Potential Impacts of Reducing Inflow to the Salton Sea

Prepared for the

State Water Resources Board

Presented by the

Salton Sea Database Program

UNIVERSITY OF REDLANDS

THE REDLANDS INSTITUTE
Environmental Design, Management, and Policy

May 14, 2002

The Salton Sea—California's Largest Lake

Closed basin, watershed draining 7,851 square miles

Surface area 367 square miles at 227 feet bsl

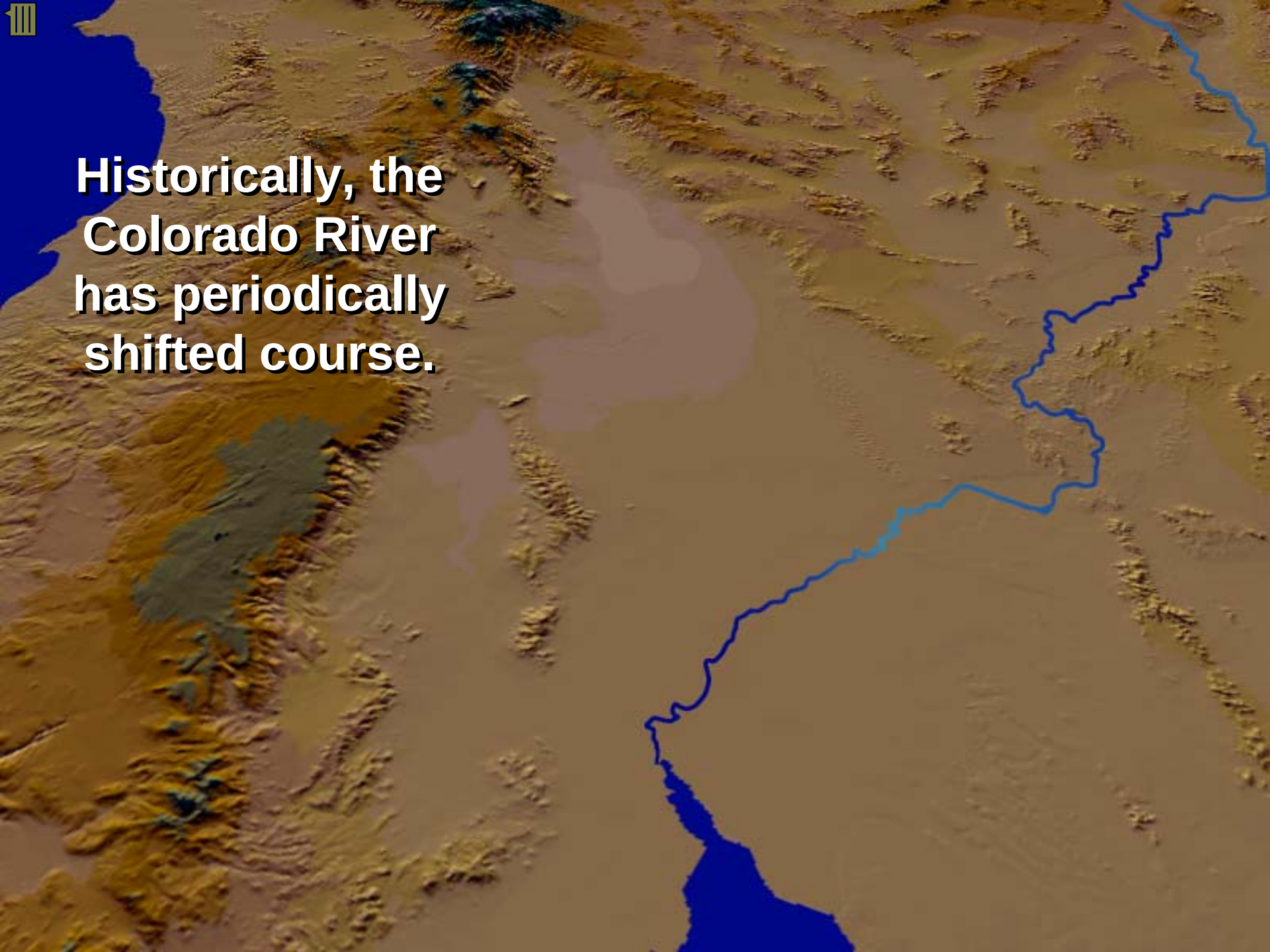
35 miles long, 15 miles wide, 51 feet deep

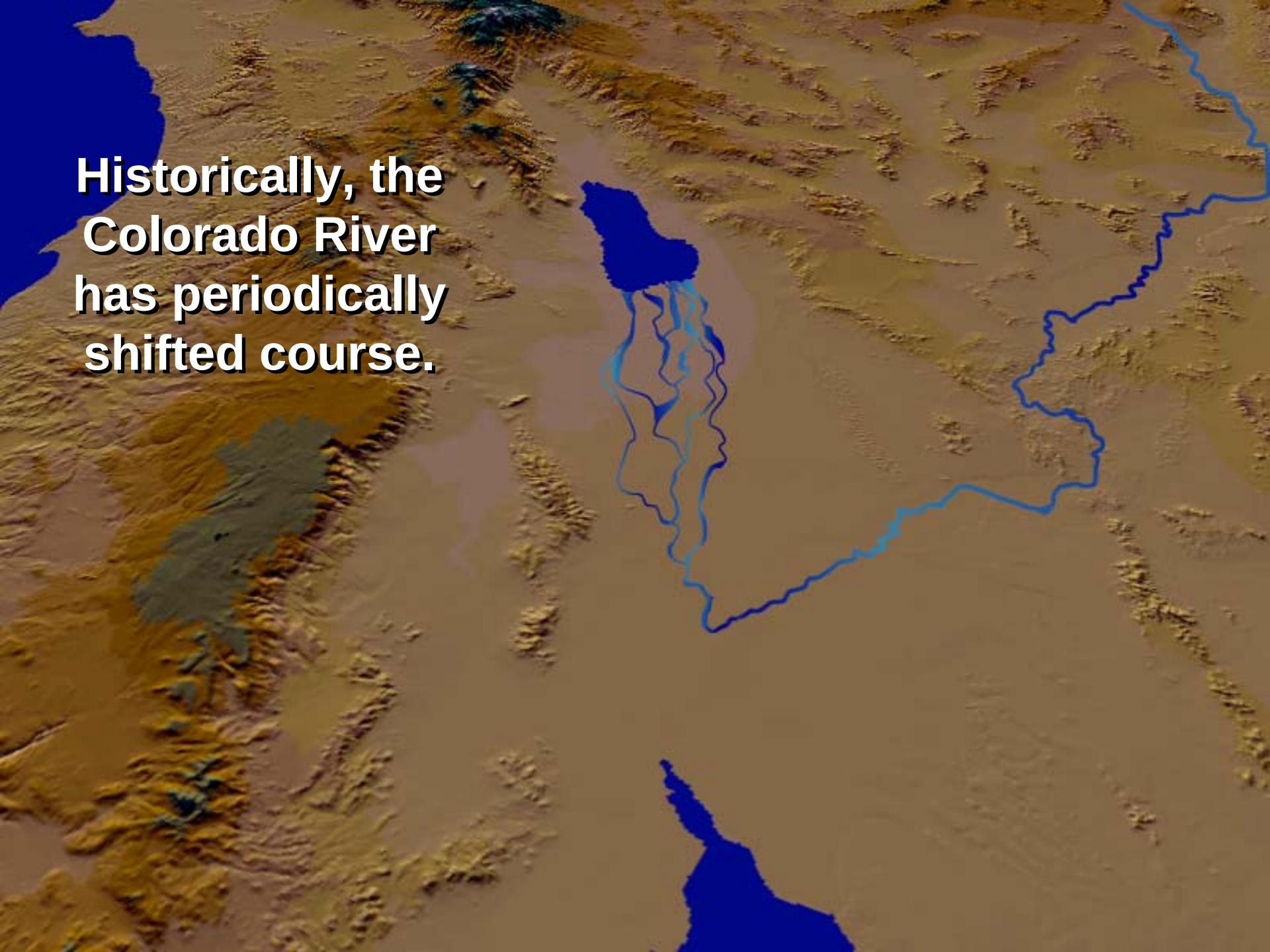

The Gulf of California
12 million years ago


Sediments start
to fill in the Gulf


Sediments from the
Grand Canyon and
Colorado Plateau
fill in the Gulf


The Salton Basin
is cut off from
the Gulf


Historically, the
Colorado River
has periodically
shifted course.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Colorado River
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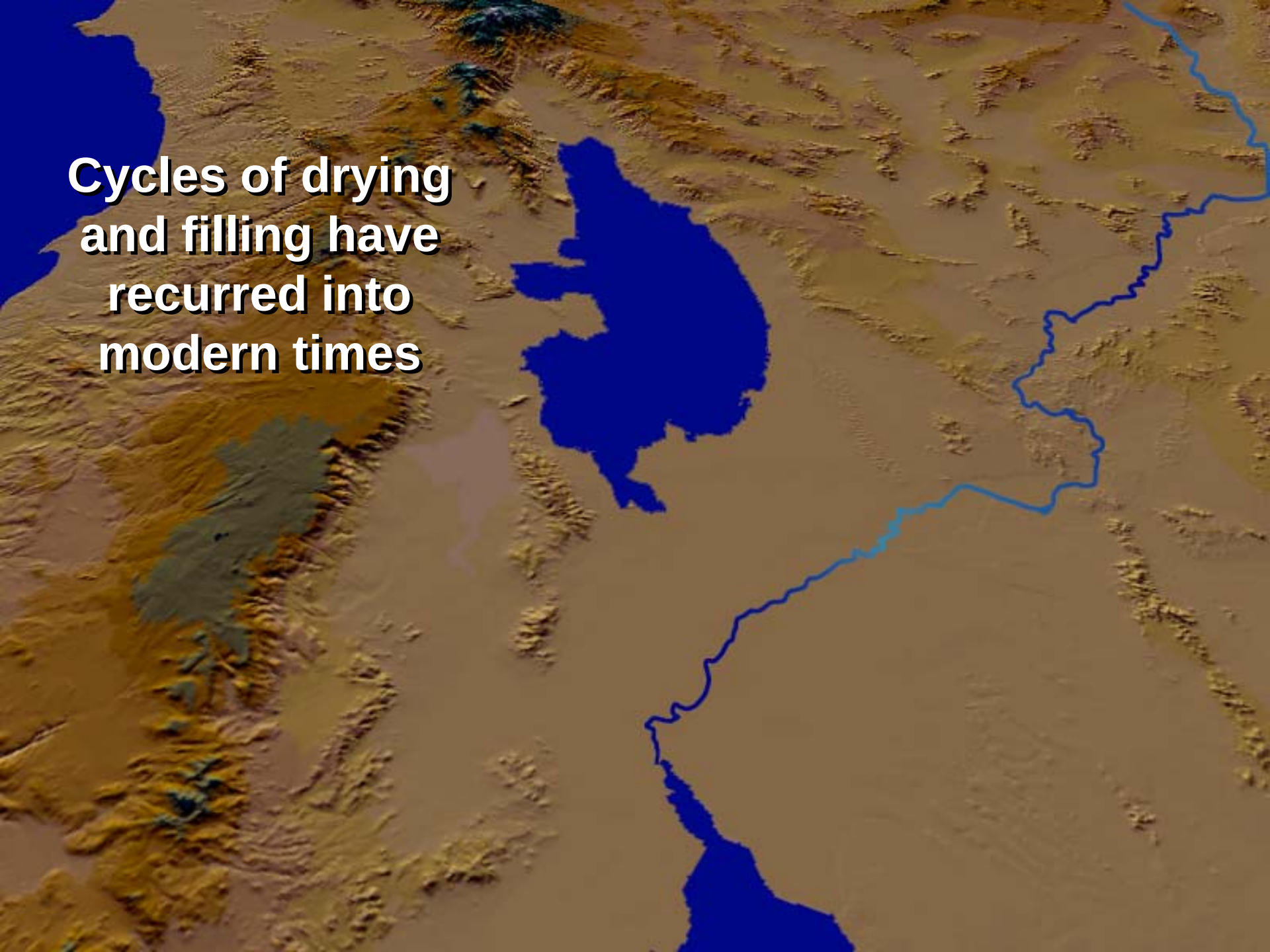
Ancient Lake Cahuilla was several times larger than the present Sea.


