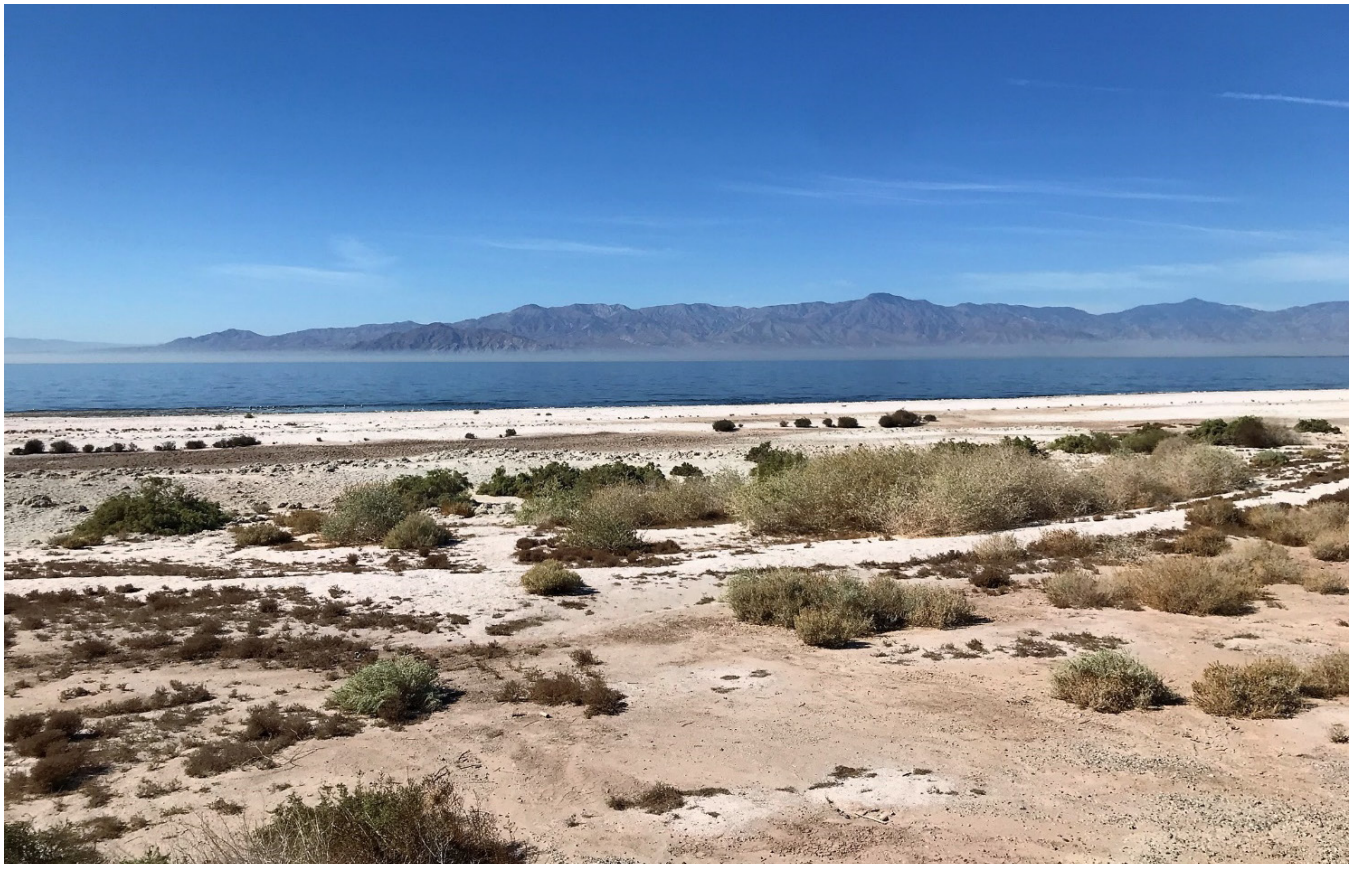
2025 SALTON SEA MIP ANNUAL WORK PLAN

Prepared for
California Natural Resources Agency,
California Department of Water Resources, and
California Department of Fish and Wildlife

February 2025

ESA



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Salton Sea MIP Annual Work Plan

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Acronyms and Other Abbreviations

Acronym or Abbreviation	Definition
Alianza	Alianza Coachella Valley
Audubon CA	Audubon California
BLM	U.S. Bureau of Land Management
Brown U	Brown University
CARB	California Air Resources Board
CDFW	California Department of Fish and Wildlife
CDPR	California Department of Parks and Recreation
CNLM	Center for Natural Lands Management
CNRA	California Natural Resources Agency
CVWD	Coachella Valley Water District
Colorado River Basin RWQCB	Colorado River Basin Regional Water Quality Control Board
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
ICAPCD	Imperial County Air Pollution Control District
H_2S	hydrogen sulfide
HARC	Health Assessment and Research for Communities, Palm Desert
IID	Imperial Irrigation District
LLU	Loma Linda University
MATES	Multiple Air Toxics Exposure Study
MIP	Salton Sea Monitoring Implementation Plan
NASA	National Aeronautics and Space Administration
NHM	Natural History Museum of Los Angeles County
NO_2	nitrogen dioxide
NSF	National Science Foundation
O_3	ozone
OBO	Oasis Bird Observatory
OEHHA	California Office of Environmental Health Hazard Assessment
PBCS	Point Blue Conservation Science
SBSSNWR	Sonny Bono Salton Sea National Wildlife Refuge
SCH	Species Conservation Habitat
SCH Project	Species Conservation Habitat Project

Acronym or Abbreviation	Definition
SCHX	Species Conservation Habitat Extension
SDSU	San Diego State University
South Coast AQMD	South Coast Air Quality Management District
TDS	total dissolved solids
Torres Martinez	Torres Martinez Desert Cahuilla Indians
TSS	total suspended solids
U. Idaho	University of Idaho
UCI	University of California, Irvine
UCLA	University of California, Los Angeles
UCR	University of California, Riverside
USBR	U.S. Bureau of Reclamation
USC	University of Southern California
USD	University of San Diego
USDA-NRCS	U.S. Department of Agriculture–Natural Resources Conservation Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compounds
Work Plan	Salton Sea MIP Annual Work Plan

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CHAPTER 1
Introduction

1.1 Background

The California Natural Resources Agency (CNRA), the California Department of Water Resources (DWR), and the California Department of Fish and Wildlife (CDFW) are implementing the Salton Sea Management Program (SSMP) to address air quality and ecological threats at the Salton Sea. The SSMP has a plan for action over the 10-year period from 2018 to 2028 (Phase 1: 10-Year Plan), which aims to improve conditions around the Salton Sea by constructing projects that create habitat and reduce dust from the exposed lakebed on 30,000 acres. Since the State of California (State) is not a significant landowner in the area, collaboration with land-owning entities is essential and a top priority for the SSMP. The SSMP Team also recognizes the crucial role of partnerships in meeting restoration goals through collecting data, facilitating project implementation, and helping obtain funding sources.

The Salton Sea Monitoring Implementation Plan (MIP) is a regional-scale monitoring plan for the Salton Sea ecosystem (CNRA 2022). The MIP, which was developed with input from implementing partners (agencies, non-governmental organizations, universities, and other research partners) and the SSMP Science Committee, describes recommended monitoring activities to measure conditions of water, air quality, land cover, biological resources, and socioeconomics. The MIP prioritized indicators and metrics and summarized methods and sampling regimes. These indicators were prioritized based on their informativeness and relationship to key resources and drivers of the Salton Sea ecosystem, feasibility of measurement, and relevance for management actions. Some indicators were recommended only for focused study to inform a specific management-articulated information need or specifically identified data gap.

1.2 MIP Work Plan

The Salton Sea MIP Annual Work Plan (Work Plan) tiers off the MIP and reflects the monitoring and research studies within the Salton Sea ecosystem that implementing partners plan to conduct during the calendar year. The Work Plan is intended to promote collaborative science and monitoring to leverage the collective expertise and investments of partner agencies and the larger science community. The Work Plan includes monitoring and research that supports the SSMP's vision for delivering dust suppression and habitat projects during Phase 1 and informs long-range planning beyond Phase 1. This includes baseline status and trends monitoring, effectiveness monitoring of projects, and focused studies (more intensive or short-term

investigations). The first Work Plan was published in February 2024 (ESA 2024) and made publicly available in both English and Spanish.

This 2025 Work Plan compiles and updates data collection activities planned for 2025, as well as summaries of a few studies that have finished data collection (i.e. no new observations of 2025 conditions are planned) and moved into the analysis and reporting phase.

1.3 Implementing Partners

The following regional implementing partners were contacted in November 2024 to inventory activities planned for 2025 (respondents are italicized):

- Twenty-Nine Palms Band of Mission Indians
- Cabazon Band of Mission Indians
- *Alianza Coachella Valley (Alianza)*
- *Arizona State University*
- *Audubon California (Audubon CA)*
- Brown University (Brown U)
- California Air Resources Board (CARB)
- *California Department of Fish and Wildlife (CDFW)*
- California Department of Natural Resources (CNRA)
- California Department of Parks and Recreation (CDPR)
- California Department of Pesticide Regulation (DPR)
- California Department of Water Resources (DWR)
- California Office of Environmental Health Hazard Assessment (OEHHA)
- Center for Natural Lands Management (CNLM)
- *Coachella Valley Water District (CVWD)*
- *Colorado River Basin Regional Water Quality Control Board (Colorado River Basin RWQCB)*
- Emissions Analytics
- *Health Assessment and Research for Communities (HARC), Palm Desert*
- *Imperial County Air Pollution Control District (ICAPCD)*
- Imperial Irrigation District (IID)
- *Loma Linda University (LLU)*
- National Aeronautics and Space Administration (NASA)
- *Natural History Museum of Los Angeles County (NHM)*
- National Science Foundation (NSF)

- *Oasis Bird Observatory (OBO)*
- *Pacific Institute*
- *Point Blue Conservation Science (PBCS)*
- *San Diego State University (SDSU)*
- Sonoma Technology
- *South Coast Air Quality Management District (South Coast AQMD)*
- Southwest Resource Management Association
- Torres Martinez Desert Cahuilla Indians (Torres Martinez)
- U.S. Bureau of Land Management (BLM)
- U.S. Bureau of Reclamation (USBR)
- *U.S. Department of Agriculture–Natural Resources Conservation Service (USDA-NRCS)*
- *U.S. Fish and Wildlife Service (USFWS)*
- *U.S. Fish and Wildlife Service Sonny Bono Salton Sea National Wildlife Refuge (USFWS SBSSNWR)*
- *U.S. Geological Survey (USGS)*
- *University of Idaho (U. Idaho)*
- University of California, Irvine (UCI)
- *University of California, Los Angeles (UCLA)*
- *University of California, Riverside (UCR)*
- *University of California, San Diego, Scripps Institution of Oceanography*
- University of San Diego (USD)
- University of Southern California (USC)

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CHAPTER 2
2025 Monitoring Elements

The monitoring activities and studies (monitoring elements) that were voluntarily reported by partners are summarized in **Table 2-1**. In a few cases, information was submitted about studies that have completed data collection and are in the reporting phase. This Work Plan may not reflect all monitoring, studies, research, and synthesis work occurring in the Salton Sea region. Effectiveness monitoring related to specific projects to determine project performance and metrics such as air quality monitoring are included. Compliance monitoring, such as biological surveys in conjunction with as-needed construction monitoring or maintenance of drainage channels, is not discussed. Information about the timing of data collection or sampling (e.g., months, frequency, and duration) was noted if it was provided.

2.1 Status and Trends Monitoring

2.1.1 Surface Water Hydrology

Implementing Partner: USGS.

Description: Gaging stations to measure river discharge (cubic feet per second), river stage (feet), and elevation (lake).

Location: River discharge (cubic feet per second) to the Salton Sea and gage height (feet) are measured at the Whitewater River (Station 10259540, Whitewater River near Mecca), Alamo River (Station 10254730, Alamo River near Niland), and New River (Station 10255550, near Westmorland). Water surface elevation of the Salton Sea is measured on the southwest shore (Station 10254005, Salton Sea near Westmorland).

Timing: Daily.

Notes: Data is available from the USGS National Water Information System website (https://waterdata.usgs.gov/nwis/sw).

2.1.2 Salton Sea Water Quality Monitoring

Implementing Partners: CDFW, Colorado River Basin RWQCB.

Description: This study aims to reestablish long-term ambient monitoring of water quality around the Salton Sea. Monitoring is conducted by boat. Water quality parameters (temperature, electrical conductivity, pH, dissolved oxygen) are measured by a handheld YSI sonde. Additionally, water grab samples are collected and sent for lab analysis to measure

nitrate, phosphorus, total nitrogen, ammonia, organochlorine pesticides, organophosphate pesticides, pyrethroids, sulfide, sulfate, enterococcus, chloride, sodium, mercury, metals, total dissolved solids (TDS), and total suspended solids (TSS). Salinity is collected annually.

Location: Sampling sites are located in open water: three southern lake sites (i.e., USGS2, USGS3, USGS5) and two northern lake sites (dependent on accessibility).

