FRIENDS of *Great Salt Lake*

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Volume 26 Number 3 Summer 2018

Rainbow Sunset from Buffalo Point
Photograph by Wayne Wurtsbaugh
Submitted for the 2017 Alfred Lambourne Prize

The mission of FRIENDS of Great Salt Lake is to preserve and protect the Great Salt Lake ecosystem and to increase public awareness and appreciation of the lake through education, research, advocacy, and the arts.

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Executive Director's Message

The Responsibility to Sustain the Great Salt Lake Ecosystem in Perpetuity Falls Squarely on the Shoulders of the State of Utah

"The Lake is as essential to who we are and what we are as anything. When Great Salt Lake is in peril, the state is in peril. "
–Warren Peterson, State Water Strategy Advisory Team Co-chair

On March 23, 2018, water right application No. 23-3972 was filed jointly by the Utah Division of Water Resources, and the Water Resources Board of Idaho for 400,000 acre.-ft. of Bear River water. The application was filed with the Utah Division of Water Rights and proposes to store, and appropriate water that would normally be released from Bear Lake or bypass Bear Lake as a part of flood control during spring runoff. The sources of this water would include:

1) "The Bear River" (which provides the lion's share of in flows, 60%, to Great Salt Lake)

2) "Flood control releases tributary to Bear River"

3) Bear Lake inflows "tributary to Bear River"

Got that?

Beneficiaries of this stored and appropriated water would include agricultural irrigators within the Bear River Basin in Utah and Idaho, together with municipal and industrial users in selected counties in southern Idaho and along the Wasatch Front. And, although recreation and the environment have been gratuitously tossed into the mix of these beneficiaries, it's too early to say what that would look like. The Division of Water Resources (Water Resources) is emphasizing that the only way to provide insightful scenarios to answer questions being raised about volume, distribution, timing of flows, and environmental impacts or benefits to Bear Lake and Great Salt Lake will come through improved modeling of the Bear River system. Currently, the model of the system stops at the state line between Utah and Idaho. To develop a more comprehensive understanding, modeling needs to extend to the river's headwaters in the High Uintas. This will take months, money, and an interstate effort.

It should be noted that Idaho had initially intended to file the Bear River water right application on its own. However in February, Utah was invited to participate, as was Wyoming–which declined. I do wonder what might have happened if Utah had not been asked to file jointly.

Although many people were surprised by the news when it was finally made public more than a week after the filing, it's fair to say that the Division of Forestry, Fire and State Lands (State Lands) and PacifiCorp were totally blindsided.

State Lands is a sister division with Water Resources in the Department of Natural Resources. Its jurisdictional responsibility is to manage the Great Salt Lake Ecosystem as a public trust resource in perpetuity for the people of Utah. About a year ago, it completed a multi year process to develop a tool called the Great Salt Lake Integrated Water Model (GSLIM). The price tag for that was $400,000. The purpose of this model is to help State Lands manage the Lake and its resources more effectively by taking into account upstream diversions in the watershed. To say the least, this water right filing would be a significant factor in that management dynamic and until the revised Bear River model is incorporated into the GSLIM no one can fully predict how various scenarios of Bear River storage and future development will alter the Lake.

PacifiCorp has been operating on the Bear River since practically the dawn of creation. It's a source of hydroelectric power in Utah and Idaho, delivers irrigation water to stakeholders along the Bear River, and operates the top 21.65' of Bear Lake as a storage reservoir for flood control. Through court decrees, the Bear River Compact, and other settlement agreements, PacifiCorp has legal and contractual responsibilities that it is expected to meet. At the very least, in both the interest of working to achieve affective interdivisional communication, as well as promoting the practice of interstate comity, you would think that these two key stakeholders would have been notified in advance of the filing.

It's difficult not to confuse this joint water right application with the Bear River Development Project because the initial amount of water that Utah and Idaho can develop under the Project is the same–400,000 acre-ft.–sort of. And although Water Resources says that this water is for flood storage in Bear Lake and not for development, it's troubling nonetheless. It's troubling because the annual flow of Bear River into Great Salt Lake is about 1.2 million acre-feet. And the basic fact here is that taking water out of the Bear River system is taking more water out of the system. And that's a lot of water and the Lake can't afford it. So we've got to push the pause button, comment and protest, and require the necessary scrutiny that the Lake deserves. If the application is approved by Utah and Idaho water authorities, we need to be sure that at the very least, there is no net decrease, and indeed, that additional water comes to the Lake.

But more to the point with this filing, it is a clarion call for Great Salt Lake's future. This will be the first of many water claims on the Lake that will succeed in its demise of a death by a thousand cuts unless we declare our intention to save it NOW!

When the Bear River Compact was amended in 1980, it allocated ALL the waters of the Bear River to Utah, Idaho and Wyoming– and none for the Lake itself...so much for Utah's last untapped water source. These allocations include additional storage of 75,000 acre-ft. above Bear Lake, and additional depletion/consumption of 400,000 acre-ft. below Bear Lake, which is something we should all find unconscionable. The first right to develop and deplete would go to Idaho (125,000 acre-ft.), and then to Utah (275,000 acre-ft.). If there is anything left beyond that depletion, Utah and Idaho can each deplete an additional 75,000 acre-ft. of water. Any remaining water would be divided up on a 70/30 basis. This would be a total depletion of 550,000 acre- ft. of

Bear River water and the demise of Great Salt Lake as we know it. Average lake elevations would hover between 4192' and 4194' for extensive periods of time (20-40 yrs) exposing untold thousands of acres of lakebed to potential dust events, navigation and recreation would be severely impacted, Gunnison Island, home to the 3rd largest breeding population of American White Pelicans in North America would be exposed for periods of 40 years, migratory bird use and habitats would be in trouble, and all industries including the brine shrimp fishery would be significantly impacted. Just because we can doesn't mean we should.

In Leia Larsen's April 4th Standard Examiner article about the UT/ID water right, Eric Millis, Water Resources director and Bear River Commissioner said, "It is water that would've gone to Great Salt Lake, that's true. I think in the discussion we have to have, we'd be looking at what we are doing to and for Great Salt Lake in all of this."

What's important to remember in this conversation is how critical timing and the volume of inflows to the Lake are. There is a direct effect on lake levels that in turn influences ecological dynamics and economic values of the system. That's why in this newsletter we have included a protest filed against application No. 23-3972 by Dr. Wally Gwynn. Although no formal public notification of the application has been made yet, when the news of the joint filing became public, protests were immediately being filed. Gwynn has calculated how 400,000 acre-ft. of Bear River inflows to Great Salt Lake at different elevations has a significant impact on salinity, the brine shrimp fishery, migratory birds, and mineral extraction. When you fold climate change into the mix, you'll see how that amount of water flowing into the Lake from the Bear River provides a critical cushion for the system. Without this cushion there will be dire consequences to the Lake. In the initial characterizations of the joint filing by Water Resources about how Great Salt Lake could fit into the "Win-Win-Win" outcome it envisioned, water to the Lake would be too little and too late to address the cushion Gwynn identifies.

Since Great Salt Lake belongs to all of us as a public trust resource, Water Resources is conducting a scoping process. It's an attempt to bring stakeholders up to speed on this issue, hear our questions and concerns, and engage us more fully. To date, Water Resources has met with 33 different stakeholder interests that include representatives from Idaho and Wyoming, PacifiCorp, water conservation districts, conservation, recreation, and GSL interests, the Great Salt Lake Advisory Council, the State Water Development Commission, GSL Technical Team, and members of the Executive Water Task Force. One useful outcome from all of this would be a scoping document that reflects this comprehensive input and provides a responsible basis for moving forward on this front.