At 39 ft above sea level, Lake Cahuilla would spill over into the Gulf


Cycles of drying and filling have recurred into modern times


Cycles of drying
and filling have
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modern times


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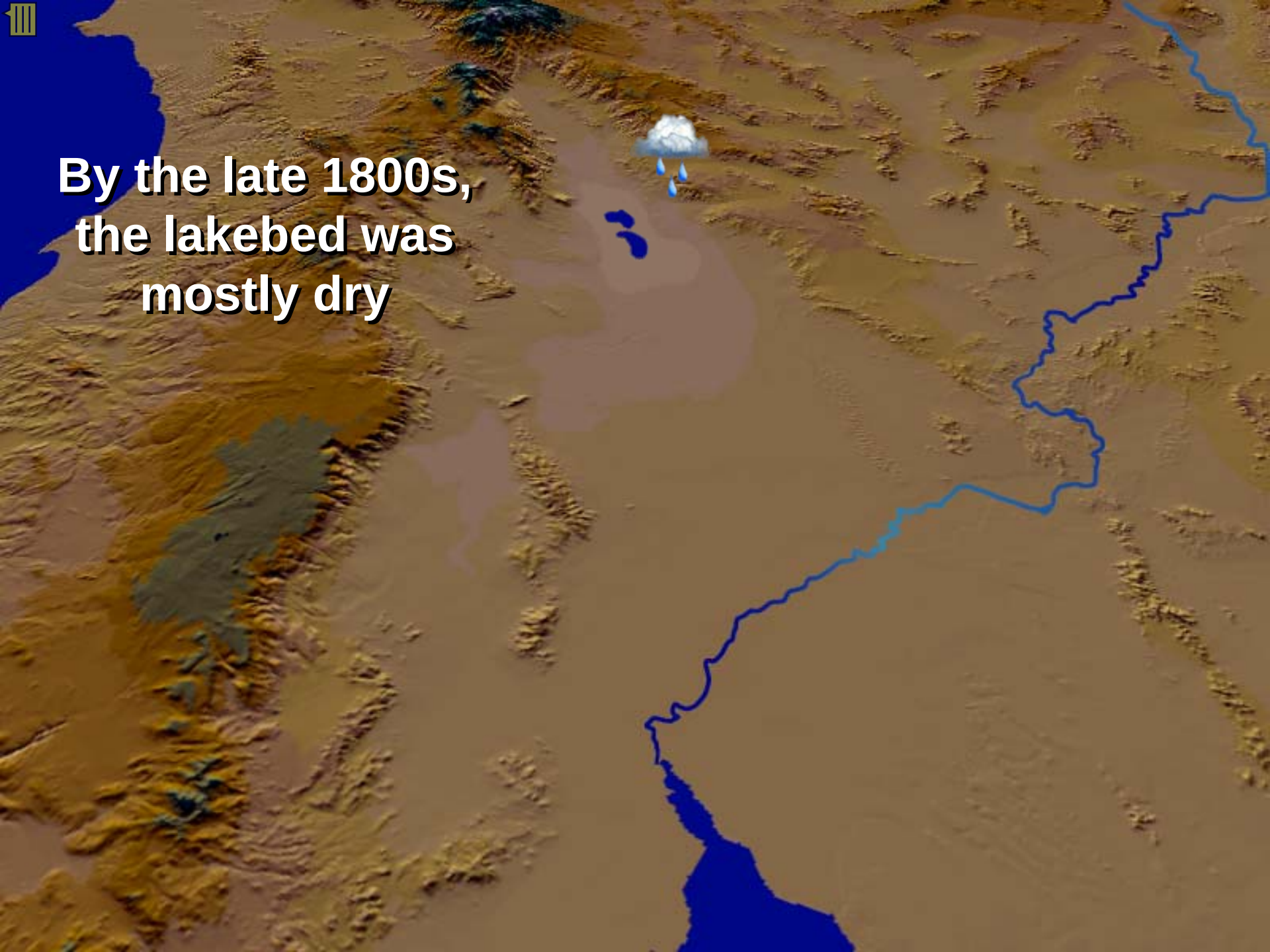
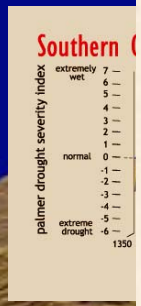
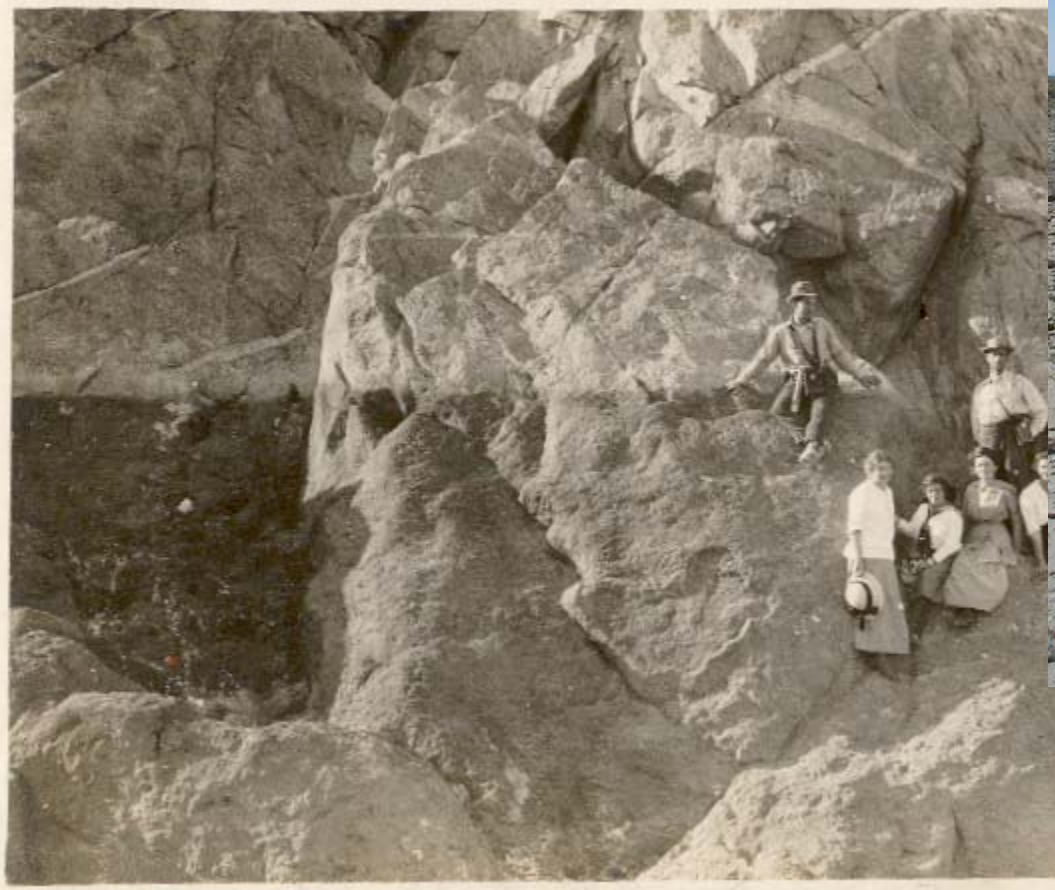

By the late 1800s, the lakebed was mostly dry


In 1905, a series of floods tore a breach in a diversion canal

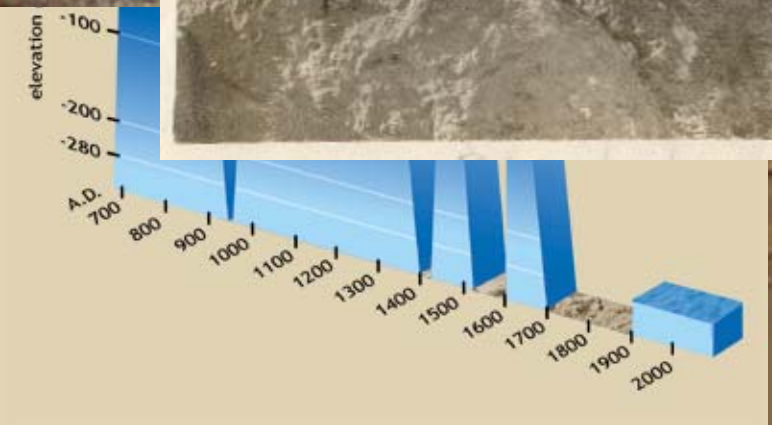

Today, the Sea is sustained by agricultural drainage
Coachella Canal
All-American Canal

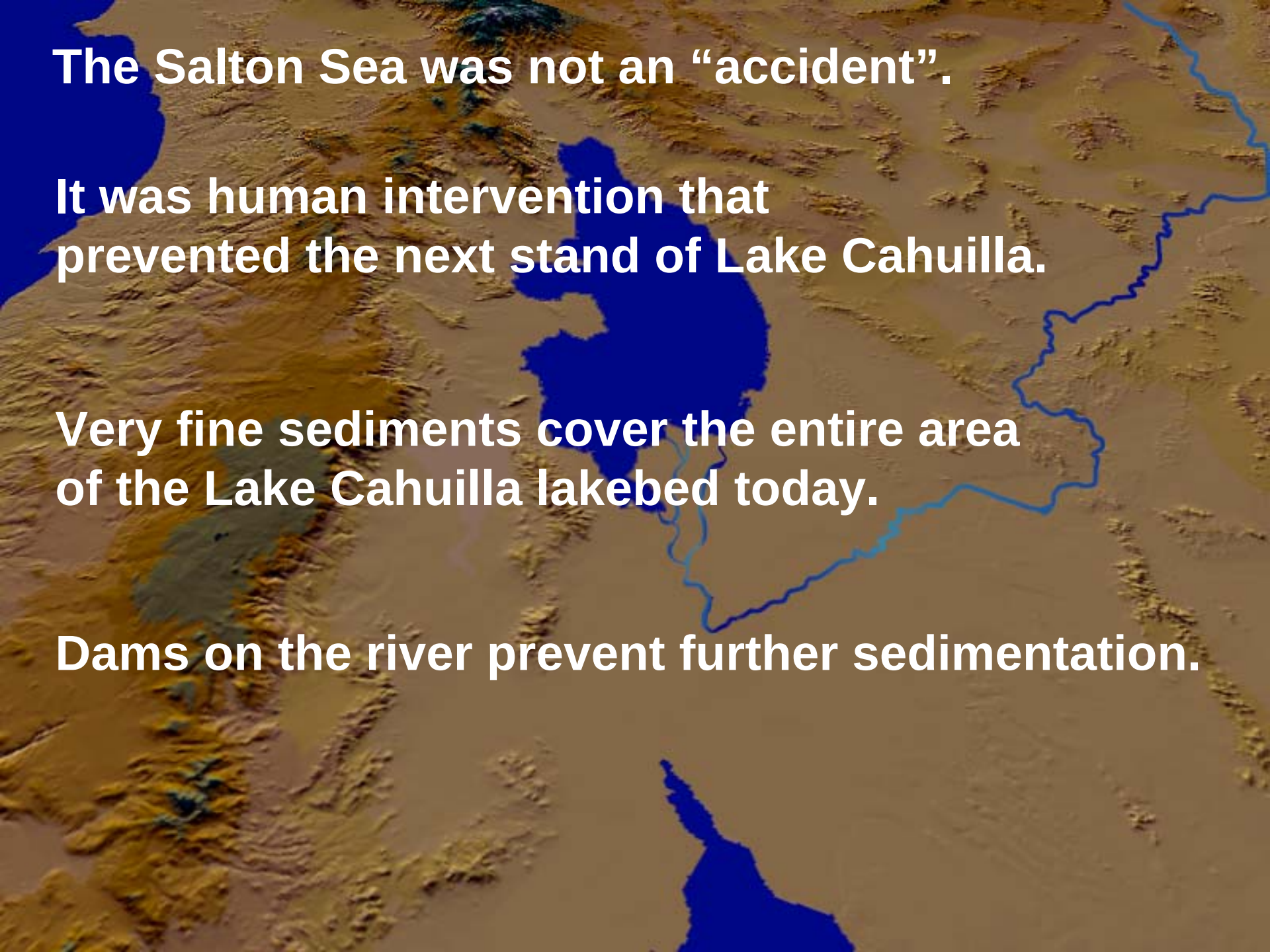
Ancient shoreli





Cahuilla fish trap





The Salton Sea was not an “accident”.

It was human intervention that
prevented the next stand of Lake Cahuilla.

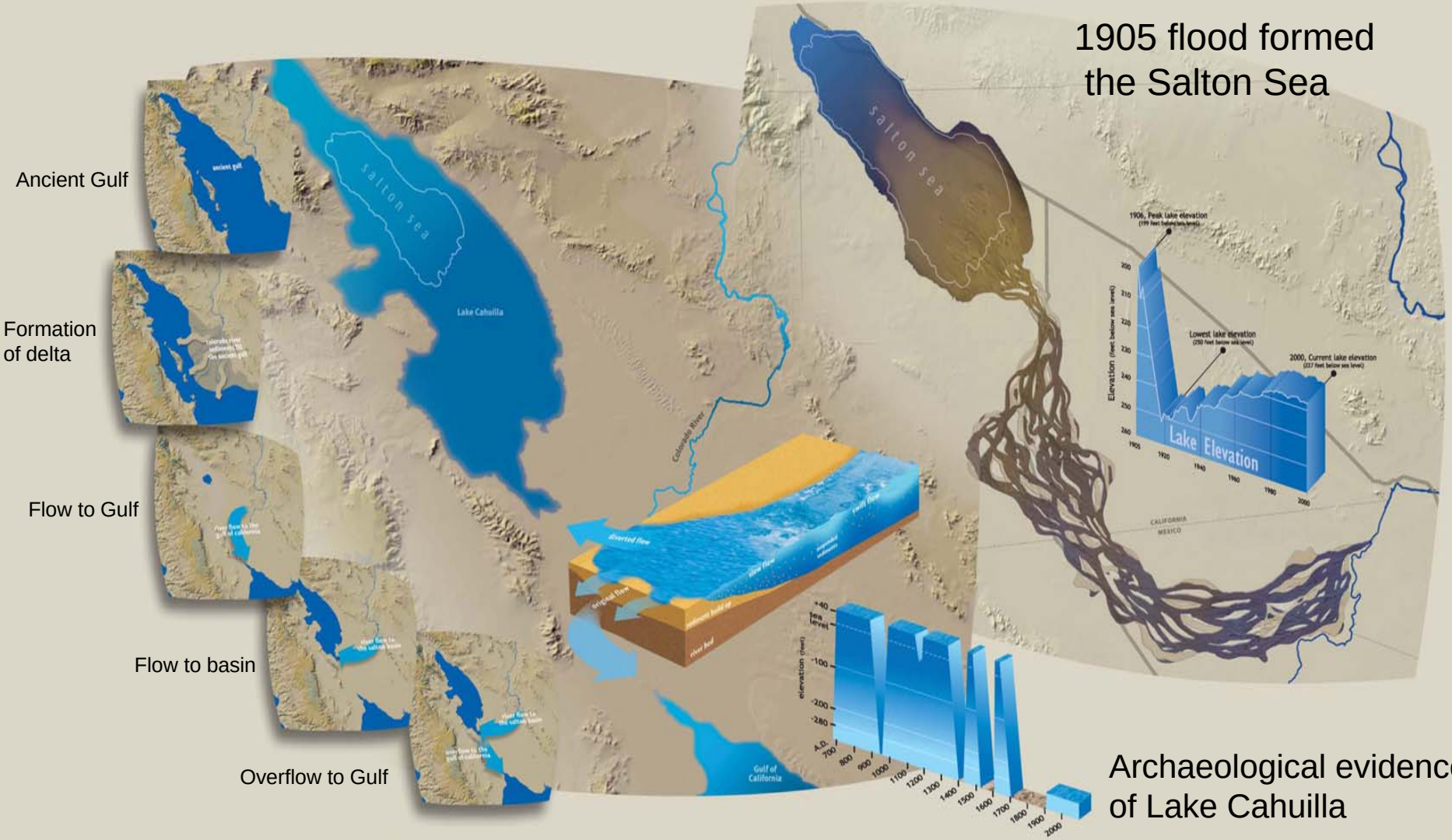
Very fine sediments cover the entire area
of the Lake Cahuilla lakebed today.

