Colorado River Innovative Sustainability Plan (CRISP)

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Mission Statement:

CRISP's goal is to understand how climate change and additional factors, like drought and contamination, are impacting the health and longevity of the Colorado River Basin in and around the Grand Canyon. CRISP aims to inform regulatory agencies on measures to improve and sustain the condition of the Colorado River to mitigate adverse effects of climate change, uranium contamination, and species vulnerability on the immediate and surrounding ecosystem. This group's goals will be met upon the reduction of uranium concentrations to the 30 ug/L (ppm) MCL set by the EPA.

Background

The Colorado River Basin plays a vital role in the American economy, serving as a critical water source for people, agriculture, and nature. The watershed spans 250,000 square miles, encompassing a large swath of the American Southwest. The basin covers most of the state of Arizona, along with parts of Utah, Wyoming, Colorado, New Mexico, California, and the Mexican state of Sonora. It supplies over 1 in 10 Americans with water for municipal use and drinking, making it essential to the daily lives of millions. Not only does the area contain urban areas like Phoenix and Las Vegas, but cities outside of it like LA and San Diego receive their drinking water from it.. In addition to its importance for human consumption, the basin supports agricultural productivity by providing irrigation water to approximately 5.5 million acres of land.

Figure 1: Map of the Colorado River Basin, highlighted in blue.

The region is also home to 22 federally recognized Tribes, many of whom hold significant cultural and legal rights tied to the river. Beyond water, the Colorado River Basin contributes to the region's energy infrastructure, offering 4,200 megawatts of electrical generating capacity, which is enough to power millions of homes. This combination of water, cultural heritage, agriculture, and energy makes the Colorado River Basin one of the most important and contested water systems in the United States.

Policies and Mandates

Watershed management within the Colorado River basin is dictated by the network of historic and modern policies that have changed the way the United States balances water use, environmental conservation, and regional and national coordination. In the early 1920s, talk of new water infrastructure, primarily the Hoover Dam and the All-American canal, incited fear in states further downstream on the Colorado River. Talk of project approvals worried state governments and individuals about their rights to water. In 1922, the Supreme court ruled that the Water Rights Doctrine of Prior Appropriation still holds, regardless of state borders. This ruling meant that the state which first used a water source, had the use and ownership rights to that waterbody, regardless of which state(s) the waterbody exists within. This event led to a monumental conversation about water rights, ownership, and most importantly, water sharing agreements. In 1922, the seven states within the Colorado River Basin joined together to create the Colorado River Compact of 1922, which split the basin into two subbasins, the North and South, and guaranteed each subbasin the right to use 7.5 million acre-feet of water each year. This agreement temporarily resolved significant western America water conflicts, but failed to address developing concerns for international water rights. Geographical placement along a major waterbody, like the Colorado River, can greatly influence the natural ease of water access of an interested party. In this case, the basin reaches into Mexico, making it the most downstream group relying on the Colorado River as a water source, and therefore making it the most vulnerable to a water shortage. If the United States decided to dam up the Colorado River, this would severely reduce the flows of water, downstream, to Mexico. For the listed reasons and in the interest of maintaining strong relations with a border country, the Mexican Water Treaty of 1944 was born. This agreement stated that the United States must allow for 1.5 million acre-feet

of water to flow down to Mexico each year, essentially guaranteeing Mexico their critical water source. For decades, these agreements sufficed in solving national and international water rights conflicts. In the turn of the 20th century, new issues arose as continued overuse within the basin depleted water storage. This provoked the United States, including federal and state governments of the seven involved states, and Mexico to form the Minute 323 agreement. This 2017 resolution aimed to increase water storages in Lake Mead through funding and supporting water conservation and development projects in Mexico. Minute 323 succeeded in having Mexico and the United States agree to follow the Binational Water Scarcity Contingency Plan, which supports water use reduction initiatives and emphasized a shared responsibility between Mexico and the United States regarding water shortages and surpluses within the Colorado River Basin. This statement ensures that in periods of drought, both countries will feel the impacts equally, and in cases of increased water storage, both the United States and Mexico will reap the benefits. Legislation is a critical factor in watershed management, as it allows the government and communities to collaborate and set goals and standards on how the shared water sources of our country should be used.

Problems

Problem Overview

The following table outlines the three problems that are associated with the Colorado River Basin as well as their causes.

