

# CONSEQUENCES OF DRYING LAKE SYSTEMS AROUND THE WORLD

Prepared for State of Utah and Great Salt Lake Advisory Council

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# BENEFITS OF SALINE LAKES

- **Economic:**
  - Support mining, aquaculture, and tourism industries.
- **Social:**
  - Recreational opportunities, dust mitigation, and climate-moderating benefits.
  - In some cases, saline lakes can buffer temperature and humidity changes in nearby agricultural fields, enabling farmers to harvest earlier.
  - Great Salt Lake benefits nearby ski resorts by influencing the local climate and weather, producing “lake effect” snowstorms.
- **Environmental:**
  - Wetland and aquatic habitat; open water, emergent marsh, mudflats, and playa.
  - Critical habitat for migratory shorebirds and waterfowl that use saline lakes for nesting and feeding grounds; dense invertebrate population food source.

# CASE STUDIES

1) Lake Urmia

2) Aral Sea

3) Lake Poopó

4) Owens Lake

5) Salton Sea

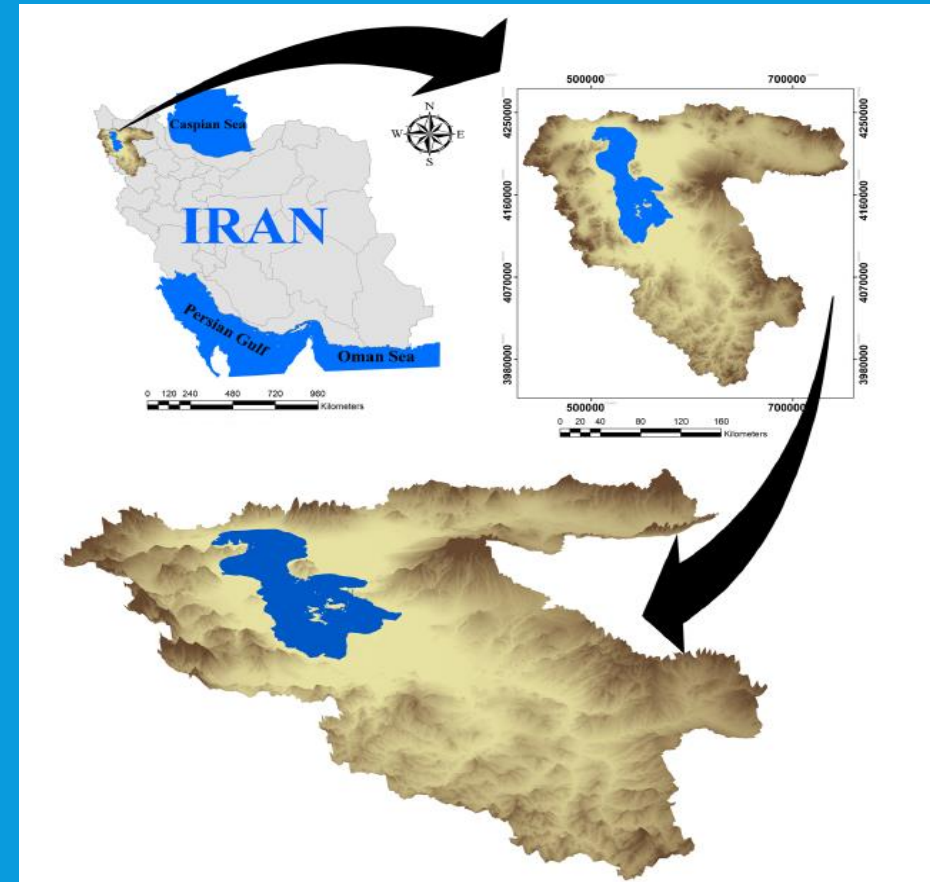
6) Dead Sea

7) Bakhtegan Lake

8) Mono Lake

# LAKE URMIA

- Largest lake in Iran
- 2nd largest hypersaline lake in the world
- Watershed Area (square miles): 20,100
- Watershed Population: 6.4M
- Salinity: 21 – 24%