The State Engineer of Utah and Idaho's comparable authority have been asked not to act on the filing by putting it out for public notification. At the very least, modeling the entire Bear River system, generating various scenarios from the modeling, incorporating those scenarios in the Great Salt Lake Integrated Water Model, and including the scoping results should be a prerequisite to going "public." Once that public notification happens, there is a 2-week notification period followed by just a 20-day public comment period during which time protests can be filed with the State Engineer. Confusingly, protests can also be filed now–before the filing is public. The application can be reviewed at: www.waterrights.utah.gov Comments can be emailed to waterrights@utah.gov or mailed to Utah Division of Water Rights, 1594 West North Temple, Suite 220, P.O. Box 146300, Salt Lake City, Utah 84114-6300. All comments and protests should reference Water Right 23-3972.

On April 17th, the Bear River Commission met at the Department of Natural Resources to discuss public input that began a year ago as a part of a 20-yr review of the Bear River Compact. Article 14 in the Compact provides this unique review opportunity for the Commission to consider any reopening requests and/or amendments proposed through this process. If after extensive study and review the Commission agrees to support amending the Compact – a Herculean prospect to say the least – "amendments would require approval of all three states, ratification by their respective legislatures and approval by all three governors, as well as consent by Congress and approval by the President."

During this 20-year review process, 67 written comments were received. Five of them requested reopening and amending the Compact. As one of them, FRIENDS urged the Commission to recognize and incorporate a greater understanding of Great Salt Lake, its ecological significance and economic importance into the infrastructure of the Bear River Compact and management of Bear River. A telling remark from one of the Idaho Commissioners that made my jaw drop was that, although it was clear that there are values and concerns about Great Salt Lake that need to be addressed, it was Utah's problem. The Commission passed a resolution not to amend the Compact. However, the Commission voted to refer a request to its technical committee to study a recommendation for some kind of mechanism or committee for environmental concerns that could be incorporated into the management considerations. This will be revisited at a future meeting.

It's been a year since FRIENDS and 40 other members of the State Water Strategy Advisory Team presented the July 2017 Recommended State Water Strategy to Governor Herbert. The Strategy is a timely and responsible outcome that is intended to begin laying the foundation for a necessary dialogue about water policy and collaborative decision-making for the second most arid state in the nation, one that continues to grow.

Given what we know about the fate of the Bear River and how diversions and development will impact the Lake, we need to build collaborative partnerships and find solutions that will work. We don't have the luxury of time. The Lake will not wait for us. Although the responsibility to sustain the Great Salt Lake Ecosystem in perpetuity falls squarely on the shoulders of the State, it's up to us to make sure that happens.

In saline,
Lynn

Friends' Organizational Statement

Founded in 1994, FRIENDS of Great Salt Lake is a membership-based nonprofit 501c3 with the mission to preserve and protect Great Salt Lake ecosystems and increase public awareness and appreciation of the Lake through education, research, advocacy, and the arts. The long-term vision of FRIENDS is to achieve comprehensive watershed-based restoration and protection for the Great Salt Lake ecosystem.

FRIENDS of Great Salt Lake sponsors programs related to our mission statement: Lakeside Learning, the Doyle W. Stephens Scholarship, the Great Salt Lake Issues Forum, and the Alfred Lambourne Prize.

Lakeside Learning Field facilitates 2.5 hour inquiry-based educational field trips for 4th grade students. The trips combine informal environmental education strategies while incorporating science, technology, engineering, art and math (STEAM) to reinforce the Utah Common Core State Science Standards. Lakeside Learning emphasizes learning through participation.

Within the research component of our mission, we sponsor the Doyle W. Stephens Scholarship for undergraduate or graduate research on Great Salt Lake ecosystems. Established in 2002, the scholarship supports students in new or on-going research focused within the Great Salt Lake watershed. Recent project winners span the effects of changing salinity on microbialites to the impacts low water levels in Great Salt Lake have on Utah's air quality.

FRIENDS is actively involved in advocating for Great Salt Lake. Every two years, FRIENDS hosts the Great Salt Lake Issues Forum to provide focused discussions about the Lake for a variety of stakeholders including policy makers, researchers, and industry leaders. Each Forum engages the community in constructive dialogue regarding the future of Great Salt Lake.

In 2014, FRIENDS established the annual Alfred Lambourne Prize for creative expressions of our Inland Sea in the categories of visual art, literary art, sound, and movement. FRIENDS celebrates the relationship between local artists and one of Utah's most precious natural resources, Great Salt Lake. Through artistic expressions, we enhance our capacity to build awareness about the Lake and our need to preserve and protect it for the future.

FRIENDS maintains a Board of Directors and Advisory Board composed of professionals within the scientific, academic, planning, legal, arts, and education communities. Staff members include, Lynn de Freitas, Executive Director; Holly Simonsen, Membership & Programs Director; and Sarah Radcliff, Education & Outreach Director.

Black Rock Summer 2015
Painting by Kirk Henrichsen
Submitted for the 2015 Alfred Lambourne Prize
See more at kirkhenrichsen2015.fineartstudioonline.com

On the Cover

"During November of 2013, my wife and I spent a day on Antelope Island with San Francisco-based photographer, Dan Fox, compliments of a winning bid at a fundraiser for Stokes Nature Center. We spent most of the day photographing bison, which had caught Dan's attention, but near dusk we hiked up to Buffalo Point and were treated to this unusual rainbow sunset over the lake. Over the past 35 years, most of my time at Great Salt Lake has been out on the open water taking samples and viewing distant shorelines, but this was a special day for us, as it reminded us of the stark beauty of the lake and the many surprises it offers. With the efforts of FRIENDS and others concerned about keeping water in the lake, we hope it will continue to inspire others for generations to come." —Wayne Wurtsbaugh

Creative Expression Inspired by Our Inland Sea

Serenity
Photograph by David Terry
Submitted for the 2017 Alfred Lambourne Prize

The peace and serenity of yoga combined with the beauty of the Great Salt Lake at sunset creates wonders beyond the ordinary and into the extraordinary. Terry's photograph features Acro Yoga models, Eddy Goh and Morjan Sjoblom.

The Bear Lake Connection

Bear Lake has been described at the oldest, continually "wet" lake in North America, one of the five oldest in the world. It was in existence when Lake Bonneville filled the valleys below. No – it is not a remnant. Bear Lake is higher in elevation than Lake Bonneville was and MUCH higher than the Great Salt Lake and that begins our story of connections.

Emerald among the mountains…
Most beautiful lake…
Waves of blue…
Incomparable…
Vivid coloring…

This is how the explorers, trappers and settlers described the beautiful lake that we now call Bear Lake. It was an incredibly unique combination of features created by natures forces. The deeper part of the valley, caused by faulting, had walled itself off from the Bear River that would often spread out and flood the valley floor.

This "disconnection" was key to its beauty. Bear Lake's crystal-clear waters that give off the vivid colors of blue were the result of the un-tainted water quality and the unique chemistry of the limestone rock through which the waters percolated before entering the lake by way of mountain streams, springs and ground water. Some of the connections and chemistry are still a mystery.

The marsh to the north was also a "distinctive feature" as described in an early report to congress: "Here is found the distinctive feature of this drainage basin the peculiar lake and marsh, which act as a great natural reservoir, or rather as an equalizer of the flow of the lower Bear River. The river does not, as shown on the Land Office maps, enter the lake, but passes along in front of or below the open lake, meandering through the great marsh or level plain. In times of high water it spreads out through and over the marsh and its waters back up into the lake. In times of drought the marsh dries, much of it becomes good hay land, and the water from the lake finds its way through tortuous channels down to the river" (Report of AH Thompson in 11th Annual Report of USGS, Part II-Irrigation).

Settlers, seeking the beautiful lands and freedoms of the open west, settled in the valley to start new lives and create new livelihoods for which land and water were the main ingredients. They found both in this Bear Lake valley. Above the lake, they harnessed the local creeks to irrigate farming and fruit orchards. The water in the lake served other purposes: commercial fishing of the large and abundant cutthroat trout, a major means transportation, and yes, even then, "recreation"– a refreshment of strength and spirits after days and weeks of work, it brought joy to people's lives.