Dams on the river prevent further sedimentation.

Formation

Lake Cahuilla would form when seasonal floods would overflow the river

1905 flood formed the Salton Sea



Archaeological evidence of Lake Cahuilla

Formation of Salton Sea

Personal accounts of floods in 1840, 1849,1852, 1859, 1867, & 1891

Natural flood on the Colorado River breached a diversion canal in 1905

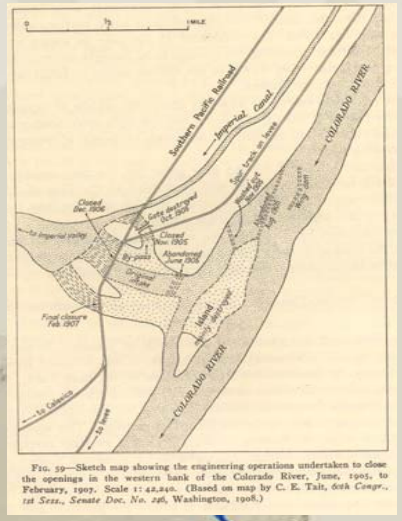
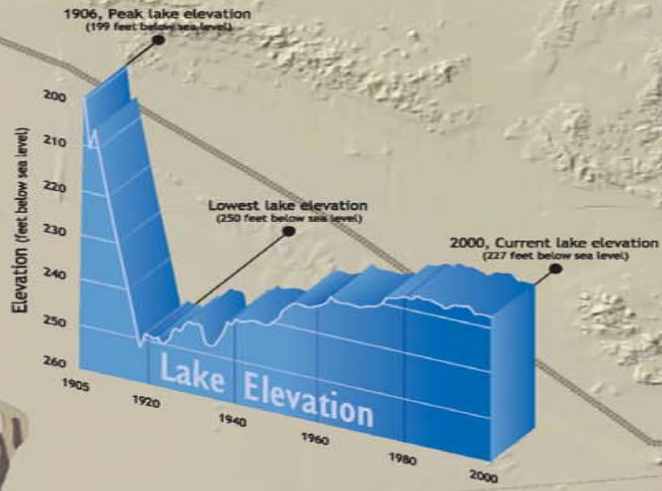


Fig. 59—Sketch map showing the engineering operations undertaken to close the openings in the western bank of the Colorado River, June, 1905, to February, 1907. Scale 1: 42,240. (Based on map by C. E. Tait, *60th Congr., 1st Sess., Senate Doc. No. 246*, Washington, 1908.)



28 ft. waterfall near Calexico

Southern Pacific Railroad fills breach

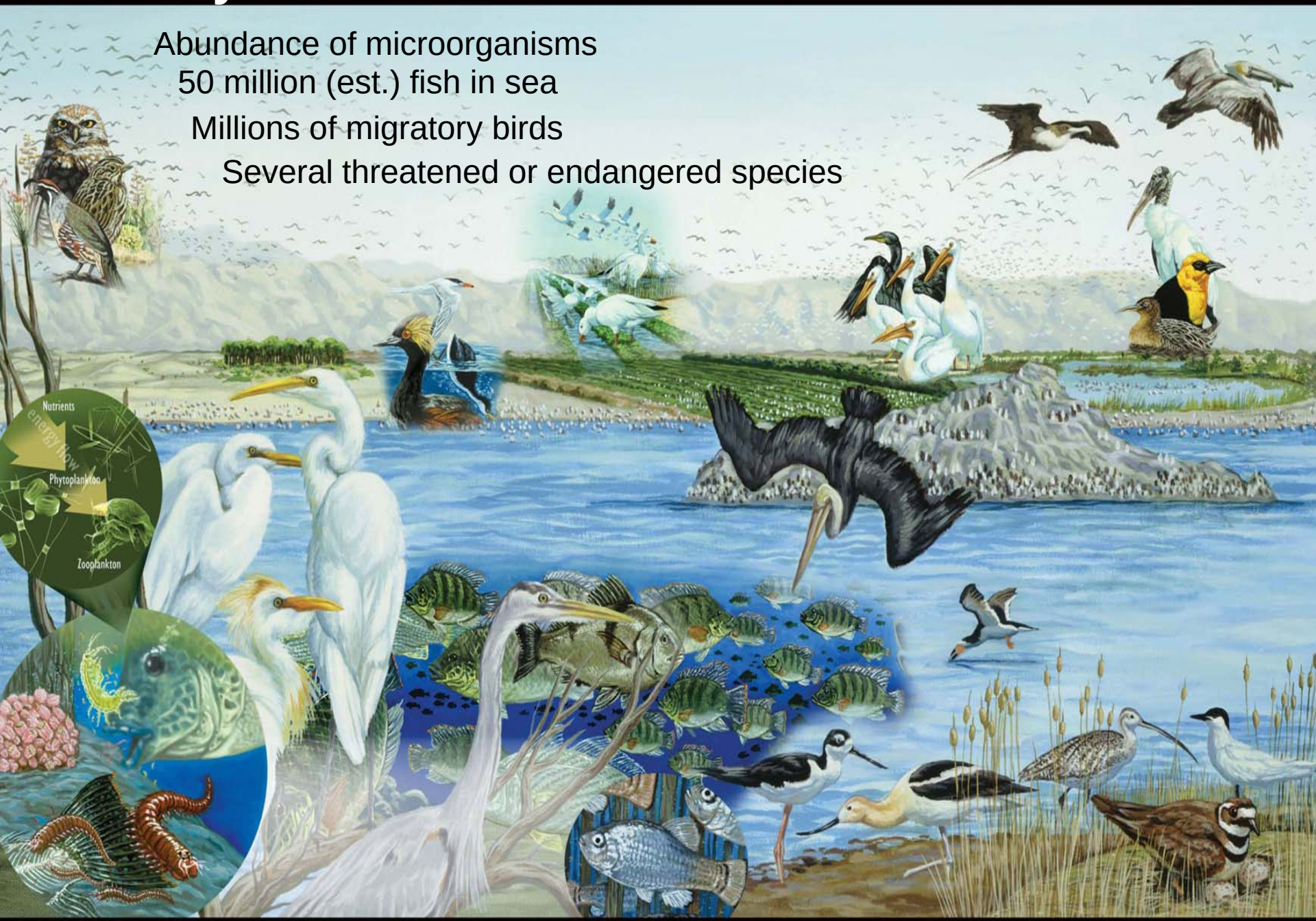
Diversity of Life

Abundance of microorganisms

50 million (est.) fish in sea

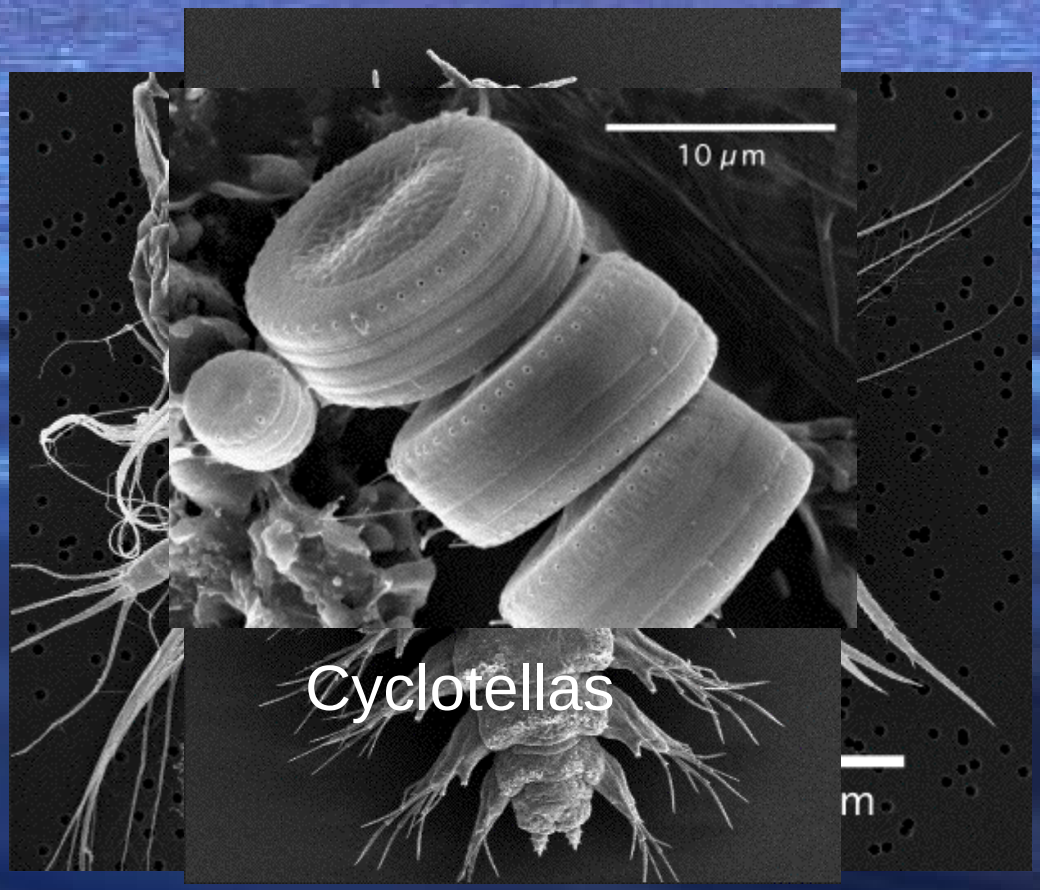
Millions of migratory birds

Several threatened or endangered species



Diversity of Life

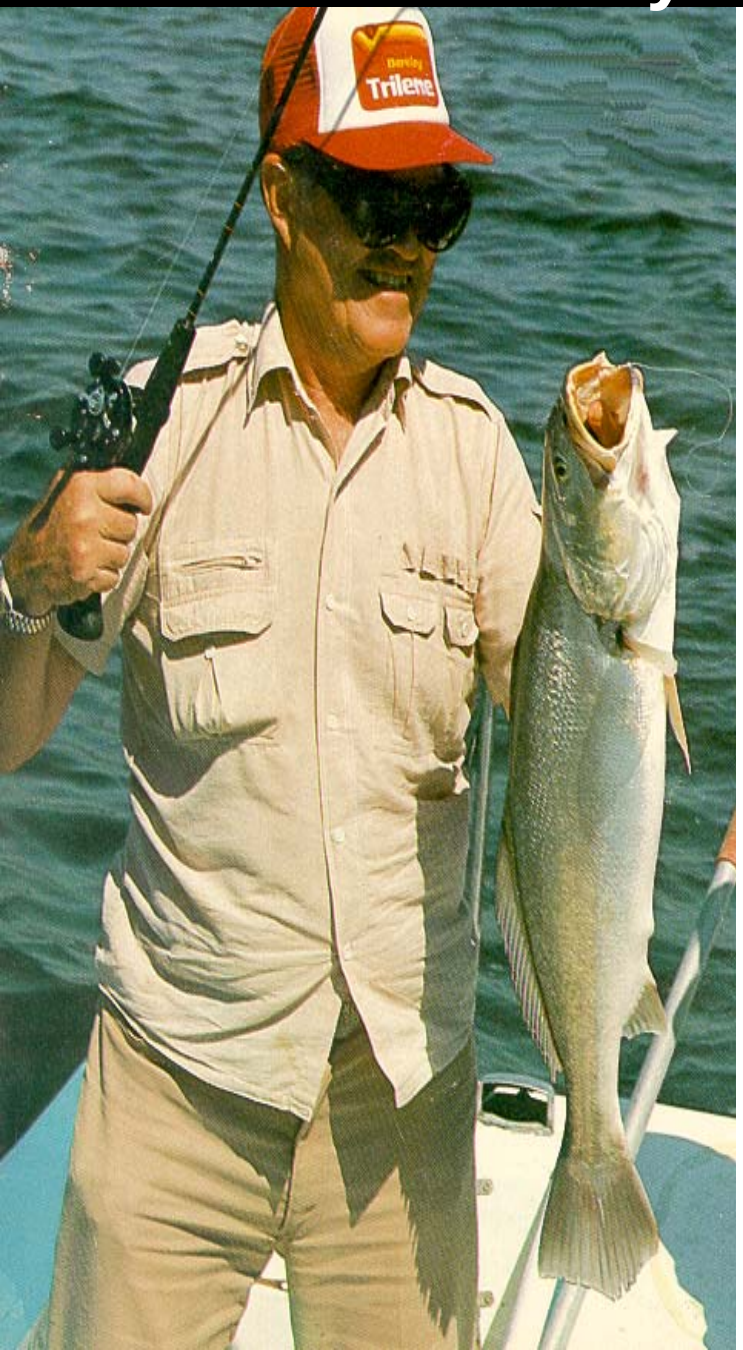
- Over 400 species of plankton



Balanus amphitrite saltonensis

Neanthes succinea

Salton Sea Fishery



Study: Salton Sea fishery healthier than previously believed

TOM VERDIN, Associated Press Writer

(04-20) 14:14 PDT SALTON CITY, Calif. (AP) -- New research disputes the widely held view that the Salton Sea, California's largest lake, is a chemical sump on the verge of ecological collapse.

The Salton Sea, the subject of intense restoration efforts, is home to one of the most productive fisheries in the world, and its fish appear healthier than previously thought, according to a new study.

It is the first broad study of the sea's fishery in half a century and comes after a separate analys
no measurable amount
or pesticides in the mu
bottom.

``We're coming to a c
popularly conceived n
Salton Sea is dead or
totally out of whack. I

be submitted by N
Sea Authority, the
coordinating resto
Interior Departme

Periodic bird and
Salton Sea and th
have captured pul
years.

