Great Salt Lake

JANUARY 15, 2024

THE GREAT SALT LAKE STRATEGIC PLAN

SUBMITTED BY:

Brian Steed, JD, PhD
Great Salt Lake Commissioner

TABLE OF CONTENTS

INTRODUCTION

In November of 2022, the Great Salt Lake fell to a new record low water level not seen in all the years since elevation levels were first recorded from when pioneers settled the valley in 1847. As water levels dropped, salinity spiked, threatening an ecosystem that supports over 10 million migratory birds and a brine shrimp industry that helps feed tens of millions of people around the world.

The Great Salt Lake protects Utahns' quality of life in many ways: the very air we breathe, the water we drink, and the food we eat. Minerals extracted from the lake find their way into cell phones, laptop computers, soda cans, airplane wings, medical devices, and so much more. Fertilizers nourish fruit and nut crops grown in California. Shrimp farmers use brine shrimp from the Great Salt Lake in far-flung corners of the globe, such as Ecuador, Israel, and Indonesia. Birds stop to refuel at the Great Salt Lake as they wing their way to Siberia, the Canadian Maritimes, and Central and South America. High lithium levels in the lake's waters may help Utah get a jumpstart on the next generation of energy technology. Low lake levels threaten all these uses.

The Utah State Legislature and other stakeholders have responded with significant public investments and policy changes in response to these persistent and dramatic lake declines. One of which, HB 491, "Amendments Related to Great Salt Lake" (2023), sponsored by Representative Mike Schultz and Senator Scott Sandall, established the Office of the Great Salt Lake Commissioner and required the Commissioner to, among other things, prepare a strategic plan applying "a holistic approach that balances the diverse interests related to the health of the Great Salt Lake…."

According to the Act, the strategic plan must include the following elements:

- Coordination of efforts related to the Great Salt Lake;
- A sustainable water supply for the Great Salt Lake, while balancing competing needs;
- Human health and quality of life;
- A healthy ecosystem;

IN THIS SECTION

- Economic development;
- Water conservation, including municipal and industrial uses and agricultural uses;
- Water and land use planning;
- Regional water sharing; and
- Other provisions that the Commissioner determines would be for the benefit of the Great Salt Lake.

This document represents an initial strategy to more effectively protect the Great Salt Lake, while balancing the other ecological, economic, and societal interests surrounding the lake. This is no small task, particularly in light of continued economic growth, sustained drought, and higher temperatures, which threaten to increase demand and shrink available water supplies even further.

The Great Salt Lake remains a dynamic system. Our management approach to the lake must be similarly dynamic: revisited regularly and adjusted as necessary to meet new challenges and new opportunities. Accordingly, the strategy that follows reflects three distinct time frames for action: short term (within the next year), medium term (1 to 5 years), and long term (6 to 30 years).

Any strategy for returning the lake to a healthier range will be challenging. Filling the lake in 30 years to the low end of the healthy range[1] for the long-term health of the lake – based on the Great Salt Lake Elevation matrix (4,198 feet) – will require between 471,000 and 1,055,000 acre-feet per year of additional water delivered to the lake.[2] To put that into perspective, a 19% reduction of all water depletions, based on the average depletions between 1989-2020, in the Great Salt Lake Basin is estimated to result in 399,000 acre-feet of conservation per year. The good news is that any increase in water elevation from where the lake is today will bring additional benefits to the ecosystem, human health, and the economy as we bring the lake back up to its healthy range.

Any proposed solution to sustaining the Great Salt Lake is most likely to be successful only if it is:

- Ecologically sustainable,
- Economically viable,
- Politically possible,
- Technically feasible, and
- Legally sound

"The Great Salt Lake remains a dynamic system. Our management approach to the lake must be similarly dynamic: revisited regularly and adjusted as necessary to meet new challenges and opportunities."

All five of these criteria are necessary for success, including being politically possible at both the state and federal level. For instance, high costs may doom a potential solution even if something is easily engineered, ecologically sustainable, and politically popular. Similarly, a simply engineered, lower-cost proposed solution may fail if it is not politically implementable.

The short-term and medium-term strategies include implementing and refining the tools that the Legislature has adopted over the last couple of years and ensuring that the state is maximizing the investment that has been made to ensure the long-term health of the Great Salt Lake.

Before delving into the specifics of the strategy, it may be helpful to provide some background information on the Great Salt Lake to more fully understand its local, national, and global importance and the conditions that have brought the lake to where it is today.

BACKGROUND

The Great Salt Lake is the largest saline lake in the Western Hemisphere and the eighth largest in the world. The lake's ecology is an extraordinary example of the rich web of relationships between people, land, water, food, and survival. The 1,700 square miles of various water environments, remote islands and shorelines, with Utah's highest density of wetlands, provide habitat for plants, brine shrimp, reptiles, amphibians, mammals, shorebirds, and waterfowl. Birds rely on the lake, a critical link in the Pacific Flyway between North and South America. Every year, 10 to 12 million birds from 338 species come to rest, eat, and breed during migrations of a thousand miles or more. With the decline of other lakes, the Great Salt Lake is increasingly important to these species.

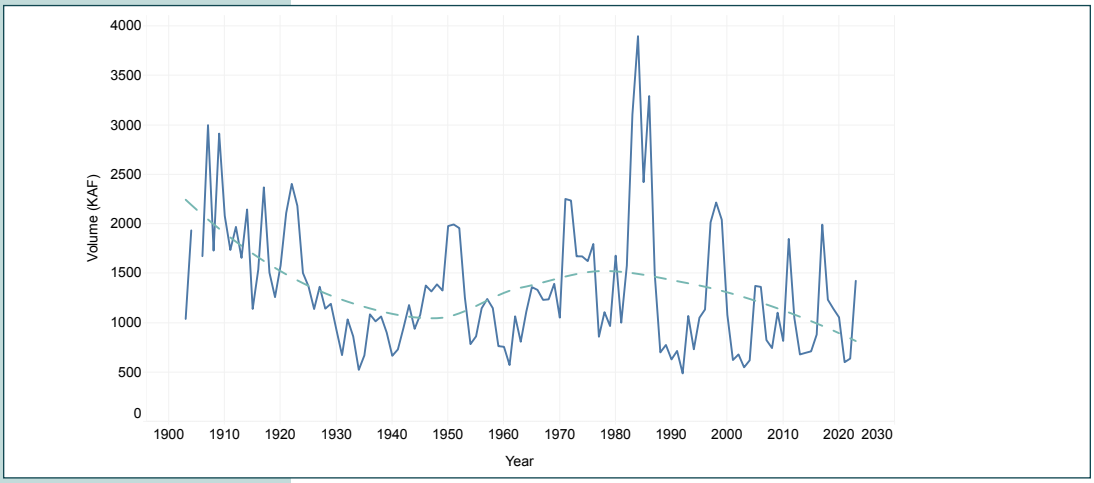
Runoff from the Uinta, Wasatch, and Bear River ranges provides the primary water source for the Great Salt Lake. This runoff feeds the lake's largest tributaries – the Bear River, the Jordan River, and the Weber River. Combined, these sources supply nearly 70% of water in the lake. The majority of the remaining water comes from direct precipitation on the lake, groundwater, and intermittent streams in the West Desert.[3]

One of the major problems currently facing the lake is the declining inflows from the Bear, Jordan, and Weber Rivers. The graph below shows that water flowing into the lake has declined over the past century.

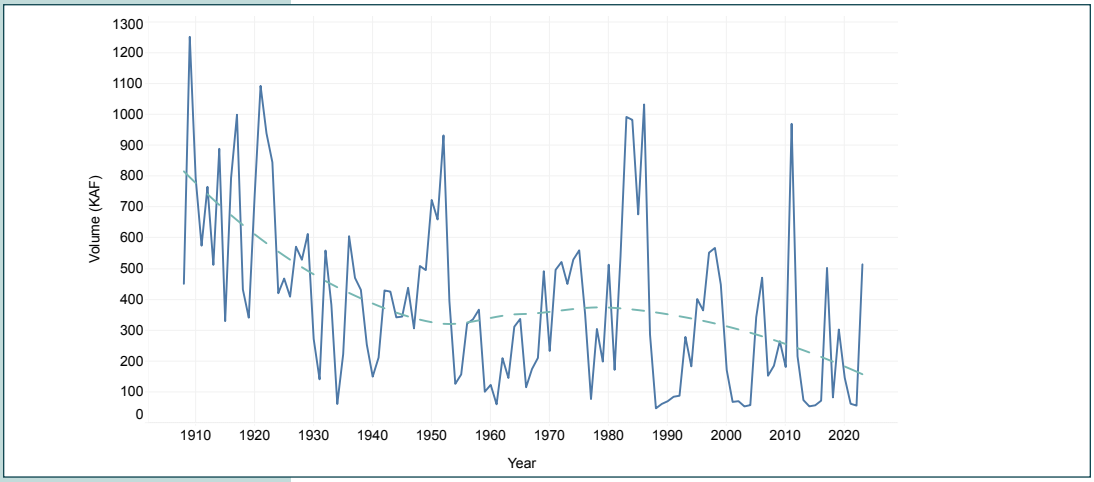
As a terminal lake, once water arrives in the Great Salt Lake, it stays there until it evaporates. Hence, a lower amount of water reaching the lake will, over time, ensure a smaller lake. Additionally, drought and warmer temperatures may speed up the lake's decline. Unfortunately, the West has experienced both higher temperatures and extended drought since the mid-1980s. All of these factors have combined to produce the lowest lake levels seen since the Pioneer Era.

FIGURE 1: BEAR, WEBER AND JORDAN RIVER ANNUAL STREAMFLOW (1900 - 2023)

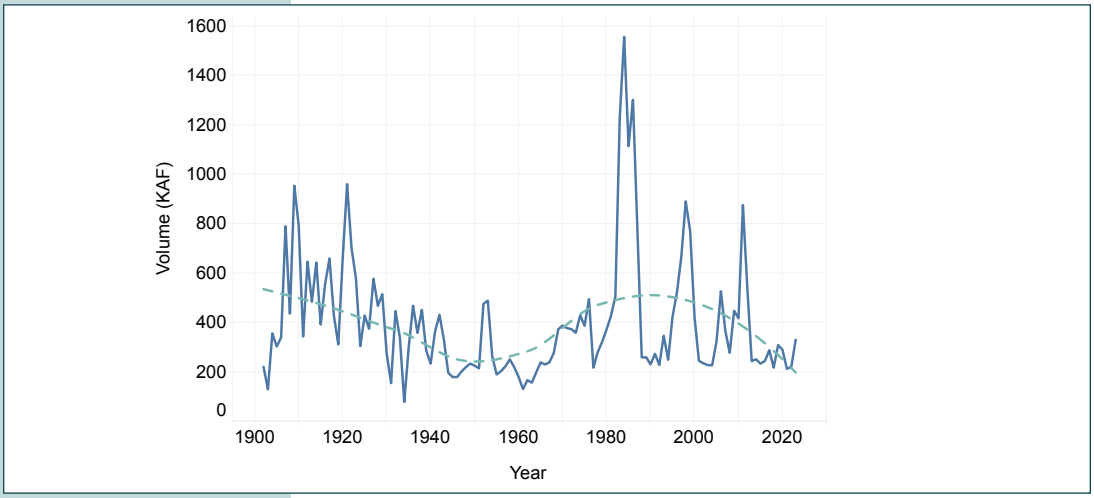
BEAR RIVER



WEBER RIVER

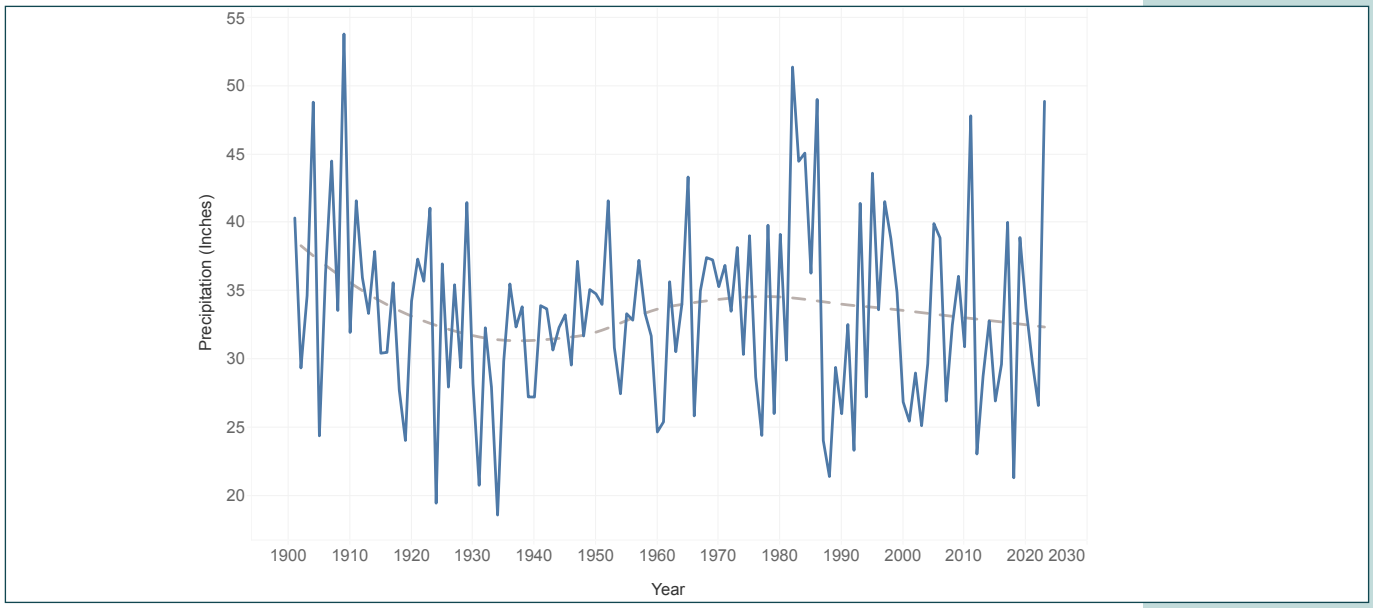


JORDAN RIVER



As seen in FIGURE 3, the state tracks elevations on the North Arm and the South Arm. In 1959, the Union Pacific Railroad replaced its existing bridge across the lake with a rock causeway. The causeway has resulted in two major impacts. First, the North Arm has limited direct inflow. Accordingly, the water in the North Arm has become increasingly saline to the point where most ecological functionality has been lost. It is simply too salty for brine shrimp, brine