# LAKE URMIA

Economic Consequences	Social Consequences	Environmental Consequences
\$1.4B for restoration program	Public health impacts from dust storms (PM <sub>10</sub> )	86% of the lake became a salt desert
Current project: \$56M to transfer water from Kani Sib River	Displaced farmers	Migratory birds have been reduced and thousands have died from starvation
\$1.6M recreation value		Threatened brine shrimp survival
Agricultural damages		

# ARAL SEA

- Watershed Area (square miles): 700,000
- Watershed Population: 60M
- Salinity: +10%

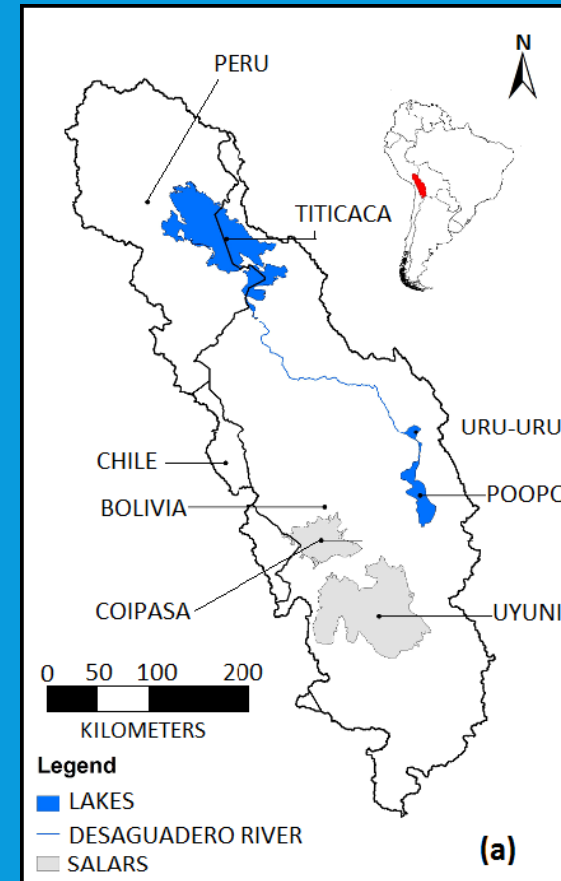


# ARAL SEA

Economic Consequences	Social Consequences	Environmental Consequences
\$24.4 to \$33.6B to improve irrigation & drainage systems	Public health impacts from dust storms (PM <sub>10</sub> )	Desertification in the region; salt flats on portions of lake bed
More than \$270.7M for restoration projects	Dry lakebed contains high levels of salt and toxins and can be transported 300 miles	Mammal and bird species reduced by half
70% of irrigated land impacted by salinity from dust storms	High levels of esophageal cancer, respiratory illnesses, and eye problems in the surrounding region	Threatened permanent and migratory birds
60,000 people lost their livelihood when fishery was lost		Native plants replaced by plants adapted to dry, saline conditions

# LAKE POOPÓ

- Watershed Area (square miles): 360,000
- Watershed Population: 10,000
- Size of dry lakebed (square miles): 380



