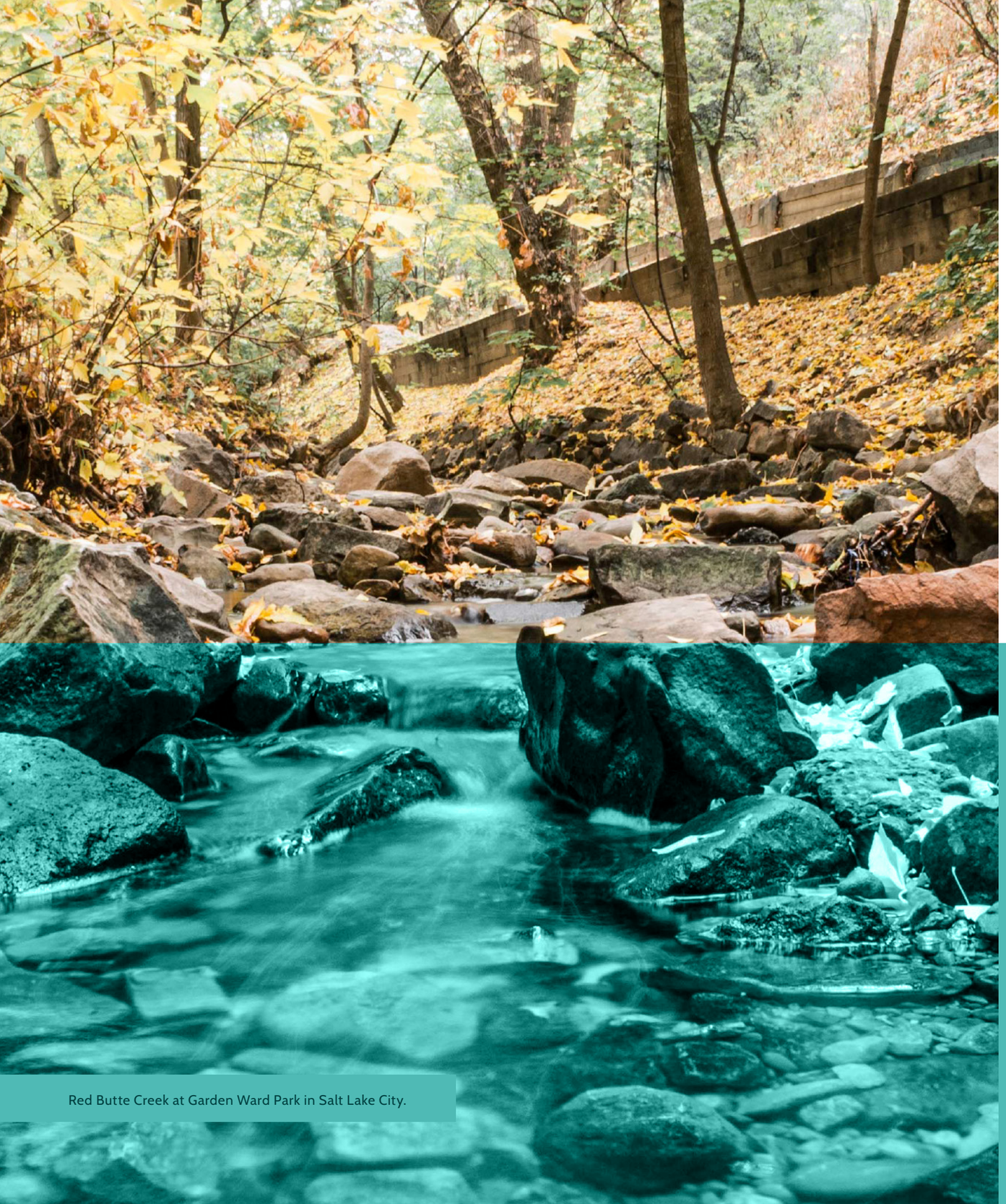


Red Butte Creek at Garden Ward Park in Salt Lake City.

WATER

Our creeks originate high in the Wasatch Range surrounding the Valley. Our snowpack melts, flowing into our cities, and providing water for our people, plants, and wildlife. Greenways carry water from our high-alpine headwaters and reservoirs through our backyards, connecting us to the very water that sustains us.

OUR URBAN CREEKS HAVE THE POTENTIAL TO BECOME AN EQUITABLE, INNOVATIVE, AND RESILIENT SYSTEM OF GREENWAY CORRIDORS.