FIGURE 2: MEAN NORTHERN UTAH PRECIPITATION AND TEMPERATURE (1901 - 2023)



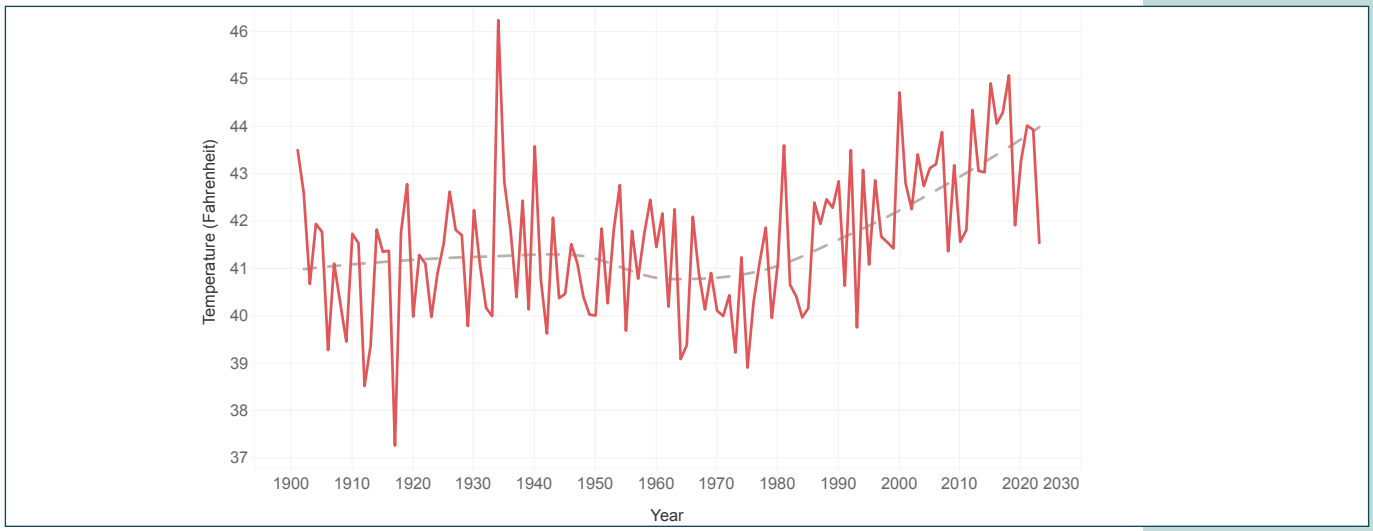
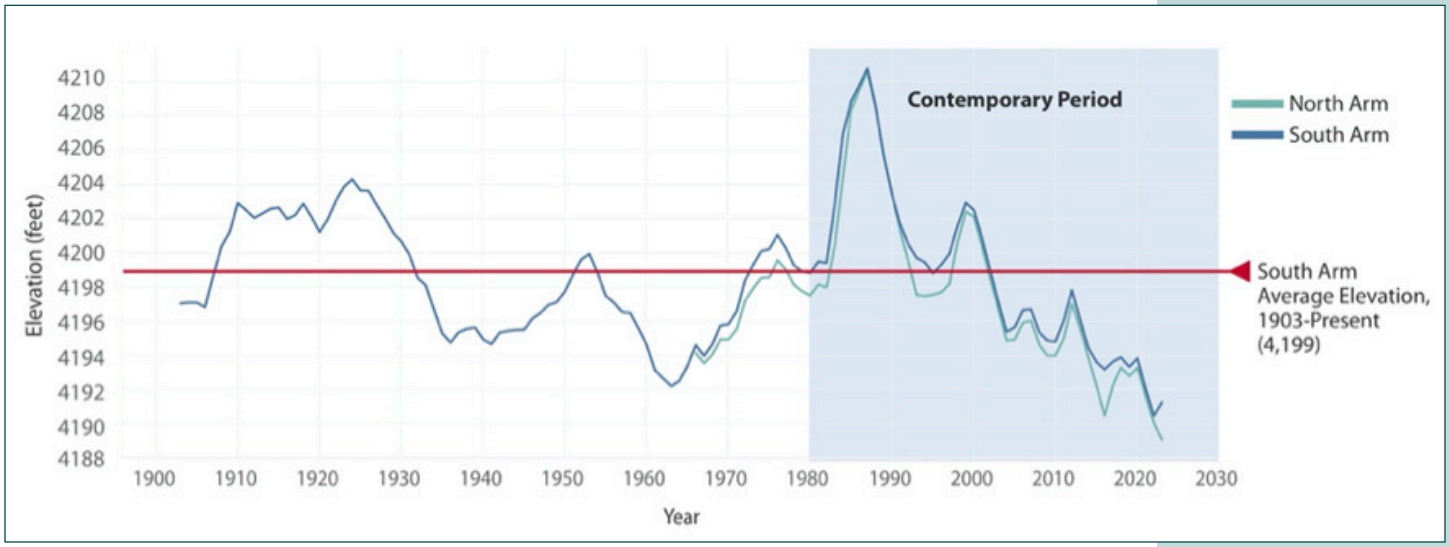


FIGURE 3: AVERAGE ANNUAL ELEVATION OF THE GREAT SALT LAKE (1903 - 2023)



flies, or even the blue-green algae that forms the microbialite structures in the lake. Second, it is common to see elevations in the North Arm lower than the South Arm due to the lack of inflows to the North Arm and limited connectivity between the Union Pacific Causeway.

Water levels on the lake provide differing benefits and costs. Lower lake levels have resulted in higher salinity and lower ecologic productivity, and increased dust from the lakebed. The Utah Division of Forestry, Fire, and State Lands, along with stakeholders, evaluated resource-specific lake level impacts in the 2013 Great Salt Lake Comprehensive Management Plan to determine a range of healthy lake levels. These efforts created a range of outcomes seen at differing lake levels, as seen in FIGURE 4. This analysis has determined that the healthy range of the lake for both human and ecological interests is between 4,198 and 4,205 feet above sea level. Higher lake levels than this range will start seeing costs. Similarly, lower lake levels will see costs, too.

As the lake hit record lows last year, the state experienced serious adverse consequences on the lake. These adverse effects included significant ecologic impacts from dramatically diminished brine fly populations and lower brine shrimp reproductive levels. The direct human consequences were tangible, with the loss of boating access from both Antelope Island and Great Salt Lake Marina State Parks, along with an uptick in the occurrence of dust events from the dry lakebed.

THE IMPORTANCE OF WATER IN UTAH

Water is the lifeblood of the West. The availability of water on the shores and tributaries of the lake attracted sizable populations of indigenous peoples to the area. When European American pioneers arrived, they also saw the value of water. On their first days in the Salt Lake Valley, the pioneers began diverting water from City Creek to start agricultural production. Since those early days, Utahns have engineered a water delivery system to provide water security for human uses. This complicated system can store and deliver millions of acre-feet of water per year.

Human water depletion numbers have varied through the years, as have the competing demands for water. Historically, agricultural activities used almost all water diverted by humans out of the natural system. Today, water use has diversified to include municipal, industrial, and mineral extraction in addition to agricultural use as shown on FIGURE 5. Total human depletion from 2017-2021 was estimated to be about 2.3 million acre-feet per year. In the same timeframe, agricultural depletion averaged about 1.48 million acre-feet per year and municipal and industrial uses averaged about 375,000 acre-feet per year. Other significant contributors to depletions include mineral extraction activities (165,000 acre-feet), evaporation off of reservoirs (28,000 acre-feet), and water diverted into managed wetlands (283,000 acre-feet).[4]

"As the lake hit record lows last year, the state experienced serious adverse consequences on the lake. These adverse effects included significant ecologic impacts from dramatically diminished brine fly populations and lower brine shrimp reproductive levels."

FIGURE 4: ELEVATIONS OF GREAT SALT LAKE NORTH & SOUTH ARMS WITH ELEVATION ZONES 1903-2023

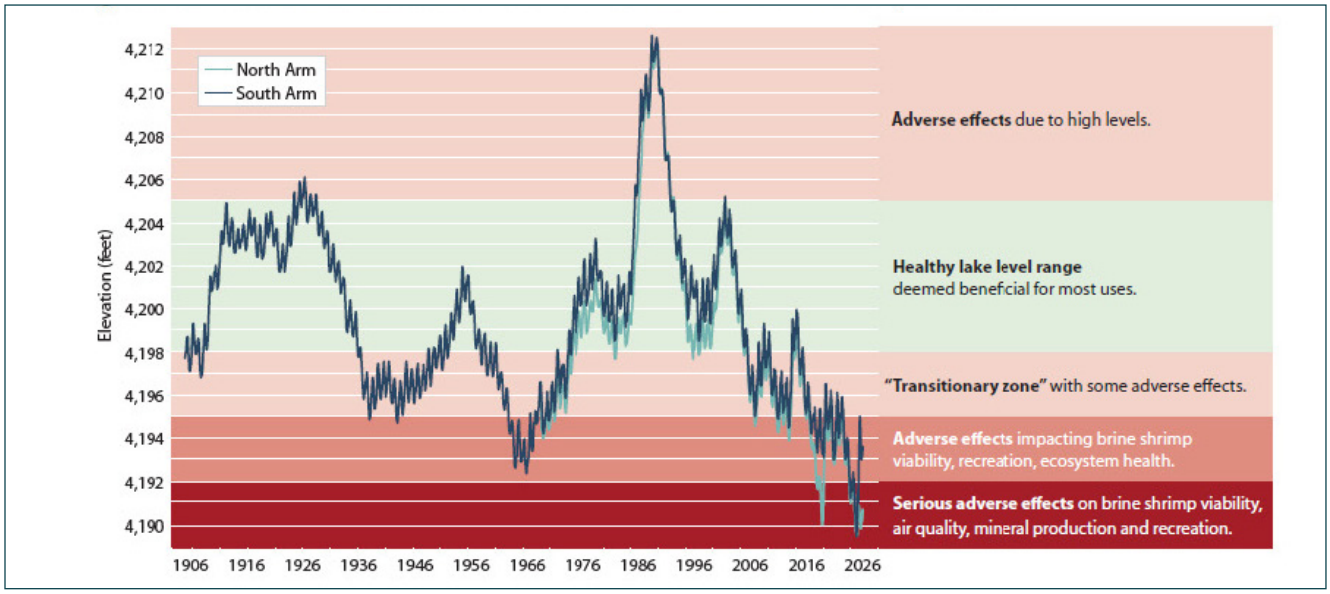


FIGURE 5: HUMAN WATER DEPLETION BY TYPE IN THE CONTEMPORARY PERIOD (1989-2021)

