

# **Total Selenium in Irrigation Drain Inflows to the Salton Sea, California, April 2009**

Open-File Report 2009–1230

**U.S. Department of the Interior**  
**U.S. Geological Survey**



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By Thomas W. May, Michael J. Walther, Michael K. Saiki, and William G. Brumbaugh

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**U.S. Department of the Interior**  
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**U.S. Geological Survey**  
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## Conversion Factors, Abbreviations and Datums

SI to Inch/Pound

Multiply	By	To obtain
	Length	
millimeter (mm)	0.03937	inch (in.)
	Volume	
liter (L)	33.82	ounce, fluid (fl. oz)
milliliter (mL)	.034	ounce, fluid (fl. oz)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)
milligram (mg)	.000035	ounce (oz)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F}=(1.8\times^{\circ}\text{C})+32$$

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Concentrations of chemical constituents in solid materials are given in micrograms per gram (µg/g) dry weight



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## Abstract

This report presents the results for the final sampling period (April 2009) of a 4-year monitoring program to characterize selenium concentrations in selected irrigation drains flowing into the Salton Sea, California. Total selenium and total suspended solids were determined in water samples. Total selenium, percent total organic carbon, and particle size were determined in sediments. Mean total selenium concentrations in water ranged from 0.98 to 22.9 micrograms per liter. Total selenium concentrations in sediment ranged from 0.078 to 5.0 micrograms per gram dry weight.

## Introduction

Monitoring surveys are being conducted by the U.S. Geological Survey (USGS) for 4 years to provide a profile of selenium concentrations in selected irrigation drain inflows to the Salton Sea, California. The 16th and final sampling in April, 2009, consisted of collecting water samples for total selenium and total suspended solids and collecting sediment for total selenium, percent total organic carbon, and particle size. This report presents these analytical results for this final collection period.

## Methods

### Field Collection and Preservation

The USGS sampling team used the laboratory at the U.S. Fish and Wildlife Service Sonny Bono Salton Sea National Wildlife Refuge (henceforth referred to as “the Refuge”) for certain aspects of sample processing and for preparing samples for shipment during field trips to irrigation drains.

*Unfiltered Water:* Each water sample [1,000 milliliters (mL)] to be analyzed for total selenium was poured through a 1-millimeter (mm) polypropylene sieve attached to a 1-liter (L) precleaned borosilicate glass bottle. Upon collection, the water sample was acidified to less than pH 2 with 6 normal

(N) hydrochloric acid (HCl), chilled to approximately 4 degrees Celsius ( $\sim 4^{\circ}\text{C}$ ), and kept in the dark during transport to the USGS. Each water sample (1,000 mL) intended for analysis of total suspended solids (TSS) was poured through a 1-mm polypropylene sieve attached to a precleaned wide-mouth 1-L polypropylene bottle. The TSS samples were chilled to approximately ( $\sim 4^{\circ}\text{C}$ ) during transport to the USGS.

*Sediment:* Five sampling points for sediment collection were identified along the length of each drain. At each sampling point, the uppermost 2 to 6 centimeters (cm) of sediment were collected with a stainless steel dredge. The dredge was cleared of mud and rinsed with site water while used within a drain. At a new site, the dredge was rinsed with deionized (DI) water followed by site water before the first sample was collected. From each of the five sampling points, enough sediment to fill a 250-mL container was collected and mixed to form a composite sample (1,250-mL total). An aliquot of this composite was then placed into a 120- and a 500-mL polypropylene container for each drain sampled. All containers were placed on ice in the field. Samples were chilled ( $\sim 4^{\circ}\text{C}$ ) during transport to the USGS.

### Sampling History

The irrigation drain monitoring samples collected by USGS personnel were received in two shipments by the Environmental Chemistry Branch Inorganic Section (henceforth referred to as “the laboratory”) of the USGS shortly after collection to meet the 7-day holding time specified for TSS in water and the 14-day holding time for total organic carbon (TOC) in sediments.

The first set of samples was collected April 17 and 18, 2009, was received by the laboratory on April 21, 2009, and contained 15 TSS water samples, 24 water samples for total selenium, and 4 sediment samples for total selenium. The samples were assigned USGS batch number 1582 and USGS sample identification numbers 46140 to 46182.