Timing: Quarterly events occur in February, April, August, and October.

Notes: Salton Sea monitoring is difficult due to the lack of boat access as the shoreline recedes. One monitoring location in the southern lake site was relocated due to receding shoreline. Access issues may improve in 2025, but will remain challenging. The two northern lake sites will be sampled if boat launching access in the northern part of the lake is improved in 2025.

2.1.3 CVWD Agricultural Drain Monitoring

Implementing Partner: CVWD.

Description: The CVWD maintains a system of 25 agricultural drains at the northern Salton Sea, which drain into the Salton Sea around the Whitewater River. Flow (discharge) from CVWD agricultural drains is measured monthly using a SonTek FlowTracker 2 handheld velocimeter instrument or dedicated flowmeter. Water quality parameters (i.e., temperature, field pH, and field electrical conductivity) are measured bi-annually using the handheld Hach HQ2200 multi-parameter instrument. Water grab samples are collected annually for lab analysis (TDS and nutrients).

Location: CVWD direct drains that discharge to the north Salton Sea.

Timing: Monthly discharge measurements; biannual (February and April) water quality measurements of temperature, field electrical conductivity, and field pH; and annual (August) water sample collection for nutrients and TDS lab analysis.

Notes: CVWD continues to conduct agricultural drain monitoring in association with ongoing operations and maintenance.

TABLE 2-1
2025 MONITORING AND STUDIES AT THE SALTON SEA

Section	Title	Implementing Partner(s)[1]	Indicator	Stage	Timing of Data Collection[2]	Location
	Status and Trends					
2.1.1	Surface Water Hydrology	USGS	Hydrology (discharge, elevation)	Data Collection	Daily	Rivers (Whitewater, Alamo, New), Salton Sea near Westmorland
2.1.2	Salton Sea Water Quality Monitoring	CDFW, Colorado River Basin RWQCB	Water quality (basic, contaminants, nutrients)	Data Collection	Quarterly (Feb, Apr, Aug, Oct)	Two northern and three southern sites (i.e., USGS2, USGS3, USGS5) within the Salton Sea
2.1.3	CVWD Agricultural Drain Monitoring	CVWD	Hydrology (discharge), water quality (basic)	Data Collection	Discharge: Monthly Water quality: Biannual (Feb, Aug) Nutrients and TDS: Annually (Aug)	North Salton Sea drains
2.1.4	Salton Sea Environmental Timeseries – Water Quality and Air Quality	Alianza, LLU, Brown U, UCLA, USD, Claremont College.	Water quality, air quality	Data Collection	Water quality: Quarterly (Feb, May, Aug, Nov) Water inflow: Feb, May, Jun, Sep, Dec Air quality: continuous	Northwest Salton Sea near Whitewater River inflow
2.1.5	Meteorology and Air Quality Monitoring	South Coast AQMD, ICAPCD, IID, Torres Martinez, Twenty-Nine Palms/Cabazon	Air quality	Data Collection	Continuous	Dust control areas, shoreline, playa
2.1.6	Shoreline Waterbird Surveys – Tri-annual	PBCS, Audubon CA, OBO, CDFW, USFWS, LAMNH	Birds	Data Collection	Seasonally (Apr, Aug, Nov-Dec)	Entire shoreline
2.1.7	Shoreline Waterbird Survey – Quarterly	Audubon CA	Birds	Data Collection	Quarterly	Entire shoreline
2.1.8	Shoreline Waterbird Surveys – Weekly	OBO	Birds	Data Collection	Weekly and Monthly	North Salton Sea shoreline (between Desert Shores and Salt Creek, including Whitewater River)
2.1.9	Marshbird Callback Surveys – Restoration Sites	CDFW	Birds	Data Collection	Annually (Mar 1-May 15)	Surveys at Salton Sea North Lake
2.1.10	Marshbird Callback Surveys – SBSSNWR	USFWS SBSSNWR	Birds	Data Collection	Annually Mar-May	South end of Salton Sea on SBSSNWR refuge land and adjacent unmanaged marshes
2.1.11	Wintering Waterfowl Aerial Surveys	USFWS SBSSNWR	Birds	Data Collection	January	Imperial Valley and Salton Sea
2.1.12	Nesting Seabird Surveys	CDFW, USFWS	Birds	Data Collection	Weekly in Summer during bird nesting season	Southern shoreline of Salton Sea: SCH and East Pond
2.1.13	Evening Sandhill Crane Roost Surveys	USFWS SBSSNWR	Birds	Data Collection	Monthly: Sep-Feb	Throughout Imperial Valley
2.1.14	Salton Sea Fish Survey	CDFW	Aquatic (fish)	Reporting	Fall	Imperial Valley: New River, Alamo River, and Whitewater River Deltas, Salton Sea proper
2.1.15	Desert Pupfish Survey	CDFW, IID, CVWD, USFWS, BLM, CNLM, CDPR, SRMA	Aquatic (pupfish, other fishes)	Data Collection	Mar/Apr to Oct	Entire Salton Sea
2.1.16	SSMP and Community Engagement Committee	SSMP	Public engagement	Data Collection	Meetings throughout the year	Virtual meetings
2.1.17	SSMP Engagement Opportunities and Outreach	SSMP	Public engagement	Data Collection	Meetings throughout the year	Virtual and in-person in communities around the Salton Sea
2.1.18	SSMP and Community Needs	CNRA	Public input	Reporting	Surveys and meetings conducted in 2023	Communities around Salton Sea
2.1.19	Bird Habitat Quantification	Audubon CA	Birds	Reporting	Year-round, completed in 2024	Entire Salton Sea
2.1.20	Vegetation Classification Analysis	Audubon CA	Vegetation	Reporting	Year-round	Salton Sea vicinity
2.1.21	Emerging Wetlands Analysis	Audubon CA	Vegetation	Reporting	Jan 2020, Jan 2022	Salton Sea playa
2.1.22	Trends in Bird Populations and Habitats at the Salton Sea	Audubon CA	Birds	Reporting	Weekly (Nov 2016–Dec 2019) Monthly (Jan 2019–Sep 2022) Quarterly (Oct 2022– Dec 2024)	Entire Salton Sea

Section	Title	Implementing Partner(s)[1]	Indicator	Stage	Timing of Data Collection[2]	Location
2.1.23	Measurements of Dust Storms in the Salton Sea Region	UCSD, NASA	Air quality	Data Collection	Year-round (Dec 2019 – Present)	Western shoreline of the Salton Sea
2.1.24	Salton Sea Environmental Timeseries: Moored Continuous Hydrodynamic and Biochemical Observations	UCLA, Alianza, LLU, Brown U	Water quality	Data Collection	Year-round	North Salton Sea and shoreline; co-located with the northern Alianza H_2S monitor
2.1.25	Salton Sea Odor Monitoring and Notification System	South Coast AQMD, Sonoma Technology	Air quality	Data Collection	Ongoing, long-term monitoring	Eastern Coachella Valley
	Focused Studies					
2.2.1	Surface Water and Groundwater Budgets	USBR, USGS	Hydrology (groundwater)	Reporting	-	Salton Sea HUC6 watershed, with more detail in the northern region
2.2.2	Spatial and Temporal Patterns and Controls on Water-Column Redox and Temperature Structures in the Salton Sea	UCR	Water quality (oxygen, sulfur)	Reporting	-	Entire Salton Sea basin (shallow and deep water)
2.2.3	Sulfur Cycling in the Salton Sea Water Column and Sediments	UCR	Water quality (sulfur)	Reporting	-	Entire Salton Sea basin (shallow and deep water)
2.2.4	Nutrient Sources, Sinks, and Cycles in the Salton Sea	UCR	Water quality (nutrients)	Reporting	-	Entire Salton Sea basin (shallow and deep water)
2.2.5	Selenium Cycling and Bioaccumulation in Foodwebs in Salton Sea Wetlands	USBR, DWR, USFWS, CDFW, USGS	Water quality, detritus, primary producers, invertebrates, fish (selenium, isotopes, genetics)	Reporting	March and April	Wetlands at the southern Salton Sea (managed and emerging wetlands)
2.2.6	Selenium Concentrations in Yuma Ridgway's Rails and Prey	USGS, USFWS, U. Idaho	Water quality, birds (selenium in Yuma Ridgway's rails and prey)	Data Collection	March-August 2025	Marshes around Salton Sea
2.2.7	Trace Metal Patterns and Controls in the Sediments of the Salton Sea	UCR	Water quality (metals)	Reporting	-	Entire Salton Sea basin (shallow and deep water)
2.2.8	Patterns of Pesticide Enrichment in Salton Sea Sediments	UCR, SDSU	Water quality (pesticides)	Reporting	-	Entire Salton Sea basin (shallow and deep water)
2.2.9	Lithium Measurements in Sediments and Surface Water	UCR	Water quality (lithium)	Data Collection	Every few months	Salton Sea near river inflows and power plants
2.2.10	Salton Sea Coastal Zone Soil Survey	USDA-NRCS, USBR	Soils	Data Collection	Ongoing through 2027	Entire shoreline
2.2.11	Microbially and Enzyme-Induced Calcite Precipitation for Mitigation of Fugitive Dust	USBR, ASU, IID	Soils (biocrust)	Data Collection	Fall 2025	Near Salton City
2.2.12	Aerosolized Toxins around the Salton Sea	USBR, HARC (Palm Desert), UCR	Air quality (particulates, toxin)	Data Collection	Year-round 2023-2026	Imperial Valley (various Salton Sea locations)
2.2.13	Public Health Impacts from Salton Sea Playa Dust	UCR, BREATHE Center, CE-CERT	Air quality (playa dust), Health	Data Collection	Ongoing until Spring 2026	Coachella and Imperial Valleys
2.2.14	Low-Cost Ambient Air Quality Network Development	UCR	Air quality	Reporting	Data collection complete	Coachella and Imperial Valleys
2.2.15	Indoor Air Quality and Filtration Study	UCR	Air quality	Reporting	Summer 2023-Summer 2024; Data collection complete	Coachella and Imperial Valleys
2.2.16	Salton Sea Air Quality Assessment	Pacific Institute	Air quality	Reporting	No new data collection scheduled	Salton Sea and surrounding areas
2.2.17	Yuma Ridgway's Rail Movements and Migration Behavior	U. Idaho, USGS	Birds (Yuma Ridgway's rail)	Data Collection	Deploy GPS transmitters Mar–Jul 2025; Location data collected through 2025	Imperial Valley: Marshes around the Salton Sea and in Arizona along the Lower Colorado River
2.2.18	Microbial Ecology: Patterns of Lateral and Vertical Variability and Controls	UCR	Aquatic (microbes)	Reporting	Data collection complete	Entire basin (shallow and deep water)
2.2.19	Biofilm as a Food Resource for Shorebirds at the Salton Sea	Audubon CA	Aquatic (plankton, macroinvertebrates)	Reporting	2023-2024: Spring (late Apr), summer (late Jul), and fall (early Oct)	Salton Sea shoreline and coastal mudflats