But Costa-Pierce
researchers, who
January 1999, fou
and their apparen
``pretty much of a

California's "Everglades"

- More than 400 species recorded

- 90% of North American eared grebes
- 90% of western population of American white pelican

- Over 40,000 ruddy ducks (half of ruddies in Pacific Flyway)

California's "Everglades"

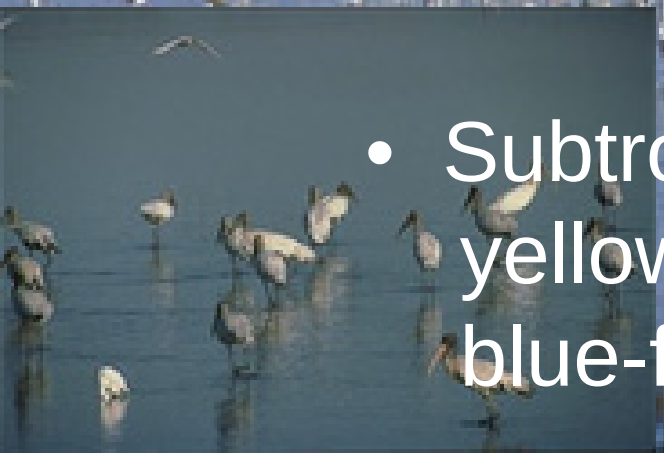
- Brown pelican nesting (only inland breeding site)

- 25,000+ snow and Ross' geese
- Largest breeding gull-billed terns in Western States
- Substantial populations of Caspian tern and black skimmer
- 45% of Yuma clapper rail

California's "Everglades"

- More than 124,000 shorebirds of more than 44 species

- Thousands of herons and egrets, including more than 30,000 cattle egret nests in one colony



- Subtropicals include wood storks, yellow-footed gulls, white-faced ibises, blue-footed boobies, and frigatebirds

Salton Sea International Avian Airport

20,000 bird band records

Birds recovered from as far away as Russia and Peru

2/3 of all migrating birds in the continental U.S. visit the Salton Sea

Values Of Agriculture and Recreation

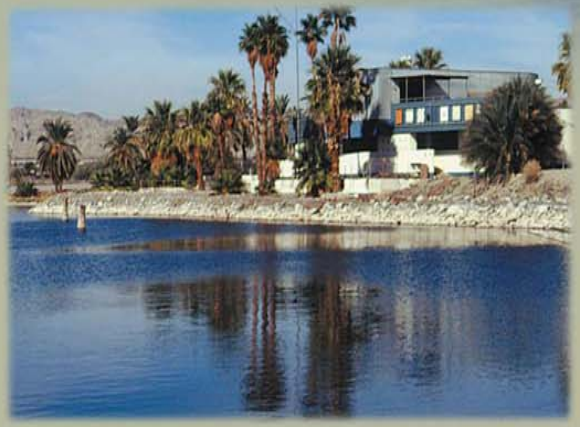
America's Winter 'Bread Basket'

Over 6 million acres of farmland

200,000 visitors annually

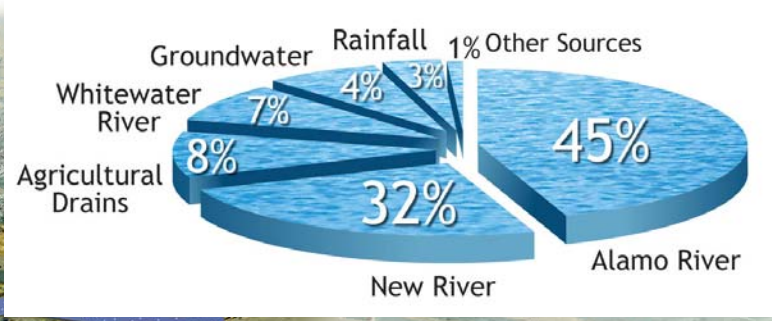
Bird watching, boating, fishing, and more

$1.5 billion annual industry



Salton Sea Hydrology

- 1.346 maf/yr inflow
- 5.78 ft/yr evaporation
- Salinity 44,000 mg/l



Whitewater River 7%

Other inflow 1%

Alamo River 45%

Rainfall 3%

Agricultural Drains 8%

Agricultural runoff

New River 32%

Groundwater 4%

Urban runoff

Potential Inflow Reductions

- "Entitlement enforcement" and other baseline reductions (100kaf)
- Transfers (300kaf)
- Mexicali wastewater (65kaf)
- Salinity control (110kaf)
- Canal lining (20kaf)

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Calculating reduced inflow

- SSDP has calculated two scenarios
  - 300kaf reduction
  - 500kaf reduction
- Grid calculation using BOR bathymetry and IID inflow rates

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Baseline Conditions

- Elevation at –227(-228)
  (Transfer EIR/EIS –235)
- Inflow 1.346maf

- Evaporation rate of 5.78 feet/yr
  (Hely 1966)

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Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
81st Avenue Snags
Whitewater River
Oasis
North Shore
Salton Sea State Park Boat Landing
Salton Sea State Park
Salt Creek
Corvina Estates Boat Launch
Thiery Creek
Desert Shores Boat Launch
Desert Shores
Salton Sea Beach Marina
Salton Sea Beach
Bombay Beach Rookery
Bombay Beach
Bombay Marina
Johnsons Landing
Salton City
Mallard Road Rookery
Ibis Road Rookery
South Ibis Road Blinds
Wister Blinds
Niland
Sonny Bono Salton Sea National Wildlife Refuge (SBSSNWR)
Red Hill Marina
Mullet Island
Old Alamo River Channel
Salton Sea Test Base
Test Base Pier
Red Hill Snag Field
Impoundment Area
Obsidian Butte Island
San Felipe Creek
San Felipe Rookery
Lack/Lindsey Rookery
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
No Lake Drawdowns or Water Diversions
Lake Level Remains at Current Elevation (-227)


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West Whitewater Rookery
76th Avenue Powerline
81st Avenue Snags
Whitewater River
North Shore
Salton Sea State Park Boat Landing
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West Trifolium 1 Drain
New River
Ramer Lake North
New Baseline Level for the Salton Sea
Lake Level Set at -235 Elevation


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Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
Drawdown of 20 KAF Relative to New Baseline
Lake Level At Approximately -237 Elevation


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81st Avenue Snags
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Salton Sea State Park Boat Landing
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New River West Ext
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West Trifolium 1 Drain
New River
Ramer Lake North
195
111
86
78
Drawdown of 40 KAF Relative to New Baseline
Lake Level At Approximately -238 Elevation


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81st Avenue Snags
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Drawdown of 60 KAF Relative to New Baseline
Lake Level At Approximately -239 Elevation


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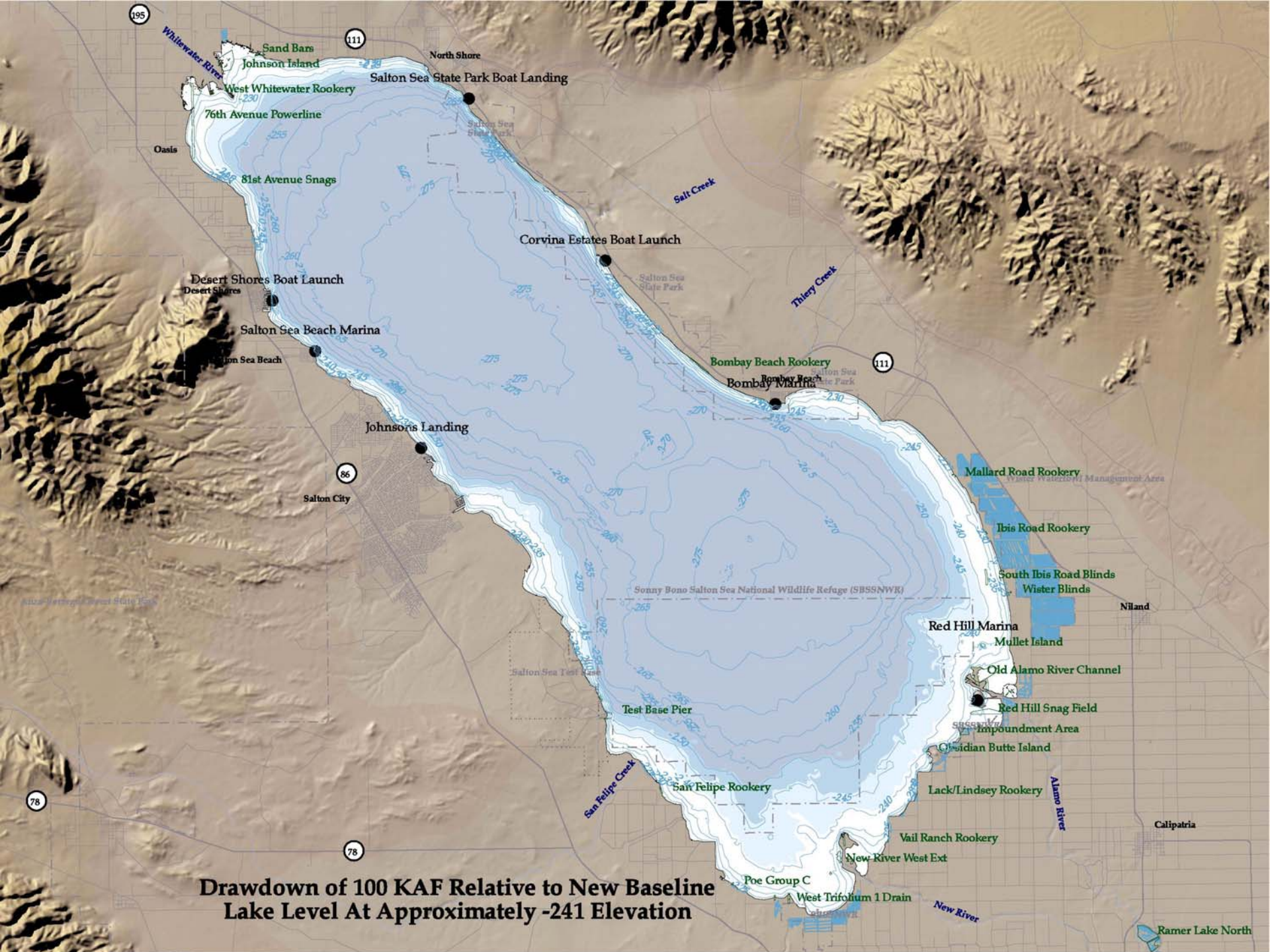
Drawdown of 80 KAF Relative to New Baseline
Lake Level At Approximately -240 Elevation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Drawdown of 100 KAF Relative to New Baseline
Lake Level At Approximately -241 Elevation


Drawdown of 120 KAF Relative to New Baseline
Lake Level At Approximately -242 Elevation
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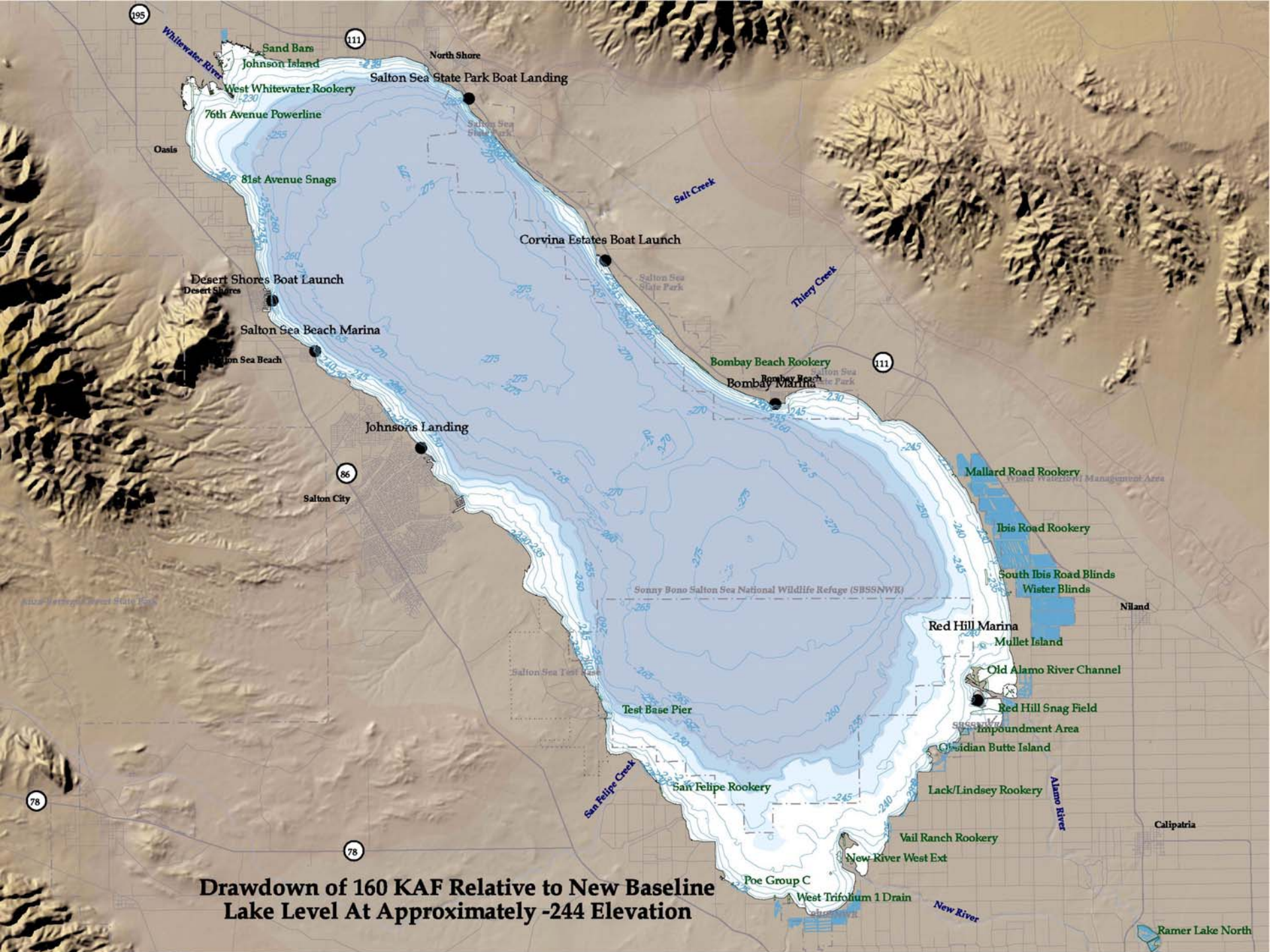
Drawdown of 140 KAF Relative to New Baseline
Lake Level At Approximately -243 Elevation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Drawdown of 160 KAF Relative to New Baseline
Lake Level At Approximately -244 Elevation


