan Knowlton Meagan Knowlton is a Sustainability and Environmental Specialist for Swire Coca-Cola, USA, a bottling company based in Draper, UT. She enjoys creating shared value for companies and the environment via environmental and sustainability initiatives. Her expertise lies in watershed health and water sustainability. She received a Master of Environmental Management with a concentration in Water Resources Management from Duke University. She also holds a B.S. in Environmental Science from Tulane University. Originally from Atlanta, Georgia, Meagan loves the beautiful mountains and hiking opportunities that Utah has to offer.

Lewis Kogan Open Space Lands Program Manager, Salt Lake City Parks and Public Lands.

Hanyan Li University of Utah

Gabriel Lozada My general field is microeconomic theory/mathematical economics. My area of specialization is the theory of exhaustible resource extraction and sustainability. "Theory" here means that I don't use empirical data in my research, just mathematical explorations of exploiting an abstract resource "x". Another interest of mine is the application of the Second Law of Thermodymanics (the "Entropy Law") to Economics (I have a BS in physics). I teach environmental economics (pollution), cost/benefit analysis, non-market valuation techniques, and renewable resource economics at the undergraduate and PhD levels.

Darin Mann Darin Mann studied English Literature at the University of Utah. He garnered a love for politics and the environment reading theorists and poets like Guy Debord and Robert Frost. His commitment to changing Utah's politics is only matched by his passion for the forests, rivers and lakes of Utah. When he is not at the office, you can find Darin in the ring getting bruised up by his boxing students or sitting under the shade of his favorite tree reading a book.

Michelle Mileham Michelle Mileham is the Director of Education at Tracy Aviary in Salt Lake City. Prior to moving to Utah, Michelle was a graduate student at Oregon State University where she finished her Master's and Ph.D. in Environmental Sciences and Education with a specific focus on museum education. She is interested in how museums use storytelling to understand their visitors, staff, and volunteers and studies how to provide the most engaging environmental education learning experiences for all audiences.

Theron Miller Education: BS Wildlife Sciences, Utah State University, BS Aquatic Sciences, Utah State University, MS Aquatic Toxicology, University of Alberta, PhD Environmental Biology and Ecology, University of Alberta. Career highlights: Fishery Biologist, US Bureau of Reclamation, Ecological aspects of largemouth bass reproduction in Lake Mead. Research Associate in Limnology, UNLV, describing the ecological effects of nutrient loads from Las Vegas treated wastewater on Lake Mead. Aquatic toxicologist, US EPA, focusing on discharges of toxic metals and ammonia on receiving streams nationwide. Commercial aquaculture, spawning and raising catfish, largemouth bass and goldfish. Consultant, improving water quality in drinking water source lakes in the far North (on and near the shores

of the Beaufort Sea) in the Northwest Territories. Scientist, DWQ, Nonpoint source coordinator, lakes assessment and wetlands program manager. Scientist, JR/FBWQC, nutrient and oxygen dynamics in Jordan River, Farmington Bay wetlands condition and beneficial use assessment methods development, Farmington Bay open water, eutrophication, cyanobacteria blooms and measures of beneficial use support.

W. Paul Miller Paul Miller currently works for the Colorado Basin River Forecast Center as the Service Coordination Hydrologist in Salt Lake City, Utah. Prior to joining the CBRFC in November 2012, Paul worked for the U.S. Bureau of Reclamation, Lower Colorado Region for about 7 years investigating the impacts of climate change to the Colorado River Basin. Paul received his B.S. in Environmental Hydrology and Water Resources from the University of Arizona in 2003, his M.S. in Environmental Engineering from the University of Notre Dame in 2005, and his Ph. D. in Civil and Environmental Engineering from the University of Nevada, Las Vegas in 2010. His dissertation was titled, "Assessment of Impacts to Hydroclimatology and River Operations due to Climate Change over the Colorado River Basin." He has also taught introductory hydrology and fluid mechanics courses at the University of Nevada Las Vegas.

Mallory Millington Mallory Millington is a 2nd year Master's student at the University of Utah. She studies the influence of urban land use and runoff affects water quality in a semi-arid mountain environment.

Michael Navidomskis Michael (Mickey) Navidomskis is an undergraduate student majoring in Civil Engineering and minoring in Environmental & Sustainability Studies at the University of Utah. He is a research technician who also is conducting independent research on nitrogen dynamics of the Jordan River under the supervision of Dr. Rose Smith in the the Department of Biology.

