United States Department of the Interior

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May 23, 2023

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Subject: **USGS proposed program for FY23–24**.

The United States Geological Survey (USGS) proposes to monitor seawater intrusion and land deformation and to provide technical support for the Sweetwater Authority (SWA) in FY23–24. Similar monitoring was done in 2017 and 2019, and similar technical support was provided during our cooperative investigations from 2001 to 2020. Total cost for this FY23–24 effort is $342,000; the USGS will contribute $60,000 subject to the availability of federal matching funds. ***Total cost to the Sweetwater Authority is the balance of $282,000***. The specifics of the proposed work are described below.

Background

In 2001, the USGS began a cooperative study with the Sweetwater Authority to investigate the San Diego Formation. In 2003, the USGS began installing multiple-depth, monitoring-well sites throughout the coastal San Diego area (figure 1). These well sites were designed to aid in expansion of the Reynolds Groundwater Desalination Facility, and in subsequent management of that facility. Since installation, these 12 sites have been used to monitor groundwater levels continuously at different depths in the coastal aquifer, from depths of a few feet below land surface to a maximum depth of 2,658 feet below land surface. These water-level data are provided to the SWA automatically via a USGS project website (http://ca.water.usgs.gov/sandiego). Some well sites also are used to track seawater intrusion by measuring electromagnetic (EM) conductance throughout the full depth of the deepest well and by sampling groundwater quality from each of the several individual wells.

In 2017 and 2019, seawater intrusion was measured using the 5 well sites closest to the ocean. Modest seawater intrusion was detected (figure 2). Land subsidence also was measured using Interferometric Synthetic Aperture Radar (InSAR) data from satellites and land-based surveying. Between 2017 and 2019, about 2.4 inches of land subsidence was detected, most of which was elastic deformation caused by pumpage from the 5 new production wells (SDF7–SDF11) installed

for expansion of the Reynolds facility (figure 3). These land-deformation data were analyzed and results are presented in a USGS report by Sneed and others (c2023), which is currently in review.

Ongoing USGS work that is not part of this contract includes: (1) continued monitoring of several multiple-depth, monitoring-well sites; and (2) completion of several reports. These reports include 3 reports (Data, Paleontology, and Land Deformation) that we expect to be finalized for publication by September 30, 2023; and two reports (Gravity and Geology) that we expect to be submitted for USGS review by December 31, 2023. Specific plans for 3 additional USGS reports (Hydraulic, Model, and Professional Paper, aka Coffee Table book) will be discussed with SWA in early 2024.

Work elements

1. **Collect electromagnetic (EM) geophysical logs in the deepest well at 5 USGS multiple-depth, monitoring-well sites.**
   Electromagnetic (EM) geophysical logs are an excellent way to determine potential zones of seawater intrusion, especially by comparing data collected from the same well sites at different times. The process is to collect an EM log from the deepest well at 5 multiple-depth, monitoring-well sites—in particular at USGS sites SDNB, SDMC, SDSW, SDLD, and SDOT. These well sites are located along the coast and, as such, will be the first sites to detect any seawater intrusion. In 2017 and 2019, EM logs were collected at these sites, and some seawater intrusion was observed. Based on these results, monitoring, such as described in this proposal, is suggested in order to track any seawater intrusion that has occurred in the past 4 years.

2. **Collect and process water-quality samples from all 27 wells at 5 USGS well multiple-depth, monitoring-well sites.**
   Sampling water quality of key wells near the coast is necessary to confirm any seawater intrusion that may be suspected from analysis of EM logs. Water-quality samples will be collected from each well at the following 5 multiple-depth, monitoring well sites (SDNB, SDMC, SDSW, SDLD, SDOT).

3. **Collect and process land-deformation (InSAR) data obtained from satellites.**
   Using Interferometric Synthetic Aperture Radar (InSAR) data obtained from satellites is an outstanding way to inspect the land surface for deformation caused by pumping. Because these data cover the entire coastal area of San Diego, processing can detect land deformation anywhere of interest along the coast.

4. **Analyze and interpret seawater intrusion.**
   Results of the EM logging and water-quality sampling, as described in this program letter, will be analyzed and compared to prior data. This analysis will yield an understanding of the amount and rate of seawater intrusion.

5. **Analyze and interpret land subsidence.**
   Results of the satellite InSAR data collection, as described in this program letter, will be analyzed and compared to prior data and to the land-deformation report (Sneed and others, c2023) that analyzes land deformation from 1995–2019.

