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State of California
The Natural Resources Agency
DEPARTMENT OF WATER RESOURCES
South Central Region Office

San Joaquin Valley
Drainage Monitoring Program
2011 - 2012

Region Report

September 2015

John Laird Secretary for Natural Resources The Natural Resources Agency	Edmund G. Brown Jr. Governor State of California	Mark Cowin Director Department of Water Resources

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Foreword

This report shares valuable information about agricultural drainage water in order to increase the understanding of its potential impacts and improve its management in the San Joaquin Valley (SJV).

The Drainage Monitoring Program is a cooperative effort of State, federal, and local agencies. Program staff collect, assemble, review, evaluate, and disseminate data on both the quality of drainage water as well as the depth of shallow groundwater in the SJV. Fifty-five drainage sump systems are monitored for flow, sodium, sulfate, total dissolved solids, selenium, and other constituents. Staff also combine the Department of Water Resources' (DWR's) data with data from five other agencies for this report.

DWR used depth information, gathered from approximately 1,300 shallow groundwater wells, to draw Present and Potential Drainage Problem Areas Maps for the period from 2011 through 2012. These maps show over one million acres of potentially impacted lands. Data provided by several agencies, including the Buena Vista Water Storage District, Central California Irrigation District, Kern County Water Agency, Panoche Water and Drainage District, San Luis Canal Company, Westlands Water District, and DWR was combined to create the maps.

DWR also drew electrical conductivity (EC) maps from ECs measured in about 950 of those wells for the years 2011 and 2012. All of the maps help inform managers of potential drainage problems in their areas due to encroachment of shallow groundwater. The number of agencies participating is a reflection of the significance of drainage problems in the SJV and the potential impacts.

This report focuses on two years of data collection and compilation for the calendar years 2011 through 2012, with a special focus on historical nitrates and selenium. In addition, pesticide and nutrient data have been added to this report for your use.

Over the years, this report has been published and distributed. All of the collected drainage data and related information will be made available on our website or upon request a copy of this report will be mailed. Please contact staff with your questions or needs.

Kevin Faulkenberry, Chief
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Symbols and Abbreviations

Acronyms

ASAR	adjusted sodium adsorption ratio
USBR	U.S. Bureau of Reclamation
DFA	California Department of Food and Agriculture
DFW	California Department of Fish and Wildlife
DTW	depth-to-water
DWR	California Department of Water Resources
EC	electrical conductivity
EPA	U.S. Environmental Protection Agency
MCL	maximum contaminant level
MOU	memorandum of understanding
SAR	sodium adsorption ratio
SJVDIP	San Joaquin Valley Drainage Implementation Program
SJVDP	San Joaquin Valley Drainage Program
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Glossary

Time	Pacific Standard Time on a 24-hour clock
Temp.	Temperature of water at time of sampling in degrees Celsius (°C) and degrees Fahrenheit (°F)
pH	pH is the amount of hydrogen ions in solution; measures acidity (<7) or alkalinity (>7) of the solution
EC (µS/cm)	Electrical conductance in microsiemens per centimeter at 25 °C
mg/L	milligram per Liter – concentration of a constituent by weight in a liter of solution
meq/L	milliequivalents per Liter – concentration of a constituent by ionic strength in a liter of solution; meq/L is obtained by taking the concentration in mg/L and dividing the concentration by the constituent's atomic weight divided by the absolute value of the common valence
ppb	parts per billion
prv	percent reactance value – values indicate the relative percentage of the various major constituents

$$\text{prv (for each ion)} = \frac{\text{cation}}{\sum \text{cations}} \text{ or } \frac{\text{anion}}{\sum \text{anions}} \text{ in meq/L x } 100$$

Mineral and Trace Element Constituents

As	Arsenic
B	Boron
Ca	Calcium
$CaCO_3$	Calcium Carbonate
Cl	Chloride
HCO_3	Bicarbonate
K	Potassium
Mg	Magnesium
Na	Sodium
Ni	Nickel
NO_3	Nitrate
OH	Hydroxide
Se	Selenium
SO_4	Sulfate
T. Alk	Total Alkalinity (expressed as mg/L as $CaCO_3$)
TH	Total Hardness (expressed as mg/L as $CaCO_3$)
TDS	Gravimetric determination of total dissolved solids at 180 °C
Sum TDS	TDS approximation (for confirmation purposes) determined by addition of the following analyzed constituents:

$$Ca + Mg + Na + 0.6\ (\text{Total Alkalinity}) + SO_4 + Cl + NO_3$$

Indices

SAR — Sodium Adsorption Ratio (developed by U.S. Salinity Laboratory)

$$SAR = \frac{Na}{\sqrt{\frac{(Ca)+(Mg)}{2}}}$$

Na, *Ca*, and *Mg* represent the concentrations in milliequivalents per liter

ASAR — Adjusted Sodium Adsorption Ratio:

adj SAR = SAR [1 + (8.4 – pHc)] x 0.5

where pHc is a theoretical calculated pH of the irrigation water in contact with lime and in equilibrium with soil CO_2

Metric Conversion

Quantity	To convert from metric unit	To customary unit	Multiply metric unit by	To convert to metric unit multiply customary unit by
Length	millimeters (mm)	inches (in)	0.03937	25.4
	centimeters (cm) for snow depth	inches (in)	0.3937	2.54
	meters (m)	feet (ft)	3.2808	0.3048
	kilometers (km)	miles (mi)	0.62139	1.6093
Area	square millimeters (mm^2)	square inches (in^2)	0.00155	645.16
	square meters (m^2)	square feet (ft^2)	10.764	0.092903
	hectares (ha)	acres (ac)	2.4710	0.40469
	square kilometers (km^2)	square miles (mi^2)	0.3861	2.590
Volume	liters (L)	gallons (gal)	0.26417	3.7854
	cubic meters (m^3)	cubic feet (ft^3)	35.315	0.028317
	cubic meters (m^3)	cubic yards (yd^3)	1.308	0.76455
	cubic decameters (dam^3)	acre-feet (ac-ft)	0.8107	1.2335
Flow	cubic meters per second (m^3/s)	cubic feet per second (ft^3/s)	35.315	0.028317
	liters per minute (L/min)	gallons per minute (gal/min)	0.26417	3.7854
	cubic decameters per day (dam^3/day)	acre-feet per day (ac-ft/day)	0.8107	1.2335
Mass	kilograms (kg)	pounds (lb)	2.2046	0.45359
		tons (long)	1.1023	0.90718
Velocity	meters per second (m/s)	feet per second (ft/s)	3.2808	0.3048
Power	kilowatts (kW)	horsepower (hp)	1.3405	0.746
Pressure	kilopascals (kPa)	pounds per square inch (psi)	0.14505	6.8948
	kilopascals (kPa)	feet head of water	0.33456	2.989
Specific Capacity	liters per minute per meter drawdown	gallons per minute per foot drawdown	0.08052	12.419
Concentration	milligrams per liter (mg/L)	parts per million (ppm)	1.0	1.0
Electrical Conductivity	microsiemens per centimeter (μS/cm)	micromhos per centimeter (μmho/cm)	1.0	1.0
Temperature	degrees Celsius (°C)	degrees Fahrenheit (°F)	(1.8 x °C) + 32	(°F – 32)/1.8

Introduction

In 1959, the California Department of Water Resources (DWR) began monitoring agricultural drainage water in the San Joaquin Valley. Initial monitoring efforts from 1959 to 1963 focused on mineral analyses. In 1963, the monitoring program became part of the San Joaquin Drainage Investigation and included analyses for pesticides in both surface and subsurface drainage waters. From 1966 to 1969, intensive nutrient sampling became a part of the investigation.

Although the San Joaquin Drainage Investigation ended in 1970, DWR continued the monitoring as a separate departmental activity until 1975 when DWR, the U.S. Bureau of Reclamation (USBR), and the State Water Resources Control Board (SWRCB) formed the San Joaquin Valley Interagency Drainage Program. The program continued until 1979 when monitoring resumed as a separate activity under its Agricultural Drainage Program.

The discovery in 1983 of migratory bird deaths and deformities linked to high selenium levels in drainage water at Kesterson Reservoir focused national attention on drainage of the San Luis Drain and drainage-related problems. This discovery resulted in an interagency drainage study.

The following year, U.S. Secretary of the Interior William Patrick Clark and Governor of California George Deukmejian established the San Joaquin Valley Drainage Program (SJVDP). It was created to investigate and identify solutions to drainage problems. Cooperating agencies were DWR, California Department of Fish and Game (DFG), U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS), and the U.S. Bureau of Reclamation (USBR). The SJVDP developed a comprehensive study titled *A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley,* also known as the *Rainbow Report* (September 1990). It summarized the results of subsurface agricultural drainage problems and presented a plan for managing drainage problems.

In 1991, federal and State agencies initiated the San Joaquin Valley Drainage Implementation Program (SJVDIP) to pick up where SJVDP left off. Four federal agencies (Natural Resources Conservation Service, USFWS, USGS, and the USBR) and four State agencies (DFG, DWR, Department of Food and Agriculture, and SWRCB) signed a memorandum of understanding (MOU) and released an implementation strategy in December 1991. They agreed to work together and identify specific tasks associated with responsible parties, seek needed funding and authority, and set schedules for implementing all components of the SJVDP's 1990 *Rainbow Report*.

All the agencies involved recognized that the success of the program depended on local districts and irrigators to effectively manage drainage. Because drainage is a regional problem, federal and State agencies continue to coordinate efforts. DWR continuously evaluates and modifies its drainage monitoring program so that it meets the needs of the implementation strategy.

The Drainage Problem

The San Joaquin Valley, one of the world's most productive agricultural regions, is experiencing mounting problems with the management and disposal of agricultural drainage water.

The drainage problem is an outgrowth of imported water, naturally saline soils, and the valley's distinctive geological makeup which prevents effective natural drainage in certain areas. Soils on the western side of the valley come from the marine sediments that make up the Coast Range. These soils, high in salts and trace elements, are similar to those that occur in the ocean. Also, just below the surface of much of the valley's soil, is a shallow clay layer that obstructs vertical movement of irrigation water. As salts and minerals from surface soils are leached into the shallow groundwater, the water table rises to within a few feet of the surface and into the root zone. Unless this water is removed, crops growing in these soils eventually die.

In the late 1940s, farmers began installing subsurface drains in fields with drainage problems. By 1965, 330 miles of subsurface drains and 750 miles of open ditch drains operated in the valley, delivering drainage water to evaporation ponds and other discharge sites. With this drainage network in operation, the main problem became how to manage and dispose of the salty drainage water.

The original plan was to construct a master drain (the San Luis Drain) to collect the water and route it out of the valley into the Sacramento-San Joaquin River Delta. By 1973, an 87-mile-long section of the San Luis Drain was receiving irrigation runoff and discharging into Kesterson Reservoir. The plan was to extend the drain north to a discharge site in the Delta. Kesterson Reservoir was intended to regulate discharges going to the Delta and provide a wetland habitat. However, the San Luis Drain was never completed, and drainage accumulated at Kesterson Reservoir.

In 1982, federal studies reported high selenium levels in fish taken from Kesterson Reservoir. In 1983, federal-State studies determined that the bioaccumulation of selenium was causing deformities in embryos of waterfowl nesting at the reservoir. In 1985, the U.S. Department of the Interior ordered a halt to drainage water discharges into the San Luis Drain and Kesterson Reservoir, even though irrigation water deliveries to west side agricultural lands continued.

Today, practices of disposing and managing drainage water are being scrutinized for their effects on the environment. Management practices such as source control, drainage reuse, groundwater management, integrated on-farm drainage management, and others identified in the *Rainbow Report* are being used. Monitoring of shallow groundwater and agricultural drainage water is integral to assist in the evaluation of the effectiveness of these management practices.

Drainage Problem Areas

The San Joaquin Valley is a rich agricultural region that encompasses large areas with high water tables. Irrigation practices, cropping patterns, seepage from unlined ditches or ponds, soil type, geology, and other factors influence the elevations of these water tables. The poor natural drainage conditions, coupled with rising groundwater levels and increasing soil salinity, have meant that various soils could no longer produce crops, and some farms in the problem area have been abandoned.

In this report, “present problem area” is defined as a location where the water table is within 5 feet of the ground surface at any time during the year. A "potential problem area" indicates the water table is between 5 and 20 feet below the surface. Present and potential drainage problem areas are determined by the use of ArcGIS software within specific intervals as found in DWR's annual "Present and Potential Drainage Problem Area" maps for 2011 and 2012, Figures 8 and 9, respectively. In addition, Electrical Conductivity (EC) maps are presented for 2011 and 2012, Figures 10 and 11, respectively. Beginning with the 1991 map, DWR drew study-area boundaries that encompassed these problem areas.

Beginning in 1994, DWR established and published standard methods for collecting data for environmental measurement projects (DWR Quality Assurance Technical Document 2). This document specifies methods for the preparation, collection, handling, preservation, and transportation of samples and calibration of instruments. These methods were used to measure water levels in a network of monitoring wells in the study-area boundaries and in the interpretation of the data to establish acreage areas of the particular depth-to-water (DTW) intervals. The maps display an overview of the respective depth-to-water intervals, as well as the boundaries of study for Grasslands, Westlands, Tulare, and Kern subbasins. Table 1, Acreage of Present and Potential Drainage Problems, lists the acreages with drainage problems in the study area for 1991 through 2012. These acreage trends are graphed in Figure 1. Further focus on the individual subbasins can be found in Appendix A.