Section	Title	Implementing Partner(s)[1]	Indicator	Stage	Timing of Data Collection[2]	Location
2.2.20	Eastern Coachella Valley Fumigation/Pesticides Study	South Coast AQMD, CARB, OEHHA, DPR, AB 617 Community Steering Committee	Air quality	Completed	Nov 2022–Feb 2023	Eastern Coachella Valley
2.2.21	Dust Characterization Study	South Coast AQMD, CARB, UCR, AB 617 Community Steering Committee	Air quality	Data Collection	Jan 2022–Jan 2026	Eastern Coachella Valley - Mecca
2.2.22	Multiple Air Toxics Exposure Study (MATES) VI	South Coast AQMD, Emissions Analytics, UCI, USC	Air quality	Data Collection	Feb 2025–May 2026	South Coast AQMD Jurisdiction, including Eastern Coachella Valley
2.2.23	Human Health Risks from Metals in Exposed Playa Sediments	USD, LLU	Playa and sediments, Water quality	Reporting	Once per year	Playa sites throughout Salton Sea
2.1.24	NASA Earth Observations for a Resilient Salton Sea	Brown U, Alianza, UCLA, LLU.	Air quality, public health	Data Collection	Continuous until Nov 2027	One location in the northern Salton Sea and one location in the southern Salton Sea
2.2.25	Water Quality at Emergent Wetlands	Audubon CA, LLU	Water quality	Data Collection	Winter 2024/Spring 2025	Agricultural wetlands with Colorado River input in the northern Salton Sea shoreline and Bombay Beach Wetland
2.2.26	Salton Sea Aquatic Invertebrate Monitoring	CDFW, Colorado River Basin RWQCB	Aquatic (plankton, macroinvertebrates), water quality	Data Collection	Quarterly Sampling: Spring, summer, fall, and winter	Salton Sea and Shoreline: 3 water quality monitoring locations in the south, 1-2 water quality monitoring locations in the north
2.2.27	Project- Specific Salinity Measurement Methods	USD, Alianza, LLU, UCLA, Brown U	Water quality (salinity)	Data Collection	Five times per year (2 in Spring, 3 in Fall)	Bombay Beach and Desert Shores in North Salton Sea, boat transects in the Sea
	Effectiveness Monitoring					
2.3.1	SSMP Species Conservation Habitat Project	DWR, CDFW, Colorado River Basin RWQCB	Water quality (basic, selenium)	Data Collection	Quarterly	SCH Project near New River (interception ditch, ponds, water supply)
2.3.2	SSMP Dust Suppression Project Monitoring	DWR	Air quality (particulates)	Data Collection	Continuous	SSMP dust suppression projects (Clubhouse, Tule Wash, West Bombay Beach)
2.3.3	IID Salton Sea Air Quality Mitigation Program	IID	Air quality (particulates)	Data Collection	Continuous	IID dust suppression project areas (southern shoreline, playa)
2.3.4	SSMP Species Conservation Habitat Project – Aquatic Invertebrate Monitoring	CDFW	Aquatic (plankton, macroinvertebrates)	Data Collection	Quarterly Sampling: Spring, summer, fall and winter	South Salton Sea and Shoreline: SCH and SCHX
2.3.5	SSMP Species Conservation Habitat Project – Fish Monitoring at SCH West Sedimentation Basin	CDFW	Aquatic (fish, invertebrates)	Data Collection	Quarterly	South Salton Sea: SCH West Sedimentation Basin
2.3.6	SSMP Species Conservation Habitat Project – Predator Prevention Scent Barrier	CDFW, DWR, MWH Contractors Inc.	Birds, mammal predators	Completed	Summer months during bird nesting season	South Salton Sea: SCH and SCHX on the causeway
2.3.7	SSMP Project Tracker	SSMP	Public engagement	Reporting	Acreage totals updated twice per year	Projects around perimeter of the Salton Sea
2.3.8	SSMP Dust Suppression - Vegetation Monitoring	DWR	Habitats (other)	Data Collection	Four times per year (Mar, Jun, Sep, Dec)	SSMP dust suppression projects (Clubhouse, Tule Wash, and West Bombay Beach)
2.3.9	Bombay Beach Wetland Restoration Project	Audubon CA, CNRA	Habitats (wetlands), birds	Design Phase	February 2022–February 2026	Bombay Beach Wetland

NOTES:

1 Abbreviations: Alianza = Alianza Coachella Valley; Audubon CA = Audubon California; BLM = Bureau of Land Management; Brown U = Brown University; CDFW= California Department of Fish and Wildlife; CNRA = California Natural Resources Agency; CNLM = Center for Natural Lands Management; CVWD = Coachella Valley Water District; CDPR = California Department of Parks and Recreation; CE-CERT = College of Engineering, Center for Environmental Research & Technology; Colorado River Basin RWQCB = Colorado River Basin Regional Water Quality Control Board; DOI = Department of the Interior; DPR = California Department of Pesticide Regulation; DWR = Department of Water Resources; H_2S = hydrogen sulfide; HARC = Health Assessment and Research for Communities, Palm Desert; ICAPCD = Imperial County Air Pollution Control District; IID = Imperial Irrigation District; LLU = Loma Linda University; MATES = Multiple Air Toxics Exposure Study; MNH = Natural History Museum of Los Angeles County; NASA = National Aeronautics and Space Administration; NSF = National Science Foundation; OBO = Oasis Bird Observatory; OEHHA = California Office of Environmental Health Hazard Assessment; PBCS = Point Blue Conservation Science; SCH -= Species Conservation Habitat; SCHX = Species Conservation Habitat Extension; SCH Project = Species Conservation Habitat Project; South Coast AQMD = South Coast Air Quality Management District; SDSU = San Diego State University; SSMP = Salton Sea Management Program; TDS = total dissolved solids; Torres Martinez = Torres Martinez Desert Cahuilla Indians; Twenty-Nine Palms/Cabazon = Twenty-Nine Palms Band and Cabazon Band of Mission Indians; U. Arizona = University of Arizona; UCI = University of California, Irvine; UCR = University of California, Riverside; U. Idaho = University of Idaho; UCLA = University of California, Los Angeles; USC = University of Southern California; USBR = U.S. Bureau of Reclamation; USDA-NRCS = U.S. Department of Agriculture – Natural Resources Conservation Service; USFWS = U.S. Fish and Wildlife Service; USFWS SBSSNWR = U.S. Fish and Wildlife Service Sonny Bono Salton Sea National Wildlife Refuge, USGS = U.S. Geological Survey

2 - = timing or location of data collection not specified by respondent, or using existing data.

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2.1.4 Salton Sea Environmental Timeseries – Water Quality and Air Quality

Implementing Partners: Alianza, LLU (Ryan Sinclair), Brown U (Mara Freilich, Alejandra Lopez), UCLA, USD, Claremont College.

Description: This monitoring program is a community science project in the northwest Salton Sea to simultaneously measure air quality and water quality. An Aeroqual sensor (AQS1 Gas Sentry Pro) was deployed in August 2023 to measure hydrogen sulfide (H_2S), volatile organic compounds (VOC), and nitrogen dioxide (NO_2). Basic water quality metrics (temperature, dissolved oxygen, pH, specific conductivity, chlorophyll a, phycoerythrin, and turbidity) are measured using a YSI ProDSS sonde. Nutrients (nitrate, ammonia, phosphate, sulphate, and sulfide) are measured using a YSI 6500 photometer. Additionally, turbidity is measured using a TN400 turbidity meter.

This monitoring program measures water quality in quarterly increments in the northwest Salton Sea, a location that is currently not monitored by the state or local water boards for the parameters the Salton Sea Time Series is currently monitoring. The sampling sites have been shifted to better reflect the water quality of the nearshore areas along the northwest shore of the Salton Sea. Previous sites with the most relevant data (center of the lake, air quality sensor, and the mouth of the Whitewater River) will continue to be sampled.

Location: Northwest Salton Sea about 2 miles off the northwestern shore near the Whitewater River. Six sample points include following locations: 4 km south of the whitewater river (33° 28' 11" N, 116° 1' 31" W), 1.9 km south of the whitewater river and collocated with an air quality sensor (33° 28' 52” N, 116° 2' 52" W), the mouth of the whitewater river (33° 29' 49" N, 116° 3' 13" W), the mouth of the agricultural drain along the north shore (33° 31' 5" N, 115° 58' 18" W), nearshore at the North Shore Yacht Club (33° 31' 3" N, 115° 56' 25" W), and nearshore at the Salton Sea State Recreation Area (33° 30' 8" N, 115° 55' 4" W). The Aeroqual sensor is deployed on the northwestern part of the lake on a structure sitting on the border of parcel, APN 737-060-005.

Timing: Water quality monitoring occurred four times in 2024 (February 17, May 11, August 26, and November 16). In 2025, basic water quality and nutrients will be measured four times on the third Saturday of February, May, August, and November. Monitoring of inflowing river water will occur five times (February, May, June, September, and December). Air quality monitoring is ongoing with the Aeroqual monitor that measures H_2S, VOC, and NO_2.

Notes: The air monitor posts data in real time and is viewable at https://saltonseascience.org/.

2.1.5 Meteorology and Air Quality Monitoring

Implementing Partners: South Coast AQMD and the ICAPCD operate regulatory monitoring equipment within Riverside and Imperial County, respectively, to the north and south of the Salton Sea. The IID Salton Sea Air Quality Mitigation Program maintains a non-regulatory monitoring network. Other monitoring stations are maintained by the Torres Martinez, the Twenty-Nine Palms Band of Mission Indians, and the Cabazon Band of Mission Indians.

Description: Real-time monitoring focuses on criteria and noncriteria air pollutants of concern, mainly particulate matter (PM_{10}, $PM_{2.5}$), H_2S, and ozone (O_3). Monitoring sites and parameters measured are summarized in **Table 2-2**, as cataloged by CARB. The general methods are listed in **Table 2-3** for each parameter.

TABLE 2-2
SALTON SEA AIR BASIN AIR QUALITY MONITORING SITES

County	CARB Site Number[1]	Site Name	Agency	Meteorological and Air Quality Parameters[2, 3]
Riverside	TBD (060652007)	Indio-Amistad High School AQS	South Coast AQMD, IID	O_3, H_2S, H_2S, PM_{10} BAM, PM 2.5 BAM, Outdoor Temperature, Relative Humidity, Wind Direction-Scalar, Wind Direction-Resultant, Wind Speed-Resultant, Wind Speed-Scalar, Barometric Pressure
Riverside	33137	Palm Springs-Fire Station	South Coast AQMD	CO, NO_2, O_3, PM_{10}, Continuous PM_{10}, 24-hour $PM_{2.5}$, Relative Humidity, Wind Direction-Scalar, Wind Direction-Resultant, Wind Speed-Resultant, Wind Speed-Scalar, Barometric Pressure
Riverside	n/a	Twenty-Nine Palms and Cabazon	Twenty-Nine Palms and Cabazon Bands of Mission Indians[4]	PM_{10}, $PM_{2.5}$, Wind Direction, Wind Speed, Outdoor Temperature
Riverside	33033	Mecca–Saul Martinez	South Coast AQMD	Continuous metals, Black Carbon, Organic Carbon, Ammonia H_2S, NO_2, PM_{10} BAM, Outdoor Temperature, Relative Humidity
Riverside	33601	Torres Martinez (aka Near-Shore)	Torres Martinez, South Coast AQMD, IID	H_2S, TEOM $PM_{2.5}$, Outdoor Temperature, Relative Humidity, Wind Direction-Scalar, Wind Speed-Scalar, Barometric Pressure
Imperial	13601	Bombay Beach	IID	Low-Vol PM_{10}, TEOM $PM_{2.5}$, Outdoor Temperature, Relative Humidity, Wind Direction-Scalar, Wind Speed-Scalar, Barometric Pressure
Riverside	33602	Salton Sea Park	IID	TEOM PM_{10}, TEOM $PM_{2.5}$, Outdoor Temperature, Relative Humidity, Wind Direction-Scalar, Wind Speed-Scalar, Barometric Pressure
Imperial	13603	Naval Test Base	IID	TEOM $PM_{2.5}$, Outdoor Temperature, Wind Direction-Scalar, Wind Speed-Scalar
Imperial	13604	Salton City	IID	TEOM $PM_{2.5}$, Outdoor Temperature, Relative Humidity, Wind Direction-Scalar, Wind Speed-Scalar, Barometric Pressure
Imperial	13602	Sonny Bono	IID	Low-Vol PM_{10}, TEOM $PM_{2.5}$, Outdoor Temperature, Wind Direction-Scalar, Wind Speed-Scalar, Barometric Pressure
Imperial	13997	Niland–English Road	ICAPCD	O_3, BAM PM_{10}, Outdoor Temperature, Wind Direction-Resultant, Wind Speed-Resultant, Barometric Pressure

County	CARB Site Number[1]	Site Name	Agency	Meteorological and Air Quality Parameters[2, 3]
Imperial	13697	Westmorland	ICAPCD	O_3, BAM PM_{10}, Outdoor Temperature, Wind Direction-Resultant, Wind Speed-Resultant, Barometric Pressure
Imperial	13701	Brawley−Main Street #2	ICAPCD	BAM PM_{10}, BAM $PM_{2.5}$

SOURCE: CARB 2024

NOTES:

1. The California Air Resources Board (CARB) provides information on sites and parameters here: https://ww2.arb.ca.gov/applications/quality-assurance-air-monitoring-site-list-generator-1. This page does not necessarily reflect all parameters monitored at a site.
2. Particulate matter - sampling techniques for continuous measurement of suspended particulate matter vary among sites, including low-volume and high-volume samplers, TEOM (tapered element oscillating microbalance), and BAM (Beta Attenuation Monitor).
3. Hydrogen sulfide - Real-time H_2S data is available at: https://saltonseaodor.org/
4. Data for the Twenty-Nine Palms and Cabazon monitoring site is available at: https://www.29palmstribe.org/departments/tribal-epa/air-quality/

TABLE 2-3
SALTON SEA AIR BASIN AIR QUALITY MONITORING METRICS AND METHODS

Metrics	Methods	Timing
Black Carbon (CD)	Real Time, AE33 and MA350	Ongoing
Total Carbon (TC)	Real Time, Total Carbon Analyzer	Monitor removed in Nov 2024
Metals	Real Time, Xact 625i	Ongoing
NO_X/NO/NO_2	Real Time, T200	Ongoing
O_3	Real Time, T400	Ongoing
Ammonia	Real Time, Picarro	Ongoing

Location: As cataloged by CARB, there are 13 active air quality monitoring sites near the Salton Sea (Table 2-2). Three sites are in the north (Indio, Mecca, and Torres Martinez), two are on the east shore (Salton Sea Park, Bombay Beach), two are on the west shore (Salton City, Naval Test Base), four are in the south (Sonny Bono, Niland-English Road, Westmorland, and Brawley), and one is Palm Springs (Palm Springs Fire Station). The Cabazon and Twenty-Nine Palms tribes installed an air quality monitoring station near the Eagle Falls Golf Course in Indio.

Timing: Real-time continuous monitoring.