The second set of samples was collected from April 19 to 21, 2009, was received by the laboratory on April 23, 2009, and contained 6 TSS water samples, 12 water samples and 12 sediment samples for total selenium, and 14 sediment samples for TOC and particle size analysis (PSA). The samples were

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assigned USGS batch number 1584 and USGS sample identification numbers 46208 to 46251.

The third set of samples was collected April 21 and 24, 2009, was received by the laboratory on April 28, 2009, and contained 10 TSS water samples, 26 water samples and 15 sediment samples for total selenium, and 17 sediment samples for TOC and PSA. The samples were assigned USGS batch number 1585 and USGS sample identification numbers 46252 to 46319.

### Homogenization and Lyophilization

Sediment samples designated for total selenium analysis were lyophilized in a Virtis Genesis® 35EL freeze dryer. Percent moisture was determined as part of the lyophilization process. After lyophilization, dried sediment was placed into a plastic bag, sealed, and then pulverized by using a rolling pin on the plastic bag to produce a coarse powder product.

### Chemical Procedures

*Total Selenium in Water:* Before analysis, all water samples were stored in the dark at ~4 °C. For the subsequent determination of total selenium in filtered and unfiltered samples, a 20-mL aliquot of each acidified water sample was subjected to an HNO<sub>3</sub>-magnesium nitrate [Mg(NO<sub>3</sub>)<sub>2</sub>] ashing procedure, followed by treatment with HCl. The ashing procedure consisted of three steps: (1) boiling with HNO<sub>3</sub> for solubilization and partial oxidation; (2) ashing at 500 °C with Mg(NO<sub>3</sub>)<sub>2</sub> to complete the oxidation and decompose remaining organic matter; (3) and heating with 20 mL of 50 percent (v/v) HCl to dissolve the ash and chemically reduce selenium to the selenite (Se<sup>+4</sup>) oxidation state required for detection by hydride generation atomic absorption spectrophotometry. Following reduction, digestates were diluted to ~100 mL with DI water, yielding a final acid matrix of 10 percent HCl.

*Sediment:* An approximately 0.25-gram (g) aliquant of each dried sample was subjected to a HNO<sub>3</sub>-Mg(NO<sub>3</sub>)<sub>2</sub> ashing procedure, followed by HCl chemical reduction of selenate to selenite for the determination of selenium. The steps in the procedure were the same as those described above for total selenium in water. Digestates were diluted to about 100 mL with DI water, yielding a final acid matrix of 10 percent HCl.

### Instrumental Analysis

*Total Selenium:* Total selenium was determined in all ashed samples by flow injection hydride generation atomic absorption spectrophotometry (FIHGAAS). For this procedure, the digestate is mixed with an HCl-carrier solution and then reduced by sodium tetrahydridoborate that has been stabilized with sodium hydroxide. Selenium in the sample is converted to volatile hydrogen selenide and transferred with argon carrier gas into a heated quartz cell mounted on an

atomic absorption spectrophotometer for decomposition into atomic vapor and measurement.

*Total Suspended Solids:* Upon arrival at the laboratory, all TSS samples were transferred to the Ecology Branch for TSS analysis. TSS were analyzed with methods recommended by the American Public Health Association (1998). Samples were brought to room temperature and mixed with a magnetic stirrer and subsequent manual inversions of the sample container. The sample was measured into a graduated cylinder, poured into a filtration apparatus, and filtered through a ProWeigh® glass fiber filter. The samples were prewashed three times in DI water, dried at 105 °C, and weighed to the nearest 0.1 milligram (mg). Sample volume varied to yield a dried residue between 2.5 and 200 mg. For each volume of sample used, an equal volume of DI water also was filtered for a blank determination. After filtering, large or nonhomogeneous materials were removed from the filter and the filter was rinsed with three 10-mL aliquots of DI water. Filters were then dried for at least 1 hour in an oven at 103 to 105 °C. After cooling to room temperature in a desiccator, filter and residue were weighed to the nearest 0.1 mg. Drying, cooling, and weighing of the filter were repeated until the weight difference was less than (<) 4 percent or 0.5 mg, whichever was less. The average of these weights was used to determine the constant weight of the filter and residue, which was then corrected for any weight gain or loss of the blank. After subtracting the filter weight, this blank-corrected dried residue in milligrams was divided by the sample volume in liters to yield TSS in milligrams per liter (mg/L).