VALUES

In the 2014 "Your Utah, Your Future" survey, residents ranked water as the second-highest priority and level of concern for the future. Of 100 points available, Utahns allocated 37 points to ensure there is enough water in our streams and lakes for wildlife and recreation. This was the highest allocation of all water categories. Farms and food production were allocated at 30 points. One of the recommendations was to: "Ensure water quality and quantity to adequately sustain and maintain the environment by improving watershed management and preserving natural systems."[1]

In the ten big ideas identified in *Reimagine Nature*, the "From the Mountains to the Lake" idea proposes increasing connectivity among Salt Lake City's parks and open spaces. Efforts would identify and invest in corridor alignments that connect the Wasatch Range to the Jordan River, especially along our creeks. Additionally, they would identify priority daylighting projects on City, Red Butte, Emigration, and Parleys Creeks.[2]

According to the *Watershed Public Opinion Survey*, Salt Lake County residents valued water quality the most—more than recreation, scenery, habitat, and the economy combined. Of eight concerns surveyed, an adequate supply of good drinking water, industrial pollution, and litter problems were the top choices. Respondents had varied impressions on the health of the stream closest to them and whether their actions affect water quality. Importantly, four of five residents support more public funding to improve our waterways. Finally, they strongly support four public policies to improve water quality that require:

- Landowners to leave vegetation in place near waterways;
- Landowners to plant new vegetation along waterways;
- New developments to set aside natural open space; and
- New developments create green infrastructure.[3]

WATER QUALITY & QUANTITY

Our creeks are critical to the Salt Lake Valley's drinking water supply. Four of our creeks—City, Parleys, Big Cottonwood, and Little Cottonwood Creeks—supply the majority of our water. In the project area, there are nine community water systems: Salt Lake City Water System, Veterans Affairs Medical Center Salt Lake City, South Salt Lake City Water System, Cottonwood Coves Incorporated, Jordan Valley Water Conservation District, Holliday Water Company, Murray City Water System, Midvale City Water System, and Sandy City Water System.

In total, the Jordan River Basin provides 234,795 acre-feet of potable water to approximately 1,111,606 people. An additional 30,699 acre-feet were supplied to users by various canals.[4] Average peak and annual flows are strongly influenced by the melting and size of our snowpack. Additionally, flows are influenced by precipitation, runoff, tributaries, groundwater, and inputs from canals.

Our water supply is unique because consumers are so close to the source waters. It takes an estimated 24 hours or less for a drop of water in one of the creeks, at the top of the Wasatch, to reach a faucet in the Valley.[5] In other areas, water sources must travel hundreds of miles through aqueducts to large population centers.

Water quality is heavily monitored and controlled in the protected upper watershed areas in City Creek, Parleys Creek, Big Cottonwood Creek, and Little Cottonwood Creek. Dogs and horses are prohibited in these protected areas. Water treatment plants are located at the mouth of each of these canyons. Even with these protections and treatment, the most economic water quality improvement comes from protecting and restoring our headwaters, according to the Center for Watershed Protection.

Protections diminish as creeks flow into the urbanized valley, and historic modification has left them in a degraded condition. As the Salt Lake Valley urbanized, riparian ecosystems gave way to concrete and asphalt, bricks and mortar. Portions of our creeks were diverted from aboveground channels into storm water pipes underneath our neighborhoods. Others were channelized to control flooding. Banks steepened and eroded. Dams and aging infrastructure eliminated fish passage, disjoined wildlife corridors, and reduced access.

According to the Utah Division of Water Quality, the lower watersheds of all seven creeks support the following beneficial use classes: 2B – Secondary contact recreation (such as