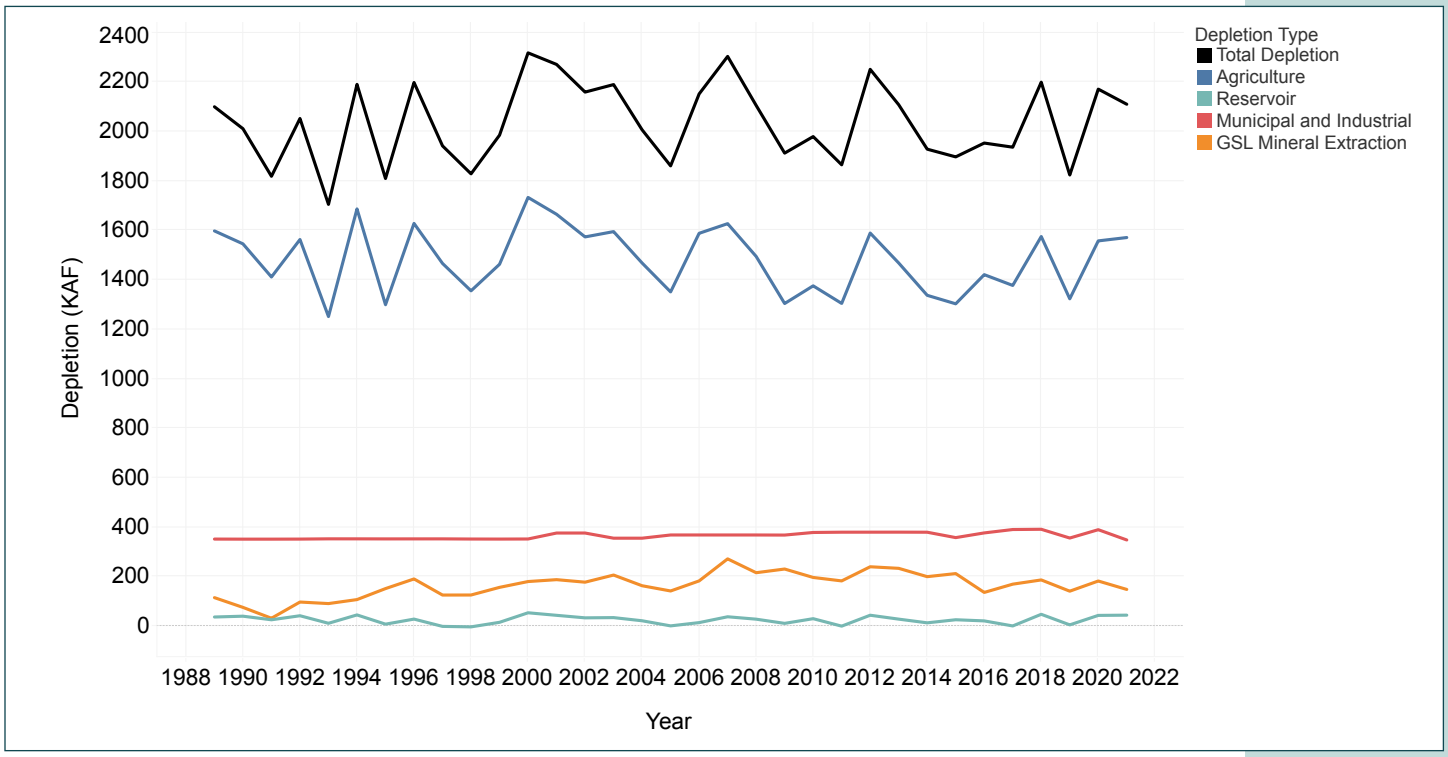
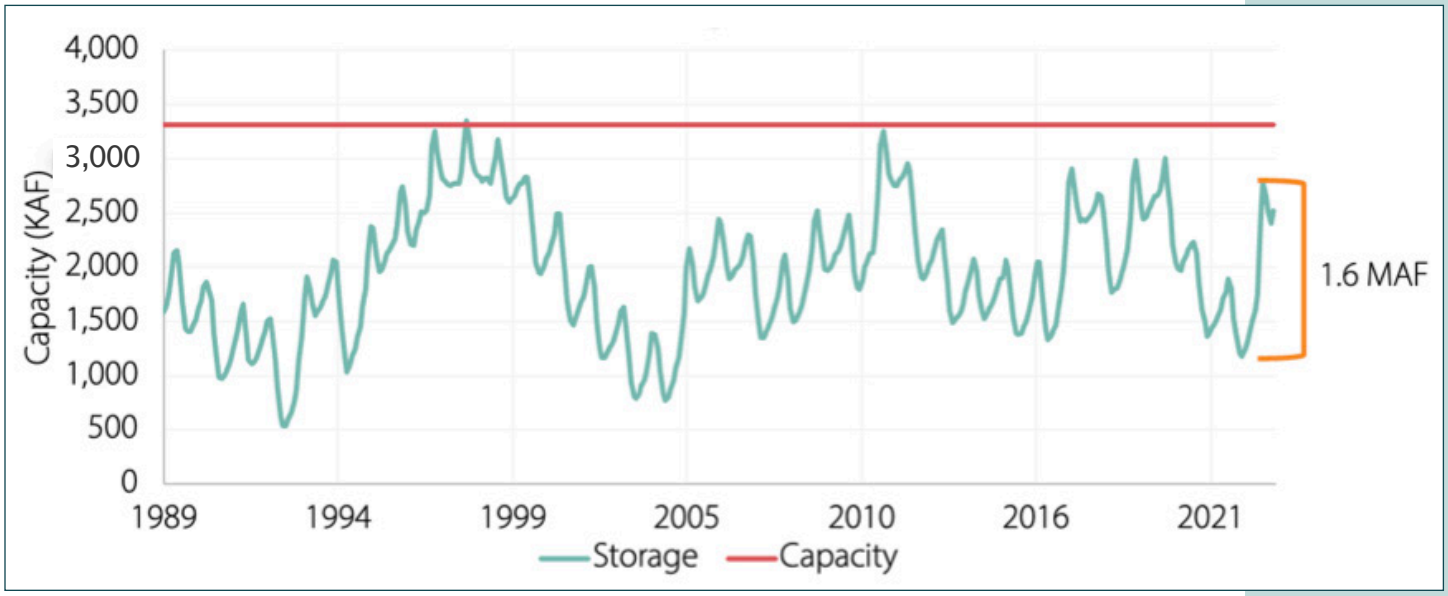


FIGURE 6: RESERVOIR STORAGE IN THE GREAT SALT LAKE BASIN (1989-2023)



Even in large water years, human water needs often compete with the lake. For instance, after years of prolonged drought, reservoirs throughout the Great Salt Lake watershed were severely diminished leading into the 2022-2023 winter. Even though the area received record amounts of precipitation, much of that water never reached the lake. A significant portion of that precipitation recharged parched soils. Approximately 1.6 million acre feet of water was captured and stored in reservoirs higher up in the system. This increased water storage provides necessary water security for human water uses.

Human water demand is only expected to increase in the region. In January 2022, the Kem C. Gardner Policy Institute projected that the Greater Salt Lake Economic Region will lead statewide population growth, growing from 2.8 million residents in 2020 to 4.6 million in 2060 and economic growth through the addition of nearly 1.2 of the 1.3 million new jobs statewide.[5] This growth cannot occur without sufficient water, and that water can only come from three possible sources: (1) conservation (i.e., from existing consumptive uses: M&I or agriculture), (2) the natural environment, including the Great Salt Lake, and (3) imported from somewhere else, with all the associated legal, political, and economic challenges. One thing is clear: everyone living in or moving into the Great Salt Lake Basin needs to embrace a new model for what growth looks like, one that values and limits the amount of water we need for every new home and business.

THE HUMAN IMPORTANCE OF THE LAKE

The Great Salt Lake has historically contributed to the local economy with an economic output of more than $1.3 billion[6] each year and providing over 7,700 jobs.[7] Other economic activity associated with a healthy lake bolsters economic activity as well. The ski industry, for instance, supports 20,000 jobs and another $1.2 billion.

While the positive economic impacts of the lake are significant, a drying lake is beginning to have negative effects on the region. A 2019 *Assessment of Potential Costs of Declining Water Levels in Great Salt Lake*[8] compiled by EcoNorthwest and Martin & Nicholson for the Great Salt Lake Advisory Council calculated that "the monetized potential costs of a drying Great Salt Lake could be as much as $1.69 billion to $2.17 billion per year and over 6,500 job losses. Over twenty years, these costs could be as high as $25.4 billion to $32.6 billion (discounted using a 3 percent discount rate)."

Lower lake elevations result in more exposed lakebed and an increase in dust emissions. As of 2023, more than 800 square miles of lakebed were exposed to wind erosion. Winds across the lakebed generate dust that is then transported to communities downwind, potentially impacting all 2.5 million residents along the Wasatch Front. The Office of Legislative Audit General recently identified dust as an emerging risk for air quality. They noted:

> *"Dust mitigation is estimated to be at a minimum $1.5 billion in capital costs with ongoing annual maintenance of $15 million. Those estimates skyrocket if costs and affected surface area increase. Beyond these direct costs, ecological impacts become more difficult to quantify but may have far reaching impacts if protected birds become adversely affected, which initiates a federal response. In sum, low water levels could damage Utah's public health and environment and threaten billions of dollars in economic activity."*[9]

In addition to contributing to the Wasatch Front's already-impaired airshed, it also accelerates the melting of snowpack. Research has shown that when dust falls on snowpack, the snowpack loses reflectiveness and absorbs heat more quickly. This, in turn, makes snowpack melt more quickly. Researchers at the University

of Utah measured the highest levels of dust on snow in 2022, the same year the lake hit record lows, and estimated that dust on snow caused the snowpack to melt 17 days earlier than normal.[10] When the snowpack melts too quickly, it can have major impacts on water storage for the state because our entire water storage system is dependent upon water being stored as snowpack and being slowly released as the snow melts in the spring and summer.

Additionally, a smaller lake has the potential to reduce the amount of lake effect snow coming from the lake. Lake effect snow is the cause of between 5 to 10 percent of snow falling in the Cottonwood Canyons. Any reduction in that amount of snowfall could have very serious consequences to our water budget.

THE COORDINATION PROBLEM

One of the most complicated features of crafting policy for the Great Salt Lake has been the number of entities that work on lake issues. Many state, federal, and local government agencies, non-profit organizations, academic institutions, industry representatives, councils, and committees are simultaneously working on various facets of lake governance. Each of these entities has its own mission, tasks, or directives.

Within state government, there are at least 10 separate agencies that oversee at least one aspect of the lake. These include: the Utah Division of Forestry, Fire, and State Lands; the Utah Division of Water Rights; the Utah Division of Water Resources; the Utah Division of Wildlife Resources; the Utah Division of State Parks; the Utah Division of Outdoor Recreation; the Utah Division of Oil, Gas and Mining; the Utah Geological Survey; the Utah Division of Water Quality; and the Utah Division of Air Quality.

While these agencies often interact, more centralized coordination is needed. That absence of sufficient coordinated effort becomes even more exaggerated when considering the various federal agencies, outside of state control, that also have influence on the Great Salt Lake governance, including the United States Bureau of Reclamation; the United States Army Corps of Engineers; the United States Fish and Wildlife Service; and the United States Geological Survey. Historically, the state's engagement with the various non-governmental agencies working on lake issues has been limited.

Lastly, the lake's largest tributary, the Bear River, begins and ends in Utah, but also runs through Wyoming and Idaho on its course to the lake. The Bear River Compact, the interstate agreement governing the river, includes water being used in Wyoming and Idaho. While Utah has maintained a generally positive relationship with its neighboring states, it has not undertaken a concerted effort to ensure that all of the Bear River states are committed to getting water to the lake.

RECENT MUNICIPAL AND INDUSTRIAL CONSERVATION EFFORTS

The state is actively working to enhance conservation efforts. An important next step is to ensure water saved from conservation efforts is committed to and reaches the lake.

Regional Water Conservation Goals

Regional water conservation goals were developed to enhance water conservation efforts around the state. Region-specific goals support the unique characteristics and needs of Utah's diverse climates and ecosystems. Thanks to the efforts of many Utahns and their water providers, per capita water use has declined by at least 18%. We've made significant progress, but more must be done to accomplish these goals, including policy and ordinance changes on state, local, and municipal levels.

Secondary Metering

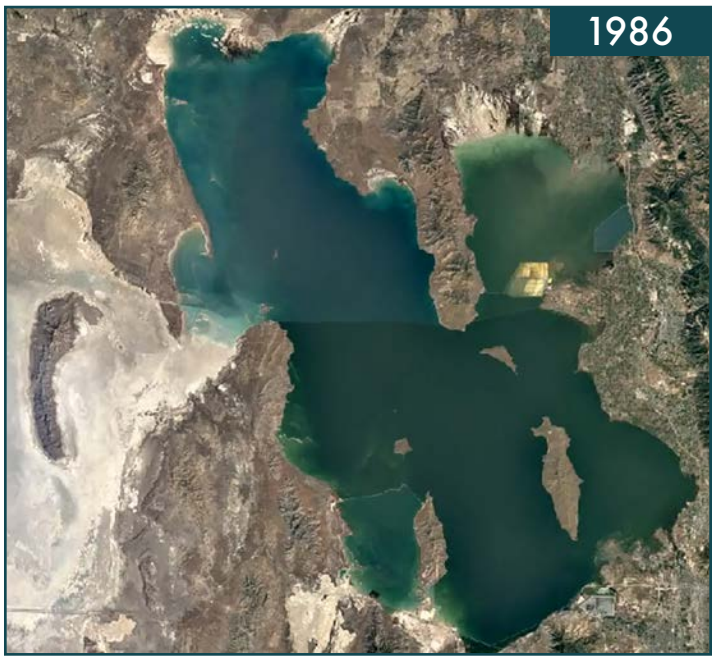
Many residential connections use secondary water for outside irrigation. When connections aren't metered, it is difficult to track and conserve secondary water. Meters have been proven to help reduce water use by informing users of their consumption without mandating water restrictions. In 2022, the state required that all secondary pressurized connections be metered by January 1, 2030. The state also appropriated $250 million in American Rescue Plan Act grant funding for the purchase and installation of secondary water meters. The Board of Water Resources was tasked with distributing these funds. To date:

- All $250 million has been authorized and committed by the Board of Water Resources.
- Of that, $170 million has been contracted, and work has begun to put the meters into the ground.