*Particle-Size Analysis:* Sediment samples designated for PSA were transferred to the USGS Ecology Branch upon arrival. The method requires use of a Bouyoucos hydrometer, adapted from American Society for Testing and Materials (2003). Wet sediment was sieved through a 2-mm sieve to remove any particles larger than coarse sand and then dried at 60 °C using a convectional drying oven. Approximately 100 g of dried sediment was mixed with 250 mL of DI water and 100 mL of a 50 mg/L sodium hexametaphosphate solution. A stir bar was then added and the mixture was stirred with a magnetic stirring plate. After calibrating the hydrometer, the suspended sediment mixture was transferred to a sedimentation cylinder and the volume adjusted to 1 L with DI water. After allowing for thermal equilibration, the temperature was recorded. Cylinder contents were then mixed thoroughly, and the hydrometer was inserted into the suspension. The meniscus reading was taken after 30 seconds and the hydrometer was removed and dried. After 120 minutes, the hydrometer was reinserted and the meniscus read again. All hydrometer meniscus readings were corrected by adjusting +0.25 for each degree above 18 °C and -0.25 for each degree below 18 °C. Percent fractions were determined as follows:

- Grams sand = sediment dry weight – (corrected 30 second reading – corrected calibration);
- Percent sand = grams sand/sediment dry weight x 100;



- Grams clay = sediment dry weight – (corrected 120 minute reading – corrected calibration);
- Percent clay = grams clay/sediment dry weight x 100; and
- Percent silt = 100 – (percent sand + percent clay).

**Total Organic Carbon:** TOC was determined with a Universal Instruments Corporation (UIC) Model 5014 Coulometer that determines carbon in any carbon dioxide (CO<sub>2</sub>) containing gas stream (Universal Instruments Corporation, 1999). The coulometer was used as a detector with different carbon front-end units and detected carbon in the range of 0.01 micrograms (µg) to 100 mg. The coulometer cell was filled with a proprietary solution containing monoethanolamine and a colorimetric pH indicator. Platinum (cathode) and silver (anode) electrodes were positioned in the cell. The cell assembly was then placed in the coulometer cell compartment between a light source and a photodetector in the coulometer. As a CO<sub>2</sub> gas stream passed into the cell, the CO<sub>2</sub> was quantitatively absorbed and reacted with the monoethanolamine to form a titratable acid. This acid caused the color indicator to fade. A photodetector monitored the change in the color of the solution as a percent transmittance (percent T). As the percent T increased, the titration current automatically was activated to electrochemically generate base at a rate proportional to the percent T (approximately 1,500 µg carbon/minute). When the solution returned to its original color (original percent T), the current stopped.

For TOC analysis, total carbon (TC, µg/mg) and total inorganic carbon (TIC, µg/mg) were determined. Total carbon was determined by combustion of weighed sediments at 925 °C. In TIC analysis, weighed sediments were exposed to heated 2 N sulfuric acid. Any inorganic carbonates were chemically reduced to mineral components and CO<sub>2</sub> gas. The gas was carried in high purity oxygen to the coulometer cell, where it was measured by the procedure described above. Percent TOC was calculated as follows:

$$\text{Percent TOC} = [(TC - TIC)/TC] \times 100 \quad (1)$$

## Quality Assurance

Samples were processed through the preparative and analytical flow scheme in three analytical blocks for selenium and one block each for TSS, PSA, and TOC. Each block was assigned a block initiation date (BID) used to identify samples and quality-control samples/materials prepared and analyzed collectively as a unit. For samples analyzed by atomic absorption for total selenium, predigestion quality control included digestion blanks, replicates, spikes, and reference solutions. Analytical quality-control for selenium included calibration verification solutions, replicate analyses, and analysis spikes. Quality control for the TSS, PSA, and TOC determinations included reference materials, duplicates, and replicates.