Table 1. Acreages of Present and Potential Drainage Problems, 1991 through 2001

Depth to Groundwater	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Grasslands Subbasin											
0 to 5 ft	114,000	136,000	147,000	146,000	166,000	164,000	156,000	235,000	182,000	130,000	96,000
5 to 10 ft	184,000	150,000	131,000	128,000	144,000	153,000	186,000	117,000	150,000	165,000	171,000
10 to 15 ft	72,000	77,000	99,000	86,000	64,000	59,000	44,000	39,000	59,000	60,000	47,000
15 to 20 ft	42,000	46,000	33,000	51,000	35,000	33,000	22,000	7,000	5,000	17,000	17,000
TOTAL	412,000	409,000	410,000	411,000	409,000	409,000	408,000	398,000	396,000	372,000	331,000
Kern Subbasin											
0 to 5 ft	40,000	34,000	24,000	10,000	32,000	50,000	58,000	84,000	77,000	39,000	26,000
5 to 10 ft	121,000	172,000	126,000	148,000	173,000	163,000	182,000	195,000	155,000	176,000	153,000
10 to 15 ft	152,000	84,000	162,000	137,000	115,000	82,000	78,000	77,000	96,000	87,000	53,000
15 to 20 ft	15,000	40,000	17,000	32,000	8,000	31,000	8,000	0	5,000	11,000	12,000
TOTAL	328,000	330,000	329,000	327,000	328,000	326,000	326,000	356,000	333,000	313,000	244,000
Tulare Subbasin											
0 to 5 ft	119,000	189,000	199,000	131,000	195,000	219,000	307,000	264,000	233,000	113,000	101,000
5 to 10 ft	244,000	121,000	135,000	212,000	157,000	104,000	65,000	20,000	107,000	178,000	243,000
10 to 15 ft	2,000	54,000	30,000	23,000	11,000	17,000	6,000	0	0	0	5,000
15 to 20 ft	0	1,000	0	0	0	0	0	0	0	0	0
TOTAL	365,000	365,000	364,000	366,000	363,000	340,000	378,000	284,000	340,000	291,000	349,000
Westlands Subbasin											
0 to 5 ft	38,000	110,000	75,000	34,000	126,000	104,000	228,000	278,000	146,000	146,000	149,000
5 to 10 ft	201,000	160,000	172,000	194,000	150,000	205,000	90,000	94,000	180,000	178,000	142,000
10 to 15 ft	85,000	69,000	87,000	96,000	65,000	58,000	49,000	20,000	49,000	46,000	36,000
15 to 20 ft	85,000	73,000	77,000	85,000	68,000	41,000	41,000	0	32,000	15,000	15,000
TOTAL	409,000	412,000	411,000	409,000	409,000	408,000	408,000	392,000	407,000	385,000	342,000
TOTALS											
0 to 5 ft	311,000	469,000	445,000	321,000	519,000	537,000	749,000	861,000	638,000	428,000	372,000
5 to 10 ft	750,000	603,000	564,000	682,000	624,000	625,000	523,000	426,000	592,000	697,000	709,000
10 to 15 ft	311,000	284,000	378,000	342,000	255,000	216,000	177,000	136,000	204,000	193,000	141,000
15 to 20 ft	142,000	160,000	127,000	168,000	111,000	105,000	71,000	7,000	42,000	43,000	44,000
TOTAL AREA	1,514,000	1,516,000	1,514,000	1,513,000	1,509,000	1,483,000	1,520,000	1,430,000	1,476,00	1,361,000	1,266,000

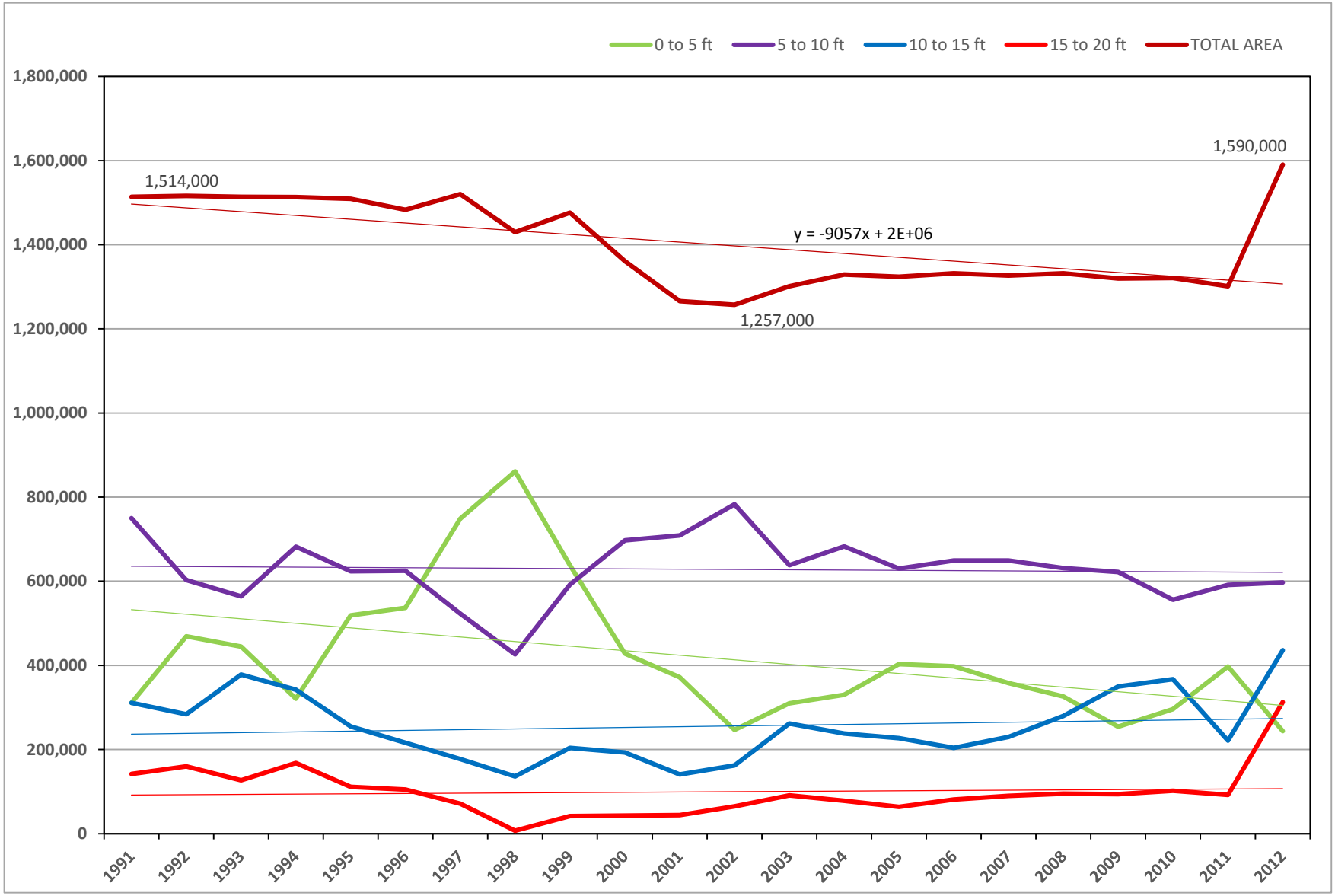
Variations in total result from rounding of numbers.

Table 1 (continued) Acreages of Present and Potential Drainage Problems, 2002 through 2012

Depth to Groundwater	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Grasslands Subbasin											
0 to 5 ft	129,000	95,000	128,000	163,000	138,000	128,000	130,000	89,000	121,000	143,000	91,000
5 to 10 ft	165,000	149,000	180,000	148,000	170,000	152,000	153,000	176,000	156,000	164,000	203,000
10 to 15 ft	54,000	77,000	50,000	52,000	53,000	61,000	70,000	73,000	64,000	54,000	103,000
15 to 20 ft	16,000	39,000	27,000	28,000	29,000	35,000	28,000	35,000	32,000	27,000	31,000
TOTAL	364,000	360,000	385,000	391,000	390,000	376,000	381,000	373,000	373,000	387,000	428,000
Kern Subbasin											
0 to 5 ft	6,000	6,000	2,000	2,000	8,000	6,000	2,000	5,000	2,000	6,000	8,000
5 to 10 ft	125,000	111,000	108,000	104,000	126,000	117,000	101,000	88,000	90,000	98,000	100,000
10 to 15 ft	58,000	68,000	78,000	77,000	49,000	66,000	80,000	89,000	95,000	74,000	195,000
15 to 20 ft	31,000	20,000	15,000	14,000	17,000	24,000	28,000	23,000	24,000	31,000	142,000
TOTAL	220,000	205,000	203,000	197,000	200,000	213,000	211,000	205,000	211,000	209,000	445,000
Tulare Subbasin											
0 to 5 ft	45,000	147,000	138,000	139,000	197,000	191,000	173,000	146,000	162,000	223,000	107,000
5 to 10 ft	279,000	165,000	190,000	185,000	141,000	160,000	167,000	185,000	158,000	124,000	140,000
10 to 15 ft	2,000	44,000	30,000	28,000	14,000	7,000	18,000	27,000	37,000	11,000	20,000
15 to 20 ft	0	3,000	0	0	6,000	0	0	1,000	1,000	0	20,000
TOTAL	326,000	359,000	358,000	352,000	358,000	358,000	358,000	359,000	358,000	358,000	287,000
Westlands Subbasin											
0 to 5 ft	67,000	62,000	62,000	99,000	55,000	33,000	21,000	14,000	11,000	25,000	38,000
5 to 10 ft	214,000	213,000	205,000	193,000	212,000	220,000	210,000	173,000	152,000	205,000	154,000
10 to 15 ft	48,000	73,000	80,000	70,000	88,000	96,000	112,000	161,000	171,000	82,000	118,000
15 to 20 ft	18,000	29,000	36,000	22,000	29,000	31,000	39,000	35,000	45,000	34,000	120,000
TOTAL	347,000	377,000	383,000	384,000	384,000	380,000	382,000	383,000	379,000	346,000	430,000
TOTALS											
0 to 5 ft	247,000	310,000	330,000	403,000	398,000	358,000	326,000	254,000	296,000	397,000	244,000
5 to 10 ft	783,000	638,000	683,000	630,000	649,000	649,000	631,000	622,000	556,000	591,000	597,000
10 to 15 ft	162,000	262,000	238,000	227,000	204,000	230,000	280,000	350,000	367,000	221,000	436,000
15 to 20 ft	65,000	91,000	78,000	64,000	81,000	90,000	95,000	94,000	102,000	92,000	313,000
TOTAL AREA	1,257,000	1,301,000	1,329,000	1,324,000	1,332,000	1,327,000	1,332,000	1,320,000	1,321,000	1,301,000	1,590,000

Variations in total result from rounding of numbers.

Figure 1, Depth to Water Acreage Trends of Drainage Impaired Lands 1991-2012



2011-2012 Drainage Monitoring Program

DWR's San Joaquin Valley drainage-monitoring for 2011 through 2012 consisted of collecting water samples from as many as 49 drainage sumps. Figure 2 (shown on page 9) provides an overview of the sampling area locations with boundaries representing the Northern, Central, and Southern areas.

The Northern Area, once monitored by USBR, is now a part of DWR's monitoring program. Beginning in 2010, preliminary investigative monitoring began with one surface and seventeen subsurface tile drains. As Northern locations and data are reviewed, only candidate sumps with continuing data and easy access will be included into the program.

The data presented includes all stations monitored, as shown in Tables 2 through 3, for the years 2011 through 2012, respectively. An overview of the monitoring stations are presented in Figures 2 through 7 (shown on pages 9 through 14), respectively.

TABLE 2
2011 DRAINAGE MONITORING STATIONS

Northern Area		Central Area		Southern Area	
VNS	2923	BVS	6001	BRL	2235
VNS	3733	BVS	7007	CCN	3550
VNS	4734	BVS	7402	CNR	0801
VNS	4931	BVS	8003	COC	4126
VNS	4951	CTL	3728	COC	8221
VNS	5661	DPS	1016	ERR	8429
VNS	6035	DPS	1367	ERR	8641
VNS	6927	DPS	2535	GSY	0935
VNS	6961	*DPS	3235	HCH	7841
VNS	7026	DPS	3465	LNW	5467
*VNS	7027	DPS	4616	LNW	6467
		FBH	2016	VGD	3906
		FBH	4045	VGD	4406
		FBH	5056	VGD	4806
		FBH	8061	VGD	5412
		HMH	7516	VGD	5509
		OAS	0364		
		OAS	2548		

*Surface drain

TABLE 3
2012 DRAINAGE MONITORING STATIONS

Northern Area		Central Area		Southern Area	
VNS	2923	BVS	6001	CCN	3550
VNS	3622	BVS	7007	CNR	0801
VNS	3733	BVS	8915	COC	4126
VNS	3848	CTL	3728	COC	8221
VNS	4734	DPS	1016	ERR	8429
VNS	4931	DPS	2535	ERR	8641
VNS	4951	*DPS	3235	GSY	0935
VNS	5661	DPS	4616	HCH	7841
VNS	5951	FBH	2016	HNE	3160
VNS	6035	FBH	4045	HNW	3111
VNS	6927	FBH	5056	LME	1546
VNS	6961	FBH	8061	LNW	5467
VNS	7026	HMH	7516	LNW	6467
*VNS	7027	OAS	2548	SFD	2944
		*PFM	6867	SFD	3027
				VGD	3906
				VGD	4406
				VGD	4806
				VGD	5412
				VGD	5509