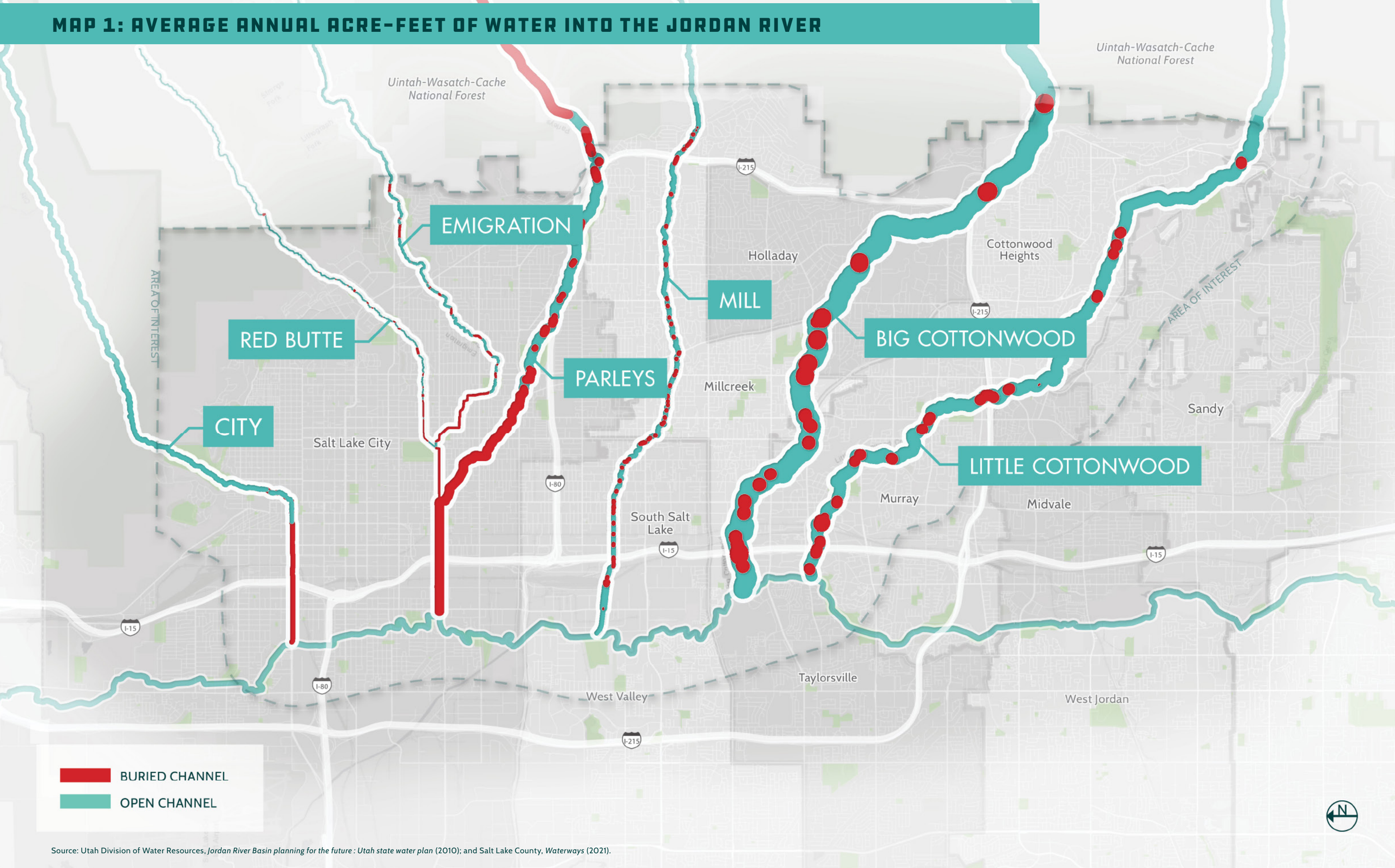
Table 1: Beneficial Use Impairments

CREEK	LOCATION	USE	STATUS	CAUSE
City - 1	Memory Grove to treatment plant	2B, 3A	Insufficient data	
City - 2	Treatment plant to headwaters	1C, 2B, 3A	No evidence	
Red Butte - 1	1100 E to reservoir	1C, 2B, 3A	Not supporting	Macroinvertebrates
Red Butte - 2	Reservoir to headwaters	2B, 3A, 4	No evidence	
Emigration - 1	1100 E to Rotary Glen Park	1C, 2B, 3A, 4	Not supporting	*E. coli*
Emigration - 2	Rotary Glen Park to headwaters	2B, 3A, 4	Not supporting	*E. coli*
Parleys - 1	1300 E to Mountain Dell Reservoir	1C, 2B, 3A	Not supporting	*E. coli*, macroinvertebrates
Parleys - 2	Mountain Dell Reservoir to headwaters	1C, 2B, 3A	Not supporting	Cadmium
Mill - 1	Confluence to I-15	2B, 3C, 4	Not supporting	*E. coli*, macroinvertebrates
Mill - 2	I-15 to Forest Service boundary	2B, 3A, 4	Not supporting	*E. coli*, macroinvertebrates
Mill - 3	Forest Service boundary to headwaters	2B, 3A, 4	No evidence	
Big Cottonwood - 1	Confluence to treatment plant	2B, 3A, 4	Not supporting	*E. coli*, macroinvertebrates, temperature
Big Cottonwood - 2	Treatment plant to headwaters	1C, 2B, 3A	Not supporting	Cadmium, copper
Little Cottonwood - 1	Confluence to treatment plant	2B, 3A, 4	Not supporting	Cadmium, *E. coli*, macroinvertebrates, temperature, total dissolved solids
Little Cottonwood - 2	Treatment plant to headwaters	1C, 2B, 3A	Not supporting	Cadmium, copper, pH, Zinc

Source: Utah Division Of Water Quality, *Combined 2018/2020 Integrated Report* (2021).