6. **Present monitoring results to the Sweetwater Authority.**
   Results of the 5 work elements described above (EM logging, water-quality sampling, and land deformation analysis) will be presented to Sweetwater Authority in working groups and at board meetings.

7. **Provide technical support to the Sweetwater Authority.**
   The USGS will provide technical support to the SWA, as requested. This support will focus on review and evaluation of the SWA water-management plan, in particular siting new production wells, possible construction of a second desalination facility, and possible injection of treated wastewater. Addition technical support likely will include discussions with SWA staff and consultants, and presentations to the SWA board.

Table 1. Work elements and associated costs

Work Element	SWA	USGS	Total
1. Collect an electromagnetic (EM) geophysical log in the deepest well at 5 USGS multiple-depth, monitoring-well sites.	$30,000	$10,000	$40,000
2. Collect and process water-quality samples from 27 wells at 5 USGS multiple-depth, monitoring-well sites.	$173,000	$27,000	200,000
3. Collect and process land-deformation InSAR data obtained from satellites.	$15,000	$5,000	20,000
4. Analyze and interpret EM geophysical logs and water-quality data to define seawater intrusion.	$9,000	$3,000	$12,000
5. Analyze and interpret satellite InSAR data and results to define land subsidence.	$9,000	$3,000	$12,000
6. Present monitoring results to the Sweetwater Authority.	$6,000	$2,000	$8,000
7. Provide technical support.	$40,000	$10,000	$50,000
TOTAL	**$282,000**	**$60,000**	**$342,000**

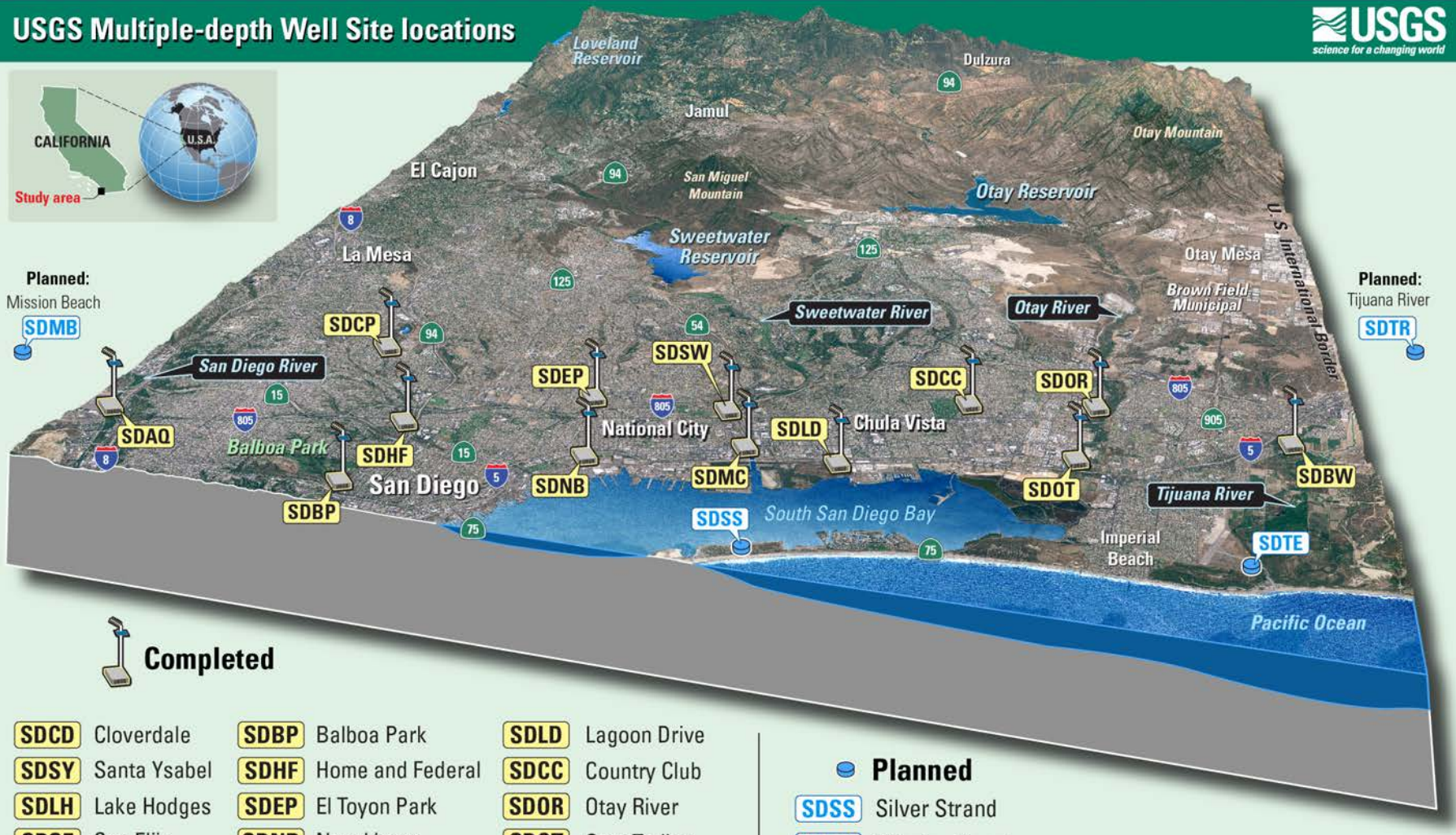
Thank you for your long-standing support of our collective efforts to better understand the ground-water resources of the San Diego area.