*Surface drain

Figure 2. Overview of Sampling Area Locations

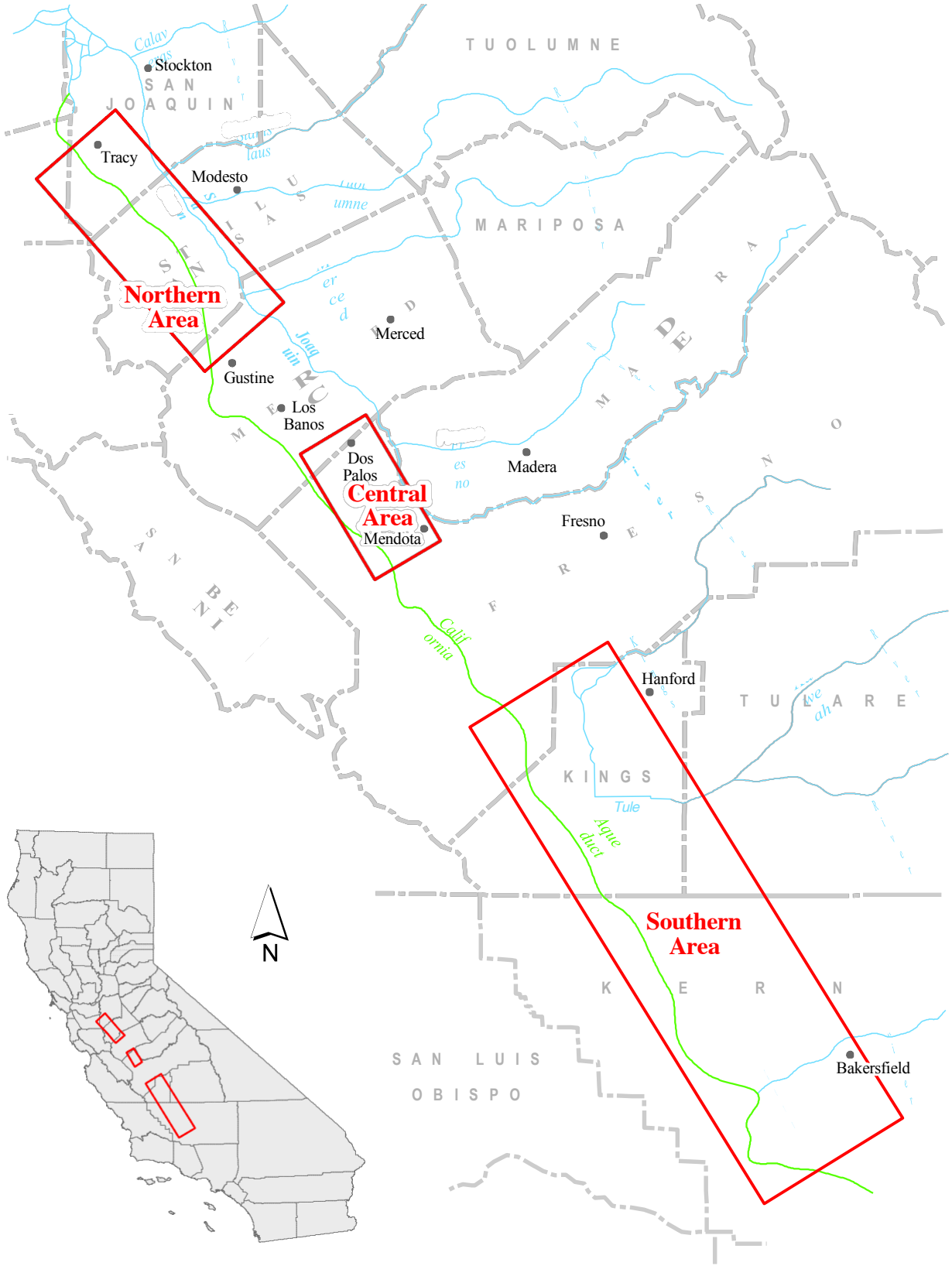


Figure 3. Northern Area Drain Locations

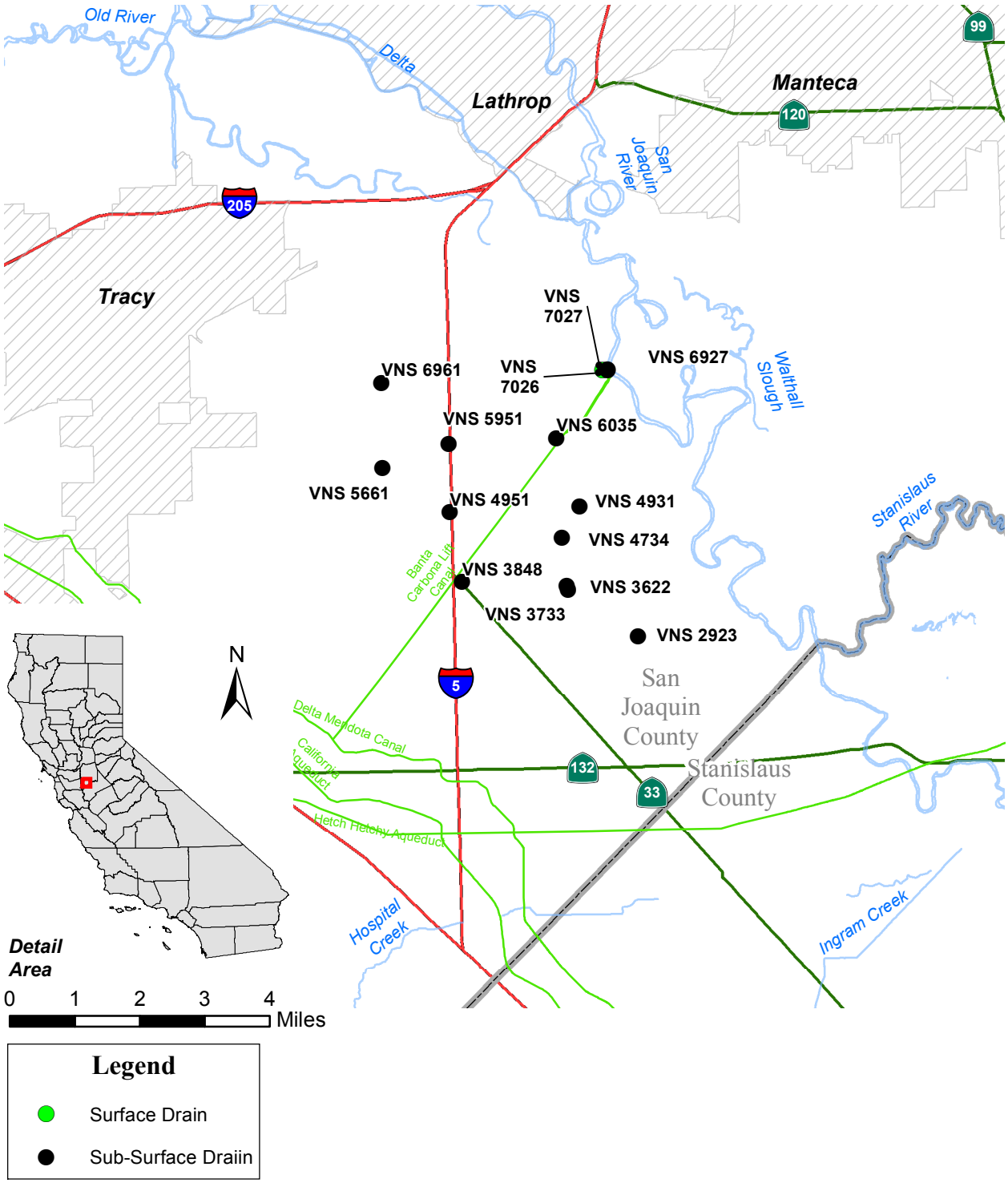


Figure 4. Central Area Drain Locations

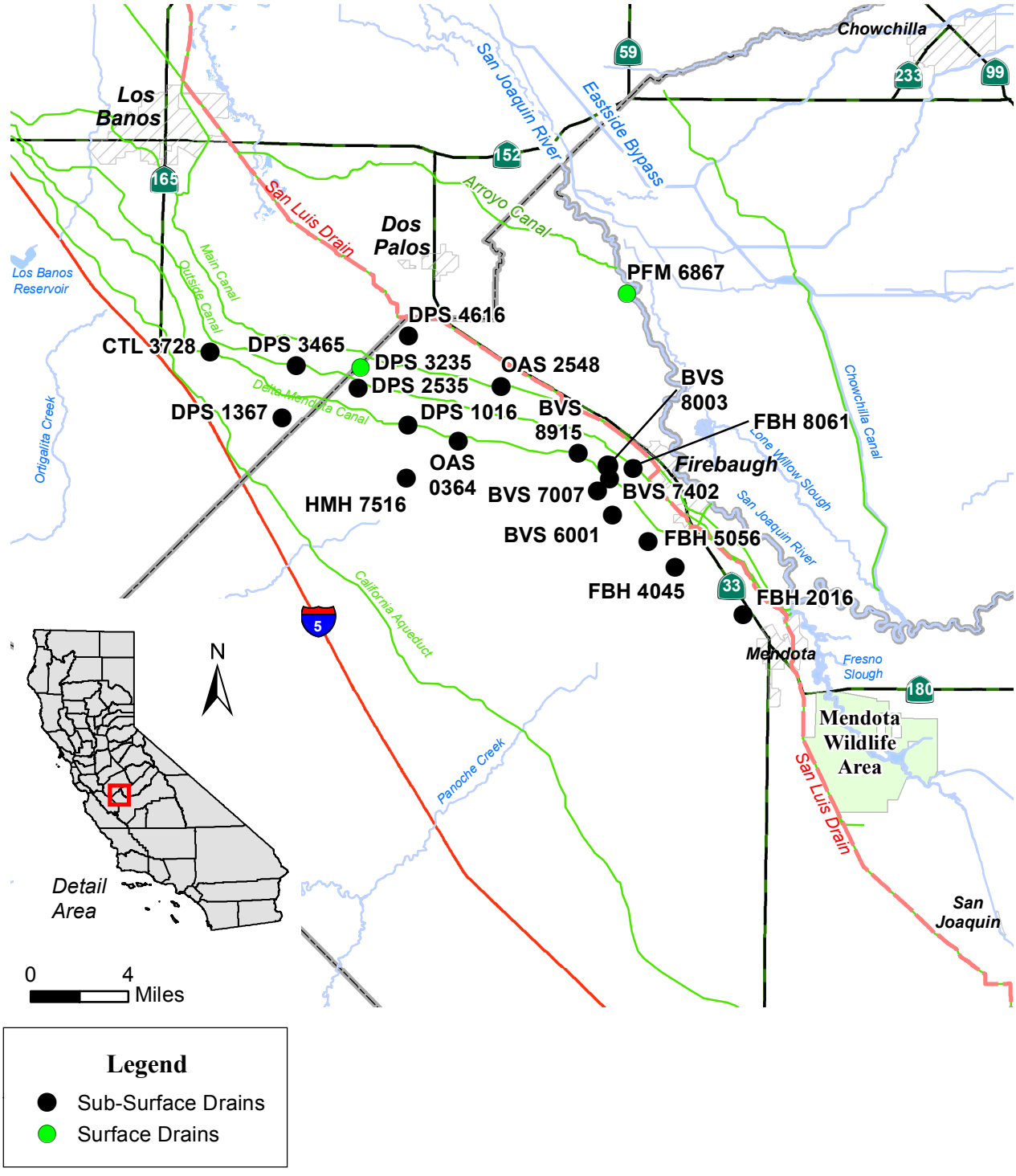


Figure 5. Southern Area Drain Locations - Lemoore/Corcoran

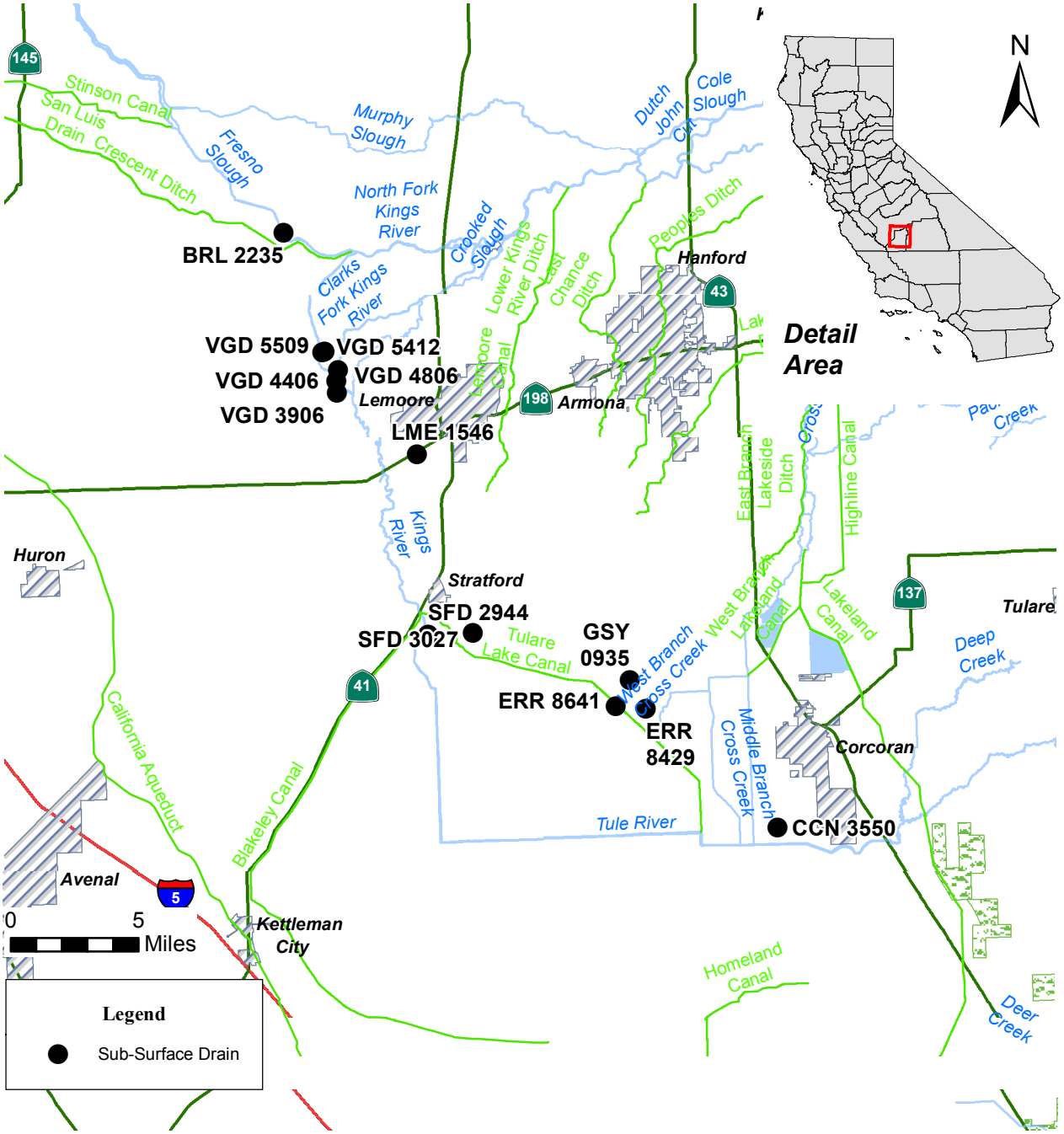


Figure 6. Southern Area Drain Locations - Lost Hills/Semitropic

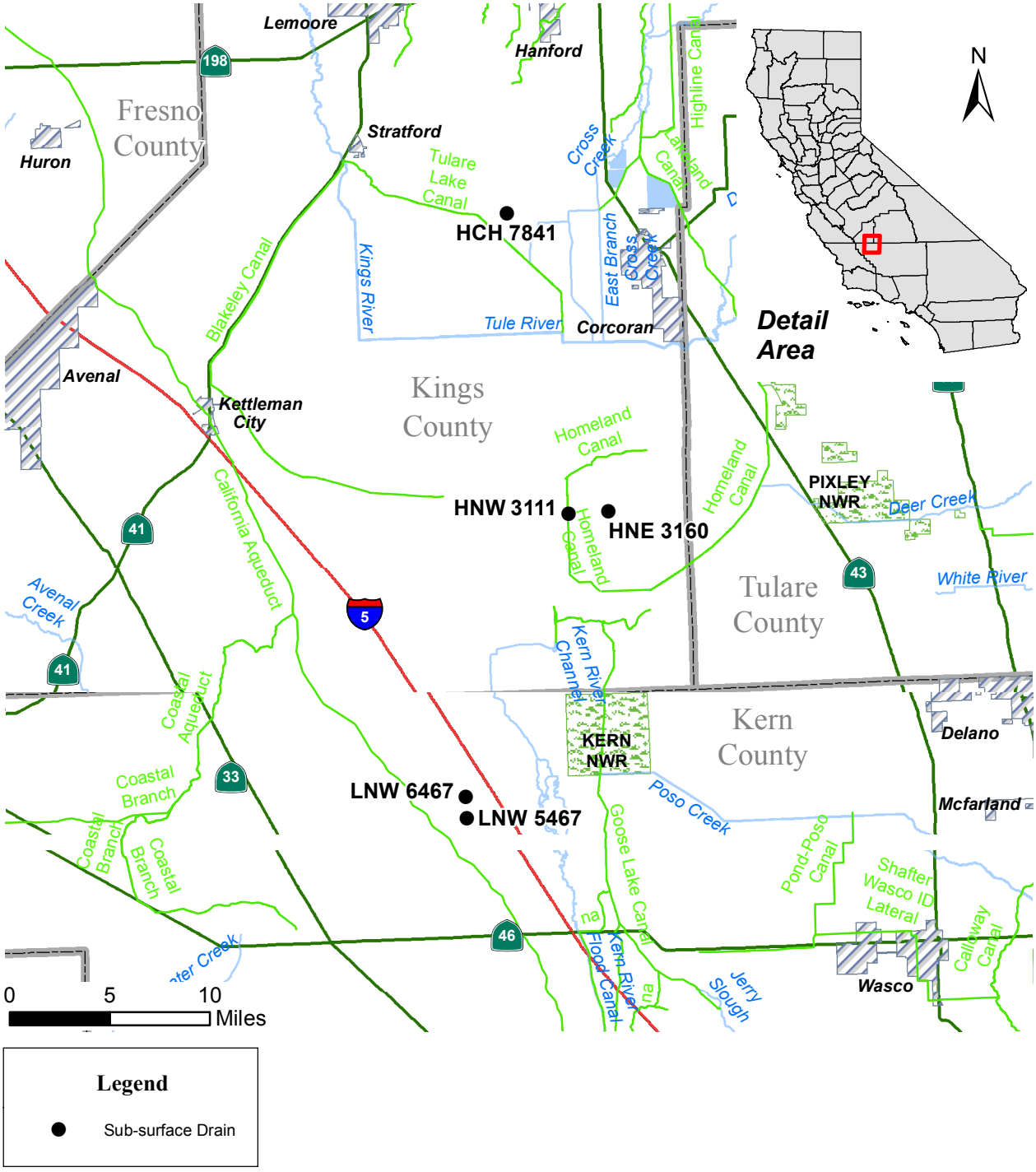
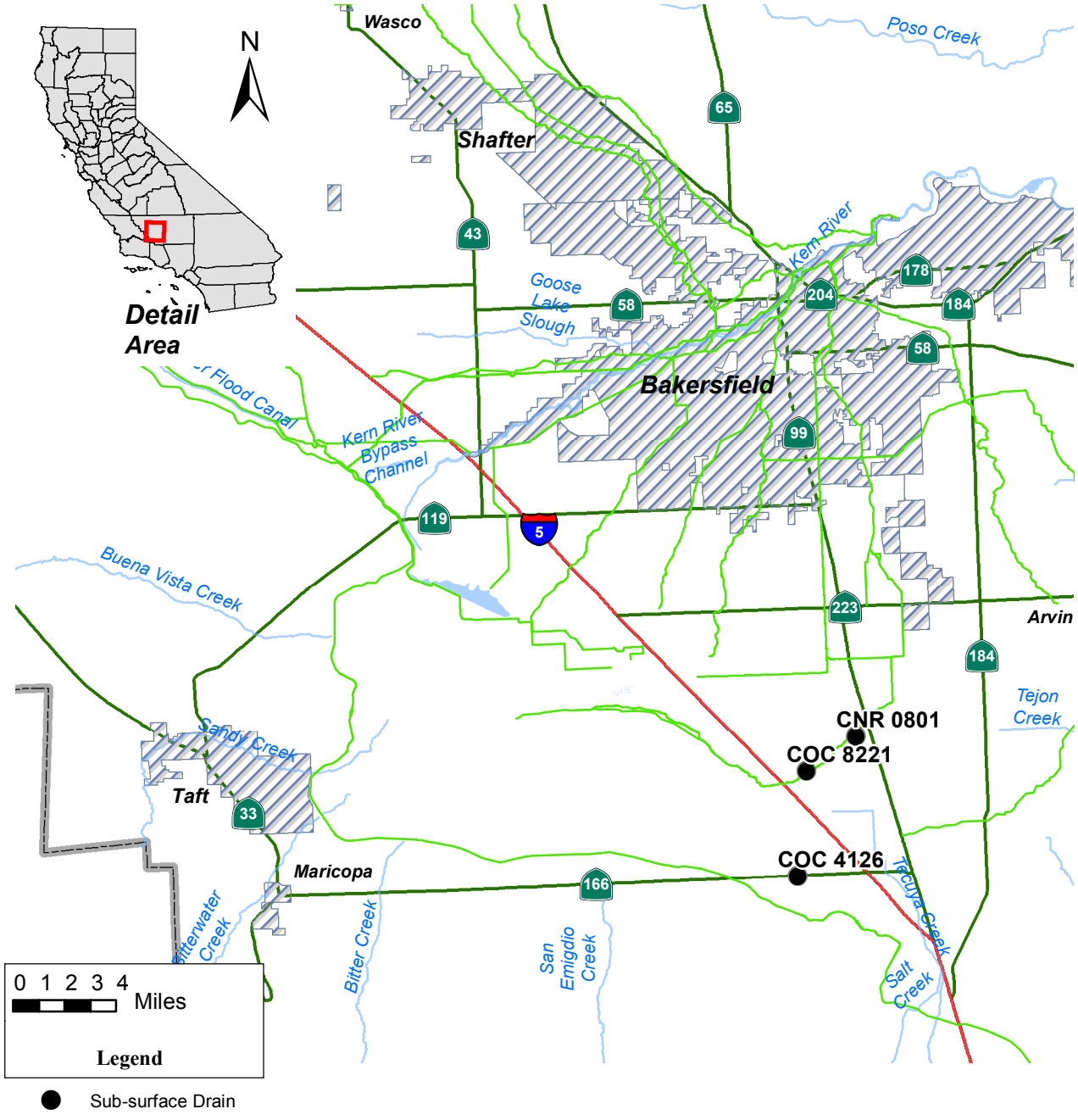