1 - Envision Utah, *Water Vision Book* (2014).
2 - Salt Lake City, *Reimagine Nature Preliminary Engagement Findings* (2020).
3 - Salt Lake County, *Watershed Public Opinion Survey Report of Findings* (2015).
4 - Utah Division of Water Resources, *Municipal and Industrial Water Use Data* (2015).
5 - Briefer, *Drinking Water and the Wasatch Front* (2018).

MAP 1: AVERAGE ANNUAL ACRE-FEET OF WATER INTO THE JORDAN RIVER



Source: Utah Division of Water Resources, *Jordan River Basin planning for the future : Utah state water plan* (2010); and Salt Lake County, *Waterways* (2021).

Table 2: Average annual acre-feet of water into the Jordan River

CREEK	ACRE-FEET
City	11,750
Red Butte	2,450
Emigration	4,440
Parleys	18,130
Mill	10,760
Big Cottonwood	51,240
Little Cottonwood	46,190

Source: Utah Division of Water Resources, *Jordan River Basin planning for the future : Utah state water plan* (2010).(2021).

wading, fishing, or hunting) and 3A – Cold-water fishery. Lower Red Butte, Emigration, Mill, Big Cottonwood, and Little Cottonwood watersheds support: 4 – Irrigation; Emigration and Parleys support: 1C – Drinking water; and only Mill supports: 3C – Non-game fishery.

Beneficial use classes determine water quality standards necessary to meet uses. Creek segments that are not able to meet the standards are placed on the Clean Water Act's Section 303(d) List of Impaired Waters. They are then prioritized for developing total maximum daily loads (TMDLs) to determine the factors contributing to the impairment and solutions to the issue. TMDLs for Emigration Creek (*E. coli*) and Little Cottonwood Creek (zinc) have been developed, approved, and are being implemented.[6]

Water quality impairments in the seven creeks include:

- Cadmium
- Copper
- pH
- Zinc
- Temperature
- Total dissolved solids
- *E. coli*
- Macroinvertebrates

Table 1 shows the beneficial use classes and water quality impairments of each creek.

CLIMATE CHANGE

Climate change is contributing to snowpack loss all over the western United States. Predictions estimate a 60 percent loss of snowpack water storage within the next three decades.[7] Moreover, expected population growth, longer growing seasons, and hotter temperatures in the Salt Lake Valley may increase water demand.

The snowpack is the most important feature of our drinking water conveyance system. It acts as a reservoir and provides drinkable water as the snow melts. Snow often totals over 500 inches in Little Cottonwood Canyon.[8] Most known for its renowned ski conditions, the "Greatest Snow on Earth" has provided a reliable water source for thousands of years of habitation in the Salt Lake Valley.

However, climate change is impacting the amount of water we have, when snow melts, and its quality. With every degree Fahrenheit increase in temperature, a 3.8 percent decrease in overall water volume is expected in our creeks.[9] 2018 was Utah's driest on record and only one other year was warmer.[10] In response, Salt Lake City issued a Stage 1 Drought Advisory.

Climate models show precipitation more frequently arriving in the form of rain, rather than snow.[11] Additionally, smaller snow packs are forecasted to melt earlier, all while demand is expected to increase. Climate-driven drought and changes in the hydrologic cycle will challenge the water resource redundancies in our water system.

Summertime algal blooms in Utah Lake and the Jordan River, due to an increase in temperature, have become the new norm. In 2016, an algal bloom on Utah Lake made over 100 people sick. Farmers scrambled to find alternative water sources and, ultimately, had to make difficult decisions regarding their crops.[12] Conditions are forecasted to continue, threatening all our reservoirs, like Sugar House Pond and Liberty Lake, and our high-alpine lakes critical to drinking water quality.[13]

Figure 1: Burial of City Creek in culvert, circa 1910. Courtesy of Utah State Historical Society.