Landscape Conversion Incentive Program

In Utah, 60% of residential water use goes toward outdoor irrigation. To encourage the use of waterwise plants and landscape principles, the state is incentivizing the replacement of thirsty lawns with waterwise landscaping through Utah Water Savers. To date:

- 5,447 applications for rebates have been received statewide.
- A total of over $5 million has been spent by the districts and state.
- Over 3.5 million square feet of grass have been replaced statewide.
- An estimated 104 million gallons of water are being saved annually (about 320 acre-feet).



Statewide Water Saving Device Rebates
As part of Utah's water conservation efforts, there are rebates available statewide for toilet replacement and smart sprinkler controller installation.

Integrating land use and water planning
Integrating water considerations into land planning presents a significant opportunity to reduce Municipal and Industrial water use.

Too often, land use planning is undertaken independently of water use and planning efforts, even though the two can and should inform one another. Integrating these two processes from the beginning of any development proposal is far more cost-effective than retrofitting existing development for water efficiency after the fact.
To date, the state has:

- Developed an Integrated Water and Land Use Planning Framework, including a Framework for Community Action, a Stakeholder Checklist, and a Utah Community Self Assessment.
- Held two Growing Water Smart workshops and have two more planned in the coming months.
- Developed resources for municipalities and counties to include water use and preservation elements in their General Plans.
- Technical assistance available for municipalities and water suppliers to integrate land use and water planning.

Recent Agricultural Conservation Efforts
The Utah Legislature created the Agricultural Water Optimization Task Force in 2018 to find ways to better optimize agricultural water supplies in order to provide for future water needs and to sustain Utah's agricultural industry and heritage.[11] In 2022, in response to declining water levels on the Great Salt Lake, the Legislature appropriated $70 million to fund agricultural water optimization projects around the state.

The Utah Department of Agriculture and Food provides additional points as part of their ranking criteria for agricultural optimization projects located in the Great Salt Lake watershed.

In 2023, the Legislature passed SB 277, "Water Conservation and Augmentation Amendments," which appropriated an additional $200 million for agricultural optimization and created a new committee housed within the Utah Department of Agriculture and Food.[12] The Utah Department of Agriculture and Food also funded 93 projects with over $20 million from the appropriated funds. Utah Department of Agriculture and Food estimates that the funded projects will have an annual water savings of 61,599 acre-feet in diverted water. Previously funded agricultural optimization projects have an estimated yearly water savings of 172,847 acre feet of diverted water. Despite these successes, questions remain as to whether these water savings result in decreased depletion and whether any of this water has made its way to the lake.

In response to questions and concerns about whether dollars invested in agricultural water optimization would measurably benefit the Great Salt Lake, legislators and other stakeholders began drafting legislation in advance of the 2024 session to more clearly quantify and account for water savings generated through agricultural water optimization programs.

The Way Forward
Short Term (Next Year)

In this section:

- Better coordinating efforts on the lake
- Ensuring that decisions are based upon the best available science and data
- Getting more water to the lake
- Protecting the Great Salt Lake water quality and air quality

The first year of the strategic plan is focused on four objectives: 1) Better coordinating efforts on the lake; 2) Ensuring that we have the best available science and data to govern future strategies and actions; 3) Getting more water to the lake; and 4) Increasing monitoring and management of salinity levels, dust levels, and water quality to ensure that public health is protected and that the lake's ecosystem and the businesses that rely upon it remain viable in the future.

The actions identified in the plan's first year largely build upon initiatives, partnerships, and programs that have already begun to help the Great Salt Lake. The short-term actions are designed to provide a foundation and guidance for longer term strategies and actions.

OBJECTIVE 1 - BETTER COORDINATING EFFORTS ON THE LAKE

Numerous state, federal, and local government agencies, non-profit organizations, academic institutions, industry representatives, councils, commissions, and the public work on Great Salt Lake issues.

Part of the role of the Great Salt Lake Commissioner is to better coordinate these efforts. FIGURE 7 on page 16 illustrates the array of organizations involved and invested in Great Salt Lake issues. While each entity and project has its own mission, tasks or directives, the Commissioner's Office intends to ensure that all are working together to protect the lake. The graphic in this figure is by no means exhaustive of all the groups dedicated to this effort, but rather provides a glimpse into the management complexity of the Great Salt Lake. The Commissioner's Office is set up to be a clearinghouse of Great Salt Lake information, a convenor of the separate interests on the lake, and the ultimate advisor for state policy on the lake.

To better coordinate actions on the lake, the state will engage in the following actions:

Action – Better coordination between state agencies. To better coordinate state efforts, the Commissioner's Office will hold regular cross-agency coordination meetings to discuss management issues and emerging issues on the lake. The invited participants will include agency heads or their designees.

The Commissioner's Office will also work with the Legislature, the Division of Water Resources, the Division of Water Rights, the Division of Forestry, Fire, and State Lands, the Division of Wildlife Resources, farmers and ranchers, irrigation companies, and others to assist the Utah Department of Agriculture and Food in the development of a strategic plan for agricultural optimization, and in the development of water shepherding plans and agreements that:

1. Support the current efforts to clarify the definition of saved water in both law and administrative rule.
2. Support the current efforts to install measurement systems necessary to measure the amount of water saved and to be able to shepherd saved water to the Great Salt Lake.
3. Identify a target for how much water agricultural optimization will save and potentially could be delivered to the Great Salt Lake as well as project the cost per acre foot.
4. Work with recipients of the funding to commit saved water to the Great Salt Lake.

The Commissioner's Office will also work with Utah Water Ways and the Utah Division of Water Resources to develop a public education and engagement campaign to educate the public about actions needed to help conserve and commit water to the lake.

Action – Better coordination between the state and federal government. The Commissioner's Office is working to foster a more coordinated effort between state and federal government agencies. The first step to this coordination will be the formal signing of a Memorandum of Understanding between the state, the U.S. Bureau of Reclamation, the U.S. Geological Survey, and the Army Corps of Engineers, ensuring cooperation and coordination on lake projects. It is anticipated that this MOU will be signed in early 2024.

Next, the state will pursue funding opportunities from the federal government. The first of these is the proposed Great Salt Lake Water Delivery Program.

FIGURE 7: THE GREAT SALT LAKE GOVERNANCE ORGANIZATION

This proposed program seeks funding from the U.S. Bureau of Reclamation from monies appropriated through the Inflation Reduction Act. Collectively, the program will deliver conserved water to the lake, deplete less water within the Great Salt Lake Basin, and more closely monitor and understand surface water flows throughout the complex system. The federal funds will complement the significant financial commitments the state of Utah has made in recent years to protect the Great Salt Lake.

The proposed Water Delivery Program contemplates utilizing these funds for split season and seasonal leases of agricultural water on a voluntary basis, which will then be shepherded to the lake. It also includes a proposed durable component in the Lower Bear River to aid water conservation programs within the Bear River Canal Company through a combination of incentivized transformation to drip irrigation systems, canal lining and piping, and automation. The final component of the program is to assist the Weber Basin Water Conservancy District in lining the Willard Canal to ensure more efficient water delivery to and from Willard Bay. The state is currently awaiting a decision from the federal government on its funding request for the Water Delivery Program.

Over the next year, the state will continue to engage with the federal government to identify additional funding opportunities and other joint projects.

Action – Engage in state-to-state coordination with Wyoming and Idaho on the Bear River. The Bear River begins and ends in Utah but travels through portions of Wyoming and Idaho. Accordingly, it is subject to an interstate compact. The Bear River Commission (BRC) manages the interstate compact obligations of the states.

Through 2024, the Commissioner's Office and the Utah Department of Natural Resources will meet with the Management Committee of the BRC to discuss the regional importance of the lake and learn how all states can act together to avoid an adverse federal regulatory or judicial action on the Bear River.

The Commissioner's Office and the DNR will work with the Governor's Office to facilitate an ongoing conversation with the Governors' offices of Wyoming and Idaho on joint interests on the Bear River.

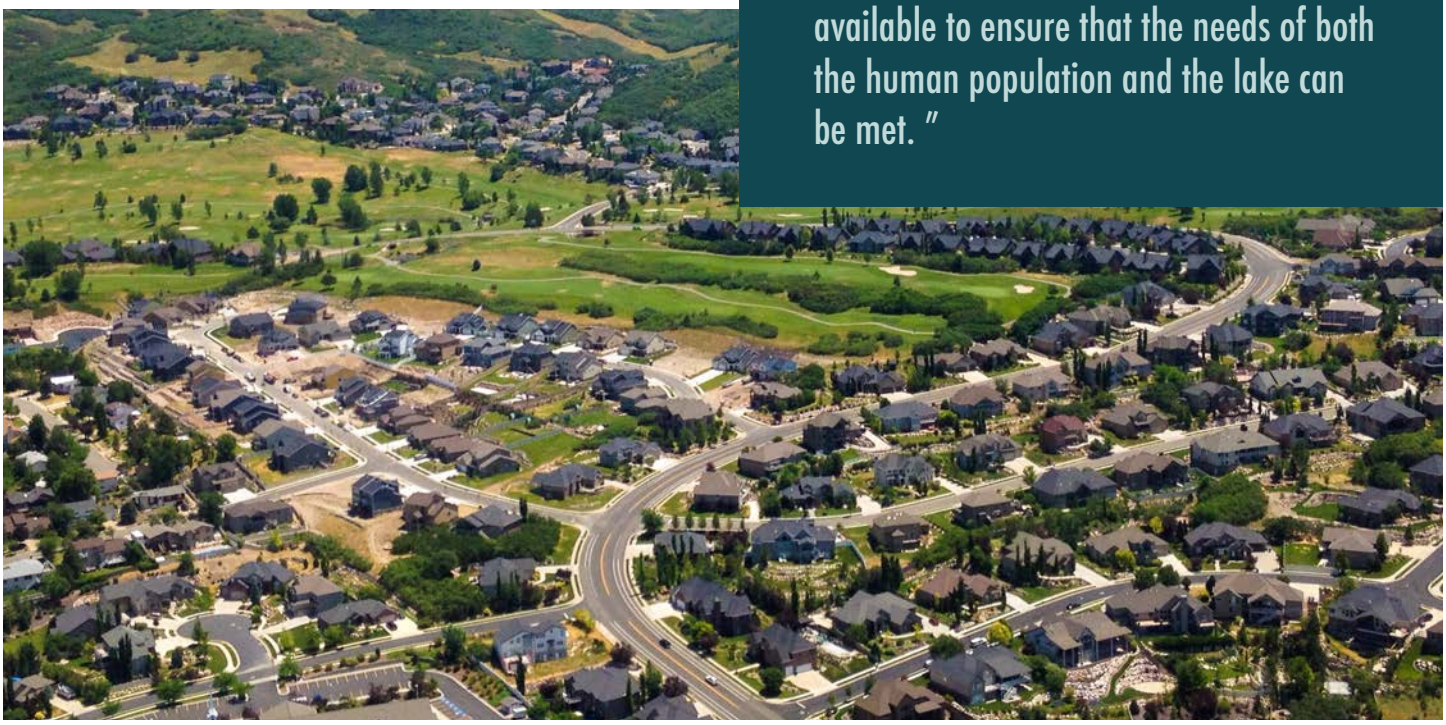
Action – Work toward improved coordination and regionalization of water providers. SB 76 in the 2023 Legislative Session mandated the Division of Drinking Water and Division of Water Resources to study the possibility of improved coordination, consolidation, and regionalization between water providers. This bill further mandated that the divisions include policy and funding recommendations. This report will be completed in 2024 and will include opportunities to make water systems and districts more resilient and interconnected to stretch and optimize existing water supplies and allow more water to be discharged into the lake.

Action – Establish more meaningful state and non-governmental coordination. The Commissioner's Office will also regularly meet with water conservancy districts, water providers, universities, interested parties and non-governmental entities to coordinate efforts and share information where possible.

Action – Solidify the role of the Great Salt Lake Advisory Council (the "Council") as the primary venue to engage stakeholders and coordinate actions to protect the lake. The Great Salt Lake Commissioner Act provides that the Council, which already serves as a de facto watershed council for the Great Salt Lake, will advise the Commissioner, along with the Governor, the Department of Natural Resources, and the Department of Environmental Quality on "the sustainable use, protection, and development of the Great Salt Lake."[13] To avoid potential duplication of effort, conflicting mandates, and burdens on stakeholders, it is recommended that the statute governing the Council be amended to allow for the Council to serve as both the board advising the Commissioner's Office and as the Great Salt Lake watershed council under the Utah Watershed Council Act. This designation would better ensure coordination between the Council and the new watershed councils in the basin.

Action – Ensure robust public engagement. The Commissioner's Office and agencies working on the Great Salt Lake will ensure that there is robust public engagement in the implementation of this strategy. Specific public engagement opportunities include public meetings, such as the Great Salt Lake Advisory Council, Salinity Advisory Committee, and the Great Salt Lake Technical Team, where the public will have the opportunity to engage with decision makers and resource managers. Additionally, it is critical that the public participates in the crafting of the Great Salt Lake Comprehensive Management Plan and the Basin Integrated Plan in order to shape the future of the Great Salt Lake.

"Good policy cannot be crafted in the absence of good science and data. As such, it is vital that we get the best information available to ensure that the needs of both the human population and the lake can be met."