Alexis Nelson Alexis Nelson is a Biology/Pre-med student at Westminster College.

Jeff Niermeyer Jeff graduated from the University of Utah with a B.S. Civil Engineering. He has focused his career on water resource management. Prior to his retirement in January of 2016, he served as the Director of the Department of Public Utilities for Salt Lake City. He was appointed by Mayor Rocky Anderson in 2007 after serving as Deputy Director for the previous 10 years. Responsible for the overall water, sewer and storm water functions for Salt Lake City. Responsibilities included management of 185 square miles of watershed, source of water supplies, distribution of culinary water, irrigation systems, sewer collection and treatment, storm water collection and permitting. He was responsible for directing the implementation of the Department's programs to meet the City's obligations under the Safe Drinking Water Act and the Clean Water Act, budget development, program monitoring, water rights, water supply, and all contractual matters. He oversaw a combined annual budget of over $84,000,000 for three utility enterprise funds and a workforce of 400 employees. The three funds are for water, sewer and storm water. As Director, he was accountable for the capital improvement program for the Department. Projects included water, sewer and storm drainage infrastructure. Scope of projects involve waterlines, sewer lines, pumps stations, water tanks, pressure reducing valve stations, treatment plants and large diameter interceptors lines. Jeff was responsible for implementing a Storm Water Utility for Salt Lake City. This included developing overall Storm Water Master Plans for Salt Lake City. He wrote and implemented the City's storm water quality program required under the EPA storm water regulations. Jeff's continuing education includes study at Harvard University Program for Senior Executive and State and Local Government, Interest-Based Bargaining in the Public Sector - Federal Mediation and Conciliation Service, Thinking Getting Staying Competitive - Association of Metropolitan Water Agencies and numerous Emergency Management Courses – FEMA. Jeff is a Professional Engineer in Utah. He is a member of American Society of Civil Engineers, Water Environment Federation, American Water Works Association and the Association of Metropolitan Water Agencies. He is a past Chair of the Intermountain section of AWWA. Jeff is enjoying his retirement. He spent the summer 2016 bike packing 2200 miles of the Great Divide Mountain bike route through Montana, Idaho, Wyoming, Colorado and New Mexico.

Scott Olsen Imessa Research, LLC

Aiswarya Rani Pappu Aiswarya is a graduate student in Civil and Environmental Engineering at the University of Utah, focusing on Urban green infrastructures and greenhouse gases.

David Richards Dr. David Richards has been a research ecologist studying aquatic ecosystems throughout the western hemisphere since time immemorial. Dr. Richards earned a Masters of Science in Entomology, a Masters of Science equivalent in Statistics, and a Ph. D. in Ecology. He has his own successful consulting company OreoHelix Consulting. David reluctantly began studying the ecology of Utah Lake several years ago naively thinking it was just a degraded puddle not worthy of consideration. However, once he began to understand the lake, he was enthralled and moved to its shores this past year to be able to focus his research attention on this truly unique and wonderful ecosystem and how we might protect and restore Utah Lake.

Eli Robinson Eli Robinson is an AmeriCorps Intern with USU Water Quality Extension. He assists with program coordination of Utah Water Watch and education programs and enjoys working to move the program in new directions. He received a Biology Degree from Whitman College in Washington.

Jennifer Follstad Shah Dr. Jennifer Follstad Shah is an Assistant Professor (Lecturer) in the Environmental and Sustainability Studies (ENVST) Program and a Research Assistant Professor in the Department of Geography at the University of Utah. She also is affiliated faculty of the Global Change and Sustainability Center and the iUTAH Program. Jennifer is a freshwater ecosystem ecologist whose research examines the effects of global change (rising temperature, altered river flow, eutrophication, and biotic invasion) on microbial community ecoenyme expression and ecological processes, such as metabolism, decomposition, and nutrient cycling. She also is interested in the practice of restoration in river, riparian, and wetland habitats.

Rose Smith Rose Smith received her Ph.D in Geology from the University of Maryland and B.A. from Mount Holyoke College. For her PhD dissertation, Rose examined the role of urban stormwater and sanitary infrastructure on carbon and nitrogen loading as well as greenhouse gas emissions from streams in Baltimore, MD. Rose is currently a postdoctoral fellow examining nitrogen sources in human-impacted waterways with Gabe Bowen and Diane Pataki at the University of Utah and Carol Kendall at the U.S. Geological Survey and is affiliated with the iUTAH Program. Urban and agricultural landscapes are associated with excess nitrogen in streams and rivers. Nitrogen sources are often difficult to quantify due to spatial heterogeneity in inputs as well as biogeochemical processes. Using a combination of stable isotope tracers and spatial statistical tools, she aims to quantify the contribution of different nitrogen sources and in-stream processes to nitrogen cycling in rivers with urban and agricultural impacts.