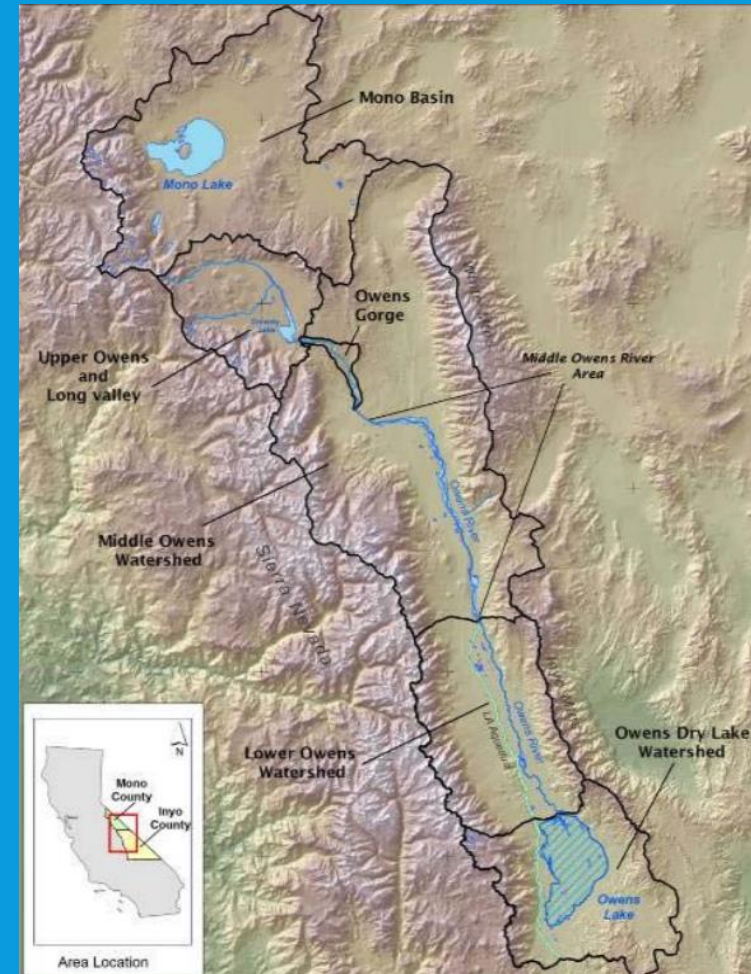


# LAKE POOPÓ

Economic Consequences	Social Consequences	Environmental Consequences
Complete loss of fishing industry	Displaced fishermen and indigenous people that depended on the lake	Millions of dead fish and mass die off of hundreds of birds
		Loss of wildlife in surrounding areas

# OWENS LAKE

- Watershed Area (square miles): 1,000
- Size of dry lakebed (square miles): 110
- Salinity: 6 – 7%