Problem	Description:	Causes:
P1: Water Shortage	Reservoirs within the Colorado River Basin are becoming critically low, which is threatening water security for surrounding cities, ecosystems, and agriculture.	Prolonged drought, decreasing river flow, and reduced snowpack Climate change effects
P2: Increasing Uranium Levels from Mining	Leaks in the uranium mines near the Grand Canyon are leaching into the Colorado River, leading to contamination that threatens the drinking water supplies of millions of people.	Increased uranium demand Lack of water infrastructure at the mines
P3: Threatened Wildlife	The Colorado River supports over 150 threatened species. The health of the river directly reflects on the ecosystem's health.	The diminishing water level and contamination of the river, challenges the survival of different animals.

Problem 1: Water Shortage

The Colorado River, a lifeline for nearly 40 million people across seven western states, is facing a rapid crisis of water scarcity due to the compounded effects of climate change. Persistent drought conditions have significantly reduced snowpack levels in the Rocky Mountains which is the river's primary source of water. This reduction in runoff has led to a decrease in river flow, which has caused the region's two largest reservoirs, Lake Mead and Lake Powell, to drop to record-low levels. These reservoirs, symbolizing water security, are now a major warning sign of a water crisis.

The environmental stress and the over-allocation of water rights is a major problem as well. More water is legally promised to states, tribal nations, and Mexico than the river can

reliably provide. As climate change intensifies and replenishment is insufficient, this imbalance becomes increasingly unsustainable. The shrinking reservoirs not only jeopardize water supplies for cities and agriculture but also threaten the region's hydropower capabilities. As water levels become lower, this reduces the capacity to generate electricity at major dams like Hoover.

Aquifers in the region are being over-pumped as communities and farmers turn to groundwater to offset surface water shortages. This is leading to long-term declines in water tables. The pressure on water resources is further worsened by the growing demands of an increasing population and agricultural practices that require large amounts of water. As the Colorado River system continues to struggle under these pressures, the risks to surrounding ecosystems, urban centers, and farmland become more prominent. It is a signal of a future of long-term instability unless strict reforms and adaptive management strategies are implemented.

Goal 1: Ensure Long-Term Water Security and Resilience

The Colorado River Basin is currently facing a Tier 1 water shortage, highlighting the urgent need for long-term strategies that address both immediate and systemic threats to water security. Prolonged drought, exacerbated by climate change and overallocation of river resources, has drastically reduced inflows into major reservoirs like Lake Mead and Lake Powell. These critical water storage systems are now operating at historically low levels, triggering mandatory cutbacks for Lower Basin states and raising concerns over future water availability for municipalities, agriculture, ecosystems, and tribal nations. Ensuring water security in this context requires a shift from reactive measures to adaptive watershed management grounded in sustainability.

In the short term (2025–2030), the plan will focus on expanding water conservation efforts across all sectors, including municipal, industrial, and agricultural users. Measures will include incentivizing efficient irrigation practices, promoting low-water landscaping, and increasing public education on water-saving behaviors. The Binational Water Scarcity Contingency Plan currently in place will guide response actions and foster interstate cooperation. Building a culture of inclusive water stewardship, particularly with tribal communities, will be important to managing the limited supplies equitably.

Looking ahead to 2040, our plan emphasizes resilience through structural and ecological improvements. These include modernizing water infrastructure, investing in aquifer recharge, and restoring natural watershed features such as riparian zones and wetlands. By aligning land use planning with water availability, the basin can move toward a future where water use is efficient and storage is flexible. It is also important to integrate long-term climate projections to help keep ecosystems viable. To achieve stable water supplies by 2040, it will require multidisciplinary coordination, science-based planning, and inclusive decision-making across the Colorado River watershed.

Problem 2: Uranium Mining

Uranium is a naturally occurring element that is primarily used as fuel for nuclear reactors and power plants for electricity generation. There is estimated to be a 28% increase in uranium demand in the next 5 years (World Nuclear Association). As a result of this increase in uranium demand, the United States has begun to reopen their uranium mines, some of which have been closed for many years. In specific, the Pinyon Plain uranium mine, located 10 miles outside of the Grand Canyon National Park, has recently reactivated. However, the reopening of

this mine has caused drastic health and ecological effects to the Colorado River Basin, specifically through the Grand Canyon.

Due to a lack of protective water infrastructure at the uranium mine, uranium has gotten into the groundwater aquifer below the mines. This lack of protective water infrastructure is due to the Arizona Department of Environmental Quality's original claim that there was no risk of uranium depositing into the aquifer beneath the mines as the rock layer is impermeable. However, a new 2024 study suggested otherwise. It found that there was uranium contamination in the groundwater aquifer, which then connects to the Colorado River, polluting it with uranium.