Nicholas von Stackelberg Nicholas von Stackelberg is an environmental engineer with the Utah Department of Environmental Quality. Nicholas has worked on water resources and water quality projects for twenty years with several consulting firms and governmental agencies in Seattle and Salt Lake City. In his current position with the Division of Water Quality, he is responsible for water quality modeling to support discharge permitting, total maximum daily load studies and standards development. He also manages the antidegradation program and provides support to the nutrient reduction program. He received his Bachelor of Science in Civil Engineering from the University of Washington and Masters of Science in Biological and Agricultural Engineering from North Carolina State University. Nicholas is a registered Professional Engineer in Washington and Utah

Melissa Stamp Melissa Stamp has worked as a Project Coordinator for the Mitigation Commission since November 2015. Prior to joining the Commission, she worked as an Education Assistant at Red Butte Garden developing educational mobile games, teaching summer camps, and leading school field trips. Ms. Stamp also spent many years as an environmental consultant working on various water resource projects in Salt Lake County and beyond. She holds an M.S. in Watershed Science from Utah State University and a B.A. in Geography.

Court Strong Dr. Court Strong is an Associate Professor with tenure in the Department of Atmospheric Sciences at the University of Utah. He is an expert in the simulation and analysis of climate dynamics with special interest in the cryosphere (the frozen portion of the climate system including mountain snowpack). He is co-principal investigator on the $20M iUTAH project focusing on water and climate in Utah, and he led high resolution modeling of climate change for Utah and Wyoming as part of the $5M CI-WATER project funded by the National Science Foundation. Dr. Strong is author on more than 35 peer-reviewed publications and has delivered 30 invited or keynote talks on climate. He participated in roundtable discussion on climate with EPA Administrator Gina McCarthy in 2014, and is a member of the Climate Team that developed "Summary of climate change understanding and projections for the Mountain Accord" (www.mountainaccord.com). Dr. Strong served as an invited expert reviewer for "Assessment of Climate Change in the Southwest United States: A Report Prepared for the 2013 National Climate Assessment," and briefed Salt Lake City Mayor Ralph Becker for his appointment to White House State, Local, and Tribal Leaders Climate Resiliency Task Force in 2013.

Anne Terry Anne Terry is Education Manager at Tracy Aviary. She got her start in environmental education by volunteering at a zoo in Texas at the age of thirteen and quickly realized it was the field for her. She has a B.S. in Biology from the University of Texas. An internship with the City of Austin Watershed Protection Department introduced her to watershed education, and in her four years at Tracy Aviary, she has enjoyed finding new ways to connect people to their watersheds. She loves bike commuting (and all sustainable transportation), yoga, and of course, birding.

Robert Thompson Robert Thompson manages the Salt Lake County Watershed section and is a professionally licensed Geologist in the state of Utah. He specializes in fluvial geomorphology and the restoration of fluvial systems. He has

a background in water quality data collection, restoration design, construction and monitoring and education. His outside interests include river running, cycling and trail running.

Brian Tonetti Brian Tonetti is the Co-Director, as well as a founder of the Seven Canyons Trust. He is also the Program and Policy Planner at the Jordan River Commission. He graduated from the University of Utah with a BS in Environmental and Sustainability Studies and Urban Planning.

Laura Vernon Ms. Vernon, Land Use Planner and the Forest Legacy Coordinator for the Utah Division of Forestry, Fire & State Lands. Over the last 15 years, Laura Burch Vernon has worked with federal, state, and local governments and industry leaders on contemporary planning and environmental policy issues in the West. Her education and professional experience focuses on land use planning, public involvement, socioeconomic analysis, project management, and technical writing. Laura received her Master of Public Administration from the University of Utah in 2003. She served as the project manager for the Forestry, Fire & State Land's Great Salt Lake Management Plan, and is currently overseeing completion of the Jordan River Comprehensive Management Plan and the Integrated Water Resources Management Model.