Figure 7. Southern Area Drain Locations - Kern Lakebed



Flows

DWR collects flow data from tiled area drainage sumps with functional flow meters. Many drains receive groundwater from areas outside the drainage pipe collector network. As a result, one drainage sump may act as a collector point for six or more systems. Depending on the soil surrounding the drain, one month's flow may have resulted from part of the previous month's irrigation. The 2011 – 2012 tiled acre subsurface drain flows are listed in Tables 4 through 5.

Table 4. Subsurface Drain Flows in acre-feet, 2011

Station	Area (acres)	Jan - Mar	Mar - May	May - Aug	Aug - Jan
Central Area					
BVS 6001	-	13.7	14.1	23.8	7.5
BVS 7007	-	41.9	107.2	133.4	5.7
BVS 7402	-	45.6	45.1	114.6	-
BVS 8003	110	-	-	-	-
CTL 3728	-	106.1	123.3	204.3	284.3
DPS 1016	-	4.4	0.8	-	0.4
DPS 1367	120	33.1	42.6	81.3	95.6
DPS 2535	320	68.5	59.4	134.3	84.4
DPS 3465	160	16.2	-	34.8	-
DPS 4616	140	6.4	-	16.3	4.2
FBH 2016	80	9.7	6.7	22.0	22.0
FBH 4045	400	-	-	-	-
FBH 5056	-	15.7	0.5	3.6	0.7
FBH 8061	320	33.7	37.4	66.6	20.6
HMH 7516	110	-	-	-	-
OAS 0364	-	-	-	-	-
OAS 2548	-	14.8	9.4	45.5	32.2
Southern Area					
BRL 2235	-	-	-	-	-
CCN 3550	560	12.3	12.4	18.1	29.9
CNR 0801	68	-	-	-	-
COC 4126	120	-	-	-	-
COC 8221	-	-	-	-	-
ERR 8429	-	-	-	-	-
ERR 8641	258	24.0	45.1	143.5	225.1
GSY 0935	-	170.3	221.1	360.3	266.8
HCH 7841	-	40.7	39.1	64.5	77.9
LNW 5467	1,770	-	-	-	-
LNW 6467	1,420	20.4	3.1	-	5.8
VGD 3906	870	-	-	-	-
VGD 4406	310	-	-	-	-
VGD 4806	-	-	-	-	-
VGD 5412	275	-	-	-	-
VGD 5509	-	-	-	-	-

- Denotes no reading or insufficient data

Table 5. Subsurface Drain Flows in acre-feet, 2012

Station	Area (acres)	Jan - Mar	Mar - May	May - Aug	Aug - Jan
Central Area					
BVS 6001	-	11.1	17.5	4.2	0.2
BVS 7007	-	54.1	111.7	4.3	-
BVS 8915	-	-	-	-	-
CTL 3728	-	144.2	177.9	94.5	108.7
DPS 1016	-	22.3	46.4	0.1	16.5
DPS 2535	320	-	-	199.9	28.9
DPS 4616	140	2.4	9.6	1.3	-
FBH 2016	80	26.2	40.6	-	29.6
FBH 4045	400	-	8.0	-	-
FBH 5056	-	3.4	20.7	13.9	-
FBH 8061	320	67.1	31.1	6.8	4.0
HMH 7516	110	-	-	-	-
OAS 2548	-	18.1	58.2	6.9	6.7
Southern Area					
CCN 3550	560	14.7	13.8	12.3	6.9
CNR 0801	68	-	-	-	-
COC 4126	120	-	-	-	-
COC 8221	-	-	-	-	-
ERR 8429	-	-	-	-	-
ERR 8641	258	92.7	94.7	25.5	68.8
GSY 0935	-	-	-	220.4	222.3
HCH 7841	-	63.9	54.5	-	60.9
HNE 3160	-	-	-	-	-
HNW 3111	-	-	-	-	-
LME 1546	-	-	-	-	-
LNW 5467	1,770	-	-	-	-
LNW 6467	1,420	0.112	0.007	-	0.003
SFD 2944	-	-	-	-	-
SFD 3027	-	-	-	-	-
VGD 3906	870	-	-	-	-
VGD 4406	310	-	-	-	-
VGD 4806	-	-	-	-	-
VGD 5412	275	-	-	-	-
VGD 5509	-	-	-	-	-

- *Denotes no reading or insufficient data*

Mineral Constituent and Trace Element Concentrations

This report provides a summary of the analyzed constituents analyzed in Tables 6 through 11 (pages 18–25) for the Northern, Central, and Southern Area drains, respectively. The Southern Area mineral constituents are divided into three sub-areas: Lemoore-Corcoran, Lost Hills-Semitropic, and Kern Lakebed. A complete list of minerals and trace element results for each station is given in Appendices D through I. DWR monitored only arsenic, barium, boron, molybdenum, and selenium trace elements for this report.

The report presents two averages: arithmetic average and geometric mean. The arithmetic average is the average of all data obtained for the given period, whereas, the geometric mean (extensively used by regulatory agencies) gives an average of central tendency that is less influenced by spiked values in the data. This report evaluates detection-only analyses. Detection limits reported with a "<" sign are not used to calculate averages.

This report also includes the 2011 and 2012 Areal Distribution of Shallow Groundwater and Electrical Conductivity Maps (Figures 8 through 11). The maps display an overview of the shallow groundwater conductivity within the respective subbasin study areas.

We used the sodium adsorption ratio (SAR) as an index to evaluate infiltration problems. It is a ratio of calcium and magnesium to sodium for soil extracts and irrigation water and is used to express the relative activity of sodium ions in exchange reactions in the soil. When sodium exceeds calcium by a ratio of 3:1 or greater, severe water infiltration problems occur because of the soil's structural makeup. The soil particles that plug and seal pores are dispersed through the soil column. The adjusted SAR (ASAR) is a refinement of the SAR and is no longer recommended by Oster and Rhoades (1977), Oster and Schroer (1979), and Suarez (1981), who conclude the procedure over-predicts the sodium hazard. They suggest the method be further adjusted by a 0.5 factor to evaluate more correctly the effects of bicarbonate on calcium precipitation (adj SAR x 0.5). This report presents the ASAR without further adjustment for those who prefer the given data and want to follow up on the recommended studies.

Low salinity water, water below 500 μS/cm, can cause infiltration problems in much the same manner as a high ASAR water affects the soil column. Low salinity water leaches minerals and salts from the soil, reducing the soil's structural integrity and causing soil dispersion. The finer dispersed soil particles fill many of the soil pores, plugging and sealing the pores, and preventing the irrigation water from passing through the soil column. Soil crusting and crop emergence problems often result (Ayers and Wescott, 1985).

This report presents historical selenium data and trends. Selenium averages for the Northern, Central, and Southern Areas are presented in Tables 12-14 (pages 27-28).

Table 6. 2011 Summary of Minerals and Trace Elements in Northern Area Drains
(milligrams per Liter)

Element	Minimum	Maximum	Arithmetic Average	Geometric Mean
Subsurface Stations				
Arsenic	0.001	0.003	0.002	0.002
Barium	<0.050	0.065	-	-
Boron	0.1	4.5	2.0	1.5
Calcium	13	233	131	103
Chloride	28	454	265	209
Hardness (as $CaCO_3$)	58	1,000	544	430
Magnesium	6	102	53	42
Molybdenum	< 0.005	< 0.005	-	-
Nitrate	1.8	75	50	36
Potassium	1.2	6.4	2.3	2.2
Selenium	0.001	0.011	0.007	0.006
Sodium	27	448	244	195
Sulfate	28	975	390	277
Total Alkalinity (as CaCO3)	47	345	262	226
TDS	154	2,560	1,380	1,100
Lab EC (µS/cm)	250	3,408	2,016	1,646
SAR	1.5	6.3	4.4	4.1
ASAR	0.7	8.1	5.3	4.4

All data collected in accordance with DWR's Quality Assurance Technical Document 2

Table 7. 2011 Summary of Minerals and Trace Elements in Central Area Drains
(milligrams per Liter)

Element	Minimum	Maximum	Arithmetic Average	Geometric Mean
Subsurface Stations				
Arsenic	0.003	< 0.020	0.006	0.005
Barium	< 0.050	< 1.0	-	-
Boron	1.6	79.7	12.3	9.3
Calcium	211	671	408	396
Chloride	133	2,680	716	606
Hardness (as $CaCO_3$)	705	3,870	1,747	1,657
Magnesium	43	623	176	154
Molybdenum	< 0.025	0.336	0.094	0.077
Nitrate	1.6	225	98	78
Potassium	1.0	7.2	3.5	3.2
Selenium	0.005	0.314	0.126	0.090
Sodium	148	3,950	1,073	890
Sulfate	689	8,880	2,650	2,321
Total Alkalinity (as CaCO3)	115	480	214	206
TDS	1,430	16,770	5,428	4,877
Lab EC (µS/cm)	1,872	18,210	6,531	5,990
SAR	2.4	32.7	10.7	9.5
ASAR	3.2	45.7	14.2	12.4

All data collected in accordance with DWR's Quality Assurance Technical Document 2

Table 8. 2011 Summary of Minerals and Trace Elements in Southern Area Drains
(milligrams per Liter)

Element	Minimum	Maximum	Arithmetic Average	Geometric Mean
Lemoore-Corcoran Stations				
Arsenic	0.001	0.190	0.061	0.032
Barium	< 0.05	< 1.0	-	-
Boron	0.1	35.2	12.0	5.1
Calcium	13	376	234	180
Chloride	11	1,860	667	479
Hardness (as $CaCO_3$)	48	4,768	1,722	1,122
Magnesium	4	954	276	154
Molybdenum	0.005	0.880	0.353	0.230
Nitrate	2.5	90.0	38.0	26.0
Potassium	0.9	21.7	8.0	6.6
Selenium	< 0.001	0.026	0.012	0.011
Sodium	27	6,450	2,548	1,523
Sulfate	40	16,600	5,737	2,707
Total Alkalinity (as CaCO3)	60	720	434	408
TDS	158	23,700	9,030	5,781
Lab EC (µS/cm)	270	22,510	9,971	6,975
SAR	1.7	48.5	24.6	19.8
ASAR	0.7	75.2	35.6	26.2
Lost Hills-Semitropic Stations				
Arsenic	0.020	0.258	0.083	0.053
Barium	< 0.25	< 1.0	-	-
Boron	3.0	41.8	24.1	17.8
Calcium	93	665	443	355
Chloride	722	6,540	3,607	2,846
Hardness (as $CaCO_3$)	473	3,244	2,138	1,784
Magnesium	58.0	405	251	214
Molybdenum	0.274	1.140	0.750	0.694
Nitrate	107	300	228	213
Potassium	5.4	10.0	7.7	7.5
Selenium	0.015	0.548	0.264	0.156
Sodium	980	6,070	3,788	3,314
Sulfate	1,190	7,730	5,031	4,317
Total Alkalinity (as CaCO3)	117	627	251	199
TDS	3,600	22,340	13,265	11,574
Lab EC (µS/cm)	5,206	26,060	15,898	14,241
SAR	19.6	47.3	35.1	34.1
ASAR	23.6	66.2	46.0	44.3

All data collected in accordance with DWR's Quality Assurance Technical Document 2

Table 8 continued on next page

Table 8 (continued). 2011 Summary of Minerals and Trace Elements in Southern Area Drains
(milligrams per Liter)

Element	Minimum	Maximum	Arithmetic Average	Geometric Mean
Kern Lakebed Stations				
Arsenic	0.005	0.026	0.015	0.010
Barium	< 0.25	< 0.50	-	-
Boron	1.8	18.7	8.1	5.6
Calcium	326	558	432	426
Chloride	149	509	292	258
Hardness (as $CaCO_3$)	1,350	2,657	1,915	1,868
Magnesium	84	397	203	177
Molybdenum	0.088	0.564	0.261	0.197
Nitrate	105	273	191	180
Potassium	4.7	75.7	27.2	17.2
Selenium	0.014	0.035	0.025	0.024
Sodium	305	1,950	1,030	872
Sulfate	1,720	5,260	3,203	2,969
Total Alkalinity (as CaCO3)	180	286	226	223
TDS	3,260	9,460	5,458	5,086
Lab EC (µS/cm)	3,611	10,430	6,260	5,865
SAR	3.3	16.6	9.9	8.8
ASAR	4.7	24.7	13.4	11.7