Sincerely,

Wesley R. Danskin

Wesley R. Danskin
Research Hydrologist

USGS Multiple-depth Well Site locations



SDCD	Cloverdale	SDBP	Balboa Park	SDLD	Lagoon Drive
SDSY	Santa Ysabel	SDHF	Home and Federal	SDCC	Country Club
SDLH	Lake Hodges	SDEP	El Toyon Park	SDOR	Otay River
SDSE	San Elijo	SDNB	Naval base	SDOT	Otay Trolley
SDAQ	Aqua Culture	SDSW	Sweetwater	SDBW	Boundary Waters
SDCP	Chollas Park	SDMC	Mile of Cars		

Planned

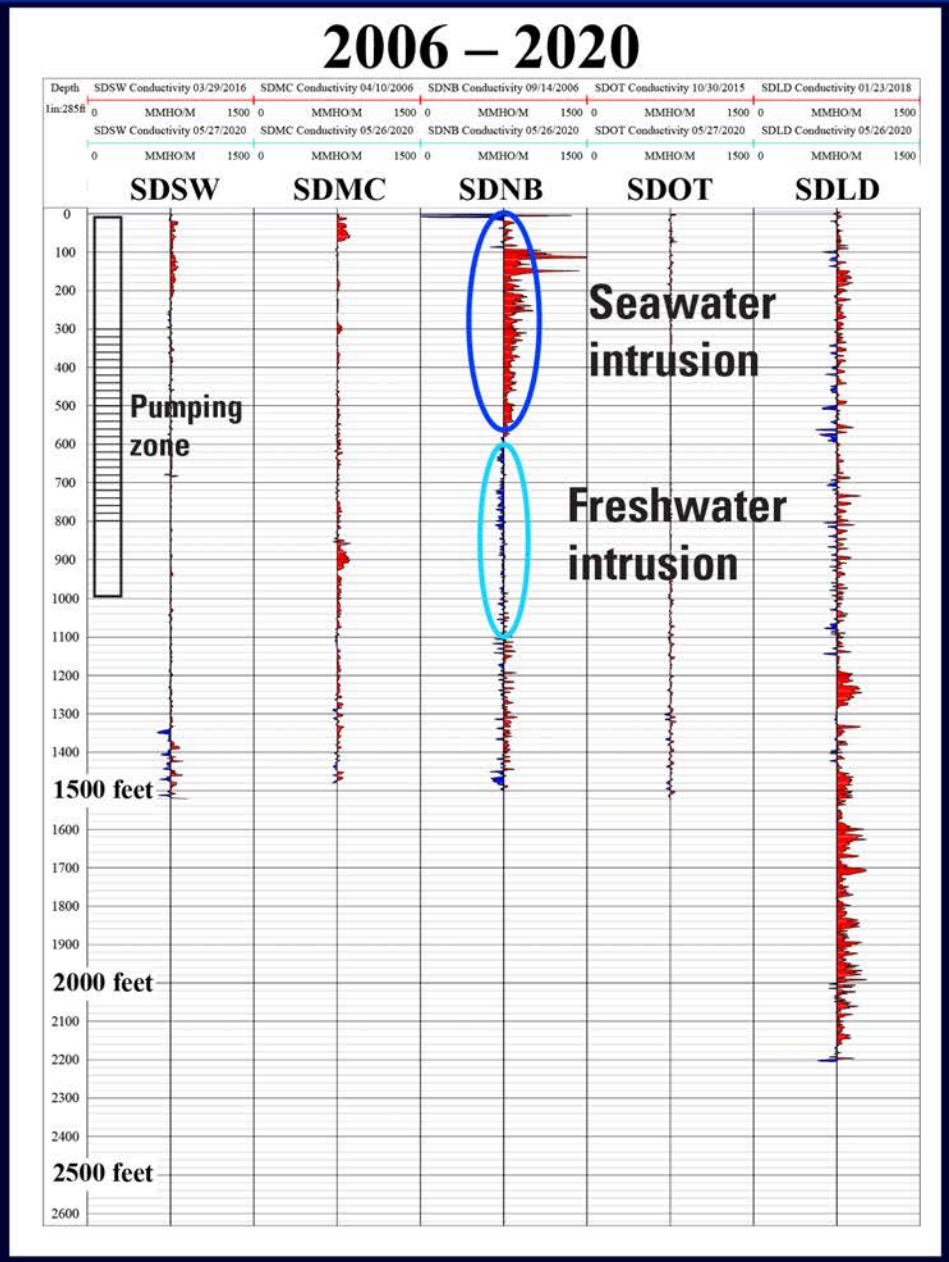
SDSS	Silver Strand
SDMB	Mission Beach
SDTE	Tijuana Estuary (U.S.)
SDTR	Tijuana River (Mexico)