This poses a health risk to wildlife that inhabit the river and its riparian zone. The millions of visitors who recreate in Grand Canyon National Park and downstream (including Lake Mead) are also at risk. A further consideration is the 22 Indigenous nations which have reservations on the Colorado River. If this mining continues to leach uranium into the river, over 40 million people who use the water will be impacted.

Goal 2: Removing uranium and Finding Alternatives

To remedy the uranium pollution in the Colorado River from the uranium mines, we looked to the EPA Maximum Contaminant Level (MCL) for where the safe limit for uranium is in drinking water. According to the EPA, the MCL for uranium is less than 30 micrograms/L (ppm). Our goal for the Colorado River Basin is to get water in both the River itself and the surrounding aquifer near the mine to below this limit.

There are three main techniques to remove uranium from water. The first method is reverse osmosis. This method involves forcing water at a high pressure through a semipermeable membrane which removes the contaminants. Not only would this method remove uranium, but it

also can remove other contaminants such lead, arsenic, and PFAs. The second removal technique is through an ion exchange water filter. These can be made on both large scales, or individual scales, making them very versatile. It is also relatively inexpensive compared to the other two techniques. The last technique is simple distillation. This process involves the purification of water by heating it into a vapor and then recondensing it into a liquid. The vapor then takes out any contaminants or impurities from the water. While this method is much simpler than the other two methods, it is the least effective at removing uranium.

In addition to our goal of removing uranium from the groundwater aquifer and the Colorado River to meet the 30 ppm MCL limit, we also have set a goal to research and find alternative solutions to uranium use. This will require research in various strategies such as fuel recycling or using alternative, but more sustainable fuels for nuclear energy. By researching these strategies and supporting organizations and research groups who are studying this, it will help reduce the overall uranium demand and need for mining.

Problem 3: Threatened Wildlife

The Colorado River has existed for millions of years, and the surrounding ecosystem has established a bountiful wildlife community. The nature and wildlife that relies on the Colorado River Basin is now threatened. There are 150 threatened species, including 4 threatened or endangered fish species. Since the Colorado River basin is a very large area, it may be more resilient to disruptions, but this wildlife and habitat disruption in Colorado echoes what is happening worldwide with nature disruption. There are numerous issues that the river is battling, which makes survival of some native fish species and other wildlife more difficult. Some of the threats to the river include: water shortage, chemical contamination, introduction of non-native species, and habitat disruptions.

The water shortage is more of an indirect effect, since it is slowly taking away where the species can live. As well, the plants and other nature that rely on the water for survival slowly are losing a precious resource they need for survival. There is chemical contamination of uranium directly from the mines, but from other sources too. Plastic and consequently microplastics have made their way into almost every corner of the earth. Similarly PFAS chemicals get into species easily, especially fish. While the effects of the substances are not fully known they are certainly harmful. Non-native species have been introduced to the river. Non-native species were added for fishing, but have since become top competitors in the food chain and taken over. Additionally, disruption to habitat via dams affect water velocity and temperature. WHich add external stressors that the fish must deal with to survive.

While it is disheartening to have all of these matters occurring, there are efforts to counteract the negative effects. There is the Lower Colorado River Multi-Species Conservation Program. This program covers 32 species and there is a range of animal and plant species.

Goal 3: Support Federal Lands

"The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased, and not impaired, in value." ~Theodore Roosevelt

Kaibab National Forest, which flanks the Grand Canyon to its north and south

The National Park Service (NPS), Bureau of Land Management (BLM), Forest Service (USFS), and Fish and Wildlife Service (USFWS) of the federal government together protect millions of acres within the Colorado River Basin. In fact, most of the area in and around the Grand Canyon is federally protected. According to the Colorado River Basin Water Supply and Demand Study, nine NPS units and seven USFWS units are directly linked to the watershed. This patchwork of federal agencies are responsible for maintaining the health and availability of natural resources for conservation, recreation, and light extraction.

By increasing public awareness through campaigns and education programs, communities can mobilize around environmental protection and amplify calls for government funding and action. Awareness plays a crucial role in fostering a conservation ethic among visitors and residents alike. According to the National Parks Conservation Association, public

engagement is directly linked to increased support for policies that protect natural and cultural resources (NPCA, 2023).