## Results

**Total Selenium:** Total selenium concentrations [micrograms per liter, (µg/L)] in unfiltered water samples for the April 2009 samples are listed in table 1 (at the back of this report). Mean selenium concentrations were most elevated in water from Trifolium 18 drain (22.9), followed by Q drain (9.73). The lowest mean selenium concentration was from Trifolium 14 drain (0.98).

**Total Suspended Solids:** TSS concentrations (mg/L) in unfiltered water collected during the April 2009 samplings are presented in table 2 (at the back of this report). TSS concentrations ranged from a high of 856 (W drain) to a low of 4.7 (Trifolium 18 drain).

**Sediment:** Percent moisture and selenium concentrations (µg/g dry weight) in sediment are presented in table 3 (at the back of this report). Percent moistures ranged from 22.1 to 71.6. Selenium concentrations in sediment ranged from 0.08 (Former Trifolium 20) to 5.99 (Vail 5). The particle size analyses of sediments, expressed as percent sand, silt, and clay, are presented in table 4 (at the back of this report). Percent sand ranged from 0 to 88; percent silt from 7.5 to 59; and percent clay from 4.7 to 74. Percent TOC in sediments is given in table 5 (at the back of this report) and ranged from 0.2 (Trifolium 12 and Trifolium Storm) to 3.7 (Lack and Linsey Pond).

## Quality-Control Results

**Calibration Verification:** During the selenium determinations, a calibration verification solution (Spex Claritas PPT<sup>®</sup>; Cat No. CLSe2-2Y) was analyzed at the beginning and end of each analytical run. Calibration was considered acceptable if the check solution was within plus or minus 10 percent of the actual concentration (3 µg/L), which was achieved during all analyses.

**Reference Materials:** Recoveries of selenium from QC Plus+ Trace Metals Quality Control Standard [n=2 (2 samples)] and National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) 1643e Trace Elements in Water (n=2) averaged 106 percent. The recoveries of selenium from National Research Council of Canada (NRCC) PACS-1 and MESS-3 (n=2) and NIST 2702 (n=1) marine sediments were 100 percent. Recoveries of TSS from a TSS reference solution (Environmental Resource Associates Hardness Wastewater Standard 507; n=3) were 100 percent. The recovery of total carbon from a carbon reference material (Environmental Resource Associates Nutrients in Soil 542; n=1) was 100 percent. Recoveries of percent sand, silt, and clay from a USGS research sediment material ranged from 93 to 106 percent.

**Analytical and Method Precision:** Instrumental precision for selenium as determined by repeated analysis of a standard throughout the run for each block (n=3) was less than 4 percent relative standard deviation (RSD). Relative percent

differences (RPDs) between field duplicates (n=29) of unfiltered water samples analyzed for selenium mostly were  $\leq$  (less than or equal to) 8 (n=27), but two of these duplicates exhibited greater RPDs of 12 and 17. Laboratory method precision for the triplicate preparation and analysis of water (n=4) and sediment (n=2) samples for selenium was  $<5$  percent RSD. Instrumental precision was based on duplicate analysis of sample digestates from each sample matrix, which resulted in RPDs  $<2$  percent. Duplicate analysis of water samples for TSS (n=3) resulted in RPDs ranging from 1.5 to 25 percent, whereas triplicate analysis for TSS (n=2) resulted in RSDs  $<8$  percent. The duplicate analysis of drain sediments (n=2) for PSA resulted in RPDs  $<6$  percent for the fractions. Triplicate analyses of drain sediments (n=2) for PSA resulted in RSDs  $<9$  percent for the fractions. The duplicate analysis of four drain sediments for TOC resulted in RPDs ranging from 14 to 32 percent. A replicate analysis of a TOC control material and one drain sediment resulted in RSDs of 6.7 and 25 percent.