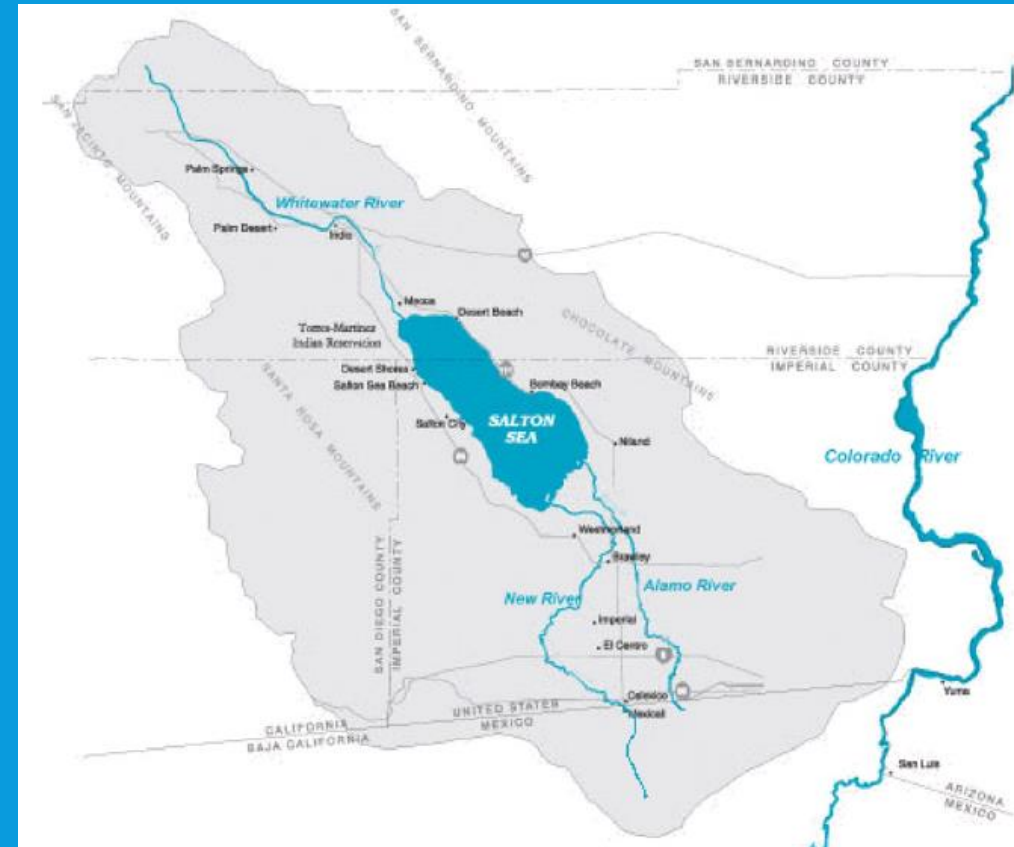


# OWENS LAKE

Economic Consequences	Social Consequences	Environmental Consequences
\$3.6B for mitigation through 2025	Public health impacts to ~40,000 permanent residents from dust storms (PM10)	Rehydration efforts have provided habitat for 100,000 shorebirds annually
\$5M in noncompliance fees to Great Basin Unified Air Pollution Control District	In 1987, USEPA declared the dry lakebed to be the source of the worst dust problem in the U.S.	

# SALTON SEA

- Watershed Area (square miles): 8,400
- Watershed Population: 650,000
- Salinity: +6%

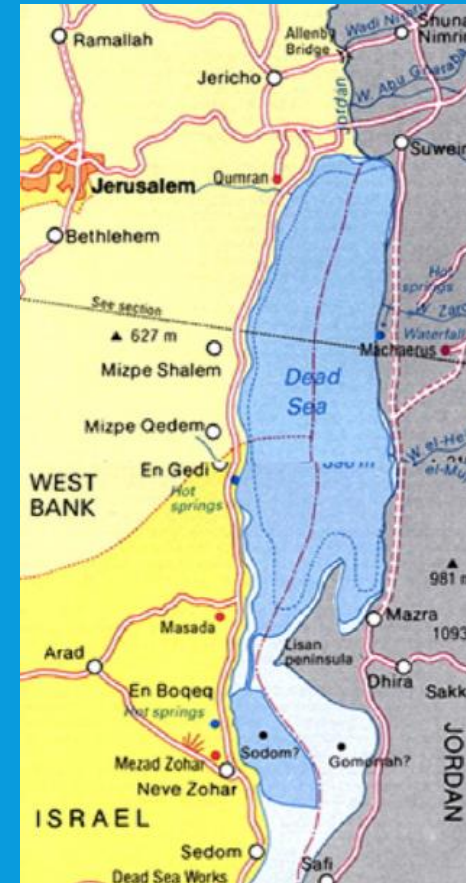


# SALTON SEA

Economic Consequences	Social Consequences	Environmental Consequences
Up to \$16.9 billion for restoration; \$472 million for Phase 1 habitat & dust suppression	Childhood asthma hospitalization rates are the highest in CA & 3 times the CA average	\$2.8 billion annual ecological benefits is declining as sea shrinks
\$550M reduced to an annual recreational value of \$26.5M	Emergency room visits for children are over twice the statewide average in CA	Fish populations declined by over 95% since 1999 due to increased nutrient concentrations
Loss of commercial and sport fishing industry	Public health impacts from dust storms estimated at \$40 billion	One of the few remaining wetland habitats for avian species in CA
Loss of \$1.9 billion agricultural industry		
Property value loss up to \$7 billion		