Notes: CARB provides information on sites and parameters online at: https://ww2.arb.ca.gov/applications/quality-assurance-air-monitoring-site-list-generator-1. More information is available online from South Coast AQMD: Salton Sea Air Basin Air Quality Monitoring Metrics and Methods.

2.1.6 Shoreline Waterbird Surveys – Tri-annual

Implementing Partners: PBCS, Audubon CA, OBO, CDFW, USFWS, NHM.

Description: Coordinated regional- and flyway-scale surveys for migratory shorebirds that rely on a standardized survey protocol. The Intermountain West Shorebird Survey is a biannual survey during migration (April and August) from 2022–2026 at more than 200 freshwater wetland and saline lake sites in 11 U.S. western states. The Pacific Flyway Shorebird Survey occurs each winter at more than 400 sites in all 13 countries of the Pacific Coast of the Americas, including every December since 2010 at Salton Sea. Shorebird abundance is measured around the Salton Sea shoreline, peripheral emergent habitats around drains and wetlands (including near Bombay Beach), and managed wetland complexes at Imperial Valley Wildlife Area and Sonny Bono Salton Sea National Wildlife Refuge (SBSSNWR). Incidental observations are collected for any dead and sick birds.

The Intermountain West Shorebird Survey also provides information about the abundance and distribution of snowy plovers along the shoreline. Although the surveys do not involve nest searching, plovers are territorial breeders, so their distribution in late April is a coarse-scale indicator of the distribution of preferred breeding habitat. The August survey will provide information on local abundance in the context of the regional population when compared to other interior sites.

Survey data will also be contributed by OBO and Audubon CA from their regular monitoring locations. Volunteers and staff from Point Blue, Audubon CA, CDFW, and USFWS will conduct the surveys.

Location: The surveys cover the entire Salton Sea shoreline (19 segments, with 85 subsegments). Surveys will also include the greater wetland complex of impoundments in Wister, SBSSNWR, Imperial Wildlife Area, Sonny Bono and Species Conservation Habitat (SCH) ponds, Bombay Beach, Ramer Lake.

Timing: Three times annually in April, August, and November–December.

Notes: Complete shoreline surveys are dependent upon having an airboat to cover portions of the shoreline inaccessible by foot or all-terrain vehicle. Boat access to the Sea has become difficult in recent years due to the receding shoreline. Thus, many surveys have not covered the entire shoreline since 2015. If CDFW or USFWS cannot provide a boat, additional support will be needed to purchase a boat for non-governmental organizations to lead the boat survey portion. For more information of the survey methodologies used, please visit: https://migratoryshorebirdproject.org/pfss/ and https://www.imwss.org/.

2.1.7 Shoreline Waterbird Surveys – Quarterly

Implementing Partner: Audubon CA.

Description: Waterbird surveys have been conducted since November 2016 at 14 sites around the Salton Sea. These surveys are conducted quarterly in February, May, August, and November. Surveys consist of bird counts taken from a predetermined survey point with a spotting scope, covering a distance 500 m to the left and right of the survey point and 1 km offshore of the point creating a "survey box" in which birds are counted for roughly 15 minutes and are identified to species. Counts include birds on the shore, on the water and in flight. Because the Sea is rapidly receding in some areas it was necessary to move survey points towards the water's edge as the Sea receded to ensure the surveys were covering the intended habitat. In some cases, the original point is now over a mile from the shoreline.

Location: 14 sites along the shorelines of the Salton Sea.

Timing: Quarterly

2.1.8 Shoreline Waterbird Surveys – Weekly

Implementing Partner: OBO.

Description: OBO began weekly waterbird surveys at various shoreline viewsheds along the middle and northern sections of Salton Sea in 2014. The intent of weekly annual surveys was to monitor the spatial and temporal patterns of waterbirds at Salton Sea over multiple years (2014 through 2026), as well survey bird/habitat use of Salton Sea's shoreline and nearshore habitats. Surveys for waterbirds will estimate species and numbers of birds at each site, including shoreline habitats and an open water viewshed of approximately 1 km perpendicular from the shore to monitor spatial and temporal patterns, migration, phenology, and other behavioral patterns of bird populations at the Salton Sea. Surveys are conducted during mornings and afternoons. Sites are surveyed for 60 to 120 minutes, depending on the relative abundance of waterbirds, to ensure accurate identifications and abundance estimates. During each survey, observer(s) record all waterbirds within approximately 1 km of the count location. Observer(s) survey shoreline, open water, and airspace with a spotting scope (20x60) and binoculars (8x42, 10x42) and record the number of species and individuals. Weekly surveys cover approximately 25 km^2 of the shoreline and offshore zones. All waterbird species are estimated on weekly counts, including seasonal focused assessments of waterfowl trends, eared grebe trends, semipalmated plover staging, snowy plover breeding trends, sanderlings, red knots staging, gulls, and terns trends.

Location: Ten sites along the northern shoreline between Desert Shores and Salt Creek.

Timing: Eight sites are visited weekly, and two sites are visited monthly.

Notes: All weekly shoreline surveys in 2024 have been completed. Studies are intended to be concluded in 2026.

2.1.9 Marshbird Callback Surveys – Restoration Sites

Implementing Partner: CDFW.

Description: Conducting surveys along the northern shoreline for the purpose of project impact evaluation, documenting suitable habitat and occupancy for the future north lake projects.

Location: Surveys will be conducted at the Salton Sea North Lake.

Timing: March 1 through May 15, 2025.

2.1.10 Marshbird Callback Surveys – SBSSNWR

Implementing Partner: USFWS SBSSNWR.

Description: Conduct annual secretive marshbird audio call-back surveys for Ridgway's rail, Virginia rail, black rail, least bittern, American bittern, and pied-billed grebe.

Location: South end of Salton Sea at managed marshes on the refuge and adjacent unmanaged marshes.

Timing: One visit to each marsh every 15 days from March through May.

2.1.11 Wintering Waterfowl Aerial Surveys

Implementing Partner: USFWS SBSSNWR.

Description: Aerial survey of waterfowl wintering at the Salton Sea. In addition, an annual white goose survey is conducted in the Imperial Valley.

Location: Imperial Valley and Salton Sea.

Timing: One time, in January.

2.1.12 Nesting Seabirds Surveys

Implementing Partners: CDFW, USFWS.

Description: Weekly surveys for nesting Caspian terns, gull-billed terns, Forster's terns, black-necked stilts, American avocet, and black skimmers to determine nesting success for these species while nesting on SCH. Using binoculars and/or a scope, numbers of adult birds, nests, chicks, and fledglings will be recorded for several colonial nesting birds on the east side of SCH.

Location: Southern shoreline of Salton Sea: specifically, the SCH and an inundated island in the East Pond.

Timing: Weekly surveys in the summer, during bird nesting season.

Notes: The study was included in the 2024 Annual Work Plan and was to be led by USFWS. However, in 2024, CDFW took over the monitoring effort to survey the nesting colonial birds because they no longer nested on SBSSNWR and USFWS personnel did not survey for these birds. CDFW and USFWS will collaborate moving forward as these seabird colonies may continue to change nesting locations.

2.1.13 Evening Sandhill Crane Roost Surveys

Implementing Partner: USFWS SBSSNWR.

Description: Evening surveys for sandhill crane roosts.

Location: Throughout Imperial Valley, at various wetlands, farms, and granaries.

Timing: Monthly surveys in September–February.

2.1.14 Salton Sea Fish Survey

Implementing Partner: CDFW.

Description: General fish surveys conducted by boat with trammel nets at nearshore locations and by cast nets at river deltas to document fish species and abundance.

Location: Imperial Valley: New River, Alamo River, and Whitewater River Deltas.

Timing: Fall 2024.

Notes: Conducting fish surveys has become difficult in recent years due to the lack of boat access as the Salton Sea recedes. A fish survey was conducted in fall 2024, and a summary report of the findings is currently being drafted.

2.1.15 Desert Pupfish Survey

Implementing Partners: CDFW, IID, CVWD, USFWS, BLM, CNLM, CDPR, SRMA.

Description: Long-term monitoring of desert pupfish populations throughout range in California, presence and relative abundance, general trend information. Pupfish surveys are primarily conducted using minnow traps. Dip nets may be used to confirm presence if the water is too shallow to set minnow traps. Information collected during surveys includes general habitat conditions; presence and relative abundance (catch per unit effort) of pupfish and non-native species; and basic water quality data (conductivity, dissolved oxygen, and temperature).

Location: Irrigation drains/shoreline pools, tributary streams/creeks, ponds, former Salton Sea marinas, refuges (artificial habitat).

Timing: Each site is visited once annually primarily at the end of March or early April through October. Some drains may be sampled more frequently, if pupfish are not detected during the first survey, to confirm negative results. A few sites may be surveyed more frequently (e.g.,

quarterly) depending on the need for more information. Ideally, sites should be surveyed during the spring, summer, and early fall, but this is often difficult due to staff workload.

Notes: While primarily monitoring desert pupfish, other fish species may be monitored too. This long-term monitoring effort is expected to continue for many years to come.

2.1.16 Salton Sea Management Program and Community Engagement Committee

Implementing Partner: SSMP.

Description: The SSMP Community Engagement Committee and its subcommittees serve as the hub and primary venue to plan engagement activities and identify best outreach and involvement strategies for SSMP public events. The Community Engagement Committee consists of representatives from community-based organizations, stakeholder groups, local leaders, governmental agencies, and Tribal governments. It enlists leaders of local community groups and non-governmental organizations to help guide SSMP engagement efforts, reach community members through varying communications channels, and increase community engagement in SSMP planning activities. The Committee is led by two co-chairs, one from Alianza and one from the County of Imperial. A new Community Outreach and Engagement Plan was released in December 2024, capturing the recommended strategies and tactics to best engage with Salton Sea communities.

Location: Virtual meetings.

Timing: Various meetings throughout the year.

Notes: Meetings occur in preparation for public community meetings and engagement opportunities.

2.1.17 Salton Sea Management Program Engagement Opportunities and Outreach

Implementing Partner: SSMP.

Description: The SSMP Team hosts regular public meetings and workshops to share information and gather community feedback. The SSMP Team continues to use and is working to update a comprehensive website, www.saltonsea.ca.gov, to continue to provide information on SSMP projects, processes, and provide opportunities to receive input. Additionally, the SSMP released the SSMP Project Tracker for public view in 2024.

The State also continues to share news, engagement opportunities, and project updates via the SSMP update e-newsletter. The SSMP update e-newsletter is distributed through the CNRA Salton Sea mailing list to over 1,900 subscribers.

Location: Virtual meetings and in-person meetings in communities around the Salton Sea.

Timing: Various meetings throughout the year.

Notes: Newsletters are issued monthly or when needed for updates.

2.1.18 Salton Sea Management Program and Community Needs

Implementing Partner: CNRA.

Description: Acknowledging the concerns raised by community members and advocates over the past decades about the actions and inactions in the Salton Sea region, CNRA recognized the need to better understand community needs and identify better pathways to achieve co-benefits while achieving the SSMP's goals and commitments to implement nearly 30,000 acres of dust suppression and habitat restoration projects. The Salton Sea Management Program and Community Needs Report identifies community needs related to the Salton Sea, describes the status of SSMP efforts, and lists potential opportunities for the SSMP to address community needs while implementing restoration projects.

Accompanying the release of the SSMP report is a public draft of the Salton Sea Community Needs and Recommended Actions Report by Better World Group Advisors. This document reflects the broader feedback of community members and Tribes in public comment letters, interviews, and work group sessions as a part of CNRA and Better World Group's public engagement project. This report identifies community needs and recommends actions that can be taken by federal, state, and local government agencies, business organizations, philanthropy, community-based groups, and nonprofit organizations.

Location: Communities around the Salton Sea.

Timing: Surveys and meetings conducted in 2023.

Notes: The final reports were released in September 2024.

2.1.19 Bird Habitat Quantification

Implementing Partner: Audubon CA.

Description: To reassess and quantify current bird habitats at the Salton Sea, the same methods and approaches that were used to assess habitats at the Salton Sea in 1999 and 2015 (Jones et al. 2016) were used and applied to the most current conditions in 2023. Five habitats were assessed and quantified (i.e., playa, mudflats and shallow water, mid-depth water, deep water, permanent vegetated wetlands) using a model that uses bird survey data and environmental variables (e.g., land cover, bathymetry). Preferred habitat acreages of the model were compared with previous assessments for 1999 and 2015. This study will be a part of a comprehensive report that is being developed to tell the story of how birds are responding to dynamic environmental changes at the Salton Sea.

Location: Throughout the Salton Sea.

Timing: Year-round in 2024.

Notes: Completed December 2024. Publish 2025

2.1.20 Vegetation Classification Analysis

Implementing Partner: Audubon CA.

Description: As Colorado River water allocations are reduced and the Salton Sea continues to recede, there is less habitat available for birds. By identifying vegetation on exposed playa that birds are still using as habitat, these areas can be prioritized for management and protection. High-resolution drone imagery, field mapping, and machine learning techniques are used to classify the vegetation types surrounding the Salton Sea, specifically as tamarisk or cattails. Vegetation identified on the desktop will be ground-truthed at various survey locations surrounding the Salton Sea. This vegetation mapping, along with quarterly bird surveys around the Salton Sea, will allow for a better understanding of where birds are using vegetated wetland habitats.