SEASONAL DEWATERING

Many water rights claims from mining operations and farmers predate the formation of cities along the Wasatch Front. This has led to intricate and complex exchange agreements. Cities get high-quality drinking water at the water treatment plants in exchange for rights to lower quality Utah Lake water through canals.

Big Cottonwood Creek is seasonally dewatered for four miles between the canyon mouth and Cottonwood Lane. From November to March, an estimated 50 percent of the creek runs dry within the scope area. Between April and October, Utah Lake water is pumped into the creek to satisfy water rights. This has seriously degraded water quality and the riparian ecosystem.[14]

6 - Salt Lake County, *Integrated Watershed Plan* (2015).

7 - Fife, *Large near-term projected snowpack loss over the western United States* (2017).
8 - University of Utah, *Hidden Water – A Survey of Salt Lake Valley Survey Water: Little Cottonwood Creek* (2021).
9 - Biskupski, *Testimony before the Committee on Energy and Commerce Subcommittee on Environment and Climate Change* (2019).
10 - Maffly, *Utah just experienced its driest year since scientists have kept records* (2018).
11 - Utah Rivers Council, *Crossroads Utah* (2012).

12 - Associated Press, *Huge toxic algae bloom sickens more than 100 in Utah amid heatwave* (2016).
13 - Biskupski, *Testimony before the Committee on Energy and Commerce Subcommittee on Environment and Climate Change* (2019).

14 - Salt Lake County, *Stream Care Guide* (2014).

Figure 2: Kayaker on State Street in 1983 flooding of City Creek. Courtesy of Utah State Historical Society.

Little Cottonwood Creek has little to no flow in the scope area from July to March due to culinary and hydropower diversions. To supplement, Jordan River water is brought in, via a canal, at Fort Union Boulevard. This nine-mile stretch from canyon mouth to Fort Union is seriously impacted.[15]

WATER BANKING

In 2020, the Utah State Legislature approved the Utah Water Banking Strategy, a three-year pilot program to study alternatives to water transfers. Utah is a "use-it-or-lose-it" state. If water rights are not put to beneficial use over a certain period, the right may be forfeited. Through the water banking program, rights holders can temporarily sell water rights without risk of losing this water permanently. This program could be critical to securing water for instream flows (such as in Big Cottonwood and Little Cottonwood Creeks to prevent seasonal dewatering) to improve water quality, recreation, and habitat.

FLOODING & URBANIZATION

Urbanization markedly increased flooding during the 20th century. Imperviousness is categorized by changes in land-use that do not allow for precipitation to soak into the ground, such as roads, sidewalks, and buildings. Rather, water runs off the surface of our cities and into the storm water system.

Historic 100-year floods double in size with 30 percent imperviousness.[16] Salt Lake County's average impervious area is estimated at 33 percent.[17] Channeling and piping streams transferred impacts downstream, increasing flooding and erosion in our west-side communities along the Jordan River. Smooth concrete pipes and straightened, deepened streams speed up water velocity.

In 1983, a large snowpack and fast spring melt caused historic flooding "termed the worst in Salt Lake County history," according to the Deseret News. Over 1,000 homes were flooded and an estimated 400 people were forced to evacuate. Mud and rockslides closed Big and Little Cottonwood Canyons. The water treatment plant at the mouth of Big Cottonwood was forced to shut down as four feet of mud inundated the area. Famously, City Creek overtopped its banks and ran down State Street in a sandbagged channel. Kayakers were photographed in the new "State Street River," and it was rumored a cutthroat trout was caught in the channel. Similarly, Red Butte, Emigration, and Parleys Creeks were sandbagged down 1300 South.

Although, it wasn't all fun and games. The estimated cost of the three-mile Red Butte, Emigration, and Parleys canal was over $500,000. The combined flow of the creeks was 736 cubic feet per second. Approximately $2 million was spent repairing City Creek, which peaked at 305 cubic feet per second (nearly double the record from 1921). Over 2.6 million sandbags were filled and placed throughout Salt Lake County. Damages were estimated at $34 million across 1,500 identified sites.[18]

In 2017, a 200-year precipitation event overwhelmed Salt Lake City's storm water system in areas surrounding our underground creeks, primarily the Ballpark and Sugar House neighborhoods, as well as across the Jordan River corridor. Parleys Creek overtopped its culvert at Hidden Hollow, leaving five feet of water in the basement of the historic Sprague Library. Over 1,000 books ended up in the dumpster. Damage was estimated at $1.5 to $2 million, and the branch was closed for four months.[19] The Salt Lake City Fire Department estimated 100 homes were flooded. Over 5,000 customers in Salt Lake County experienced power outages. Utah Transit Authority reported delays as tracks and roads were submerged.[20] Salt Lake City School District estimated $2 to $3 million worth of damage at four schools.[21]

Utah Hazard Mitigation is evaluating the Salt Lake County Flood Insurance Rate Maps for accuracy. These maps identify the flood risk and areas where flood insurance is required for property owners. It is important development occurs away from the floodplain and in safe areas as deemed by the flood mapping. Otherwise, property owners may be required to pay for flood insurance.