With no air conditioning in the valley communities, it didn't take long for folks to seek out the pleasant days of Bear Lake summers. Its shorelines became a respite from the hot valleys below. People came from far and wide to enjoy the lakeside nature, beauty, and even music and dancing.

Bear Lake, photograph Courtesy of NASA

Meanwhile, down in those valleys below, people had land

and they had rights to use the water from the Bear River which flowed heavily during the spring, but by the heat of summer often fizzled out. It was difficult to harvest a good crop during the low water years. So, they also looked high in the mountains, to a Bear Lake that, seemingly, had "room" to hold some of the springtime runoff… If they could just figure out a way to get it in there and then out again when they needed it. Early-on, there were several attempts at this, but none were successful.

Then, along came a new wave of the Industrial Revolution, at first it was powered by fire and steam, and then came the generation of electrical power, doing work more quickly and efficiently than man-power. It changed the world.There were many on-going experiments by the inventive and industrious. Each creating their own little world of power generation and uses. Much of this was by burning coal which, even then, people realized was dirty and unhealthy for people.

Then, an old idea became a new idea! Hydropower–rather than using falling water to just turn the mills, use it to turn electric generators to power mines and industries, light up cities, and eventually light rural towns and homes. Because the elevation drop from Bear Lake to Great Salt Lake is substantial. If harnessed, it was a gold mine of energy. A new era of connections and disconnections began.

This innovation also needed the combination of storing water up high, to take advantage of every foot of elevation change, and the flexibility to release it when desired. Plans evolved that could provide for both, electricity and grow crops along the way–seemingly a perfect connection.
A swell idea…We will just store the springtime water in Bear Lake and use it in the summer, and all will be well. Except the water doesn't always come in the spring so maybe we'll need enough for another year oh, and maybe the year after that… Eventually this theory was applied and created great benefit for the industries and agriculture lands connected to it. The lake was not built-up or raised higher, but a great caisson was sunk deep into the natural barrier that would house pumps to draw the water up over 20 feet and out of the lake, making a very deep connection between lake and river.

But what of the disconnect? An abundant replacement water supply didn't always come out of the mountains in the springtime, and the connection of drought and the growing demand for power generation caused long and deep drawdowns on Bear Lake, leaving some tracts of lake-bed disconnected and exposed for many years. This cycle had been repeated many times over the last century, each time leaving the effects of lakebed over run with foreign sediment and vegetation–business and property lost.

This has been the plight of Bear Lake–right up to this day. Great plans were made for the use of the water, but no plan was ever made for the lake, as a whole, nor any regard given for the lands and the people surrounding the lake.

Until on a day in the 1990's, when some people, who loved Bear Lake, finally said "Enough! We must find management strategies that will protect the lake and its environment from degradation and ruin." In the home of friends on a pleasant summer's eve, Bear Lake Watch was born, when a small group pledged their time and treasure to preserve Bear Lake.

The multitude of people who appreciate this beautiful treasure, granted at statehood, are so grateful to Merlin Olsen, Jim Kimbal and the other brave founders of this organization. Their bold actions brought accountability and limitations to the use of the waters of Bear Lake.

This was a giant stride and very important for all who love Bear Lake, yet the work goes on. It is our hope that, again, through technology, persistence and ingenuity of man, that we will find new ways to reduce the draw on the waters of Bear Lake and other natural systems.

Bear Lake, photograph courtesy of CarolAnn Dyer

A lake is more than water! It is all that is in, under and around this natural wonder that was shaped by the forces of nature and now used by mankind. The forgotten forces: water, wind, waves, sand and ice have shaped and defined this lake for centuries. We have been keeping them from their duty by moving the water away from the true shoreline.

As long as society uses this beautiful lake as a reservoir, the detrimental impacts will continue to mount. It will be up to us, this organization, Bear Lake Watch, to again take the action. Our quiver needs to be filled with science, data, logic, and common sense. Working together and facing the problems, we, as a society, can again, revolutionize the ways of the past. We just need to make the connections.

We are excited to continue the connections with our FRIENDS of Great Salt Lake and others with honest desires to improve the world we live in.

Claudia & David Cottle
Executive Directors
Bear Lake Watch

Class V Waste Disposal at the Promontory Point Landfill Presents Unacceptable Risks to Biota and the Ecosystem of Great Salt Lake

[This article is a condensed version of a white paper submitted by the GSL Institute and sent to Allan Moore at the Division of Waste Management and Radiation Control regarding the Promontory Point landfill request to receive Class V waste. The white paper version is entitled "Risks to Biota and the Ecosystem of Great Salt Lake from the PPL with Particular Emphasis on Potential Harm to the Brine Shrimp (Artemia franciscana) Population". It was written on behalf of the Great Salt Lake Brine Shrimp Cooperative, Inc., Ogden Utah. The white paper is posted on the FRIENDS website: www.fogsl.org/advocacy/land-use]

Although Promontory Point Resources LLC (PPR) withdrew its application on February 16, 2018, for a Class V permit, there remains concern that this is a temporary delay in the effort to obtain regulatory permission to dispose of Class V waste at the PPR facility. Of particular interest in obtaining the Class V permit is the ability of the PPR to accept coal combustion residue (CCR) waste (SLTRIB, 2017; UDEQ 2017). There is evidence to conclude that such waste disposal at the PPR site represents an unacceptable risk to the integrity of the GSL ecosystem.

Great Salt Lake Constellation (Artemia franciscana), photograph courtesy of John P. George

Evidence of such risk is documented both within the USA and internationally in the accounts of damage to ecosystems by accidental or intentional discharge of CCR waste. Not only are there many media reports documenting the impact of CCR waste on the environment, there is also a large body of peer-reviewed, scientific evidence over the past half-century that reveals that such discharge into the environment has caused extensive long-term damage to biota and to water quality. The economic cost of such discharges of Class V waste into ecosystems has resulted in mitigation and cleanup costs that are in the range of tens to hundreds of millions of dollars on an annual basis for each contaminated site (Gottleib, Gilbert and Evans, 2010; Lemly, 2015) and there are examples of single sites where the damage mitigation costs are in excess of a billion dollars (Deonarine et al., 2014; TVA, 2009). The most extensive and prolonged damage from CCR waste occurs when the waste enters an aquatic system (Rowe et al., 2014; Ruhl et al., 2012, Ruhl et al., 2010; Rowe et al., 2002). Damage occurs from contaminants, such as heavy metals and selenium, and non-contaminant effects such as smothering of benthos or lethal changes in water quality (Carlson, C. L., & Adriano, D. C. 1993; Furr et al., 1979). A distillation of all of the research on Class V CCR waste risks to the environment leads to one conclusion—**CCR waste should never be disposed of in close proximity to any surface or ground water source.**

The details of Class V CCR waste impacts on ecosystems can be illustrated by many examples in the USA. Reports by the USEPA and by private organizations such as the Environmental Integrity Project (EIP) have shown a high percentage of sites that are high or significant hazards out of those surveyed (e.g., High Risk or Leaking sites/Total # Sites: 559/676, 563/1161, 67/85) (EIP, 2012; USEPA, 2014; USEPA, 2007). The majority of damaging discharge of CCR waste into surrounding environments is the result of surface impoundments or failure of landfill due to flooding or other events that exceeded the capacity of the site to contain waste (Lemly and Skorupa, 2012; Blight and Fourie, 2005). Recognizing that the PPR site is reported to be between 500 and 1,800 feet of the shoreline of Great Salt Lake (GSL), the level of potential harm to the ecosystem is magnified by this proximity and represents an unacceptable risk.