*Spikes:* Recoveries of selenium [selenate ( $\text{Se}^{+6}$ ), or selenomethionine] spiked into water samples (n=8) ranged from 98 to 105 percent, averaging 103 percent. Recoveries of selenium spiked into sediment (n=4), ranged from 100 to 102 percent, averaging 101 percent. Recoveries of selenium spikes added to water during analysis (n=5) ranged from 96 to 108 percent, averaging 105 percent. Analysis spikes of sediment (n=3) ranged from 100 to 104 percent, averaging 102 percent.

*Blank Equivalent Concentrations:* Blank equivalent concentrations (BECs) were computed for selenium for each matrix and for TSS blanks analyzed with the drain water samples. Selenium BECs for water and sediment were  $\leq$  their respective method detection limits (MDLs), whereas BECs for TSS were less than the TSS MDL. TSS sample data were corrected for procedural blanks, whereas total selenium sample data were not blank corrected.

*Instrument Detection, Method Detection, and Method Quantitation Limits:* The FIHGAAS instrument detection limit for selenium was  $0.028 \mu\text{g/L}$ , and  $0.09 \text{ mg}$  for TSS. MDLs for each matrix for selenium were computed for each analytical block (n=3) using the formula:

$$3(\text{SD}_b^2 + \text{SD}_s^2)^{1/2} \quad (2)$$

where

$\text{SD}_b$  = standard deviation of a blank (n=3); and  
 $\text{SD}_s$  = standard deviation of a low level sample or spiked sample (n=3).

Calculated selenium MDLs for water were  $0.16$  to  $0.13 \mu\text{g/L}$  and  $0.009 \mu\text{g/g}$  dry weight for sediment. Method quantitation limits (MQLs) for each matrix were calculated as  $3.3 \times$  MDLs. Selenium MQLs for water were  $0.54$  and  $0.42 \mu\text{g/L}$  and  $0.026 \mu\text{g/L}$  for sediment. The MDL for TSS was  $8.80 \text{ mg/L}$  and the MQL was  $29 \text{ mg/L}$ . Overall, quality-control results for the study were within acceptable limits as specified by USGS.

## References Cited

- American Public Health Association, 1998, Standard methods for the examination of water and wastewater (20th ed.), Method 2540: Washington, D.C., American Public Health Association, p. 257–258.
- American Society for Testing and Materials, 2003, Standard test method for particle-size analysis of soils, D422–63 (2002), in Annual Book of ASTM Standards, v. 04.08. West Conshohocken, Pa., American Society for Testing and Materials, p. 10–17.
- Universal Instruments Corporation, 1999, Operating manual for Model CM 5014 Coulometer.

## Tables

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## 6 Total Selenium in Irrigation Drain Inflows to the Salton Sea, California, April 2009

**Table 1.** Total selenium concentrations in duplicates of unfiltered irrigation drain-water samples, Salton Sea, California, April 2009.

[ID, identification; Rep, field replicate; µg/L, microgram per liter; SD, standard deviation; --, no data; <, less than; nc, not collected]