All data collected in accordance with DWR's Quality Assurance Technical Document 2

Table 9. 2012 Summary of Minerals and Trace Elements in Northern Area Drains
(milligrams per Liter)

Element	Minimum	Maximum	Arithmetic Average	Geometric Mean
Subsurface Stations				
Arsenic	0.001	0.005	0.002	0.002
Barium	0.020	0.071	0.038	0.036
Boron	0.1	4.0	1.9	1.4
Calcium	14	251	129	108
Chloride	31	553	253	219
Hardness (as $CaCO_3$)	64	1,063	534	453
Magnesium	7	106	51	44
Molybdenum	< 0.005	< 0.025	-	-
Nitrate	2.4	97.8	48	36
Potassium	1.3	4.2	2.9	2.8
Selenium	0.001	0.015	0.007	0.006
Sodium	28	393	229	199
Sulfate	32	881	358	276
Total Alkalinity (as CaCO3)	45	347	252	229
TDS	172	2,450	1,283	1,100
Lab EC (µS/cm)	305	3,391	1,929	1,703
SAR	1.5	5.4	4.2	4.1
ASAR	0.7	7.3	5.1	4.6

All data collected in accordance with DWR's Quality Assurance Technical Document 2

Table 10. 2012 Summary of Minerals and Trace Elements in Central Area Drains
(milligrams per Liter)

Element	Minimum	Maximum	Arithmetic Average	Geometric Mean
Subsurface Stations				
Arsenic	0.001	< 0.010	0.004	0.004
Barium	0.018	< 0.050	0.033	0.032
Boron	1.2	63.9	10.8	8.1
Calcium	100	662	375	347
Chloride	94	1,930	609	504
Hardness (as $CaCO_3$)	431	2,944	1,572	1,430
Magnesium	30	414	154	130
Molybdenum	0.005	0.156	0.063	0.050
Nitrate	3.5	441.0	93	68
Potassium	1.2	11.1	4.9	4.6
Selenium	0.002	0.578	0.112	0.069
Sodium	117	2,670	900	723
Sulfate	380	6,111	2,241	1,881
Total Alkalinity (as CaCO3)	97	510	221	210
TDS	945	12,270	4,703	4,086
Lab EC (µS/cm)	1,380	13,630	5,743	5,125
SAR	1.9	21.4	9.5	8.3
ASAR	2.3	31.0	12.6	10.8

All data collected in accordance with DWR's Quality Assurance Technical Document 2

Table 11. 2012 Summary of Minerals and Trace Elements in Southern Area Drains
(milligrams per Liter)

Element	Minimum	Maximum	Arithmetic Average	Geometric Mean
Lemoore-Corcoran Stations				
Arsenic	0.003	0.228	0.058	0.033
Barium	0.017	< 0.100	0.034	0.032
Boron	0.2	34.7	10.2	4.7
Calcium	20	415	225	180
Chloride	15	1,620	563	404
Hardness (as $CaCO_3$)	68	3,682	1,483	1,053
Magnesium	4.0	703.0	224.4	137.6
Molybdenum	0.011	0.885	0.327	0.218
Nitrate	0.6	101.0	43.2	31.8
Potassium	2.0	27.0	10.0	8.1
Selenium	< 0.001	0.037	0.012	0.009
Sodium	47	5,500	2,111	1,349
Sulfate	97	12,300	4,567	2,506
Total Alkalinity (as CaCO3)	40	733	434	397
TDS	25	19,620	8,043	5,045
Lab EC (µS/cm)	420	20,480	9,229	6,752
SAR	2.5	45.2	22.2	18.1
ASAR	1.1	70.1	32.3	24.3
Lost Hills-Semitropic Stations				
Arsenic	0.020	0.235	0.101	0.071
Barium	< 0.025	< 0.100	0.032	0.031
Boron	2.8	45.0	20.4	11.8
Calcium	62	692	352	247
Chloride	640	8,280	3,189	2,019
Hardness (as $CaCO_3$)	355	3,944	1,882	1,359
Magnesium	49	538	244	178
Molybdenum	0.311	1.220	0.771	0.714
Nitrate	61	317	186	162
Potassium	4.0	28.3	14.2	11.9
Selenium	0.013	0.530	0.183	0.075
Sodium	931	6,910	3,256	2,583
Sulfate	1,100	6,980	3,983	3,186
Total Alkalinity (as CaCO3)	111	560	332	276
TDS	3,190	23,720	11,817	9,150
Lab EC (µS/cm)	4,853	29,210	14,877	12,101
SAR	21.5	49.8	31.8	30.5
ASAR	25.8	69.7	42.3	40.4

All data collected in accordance with DWR's Quality Assurance Technical Document 2

Table 11 continued on next page

Table 11 (continued). 2012 Summary of Minerals and Trace Elements in Southern Area Drains
(milligrams per Liter)

Element	Minimum	Maximum	Arithmetic Average	Geometric Mean
Kern Lakebed Stations				
Arsenic	< 0.005	0.016	0.012	0.012
Barium	< 0.025	< 0.050	-	-
Boron	1.7	20.9	6.9	5.2
Calcium	333	521	418	414
Chloride	106	486	245	224
Hardness (as $CaCO_3$)	1,293	2,371	1,751	1,723
Magnesium	78	327	172	154
Molybdenum	0.070	0.585	0.213	0.164
Nitrate	89.3	372.6	192.4	175.4
Potassium	4.7	62.0	24.8	17.6
Selenium	0.012	0.034	0.022	0.021
Sodium	259	1,840	798	713
Sulfate	1,540	4,820	2,615	2,501
Total Alkalinity (as CaCO3)	177	296	205	203
TDS	2,830	8,620	4,763	4,556
Lab EC (µS/cm)	3,146	9,229	5,448	5,242
SAR	2.9	16.5	8.2	7.5
ASAR	3.9	23.0	10.7	9.8

All data collected in accordance with DWR's Quality Assurance Technical Document 2

Selenium

Selenium is a naturally-occurring, nonmetallic chemical element that accumulates in drainage water when selenium-enriched salts leach from the soil into the shallow groundwater. Water-quality problems associated with selenium are most likely to occur in the San Joaquin Valley where soils are formed of sediments from marine sedimentary rocks of the Coast Range. The occurrence of Coast Range sediments and the highest selenium concentrations are clearly linked throughout the Valley. Three areas of the western valley have the highest soil selenium concentrations:

- The alluvial fans near Panoche and Cantua Creeks in the central western valley
- An area west of the town of Lost Hills
- The Buena Vista Lake Bed area

High concentrations of selenium occur in subsurface drain water from some agricultural lands near, but not necessarily within, all three areas.

Selenium concentrations in samples collected from the Northern Area subsurface drains ranged from 0.001 to 0.015 mg/L during 2010-2012. The highest concentrations were found in samples collected from station VNS 4734, with selenium values ranging from 0.010 mg/L to 0.015 mg/L.

Selenium concentrations in samples collected from the Central Area subsurface drains ranged from 0.005 to 0.578 mg/L during 2010-2012. The highest concentrations were found in samples collected from central station BVS 7007, with selenium values ranging from 0.220 mg/L to 0.578 mg/L. In addition, high concentration values of 0.158 mg/L to 0.346 mg/L were found in samples collected from central station FBH 2016.

The concentration levels of selenium in the Southern Area subsurface drains ranged from 0.002 to 0.548 mg/L during 2010-2012. The highest selenium concentrations were found in samples collected from Lost Hills-Semitropic station LNW 6467, with selenium values ranging from 0.348 mg/L to 0.548 mg/L. Another Lost Hills-Semitropic station, LNW 5467, recorded high values ranging from 0.236 mg/L to 0.305 mg/L.

Historical averages are listed in Tables 12-14 (pages 27-28). Graphical trend analyses for selenium within the Central and Southern Areas are presented in Appendix B.

Table 12. Selenium in Northern Subsurface Drains, 2010-2012
(milligrams per Liter)

Arithmetic Average
Geometric Mean

2010	2011	2012
0.006	0.007	0.007
0.004	0.006	0.006

Table 13. Selenium in Central Subsurface Drains, 1986-2012
(milligrams per Liter)

Arithmetic Average
Geometric Mean

1986	1987	1988	1989	1990	1991	1992	1993	1994
0.099	0.110	0.095	0.090	0.085	0.091	0.066	0.071	0.077
0.061	0.053	0.057	0.053	0.053	0.050	0.042	0.054	0.050
1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	0.077	0.089	0.080	0.086	0.114	0.117	0.133	0.139
	0.049	0.061	0.059	0.057	0.080	0.083	0.097	0.099
2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
0.146	0.134	0.140	0.122	0.130	0.122	0.124	0.126	0.112
0.104	0.093	0.098	0.085	0.089	0.072	0.085	0.090	0.069

All data collected in accordance with DWR's Quality Assurance Technical Document 2
Arithmetic Average (top value), Geometric Mean (bottom value)

Table 14. Selenium in Southern Subsurface Drains, 1986-2012
(milligrams per Liter)

Arithmetic Average
Geometric Mean

Lemoore-Corcoran Area								
1986	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
0.004	0.004	0.007	0.009	0.009	0.007	0.006	0.010	0.005
0.003	0.003	0.004	0.005	0.005	0.005	0.004	0.006	0.004
1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	0.007	0.004	0.005	0.009	0.015	0.014	0.011	0.011
	0.005	0.003	0.004	0.007	0.012	0.011	0.008	0.009
2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
0.014	0.020	0.018	0.012	0.010	0.011	0.014	0.012	0.012
0.012	0.015	0.014	0.009	0.008	0.009	0.012	0.011	0.009
Lost Hills-Semitropic								
1986	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
0.155	0.191	0.129	0.117	0.095	0.132	0.154	0.124	0.144
0.034	0.059	0.022	0.020	0.017	0.032	0.033	0.029	0.035
1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	0.152	0.147	0.191	0.134	0.153	0.148	0.166	0.146
	0.049	0.067	0.079	0.045	0.086	0.083	0.084	0.086
2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
0.164	0.150	0.185	0.161	0.207	0.212	0.224	0.264	0.183
0.097	0.090	0.092	0.084	0.119	0.115	0.155	0.156	0.075
Kern Lakebed								
1986	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
0.115	0.124	0.157	0.177	0.094	0.049	0.101	0.094	0.152
0.041	0.043	0.078	0.073	0.044	0.027	0.025	0.026	0.032
1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
	0.099	0.085	0.118	0.141	0.293	0.194	0.093	0.047
	0.040	0.045	0.063	0.052	0.098	0.074	0.050	0.036
2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
0.033	0.034	0.031	0.029	0.027	0.028	0.027	0.025	0.022
0.032	0.033	0.030	0.028	0.026	0.027	0.026	0.024	0.021

All data collected in accordance with DWR's Quality Assurance Technical Document 2
Arithmetic Average (top value), Geometric Mean (bottom value)

Nitrates

Nitrate is one of the most widespread groundwater contaminants in both the United States and globally. A variety of chemicals, including nitrate, can pass through the soil and potentially contaminate ground water. Nitrates in groundwater originate from natural and organic sources, atmospheric deposition, and inorganic fertilizer. (Harter, 2009).

Beneath agricultural lands, nitrate is the primary form of nitrogen. Nitrogen is a component of chlorophyll which is essential for photosynthesis. It is a basic element of amino acids, the building blocks of proteins that permits plants to develop. Additionally, nitrogen is a significant component of nucleic acids in DNA, the genetic material that allows cells to grow and reproduce. Nitrifying bacteria can oxidize ammonium to nitrite (NO_2^-) and then to nitrate (NO_3^-). It is soluble in water and can easily pass through soil and into the groundwater table. Nitrates can remain in ground water for decades and accumulate to high levels as more nitrogen on land surface increases yearly. (USGS, 2014). Though nitrate is a useful form of nitrogen to plants and a valuable fertilizer, excessive levels of nitrate in drinking water can produce negative health impacts. The U.S. Environmental Protection Agency (EPA) has established a drinking-water MCL of 10 milligrams per liter (mg/L) nitrate as nitrogen (44 mg/L nitrate = 10 mg/L nitrate-N).

The concentration levels of dissolved nitrate in the Northern area subsurface drains ranged from 1.8 to 97.8 mg/L for 2011-2012 . The Central area levels ranged from 1.6 to 441 mg/L. The greatest nitrate values of all three areas were recorded at central subsurface drain BVS 7007, with concentrations ranging from 154 to 441 mg/L for 2010-2011. The Southern area concentration levels ranged from 0.6 to 317 mg/L for 2011-2012.

DWR sampled thirteen subsurface and one surface Northern area drains, eighteen subsurface and two surface Central area drains, and twenty-one Southern Area subsurface drains for dissolved nitrate concentrations in 2011 and 2012. Historical nitrate averages are listed in Tables 15-17 (pages 30-32) and graphical trend analyses for area drains are presented in Appendix C.