Class V CCR waste must be disposed of with great care and in areas with essentially no linkage to aquatic systems. To address this need there are many sites around the country, and within Utah, that are reasonably suitable for such disposal—Utah alone has 4 Class V waste facilities. The Utah Department of Environmental Quality (UDEQ) has pointed out that the state currently has a sufficient number of Class V waste facilities and is not in any need of more of this type of landfill. The amount of waste proposed to be received by PPR at its site is estimated at over 100 million tons and it is likely to contain toxic elements. Toxic trace elements commonly found in CCR include arsenic, cadmium, cobalt, copper, lead, mercury, selenium, uranium and zinc (Rowe, 2014; Vassilev and Menendez, 2005). Among the many identified contaminants known to found in CCR, Ni, Co, As, Cd, Se, and U are found in leachate well above relevant environmental quality standards (Wang et al., 2008). One of the concerns about CCR waste is that in spite of known contaminants such as heavy metals, selenium and radioactive isotopes, the CCR waste is not labeled as "contaminated". This is the result of a variety of regu-

String of Pearls, photograph of Promontory Mountains courtesy of Charles Uibel

latory and economic considerations that have precluded regulators from assigning such waste as contaminated under Subtitle C (special waste--contaminated) rather than its current status as Subtitle D (non-hazardous) of the Resource Conservation and Recovery Act (RCRA) (Korb, 2012). In spite of its designation as "non-hazardous," CCR is typically contaminated with known hazardous elements.

Among the contaminants that are found in CCR ash, most are quite toxic to aquatic organisms and cause severe harm to both lentic (i.e., ponds, lakes and reservoirs) and lotic (i.e., creeks, streams and rivers) systems (Rowe, 2014; Rowe, Hopkins and Congdon, 2002; Yount & Niemi, 1990). Of the contaminants typically found in CCR waste, even a small additional discharge into GSL could place concentrations above thresholds that cause multi-trophic level damage to the ecosystem (Ohlendorf et al., 2009; Naftz et al., 2008). Because of the sheer volume of CCR that is typically disposed of in a receiving facility, even low concentrations of contaminants have the potential to harm ecosystems if CCR waste or leachate enters a receiving waterbody. In addition to the risks of contaminants, CCR waste also has the pronounced capacity to cover and suffocate the critical community of organisms found in the bottom of lentic or lotic systems (Lemly, 2015). This is a particular risk to the Great Salt Lake in which current research is illustrating the essential role that benthos serves in terms of nutrient cycling, biotic diversity and ecosystem integrity (Wurtsbaugh et al., 2011; Diaz et al., 2009; Naftz et al., 2008).
These are but a few of the economic and ecological reasons that Class V waste should not be disposed of at the PPR site. Based on our review of the proposed Class V waste disposal at the PPR site, there are three main conclusions that are quite clear:

1) An analysis of the history of ecological and economic damage from CCR waste disposal demonstrates that it should not be located near a waterbody and therefore not adjacent to Great Salt Lake.

2) There is no demonstrable need for another Class V waste disposal site in Utah—there currently is sufficient capacity of Class V waste sites already in operation.

3) The potential economic gain of 2 to 20 million dollars and 18 to 30 jobs is miniscule compared to the verified 1.32 billion per year and 7,706 full time jobs that come from a healthy GSL ecosystem. Discharge of CCR waste into GSL could destroy these dependent jobs and industries and result in billions of cleanup costs and damage that could extend for decades or longer.

Considering the hazard risks, the potential economic damage and the lack of a need for a Class V waste site the amendment of the PPR permit to include Class V waste should be denied.

Brad Marden, Senior Research Scientist, Parliament Fisheries, LLC Ogden, UT

Proposed Water Right No. 23-3972:
The Tip of a Wedge Leading to the Potential Demise of Great Salt Lake

Water Right 23-3972, as put forth by the Idaho Water Resource Board, State of Idaho and the Utah Division of Water Resources, is a well-thought-out plan to utilize water that would have been released from Bear Lake or bypassing Bear Lake for flood control purposes. Such water would be used for municipal and irrigation purposes. These uses, however important, deplete the amount of water that would otherwise reach Great Salt Lake during the spring runoff.

Of what importance is the subject 400,000 ac. ft. of water to Great Salt Lake? The fifteen protest letters associated with this Water Right application give some insight into the concerns of citizens, though most do not provide supporting information.

On the broad picture, Great Salt Lake, like many other saline lakes around the world, is in danger of disappearing. The main reason is water for irrigation. Take for examples our own Sevier Lake, Mono Lake, the Aral Sea, Lake Urmia, and the list goes on. Unfortunately, the proposed water right, along with a changing climate, are just the tip of another wedge leading to the potential demise of Great Salt Lake. The first part of the introduction of a recent article by Wurtsbaugh and others (2017) as follows, speaks volumes:

Many of the world's saline lakes are shrinking at alarming rates, reducing waterbird habitat and economic benefits while threatening human health. Saline lakes are long-term integrators of climatic conditions that shrink and grow with natural climatic variation. In contrast, water withdrawals for human use exert a sustained reduction in lake inflows and levels…

While the scale of the subject water right is exaggerated in some of the protest letters, what affect would the 400,000 ac. ft. have on Great Salt Lake? This can be seen in the following table.

This table (last column) gives an idea as to the additional water added to the entire surface of the lake if the 400,000 ac. ft. are not retained upstream. At the current lake elevations of 4193 ft. to 4194 ft., the additional water-level increase from the 400,000 ac. ft. would be in the vicinity of .66 to .50 feet, respectively. As the lake drops, this amount increases dramatically, while as the lake rises, this amount decreases. If the 400,000 ac. ft. is not allowed to flow into the lake, this little bit of protection is taken away.

While not having these amounts of elevation increase may not seem harmful on a one-time basis, they would add up over multiple years and help to sustain the level of the lake. Without them, the effects of climate change will be much greater.

What are the effects of a dropping lake level? The following are a few examples:

1. As the lake level drops, the salinity of the water increases. While this is good for the extraction industries, there will come a point at which the brine shrimp cannot survive, and that industry will be in trouble. This is especially significant for the south arm of the lake; the north arm of the lake is already too salty for the shrimp to survive.

Great Salt Lake Brine Shrimp Cooperative indicates that

Lake Level in feet above MSL	Total Lake Volume ac. ft.	Volume at next 1-foot in elevation ac. ft.	Next one 1-foot volume ac. ft.	Percent of total lake volume*	Percent of next 1-foot of volume**	**Additional feet of water on top of lake*** **
4210	27695982	29153708	1457726	1.44	27.44	**0.27**
4205	20906472	22163226	1256754	1.91	31.83	**0.32**
4200	15198981	16239332	1040351	2.63	38.45	**0.38**
4195	10249853	11695749	840000	3.90	50.0	**0.50**
4190	7708528	8310690	602162	5.19	66.43	**0.66**
4185	4981964	5448180	466216	8.03	85.80	**0.86**
4180	2766691	3165467	398776	14.46	100.31	**1.00**
4175	1113220	1399214	285994	35.93	139.86	**1.40**
4170	112549	246164	133615	355.40	299.37	**2.99**

*Percentage the 400,000 ac. ft. is of the total volume of the GSL **Percentage the 400,000 ac. ft. is of an additional 1-foot increment of water
***Additional thickness of water had the 400,000 ac. ft. had Bear River been allowed to flow into GSL

the ideal salinity range for the brine shrimp lies between 120 and 150 grams per liter (11.0 – 13.7%). On November 15, 2017, at a south arm elevation of 4193.6 ft., the average salinity of the south arm was 132 (12%) grams per liter, well within the safe range. On October 13, 2016, at a lake elevation of 4192.3 ft., the average salinity of the south arm was 163grams per liter (14.7%). This is well above the ideal range and would have been worse had 400,000 ac. ft. of water not been allowed to enter the lake.

2. As the lake level drops, it becomes more difficult and costly for at least some of the lake industries to access brine for their operations. For example, "In 2014 Morton Salt was required to dig a five-mile long canal to access the lake's water, and some companies in Gunnison Bay find that it is now cost prohibitive to pump brine to their distant facilities (Wurtsbaugh et. al., 2016)." Reducing inflow to the lake by 400,000 ac. ft., especially year after year, would exacerbate the problem.