OBJECTIVE 2 - ENSURING THAT DECISIONS ARE BASED UPON THE BEST AVAILABLE SCIENCE AND DATA.

Good policy cannot be crafted in the absence of good science and data. As such, it is vital that we get the best information available to ensure that the needs of both the human population and the lake can be met.

Action – Develop better methodology for estimating water use and processing and storing data. The Division of Water Resources and the Division of Water Rights will continue to develop and refine the state's tools and methodology for determining and measuring water depletion, including expanding the number of eddy covariance towers statewide, including in the Great Salt Lake Basin. These tools will enable the state to validate and improve evapotranspiration models statewide with the ultimate goal of using Open ET as the state's accepted method for determining evapotranspiration. The State Engineer needs a consistent, statewide method for determining evapotranspiration in administration of water rights.

In recent years, the Open ET platform has made remotely sensed evapotranspiration data easily accessible and useful for numerous applications and is emerging as the industry standard for determining evapotranspiration. Additional data from other evapotranspiration calculation methods, specifically eddy covariance towers, help validate and improve the evapotranspiration models used by Open ET. Toward this end, several state agencies and institutes of higher learning within Utah have been cooperating to expand the number of eddy covariance towers within the state.

Additionally, the State Engineer appoints River Commissioners on 13 separate river systems within the Great Salt Lake Basin to distribute water to the various water users. As water is administered by the commissioners, they collect and report streamflow and diversion measurements at about 700 sites within the basin. These data need to be efficiently processed and made available online in a usable format. As the number of measurement sites grow and remote sensing capabilities are added, there is an ever-increasing need to develop better systems and processes for managing all of these data. Good data management allows for accurate and transparent distribution accounting and makes water measurements widely available to different interests for many purposes.

Action – Explore increasing funding, multi-state and multi-agency and non-governmental coordination to monitor brine shrimp, brine flies, and birds. Ongoing research, monitoring, and cross-boundary collaboration are needed to ensure species and food webs remain healthy and viable. While there are various aspects of research and monitoring of brine shrimp, brine flies, and bird species being undertaken by state and federal agencies, non-profits, and academic institutions, there is a clear need to scale up, increase funding, and coordinate and integrate these efforts locally and regionally to achieve meaningful conservation outcomes for these species.

1. **Brine Shrimp** – Support existing coordination between the Division of Wildlife Resources and the industry when it comes to monitoring and reporting on the health of the brine shrimp population. The brine shrimp population in Gilbert Bay represents one of the most sustainable fisheries in the world, supporting tens of millions of metric tons of global seafood production annually and using a collaborative approach between industry and the

state that harvests only the excess brine shrimp cysts in the lake each year. This harvest system, which has been in place for decades, benefits not only the brine shrimp population itself, but the globally important brine shrimp industry, as well as the millions of migratory birds that rely on the brine shrimp population as fuel for their annual migrations.

2. **Brine Flies** – The brine fly population on the Great Salt Lake has not been as extensively studied or managed because it lacks the kind of industry engagement we see with brine shrimp. Nevertheless, brine flies also provide an essential food source for millions of migratory birds: for example, diving ducks are known to feed on brine fly pupae attached to microbialites; other birds eat the free swimming larvae; and, once they hatch and begin to fly, adults feed shorebirds and waterbirds alike. However, there is still much to learn and understand about brine flies at the Great Salt Lake to ensure a viable population.
3. **Birds** – the Great Salt Lake, its wetlands, and the freshwater bodies like Farmington Bay and Willard Bay, are an irreplaceable part of a larger network of saline lake ecosystems in the Intermountain West and Western Hemisphere, providing stopover and breeding habitat for more than 10 million waterbirds in western North America.[14] There are at least seven species of shorebirds and waterbirds that rely very heavily

on brine shrimp and their eggs or brine flies and their larvae and pupae at the lake during the fall or winter months, including Wilson's Phalarope, Red-necked Phalarope, Eared Grebe, Northern Shoveler, Green-winged Teal, Common Goldeneye, and California Gull.[15] Even the Snowy Plover, a species of greatest conservation need in Utah,[16] which frequents the open mudflat areas and shallow water interface, utilizes brine flies as a food source.[17]

Action – Continue work on the Great Salt Lake Basin Integrated Plan. The state is currently undertaking an unprecedented comprehensive planning process for the lake and its watershed. HB 429 from 2022 directed the Division of Water Resources to develop and implement the Great Salt Lake Watershed Integrated Water Assessment. Water Resources was subsequently awarded a WaterSMART grant from the U.S. Bureau of Reclamation to develop a Great Salt Lake Basin Study. With similar objectives aimed at better understanding the complex water supply and demand in the Great Salt Lake Basin, these two projects have merged to become the Great Salt Lake Basin Integrated Plan.

These combined projects will help to ensure a resilient water supply for the Great Salt Lake and its watershed by:

- Assessing current surface and groundwater supply in the Great Salt Lake Basin;
- Forecasting future water demands;
- Investigating potential benefits of forest management and watershed restoration;
- Coordinating efforts to quantify and incorporate demand into the water supply and demand model;
- Identifying and evaluating best management practices to provide a reliable water supply;
- Analyzing the trade-offs in relation to impacts on water users throughout the basin and avoiding deterioration of agriculture, industry and ecosystems; and,
- Recommending actionable strategies for the holistic management of water resources.
- Developing a collective assessment and planning tool encompassing the entire Great Salt Lake Basin is a massive undertaking. Thus, the project will be completed in two phases. Phase one developed a Work Plan to lay out the approach for completing the Great Salt Lake Basin Integrated Plan. This Work Plan was completed in November 2023. The Commissioner's Office will work closely with the Division of Water Resources to carry out that work plan, which will lead into phase two, initiating the longer process of creating the actionable integrated plan, which will conclude in late 2026.

Details of the work plan and an overview of what is coming next for the Integrated Plan are available at https://water.utah.gov/gsl-basin-integrated-plan/.

Action – Update the Great Salt Lake Comprehensive Management Plan. The Division of Forestry, Fire and State Lands (FFSL) is soliciting bids to update the Great Salt Lake Comprehensive Management Plan and the accompanying Great Salt Lake Mineral Leasing Plan. The plans will guide FFSL, along with other local, state, and federal partners in managing, allocating, and appropriately using GSL's sovereign land and mineral resources. The plans will clearly set forth management goals, objectives, and implementation strategies. This process will begin in the short term, with implementation occurring in the medium term.

Action – Continue work of the Great Salt Lake Strike Team. Established in summer 2022, the Great Salt Lake Strike Team includes researchers from Utah State University and the University of Utah, as well as

the Utah Departments of Natural Resources, Agriculture and Food, and Environmental Quality, and other key stakeholders. The Strike Team fulfills a two-fold purpose: 1) Serve as the primary point of contact to tap into the expertise of Utah's research universities, and 2) Provide urgent research support and synthesis that will enhance and strengthen Utah's strategies to improve watershed management and increase water levels in the Great Salt Lake. The team released a policy assessment in February 2023 and released a second report in January 2024. The reports provide data insights on key aspects of the lake (e.g. all the data graphs included in this report and inflow requirements included in Appendix 1), as well as expert analyses of many of the policy options being considered and proposed in this report. Efforts of the Strike Team will be continued to provide needed research and analyses for economic incentives, agricultural optimization, engineered options, and other policy alternatives in the coming months and years. Additional steps will be taken to integrate the team's work with the needs of the Commissioner and the Great Salt Lake Advisory Council.

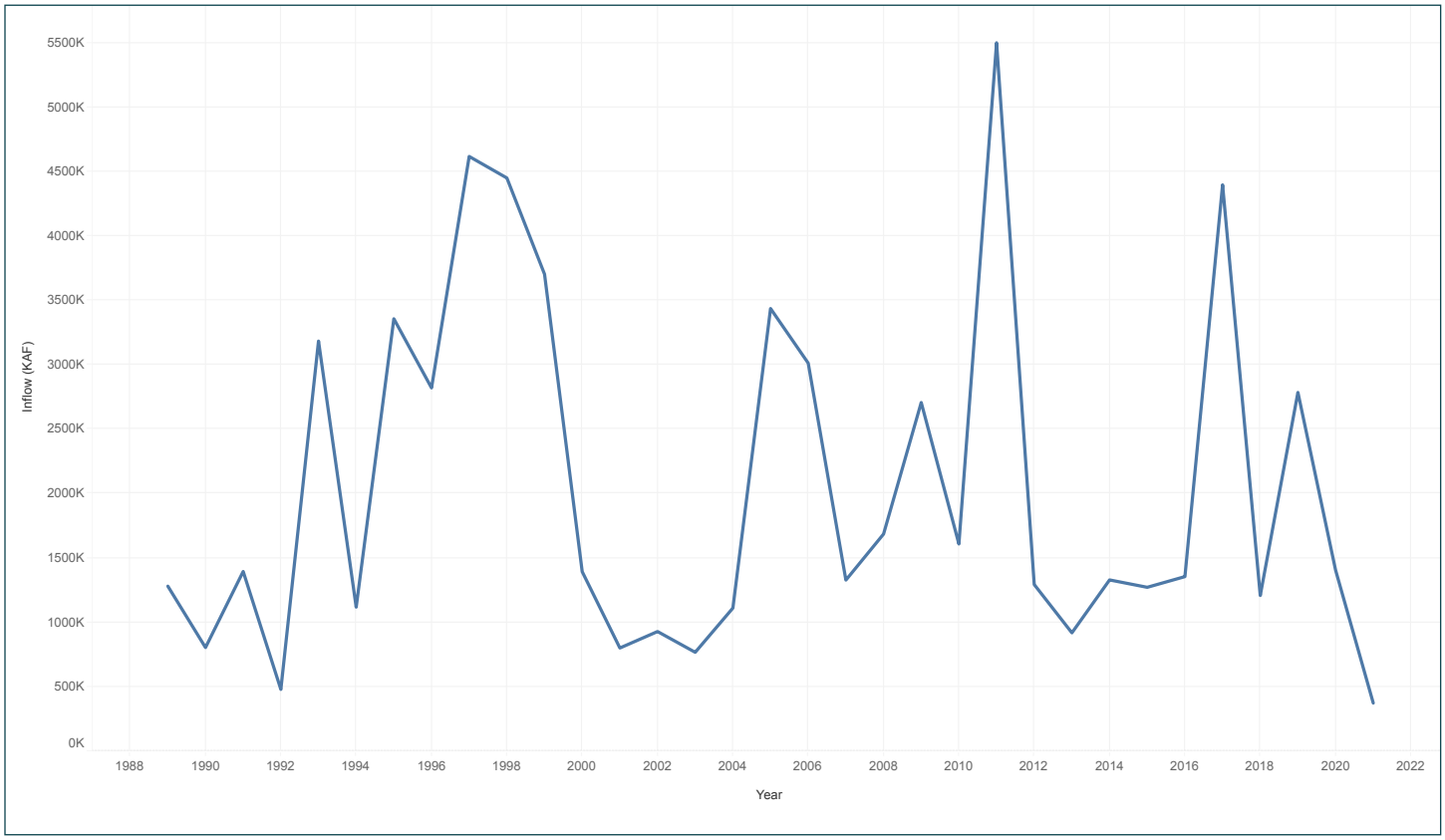
Action – Additional studies. A variety of additional studies will also be ongoing through the next year. The Division of Water Quality will be undertaking water quality monitoring and analysis to help form the baseline for understanding water quality standards for the lake. The U.S. Geologic Survey, Utah Geologic Survey, Utah State University, and University of Utah will be continuing groundwater studies to better understand the relationship between surface and subsurface water. These studies will help inform the Division of Water Rights in managing water rights within the basin. Utah State University and the Division of Water Rights will complete a measurement and telemetry gap analysis to determine river and diversion gauging needs in the Great Salt Lake Basin. This study will help future placement of measurement devices throughout the basin.

OBJECTIVE 3 - GET MORE WATER TO THE LAKE.

Action – The Commissioner is establishing a target range for the lake between 4,198-4,205 feet, based upon the healthy range for the long-term health of the entire Great Salt Lake using the Great Salt Lake Elevation Matrix.[18] The Commissioner is proposing to develop a plan for the lake to reach the target range within the next 30 years. As previously stated, any increase in lake elevation above where it stands today brings additional benefits. However, in order to know if the collective actions in this plan will be adequate to achieve and maintain the long-term health of the lake, it is important to have a target for how much additional water needs to get to the lake each year over a set period of time. In other words, do the additional flows each year add up to enough water to raise the lake into the healthy range. The good news is that we don't need to get the lake to the healthy range immediately as long as we are making progress over time.

As spelled out in this plan, Utah has already made significant investments in water conservation. Those investments in M&I conservation, agricultural optimization, and secondary water metering will make it easier for all water users to conserve water and help the state progress toward this target range.

FIGURE 8: INFLOWS TO GREAT SALT LAKE IN THE CONTEMPORARY PERIOD (1989-2021)



Over the next year, the Commissioner's Office will develop a detailed plan with the goal to reach the target range within 30 years, building off the scenarios in Appendix 1[19], that will include: annual water conservation targets; quantification of the amount of conservation that could be achieved through existing tools like secondary water metering, municipal and industrial conservation, and agricultural optimization; and trigger levels including an intermediate target elevation of 4,195 feet that will be used to adjust actions for different sectors based upon the conditions in the lake.