# DEAD SEA

- Watershed Area (square miles): 17,000
- Salinity: 34%

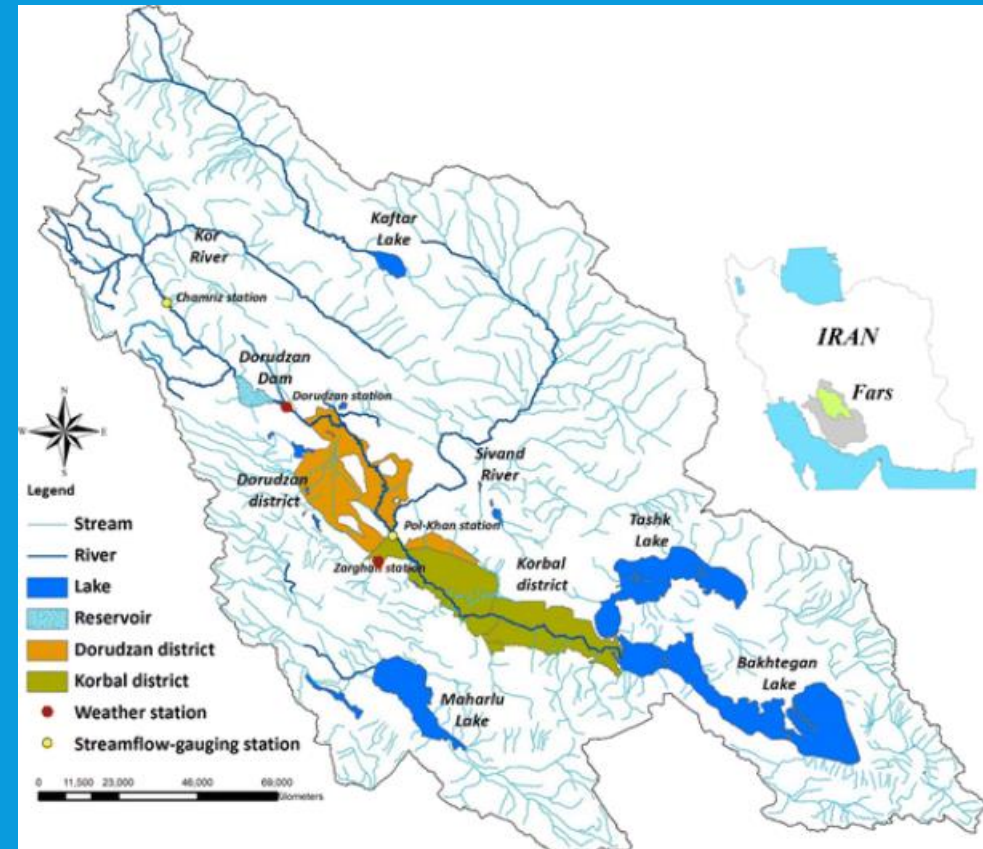


# DEAD SEA

Economic Consequences	Social Consequences	Environmental Consequences
\$11 billion to construct reclamation project, \$440M for annual O&M	Sink holes causing serious injuries	Threat to biodiversity and ecosystem
Without reclamation, potential loss of \$265M in annual revenue to the region	Sink holes threaten tourism industry, the main livelihood of the region	Environmental hazards, such as steep slopes and earthquake-associated landslides
\$800M annual revenue for mineral extraction		
Infrastructure and property damage from >1,000 sinkholes		

# BAKHTEGAN LAKE

- Watershed Area (square miles): 12,200
- Second largest lake in Iran





# BAKHTEGAN LAKE

Economic Consequences	Social Consequences	Environmental Consequences
Water scarcity threatens the agricultural sector (loss of \$2.4 B from severe drought)	Potential loss of agricultural and tourism jobs	Threatened wetland habitat; designated protected zone and wildlife sanctuary
Threatened tourism industry	Water scarcity could stimulate social conflicts	High number of bird mortalities

# MONO LAKE

- Watershed Area (square miles): 800
- Population: 14,000
- Salinity: 5 – 10%



# MONO LAKE

Economic Consequences	Social Consequences	Environmental Consequences
Threatened tourism industry	Public health impacts from dust storms (PM <sub>10</sub> )	Largest breeding ground for California Gulls in California
		Threatened brine shrimp populations
		Loss of wetland habitat

# CONCLUSION

- Delaying the restoration and mitigation of GSL desiccation can have substantial economic, social, and environmental consequences for the Salt Lake Valley.
- **Economic consequences:** Threat to property values; threatened to complete losses to the mining, agricultural, tourism, and commercial fishing industries (GSL contributes \$1.3B to the local economy).
- **Environmental consequences:** Threat to unique ecosystems and tremendous biodiversity; threat to complete loss of brine shrimp and birds.
- **Social consequences:** PM<sub>10</sub> from dry saline lakebeds can increase asthma attacks, asthma severity, hospitalizations, lung diseases and symptoms, and infections.

# CONCLUSION

- Mitigation and restoration measures can be costly and should be selected, designed and implemented strategically to maximize return on investment.
- Restoration costs tend to increase in accordance with the severity of lake desiccation.
- There is an opportunity to protect and preserve the Great Salt Lake before restoration costs become too high to manage.
- Although the mitigation and restoration costs are high, the economic, social, and environmental consequences are likely much higher.