Location: Salton Sea vicinity.

Timing: 2024 field observations. Year-round, 2024-2025 imagery.

Notes: To be completed in April 2025.

2.1.21 Emergent Wetlands Analysis

Implementing Partner: Audubon CA.

Description: Quantifying emerging wetlands and measuring changes in the persistence of vegetation and wetlands on exposed playa is important to understanding how habitat availability is changing. 10-meter resolution multispectral imagery from Sentinel 2 satellite imagery from January 2020 and January 2022 were used to assess vegetation on exposed playa. This analysis will be submitted for publication in 2025 as a part of a comprehensive report on the state of bird habitats and trends at the Salton Sea. The hope is to continue assessing vegetation around the Salton Sea every two years.

Location: Playa surrounding the Salton Sea.

Timing: Imagery from January 2020 and January 2022.

2.1.22 Trends in Bird Populations and Habitats at the Salton Sea

Implementing Partner: Audubon CA.

Description: Assessments of surveys and models of waterbird populations with habitat and food availability were combined to create a more holistic view of how the Salton Sea is changing at an ecosystem-wide scale. Audubon CA's last seven years of surveys, sampling, and analyses at the Sea were summarized by analyzing (1) bird population trends, (2) suitable bird habitats,

(3) emerging wetland habitats, (4) water quality, and (5) macroinvertebrate abundance. Specifically, data from standardized waterbird surveys conducted from 2016–2023 were used to assess population trends of representative waterbird species in order to understand how bird populations are changing. The study identified five key habitats available at the Salton Sea and representative species for each habitat to produce habitat suitability models, identifying preferred habitat for each representative species and then quantified current habitats. These findings were compared to previous habitat assessments from pre and post Quantification Settlement Agreement (Jones et al. 2016). In addition, satellite imagery was used to quantify new emerging habitats created by irrigation and other runoff onto exposed playa. Salinity and dissolved oxygen were also monitored at bird monitoring sites and macroinvertebrates were sampled at a subset of sites for two years to better understand physical conditions and food availability at monitoring sites. Together, these different elements were used to create a better understanding of the status of the Salton Sea's birds and their habitats, as well as how they are changing. These findings will offer insights for habitat management and planning in disappearing and managed inland saline lakes and wetlands.

Quarterly waterbird surveys conducted between 2016-2023 (described in Section 2.1.7, *Shoreline Waterbird Surveys – Quarterly*) were analyzed for this manuscript.

Location: Entire Salton Sea.

Timing: All data compiled, collected and analyzed in January 2025.

Notes: The manuscript will be submitted for publication in 2025.

2.1.23 Measurements of Dust Storms in the Salton Sea Region

Implementing Partners: NSF, NASA, UCSD.

Description: The purpose of this project is to generate long-term measurements of dust storms, their physical and microphysical properties, and the state of the atmosphere. Long-term measurements include sun photometer, upward looking lidar, GPS, and net surface radiation. Periodic measurements include radiosondes, aerosol size distribution, and turbulence. There are several goals of this ongoing project: (1) quantify the long-term characteristics of dust storms in the region, (2) estimate the effect of dust on the energy balance of the atmosphere, and (3) understand the meteorology of dust storms there. These results are, in turn, being used to improve the capacity for modeling dust storms in the area, including how they may change in the future.

Location: Near the western shoreline of the Salton Sea, at field site near the old Naval Test Base.

Timing: Year-round.

Notes: Data are available at https://library.ucsd.edu/dc/collection/bb9839221k.

2.1.24 Salton Sea Environmental Timeseries: Moored Continuous Hydrodynamic and Biochemical Observations

Implementing Partners: UCLA, Alianza, LLU, Brown U (Mara Freilich, Alejandra Lopez).

Description: Continuous water quality and hydrodynamic measurements have been absent in the Salton Sea for approximately 15 years. To address this gap, Alianza's deployment of two continuous hydrogen sulfide monitors over the Salton Sea were leveraged by co-locating a mooring equipped with sensors for dissolved oxygen, temperature, pressure, and nitrate. These instruments measure water quality properties at intervals ranging from 0.5 seconds to 1 hour, enabling high-resolution, continuous observations. The mooring, deployed in May 2024, will remain operational for at least two years to investigate the water quality dynamics driving hydrogen sulfide outgassing, surpassing the spatial and temporal resolution of the USBR's quarterly monitoring. Initial findings indicate that, during the summer, the Sea experiences alternating anoxic and fully mixed conditions approximately every 12 hours. Despite daily mixing, strong stratification limits sustained oxygenation beyond these short cycles. Upcoming data recovery will provide insights into seasonal transitions from summer to winter, particularly regarding stratification and oxygen dynamics.

Location: North Salton Sea and shoreline; co-located with the northern Alianza H_2S monitor.

Timing: Year-round.

Notes: Instruments that are continuously monitoring (SeaBird 56s taking temperature measurements at 2-second intervals across the water column, PME miniDOTs taking oxygen measurements at 1-minute intervals across the water column, RBR Solos taking pressure measurements at 0.5-second intervals to capture waves, and a SeaBird SUNA V2 taking nitrate measurements every hour). A conductivity probe that will take a sample every 15 minutes will be added soon.

2.1.25 Salton Sea Odor Monitoring and Notification System

Implementing Partners: South Coast AQMD, Sonoma Technology.

Description: South Coast AQMD operates three continuous, real-time H_2S monitors along with meteorological stations (and is in the process of establishing a fourth site) to measure and track odors associated with the Salton Sea. South Coast AQMD has developed a data visualization tool and a subscription-based notification system for when levels exceed health thresholds.

Location: Eastern Coachella Valley.

Timing: Ongoing, long-term monitoring.

2.2 Focused Studies

2.2.1 Surface Water and Groundwater Budgets

Implementing Partners: USBR, USGS.

Description: In the Salton Sea watershed, the magnitude and extent of groundwater use and its effect on surface water features, such as springs and marshes, is poorly understood. In recent years, the Salton Sea's water level has lowered, resulting in receding shorelines and increased lake salinity. With changes in groundwater pumping and lake-groundwater interactions, the groundwater levels have also fluctuated. Currently, there is no tool for making informed water management decisions for the Salton Sea basin that includes adequate groundwater-surface water interactions.

Location: Salton Sea HUC6 watershed, with greater detail considered in the northern region near the Torres Martinez Reservation.

Timing: Not specified.

Notes: Intermediate products expected in FY 2026 with study completion date to be determined.

2.2.2 Spatial and Temporal Patterns and Controls on Water-Column Redox and Temperature Structures in the Salton Sea

Implementing Partner: UCR (Caroline Hung, Charlie Diamond, and Timothy Lyons).

Description: Study of oxygen and sulfur geochemistry in the water column and relationships to decreasing water depth in the Salton Sea.

Location: Entire Salton Sea basin, including shallow and deep water.

Timing: Data collection is complete. Analysis and reporting are underway.

2.2.3 Sulfur Cycling in the Salton Sea Water Column and Sediments

Implementing Partner: UCR (Caroline Hung, Charlie Diamond, and Timothy Lyons).

Description: Study of dissolved and solid-phase sulfur species (reduced and oxidized, concentrations and isotopic relationships).

Location: Entire Salton Sea basin, including shallow and deep water.

Timing: Data collection is complete. Analysis and reporting are underway.

2.2.4 Nutrient Sources, Sinks, and Cycles in the Salton Sea

Implementing Partners: UCR (Caroline Hung, Charlie Diamond, and Timothy Lyons) with LLU.

Description: Study of nutrient patterns, cycles, and controls (P and N).

Location: Entire Salton Sea basin, including shallow and deep water.

Timing: Data collection is complete. Analysis and reporting are underway.

2.2.5 Selenium Cycling and Bioaccumulation in Foodwebs in Salton Sea Wetlands

Implementing Partners: USBR, DWR, USFWS, CDFW, USGS.

Description: A phased study is being conducted to further the understanding of what drives Selenium bioavailability in Salton Sea wetlands, characterize risks to species inhabiting these wetlands, and identify management practices that may minimize risks for wetland biota, including migratory birds and special status species. Study phases build on one another, such that findings from one phase will inform next steps and adaptations to actions in the following phase. In Phase I (FY21-22, Objectives 1-2) of the proposed study, resource managers and other partners helped to determine their priority management needs and identify both unmanaged and managed wetland sites fed by a range of water sources (drain, river, groundwater and/or Sea) among which Selenium biotransformation, bioavailability, and bioaccumulation in food webs can be compared. Fifteen (15) study sites were identified to conduct pilot sampling, and a study plan was finalized based on the pilot work in collaboration with local resource managers. Under Phase II (FY22-24, Objectives 3 – 4), studies aimed at understanding Selenium processes in the wetlands identified in Phase I were implemented. Data gathered from Phase II is being used in Phase III (FY25-26, Objectives 5 and 6) to identify sensitive taxa for long-term monitoring, populate predictive bioaccumulation and trophic transfer models to evaluate Selenium risks to wetland biota at each wetland type, and finally to work with managers to create testable management regimes aimed to reduce Selenium risk to wildlife in unmanaged wetlands at the Salton Sea.

Location: The study sites include managed wetlands (Hazard 9a and Unit 3a) and unmanaged emerging wetlands (Lack & Lindsey, McKendry, and Poe Road) around the southern Salton Sea.

Timing: Data collection is complete. Analysis and reporting are underway.

Notes: Information available from USGS here: https://www.usgs.gov/index.php/centers/california-water-science-center/science/selenium-cycling-salton-sea-wetlands#overview

2.2.6 Selenium Concentrations in Yuma Ridgway's Rails and Prey

Implementing Partners: USGS, USFWS, U. Idaho.

Description: Blood and feather samples are being collected from Yuma Ridgway's rails at marshes around the Salton Sea. In addition, rail prey items in those same marshes are also being collected. Blood, feathers, and prey samples will be tested for selenium concentrations. Selenium concentrations can vary between marshes fed by Colorado River water versus agricultural runoff. The study aims to document and compare selenium concentrations in Yuma Ridgway's rails throughout their range.

Location: Marshes around the Salton Sea.

Timing: Capture and sample collection from Yuma Ridgway's rails will occur between March and August 2025.

2.2.7 Trace Metal Patterns and Controls in the Sediments of the Salton Sea

Implementing Partner: UCR (Caroline Hung, Charlie Diamond, and Timothy Lyons).

Description: Study of bulk trace metal enrichments in Salton Sea sediments.

Location: Entire Salton Sea basin, including shallow and deep water.

Timing: Data collection is complete. Analysis and reporting are underway.

2.2.8 Patterns of Pesticide Enrichment in Salton Sea Sediments

Implementing Partners: UCR (Lyons research group), SDSU.

Description: Study of pesticides and breakdown products in sediments.

Location: Entire Salton Sea basin, including shallow and deep water.

Timing: Data collection is complete. Analysis and reporting are underway.

2.2.9 Lithium Measurements in Sediments and Surface Water

Implementing Partner: UCR (Michael McKibben, Maryjo Brounce, Jennifer Humpreys, Jade Simoneau, and Charlie Diamond).

Description: Spot measurements of lithium isotopes and lithium concentration in seafloor sediments, sea open water, and river inputs (Alamo River, New River, and Whitewater River) as well as geothermal wellheads, drilling samples and power plant precipitates and brines.

Location: Salton Sea near river inputs and power plants.

Timing: Lake and river water samples once in 2024. Other samples are ongoing every few months.

Notes: Funding was renewed by Lawrence Berkeley National Laboratory and the Department of the Interior. Some brine and drill cuttings data reported in *Characterization of Li in the Salton Sea Geothermal Field* (Humphreys et al. 2024).

2.2.10 Salton Sea Coastal Zone Soil Survey

Implementing Partners: USDA-NRCS, USBR.

Description: The USDA-NRCS Soil and Plant Science Division is conducting soil survey mapping through the National Cooperative Soil Survey along the perimeter of the Salton Sea on exposed playa formerly covered by water and shallow submerged areas that are projected to be exposed in the future. This work is being completed in collaboration with the Department of the Interior (through USBR and BLM) to assist efforts of restoring wetlands and reduce fugitive dust emissions from the exposed playa surface of the Salton Sea in Imperial and Riverside Counties, California.

Understanding the properties of the exposed Salton Sea playa sediments and submerged areas will be essential for land managers involved in restoring wetlands and controlling fugitive dust emissions on the playa now and in coming years as the new area of playa are exposed. Treatments to control dust will rely on understanding soil properties, such as soil texture, to strategically place soil erosion controls and restore wetlands.

Work will consist of collating existing resources for soils in the project area, describing and sample soils at additional locations, as needed, to supplement and maximize available soils resources, and meeting with key land managers (federal, state, and local), as needed. The USDA-NRCS will publish soils data in the work area using official platforms through the National Cooperative Soil Survey to support implementation of informed land management strategies.

