Lake Havasu City Watershed Management Plan

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Jenny Shanaberg & Joel D. Silverstein, Editors

Preface

This project is a collaborative effort of the people listed below. The teams worked to obtain information and concerns regarding the watershed of the Lake Havasu Basin. Each group presented a variety of issues, concerns, and challenges that Lake Havasu faces regarding water use and quality. To aid our research we used the *Appendix B: Worksheets* from the *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* from the Environmental Protection Agency.

The community, local tribal council, local business owners, and the local environmental groups convened along with the help of government officials to determine what problems pose the largest threats to the watershed, and to propose alternatives and suggest monitoring methods to ensure conservation and public safety. Each of the stakeholder groups realizes that the problems of the watershed are not exclusive to one particular group. There is a collective concern for the issues affecting the watershed of Lake Havasu City. Each group's concerns are considered equally in this document.

Business
Marlena Eastridge, Jenny Shanaberg, & Joel Silverstein

Community
Jacob Czarnecky, Kayla Kennedy, & Jabaris Massey-Lattany

Environment
Erin Cantu, Alexandria Racine & Christina Woods

Government
Kalea Bennet, Tate Bomar, & Jonathan Slater

Tribal
Alexandra Mitchel

Editors: Jenny Shanaberg and Joel D. Silverstein

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Overview

The Lake Havasu City Basin is the second smallest of the Colorado River Basins covering 252 square miles. The western border is the Colorado River, with the northern and southeastern borders distinguished by the Mohave and Bill Williams Mountains. These borders form the Chemehuevi Valley, which encompasses most of the watershed area. The Bureau of Land Management (B.L.M) manages 59.7% of the land. Private ownership for residential and commercial activity is responsible for 15.3% of the land. The State Land Trust manages 14.7% of the land for public schools, hospitals and the island connected by the London Bridge. The Havasu National Wildlife Refuge comprises 10% of the land with 8.7% federally owned; Arizona State Parks owns and manages the remaining property.

Lake Havasu City established itself in 1963 on the Southwestern portion of the basin. Lake Havasu has a water volume capacity of 620,000 acre-feet. The need for a watershed management plan became apparent with the growth of the city, but also with the growth of surrounding communities. In addition, the water needs of Phoenix, Tucson, and neighbors in Southern California make the Lake Havasu Watershed an important region.

. The Metropolitan Water District of southern California intake initiative of 1940 and the Central Arizona Project of the 1980's divert much of the water from the Colorado River for these higher population areas, restricting the amount entitled to the citizens in Lake Havasu City. There are also no other sources of surface water in the basin, aside from Lake Havasu and the Colorado River. Lake Havasu's arid desert climate makes it one of the warmest areas in the nation. Temperatures range in the low 40ºF's in the winter, with an average of 85ºF for a good part of the year; however the summertime temperatures range from 96ºF to close to 130ºF. The heat makes surface water evaporate rapidly.

Lake Havasu's immediate area elevation ranges from 450 feet above sea level at the lake shoreline to 1,500 feet at the foothills. The Mohave Mountains rise to as much as 5,000 feet just a few miles east of the city. Water allocation priorities require the lake level to remain at 440-450 feet above mean sea level. While most of the eastern border of the basin is consolidated rock, the Chemehuevi Valley offers a great deal of unconsolidated porous sediment that can store water for future use. The Basin Fill aquifer naturally recharges around 35,000 acre-feet annually (AFA) (Arizona Department of Water Resources, 2009). Vadose injection wells at the North Regional Wastewater Treatment Plant recharge the aquifer with treated wastewater. This facility injects approximately 340-acre feet of water per year to these wells. Having additional storage is important to the city because water consumption grew from 6,000 AFA in1971-1975 to an average of 16,650 AFA in 2001-2005 (Arizona Department of Water Resources, 2009). Water usage directly correlates with the population of Lake Havasu City. The growth of Lake Havasu City is a concern, as it is extremely important that the city does not take out more water than allotted. It is equally important that the city make every effort to conserve and replenish the water, in every way possible.

Known and Perceived Impairments

The two principal threats to the Lake Havasu City Watershed are Chemical Contaminants that include hexavalent chromium as well as invasive species, particularly the quagga mussel infestation, and the salt cedar trees. In addition, general pollution introduced to the river by rainwater runoff, oil and gas leakage from boats and other watercraft affect the quality of the city's water.