3. "Reduced lake levels influence the enormous bird populations that rely on Great Salt Lake for migration and reproduction; species as diverse as American avocets, mallards, swans, and pelicans are all negatively impacted by low lake levels …. Secondly, increases in salinity in Gilbert Bay, the largest portion of the lake, will decrease food available for those birds, such as grebes, shorebirds, and gulls that feed on the brine shrimp and brine flies. Additionally, further water diversions could result in more frequent water shortages for the vital freshwater bird sanctuaries such as the Bear River Migratory Bird Refuge that line much of the eastern shore of the lake…(Wurtsbaugh and others, 2016)". Reduction of the inflow to the lake by 400,000 ac. ft. will certainly add to the above-mentioned problems, especially if repeated year after year.

4. Low lake levels affect the hydrodynamics and functioning of the newly constructed bridge in the Southern Pacific Railroad causeway, bi-directional flow in particular. This in turn can directly affect the deep-brine layer and thus the salinity of the south arm of the lake. Bi-directional-flow through the new bridged opening is governed by three factors: head differential, south-arm water density and north-arm water density. If either head differential or the south arm density are increased, the depth within the bridged opening (from the water surface) at which return or bi-directional flow can occur will be increased. The shallower the depth at which return flow can occur results in a greater north-to-south flow of dense north-arm brine, which can build a deep-brine layer in the south arm and increase its overall salinity. The greater the depth at which return flow can occur results in less return flow of dense north-arm brine into the south arm. Small changes in south-arm density or the head differential due to the reduction of inflow to the lake, even at the 400,000 ac. ft. level will make a significant difference in the functioning of the newly created bridged opening.

5. Lower lake levels expose greater areas of lake bed which in turn affect local air quality and human health. "Water diversions and drought have reduced lake area from around 1,600 square miles when the pioneers arrived to 1,050 square miles in 2015. The exposed 550 square miles of lake bed increases the potential for locally severe dust storm (Wurtsbaugh and others, 2016)." Any additional decrease in the inflow to the lake will add to the lake-bed exposure problem and associated health-risk issues.

6. Lower lake levels also affect local weather patters which influence snow for the mountains, the ski business, and water for summer use. The higher the lake's level, the greater its influence.

7. Lower lake levels affect the recreation opportunities from hunting to sailing.

In conclusion, it is felt that the above effects on Great Salt Lake, as a result of implementing the subject Water Rights application parameters, should be considered prior to finalizing and approving the application.

If the water right is approved, it is suggested that the municipal water portion of the application be considered in preference to the irrigation portion due to the magnitude of the amounts of water that would be consumed.

REFERENCES

• Great Salt Lake Brine Shrimp Cooperative, Inc, 2016, Salinity impacts on Artemia franciscana in Gilbert Bay (draft), 13 p.

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Dr. Wally Gwynn is the former saline minerals geologist with the Utah Geological Survey and is the author of numerous publications dealing with Utah's natural resources.

Bear River Refuge Hunt Plan... An Exercise In Frustration

In June of this year, the management of the Bear River Migratory Bird Refuge announced its intent to comply with Secretarial Order 3356 as instructed by the Department of the Interior. Secretarial Order 3356 instructs the various Federal Refuges to look for ways of opening additional lands to hunting and fishing wherever possible. The explanation (as listed in the Bear River Refuge Environmental Assessment proposal) is as follows: "The purpose of this proposed action is to expand compatible hunting opportunities on Bear River MBR. The primary need of the proposed action is to meet the Service's priorities and mandates as outlined by the NWRSIA to "recognize compatible wildlife-dependent recreational uses as the priority general uses of the NWRS" and "ensure that opportunities are provided within the NWRS for compatible wildlife-dependent recreational uses" (16 U.S.C. 668dd(a)(4))."

With that announcement, Utah's waterfowling community erupted in a collective outpouring of surprise and joy. For years we have been trying to get the Bear River Refuge to open up more lands to public recreation, and we have only been met with stonewalling and disinterest. The process of getting these acquisitions re-opened to the public started almost a decade ago with a group of hunters that were appalled at the lack of public input accepted as the Refuge made decisions impacting stakeholders.

For a number of years now, the Refuge has been quietly buying up private lands and duck clubs from willing sellers. These newly purchased lands have historically been open to hunting through club membership or through landowner permission. When the Refuge gains title to these properties, they are usually posted as "No Trespassing" and, very quickly, new fences are erected to keep the public out. After hearing about the Secretarial Order, Utah waterfowlers were pleased with the prospect of reopening these public lands to hunting and fishing. In the past, when confronted about the property closures, the Refuge management would claim that they had no money budgeted for enforcement or proper signage on these new properties; therefore no one could be allowed to access them. They also claimed that it would literally take an act of congress to open up the newly acquired lands. As would be expected, this feedback did not set well with the many hunters and fishers that expected some increased opportunities to recreate on the Refuge.

It seems that public involvement in the management of public lands such as the Bear River Refuge has been a tough row to hoe for several decades. It wasn't always this way. The Refuge has a long history of working with the state of Utah and with sportsmen and women. It started back in the 1920's with hunters being concerned with the health of the wetlands in what is now called Bear River Migratory Refuge.

"Duck sickness" (what we now know is botulism) in Bear River Bay seemed to threaten the treasured duck hunting heritage both in Utah and throughout the West. As a result, during the 1920's, Utah began a long campaign that pushed for the refuge's creation with the understanding that it would provide both a remedy for the "duck sickness" that plagued waterfowl in Bear River Bay as well as an expansive "public shooting ground" to complement the public hunting area that Utah was creating around the same time.

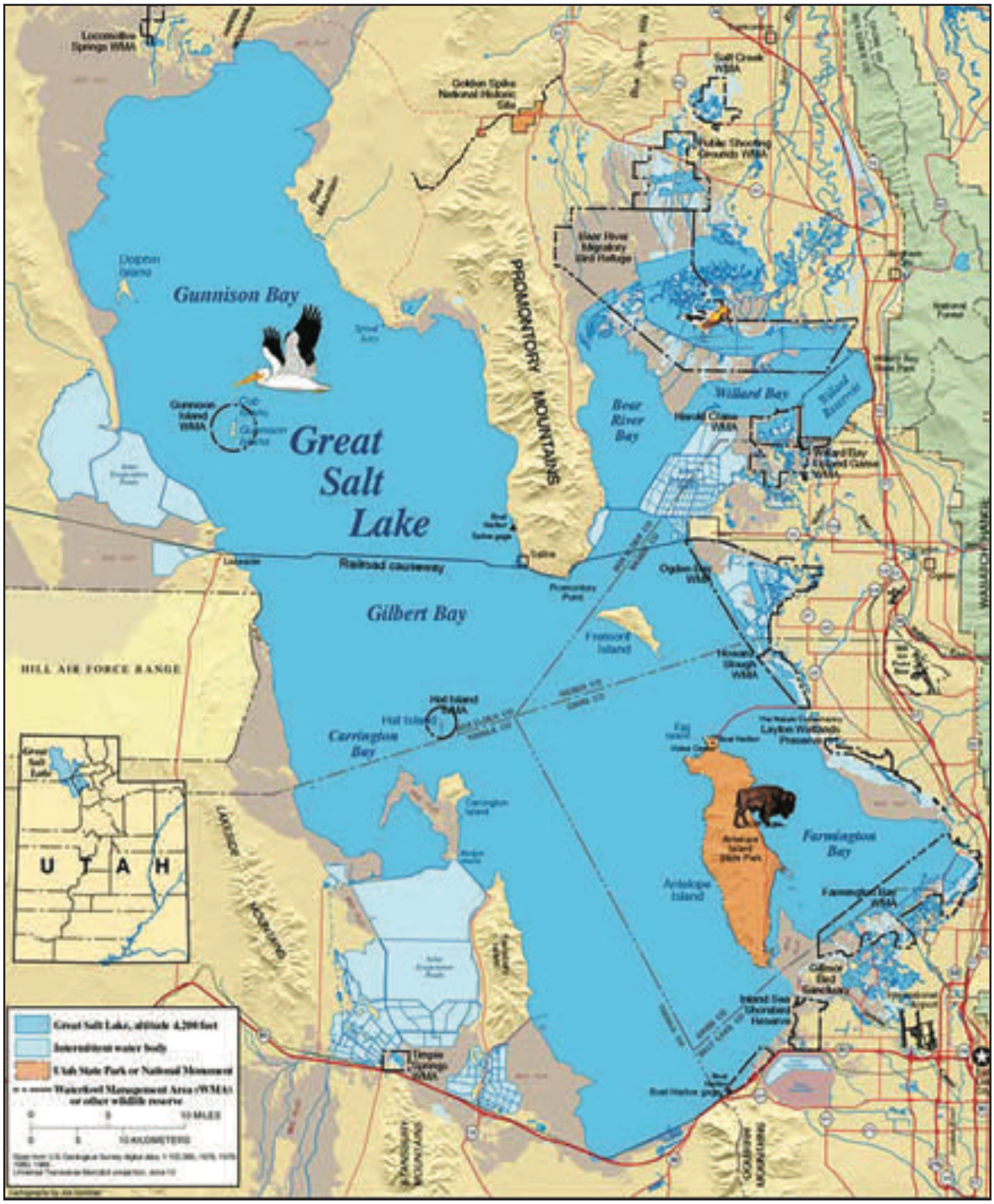
At a conference in New York in 1921, Utah Governor Charles Mabey declared, "It is the plan for the Fish and Game Department of Utah to cooperate with the federal government to cause to be set aside and maintained as a public shooting ground and nesting ground for wild fowl all the lands in the Bear River Bay not now owned by private citizens . . ." (Salt Lake Daily Telegraph, December 22, 1921). At the urging of sporting groups and others, the federal government eventually agreed to establish the Bear River Migratory Bird Refuge. Section 5 of the BRMBR enabling legislation explicitly acknowledges this dual intent: "At no time shall less than 60 per centum of the total acreage of the said refuge be maintained as an inviolate sanctuary for such migratory birds." Despite this declaration, nearly 80% of the much expanded refuge is now closed to hunting even though a 1995 Environmental Assessment reaffirmed that hunting is compatible with the purposes for which the refuge was created.