Drawdown of 180 KAF Relative to New Baseline
Lake Level At Approximately -245 Elevation
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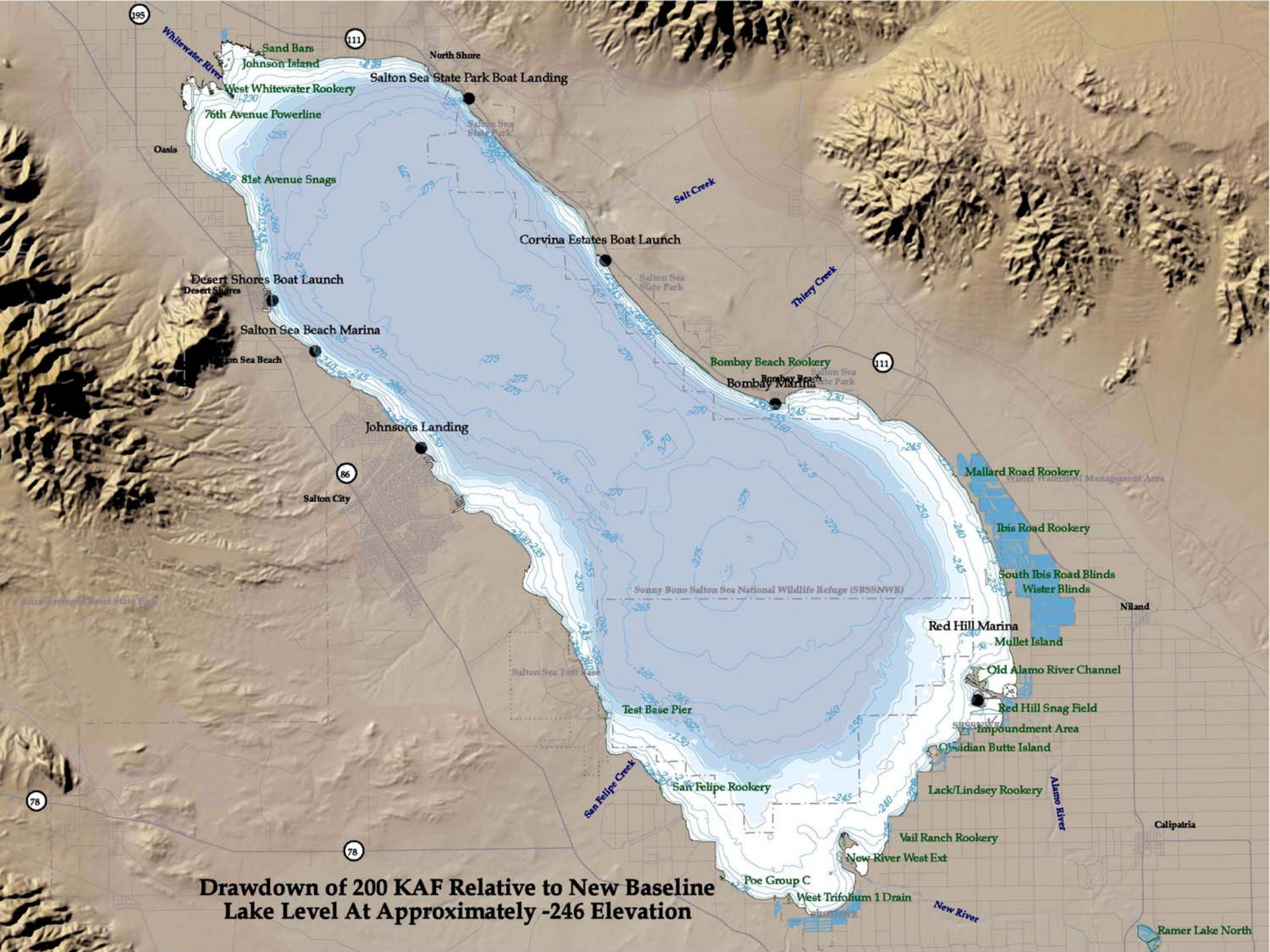
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Salton City
Mallard Road Rookery
Ibis Road Rookery
South Ibis Road Blinds
Wister Blinds
Niland
Sonny Bono Salton Sea National Wildlife Refuge (SBSSNWR)
Red Hill Marina
Mullet Island
Old Alamo River Channel
Red Hill Snag Field
Impoundment Area
Obsidian Butte Island
Test Base Pier
Salton Sea Test Base
San Felipe Creek
San Felipe Rookery
Lack/Lindsey Rookery
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
195
111
86
78
Drawdown of 200 KAF Relative to New Baseline
Lake Level At Approximately -246 Elevation


Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
81st Avenue Snags
Whitewater River
North Shore
Salton Sea State Park Boat Landing
Salton Sea State Park
Oasis
Salt Creek
Corvina Estates Boat Launch
Thiery Creek
Desert Shores Boat Launch
Desert Shores
Salton Sea Beach Marina
Salton Sea Beach
Bombay Beach Rookery
Bombay Beach
Bombay Marina
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San Felipe Rookery
Lack/Lindsey Rookery
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
Drawdown of 220 KAF Relative to New Baseline
Lake Level At Approximately -247 Elevation


Drawdown of 240 KAF Relative to New Baseline
Lake Level At Approximately -248 Elevation
Whitewater River
Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
Oasis
81st Avenue Snags
North Shore
Salton Sea State Park Boat Landing
Salton Sea State Park
Salt Creek
Corvina Estates Boat Launch
Thiery Creek
Desert Shores Boat Launch
Desert Shores
Salton Sea Beach Marina
Salton Sea Beach
Bombay Beach Rookery
Bombay Beach
Bombay Marina
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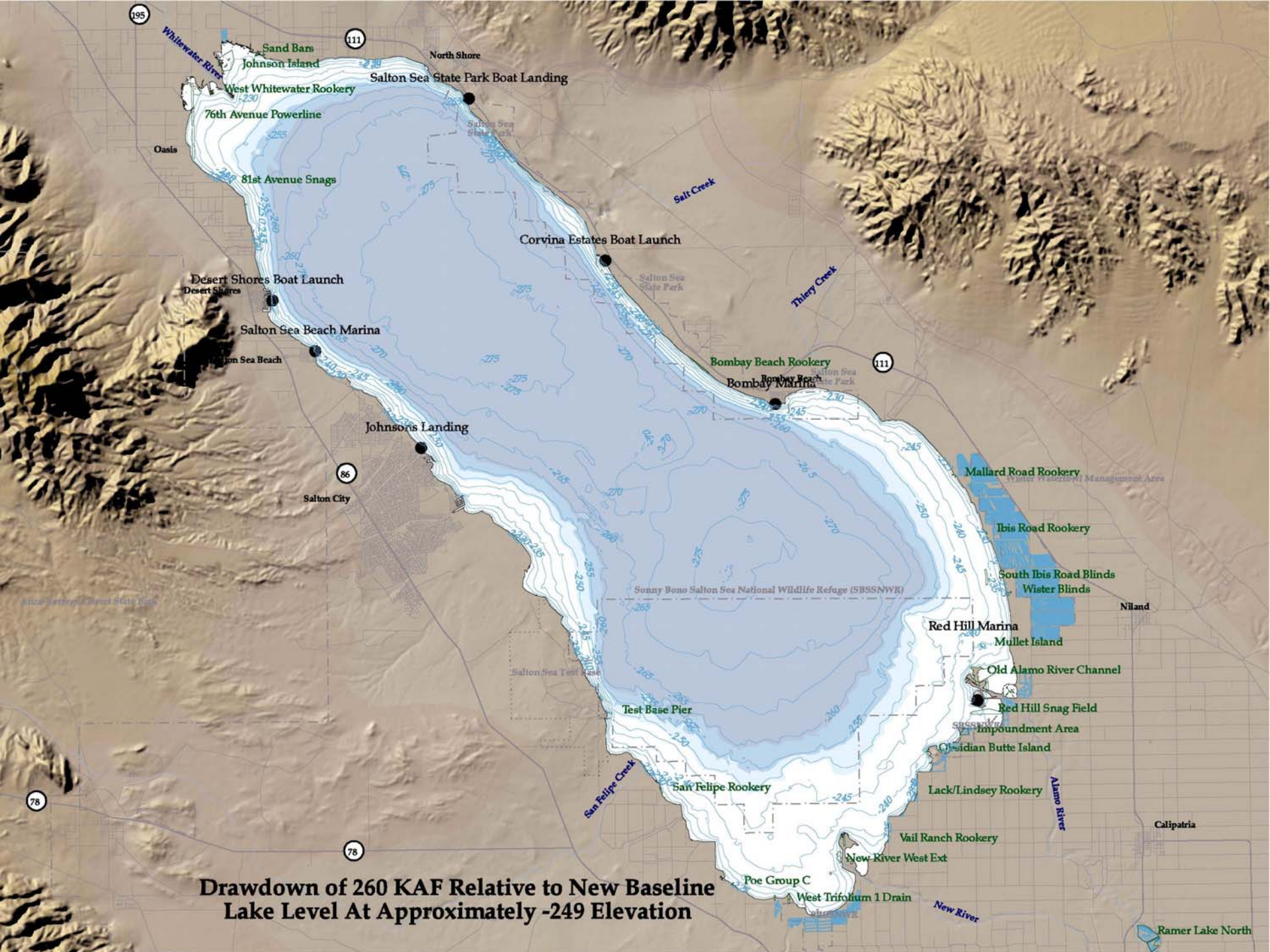
San Felipe Creek
San Felipe Rookery
Lack/Lindsey Rookery
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
195
111
86
78


Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
81st Avenue Snags
Whitewater River
Oasis
North Shore
Salton Sea State Park Boat Landing
Salton Sea State Park
Salt Creek
Thiery Creek
Corvina Estates Boat Launch
Desert Shores Boat Launch
Desert Shores
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Bombay Beach Rookery
Bombay Beach
Bombay Marina
Johnsons Landing
Salton City
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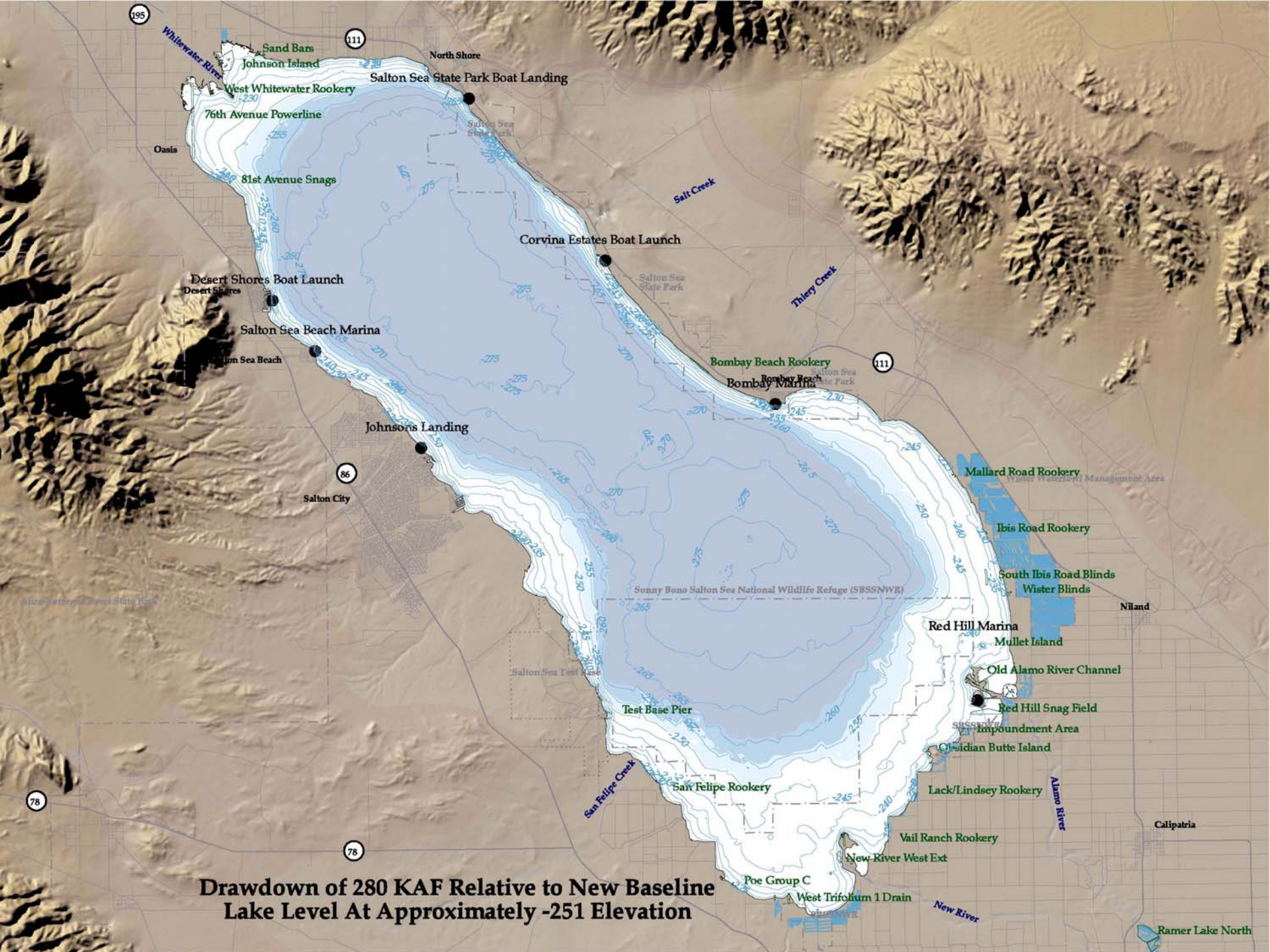
Impoundment Area
Obsidian Butte Island
Salton Sea Test Base
Test Base Pier
San Felipe Creek
San Felipe Rookery
Lack/Lindsey Rookery
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
195
111
86
78
Drawdown of 260 KAF Relative to New Baseline
Lake Level At Approximately -249 Elevation


Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
81st Avenue Snags
Whitewater River
Oasis
North Shore
Salton Sea State Park Boat Landing
Salt Creek
Corvina Estates Boat Launch
Thiery Creek
Desert Shores Boat Launch
Desert Shores
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Salton Sea Beach
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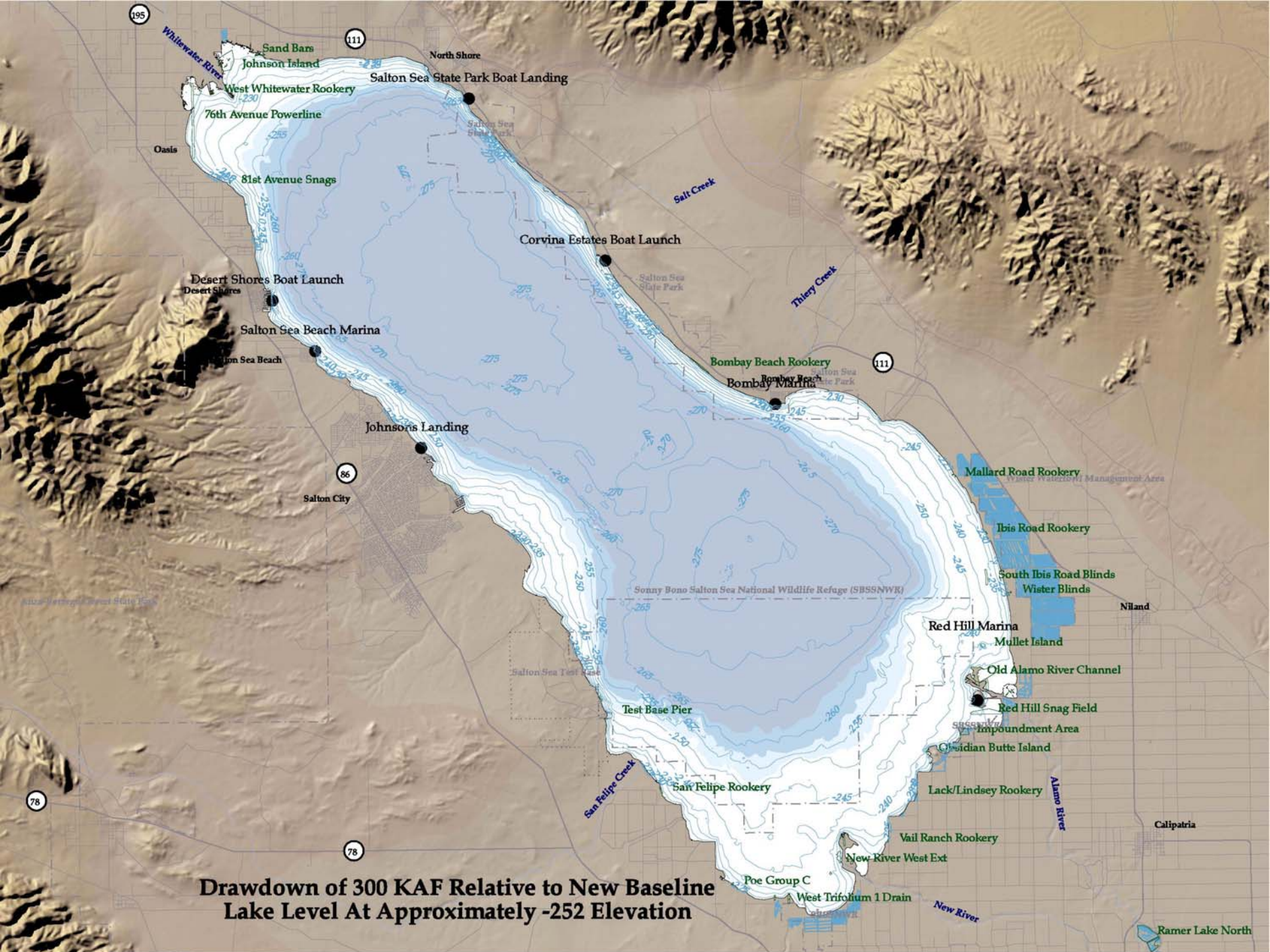
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
195
111
86
78
Drawdown of 280 KAF Relative to New Baseline
Lake Level At Approximately -251 Elevation


Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
81st Avenue Snags
Whitewater River
Oasis
North Shore
Salton Sea State Park Boat Landing
Salton Sea State Park
Salt Creek
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Corvina Estates Boat Launch
Desert Shores Boat Launch
Desert Shores
Salton Sea Beach Marina
Salton Sea Beach
Bombay Beach Rookery
Bombay Beach
Bombay Marina
Johnsons Landing
Salton City
Mallard Road Rookery
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South Ibis Road Blinds
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Red Hill Marina
Mullet Island
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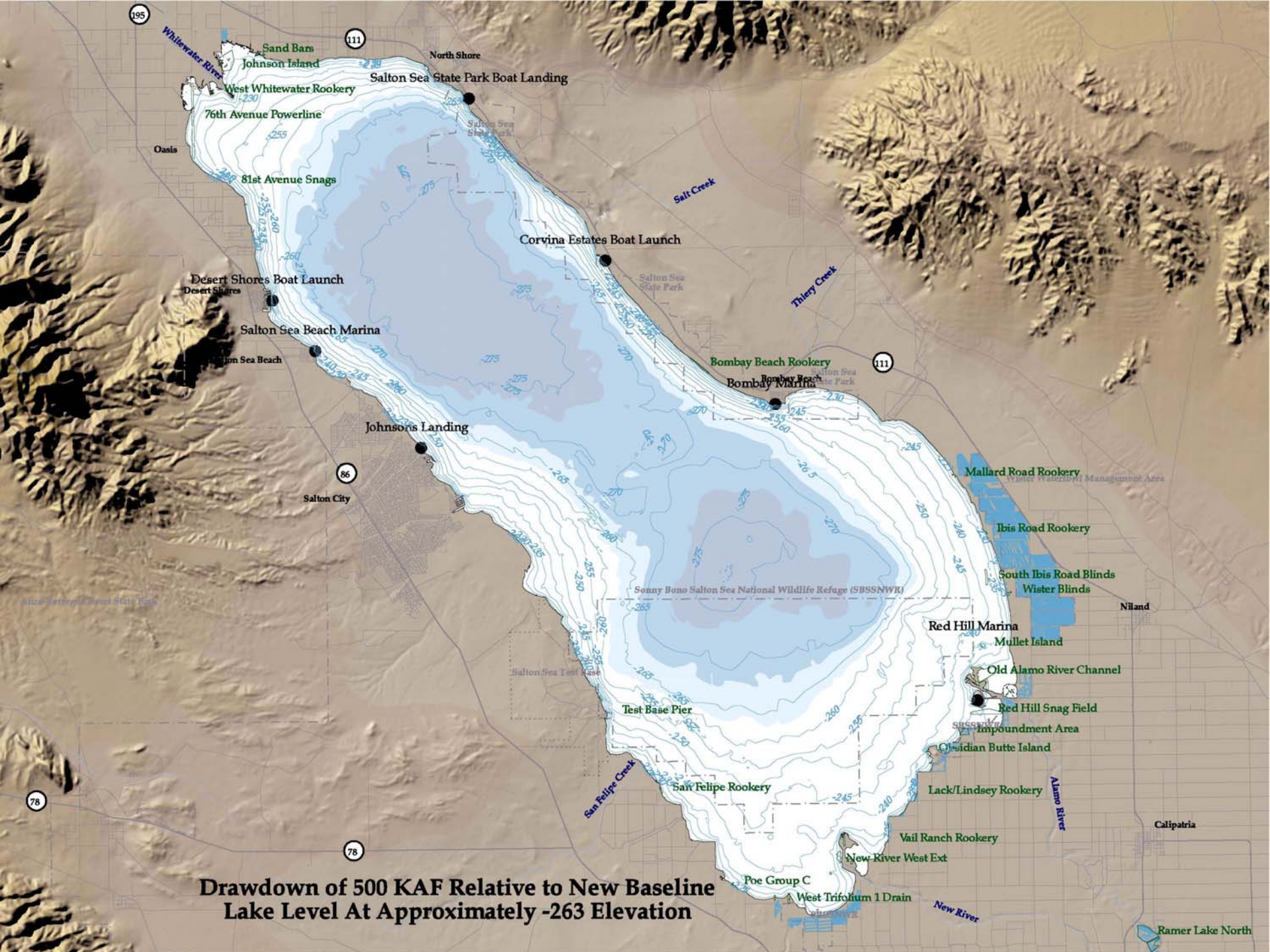
Impoundment Area
Obsidian Butte Island
Salton Sea Test Base
Test Base Pier
San Felipe Creek
San Felipe Rookery
Lack/Lindsey Rookery
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
195
111
86
78
Drawdown of 300 KAF Relative to New Baseline
Lake Level At Approximately -252 Elevation


Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
81st Avenue Snags
Whitewater River
Oasis
North Shore
Salton Sea State Park Boat Landing
Salton Sea State Park
Salt Creek
Corvina Estates Boat Launch
Thiery Creek
Desert Shores Boat Launch
Desert Shores
Salton Sea Beach Marina
Salton Sea Beach
Bombay Beach Rookery
Bombay Beach
Bombay Marina
Johnsons Landing
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Red Hill Marina
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Impoundment Area
Obsidian Butte Island
Salton Sea Test Base
Test Base Pier
San Felipe Creek
San Felipe Rookery
Lack/Lindsey Rookery
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
195
111
86
78
Drawdown of 500 KAF Relative to New Baseline
Lake Level At Approximately -263 Elevation


Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
81st Avenue Snags
Whitewater River
Oasis
North Shore
Salton Sea State Park Boat Landing
Salton Sea State Park
Salt Creek
Corvina Estates Boat Launch
Thiery Creek
Desert Shores Boat Launch
Desert Shores
Salton Sea Beach Marina
Salton Sea Beach
Bombay Beach Rookery
Bombay Beach
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Salton Sea Test Base
Test Base Pier
Red Hill Snag Field
Impoundment Area
Obsidian Butte Island
San Felipe Creek
San Felipe Rookery
Lack/Lindsey Rookery
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake North
No Lake Drawdowns or Water Diversions
Lake Level Remains at Current Elevation (-227)


Sand Bars
Johnson Island
West Whitewater Rookery
76th Avenue Powerline
81st Avenue Snags
Whitewater River
Oasis
North Shore
Salton Sea State Park Boat Landing
Salton Sea State Park
Salt Creek
Corvina Estates Boat Launch
Desert Shores Boat Launch
Desert Shores
Salton Sea Beach Marina
Salton Sea Beach
Bombay Beach Rookery
Bombay Beach
Bombay Marina
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SBSSNWR
Obsidian Butte Island
San Felipe Rookery
San Felipe Creek
Lack/Lindsey Rookery
Alamo River
Calipatria
Vail Ranch Rookery
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake Nor
111
86
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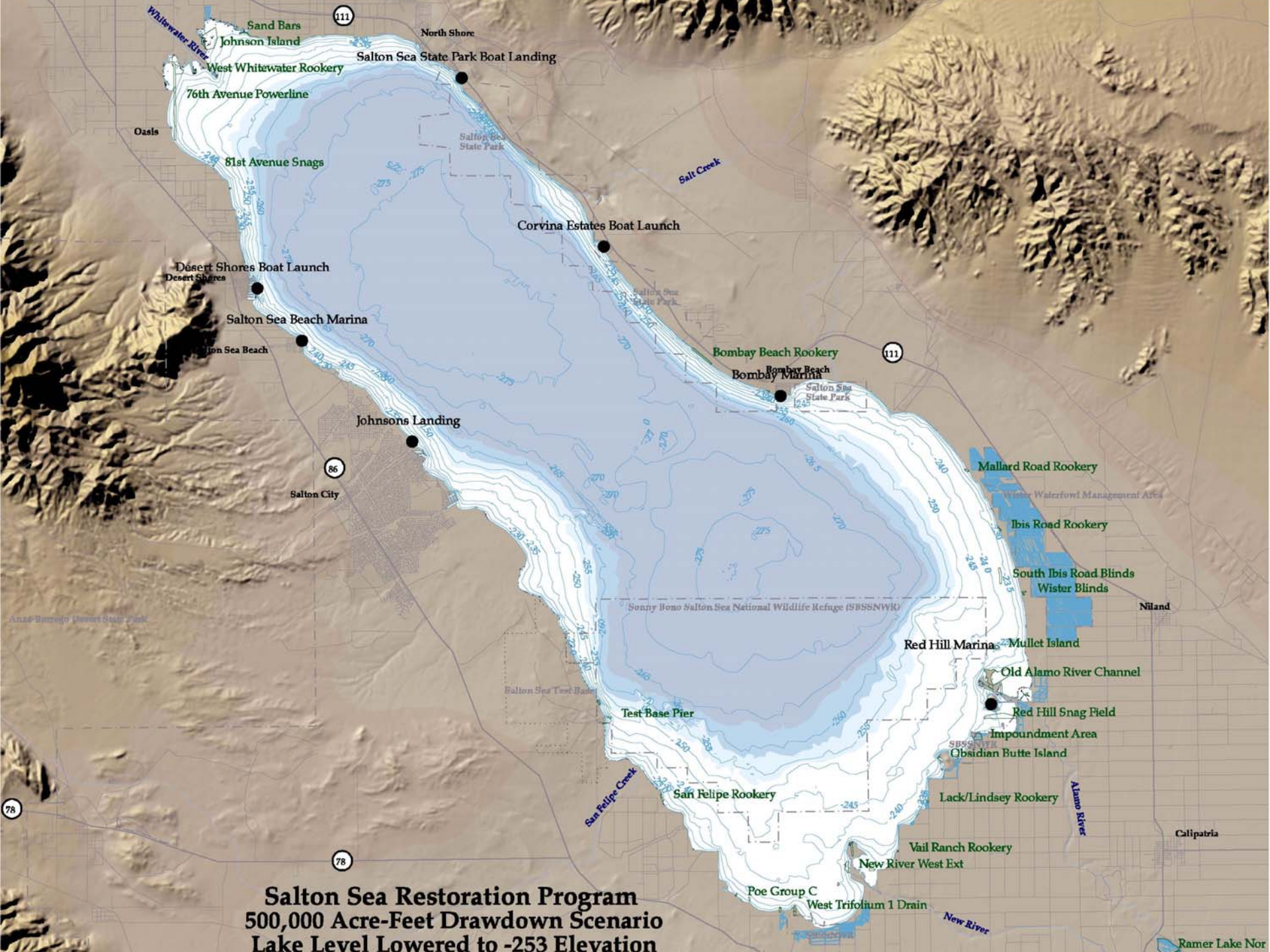
78
Salton Sea Restoration Program
300,000 Acre-Feet Drawdown Scenario
Lake Level Lowered to -243 Elevation