Chemical Contaminants

While Lake Havasu City's water is safe according to the primary drinking water standards. However a small problem exists in that constituents such as sulfate and high levels of total dissolved solids are present. In addition, there are high levels of hexavalent chromium (chromium VI) in the ground caused by the original McCulloch manufacturing plant. Keeping the levels of these constituents under control is critical to maintaining the city's water quality.

Hexavalent Chromium

A larger problem for the Lake Havasu City watershed is hexavalent chromium also known as chromium VI. In 1958 the industrialist Robert McCulloch purchased 3,353 acres of land along the Colorado River, by 1963 he had purchased another 13,000 acres, combined this became Lake Havasu City. In 1964, he opened the McCulloch Chain Saw factory that operated three manufacturing plants. These plants operated in full capacity through 1988 when the company moved to Tucson. During that time, the plant deposited a significant amount of hexavalent chromium into the land. In addition to hexavalent-chromium from the McCulloch plant, there is a plume of chromium up-stream on the California side of Topock. This is a result of the Pacific Gas and Electric Company using hexavalent chromium as a cooling and anti corrosive agent in its gas and compression pumping station just off Route 40 on the California Arizona border (PG&E, 2014). While this plume is not within the Lake Havasu Watershed, it is nonetheless something that causes Lake Havasu City concern.

Hexavalent Chromium is an element that is no stranger to affecting water quality and many water agencies are aware that large amounts of this chemical that has made its way into the ground water. Being a metallic element that is odorless and tasteless, it can easily go undetected

when mixed in water (EPA, 2010). Hexavalent chromium is used in industrial processes, but is also found in nature in things like rocks, plants, soil, humans, and animals (EPA, 2010). However, an overwhelming amount has entered the ground through leakages, poor storage, and improper disposal (EPA, 2010). While there are many different types of chromium, hexavalent chromium is the most toxic in its chemical family. Hexavalent chromium is a carcinogenic and can cause cancer as well as birth defects. In addition to cancer, topical exposure to chromium-six causes allergic dermatitis (EPA, 2013).

Major industrial sources of hexavalent chromium are chromate pigments in dyes, paints, inks, and plastics. Chromates added as anti-corrosive agents to paints, primers and other surface coatings, chrome plating by depositing chromium metal onto an items surfaces. Unfortunately, the McCulloch factory used hexavalent chromium as described here for all of its manufacturing. While work-place exposure to this chemical is no longer a concern, the chromium plume that is in the ground has been measured to be approximately one-half mile away from the lake. Should this chromium continue to move and reach the lake it would be devastating to the water supply for not only Lake Havasu, but all the downstream users of the water as well.

Invasive Species

Quagga Mussels

In 2007, quagga mussels appeared in Lake Mead, shortly after they made their way into Lake Mohave and then into Lake Havasu. These bi-valve filter feeders are a relative to the Zebra mussel that infested the Great Lakes. About the size of a thumbnail, quagga mussels multiply in great numbers at a rapid rate. A single adult can produce one million larvae annually (AZGFD, 2013). The mussel filters approximately one liter of water per day, removing phytoplankton and particulates from the water. By removing the phytoplankton, there is a decrease in the food

source for zooplankton. This alters the food web. Other impacts of the filtration include increased water clarity and decreased mean chlorophyll concentrations, as well as the accumulation of feces and pseudo-feces, the quagga's waste product. Water clarity increases light penetration causing aquatic plants to grow at an accelerated rate. A problem of the pseudofeces is that it creates an unhealthy and foul environment. As the waste decomposes, oxygen depletes while the waste product decomposes, in addition, the pH becomes very acidic and toxic byproducts can result. Another issue with the quagga is they accumulate organic pollutants within their tissue levels more than 300,000 times greater than normal environmental concentrations, these pollutants in the pseudo-feces can pass up the food chain increasing exposure to other wildlife (USGS, 2014).

In addition to the ecological effects of the quagga on the environment, there are other physical problems as well. The quagga is a "hitch-hiker" it attaches to structures and substrates and colonizes. This has significant effect on the water intakes, grates, and pipes that feed water into Lake Havasu City, the Metropolitan Water District, and the Mark Wilmer Pumping Plant that feeds the Central Arizona Project aqueducts. These quagga infestations cost the municipalities and consumers upwards of $10 million annually in cleaning, and treating water. Now there is no known predator significant enough to eradicate the quagga mussel.