Weihong Wang Dr. Weihong Wang is an Assistant Professor in the Department of Earth Science at Utah Valley University. She graduated with a Ph.D. degree in Marine Science from the University of South Carolina in 2008. Her research interests include Carbon Dynamics in Wetland Ecosystems, Climate Change and Sea Level Rise, and Energy Use and Sustainability. Her current research is focusing on using multi-proxies, such as stable isotope, trace metal, 210Pb and 14C dating, sediment particle distribution analysis, GIS spatial analysis, etc., to investigate anthropogenic impacts on Utah Lake and its surrounding wetlands.

Tom Ward Tom Ward obtained his Civil & Environmental Engineering degree from Gonzaga University and has focused his career on environmental studies, design, construction and management of water/wastewater conveyance, treatment, flood control and water quality systems. Tom's career includes design, grant funding and construction of several river restoration projects in Washington, Idaho, Nevada and Utah, including constructed wetlands, fish ladders, and natural floodplain restoration projects on the Jordan, Provo, Virgin, Santa Clara, and others with conjunctive benefits for water quality, habitat, recreation, flood control and water supply. Tom is currently Deputy Director of Salt Lake City Public Utilities and excited about the challenges and opportunities for further conjunctive improvements in the greater Wasatch, Jordan River and Great Salt Lake watershed.

Erna Waterman Erna has worked as a project manager in the EPA Superfund Program for 25 years, in addition she worked for a year in the RCRA permit program for a year. She has both a civil engineering and geology degrees and enjoys working on Utah projects.

Sandy Wingert Sandy Wingert is an Environmental Scientist who has worked for the Utah Division of Water Quality for past 9 years. She got her Master's degree in Environmental Health from the University of South Carolina. For the State, she is charged with all things related to water quality in both the Upper Provo River and Jordan River watersheds. She assesses waterbodies to determine if they are polluted, and if so then develops a restoration plan. She is currently developing Total Maximum Daily Loads (TMDLs) for several impaired rivers within these watersheds as well as implementing restoration efforts to target pollutant loading. In her spare time, Sandy enjoys spending time with her young family as well as getting outside to rock climb and bike.

Cora Winters Cora Winters is a Biology/Pre-vet student at Westminster College

Jake Wood Undergraduate research assistant working under the mentorship and supervision of Dr. Eddy Cadet, PhD

Weston Wood Weston Wood is currently finishing his H.B.S. in Communication Studies and Political Science at the University of Utah, and is passionate about the intersection of power and ecology in both study and practice. Weston interned with the organization in Fall of 2015 and is thrilled to continue to work on a variety of conservation, research and outreach initiatives at the URC. He grew up getting to know the wonder of Utah's wild watersheds and is dedicated to their defense. When not in the office or buried in books, Weston is likely escaping into our conifer forests or desert shores.

Marc Yaggi Marc Yaggi is Executive Director of Waterkeeper Alliance, the largest and fastest growing nonprofit solely focused on clean water. Marc has dedicated his entire career to environmental advocacy and has been instrumental in expanding the Waterkeeper movement around the world for nearly 20 years. Marc leads with a deep, personal passion for clean water and provides organizational leadership by developing strategic partnerships and promoting the Waterkeeper model of advocacy. Marc works daily to raise public awareness about the issues central to the

organization's vision for swimmable, drinkable, fishable water worldwide. Before joining Waterkeeper Alliance, Marc was a Senior Attorney and Watershed Program Director for Riverkeeper, Inc., where he worked to protect the 2,000-square mile watershed that serves as New York City's drinking water supply. Previously, Marc served as a Staff Attorney with the Environmental Law Institute in Washington, D.C. In addition to authoring numerous articles, Marc has appeared in publications like The New York Times, The Guardian, and Politico, and his quotes have been picked up by wire services such as AP, Bloomberg, and Reuters. For the past two decades, he has inspired audiences all over the world with keynote speeches, conference panels, and corporate seminars. Marc has a degree in Administration of Justice from The Pennsylvania State University and a J.D. and an LL.M in Environmental Law from the Pace University School of Law. He lives in Brooklyn with his wife and two children. They love getting out on the water as a family as often as they can.

Annie Young Annie Young is an educator at Tracy Aviary. Having studied at the University of Portland, she received her B.A. in International Languages and Culture focusing on Spanish, along with double minors in Biology and Chemistry. She found her passion for environmental education through an internship at Tracy Aviary focusing on education about watersheds, riparian habitats, and water conservation. In her free time Annie enjoys creating ceramic pottery, hiking and any activity that includes coffee.

Notes