As part of this process, it will be important to plan for streamflow variability. Filling and maintaining the Great Salt Lake within a target range is complicated, due to the fluctuation of streamflows from year to year as shown in the Inflows to the Great Salt Lake in the Contemporary Period, 1989–2020 graph below. We will need to capitalize on wet years, although they are infrequent. Below are two representative streamflow periods that can be used for planning:

- Low streamflow – The average of the lowest sequential five years on record: 1988 to 1992 (1,059 KAF/year).
- Average streamflow – The contemporary average inflows between 2000 and 2022 (1,643 KAF/year).

INFLOW REQUIREMENTS

Table 1 provides inflow requirements starting from the lake at 4,191 feet. The lake is considered to be at a healthy level when at or above 4,198 feet (up to 4,205 feet), to be in a transitionary zone with some adverse effects from 4,195 to 4,198 feet, to be experiencing adverse effects from 4,192 to 4,195 feet and to be experiencing serious adverse effects when below 4,192 feet. As of January 4th, 2024, the lake was at 4,192.5 feet.

TABLE 1: INFLOW REQUIREMENTS FOR TARGET LEVELS WITH THE LAKE AT 4,191 FEET (KAF/YEAR)

Target Elevation (ft.)	Fill in 5 years	Fill in 10 years	Fill in 20 years	Fill in 30 years	Maintain	Condition
4,191	-	-	-	-	1,414	Serious Adverse effects
4,192	1,564	1,504	1,476	1,468	1,463	Adverse effects
4,195	2,091	1,849	1,758	1,743	1,738	Transitionary effects
4,198	2,807	2,348	2,174	2,145	2,137	Healthy range

Action – The Commissioner's Office will work with all parties to develop a short-term contingency plan to keep the South Arm of the lake from falling below 4,190 feet or hitting a salinity trigger to avoid serious adverse effects to wildlife, public health, and the businesses that rely upon the Great Salt Lake. The short-term contingency plan will also include steps that the Commissioner's Office along with the Division of Forestry, Fire, and State Lands will take to minimize impacts on the North Arm of the lake. The purpose of a short-term contingency plan is to enable quick action in the near term while long-term actions and plans are put into place. A short-term contingency plan would involve identifying voluntary shared shortage targets across all sectors, freeing up funding to compensate water right holders for damages resulting from agreeing to decrease their water use consistent with the voluntary targets, and protections for water right holders.

In 2022, when the lake levels fell to 4,188.5 feet and salinity levels reached 185 g/L in the South Arm, there were clear indications that the food web in the lake had begun to collapse. Fortunately, a near-record water year enabled the South Arm to rise 5.5 feet. The South Arm is at 4,194.5 feet as of January 4, 2024. It is critical that we learn from the data and lessons of 2022 to take steps to help ensure that the lake does not approach the same levels as 2022.

Action – Quantify the amount of water saved through existing conservation programs and work to commit saved water to the lake. Utah has made significant investments in water conservation programs and has seen significant conservation gains. Through the next year, the state will work to determine how much water has been saved within the Great Salt Lake Basin and work to commit some or all of those savings to the long-term health of the lake.

Specifically, the Division of Water Resources will analyze water savings that have resulted from secondary metering and other municipal and industrial water conservation programs. The division will then work with water providers to temporarily or permanently commit saved water to the lake. As part of this effort, the division will also examine Utah's regional municipal and industrial water conservation goals as recommended in the Great Salt Lake Basin Integrated Plan by moving the conservation goal currently set for 2040 up to 2030 and the 2065 goal up to 2040. The analysis will include what would be necessary to achieve those goals early: limiting water demand in new development, required retrofitting of existing landscapes to waterwise landscapes, the price elasticity of water, and implementing effective tiered water pricing in the basin.

The Commissioner's Office will also work with the Division of Water Rights, Division of Water Resources, the Utah Department of Agriculture and Food, and the Legislature to more thoroughly quantify and protect water conserved through the established Agricultural Optimization Program to accomplish the following goals:

- Move more water to the lake to rebuild the lake's natural safety cushion;
- Provide meaningful incentives and legal protections to agricultural producers to participate in those efforts; and
- Preserve working agricultural lands and rural economies.

Action – Implement water transactions with saved water, including agricultural optimization, split season and seasonal leases. Lessons learned from the development of the agricultural optimization strategic plan and the work to lease water and dedicate water to the lake have paved the way for a variety of different

types of agricultural water transactions, including agricultural optimization as well as split season and seasonal leases of water.

In the upcoming year, the Commissioner's Office will work to develop a water transaction program, including split season and seasonal leasing. The Commissioner's Office will seek authorization from the Legislature of $5 million from the already appropriated funds in the Commissioner's account to develop a coordinated plan for these types of transactions in agricultural water. To achieve the greatest conservation for the amount of money available, it will be important to coordinate leases from irrigation companies and water right holders. This coordination will help to ensure that saved water from decreased diversions can be more easily shepherded to the lake.

To help initiate this process, the Commissioner's Office will work with the Utah Department of Agriculture and Food, the Utah Farm Bureau, the Division of Water Rights, and others to identify willing participants in the program and complete at least one pilot project using agricultural optimization that successfully shepherds saved water into the Great Salt Lake.

Next, the Commissioner's Office will work with the Utah Department of Agriculture and Food, the Division of Water Rights, and others to seek participants who are willing to engage in split-season or seasonal leases of water and complete at least one pilot project using a split season lease that shepherds saved water into lake within the next year.

Action – Continue working to bring additional water to the lake. Utilize funding from the Legislature and donations of water rights to enhance water quantity and water quality for the Great Salt Lake and its wetlands, as well as protecting and restoring wetland habitats to benefit the hydrology of the Great Salt Lake, while leveraging the state funds and engaging with a wide range of interests.

1. Funding from the state has facilitated or helped fund permanent and temporary water transactions that secure existing and new water flows. To date, this includes between 56,000 – 64,000 acre-feet[20] of water. These early transactions represent substantial leveraging of the state grant funds resulting from large volumes of donated water, as well as other matching cash contributions. Future transactions are likely to draw down considerably more of the remaining funding.
2. At least 25% ($10 million) of the $40 million in funding appropriated in 2022 is required to be used "to protect and restore wetlands and habitats in the Great Salt Lake's surrounding ecosystem to benefit the hydrology of the Great Salt Lake." In November 2023, eight projects were awarded a little more than $8.5 million in funding over the next two years, with applicants providing at least $6.5 million in match.
3. Taking into account projected funding commitments, as of September 2023, the available (uncommitted) balance of state funds was a little more than $25 million.

Action – Work with Utah State University to expand Ag Water Demonstration, Research and Implementation Program (Ag-DRIP) into the Great Salt Lake Basin. Ag-DRIP program plans to build resilience to drought and optimize agricultural water use by collaborating with water users and managers to help them develop and achieve irrigation management goals. With educational materials, onsite evaluations, irrigation technologies that will become demonstration projects, and data evaluation, USU researchers will work together with water users and managers to learn, improve, innovate and develop opportunities to optimize water use.

Action – Water augmentation through cloud seeding. The state has been cloud seeding since the 1970s.

In 2023, there was a significant investment in the cloud seeding program. The state of Utah appropriated $12 million in one-time funding and $5 million in ongoing funding for a cloud seeding program led by the Division of Water Resources. The division has hired a meteorologist to be the program manager, started an aerial program utilizing flights to cloud seed within the Great Salt Lake watershed, and has deployed 20 remote generators this winter. The division will also be collecting data required to understand the impact of the seeding operations.

Action – The Division of Water Quality will review reuse projects and work with other agencies, applicants, Publicly Owned Treatment Works, and municipalities to identify projects that can be discharged to a receiving water within the Great Salt Lake Basin, which includes Utah Lake, rather than reusing the water for a consumptive use. This effort will identify roadblocks, alternatives and incentives related to water quality protection, functional flow needs, and community or regional water conservation program(s) success.

"While we have seen substantial improvements in conditions over the last year, lake levels remain well below healthy levels"

Action - Industrial optimization and conservation. From 1989 to 2020, mineral extraction depletions alone accounted for 8.0% of total human depletion from the lake and grew to 181.8 KAF in 2020. The Commissioner's Office and the Division of Forestry, Fire, and State Lands will work with mineral companies and other industrial water users to decrease depletions from the lake through optimization and conservation, and explore opportunities to commit saved water to the lake. The state will also complete rule making governing mineral extraction including lithium and other minerals from the lake.

Action - Continue Invasive Phragmites Removal and Wetland Restoration. The Divisions of Forestry, Fire, and State Lands and Wildlife Resources have developed and are implementing effective best practices for the removal of invasive phragmites from the Great Salt Lake wetlands. These efforts should continue and expand. This will involve partnerships with landowners/managers so that the problem can be comprehensively addressed. Restoration and revegetation should take place once phragmites has been removed from an area. Ongoing management, maintenance, and monitoring must take place in order to preserve any progress made.

OBJECTIVE 4 - PROTECT THE GREAT SALT LAKE WATER QUALITY AND AIR QUALITY

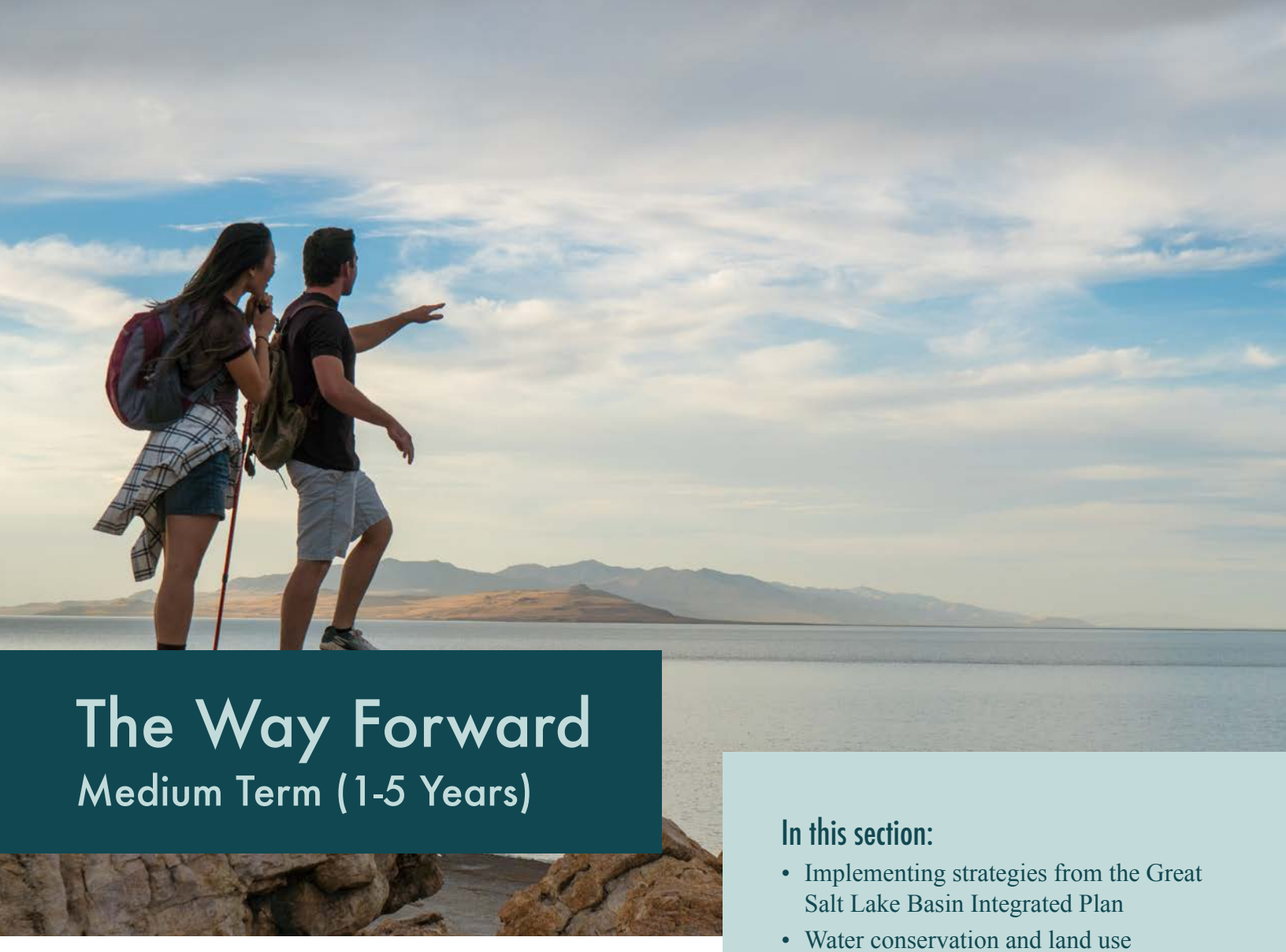
Action – Continue salinity management through berm operations. HB 513 (2023) established that "unless salinity conditions in Gilbert Bay warrant raising the adaptive management berm, the policy of the state is to keep the UP (Union Pacific) causeway breach open so as to allow the exchange of water between Gilbert and Gunnison Bays." There are two openings in the Union Pacific Railroad (UPRR) causeway that separate the North Arm and South Arm of the lake. The Lakeside breach is located on the western shoreline of the Great Salt Lake and only communicates at elevations of approximately 4193.8' and above. Another breach is located approximately 6 miles to the east in the main body of the Great Salt Lake and contains an adaptive management berm constructed of rock fill. The berm was originally constructed in 2017 to keep the dense North Arm brines from flowing into the South Arm. The berm was raised in August 2022 in order to further reduce flows from north to south and once again in February 2023 to temporarily eliminate flows altogether. The primary purpose of modifying the berm is to improve salinity conditions in the South Arm.