Salt Cedar

Salt Cedar is an invasive species with negative effects on the wildlife community of Lake Havasu. Salt Cedar's genius name is Tamarix and is a type of riparian vegetation found along the river throughout Lake Havasu (Lamberton, 2013). This tree grows at a fast pace and can survive in extremely harsh temperatures. Salt cedar can survive in a wide variety of environments and

grows in other parts of the world. The salt cedar tree was popular for decorative landscaping and as a windbreaker to protect farmland (Lamberton, 2013). Unfortunately, water developers did not foresee the impact of this species. This species has a negative impact on the native plants of the region. One major problem is the salt cedar outcompetes the native plants due to its rapid growth. One mature tree can produce, hundreds of thousands of seeds between April and October (Department of Ecology). Salt cedar has high levels of precipitate salt. If constant flooding is not present to balance the levels of salt introduced to the soil, other plants are unable to flourish and grow. By far the largest problem of the salt cedar is the amount of water it consumes, essentially stealing the life away from other flora and fauna (Lamberton, 2013). Fortunately, the tree is controllable and people are constantly finding ways to control the species without harming other parts of the environment. Nevertheless, this specie needs management.

Sources of Contaminants

Some of the non-point contaminants that threaten the water occur from rain run-off. Due to the dry arid conditions, the ground quickly saturates and water flows down hill towards the lake. As the water flows, it picks up oils, fertilizer, pesticides, and other chemicals and contaminants. This water flows into the washes and makes its way directly to the lake. Other contaminants that enter the water come from emissions from boats and watercraft. These emissions include gasoline, oil, and diesel fuel.

Lake Havasu is seeing point source emerging contaminants that include pharmaceuticals. These enter the system through wastewater and there are no affordable methods readily available to filter out the pharmaceutical contaminants. Types of pharmaceuticals identified include the antibiotics azithromycin, clarithromycin, roxithromycin, and clindamycin. Narcotics include

opiates such as hydrocodone, oxycotin and morphine. There are also illicit drugs such as methamphetamine, and ecstasy. In addition to prescription medications, typical over-the-counter products such as pseudoephedrine are in the water. Specifically in Lake Havasu both methamphetamine and MDMA ecstasy were detected during a July 2007 collection event. All of these contaminants have potential for adverse human and aquatic effects (Lepp, Sanchez, Alvarez & Wilson, 2012). Although these drugs are detected at low levels, they exist nonetheless and warrant monitoring. Hexavalent chromium is a point source contaminant. However, the full quantity of the chromium deposit is still unknown.

Sensitive Habitats

In 1992, the U.S. Bureau of Land Management entered into an ambitious fishery habitat project on Lake Havasu. The natural fish habitat had deteriorated to the point that sport and bait fish populations were in serious decline. It took almost ten years for the project to be completed. It now consists of over 900 acres of underwater fish habitats, one of the largest and most successful fish improvement projects in the U.S. The habitats are constructed with PVC and snow fence, as well as recycled Christmas trees. These habitats allow for fish spawning and breeding and provide protection for juveniles from larger predators (Shimano, 2013).

Havasu National Wildlife Refuge, originally named Havasu Lake National Wildlife Refuge, established by Executive Order by President Franklin D. Roosevelt in 1941 for the primary purpose of providing migratory bird habitat. The refuge is comprised of 37,515 acres along the lower Colorado River in Arizona and California. The refuge protects 30 river miles and encompasses 300 miles of shoreline from Needles, California, to Lake Havasu City, Arizona. One of the last remaining natural stretches of the lower Colorado River flows through the 20-

mile long Topock Gorge. The refuge is home to over 35 fish species, 318 bird species, coyotes, foxes, bobcats, rabbits, mice and desert bighorn sheep (US Fish & Wildlife 2014).

The fish habitats and natural refuge are an important part of the region as they are a prime contributor to the economy for recreation and attraction of tourism. Both aquatic and land habitats are in reasonably good condition, but they are sensitive and are being affected by the quagga mussel and the salt cedar trees. However, it the hexavalent chromium reaches the lake the entire ecosystem would be in critical condition.

Alternative Solutions

The hexavalent chromium plume is a major concern. If the chromium reaches the lake, it would be extremely devastating for drinking water, aquatic ecosystem, and the need for water to downstream recipients. Private companies, ADEQ and the EPA are monitoring the site, drilling test locations and exploring a process to slow if not stop the flow of the chromium from reaching the river. For the chromium, an environmental consulting company has looked into injecting a substance in the ground to freeze the flow of chromium. These substances include phosphate-based reducing agents. Also should further exploration lead to the identification of large pools or chromium affected ground water it could be pumped out into a holding tank and then treated with sodium bisulfate to mitigate the problem (Hale, Britto & Brown, 2012).