USGS ID	Field ID	Drain name/ID	Collection date	Total selenium concentration			SD
				Rep 1 (µg/L)	Rep 2 (µg/L)	Mean (µg/L)	
46303	Blank 1	--	4/28/2009	< 0.16	--	--	--
46304	Blank 2	--	4/28/2009	<0.16	--	--	--
46238	BLNDWATSE16A	--	4/17/2009	1.68	--	--	--
46239	BLNDWATSE16B	--	4/21/2009	2.47	--	--	--
46287, 46288	LKLNWATSE16	Lack & Linsey Pond	4/18/2009	3.86	3.89	3.87	0.02
46279, 46280	NLD1WATSE16	Niland 1	4/25/2009	5.15	5.09	5.12	0.04
46281, 46282	NLD2WATSE16	Niland 2	4/25/2009	2.15	2.03	2.09	0.08
46283, 46284	NLD3WATSE16	Niland 3	4/25/2009	1.89	1.77	1.83	0.09
46285, 46286	NLD4WATSE16	Niland 4	4/25/2009	1.76	1.83	1.79	0.05
46228, 46229	OOOOWATSE16	O	4/20/2009	5.20	5.27	5.23	0.05
46230, 46231	PPPPWATSE16	P	4/19/2009	2.04	2.30	2.17	0.19
46175, 46176	POEDWATSE16	Poe Rd	4/17/2009	4.64	4.62	4.63	0.02
46289, 46290	PUMCWATSE16	Pumice	4/23/2009	4.14	4.10	4.12	0.03
46232, 46233	QQQQWATSE16	Q	4/20/2009	9.73	9.68	9.71	0.04
46234, 46235	RRRRWATSE16	R	4/21/2009	2.75	2.84	2.80	0.06
46236, 46237	SSSSWATSE16	S	4/21/2009	4.77	4.72	4.75	0.03
46177, 46178	SFWHWATSE16	San Felipe Wash	4/16/2009	2.66	2.70	2.68	0.03
46293, 46294	TTTTWATSE16	T	4/21/2009	1.98	1.90	1.94	0.06
46155, 46156	TR01WATSE16	Trifolium 1	4/18/2009	5.61	4.75	5.18	0.60
46291, 46292	TR12WATSE16	Trifolium 12	4/23/2009	7.22	7.32	7.27	0.07
46157, 46158	TR13WATSE16	Trifolium 13	4/19/2009	2.61	2.57	2.59	0.03
46159, 46160	TR14WATSE16	Trifolium 14	4/19/2009	0.99	0.98	0.98	0.001
46161, 46162	TR18WATSE16	Trifolium 18	4/18/2009	23.1	22.8	22.9	0.23
46163, 46164	TR19WATSE16	Trifolium 19	4/17/2009	1.60	1.67	1.63	0.04
46171, 46172	FT20WATSE16	Former Trifolium 20	4/16/2009	3.99	3.93	3.96	0.05
46165, 46166	TR20WATSE16	Trifolium 20	4/17/2009	3.05	2.93	2.99	0.09
46167, 46168	TR22WATSE16	Trifolium 22	4/16/2009	4.79	5.01	4.90	0.15
46169, 46170	TR23WATSE16	Trifolium 23	4/16/2009	3.71	3.63	3.67	0.05
46173, 46174	TRSTWATSE16	Trifolium Storm	4/18/2009	6.19	6.24	6.22	0.03
46295, 46296	UUUUWATSE16	U	4/24/2009	1.68	1.56	1.62	0.08
46297, 46298	VL05WATSE16	Vail 5	4/23/2009	1.91	1.96	1.93	0.04
46299, 46300	WWWWWATSE16	W	4/24/2009	4.01	4.18	4.10	0.12
46301, 46302	ZSPLWATSE16	Z Spill	4/24/2009	4.17	3.91	4.04	0.18

**Table 2.** Total suspended solids concentrations in unfiltered Salton Sea, California, irrigation drain-water samples, April 2009.

[ID, identification; TSS, total suspended solids; mg/L, milligram per liter]

Field ID	Drain name/ID	April, 2009	
		USGS ID	TSS (mg/L)
BLNDWATSS16a	Blind A	46154	45
BLNDWATSS16b	Blind B	46213	72
LKLNWATSS16	Lack & Linsey Pond	46153	25
NLD1WATSS16	Niland 1	46252	196
NLD2WATSS16	Niland 2	46253	28
NLD3WATSS16	Niland 3	46254	154
NLD4WATSS16	Niland 4	46255	62
OOOWATSS16	O	46208	84
PPPWATSS16	P	46152	95
POEDWATSS16	Poe Rd	46150	7.9
PUMCWATSS16	Pumice	46256	201
QQQWATSS16	Q	46209	148
RRRRWATSS16	R	46210	106
SSSSWATSS16	S	46211	156
SFWHWATSS16	San Felipe Wash	46151	16
TTTTWATSS16	T	46212	160
TR01WATSS16	Trifolium 1	46140	123
TR12WATSS16	Trifolium 12	46257	116
TR13WATSS16	Trifolium 13	46141	36
TR14WATSS16	Trifolium 14	46142	44
TR18WATSS16	Trifolium 18	46143	4.7
TR19WATSS16	Trifolium 19	46144	12
FT20WATSS16	Former Trifolium 20	46148	78
TR20WATSS16	Trifolium 20	46145	67
TR22WATSS16	Trifolium 22	46146	36
TR23WATSS16	Trifolium 23	46147	53
TRSTWATSS16	Trifolium Storm	46149	41
UUUWATSS16	U	46258	34
VL05WATSS16	Vail 5	46259	36
WWWWATSS16	W	46260	856
ZSPLWATSS16	Z Spill	46261	524

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**Table 3.** Selenium concentrations in sediment samples collected from Salton Sea, California, irrigation drains, April 2009.