Both short- and long-term management of the berm must be dynamic. It should be noted that there are other dikes and berms that are within the footprint of the lake that should be considered as part of management plans and decisions, too. Additionally, management decisions should be based on scientific observations and the best forecasting and modeling available at the time. In addition to modifying the berm to manage salinity, the Commissioner's Office and the Division of Forestry, Fire and State Lands will investigate methods to improve the mixing of inflows into the main body of the lake to ensure that flows through the breach are fully mixed. Full mixing ensures that the maximum amount of salt is transferred through the breach to the North Arm, where salinity is not a concern. Additionally, there is an advantage to maintaining a slightly higher South Arm Elevation, which ensures that the dense North Arm brines are unable to flow back through the breach, or through the permeable causeway, into the South Arm.

It is critical that lake managers adapt to observed lake conditions, drought, and flooding when considering modifications to the berm. The Division of Forestry, Fire, and State Lands will consult with the Commissioner's Office prior to modifying the berm. The Commissioner's Office will work with stakeholders to develop a salinity management plan in consultation with the Division of Forestry, Fire and State Lands and the Division of Water Quality. The salinity management plan will include a long-term management strategy for the berm and other methods to control and optimize salinity levels.

Action – Continue water quality monitoring and assessment of the Great Salt Lake. The Division of Water Quality will continue to monitor water quality including salinity levels and conduct analysis and assessments necessary to protect the Great Salt Lake's ecological health and beneficial uses.

Action – Expand air quality monitoring conducted by the Division of Air Quality for the areas surrounding the Great Salt Lake, including increasing the number of monitoring stations in populated areas and work in cooperation with the Division of Forestry, Fire and State Lands to identify dust hot spots for potential mitigation.



The Way Forward
Medium Term (1-5 Years)

In this section:

- Implementing strategies from the Great Salt Lake Basin Integrated Plan
- Water conservation and land use planning
- The Great Salt Lake Water Enhancement Trust
- Water banking and water markets
- Government and non-government research and assessments
- FFSL pilot projects on lakebed dust
- The Commissioner's Office and Governor's Office funding plan
- Water Augmentation from cloud seeding

The medium term strategies are designed to build off the lessons learned from the first year of the plan. These strategies will be adapted based on those lessons and are largely focused on actions that the state can take without relying upon large-scale infrastructure projects or water augmentation from outside of the state. The Commissioner will update the plan annually to reflect lessons learned and adapt to changing conditions.

In addition to all of the effective short term strategies explored over the next year, the state will be undertaking the following actions in the next 1 to 5 years:

Action – Complete and implement strategies identified by the Great Salt Lake Basin Integrated Plan.[21] The Integrated Plan is following a collaborative framework, including strategic research, decision-making

tools, solution development, and capacity development. Completing the plan will allow for more informed decision-making and more tools to solve complex lake issues. The following areas of interest will be developed over the coming years:

- Strategic research better quantifying water budgets and evaporative losses from the lake, identifying water requirements of GSL shorebirds, updating safe yield estimates for aquifers in GSL watershed, and analyzing minimum functional flows for stream.
- Development of decision-making tools that allow decision-makers the best contingency planning for scenarios involving decreased water budgets, river basin models, lake models, and adaptation/mitigation strategy development, and tradeoff analysis.
- Solution development – Identifying the opportunities and costs for agricultural water optimization, M&I water conservation, and the options and costs for GSL dust control.
- Capacity development – Helping the state have the best data, tools, and personnel available to tackle the challenges facing the lake. One of the tools that has been specifically identified by the Integrated Plan is developing a Great Salt Lake Data Hub in coordination with the U.S. Geological Survey.
- While the final Integrated Plan will be completed in 2027, critical research, tools and information will be released as soon as they are available. The Commissioner will use the tools and information produced for the Integrated Plan to assist in the implementation and revision to the strategic plan.

Action – Work toward a model for growth that values water and protects the Great Salt Lake. With the Greater Salt Lake Economic Region set to grow from 2.8 million residents in 2020 to 4.6 million in 2060, we need a new model for how growth can occur while protecting the Great Salt Lake. The actions below are designed to help establish that new model including:

1. **Water Conservation Goals**. The Division of Water Resources will evaluate and make recommendations to revise regional conservation goals to take into consideration the Great Salt Lake, as required by SB 76 (2023). The division will also explore opportunities to accelerate these goals.
2. **Integrated Land and Water Use Planning.** The Division of Water Resources, Utah Department of Agriculture and Food, and the Division of Drinking Water will work with cities and counties to help them plan for growth including water needs and how to meet regional conservation goals. To accomplish this, the Division of Water Resources will work with the Division of Drinking Water, cities, counties, and developers to develop a proposed water use target for new development that will limit the amount of water needed for new homes and businesses as the state grows.

   By planning conservation into new growth, the amount of water needed for new development will decrease through the use of waterwise landscaping. To accomplish these ends, the state will work with water conservancy districts and local municipalities to adopt system-specific standards that reflect land-use ordinances, development patterns and density (townhomes v. single-family), and enforceable water conservation ordinances. This is one of the quickest strategies for reaching regional conservation goals.

3. **Incentives for Increasing Conservation.** Based on the work above, the Division of Water Resources will develop new incentives and proposals for increasing conservation from existing municipal and industrial development. Additionally, the division will seek additional investment into municipal and industrial water conservation efforts by incentivizing all municipalities to convert municipal nonfunctional turf into waterwise landscaping. This would result in a significant change in outdoor water use and illustrate that our government is leading by example.

   Water pricing presents another valuable tool for incentivizing water conservation in the municipal and industrial setting. While the state has made some progress in implementing tiered pricing among water providers in the state, more work is needed to ensure that the tiered structures sufficiently incentivize wise use. The Division of Water Resources will build off the SB 34 (2023) study to identify economic tools that improve how water and water conservation are valued. The Division of Water Resources and a diverse work group will evaluate the current pricing systems statewide to identify if changes are needed within the overall pricing system. Additionally, the Commissioner will also explore tax credits for water that is permanently donated to the lake and other economic tools.

Action – Develop a plan for "wet" water years to ensure that there is a coordinated effort to maximize the amount of water that makes it to the lake when there is abundant snowpack and/or rainfall. As could be noted from last year, the fastest way to get water to the lake is from abundant precipitation. To get more water to the lake in wet years, the state will work with water conservancy districts, municipalities, irrigation companies, and other reservoir owners, water users and the Trust to develop joint plans for releasing water to the Great Salt Lake in times of abundance.

Action – Expand water transactions with saved water from agricultural optimization and from split season leases and seasonal leases. The Commissioner's Office will continue working with the Trust, the Utah Department of Agriculture and Food, and the Utah Farm Bureau and others, to identify participants who are willing to engage in split-season or seasonal leases of water. It is estimated that additional funding will be needed to secure (i) 100,000 acre-feet of water (temporary or permanent); (ii) protect or restore 20,000 acres of wetlands and associated habitat in surrounding the Great Salt Lake ecosystem to benefit lake hydrology; and (iii) contribute to efforts to improve water distribution bottlenecks in the water delivery systems. The Commissioner's Office and the Department of Natural Resources will continue engaging with the Legislature and at the federal level to secure a broad base of funding to assist in these efforts.

Action – The Division of Water Resources will explore further incentivization of water banking and water markets. A functional and fluid water bank and water market will be important to be able to get water to the lake and adapt to changing conditions.

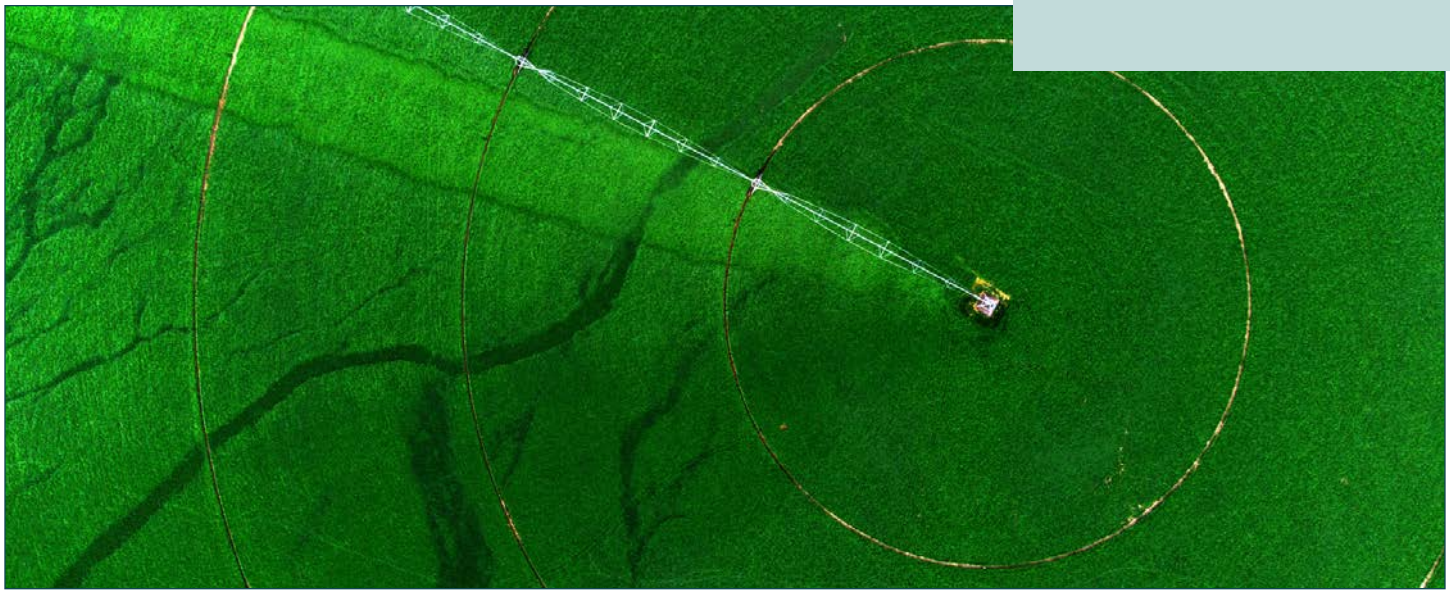
Action – Support government and non-governmental assessments and research to increase understanding of how land-use changes surrounding the lake can affect the hydrology of the wetlands and lake, as well as increase knowledge of the relationship between wetlands, lake hydrology, and interstitial and groundwater connections to lakebed to identify needs and actions to protect those functions. Wetlands associated with the Great Salt Lake are integral to the lake and its ecosystem functions. A large majority of the 338 bird species in the Great Salt Lake ecosystem rely on the large va-

riety of wetlands, from playa and mudflats to open water and the bays, feeding on abundant invertebrates and vegetation. A good portion of water flows entering the lake make their way through managed and unmanaged wetland systems.

However, the amount of additional water that needs to get to the lake will be significantly more than 100,000 acre-feet per year. The Commissioner's Office will develop projections for long-term funding needs.

Action – Explore potential water supply augmentation strategies. In any given year, the amount of water that falls as precipitation across the Great Salt Lake Basin represents a fixed amount of water available for all uses. The basin exports no water elsewhere and currently imports water from the Colorado River via the Central Utah Project. Thus, the amount of precipitation that falls within the basin plus the amount of water imported from the Colorado River represents the total volume of water available for all uses. If the amount of water depleted by one sector (agriculture, municipal, or natural environment) increases in a closed system, then that increase in depletions can only come at the expense of another use or the lake. For example, if a new dam is built in that closed system, then any new consumption associated with that dam – either by evaporation or an increase in consumption – must come at the expense of either the natural environment or another water use. To complicate mat-

"...the division will seek additional investment into municipal and industrial water conservation efforts by incentivizing all municipalities to convert municipal nonfunctional turf into waterwise landscaping. This would result in a significant change in outdoor water use and illustrate that our government is leading by example."



ters further, prolonged drought and increasing average temperatures have meant in recent years that the size of the pie (available water within the basin) is shrinking.

That reality understandably drives consideration of strategies that potentially enlarge the size of the pie. Two suggest themselves: (1) cloud seeding (artificially augmenting the amount of precipitation that falls inside the basin); and (2) interbasin or transbasin diversions that import additional water into the Great Salt Lake Basin.

Action – Water Augmentation from Cloud seeding. As noted above, the state has appropriated $12 million in one-time funding and $5 million in ongoing funding for a cloud seeding program led by the Division of Water Resources. Cloud seeding operations and data collection will continue through the next five years. Data collected from the cloud seeding program will help the state understand the benefits to the Great Salt Lake and make any adjustments needed to the program.