Table 15. Nitrates in Northern Subsurface Drains, 1970-1974, 2010-2012
(milligrams per Liter)

Arithmetic Average
Geometric Mean

1970	1972	1973	1974	2010	2011	2012
43.0	44.0	43.0	43.8	48.7	50.0	48.0
43.0	43.8	42.9	43.5	35.7	36.4	36.2

Table 16. Nitrates in Central Subsurface Drains, 1959-2012
(milligrams per Liter)

Arithmetic Average
Geometric Mean

1959	1961	1962	1963-1965	1966	1967	1968	1969	1970
168.7	68.6	142.8	73.1	168.2	96.7	107.1	117.4	108.4
91.4	25.5	83.9	43.5	130.9	64.9	59.5	91.0	71.0
1971	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
104.6	106.1	123.5	116.9	102.1	108.3	92.9	113.0	87.9
68.2	68.3	89.0	78.7	70.3	73.5	63.2	87.4	55.4
1980	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**
89.2	89.4	74.7	105.4	89.7	95.5	88.4	89.9	94.4
64.0	66.6	46.4	74.1	68.4	78.4	61.2	69.6	73.6
1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
89.9	89.8	93.8	104.2	100.5	95.2		104.0	110.1
68.6	69.7	74.0	76.0	81.9	72.1		83.1	71.2
1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
137.4	97.7	102.8	101.0	104.6	123.8	115.3	124.0	132.4
84.8	66.0	65.1	64.6	90.4	102.6	90.9	99.3	113.2
	2007	**2008**	**2009**	**2010**	**2011**	**2012**		
	113.8	102.4	100.5	105.9	97.9	87.6		
	85.6	68.6	68.5	79.0	78.2	62.6		

All data collected in accordance with DWR's Quality Assurance Technical Document 2
Arithmetic Average (top value), Geometric Mean (bottom value)

Table 17. Nitrates in Southern Subsurface Drains, 1966-2012
(milligrams per Liter)
Arithmetic Average
Geometric Mean

Lemoore-Corcoran Area

1966-1968	1970-1971	1972	1973	1974	1975	1976	1977	1978-1979
35.7	32.3	29.3	32.1	34.5	32.9	24.4	22.3	38.1
25.2	26.0	20.7	22.3	24.2	25.3	16.9	16.5	25.7
1980-1981	**1982-1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
47.9	58.1	41.8	38.4	38.5	44.5	41.1	41.2	48.1
36.5	38.4	32.0	31.5	32.0	39.0	34.8	35.2	42.3
1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
50.3	49.5	40.7		48.0	54.6	57.2	46.6	40.1
42.7	43.4	35.6		39.1	48.7	42.1	35.5	31.0
2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
59.2	38.4	48.5	50.6	55.8	50.1	37.5	40.1	40.7
23.7	21.2	34.9	39.3	49.0	35.8	27.5	23.9	28.8

2010	2011	2012
41.3	38.4	43.2
32.0	26.4	31.8

Lost Hills-Semitropic

1966-1969	1970-1971	1972-1974	1975	1976	1977	1978-1979	1980-1982	1983-1984
72.1	75.2	73.6	35.2	37.4	27.6	42.8	26.7	45.1
70.7	74.2	70.9	25.8	20.0	11.4	21.3	17.5	35.5
1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
144.6		190.5	187.9	208.9	154.1	139.1	125.9	126.0
55.8		156.6	168.2	190.8	81.7	70.9	55.4	38.7
1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
98.1	119.9	132.6	105.3	101.3	100.2	123.8	149.9	137.0
59.0	79.1	94.2	55.3	47.4	46.7	58.5	61.7	71.8
2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
169.4	163.7	173.4	174.0	155.0	178.3	173.8	231.1	228.2
95.8	124.0	152.3	148.3	124.3	159.1	130.3	216.2	213.0

2012
185.9
162.3

All data collected in accordance with DWR's Quality Assurance Technical Document 2
Arithmetic Average (top value), Geometric Mean (bottom value)

Table 17 continued on next page

Table 17 (continued). Nitrates in Southern Subsurface Drains, 1966-2012
(milligrams per Liter)

Arithmetic Average
Geometric Mean

Kern Lakebed

1966-1969	1970-1975	1976-1979	1985	1986	1987	1988	1989	1990
5.1	9.5	5.9	125.5	198.4	189.2	230.5	186.4	165.0
4.0	8.2	4.9	104.6	135.6	110.5	162.9	142.4	104.3
1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
191.1	198.3	192.2	201.2		260.5	239.8	199.1	215.3
143.9	102.0	110.1	99.9		232.7	202.3	152.7	175.6
2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
276.5	254.9	166.7	218.3	201.4	210.0	209.7	237.9	215.1
268.0	245.2	150.0	202.7	190.3	196.5	196.4	221.2	200.7
		2009	**2010**	**2011**	**2012**			
		190.3	188.6	190.8	192.4			
		176.9	176.9	180.2	175.4			

All data collected in accordance with DWR's Quality Assurance Technical Document 2
Arithmetic Average (top value), Geometric Mean (bottom value)

Pesticides

Pesticide is a generic term for compounds used as fungicides, herbicides, insecticides, nematocides, acaracides, and rodenticides. In this report, the term "pesticide" also includes transformation products and other agriculturally related organic compounds, such as, pesticide by-products or additives. For example, aldicarb sulfoxide is a degradation product of aldicarb. Pesticides do not occur naturally in the environment. The application of pesticides on agricultural crops and right-of-ways results in the presence of pesticides in drainage water.

DWR began monitoring for pesticides in 1963. Samples were collected from San Joaquin Valley tile drains (8 locations), surface drains (13 locations), surface waters (26 locations), and bay and ocean waters (10 locations). We analyzed the samples for 15 organochlorine pesticides. At the time, DDT and its metabolites (DDE and DDD) were the pesticides detected at the highest frequency. The higher concentrations of pesticides were found in surface drains and surface waters. Over time, the sampling locations, as well as the pesticides, that we analyzed (organophosphorus pesticides were added) had changed. Because pesticide concentrations in agricultural drainage were low or often not detected, DWR stopped monitoring in 1986.

DWR resumed monitoring agricultural drainage water for pesticides in 2007 with plans to continue the program every two years. Sample station locations collected in 2011 for the Northern, Central, and Southern tile drains are listed in Table 18 below.

Table 18. Pesticide Drainage Monitoring Stations, 2011

Northern Area		Central Area		Southern Area	
VNS	6035	CTL	3728	CCN	3550
*VNS	7027	FBH	2016	CNR	0801
		HMH	7516	COC	4126
		OAS	2548	ERR	8641
				HCH	7841
				LNW	5467
				VGD	3906

*Surface drain

The distribution of a pesticide is a function of its physicochemical properties, such as solubility in water, the soil's biological and physicochemical properties, and climatic variables that influence the pesticide's environmental dispersal. Environmental monitoring of pesticides is complex because pesticides are taken up by the target organisms, and pesticides are sometimes metabolized by microorganisms in the soil, evaporated from water or soil to the air through volatilization, adsorbed to soils and sediments, and broken down by photolysis or hydrolysis. Thus, from the time a pesticide is applied to the time a sample of drainage water is collected, a pesticide may no longer be at a detectable concentration.

Table 19. Pesticide Values Detected in Drainage Monitoring Stations, 2011

Station	Collection Date	Pesticide	Concentration (υg/L)	Reporting Limit (υg/L)
Northern Area				
VNS 6035	09/08/11	Metolachlor	0.05	0.05
VNS 7027	09/08/11	Metolachlor	0.06	0.05
Central Area				
CTL 3728	09/12/11	Metolachor	0.05	0.05
FBH 2016	09/12/11	Chlorothalonil	0.02	0.01
HMH 7516	09/12/11	Chlorothalonil	0.01	0.01
OAS 2548	09/12/11	Triclopyr	1.10	0.10
Southern Area				
CCN 3350	09/08/11	Simazine	0.02	0.02
CNR 0801	09/08/11	Chlorothalonil	0.01	0.01
CNR 0801	09/08/11	Dacthal (DCPA)	0.60	0.50
COC 4126	09/08/11	Simazine	0.04	0.02
COC 4126	09/08/11	Dacthal (DCPA)	3.50	0.50
ERR 8641	09/08/11	Simazine	0.20	0.02
HCH 7841	09/08/11	Atrazine	0.02	0.02
VGD 3906	09/08/11	Chlorothalonil	0.09	0.01
VGD 3906	09/08/11	Chlorpyrifos	0.02	0.01

All data collected in accordance with DWR's Quality Assurance Technical Document 2

For all station areas, at least one pesticide was detected at each location sampled. Within the Southern Area, the Lost Hills-Semitropic station LNW 5467 was the only station with non-detects.

Many pesticides not available in 1986 are now in use, while many pesticides used in the past are now prohibited. In addition, today's analytical methods achieve much lower detection limits. Of the 96 pesticides analyzed for 2011, seven pesticides were detected from the locations sampled as shown in Table 19 (above). All pesticides that were analyzed and their reporting limits are shown in Appendix J. Some properties of these pesticides are also shown in Appendix J. This information is from *The Agrochemicals Handbook*, 2nd edition, published by The Royal Society of Chemistry.

Drinking water standards have been established for only two of the pesticides that were detected. The drinking water standards and the highest concentration of pesticide that was detected in the Northern, Central, and Southern Areas are shown in Table 20. No pesticides were found above any enforceable drinking water standards.

Drinking water standards have been established for only two of the pesticides that were detected. The drinking water standards and the highest concentration of pesticide that was detected in the Northern, Central, and Southern Areas are shown in Table 20. No pesticides were found above any enforceable drinking water standards.

Table 20. Detected Pesticide Compounds with Public Agency Standards, 2011

Detected Compounds	Drinking Water Standards-Maximum Contaminant Levels (MCLs)					California Public Health Goal (PHG)	California Notification Levels	Highest Concentration Detected		
	California Dept. of Public Health		U.S. Environmental Protection Agency							
	Primary MCL (health based + technology + economics)	Secondary MCL (taste & odor or welfare-based)	Primary MCL (health based + technology + economics)	Secondary MCL (taste & odor or welfare-based)	MCL Goal (level for no adverse health effects)			North	Central	South
	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Atrazine	1		3		3	0.15				0.02
Chlorothalonil									0.02	0.09
Dacthal										3.50
Metolachlor								0.06	0.05	
Simazine	4		4		4	4				0.20
Triclopyr									1.10	

All data collected in accordance with DWR's Quality Assurance Technical Document 2

Nutrients

The SJVDMP had not sampled subsurface drains for nutrients since 1987 when total ammonia and organic nitrogen, dissolved nitrate and nitrite, dissolved ammonia, dissolved orthophosphate, and total phosphorus were last analyzed. However, the SJVDMP resumed sampling in 2007 and will continue monitoring biannually.

In 2011, DWR sampled two Northern, four Central, and seven Southern Area drains for nutrients. The samples were analyzed for dissolved ammonia as nitrogen, dissolved nitrate + nitrite, dissolved ortho-phosphate, Kjeldahl nitrogen (TKN), and total phosphorous. The 2011 data for these drains are included in Appendix J.

Nitrifying bacteria can oxidize ammonium to nitrite (NO_2^-) and then to nitrate (NO_3^-). Heavy, clay-rich soils favor denitrification whereas shallow, coarse-textured, highly permeable soils and aquifers, common in agricultural regions of the Southwest, are typically high in dissolved oxygen and more susceptible to higher levels of nitrate (Harter, 2009). A further study on nutrients will be presented in a future report

Table 21. Nutrients Detected in Subsurface Drains, 2011

Station	Date	Ammonia as Nitrogen (mg/L as N)	Dissolved Ortho Phosphate (mg/L as P)	Total Phosphorus (mg/L)	Nitrate + Nitrite (mg/L as N)	Total Kjeldahl Nitrogen (mg/L as N)
Northern Area						
VNS 6035	08/17/11	< 0.01	0.03	0.03	14.0	0.20
VNS 7027	08/17/11	< 0.01	0.03	0.03	15.0	0.20
Central Area						
CTL 3728	08/17/11	0.04	0.02	0.13	9.2	1.00
FBH 2016	08/17/11	0.01	0.06	0.09	17.0	0.20
HMH 7516	08/17/11	0.01	0.01	0.02	31.0	0.20
OAS 2548	08/15/11	0.01	0.06	0.09	5.5	0.50
Southern Area						
CCN 3550	08/17/11	0.05	0.49	0.55	10.0	0.70
CNR 0801	08/17/11	0.01	0.01	0.02	84.0	< 0.10
COC 4126	08/17/11	0.01	< 0.01	0.02	31.0	0.10
ERR 8641	08/17/11	3.50	1.60	2.30	1.1	11.00
HCH 7841	08/17/11	0.02	0.66	0.96	25.0	0.90
LNW 5467	08/16/11	0.02	0.02	0.02	80.0	< 0.10
VGD 3906	08/16/11	0.03	0.13	0.30	2.3	0.50

DWR's Future Monitoring Program

Plans are being formulated to modify and upgrade activities of DWR's ongoing monitoring program. This work involves cooperation and participation from water and drainage districts and from willing growers. Protocols to collect data from the various districts are being refined so that data can be obtained and evaluated in a timely manner. Plans are being made to solicit regulatory agencies for appropriate drainage data that can be included in future drainage monitoring program reports.

DWR's Agricultural Drainage web portal is located at **http://www.water.ca.gov/drainage**. The site presents various information to data, drainage and monitoring, and various projects the Region has participated in. Additional web pages are being developed to present monitoring data at this website.

Drainage monitoring reports, maps, and project reports are currently available at **http://www.water.ca.gov/publications/browse.cfm?display=topic&pub=120.6839.** This report will also be posted at this address.

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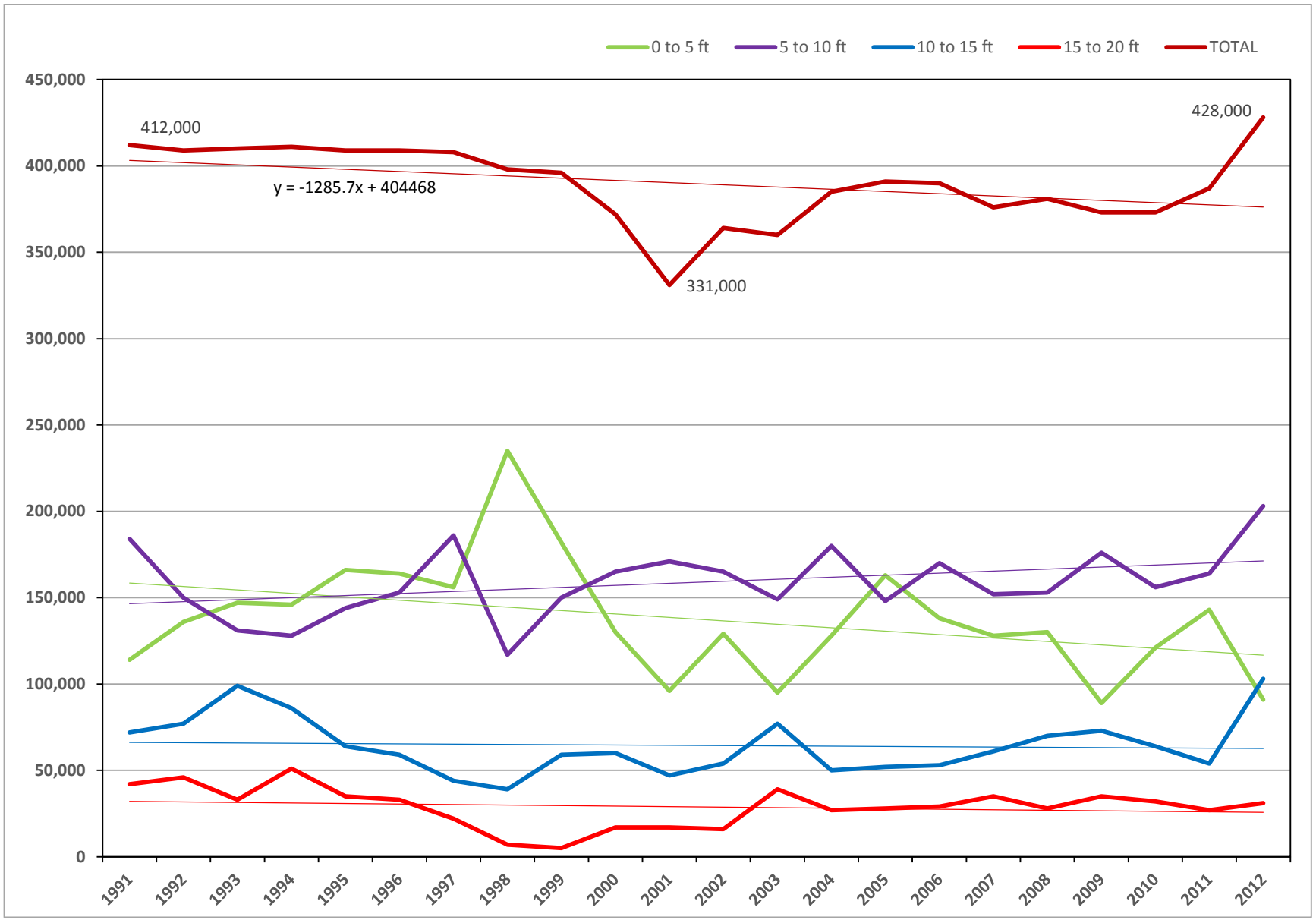
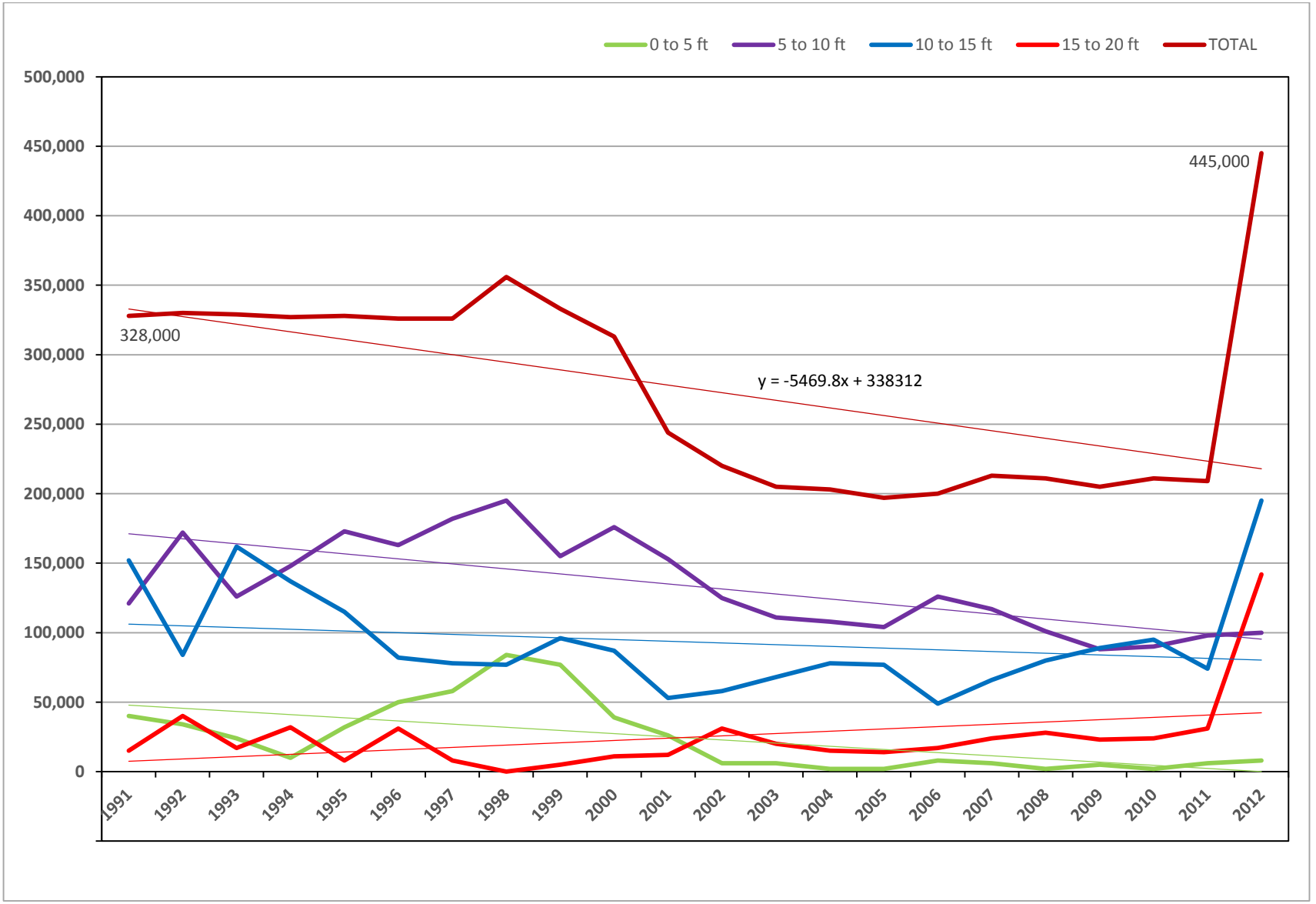
Appendix A
Depth to Water Acreage Trends of Drainage Impaired Lands 1991-2012