Location: Exposed playa along perimeter of Salton Sea in area previously covered by water and shallow water areas.

Timing: This project started in 2022 and is scheduled to be complete by 2027.

Notes: The USDA-NRCS will use a combination of available soil resources and document soil profile descriptions of soil properties at new sites to complete soil survey mapping through the National Cooperative Soil Survey.

2.2.11 Microbially and Enzyme-Induced Calcite Precipitation for Mitigation of Fugitive Dust

Implementing Partners: USBR, Arizona State University, IID.

Description: Two test plots will be constructed in 2025 for biogeotechnical fugitive dust mitigation technologies: one using Enzyme Induced Carbonate Precipitation (EICP) and a second using Microbially Induced Carbonate Precipitation (MICP). Both technologies create a dust-resistance crust by precipitation of calcium carbonate from an aqueous solution that is sprayed on the ground. Suitable site selection is anticipated in May and test plot deployment in early fall.

Location: IID land near Salton City.

Timing: Plot implementation in fall 2025.

2.2.12 Aerosolized Toxins around the Salton Sea

Implementing Partners: USBR, HARC (Palm Desert), UCR (Emma Aronson, Roya Bahreini, and David Lo).

Description: Seasonal collections of Salton Sea water, sediment below the current sea, playa soil, and dusts, from several sites around Salton Sea are proposed. More detailed microbiome studies on the microbial species, and their functional attributes, found to be characteristic of the Salton Sea water and playa ecology, in contrast to environmental microbiomes in more distant areas of the Coachella and Imperial Valleys will be performed. The study will also seek to catalog and propagate potential biocrust component microorganisms that may affect dust entrainment. Adaptation of microbial species to the chemistry of the Salton Sea water and playa are hypothesized to result in synthesis of cell wall components such as lipopolysaccharides, which are particularly toxic to the lungs of residents. This toxic material may be a major contributor to the observed health impacts in the region, such as the high incidence of asthma. The microbial products found in the biomass collected in aerosol dusts from the playa will be studied by identifying microbial species that contribute the most material, in particular the most lung-toxic components, as well as the biochemical mechanisms that lead to the entrainment of these toxic components in the playa dust.

Location: Imperial Valley. Field samples from various Salton Sea locations.

Timing: Year-round sampling between January 2023 through February 2026.

Notes: Results are being correlated with community epidemiology study performed in previous project period to assess prevalence of asthma like symptoms across the Salton Sea region.

2.2.13 Public Health Impacts from Salton Sea Playa Dust

Implementing Partners: UCR (David Lo, Emma Aronson, Roya Bahreini [BREATHE Center], David Cocker [CE-CERT]).

Description: The high incidence of childhood asthma in the Salton Sea region is associated with proximity and exposure to aerosol dusts generated at the exposed playa. These studies are aimed at identifying the biological and clinical effects of the playa dusts, including identification of the most toxic or inflammatory dust components, the related pathological mechanisms, and their clinical symptom correlates. In addition, the studies aim to understand the source of the toxic material in the dust and how it is entrained in the playa dust, and how playa features may favor the production of the toxic dust.

Location: Coachella and Imperial Valleys.

Timing: Studies are ongoing, and are expected to continue through Spring 2026 or later.

Notes: Funding provided by National Institute on Minority Health and Health Disparities/NIH (U54 MD013368), California Air Resources Board (ARB 21RD014 LO 8/22), USBR (R23AP00088) to DL. Clinical symptoms studies include preliminary epidemiology studies in the Coachella and Imperial Valley communities.

2.2.14 Low-Cost Ambient Air Quality Network Development

Implementing Partner: UCR (William Porter).

Description: Ongoing deployment of Quant-AQ MODULAIR-PM units to gather publicly available size-resolved particulate matter measurements and to supplement existing regulatory agency sites and low-cost sensor networks (such as IVAN [Identifying Violations Affecting Neighborhoods], a community-based environmental monitoring system).

Location: Coachella and Imperial Valleys.

Timing: No further measurements are planned for 2025. Data analysis and writing are underway.

2.2.15 Indoor Air Quality and Filtration Study

Implementing Partner: UCR (William Porter, Ashley Trinidad, Ann Cheney, and Sonia Rodriguez).

Description: One year of indoor particulate matter measurements using low-costs sensors, as well as deployment of “do it yourself” air filtration units to assess effectiveness at reducing indoor particulates.

Location: Coachella and Imperial Valleys.

Timing: Began in summer 2023 and continued through summer 2024. No further measurements are planned for 2025. Data analysis and writing are underway.

2.2.16 Salton Sea Air Quality Assessment

Implementing Partner: The Pacific Institute

Description: The objectives of the Institute's new Salton Sea air quality assessment are to identify and analyze relevant research on dust emissions, air quality, and related public health outcomes in the Salton Sea region and identify significant data and research gaps, resulting in a synthesis report; identify best management practices and innovative solutions to address these air quality challenges; and communicate the current state of the science and knowledge gaps in these areas to policymakers, SSMP, and stakeholders.

Location: Data will be compiled from recent studies and reports from areas immediately adjacent to the Sea and surrounding areas.

Timing: No new data collection is scheduled.

Notes: Report to be released in 2025 Quarter 2.

2.2.17 Yuma Ridgway's Rail Movements and Migration Behavior

Implementing Partners: U. Idaho, USGS.

Description: Researchers capture and attach satellite GPS transmitters to Yuma Ridgway's rails in marshes around the Salton Sea and along the Lower Colorado River (Arizona) using carpet traps and audio calls. The data from the transmitters will reveal spatial and temporal patterns in the dispersal and long-distance migration behaviors of the Yuma Ridgway's rails. This data will inform management of existing habitat and assist in identifying areas for new marsh creation/ restoration projects.

Location: Imperial Valley: Marshes around the Salton Sea and in Arizona along the Lower Colorado River.

Timing: Researchers will deploy satellite GPS transmitters between March and July 2025. The transmitters will report location data throughout 2025.

2.2.18 Microbial Ecology: Patterns of Lateral and Vertical Variability and Controls

Implementing Partner: UCR (Lyons research group with Emma Aronson and group).

Description: Microbial population study in Salton Sea water column.

Location: Entire basin, shallow and deep water.

Timing: Data collection is complete. Analysis and reporting are underway.

2.2.19 Biofilm as a Food Resource for Shorebirds at the Salton Sea

Implementing Partner: Audubon CA.

Description: The Salton Sea, the largest lake in California, is an essential habitat for birds that rely on wetlands and open water to breed and migrate long distances along the Pacific Flyway in a state where over 90% of historic wetland has been lost. As water levels decline and salinity rises in the Sea due to a reduction of water inflow, the resulting die-off of prey species has driven precipitous declines in fish-eating birds and has altered the bird communities that visit and breed at the Sea. Despite this, the Salton Sea remains a valuable resource for hundreds of thousands of shorebirds (Charadriiformes) that forage along the Sea's shoreline. The recent discovery of biofilm as a major component of the diets of migrating small-bodied shorebirds (e.g., *Calidris* sp.) on coastal mudflats elucidates these birds' complex ecological role as both primary and secondary consumers and emphasizes the need to conserve all foraging resources, including biofilm. This study investigated whether biofilm occurs at the Salton Sea, and if so, whether it was likely that shorebirds were feeding on it. Results showed a higher abundance of diatoms, a group of nutritious algal organisms that partially comprise biofilm, at the observed feeding locations of sandpipers during spring migration compared to summer feeding sites. The formation of biofilm at intertidal mudflats, where it has been more extensively studied, is driven by spring and fall mixing of salt and fresh water; this pattern appears at the Salton Sea as well, where freshwater inflows occur in spring and fall and dry up in summer. While further studies are needed to confirm the presence of biofilm in shorebird diets, this initial study suggests that it is important that freshwater inflow to the Salton Sea remain reliable during migration periods to ensure the availability of biofilm as an essential energy source for small-bodied shorebirds.

Location: Salton Sea shoreline and coastal mudflats.

Timing: 2023-2024: Spring (late April), summer (late July), and fall (early October).

Notes: This is a preliminary study that will not be published. The hope is to get funding to take the next step to capture birds and/or sample bird feces, which will determine if these sandpipers are in fact feeding.

2.2.20 Eastern Coachella Valley Fumigation/Pesticides Study

Implementing Partners: South Coast AQMD, CARB, OEHHA, DPR, AB 617 Community Steering Committee.

Description: The goals of the Eastern Coachella Valley Ambient Air Pesticide and fumigant Monitoring Investigation included gathering information and conducting air monitoring for pesticides, as well as pursuing pesticides emissions and exposure reductions. Actions identified to meet these goals included:

- Identify pesticides used in ECV (e.g., frequency, amount, and ingredients)
- Share information on statewide efforts for a pesticide notification system

- Provide consultation on field activities
- Support data analysis and interpretation
- Develop a screening approach for agricultural pesticides commonly used in ECV
- Support prioritization of pesticides for potential air monitoring based on screening criteria and other relevant information
- Support protocol development for pesticide sampling and analysis
- Coordinate sampling and analysis of pesticides
- Participate in field activities
- Analyze pesticide samples
- Evaluate potential community health risks/impacts based on air monitoring results and other relevant information
- Assist the ECV CSC in determining pesticide exposures and risks
- Identify opportunities to develop or amend pesticide regulations. (DPR works through an established pesticide Toxic Air Contaminant (TAC) process with its partner agencies (i.e., OEHHA, CARB, Air Districts, and CACs) to develop TAC-related regulations
- Support the ECV CSC's exploration of a pesticide notification system
- In collaboration with U.S. EPA, hold a Pesticides Workshop with the ECV Community and provide outreach materials, and information that include pesticide use enforcement, worker protection (including PPE and exposure reduction), and pesticide incident reporting
- In consultation with South Coast AQMD, CARB and the CSC, develop community emission reduction plan (CERP) strategies for pesticides, if warranted
- Identify funding for exposure reduction projects (e.g., air filtration systems and weatherization projects)

Location: Eastern Coachella Valley.

Timing: November 2022 – February 2023.

Notes: Final report available online at https://www.aqmd.gov/docs/default-source/ab-617-ab-134/camps/ecv/ecv-pesticide-monitoring-final-report.pdf?sfvrsn=6

2.2.21 Dust Characterization Study

Implementing Partners: South Coast AQMD, CARB, UCR, AB 617 Community Steering Committee.

Description: The primary objective of the dust characterization study in the Eastern Coachella Valley community is to identify the main sources of dust and quantify their contributions to ambient PM levels. Methodology includes time-integrated sample collection (PM_{10} and TSP), subsequent chemical analysis, and continuous measurements of PM_{10} mass and its chemical constituents.

Location: Eastern Coachella Valley.

Timing: January 2022 – January 2026.

2.2.22 Multiple Air Toxics Exposure Study (MATES) VI

Implementing Partners: South Coast AQMD, Emissions Analytics, UCI, USC.

Description: MATES VI will include a fixed site monitoring program, an updated emissions inventory of toxic air contaminants, and a modeling effort to characterize risk across the South Coast Air Quality Management District. The study focuses on the cancer risk and chronic non-cancer risk from exposure to air toxics but does not estimate mortality or other health effects from air pollutant exposures. Study methodology includes time-integrated sample collection ($PM_{2.5}$, PM_{10}, TSP, and gaseous) and subsequent chemical analysis with a focus on air toxics.

Location: South Coast AQMD Jurisdiction, including Eastern Coachella Valley.

Timing: Samples collected February 2025 – May 2026.

2.2.23 Human Health Risks from Metals in Exposed Playa Sediments

Implementing Partners: USD, LLU.

Description: This study examines exposed playa sediments for total and bioavailable metal concentrations as a proxy for possible dust exposures and human health risks.

Location: Playa sites throughout Salton Sea.

Timing: Once per year.

Notes: Data collection complete, analysis/reporting underway.

2.2.24 NASA Earth Observations for a Resilient Salton Sea

Implementing Partners: Brown U (Mara Freilich, Alejandra Lopez), Alianza, UCLA, LLU.

Description: The Salton Sea is the largest inland body of water in California, and it has a defining role in the landscape for both the surrounding communities and ecosystems. The surrounding communities in the Eastern Coachella Valley are environmental justice communities; the predominantly low income and Latinx communities are also at elevated risk for respiratory illnesses, caused at least in part by exposure to air flowing over the Salton Sea. One of the major concerns of residents is the frequent smell of hydrogen sulfide that occurs due to the anoxic conditions and high sulfate levels in the Salton Sea. This odor not only decreases quality of life but also causes nausea and headaches and may have other effects such as decreased property values. The smells suggest that water quality influences air quality in the Salton Sea region. Beyond gases such as hydrogen sulfide, recent evidence in other locations also suggests that sea

spray can travel significant distances from bodies of water, with important impacts for public health, particularly around impaired water bodies due to chemical loading, bacteria, or toxic algae blooms. Understanding the impact of the Sea on air quality is therefore a high priority so that these environmental justice communities can have agency in planning for the future of the Salton Sea.