In June, with the Refuge's announcement that public comment would be accepted in regards to opening new lands to hunting, Utah's waterfowlers were ready and willing to participate! To our dismay, it turned out that the Refuge was once again not willing to accept, nor did it solicit, any input into the process of changing the hunting boundaries. After a couple of weeks of internal discussion, the Refuge management unveiled four options that they felt would open up the additional acreage required by the Dept. of Interior. The options (Options A thru D) were mostly comprised of dry grounds with very little existing vegetation or habitat suitable for hunting. The choices also excluded other public uses such as birding or photography. And, again, they kept most of the new acquisitions closed to the public. After the official options were made public, stakeholder groups soon realized there wasn't really anything left to participate in except to choose an option that we had no involvement in.

As this article is being written, there are ongoing attempts to insert public stakeholder concerns into the decision making process. It has been said that past performance is no guarantee of future returns…well, let's hope for better returns than we've had in the past!

R. Jefre Hicks is a waterfowler and former president of the Utah Airboat Association

Great Salt Lake At A Glance



Courtesy U.S. Geological Survey

Dr. Ephydra—We Welcome Your Questions Via Email or Phone

E•phy'•dra, a noun; a genus of two species of brine flies that live on the bottom of the Great Salt Lake as larvae and pupae, and along the shores of the Lake as adults.

The Importance of Aquatic Invertebrates to Great Salt Lake Wetlands

Make no mistake about it; invertebrates will be here long after humans have flown the coop. They were here before the flowering plants; they were the reason flowering plants came into being. They were here when the dinosaurs bit the dust. They witnessed the extinction of the seventeen-foot tall cave bears, the wooly rhinoceri, giant ground sloths. You name it, they saw them come and go.

Water striders (*Hemiptera, Gerridae)* and ladybird, photograph courtesy of David Richards

Aquatic invertebrates colonized and evolved in freshwater Ancient Lake Bonneville and some continue to survive in its remnant puddles, Utah Lake and Great Salt Lake (GSL), even as these puddles turn saltier and saltier. Aquatic invertebrates are the foundation of Great Salt Lake wetlands' food webs, govern their ecosystem functions, and decide which bird species call these wetlands home, which individual birds survive, and which individuals procure enough food energy to continue their journeys to destinations far, far, away. GSL wetlands would be just another abandoned diner with 'going out of business', 'for sale' and 'closed for the season' signs without the mass numbers of aquatic invertebrates that these wetlands generate each and

Male Dragonfly *(Anisoptera, Aeshnidae, Aeshna sp.)*, photograph courtesy of David Richards

I have been studying GSL wetland aquatic invertebrate communities for almost a decade in partnership with Dr. Theron Miller of the Wasatch Front Water Quality Council and we have concluded that without a shadow of doubt, these communities are amazing, vital to the ecosystem, unique, and worth protecting in their own right.

Trico Mayflies (*Ephemeroptera, Leptohyphidae, Tricorthodes sp.*), photograph courtesy of David Richards

We have documented over 75 phytophilus (aquatic plant associated) and benthic aquatic invertebrates and about 30 zooplankton taxa in GSL wetlands and Farmington Bay (Richards 2014). Of course, these include the by now famous brine shrimp and brine flies that occur by the millions in the moderately saltier sections of Farmington Bay. But here we focus on mostly freshwater aquatic invertebrates that most of us are vaguely familiar with: dragonflies and damselflies (Odonates), mayflies (Ephemeroptera), midges (Chironomids), snails (Gastropods), and clams and mussels (Bivalves). In any one square meter of substrate in the wetlands we can expect to find about 15 to 25 taxa (Richards 2014) at very high densities ranging from 1000 to 10,000 per meter square and sometimes up to 100,000 individuals per square meter (Richards 2014). That is a lot of bugs!

These taxa comprise most of the functional feeding groups: predators, omnivores, collector-gatherers, filterers, and scrapers. If the bivalves were allowed to increase in densities in the wetlands they would be capable of filtering the entire water column in the wetlands everyday. Snails graze epiphytic algae from becoming a nuisance. Midges can even regulate cyanobacteria blooms (Richards and Miller 2017). If we adjust our ears and listen closely, each one of these invertebrate taxa has a story to tell––a niche unique to each taxon, a life history and ecology that no other taxon can claim. In combination with the aquatic plant assemblages, they can fully describe to us the water quality conditions in the wetlands, if we want to take the time to listen.

Mayfly *(Baetidae, Baetis bicaudatis),* photograph courtesy of David Richards

Unfortunately, many threats to their existence and roles in maintaining water quality, ecosystem stability and function, and of course as bird food, have come to fruition and many more are on the horizon. Even though many taxa still remain, the effective numbers of taxa in the wetlands are often low with just a few dominant taxa. To a trained ecologist this suggests lowered resistance and resilience to perturbation. By far the biggest threat is continued loss of water. Believe it or not, aquatic invertebrates need water. I flew over Farmington Bay in mid June 2018 and the water level is frighteningly low. Just a remnant of what it could be and just a salty remnant of what GSL is to the once enormous Lake Bonneville.