Insurance costs can burden low-income residents living in flood hazard areas. Additionally, they are often less able to rebuild or relocate after disasters. Residents that rent properties within hazard areas are not required to buy flood insurance, but are at no less risk. The Federal Emergency Management Agency determined that 51 percent of the non-policyholder households in flood hazard areas are low-income.[22] Flooding can spell tragedy for tenants as belongings are destroyed, and they are forced to move from homes.

15 - Salt Lake County, *Stream Care Guide* (2014).

16 - Hollis, *The effect of urbanization on floods of different recurrence interval* (1975).
17 - Salt Lake County, *2015 Salt Lake County Integrated Watershed Plan* (2017).
18 - Hooton, *Memorial Day Weekend 1983* (1999).
19 - Stevens, *Sugar House library re-opens after devastating flood that destroyed thousands of books* (2017).
20 - Williams, *Waist-deep water floods homes, cuts power in Salt Lake* (2017).
21 - Mims, *'Torrential' thunderstorms flood East High School, SLC's Sprague Branch, Wasatch Front intersections* (2017).
22 - Doswell, *The Future of Flood Insurance and its Environmental Justice Implications on North Carolina's Low-Income Communities* (2020).

OPPORTUNITY

Restoring our WATER

Stream restoration and daylighting aims to re-establish a naturally-functioning waterway and riparian ecosystem—or to the most natural state possible. This depends on factors upstream, surrounding land-use, and the space available. Efforts improve water quality through plantings, bank stabilization, and other green infrastructure. They recreate channel meanders, remove dams, and replace aging infrastructure.

Creeks have a profound effect on the surrounding environment. Evaporation and shade from the urban forest can decrease surrounding air temperatures to mitigate the urban heat island effect. Cities and the built environment can be significantly hotter than surrounding rural areas.

In 2010, Salt Lake City ranked in the top three urban heat island cities in the United States. The study identified sprawl as a critical factor in increasing urban air temperatures and recommended urban green spaces break up the built environment.[23] Additionally, urban forests can also cool surrounding air temperatures. Moreover, they improve air quality by putting out oxygen and filtering pollutants.[24]

By re-establishing naturally-functioning ecosystems, water velocity is slowed through meanders and rocky, vegetated banks. Especially with the inclusion of a floodplain, groundwater infiltration and storage are increased.[25] Natural creeks retain nutrients and clean water quality through streamside vegetation, streambank deposition, and groundwater infiltration. Removal of culverts alleviates choke points and can replace under-capacity or deteriorating culverts. We must also keep in mind the changing climate when managing water, and be active in assessing our vulnerabilities to adapt.

Natural, open space has a much lower impervious factor than other land uses. Open space averages between nine and 12 percent. Whereas, commercial areas are 85 percent and residential areas, 32 percent.[26] By creating more of these spaces, we allow more water to soak into the ground.

Green infrastructure is an important tool in restoring our creeks. It retains, treats, and absorbs storm water and pollutants at the source, before entering our creeks. Bioswales and constructed wetlands catch runoff, filtering pollutants and trapping sediment. Permeable pavements and green roofs allow water to soak into the soil, rather than running off into the storm drain and then to our creeks.

Developments serve as an important tool in implementation. Developers can be incentivized to uncover and restore creeks as an amenity for tenants and to improve property value. Furthermore, they can build publicly-accessible trails and other recreation opportunities along the creeks. Design standards can further require implementation of recommendations through ordinances, overlay zones, or other strategies.

23 - Debbage, *The urban heat island effect and city contiguity* (2015).
24 - Klapproth, *Understanding the science behind riparian forest buffers* (2009).
25 - Trice, *Daylighting Streams* (2016).
26 - Salt Lake County, *Integrated Watershed Plan* (2015).

Figure 3: Daylighting of Red Butte, Emigration, and Parleys Creek at the Three Creeks Confluence in Salt Lake City.