[ID, identification; µg/g, micrograms per gram]

<b>USGS ID</b>	<b>Field ID</b>	<b>Matrix</b>	<b>Drain name/ID</b>	<b>Moisture (percent)</b>	<b>Selenium (µg/g dry weight)</b>
46251	BLNDSDTSE16	4/19/2009	Blind	55.3	2.84
46319	BLNDSDTSE16B	4/21/2009	Blind	42.4	0.58
46247	LKLNSDTSE16	4/18/2009	Lack and Lindsay	43.4	1.55
46305	NLD1SDTSE16	4/25/2009	Niland 1	54.7	1.15
46306	NLD2SDTSE16	4/25/2009	Niland 2	54.9	1.23
46307	NLD3SDTSE16	4/25/2009	Niland 3	55.0	0.71
46308	NLD4SDTSE16	4/25/2009	Niland 4	51.8	0.69
46248	OOOOSDTSE16	4/17/2009	O	49.3	0.86
46250	PPPPSDTSE16	4/20/2009	P	42.5	0.74
46249	POEDSDTSE16	4/19/2009	Poe	25.4	0.25
46309	PUMCSDTSE16	4/23/2009	Pumice	37.9	0.88
46310	QQQQSDTSE16	4/20/2009	Q	54.3	2.58
46311	RRRRSDTSE16	4/21/2009	R	38.7	0.55
46312	SSSSDTSE16	4/21/2009	S	47.2	0.99
46179	SFWHSDTSE16	4/16/2009	San Felipe Wash	34.9	0.96
46313	TTTTSDTSE16	4/21/2009	T	40.2	0.63
46240	TR01SDTSE16	4/18/2009	Trifolium 1	67.9	3.10
46314	TR12SDTSE16	4/23/2009	Trifolium 12	28.4	0.29
46241	TR13SDTSE16	4/19/2009	Trifolium 13	43.8	1.28
46242	TR14SDTSE16	4/19/2009	Trifolium 14	55.1	2.64
46243	TR18SDTSE16	4/18/2009	Trifolium 18	44.4	5.00
46244	TR19SDTSE16	4/17/2009	Trifolium 19	57.0	2.20
46180	FT20SDTSE16	4/16/2009	Former Trifolium 20	22.1	0.08
46245	TR20SDTSE16	4/17/2009	Trifolium 20	50.6	0.91
46181	TR22SDTSE16	4/16/2009	Trifolium 22	39.8	0.64
46182	TR23SDTSE16	4/16/2009	Trifolium 23	42.4	0.69
46246	TRSTSDTSE16	4/18/2009	Trifolium Storm	34.9	0.39
46315	UUUUSD TSE16	4/24/2009	U	51.4	0.61
46316	VL05SDTSE16	4/23/2009	Vail 5	71.6	5.99
46317	WWWSDTSE16	4/24/2009	W	32.0	0.49
46318	ZSPLSDTSE16	4/24/2009	Z Spill	32.0	0.51

**Table 4.** Particle size distributions in sediment samples collected from Salton Sea, California, irrigation drains, April 2009.