Instead of taking up more space in the FRIENDS newsletter, I refer (by now curious and hopefully deeply interested readers in aquatic invertebrates of GSL wetlands) to some of the reports that we have produced for the Wasatch Front Water Quality Council. Most of these are readily available on the Council's website: http://wfwqc.org/ and are also available on my ResearchGate website: https://www.researchgate.net/profile/David_Richards20/contributions

David C. Richards, Ph.D.
OreoHelix Consulting

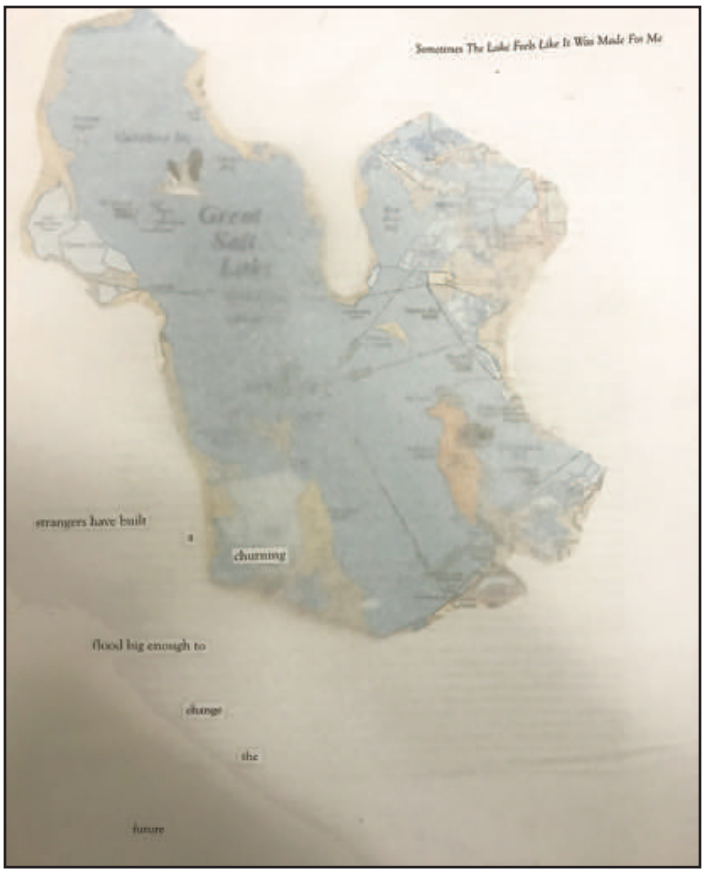
Male and Female Damselflies Mating *(Zygoptera, Coenagrionidae, Ischnura sp.)*, photograph courtesy of David Richards

Exploring Great Salt Lake

May Term at Westminster College

Each May Hikmet Loe and Holly Simonsen co-teach an intensive month-long course at Westminster College called Exploring Great Salt Lake. The class is cross-listed among the Art, English, Environmental Studies, and Honors College programs—appealing to a wide variety of students and a diversity of college majors: physics, arts administration, geology, public health, and environmental humanities, to name a few.

This May, the class engaged in an experiential exploration of Great Salt Lake through the lenses of art, art history, ecopoetics, and eco-critical theory, both within the traditional classroom and out in the field. The class travelled incrementally through time and space along the southern portion of the Lake, from the Inland Sea Shorebird Reserve to Black Rock. We also included a trip to Robert Smithson's earthwork, *Spiral Jetty*.



Student Field Guide example, courtesy of Andrea Koehler

Exploring Great Salt Lake encourages students to begin deconstructing the primary ideologies that govern our relationship with the natural world. Armed with this ability, students are then asked to use this lens during a literal exploration of the landscape. Students are expected to record their observations in field guides, created specifically for this course, and distill these experiences into final projects of their own design.

Field guides provide an opportunity to not only read collected writings for the month, but to use them as a creative means of understanding the lake through art, literature, and their own creative endeavors.

Pedagogically, Hikmet and Holly uphold an expectation that the students use this course to challenge traditionally held beliefs and take academic risks. Students are encouraged to explore the liminal spaces between both perceived and physical boundaries in order to understand Great Salt Lake in new ways.

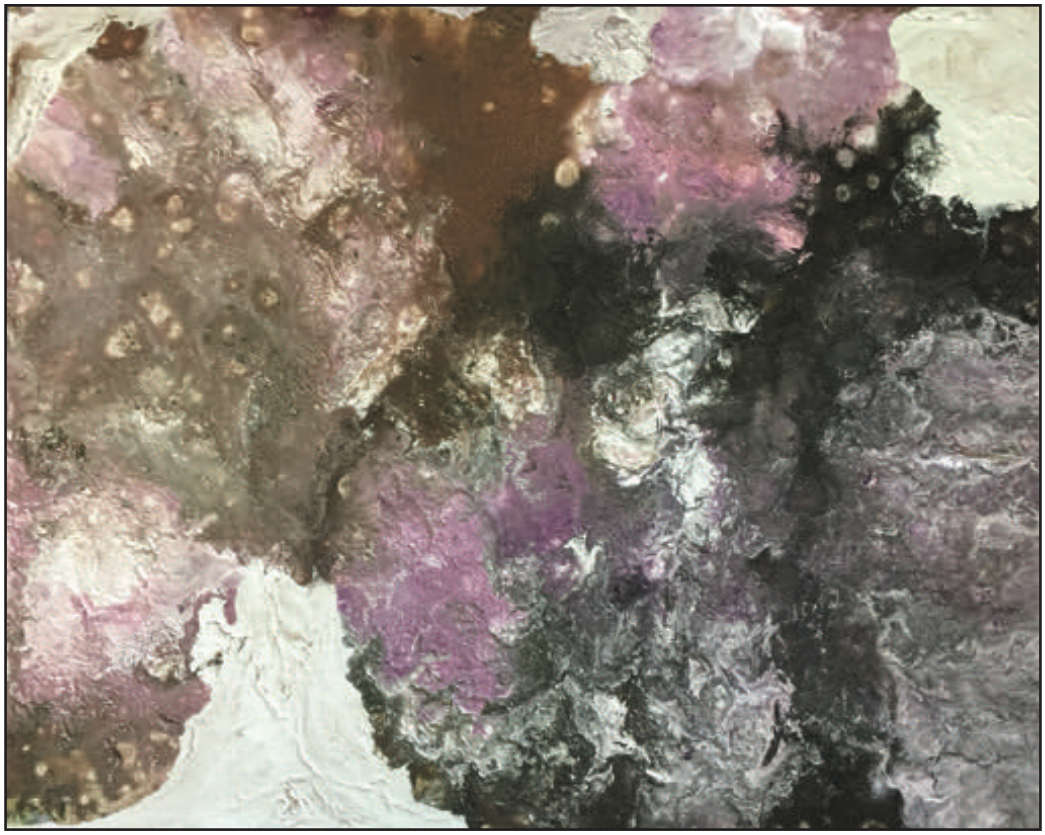
The results of these efforts are manifest in the student projects. This year students submitted short films, collections of poetry, photo-essays, acrylic paintings, and sculptural installations. Each project was distinct in the ways it interpreted, challenged, and responded to Great Salt Lake.