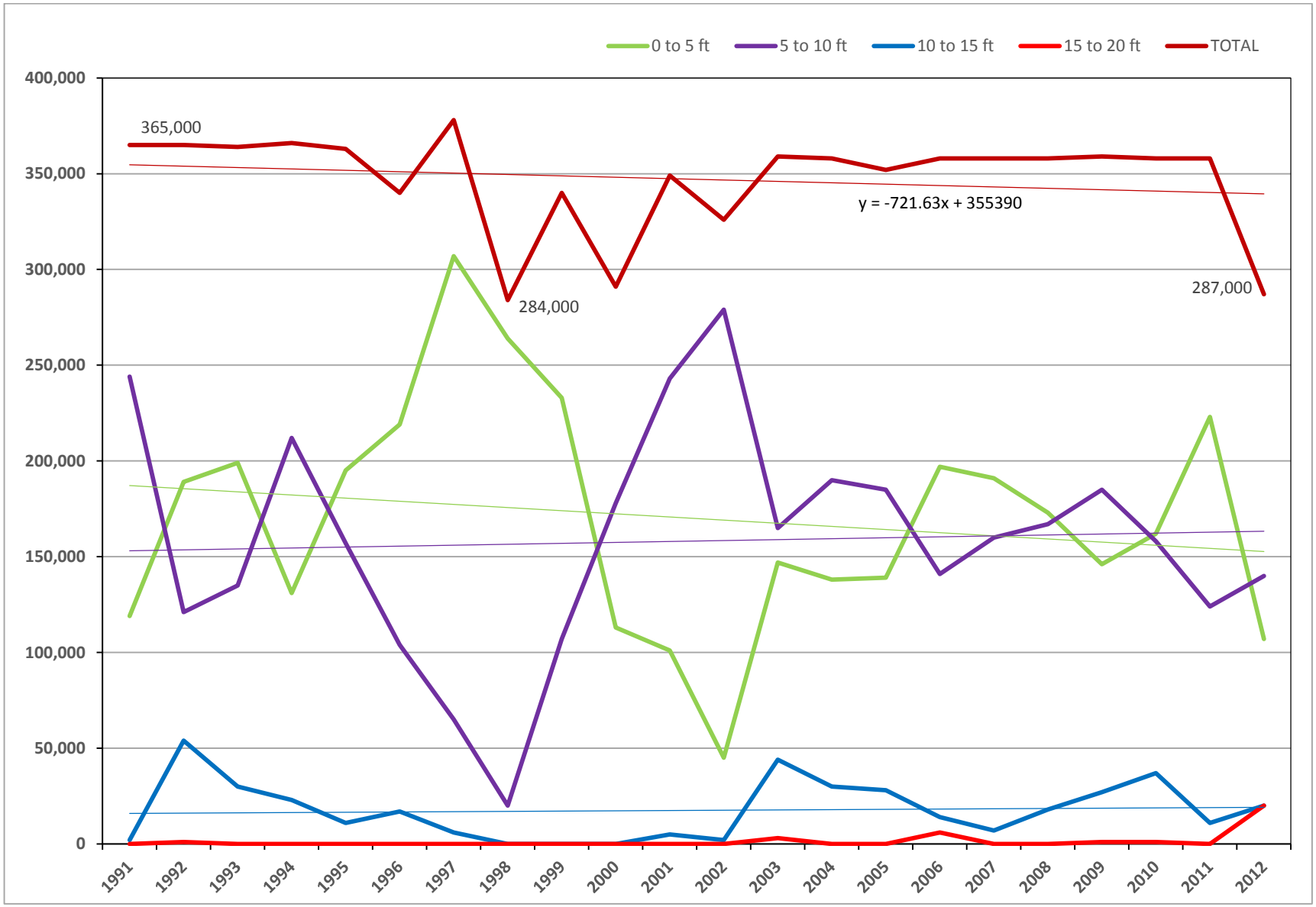
Grasslands Subbasin, Depth to Water Acreage Trends of Drainage Impaired Lands
1991-2012



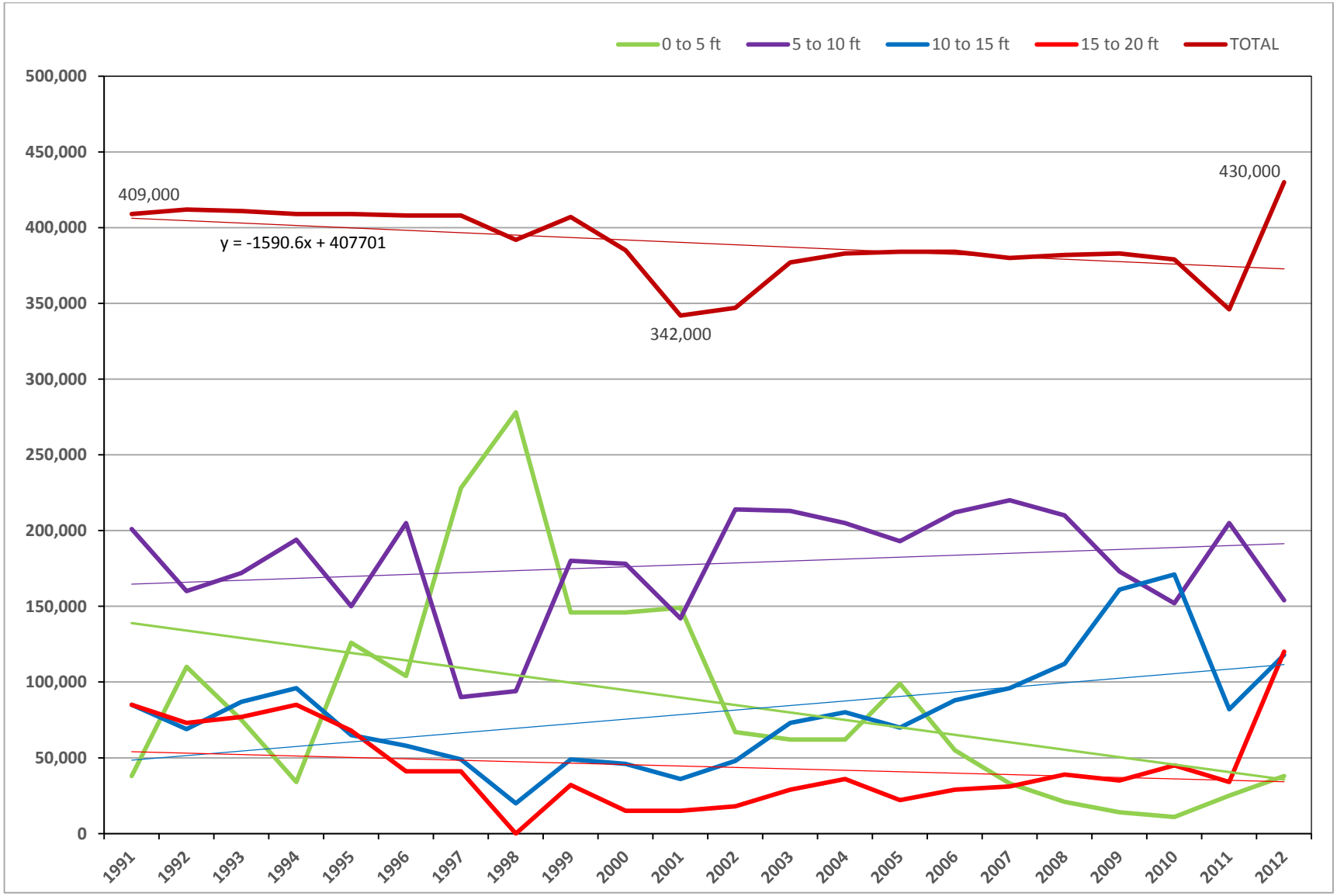
Kern Lakebed Subbasin, Depth to Water Acreage Trends of Drainage Impaired Lands
1991-2012



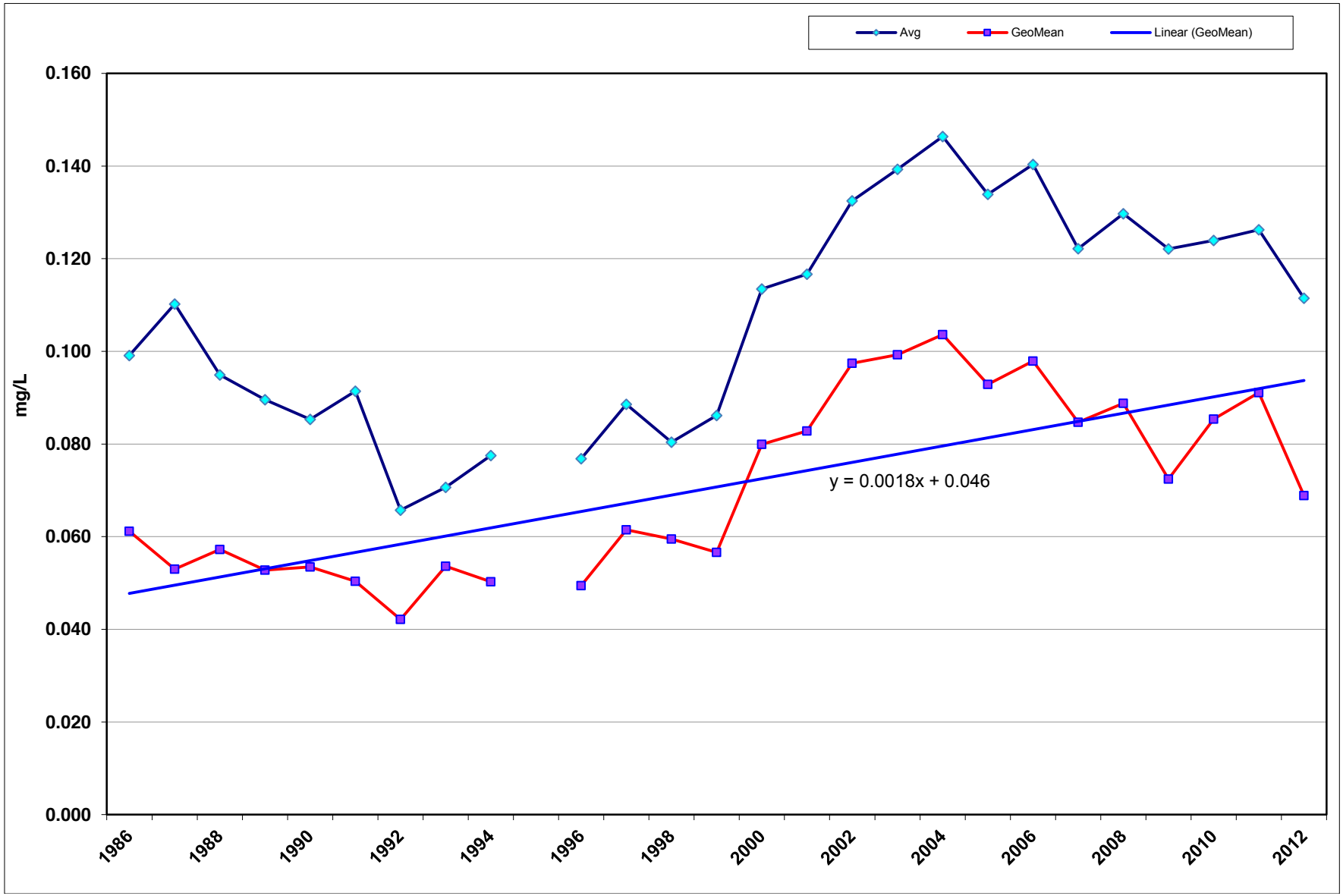
Tulare Subbasin, Depth to Water Acreage Trends of Drainage Impaired Lands
1991-2012