Beyond awareness, preserving habitats and native species is fundamental to the mission of the National Park Service. Efforts such as habitat restoration, invasive species management, and endangered species protection are ongoing in parks across the United States. For example, Glen Canyon Dam Adaptive Management Program (AMP), in collaboration with the Grand Canyon National Park and the U.S. Geological Survey (USGS). This program was established to protect and improve the Colorado River ecosystem downstream of Glen Canyon Dam, including within Grand Canyon National Park. A major component of the AMP involves controlling non-native fish species, particularly rainbow trout and smallmouth bass, which pose significant threats to native fish such as the endangered humpback chub. In response, the NPS has conducted mechanical removal projects, including electrofishing in the Colorado River and its tributaries to reduce the numbers of invasive predators.

Expanding appropriations for the National Park Service's Natural Resource Stewardship and Science Directorate would directly enhance the agency's ability to respond to ecological threats within national parks, particularly in critical regions like the Colorado River Basin. Increased funding should prioritize programs focused on invasive species removal, such as those targeting non-native fish in Grand Canyon National Park, as well as native habitat restoration efforts that support the recovery of endangered species. Additionally, investment in climate adaptation strategies—including fire management, drought resilience, and ecosystem monitoring—would allow the NPS to proactively address the accelerating impacts of climate change across park landscapes.

When awareness and preservation efforts align, the result is a flourishing ecosystem rich with wildlife and ecological resilience. Thriving national parks, like Grand Canyon National Park, exemplify this success—where native species such as the endangered humpback chub are protected through targeted conservation strategies and invasive species management along the Colorado River. Healthy ecosystems in the Grand Canyon not only sustain unique desert and riparian habitats but also offer recreational, educational, and cultural value to millions of visitors each year. Supporting the National Park Service helps ensure these critical landscapes remain safeguarded, contributing to cleaner water and ecological integrity throughout the Colorado River Basin.

Summary of Goals:

CRISP's main goals are maintaining water security, removing uranium from the river, and supporting the National Parks Service. These goals stood out as priorities due to the correlation to major issues the river is facing. Water scarcity for a river that supplies water to millions of people is a huge issue. As well. This river provides a habitat for many fish, birds, plants, and insects. Consequently, ensuring the long-term sustainability of water usage is crucial. The National Parks and wildlife surrounding the colorado river creates a booming economic opportunity due to the tourists that visit the area each year. Conserving different species ensures the parks are filled with wildlife, and the ecosystem is healthy.

The uranium mining is detrimental to water quality and not a sustainable source of power. Contamination of a drinking water source is dangerous. Since water is such a precious resource, it needs extensive treatment before distribution for municipal purposes.

Recommendations

To ensure long-term water security and resilience, CRISP recommends:

- Expand municipal, industrial, and agricultural water conservation programs and incentivize efficient irrigation and low-water-use landscaping
- Enhance aquifer recharge and natural water storage through wetlands and riparian restoration
- Develop long term monitoring and scenario-based planning tools for future climate variability
- Engage tribal nations and stakeholders in inclusive, adaptive water governance

To remove uranium from the Colorado River and reduce uranium demand, CRISP recommends:

- Investing in removal techniques such as ion exchange filters, large-scale reverse osmosis, and distillation in order to get the water to below the 30 ppm EPA MCL drinking water limit
- Research alternatives to uranium in regards to nuclear energy
    - Fuel alternatives such as thorium
    - Nuclear energy production efficiency
    - Fuel recycling

To help protect the threatened wildlife, CRISP recommends:

- Supporting the National Park Service and other federal agencies responsible for conservation within the Colorado River Basin.
    - Expand appropriations for the National Park Service's Natural Resource Stewardship and Science Directorate, prioritizing funding for invasive species removal, native habitat restoration, and climate adaptation strategies.

- Utilize campaigns and educational programs to inform the public about the necessity of supporting and protecting public lands.

Conclusion:

Overall, the Colorado River basin is one of the most vital river systems in the United States. With the Colorado River providing more than 1 and 10 Americans with their drinking water, as well as providing irrigation water to over 5.5 million acres of land, the problems regarding the river and its basin must be addressed.

The CRISP plan incorporates several solutions to address the main issues with the Colorado River Basin, including water shortage/mismanagement, uranium contamination, as well as the threatened wildlife that rely on the Colorado River for survival. The CRISP plan also emphasizes the interconnectedness of each issue and how all the problems with the Colorado River will impact millions of people and the ecosystems that reside and rely on it. Ultimately, CRISP hopes that with this watershed plan, the Colorado River will be able to be a healthy and prosperous watershed for all who use it for centuries to come.

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