Sand Bars
Johnson Island
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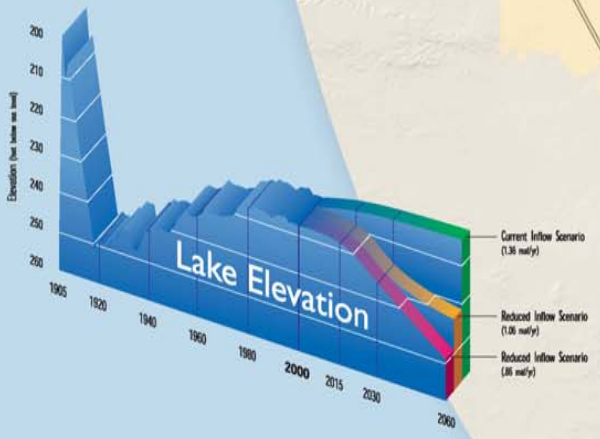
New River West Ext
Poe Group C
West Trifolium 1 Drain
New River
Ramer Lake Nor
111
86
78
Salton Sea Restoration Program
500,000 Acre-Feet Drawdown Scenario
Lake Level Lowered to -253 Elevation

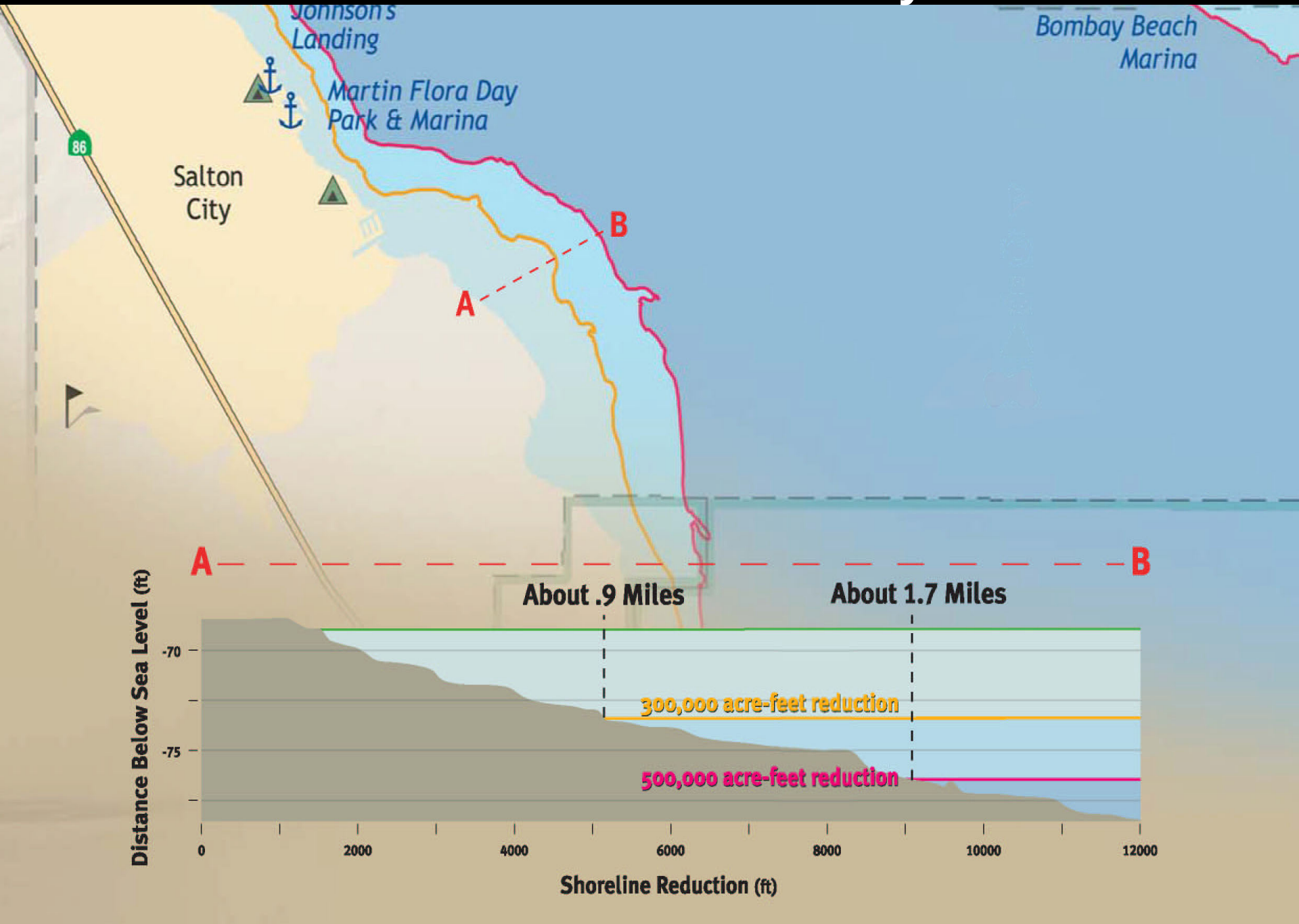
Reduced Inflow

-300kaf
Drawdown 19 feet
Exposes 53,900 acres
(84 sq. miles)

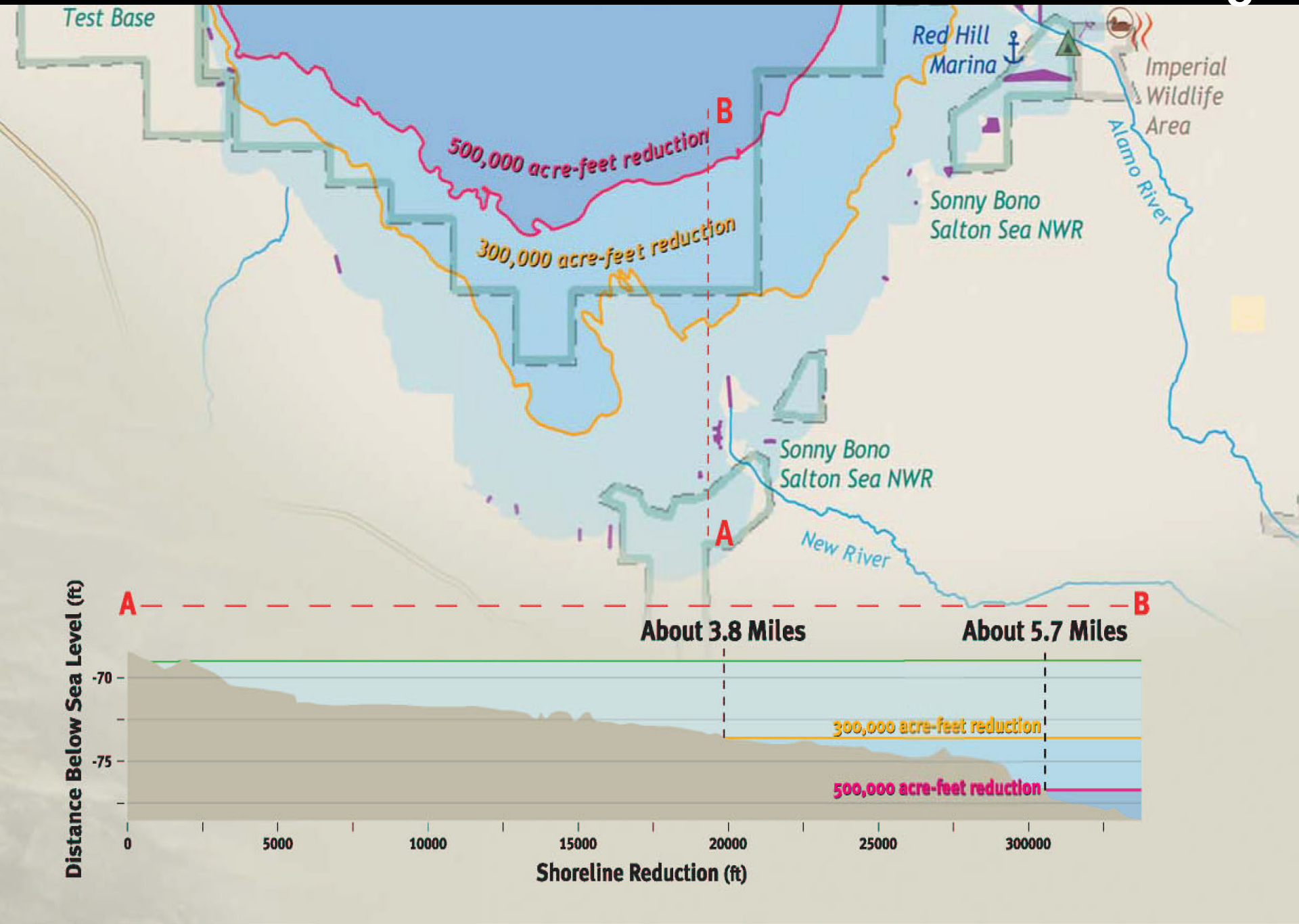
-500kaf
Drawdown 30 feet
Exposes 88,500 acres
(138 sq. miles)