The Way Forward

Long Term (6-30 Years)

In this section:

- Water conservation programs
- Expanded water banks and water markets
- The effects of cloud seeding
- Exploring water augmentation through interbasin or transbasin diversions

The long term strategies are designed to build upon the lessons from the first five years of implementation and adaptation of this plan and changing conditions in the lake. These strategies will also look forward to potential projects that could take multiple years or even decades to implement, including large scale infrastructure and water augmentation projects.

Action – Continue to refine water conservation programs and dedicate saved water to the lake. After the first five years of implementing and adapting water conservation programs under this strategy, the Commissioner's Office, the Division of Water Resources, the Utah Department of Agriculture and Food, and others will use data from those programs to determine: which programs have been successful at conserving water; the amount of water that has been saved; the amount of water that has reached the lake for each program;

and the amount of additional water that is needed. This information will be used to refine the conservation programs.

Action – Continue to hone and expand water banking and water markets. As noted above, water banking and water markets will play an essential role in the implementation of this strategy. The Commissioner's Office will work with the Division of Water Resources, the Trust and others to develop and refine the tools necessary to allow the market to respond to changing conditions and to move water more efficiently to the lake.

Action – Analyze the effectiveness of cloud seeding. While questions persist about the potential yield of cloud seeding operations, a growing body of science suggests that cloud seeding does in fact increase precipitation at the local level.[22] As has been previously noted, the state has been involved in cloud seeding since the 1970s. In 2023, there was a significant investment from the state of Utah ($12 million one time and $5 million ongoing). Data gathered from this expanded program will be analyzed in the long term to determine how effective the operations have been, whether they should be continued, or if they should be modified. This data will form the basis of future legislative requests for the cloud seeding program.

Action – Explore water augmentation through interbasin or transbasin diversions. The second way to augment supply is through interbasin diversions or transfers: importing additional water from areas outside the Great Salt Lake Basin. While such strategies make a lot of sense from a pure water availability standpoint, they face considerable political, legal, environmental, permitting, and other challenges.

One potential solution would be to import water only during times of super abundance: i.e., years when nearby river systems flood. In theory, water could be diverted in those years in ways that mitigate flood problems locally while supporting storage and/or refilling the Great Salt Lake. The challenge in both cases is that flood years remain both infequent and unpredictable, which makes imported surplus water more expensive. On the other hand, the Great Salt Lake could readily absorb surplus water to add back in the lake's natural safety cushion.

In addition to supply challenges, other challenges that will need to be overcome include construction costs, maintenance and pumping costs, and complex and time-consuming permitting.

Some of the sources of imported water that are frequently discussed include the Snake River, the Missouri River, the Mississippi River, the Colorado River, and the Pacific Ocean.

REFERENCES

1. *Utah Division of Forestry, Fire and State Lands, Great Salt Lake Lake Elevation Matrix, 2013*
2. *GSL Assessment Updates, David Tarboton, 11/23/23 (Appendix 1)*
3. *The amount of water coming from groundwater in the form of springs under the lake is currently the subject of active investigation by the Utah Geological Survey and the United States Geological Survey, but could be as high as 315 KAF. Groundwater may actually be a more significant contributor to the water budget than has been previously thought.*
4. *It should be noted that managed and unmanaged wetlands play a vital role in the ecological integrity of the lake system. They provide critical habitat, manage flood flows, filter pollution from the water flowing into the lake, and provide recreational activities. Due to these ecosystem services, large efforts have been made to keep as many of these areas intact and functional. As the main body of the lake has receded from the wetlands, it has taken more water to keep the wetlands wet.*
5. *https://gardner.utah.edu/wp-content/uploads/LongTermProj-Jan2022.pdf?x71849&x71849*
6. *Bioeconomics. (2012). Economic Significance of the Great Salt Lake to the State of Utah. Prepared for Great Salt Lake Advisory Council.*
7. *The lake leads the western hemisphere in the production of premium fertilizer like sulfate of potash, provides critical minerals like magnesium, and produces 40-45% of the world's annual supply of brine shrimp eggs, which are critical to aquaculture production.*
8. *EcoNorthwest https://documents.deq.utah.gov/water-quality/standards-technical-services/great-salt-lake-advisory-council/activities/DWQ-2019-012913.pdf*
9. *Utah State Office Of Legislative Auditor General 2023-10 High Risk List: Identifying and Mitigating Critical Vulnerabilities in Utah*
10. *Otto Lang, Derek Mallia, and McKenzie Skiles, "The shrinking Great Salt Lake contributes to record high dust-on-snow deposition in the Wasatch Mountains during the 2022 snowmelt season." Environmental Research Letters 18 064045 (15 June 2023). Available at: https://iopscience.iop.org/article/10.1088/1748-9326/acd409.)*
11. *https://le.utah.gov/~2018/bills/static/HB0381.html*
12. *https://le.utah.gov/~2023/bills/static/SB0277.html*
13. *https://le.utah.gov/~2023/bills/static/HB0491.html.*
14. *https://wildlife.utah.gov/gslep/wildlife/birds.html*
15. *Bird Species at Great Salt Lake Primarily Relying on South Arm Ecosystem, Utah Division of Wildlife Resources and National Audubon Society, https://media.audubon.org/file-attachments/article/species-table1-gsl-south_arm_specific-v1-10-28-22-l.pdf?_gl=1*bvjo84*_ga*NTgxMDA2NjY3LjE2NjQyMjI2OTU.*_ga_X2XNL2MWTT*MTcwMDM0NTYyNC41OTkuMS4xNzAwMzQ1Njc5LjUuMC4w*
16. *Utah Wildlife Action Plan - 2015-2025, https://wildlife.utah.gov/pdf/WAP/Utah_WAP.pdf*
17. *Great Salt Lake Biology, A Terminal Lake in a Time of Change, Baxter and Butler, editors; Great Salt Lake Shorebirds, Their Habitats, and Food Base, Ch. 9, Sorenson, Hoven, and Neill, 2020.*
18. *Utah Division of Forestry, Fire and State Lands, GSL Lake Elevation Matrix, 2013*
19. *GSL Assessment Updates, David Tarboton,11/23/23 (Appendix 1)*
20. *Amount based on the face value diversion rate of the water rights or shares. Note that approval is pending for some 7,200 acre-feet, which may not be completed in 2023.*
21. *GSLBIP draft work plan https://water.utah.gov/wp-content/uploads/2023/11/GSLBIP-Work-Plan-DRAFT_2023-11-15.pdf*
22. *See, e.g., James Dineen, "Can Cloud Seeding Help Quench the Thirst of the U.S. West?" Yale Environment 360 (March 3, 2022); available at: https://e360.yale.edu/features/can-cloud-seeding-help-quench-the-thirst-of-the-u.s.-west.*
23. *Charts and graphs courtesy of the Great Salt Lake Strike Team.*

APPENDIX

THE GREAT SALT LAKE STRIKE TEAM ASSESSMENT

Update 11/23/2023 by:
David Tarboton, Director
Utah Water Research Laboratory, Utah State University

INFLOW REQUIREMENTS

Table 1 provides inflow requirements starting from the lake at 4,191 feet. The lake is considered to be at a healthy level when at or above 4,198 feet (up to 4,205 feet), to be in a transitionary zone with some adverse effects from 4,195 to 4,198 feet, to be experiencing adverse effects from 4,192 to 4,195 feet and to be experiencing serious adverse effects when below 4,192 feet (Utah Division of Forestry Fire and State Lands, 2013). Two streamflow scenarios were considered to account for the variable nature of the climate:

- Drought. 1059 thousand acre-ft per year (kaf/yr) based on the lowest 5-year inflow on record that occurred from 1988 to 1992.
- Contemporary average. 1,643 kaf/yr, the average inflow for the years 2000-2022.

Assuming these inflows, the additional inflow through conservation required to fill the lake to the given target levels in 5 years is given in table 2.

TABLE 1: INFLOW REQUIREMENTS FOR TARGET LEVELS WITH THE LAKE AT 4,191 FEET

Target Elevation (ft.)	Fill in 5 years	Fill in 10 years	Fill in 20 years	Fill in 30 years	Maintain	Condition
4,191	-	-	-	-	1,414	Serious Adverse effects
4,192	1,564	1,504	1,476	1,468	1,463	Adverse effects
4,195	2,091	1,849	1,758	1,743	1,738	Transitionary effects
4,198	2,807	2,348	2,174	2,145	2,137	Healthy range

TABLE 2. ADDITIONAL CONSERVATION INFLOW NEEDED FOR DROUGHT AND CONTEMPORARY STREAMFLOW SCENARIOS, TO FILL LAKE TO TARGET LEVEL IN 5, 10, 20 AND 30 YEARS.

Target Elevation (ft)	Five Years		Ten Years		Twenty Years		Thirty Years	
	Drought (1059 kaf/yr)	Contemporary (143 kaf/yr)	Drought (1059 kaf/yr)	Contemporary (1643 kaf/yr)	Drought (1059 kaf/yr)	Contemporary (1643 kaf/yr)	Drought (1059 kaf/yr)	Contemporary (1643 kaf/yr)
4,191	355	0	355	0	355	0	355	0
4,192	505	0	445	0	417	0	409	0
4,195	1,032	448	790	206	699	115	684	100
4,198	1,748	1,164	1,289	705	1,115	531	1,055	471

(Data in GSL_LevelFlowSensitivity-11-23-23.xlsx)

CONSERVATION STRATEGY OPTIONS

Strategies to prevent further decline of the lake or to restore the lake to target levels have been evaluated considering alternatives for conservation across the water use sectors. The conservation required depends on future climate and streamflow. These strategies consider options for preventing further lake decline in the event of the drought scenario (inflow 1,059 kaf/yr) and for filling the lake under contemporary inflow conditions (inflow 1,643 kaf/yr).

Table 3 presents options for achieving conservation of 355 kaf/yr needed to prevent further decline of the lake below its current (2023) level of 4,191 feet (effective elevation based on combined N and S volumes) with the drought inflow scenario.

TABLE 3: CONSERVATION STRATEGIES TO PREVENT FURTHER DECLINE WITH DROUGHT INFLOWS. TOTAL CONSERVATION REQUIRED 355 KAF/YR.

Sector	Average Depletion 1989-2021	Equal Percentage Reductions		Primary reliance on municipal and industrial conservation		Primary reliance on agricultural conservation	
		Conservation reduction % and kaf/yr		Conservation reduction % and kaf/yr		Conservation reduction % and kaf/yr	
Agriculture	1,323	19%	254	10%	132	23%	302
Municipal and Industrial	358	19%	69	43%	153	10%	36
GSL Mineral Extraction	165	19%	32	43%	70	10%	17
Total	1,846	-	355	-	355	-	355

Note: Average depletion values in this table (and tables below) exclude the West Desert, as conservation in the West Desert is not deemed to be a viable option for getting water to the lake. Data is from the Utah Division of Water Resources, updated through 2021.

Table 4 presents options for achieving conservation of 531 kaf/yr needed to fill the lake to the lower bound of the healthy level range (4,198 feet) in 20 years, starting from its current effective level of 4,191 feet, with the contemporary inflow scenario (1,643 kaf/yr).

TABLE 4: CONSERVATION STRATEGIES TO FILL TO LOWER HEALTHY LEVEL (4,198 FEET) IN 20 YEARS WITH CONTEMPORARY INFLOW SCENARIO. TOTAL REQUIRED CONSERVATION 531 KAF/YR.

Sector	Average Depletion 1989-2021	Equal Percentage Reductions		Primary reliance on municipal and industrial conservation		Primary reliance on agricultural conservation	
		Conservation reduction % and kaf/yr		Conservation reduction % and kaf/yr		Conservation reduction % and kaf/yr	
Agriculture	1,323	29%	381	10%	132	36%	479
Municipal and Industrial	358	29%	103	76%	273	10%	36
GSL Mineral Extraction	165	29%	47	76%	126	10%	16
Total	1,845	-	531	-	531	-	531

Table 5 presents options for achieving conservation of 471 kaf/yr needed to fill the lake to the lower bound of the healthy level range (4,198 feet) in 30 years, starting from its current effective level of 4,191 feet, with the contemporary inflow scenario (1,643 kaf/yr).

REFERENCE

Utah Division of Forestry Fire and State Lands, (2013), "Final the Great Salt Lake Comprehensive Management Plan and Record of Decision," Utah Department of Natural Resources, Salt Lake City, UT, USA, 391 p., https://geodata.geology.utah.gov/pages/view.php?ref=8267.

TABLE 5: CONSERVATION STRATEGIES TO FILL TO LOWER HEALTHY LEVEL (4,198 FEET) IN 30 YEARS WITH CONTEMPORARY INFLOW SCENARIO. TOTAL REQUIRED CONSERVATION 471 KAF/YR.

Sector	Average Depletion 1989-2021	Equal Percentage Reductions		Primary reliance on municipal and industrial conservation		Primary reliance on agricultural conservation	
		Conservation reduction % and kaf/yr		Conservation reduction % and kaf/yr		Conservation reduction % and kaf/yr	
Agriculture	1,323	26%	338	10%	132	32%	419
Municipal and Industrial	358	26%	91	65%	232	10%	36
GSL Mineral Extraction	165	26%	42	65%	107	10%	16
Total	1,845	-	471	-	471	-	471

Great Salt Lake