This study will utilize satellite observations and wind observations to predict the influence of air pollution from the Salton Sea on Eastern Coachella Valley communities. The proposed work will address air pollution impacts on human health and upstream influences on coastal communities. The major goal of the prediction will be hindcasting hydrogen sulfide impacts on local communities. The study will validate the model using data collected by a community science program which engages Eastern Coachella Valley residents in air and water quality monitoring and communication of scientific findings (see 2.1.4 Salton Sea Environmental Timeseries – Water Quality and Air Quality). This will be supplemented with other in-situ observations. Using this hindcast, a study of the socio-economic demographics and geography of detectable hydrogen sulfide odor exposure will be conducted using archival research, interviews, and surveys. The combination of scientific and socioeconomic analyses will be made available as a toolkit for community members and on our accessible data dashboard to increase understanding of the role of the Salton Sea on both public health and quality of life. This project will be a collaboration between a multidisciplinary team of academics and Alianza, an environmental justice organization. Alianza convenes the Resilient Salton Sea campaign guided by the philosophy that addressing the environmental issues in the Salton Sea is about more than just an impaired body of water. It is also about shifting socio-economic conditions to benefit the most vulnerable communities in ways in which both people and the environment can prosper.

Measurements will be made with an AQS-1 air quality sensor with sensors for H_2S, NO_2, and VOCs. In addition, a handheld Jerome meter is used to map the spatial distribution of H_2S.

Location: Air sensors are located above the Salton Sea with one in the northern Salton Sea (Riverside County, 33.48N, 116.0472W) and one on the NASA platform in the southern Salton Sea (Imperial County, 33.22532 N, 115.82425 W).

Timing: Initiated in 2023 and continuous until November 2027.

2.2.25 Water Quality at Emergent Wetlands

Implementing Partners: Audubon CA, LLU.

Description: The Salton Sea faces numerous challenges, including rising salinity, nutrient pollution, increasing playa exposure from reduction in water inputs, and harmful algal blooms. As the Sea continues to shrink, wetlands emerge at irrigation drains, natural springs and desert washes that may play a crucial role in contaminant reduction to the Sea water. In this study, nutrient and contaminant concentrations are monitored across two different emergent wetlands to assess their effectiveness for contaminant reduction, providing insights into the utility and potential for wetland's role in the Salton Sea's immediate future. One wetland has an agricultural waste flow and is in the north and the other wetland is the Bombay Beach wetland

with a natural spring source located. Both are emergent wetlands but have different source water characteristics.

Samples are taken in three locations: one sample is taken in the source water before it enters the wetland, one is taken after it flows through the wetland, and one sample is taken in the sea water. Parameters measured include NO_3 (nitrate), NO_2, NH_4 (ammonium), PO_4 (phosphate), sulfide, turbidity, oxidation-reduction potential, pH, TSS, conductivity, salinity, dissolved oxygen, phycoerythrin, Total Chlorophyl, *Enterococcus*, *E. coli* and *Coliform* indicator bacteria in four trips at two wetlands.

Location: Agricultural wetlands with Colorado River input in the northern Salton Sea shoreline and Bombay Beach Wetland.

Timing: Winter 2024/Spring 2025.

Notes: All data will be provided on the open Salton Sea science dashboard as well as in a raw data form with geolocated sample positions.

2.2.26 Salton Sea Aquatic Invertebrate Monitoring

Implementing Partners: CDFW, Colorado River Basin RWQCB.

Description: South: CDFW will be collecting aquatic invertebrate samples from the Salton Sea in conjunction with a water quality monitoring initiative. Sampling will occur quarterly, in line with the schedule for water quality assessments. The study aims to identify the species composition, enumerate taxonomic groups and species, and assess the abundance of biomass in the water column and at two sampling points in the benthic zone. Species identifications will be conducted down to the family level. A trawl net off the side of an airboat and an Ekman Dredge will be utilized for benthic sampling.

Location: South Salton Sea and shoreline (including Alamo and New Rivers): 3 water quality monitoring locations; North Salton Sea and shoreline (including Whitewater River): 1-2 water quality monitoring locations.

Timing: Quarterly Sampling: Spring, Summer, Fall and Winter

2.2.27 Project-Specific Salinity Measurement Methods

Implementing Partners: USD, Alianza, LLU, UCLA, Brown U (Mara Freilich).

Description: This study compares 4–5 different lab and field methods that measure salinity in water samples. Our concern is that as the Salton Sea becomes more saline, traditional water quality probes may not remain reliable measures of salinity. The accuracy of different field and lab methods for salinity measurement will be assessed, with the goal of identifying cost-effective and user-friendly methods for anyone wishing to measure salinity accurately at the Salton Sea. Sampling includes shoreline and boat surface water sampling, with some water samples collected at depth.

Location: Bombay Beach, Desert Shores, and boat transects performed by Salton Sea Environmental TimeSeries group, including occasional samples from the middle of the Sea at the BOR site.

Timing: Approximately five times per year (two in spring, three in fall).

2.2.28 DNA Sequencing Study

Implementing Partner: CDFW.

Description: CDFW staff will collect surface water samples from the Salton Sea and from constructed shallow saline habitat at SCH. Samples will be analyzed with DNA-sequencing techniques to determine the types of species present down to genus and estimate their relative abundance.

Location: Three sites at the Salton Sea and two at SCH.

Timing: Quarterly at the Salton Sea and monthly at SCH.

2.2.29 Phytoplankton Pigment Study

Implementing Partner: CDFW.

Description: Samples from the Salton Sea will be analyzed for chlorophyll a and phycocyanin concentrations to verify estimates calculated from publicly available satellite data sponsored by the State Water Resources Control Board. The mapping tool displays satellite imagery that is used to estimate harmful algal blooms and associated parameters in many of the largest waterbodies in the state, including the Salton Sea. The grab samples of chlorophyll a and phycocyanin will be used to ground-truth those estimates.

Location: Three sites around the Salton Sea.

Timing: Quarterly at the Salton Sea with more frequent samples collected from June to August.

2.3 Effectiveness Monitoring

2.3.1 SSMP Species Conservation Habitat Project – Water Quality

Implementing Partners: DWR, CDFW, and Colorado River Basin RWQCB.

Description: The Species Conservation Habitat Project (SCH Project) is constructing saline habitat ponds at the mouth of the New River. In 2024, some portions of the ponds will be commissioned (i.e., will receive water and be partially wetted). Monitoring will measure inflows using Supervisory Control and Data Acquisition, a computer-based system for gathering and analyzing real-time data to monitor and control equipment that deals with time-sensitive operations. Measurements will be taken at the saline pump station, water intake structure, and

sedimentation basins. Continuous monitoring will use EXO3 Sonde units to measure salinity (measured as TDS), water temperature, dissolved oxygen, and water depth.

In addition, water samples will be collected from the west interception ditch along the SCH ponds. The samples will be tested for TDS, TSS, nutrients, contaminants (pesticides, herbicides, and metals such as arsenic and boron), selenium, and pathogens (bacteria, enterococcus).

Location: SCH Project (west interception ditch and wetted areas of Center and East Ponds), which flanks the mouth of the New River in the southern Salton Sea.

Timing: The west interception ditch will be monitored quarterly. Pond water supply operations will be measured continuously with sondes when the ponds are commissioned and partially wetted (date to be determined).

2.3.2 SSMP Dust Suppression Project Monitoring

Implementing Partner: DWR.

Description: DWR has implemented three vegetation enhancement projects on Reclamation lands (Clubhouse, 399 acres; Tule Wash, 1,217 acres; and West Bombay Beach, 91 acres). Vegetation was seeded/planted and irrigated within rows of grass bales. Dust suppression through temporary engineered roughness is being placed on other areas. Meteorological and air quality monitoring is underway to assess the performance of hay bales in reducing wind speed and dust emissions from the playa. Fixed stations with monitoring equipment measure particulate matters (PM_{10}, $PM_{2.5}$), wind speed, wind direction, air temperature, precipitation, relative humidity, precipitation saltation, relative humidity temperature, barometric pressure, and saltation flux.

Location: Monitoring is conducted at the Clubhouse, Tule Wash, and West Bombay Beach sites. At the revegetation sites, fixed stations are placed in transects to monitor air quality in upwind, intermediate, and downwind locations along the south-southwest (249 degrees) axis, which is the predominant direction of wind events that lead to emission of PM_{10}. At the Clubhouse site, three transects were constructed in which one transect with three stations were for Clubhouse A, and two transects with a total of six stations were for Clubhouse C. At the Tule Wash site, two transects were constructed, one for the area with bales and one for the area without bales so that the difference in air quality can be compared. The one in the bale area has three stations and the one in the without-bale area has two stations. At the West Bombay Beach site, one transect was constructed with three stations.

Timing: High-frequency measurements, every 1 minute data collection for PM_{10}, $PM_{2.5}$, and the saltation flux, and every 10 minutes for the remaining parameters. Monitoring is conducted year-round.

2.3.3 IID Salton Sea Air Quality Mitigation Program

Implementing Partner: IID.

Description: The IID Salton Sea Air Quality Mitigation Program was developed in 2016 in cooperation with ICAPCD. This program monitors dust emissions (PM_{10}) and effectiveness of dust suppression activities.

Location: Dust suppression project areas along the shoreline and playa.

Timing: Real-time continuous.

Notes: Information sourced from IID website: https://saltonseaprogram.com/aqm/

2.3.4 SSMP Species Conservation Habitat Project – Aquatic Invertebrate Monitoring

Implementing Partner: CDFW.

Description: CDFW will collect aquatic invertebrate samples from flooded areas of the SCH and Species Conversation Habitat Extension (SCHX) four times a year using dip and trawl nets. Baseline data will be gathered on species composition in both the water column and the benthic zone, identified down to the family level. Additionally, the species composition will be assessed to determine the available forage for tilapia.

Location: South Salton Sea and Shoreline: SCH and SCHX.

Timing: Quarterly Sampling: Spring, summer, fall, and winter.

2.3.5 SSMP Species Conservation Habitat Project – Fish Monitoring at SCH West Sedimentation Basin

Implementing Partner: CDFW.

Description: Monitor fish population that may be introduced in the SCH West Sedimentation Basin in 2025. Gear and methods to be determined.

Location: South Salton Sea and Shoreline: SCH West Sedimentation Basin.

Timing: Quarterly Sampling in 2025.

Notes: SCH West Sedimentation Basin may be used as an experimental site for fish establishment prior to SCH ponds being inundated.

2.3.6 SSMP Species Conservation Habitat Project – Predator Prevention Scent Barrier

Implementing Partners: CDFW, DWR, MWH Contractors Inc.

Description: Birds started nesting along a 1-mile causeway built for the SCH Project at the Salton Sea in 2022 and 2023. During the 2023 nesting season, biologists observed and documented evidence of coyotes preying on nesting birds and nests. Following discussions among various agencies, it was decided that the SSMP would try to take measures to mitigate coyotes from preying on nesting birds and nests on the causeway. It was decided that a predator scent barrier might work in the area. A small research plan was developed to evaluate the effectiveness of a potential scent barrier to deter coyotes.

Lathe stakes (with wolf and mountain lion urine placed on felt pads or vials) would be placed on both sides of the causeway at the selected location, at 12-foot intervals from the waterline to the top of the causeway road. Five cameras were set up along the barrier: two facing east, two facing west, and one facing south. The plan was to reapply the urine every two weeks.

Location: SCH and SCHX on the causeway, which is 1 mile peninsula out into the Salton Sea on SCH.

Timing: Summer 2024 during the bird nesting season.

Notes: This project was completed in 2024 and published but was not included in the 2024 work plan.

2.3.7 SSMP Project Tracker

Implementing Partner: SSMP.

Description: The SSMP team has developed an online Project Tracker to provide a comprehensive public platform with updated information on Salton Sea Management Program projects. The Project Tracker shows progress under the Salton Sea Management Program Phase 1: 10-Year Plan in a single location.

Integrated into the SSMP website at www.saltonsea.ca.gov, this tool tracks current progress on SSMP 10-Year Plan projects. Projects are viewable and sortable by project phases, activity type, and category. The Explore Projects and Project Info sections display information on the activities, outcomes, and different SSMP metrics important to the Salton Sea Region. The Results Section has a Progress Dashboard that provides a snapshot of the accomplishments and advancements being made to improve conditions at the Salton Sea and displays information on the current progress toward meeting the requirements in State Water Resources Control Board Order 2017-0134.

Location: Online at www.saltonsea.ca.gov.

Timing: Acreage totals are updated twice a year.

Notes: Debuted in March 2024.

2.3.8 SSMP Dust Suppression - Vegetation Monitoring

Implementing Partner: DWR

Description: DWR has planted vegetation to increase surface roughness and reduce dust emissions at several locations on the playa. Vegetation monitoring includes the use of belt transects, volunteer plant quadrats, and photographic monitoring. Belt transects are intended to understand shrub density, species composition trends, height distribution, and plant mortality in irrigated and non-irrigated settings within vegetation enhancement areas. Randomized belt transects are centered over linear irrigation features and non-irrigated features and are used to record shrub stem density by species and height classes for living and dead individuals.