Drawdown for residents at Salton City



Drawdown at the Salton Sea National Wildlife Refuge

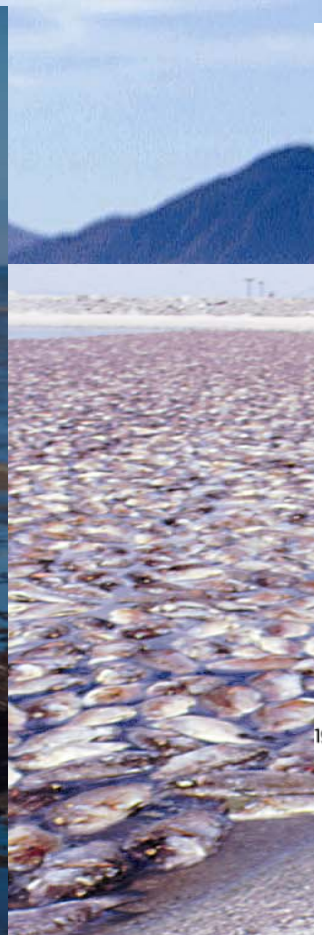


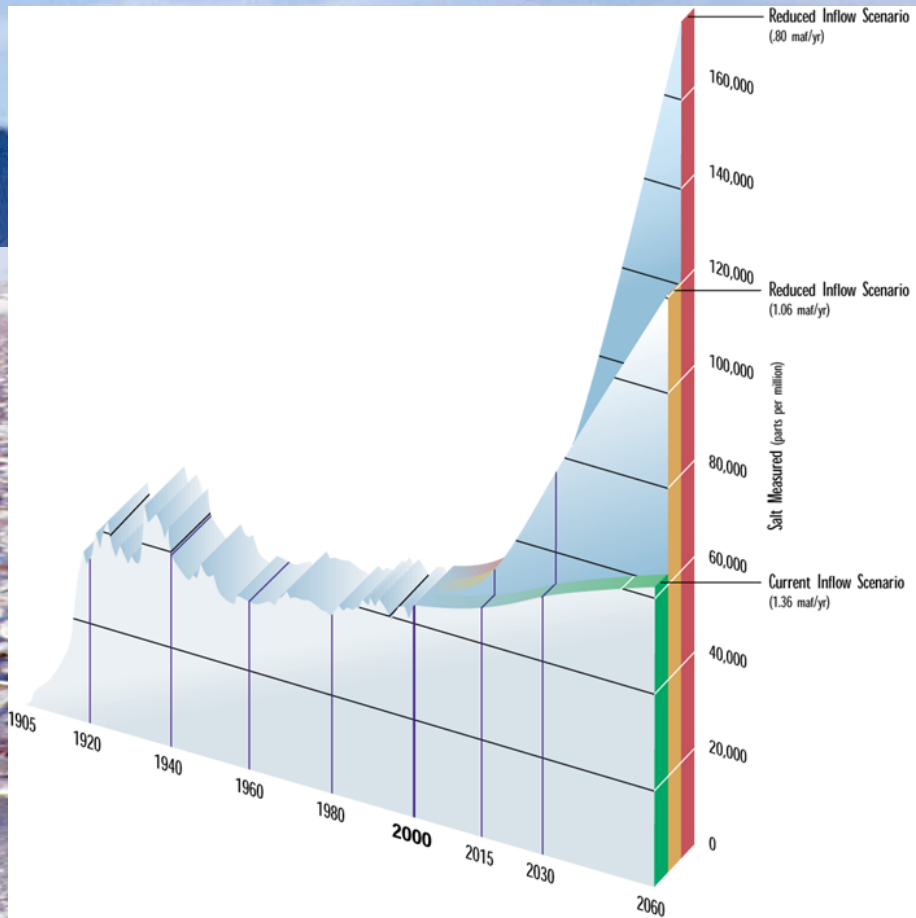
Impacts on Wildlife

Rising Salinity

Fishery Collapse

Bird Die Offs





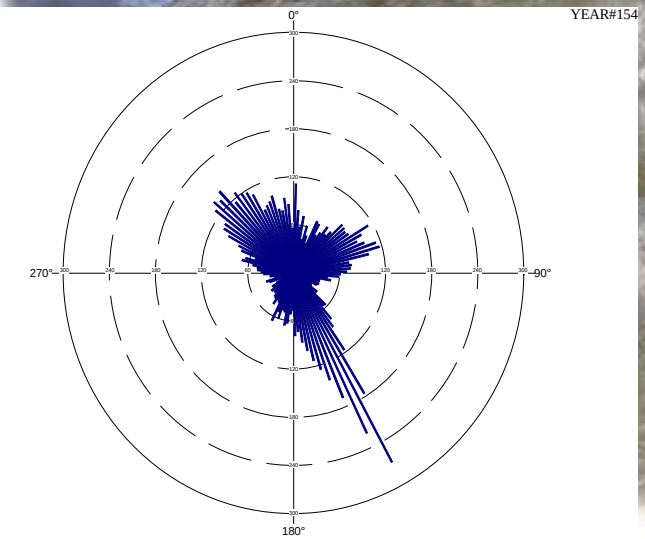
Impacts on Agriculture and Recreation

Salt and sediment deposits on croplands

Loss of recreational facilities

Saline mudflats

Impacts on Air Quality



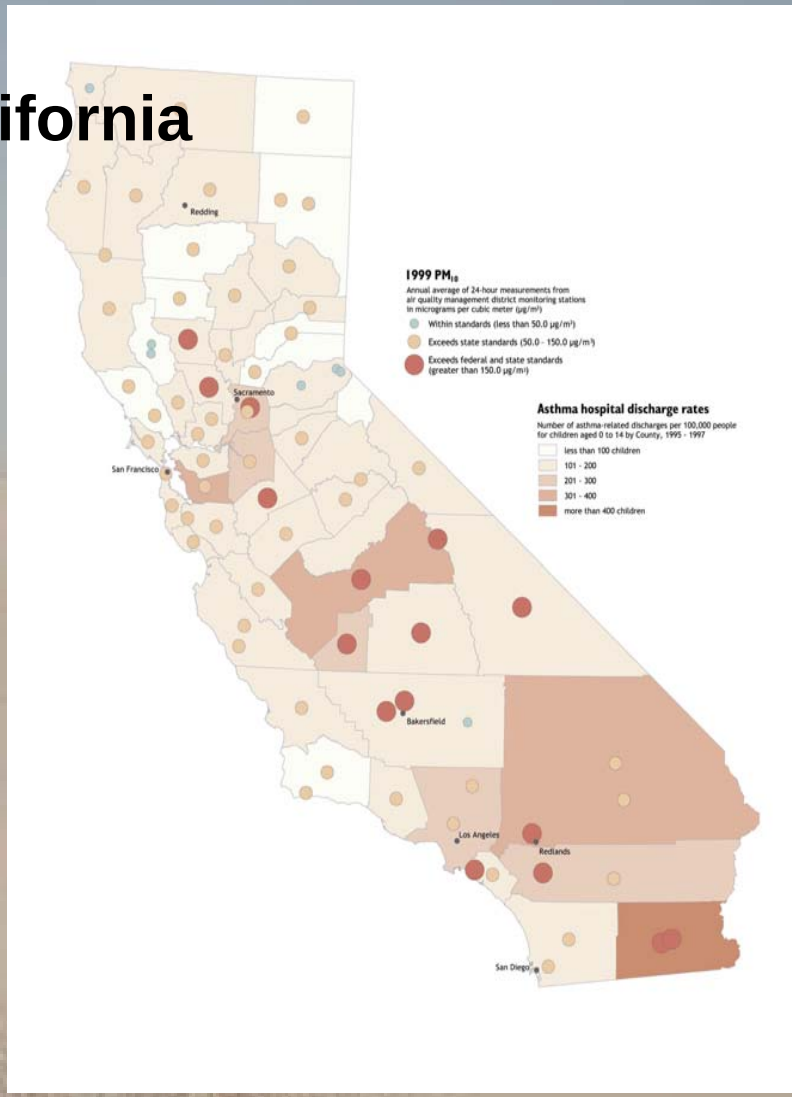
Prevailing winds pick up sediments from lakebed and deposit on leeward slopes

Impacts on Air Quality

Imperial County: Worst PM10* in California

* Particulate matter less than 10 microns

- Very fine particles, can travel long distances
- Bury downwind communities
- May contain cancer-causing chemicals such as cadmium, arsenic, and others
- Estimated as much as 1 million tons per year

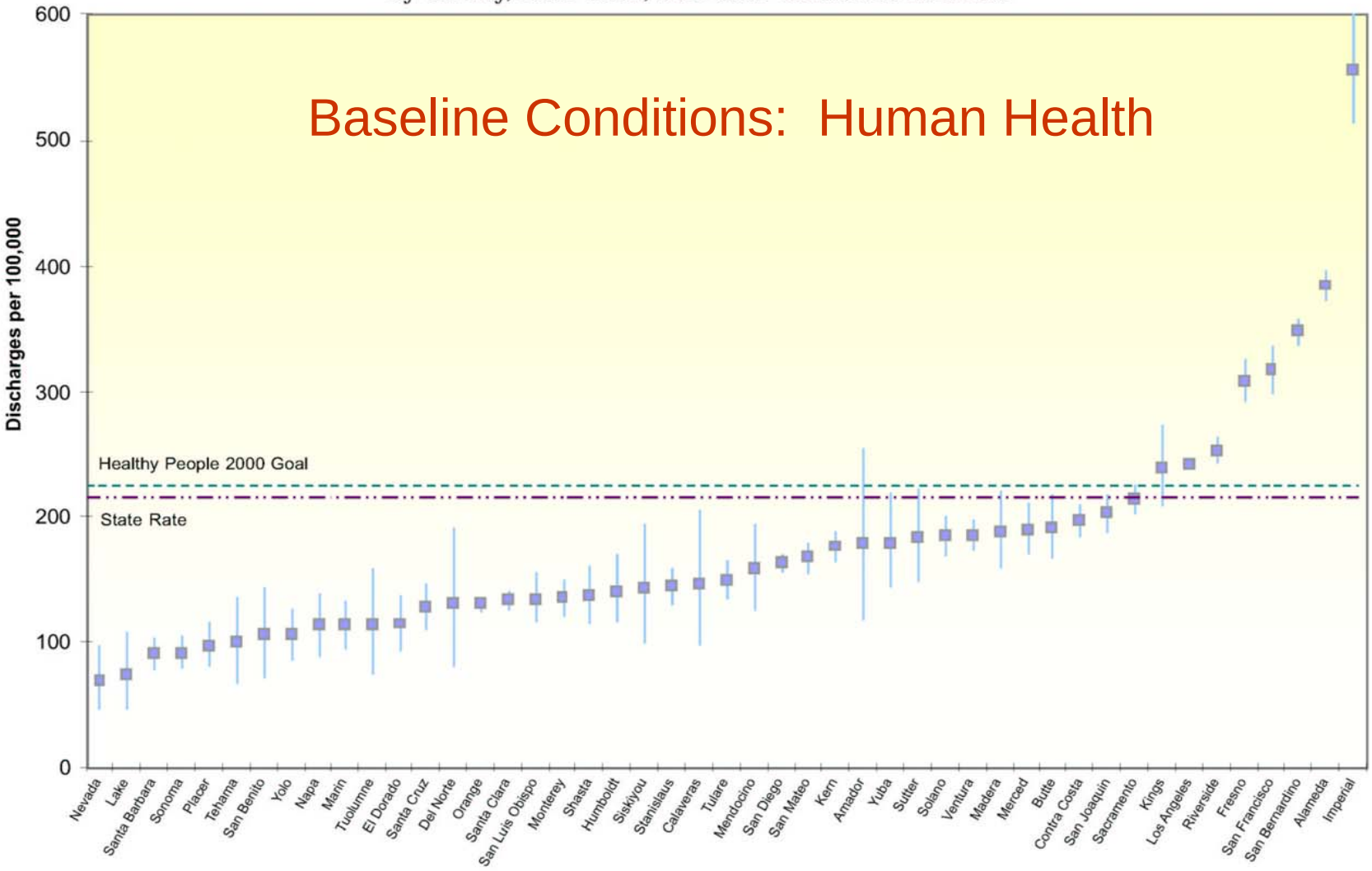


Owens Valley or Imperial Valley?

Impacts on Human Health

- Microscopic particles penetrate deep into lungs
- Studies link PM10 to respiratory disease
- Imperial County has highest incidence of childhood asthma in State

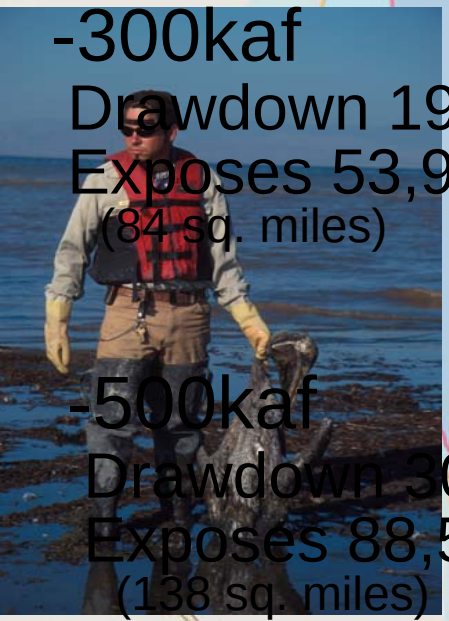
Figure 6: Age-Adjusted* Asthma Hospital Discharge Rates for Children (Ages 0-14 years) for All Races Combined, by County, 1995-1997, with 95% Confidence Intervals.



*Age-adjusted to the 1990 California population. Counties with less than 20 cases not shown.

Impact Summary

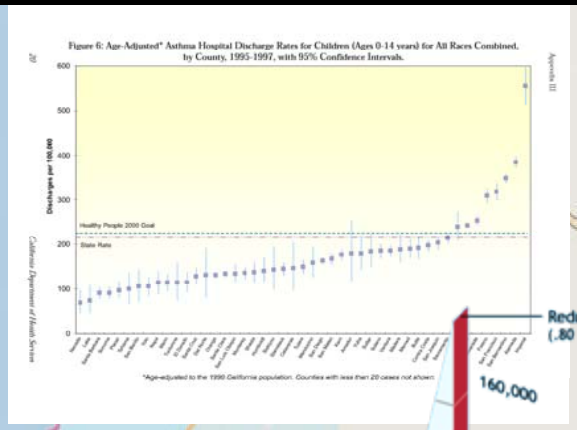
Disaster for birds



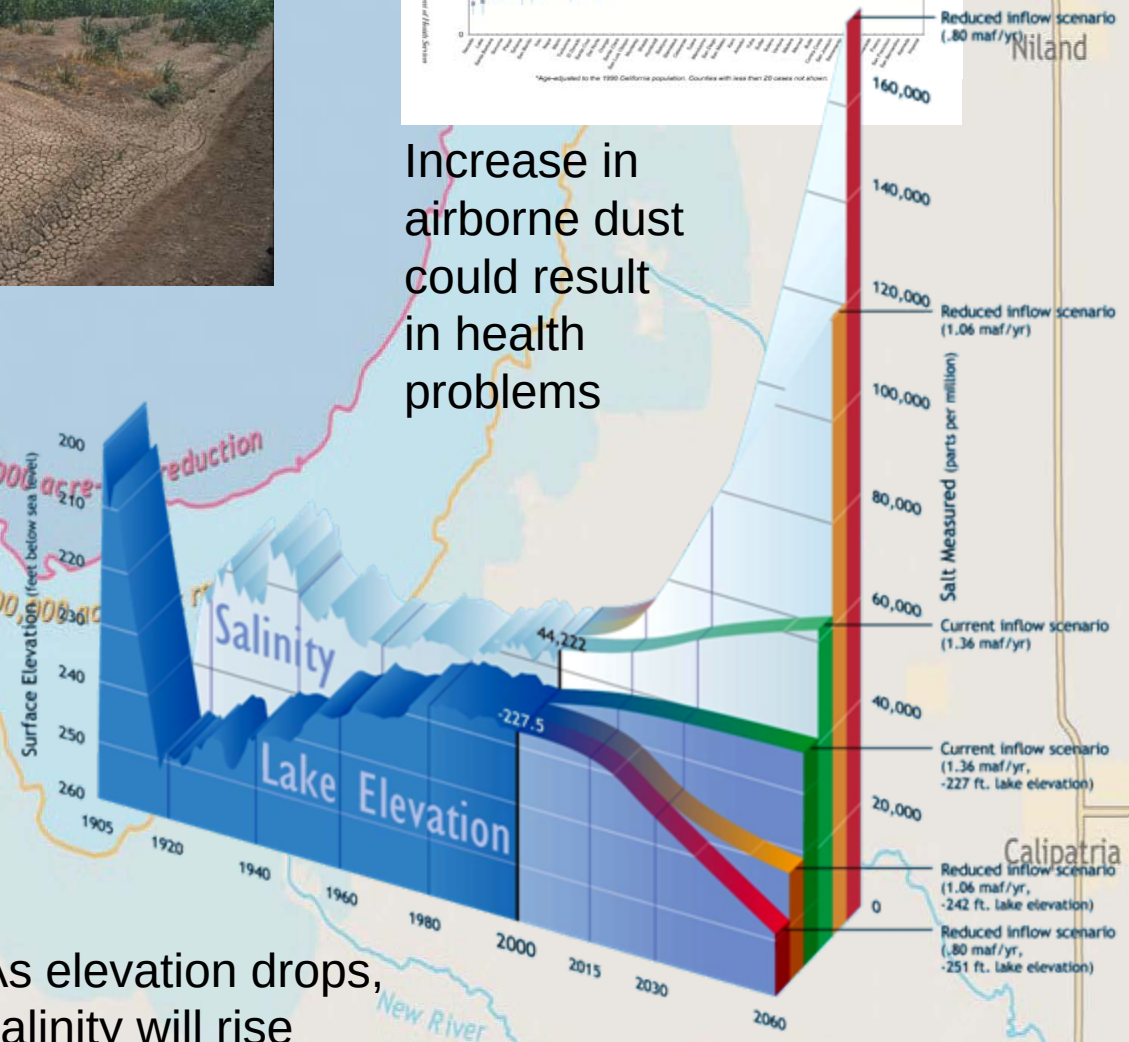
-300kaf
Drawdown 19 feet
Exposes 53,900 acres
(84 sq. miles)

-500kaf
Drawdown 30 feet
Exposes 88,500 acres
(138 sq. miles)

$1.5 billion loss
to local economy



Increase in
airborne dust
could result
in health
problems



Fishery collapse

As elevation drops,
salinity will rise