[ID, identification; &gt;, greater than; mm, millimeter]

USGS ID	Field ID	Drain name/ID	Particle size category			
			> 2 mm (percent)	Sand (percent)	Silt (percent)	Clay (percent)
46277	BLNDS DTOCa	Blind A	0.5	18	53	29
46278	BLNDS DTOCb	Blind B	0.5	19	35	45
46224	LKLNS DTOC16	Lack & Linsey Pond	21	46	21	12
46262	NLD1SDTOC16	Niland 1	0.2	3.6	46	50
46263	NLD2SDTOC16	Niland 2	0.5	6.8	47	45
46264	NLD3SDTOC16	Niland 3	0	0	32	68
46265	NLD4SDTOC16	Niland 4	0.2	0	26	74
46266	OOOOS DTOC16	O	0.7	18	36	45
46225	PPPPS DTOC16	P	0.7	18	39	42
46226	POEDS DTOC16	Poe Rd	0.9	64	21	15
46267	PUMCS DTOC16	Pumice	0.5	25	54	20
46268	QQQQS DTOC16	Q	0.1	14	46	39
46269	RRRRS DTOC16	R	0.9	40	28	31
46270	SSSSS DTOC16	S	7.3	17	32	45
46227	SFWHS DTOC16	San Felipe Wash	0.4	48	35	16
46272	TTTTS DTOC16	T	0.2	21	35	44
46214	TR01SDTOC16	Trifolium 1	1.1	15	35	49
46271	TR12SDTOC16	Trifolium 12	0	59	22	19
46215	TR13SDTOC16	Trifolium 13	0.7	39	40	20
46216	TR14SDTOC16	Trifolium 14	0.4	4.3	59	36
46217	TR18SDTOC16	Trifolium 18	1.4	71	18	9.6
46218	TR19SDTOC16	Trifolium 19	0.5	25	59	15
46222	FT20SDTOC16	Former Trifolium 20	0	88	7.5	4.7
46219	TR20SDTOC16	Trifolium 20	0.2	16	33	50
46220	TR22SDTOC16	Trifolium 22	1.0	52	21	26
46221	TR23SDTOC16	Trifolium 23	11	42	23	23
46223	TRSTS DTOC16	Trifolium Storm	0	28	52	20
46273	UUUUS DTOC16	U	0.1	2.8	39	58
46274	VL05SDTOC16	Vail 5	0.9	24	55	20
46275	WWWWS DTOC16	W	2.0	50	18	29
46276	ZSPLS DTOC16	Z Spill	11	53	17	20

**Table 5.** Percent total organic carbon in sediment samples collected from Salton Sea, California, irrigation drains, April 2009.

[ID, identification]

<b>USGS ID</b>	<b>Field ID</b>	<b>Drain name/ID</b>	<b>Total organic carbon (percent)</b>
46277	BLNDSDOCa	Blind A	1.9
46278	BLNDSDOCb	Blind B	0.4
46224	LKLNSDOCa	Lack & Linsey Pond	3.7
46262	NLD1SDTOC16	Niland 1	1.0
46263	NLD2SDTOC16	Niland 2	1.1
46264	NLD3SDTOC16	Niland 3	0.5
46265	NLD4SDTOC16	Niland 4	0.5
46266	OOOOSDOCa	O	1.1
46225	PPPSDOCa	P	0.7
46226	POEDSDTOC16	Poe Rd	0.3
46267	PUMCSDOCa	Pumice	0.8
46268	QQQSDTOC16	Q	1.1
46269	RRRRSDTOC16	R	0.8
46270	SSSSSDTOC16	S	1.2
46227	SFWHSDTOC16	San Felipe Wash	0.7
46272	TTTTSDTOC16	T	0.6
46214	TR01SDTOC16	Trifolium 1	2.6
46271	TR12SDTOC16	Trifolium 12	0.2
46215	TR13SDTOC16	Trifolium 13	1.7
46216	TR14SDTOC16	Trifolium 14	1.7
46217	TR18SDTOC16	Trifolium 18	1.5
46218	TR19SDTOC16	Trifolium 19	1.7
46222	FT20SDTOC16	Former Trifolium 20	0.2
46219	TR20SDTOC16	Trifolium 20	0.9
46220	TR22SDTOC16	Trifolium 22	0.8
46221	TR23SDTOC16	Trifolium 23	0.9
46223	TRSTSDOCa	Trifolium Storm	0.2
46273	UUUUSDOCa	U	0.8
46274	VL05SDTOC16	Vail 5	2.9
46275	WWWWSDOCa	W	0.9
46276	ZSPLSDTOC16	Z Spill	0.6



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