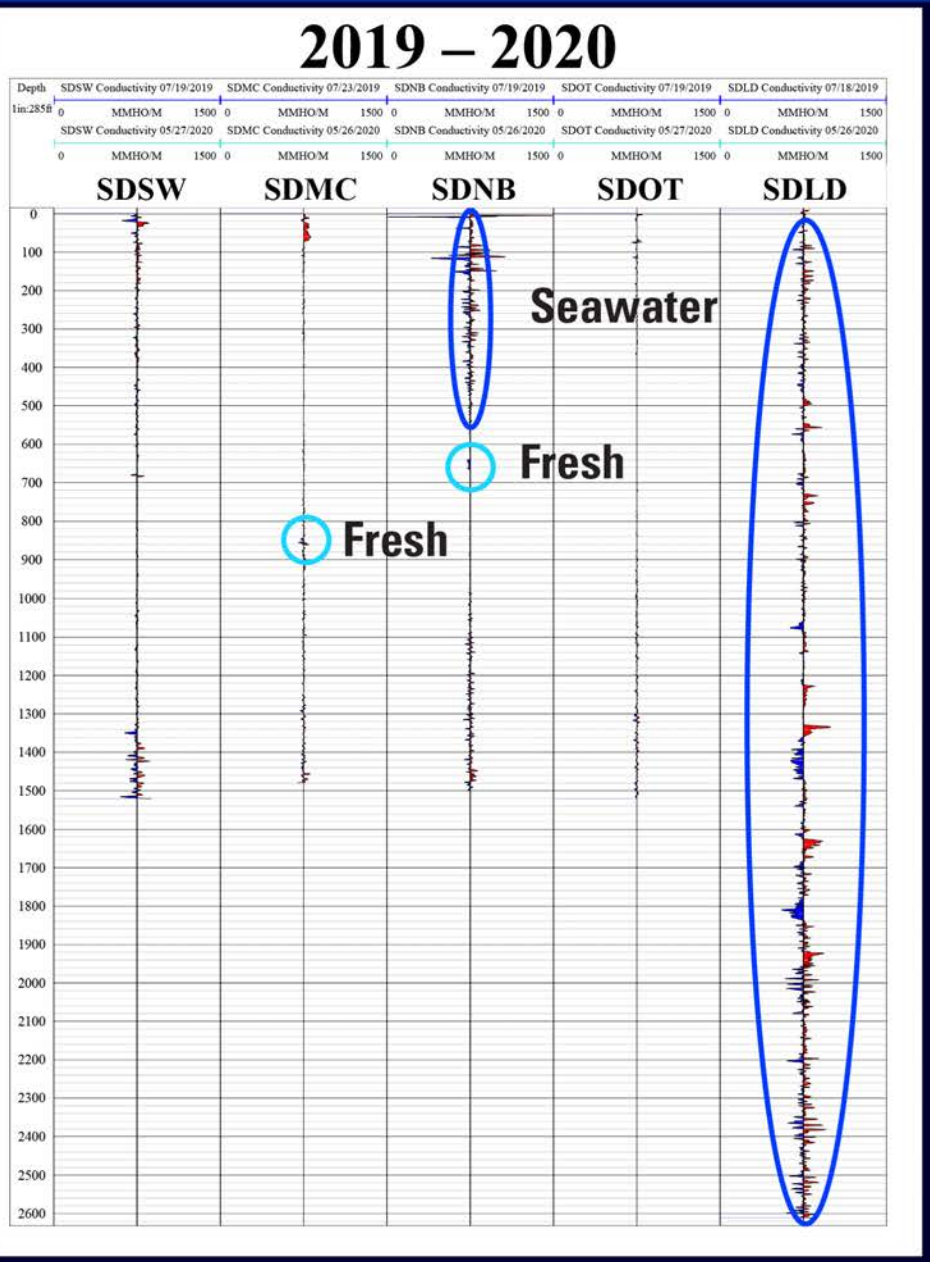
USGS science for a changing world

Sweetwater Authority, January 2023

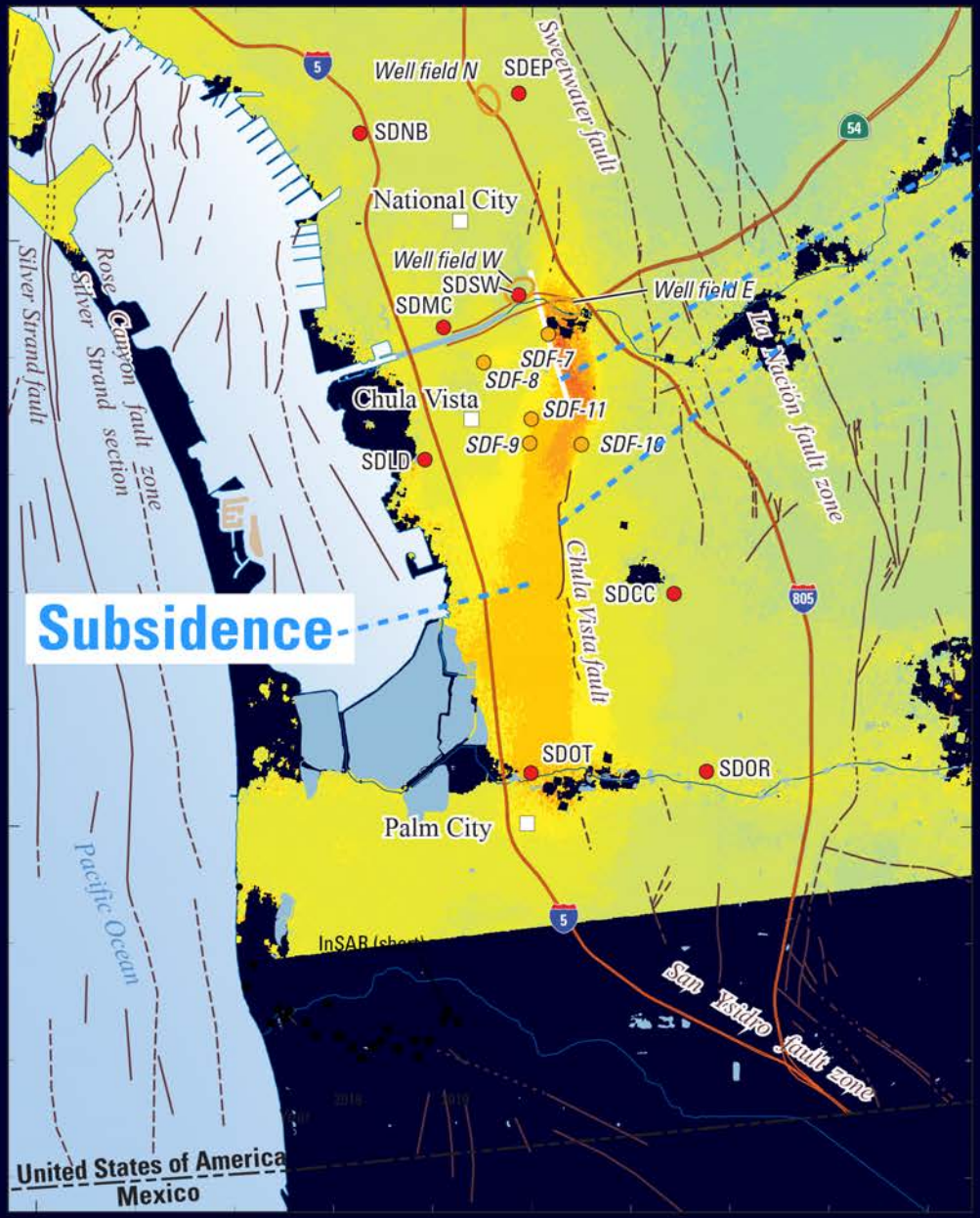
San Diego Hydrogeology

Electromagnetic logging detects seawater intrusion





Land subsidence — Caused by pumpage for Reynolds Facility



New faults found

2.4 inches of subsidence