In order to control the hexavalent chromium issue and stay within national standards regular testing should be conducted at the city's treatment centers. A semi-annual safety check and report on all industrial properties currently using chromium is in order. This would help ensure that any companies using these products are properly disposing of them. Finally, making

the public more aware of the problem and safety standards is important as well as providing information on how people can get home treatment systems to test for chromium

The quagga mussel problem is significant. There are no methods that exist that can eradicate of the infestation on a wide spread basis. While the Metropolitan Water District is using both Zequanox (a natural biological agent) as well as chlorine to treat its plant and reservoir water it has been unable to eradicate the problem. The quagga has no known predator, though the Red Ear Sunfish seem to like eating the quagga mussel. The Red Ear Sunfish is currently in the lake, and are at record high weights for the species. Further research should be conducted to determine whether stocking the lake with more of this species would be beneficial to lowering the quantity of quagga mussels in the lake. More programs should be implemented to prevent the further spread of these aquatic hitchhikers. A few public programs that exist have been helpful in educating boaters and watercraft users. They include the “Don’t Move a Mussel” placard and the “Sticker a Mussel” campaign. Education programs seem to be the best alternative at this time. The more the public knows about these little mussels and the damage they can cause the better equipped they will be to help prevent their spread.

Salt Cedar alternatives include the use of herbicides, to reduce the population production of trees (Department of Ecology). However, it might be beneficial to consider using bio control or mechanical methods to reduce the growth. A recent study shows that introducing several insects to the region can combat the tree growth. However, that method will need further study to ensure the insects do little to no harm to the native environment (Department of Ecology). This is an interesting method because it provides an opportunity to combat wildlife with biology instead of chemicals. Before implementing the bio control method, employing a mechanical method is the first choice. The mechanical method would start with root plowing or cutting out the roots

and sprouts of the trees (Department of Ecology). This method has shown to be largely successful; however, there is a risk of damaging other plants. In order to have the biggest impact on the trees we would prefer monitoring the progress of root plowing and bio control before resulting to chemical controls.

Summary

The Lake Havasu Watershed plan focuses on water quality issues while taking into account the need for conservation, public safety and the needs of each of the stakeholders. The plan addresses the three main threats posed to the Lake Havasu watershed, the sources of these threats, as well as alternatives. The three threats are Chemical Contaminants (hexavalent chromium, Invasive Species (quagga mussels & Salt cedar, (Tamarix) and other Pollutants (runoff & watercraft emissions and leaks).

Lake Havasu City's drinking water according to the primary drinking standards set forth by the Safe Drinking Water Act (SDWA) is safe. However, Lake Havasu City water has tested positive with some chemical contaminants that exceed secondary maximum contaminant levels. These include total dissolved solids and sulfate, manganese, and hexavalent chromium.

Continued monitoring at multiple sites and adherence to SDWA standards will enable the prevention of future occurrences of magnesium exceeding the secondary maximum containment level. The hexavalent chromium contaminant poses the greatest risk to the Lake Havasu watershed and is under evaluation by the EPA. Once the EPA reports are examined measures to contain the site, a feasibility study and strategic plan will be created. .

The next largest threat posed to the watershed is the invasive species that include the salt cedar and quagga mussel. The Salt cedar is invasive riparian vegetation found throughout Lake

Havasu. The salt cedar has disrupted the ecosystem by taking over large areas of land and killing the native flora and fauna. Herbicidal treatment is an alternative solution; however, root plowing is currently the process in place. Lake Havasu City is considering bringing in an insect that may deter the rapid growth but further investigation is needed.

Quagga mussels are currently the largest active invasive specie problem facing the Lake Havasu watershed. Quagga mussels clear the water and remove nutrients that create environments in which toxic algae blooms thrive. They destroy infrastructure and impede the distribution of water to other users of the basin. Currently there is no known method to eradicate quagga mussels without destroying the environment. The Red Ear Sunfish is the only known predator of the Quagga mussel, further research should be conducted to see if stocking the lake with more Red Ear Sunfish could help control the quagga infestation.

The watershed plan addresses the threats to Lake Havasu, alternatives, and suggests further research to solve the problems the watershed faces. Along with the concern of threats, the watershed plan also takes into account the lands in which it protects.

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