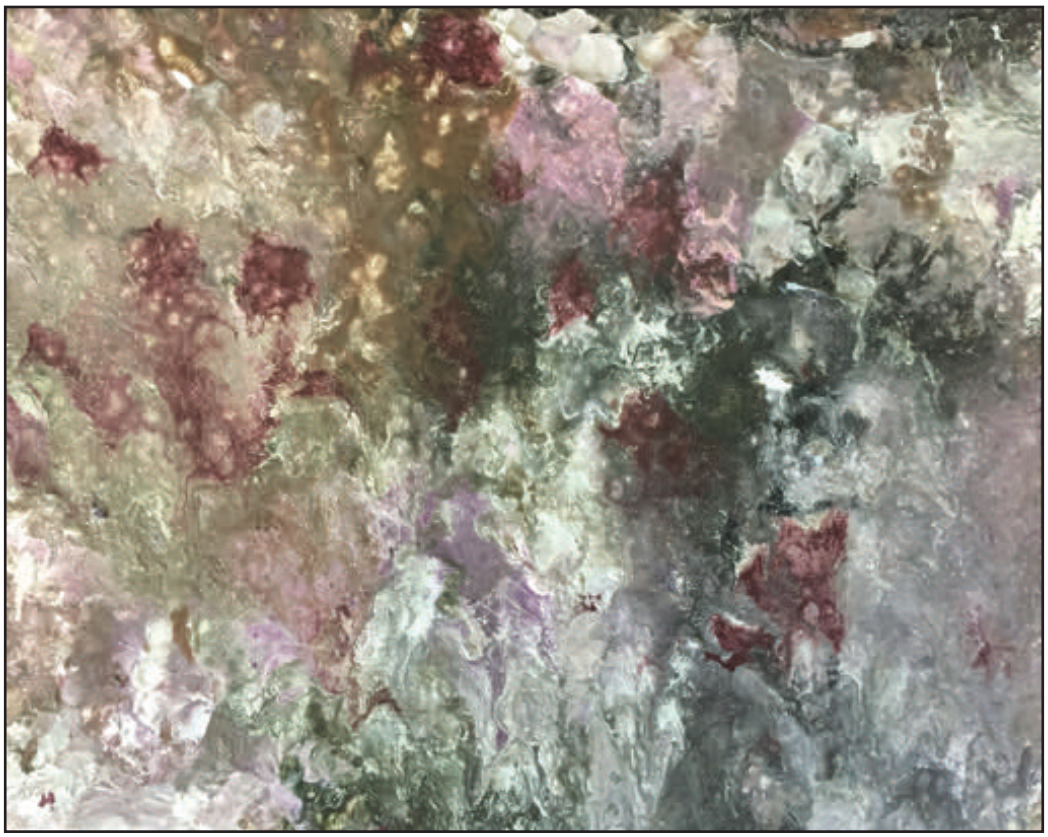
We feel the class was a success; it grows stronger each year through word of mouth and through the high expectations we ask regarding student engagement both in and out of the classroom. We will continue teaching students next year, and hopefully for years to come, helping them explore Great Salt Lake.

–Holly Simonsen

Holly Simonsen has been working in ecopoetic collaboration with Great Salt Lake for over ten years. She operates under the thesis that ecologically disrupted sites offer access points for the body to experience language as a product of the earth. She works on the page and off, incorporating installation art, performance art, sound experimentation, and ephemeral sculpture into her poetic practice. She works the Membership and Programs Director for FRIENDS of Great Salt Lake and as an adjunct professor at Westminster College.

Hikmet Sidney Loe teaches art history at Westminster College in Salt Lake City. Her work examines the changeable nature of the earth and addresses our perceptual and cultural constructs of the land. She is the author of The Spiral Jetty Encyclo: Exploring Robert Smithson's Earthwork through Time and Place (2017). She also serves as a board director for FRIENDS of Great Salt Lake.





Great Salt Lake Palette Study
Acrylic Paint and Salt on Board courtesy of Andrea Koheler
in partial fulfillment of Exploring Great Salt Lake, Westminster College, May 2018

FRIENDS of *Great Salt Lake*

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website: www.fogsl.org

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Sept. 16 (Fall)
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Mar. 16 (Spring)
June 16 (Summer)
Submit articles and images for consideration to Lynn de Freitas at ldefreitas@xmission.com or call 801-583-5593

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Save the Dates:
September 7, Alfred Lamboure Prize Gallery Opening and Reception
September 15, International Coastal Cleanup
October 11, Fall Fundraiser

Lake Facts – Questions:
•What is the average annual flow of the Bear River into Great Salt Lake?
•What is the total potential storage amount of water in Bear Lake?

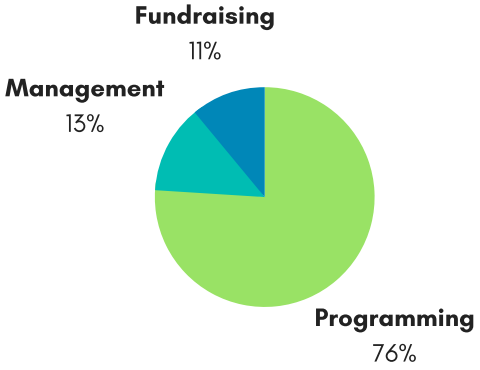
Answers:
•1.2 million acre feet
•1.4 million acre feet

Our Funding

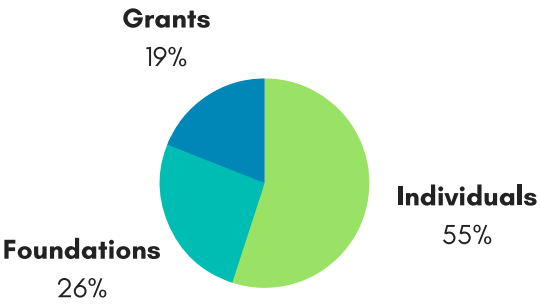
As a 501(c)(3) nonprofit, FRIENDS of Great Salt Lake relies upon the generosity of our members, individual donations, foundations, and grants. Individual memberships and donations provide the bulk of our funding at approximately 55% of our annual revenue. Foundation donations and grants make up the rest, at approximately 26% and 19%, respectively.

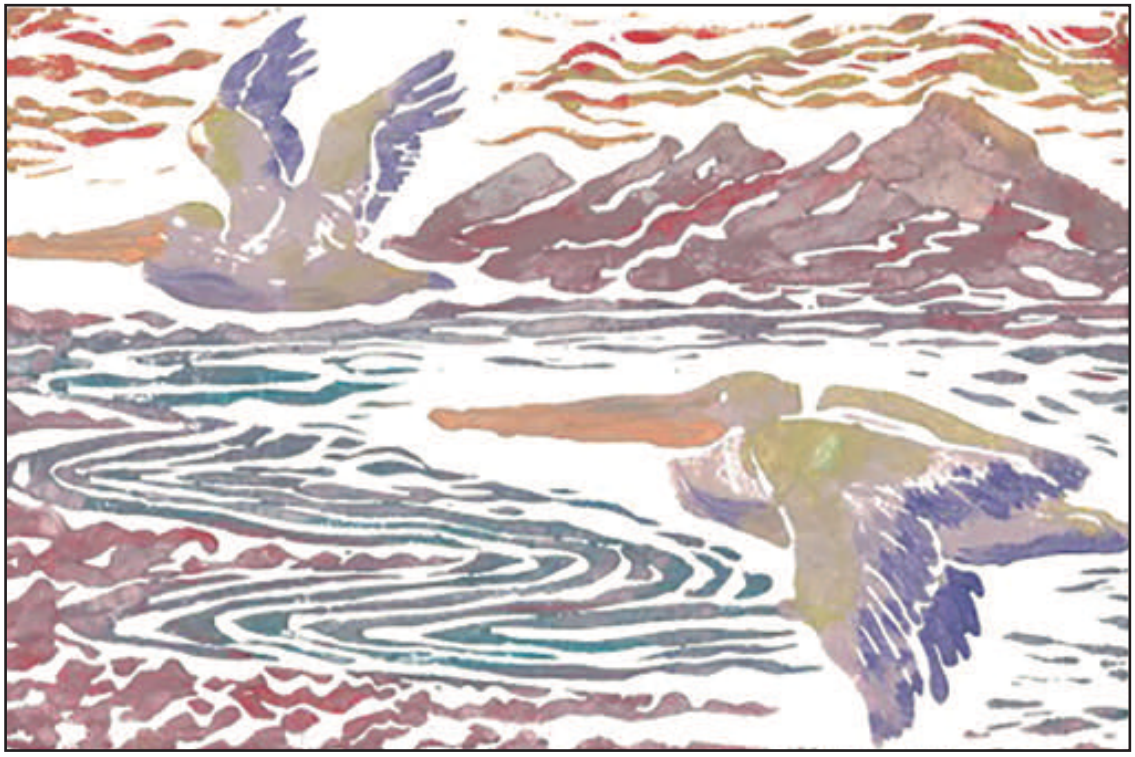
With an annual operating budget of $152,000, FRIENDS of Great Salt Lake spends a majority of funds on Programming (76%), including our Education Program Lakeside Learning Fieldtrips, The Doyle Stephens Scholarship Program, and the Alfred Lambourne Arts Prize. Management and administration costs average 13%, and general fundraising at 11%.

Expenses



Funding Sources





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Prehistoric Thinker
Photograph by Charles Uibel