Volunteer plants not within range of irrigation features are sampled using randomized quadrats and shrub plant stems as the counting unit. All shrub species, live or dead status, and height classes are recorded within each quadrat. Three volunteer location classes are used to understand plant colonization patterns: individuals near grass bales, individuals near surface manipulation features, and non-adjacent individuals.

Photographic monitoring includes repeat photography at specified stations to document landscape change and photography of transects and volunteer sampling quadrats.

Location: Vegetation monitoring is conducted at SSMP vegetation enhancement locations including the Clubhouse, Tule Wash, and West Bombay Beach sites. Vegetation enhancement locations include those sites where seeding and planting and planting has occurred, which includes irrigated and non-irrigated features.

Timing: Four vegetation monitoring events occur annually during the months of March, June, September, and December.

2.3.9 Bombay Beach Wetland Restoration Project

Implementing Partners: Audubon CA, CNRA.

Description: A 564-acre wetland restoration project co-led between Audubon CA and the CNRA to stabilize and enhance a vital wetland where groundwater discharges and several washes converge. This area already supports species like the Yuma Ridgway's rail, American avocet, and northern pintail, despite invasive tamarisk plants dominating higher-quality habitat upslope. The project's goals include enhancing saline wetlands and playa habitats, mitigating dust pollution from exposed playa, and providing recreational opportunities for the public.

Location: Bombay Beach Wetland.

Timing: Expected to be completed by February 2026.

Notes: Construction is expected to begin at the end of 2025 and is currently in the design phase. In anticipation of construction, pre-construction surveys may be conducted during 2025.

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CHAPTER 3
Discussion

3.1 Data Needs and Opportunities

Many of the priority indicators identified in the MIP are being monitored and/or are the subject of a focused study, as summarized in **Table 3-1**. There remain, however, several primary indicators that were recommended in the MIP but are not reflected in the 2025 Work Plan, because a study either has not been planned, is unknown, or was not reported. These uncertainties or gaps may also reflect limitations of outreach to potential implementing partners and voluntary reporting. Primary priority indicators not known to be monitored or studied in 2025 include the following:

- Aerial surveys to capture land cover, habitat types, and playa extent. This may present an opportunity to explore use of remote sensing technologies, such as drones.
- Groundwater well surveys to measure elevation, conductivity, temperature, dissolved oxygen, pH, depth, nutrients, TDS, TSS, and contaminants.
- Harmful algal blooms in surface water.
- Aerial surveys for piscivorous birds and colonial breeding birds are not planned for 2025; however, aerial surveys for waterfowl are being conducted by USFWS.
- Southwestern willow flycatcher survey.

Opportunities exist to standardize sampling and data collection methodologies and reporting across implementing partners.

3.2 Future Annual Work Plans and Reporting

The MIP Annual Work Plan demonstrates the breadth of monitoring and research at the Salton Sea and can be a foundation for further collaboration and coordination. Future Work Plans may include additional information, as available, including standard operating procedures and more detail regarding logistics and coordinated survey efforts. Implementing partners are encouraged to participate in an annual coordination meeting in October to develop future Work Plans.

Annual reporting is dependent on available funding. If funding is available, the annual report will summarize the data collected by the SSMP agencies (CDFW and DWR) and by implementing partners, where known. Annual reports would also include a summary of data collected during each year and cumulatively as well as recommendations for adjustment and improvement of survey locations and sampling protocol. To facilitate this process, implementing partners are encouraged to submit a summary of activities that were conducted in 2025, challenges and lessons learned from 2025 efforts, annual reports (if available), data needs and opportunities for 2026, and confirmation of anticipated monitoring activities in 2026.

TABLE 3-1
2025 MONITORING AND STUDIES COMPARED WITH MIP PRIORITIES

Resource	Indicators	Priority	Status Monitoring[1, 2]	Focused Studies[1, 2]	Effectiveness Monitoring[1, 2]
Hydrology	Surface water (inflow, surface elevation)	1	• Surface water monitoring (USGS) (2.1.1) • CVWD agricultural drain monitoring (CVWD) (2.1.3)		• SSMP Species Conservation Habitat Project (DWR) (2.3.1)
	Groundwater	1		• Surface and groundwater budgets (USBR, USGS) (2.2.1)	
Water Quality	Basic water quality (temperature, TDS)	1	• Salton Sea water quality monitoring (CDFW, Colorado River Basin RWQCB) (2.1.2) • CVWD agricultural drain monitoring (CVWD) (2.1.3) • Salton Sea Environmental Timeseries (Alianza, LLU) (2.1.4)	• Water column redox and temperature (UCR) (2.2.2) • Water column sulfur cycling (UCR) (2.2.3) • Water quality at emergent wetlands (Audubon CA) (2.2.25) • Salinity measurements (2.2.27)	• SSMP Species Conservation Habitat Project (DWR, CDFW, Colorado River Basin RWQCB) (2.3.1)
	Nutrients	1	• Salton Sea Environmental Timeseries (Alianza, LLU) (2.1.4)	• Nutrients in Salton Sea (UCR) (2.2.4)	• SSMP Species Conservation Habitat Project (DWR, CDFW, Colorado River Basin RWQCB) (2.3.1)
	Selenium (water, sediments)	1			• SSMP Species Conservation Habitat Project (DWR, CDFW, Colorado River Basin RWQCB) (2.3.1)
	Selenium (biota)	1-3		• Selenium in wetland foodwebs (USGS) (2.2.5) • Selenium in Yuma Ridgway's rails and prey (U. Idaho, USGS, USFWS) (2.2.6)	
	Pesticides, metals	2		• Trace metals in sediments (UCR) (2.2.7) • Pesticides in sediments (UCR, SDSU) (2.2.8) • Lithium in water and sediments (UCR) (2.2.9)	• SSMP Species Conservation Habitat Project (DWR, CDFW, Colorado River Basin RWQCB) (2.3.1)

Resource	Indicators	Priority	Status Monitoring[1, 2]	Focused Studies[1, 2]	Effectiveness Monitoring[1, 2]
	Harmful algal blooms	1		• Phytoplankton Pigment study (CDFW) (2.2.29)	
	Pathogens				• SSMP Species Conservation Habitat Project (DWR, CDFW, Colorado River Basin RWQCB) (2.3.1)
Geography	Land cover, playa area	1	• Vegetation classification analysis (Audubon CA) (2.1.20) • Emergent wetlands analysis (Audubon CA) (2.1.21)	• Salton Sea coastal zone soil survey (USDA-NRCS, USBR) (2.2.10)	• SSMP dust suppression projects – vegetation (DWR) (2.3.8)
Air Quality	Meteorology	1	• Meteorology and air quality monitoring (South Coast AQMD, ICAPCD, IID, Torres Martinez, Twenty-Nine Palms/Cabazon) (2.1.5) • Measurements of dust storms (UCSD, NASA) (2.1.23)		
	Particulate matter (PM_{10} and $PM_{2.5}$)	1	• Salton Sea Environmental Timeseries (Alianza) (2.1.4) • Meteorology and air quality monitoring (South Coast AQMD, ICAPCD, IID, Torres Martinez, Twenty-Nine Palms/Cabazon) (2.1.5) • Meteorological and dust measurements (UCSD, NASA) (2.1.23)	• Microbially and enzyme-induced calcite precipitation (soil crust) (ASU, IID, USBR) (2.2.11)	• SSMP dust suppression projects (DWR) (2.3.2) • Salton Sea Air Quality Mitigation Program (IID) (2.3.3.) • Testing calcite precipitation for fugitive dust (USDA-NRCS) (2.2.11)
	Hydrogen sulfide	1	• Meteorology and air quality monitoring (South Coast AQMD, Torres Martinez) (2.1.5) • Salton Sea odor monitoring (South Coast AQMD) (2.1.25)	• NASA Earth Observations (Brown U., Alianza, UCLA, LLU) (2.1.24)	
	Particulate matter chemistry	3		• Aerosolized toxins (UCR) (2.2.12) • Eastern Coachella Valley fumigation/ pesticides (South Coast AQMD, CARB, OEHHA, DPR) (2.2.20)	

Resource	Indicators	Priority	Status Monitoring[1, 2]	Focused Studies[1, 2]	Effectiveness Monitoring[1, 2]
				• Dust characterization (South Coast AQMD, CARB, UCR) (2.2.21) • Human health risks from metals in exposed playa sediments (USD, LLU) (2.2.23)	
	General air quality	3		• Low-cost ambient air quality network (UCR) (2.2.14) • Indoor air quality and filtration (UCR) (2.2.15) • Salton Sea air quality assessment (Pacific Institute) (2.2.16) • Multiple air toxics exposure (South Coast AQMD, Emissions Analytics, UCI, USC) (2.2.22)	
Biological – Birds	Shoreline waterbirds	1	• Shoreline waterbirds−tri-annual (PBCS, Audubon CA, OBO, CDFW, USFWS) (2.1.6) • Shoreline waterbirds−monthly (Audubon CA) (2.1.7) • Shoreline waterbirds−weekly north shore (OBO) (2.1.8) • Bird habitat quantification (Audubon CA) (2.1.19) • Vegetation classification (Audubon CA) (2.1.20) • Emergent wetlands analysis (Audubon CA) (2.1.21) • Trends in bird populations and habitats (Audubon CA) (2.1.22)	• Biofilm as food resource for shorebirds (Audubon CA) (2.2.19)	

Resource	Indicators	Priority	Status Monitoring[1, 2]	Focused Studies[1, 2]	Effectiveness Monitoring[1, 2]
	Marsh birds (Yuma Ridgway's rail, black rail)	1	• Marshbird callback survey – restoration sites (CDFW) (2.1.9) • Marshbird callback survey – SBSSNWR (USFWS) (2.1.10)		
	Yuma Ridgway's rail	1		• Yuma Ridgway's rail movements and migration (USGS, U. Idaho) (2.2.17) • Selenium in rails and prey (USGS, USFWS, U. Idaho) (2.2.6)	
	Piscivorous bird (aerial survey)	1	• Wintering waterfowl aerial survey (not piscivorous birds) (CDFW, USFWS) (2.1.11)		
	Colonial birds (breeding, roosting) (aerial survey)	1-2	• Nesting seabird aerial survey (not colonial) (USFWS) (2.1.12) • Sandhill crane winter roost survey (USFWS) (2.1.13)		• SCH Predator prevention scent barrier (CDFW, DWR, MWH) (2.3.6)
	Southwestern willow flycatcher	1			
	Western snowy plover	2			
Biological – Aquatic	Fish	1	• General fish survey (CDFW) (2.1.14)		• SCH fish monitoring (CDFW) (2.3.5)
	Desert pupfish	1	• Desert pupfish surveys (CDFW) (2.1.15)		
	Phytoplankton, zooplankton, benthic macroinvertebrates	2		• Aquatic invertebrate monitoring (CDFW, Colorado River Basin RWQCB) (2.2.26) • DNA sequencing study (CDFW) (2.2.28) • Phytoplankton Pigment study (CDFW) (2.2.29)	• SCH aquatic invertebrate monitoring (CDFW) (2.3.4)
	Harmful algal blooms	1		Phytoplankton Pigment study (CDFW) (2.2.29)	
	Microbial loop, pathogens	3		• Microbial ecology (UCR) (2.2.18)	

Resource	Indicators	Priority	Status Monitoring[1, 2]	Focused Studies[1, 2]	Effectiveness Monitoring[1, 2]
Socio-economic	SSMP event public participation	1	• Community Engagement Committee (SSMP) (2.1.16, 2.1.17)		
	Community benefits	1	• Community needs (SSMP) (2.1.18)	• NASA Earth Observations (Brown U, Alianza, UCLA, LLU) (2.1.25)	
	Economic indicators	2			

NOTES:

Numbers correspond to sections describing each monitoring element in Chapter 2.

Abbreviations: Twenty-Nine Palms/Cabazon = Twenty-Nine Palms Band and Cabazon Band of Mission Indians; Alianza = Alianza Coachella Valley; ASU = Arizona State University; Audubon CA = Audubon California; CARB = California Air Resources Board; CDFW= California Department of Fish and Wildlife; Colorado River Basin RWQCB = Colorado River Basin Region Water Quality Control Board; CVWD = Coachella Valley Water District; DOI = Department of the Interior; DPR = California Department of Pesticide Regulation; DWR = Department of Water Resources; ICAPCD = Imperial County Air Pollution Control District; IID = Imperial Irrigation District; LLU = Loma Linda University; NASA = National Aeronautics and Space Administration; OBO = Oasis Bird Observatory; PBCS = Point Blue Conservation Science; SBSSNWR = Sonny Bono Salton Sea National Wildlife Refuge; South Coast AQMD = South Coast Air Quality Management District; SDSU = San Diego State University; SSMP = Salton Sea Management Program; TDS = total dissolved solids; UCR = University of California Riverside; U. Idaho = University of Idaho; USBR = U.S. Bureau of Reclamation; USDA-NRCS = U.S. Department of Agriculture Natural Resources Conservation Service; USGS= U.S. Geological Survey; USFWS = U.S. Fish and Wildlife Service.

CHAPTER 4
References

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