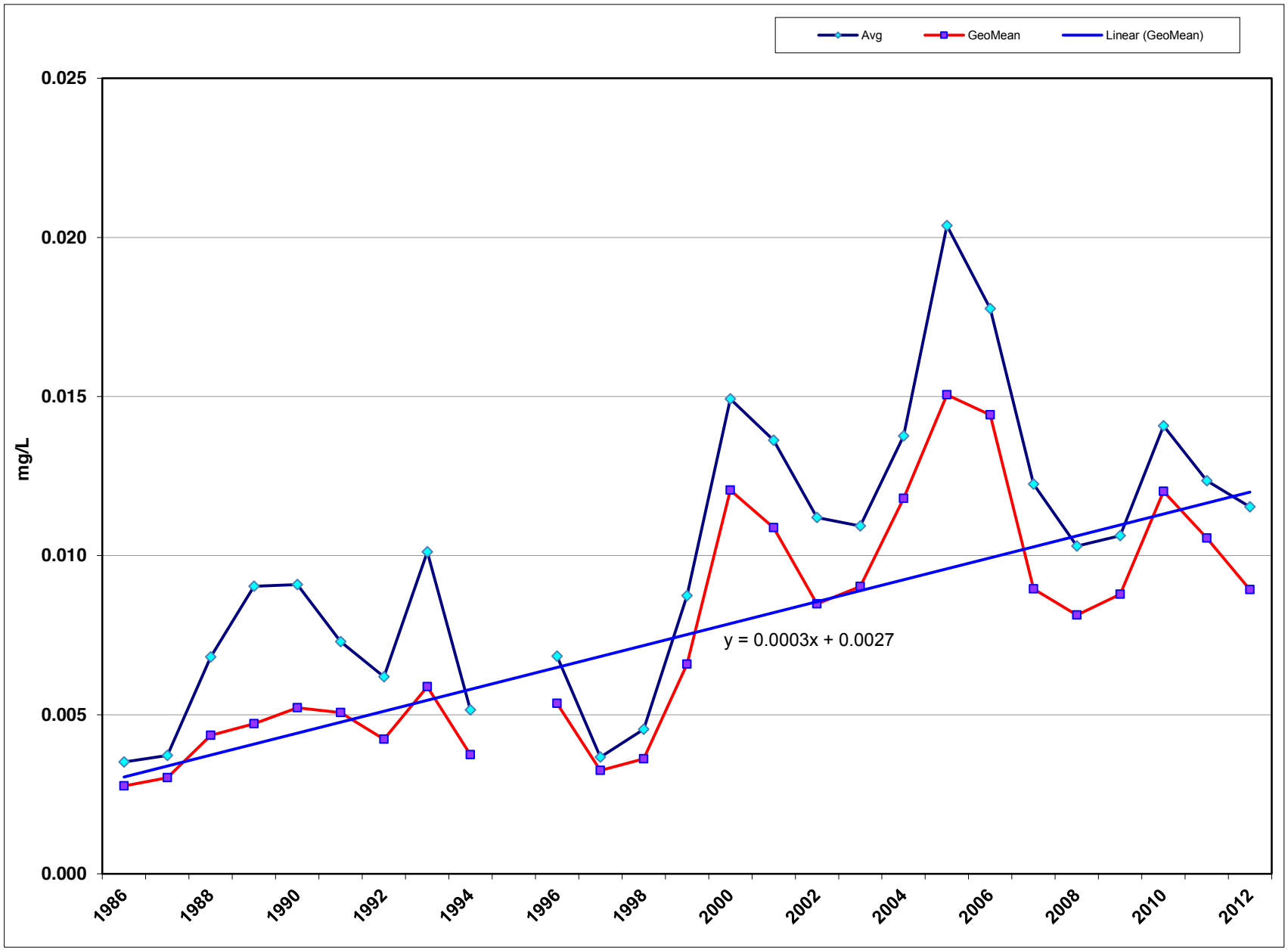
Westlands Subbasin, Depth to Water Acreage Trends of Drainage Impaired Lands
1991-2012



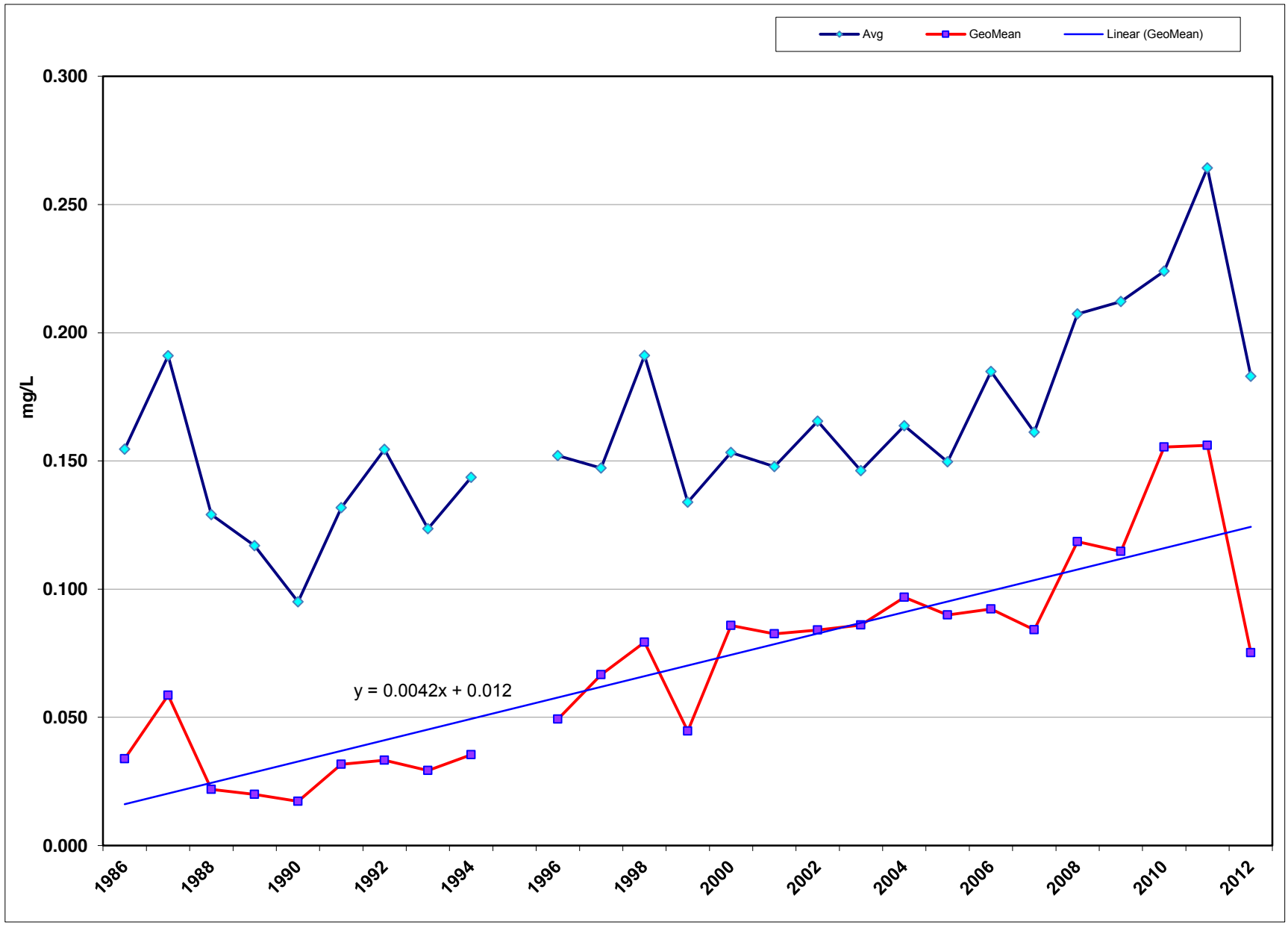
Appendix B
Selenium Trends in Central & Southern Tile Drains through 2012


Selenium in Central Subsurface Drains, 1986-2012
Avg
GeoMean
Linear (GeoMean)
mg/L
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
y = 0.0018x + 0.046
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012

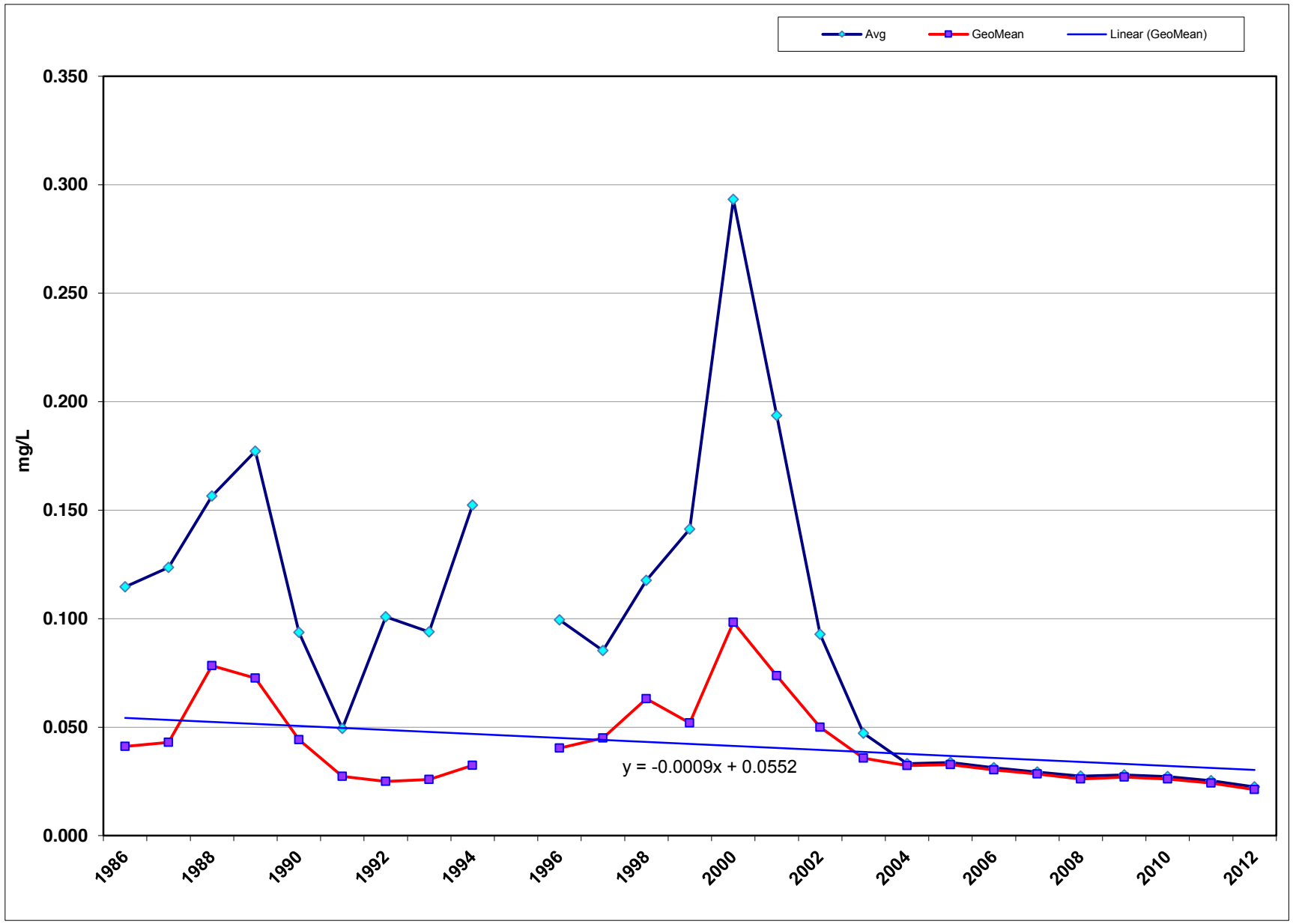
Selenium in Southern Subsurface Drains, Lemoore-Corcoran Stations, 1986-2012



Selenium in Southern Subsurface Drains, Lost Hills-Semitropic Stations, 1986-2012

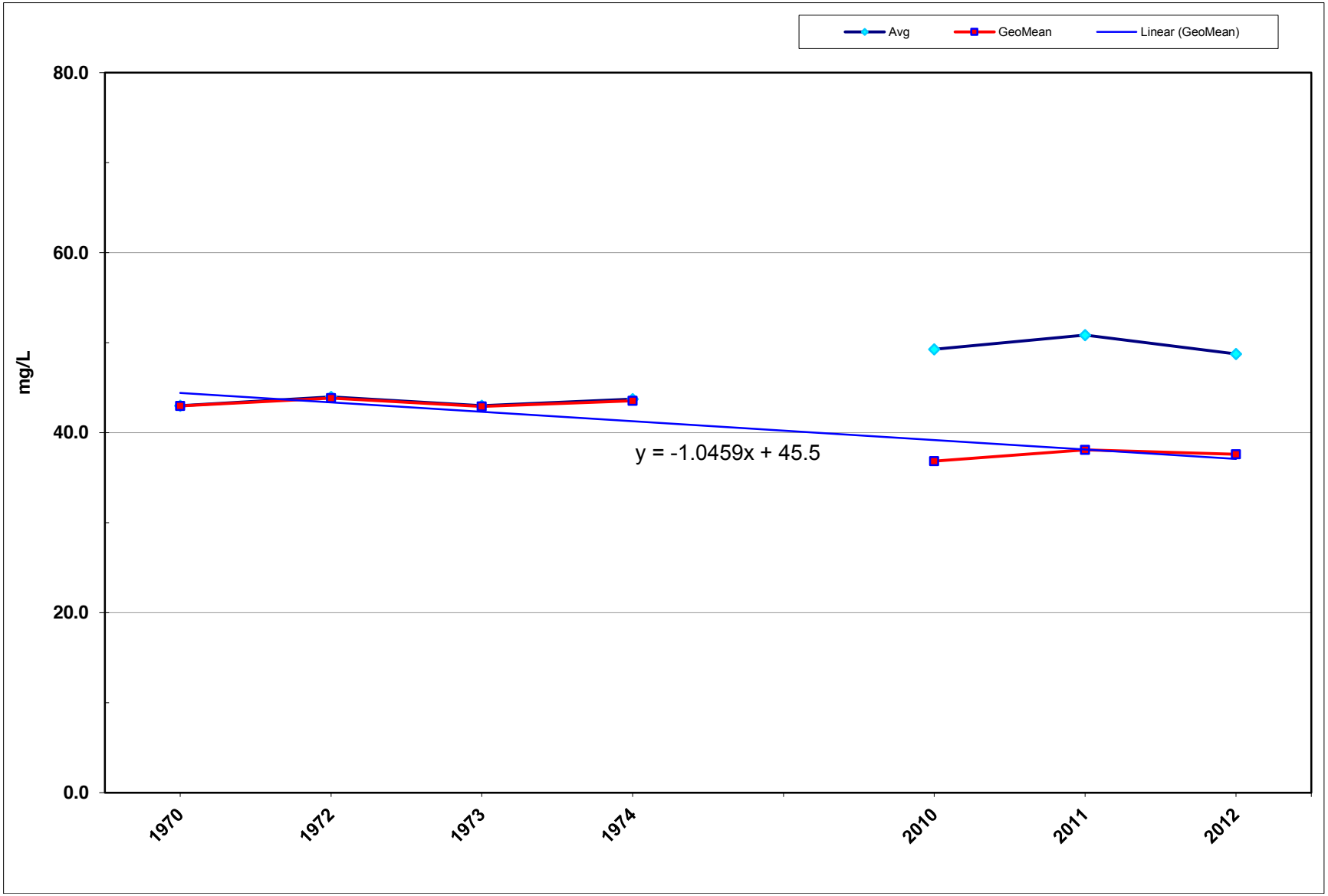


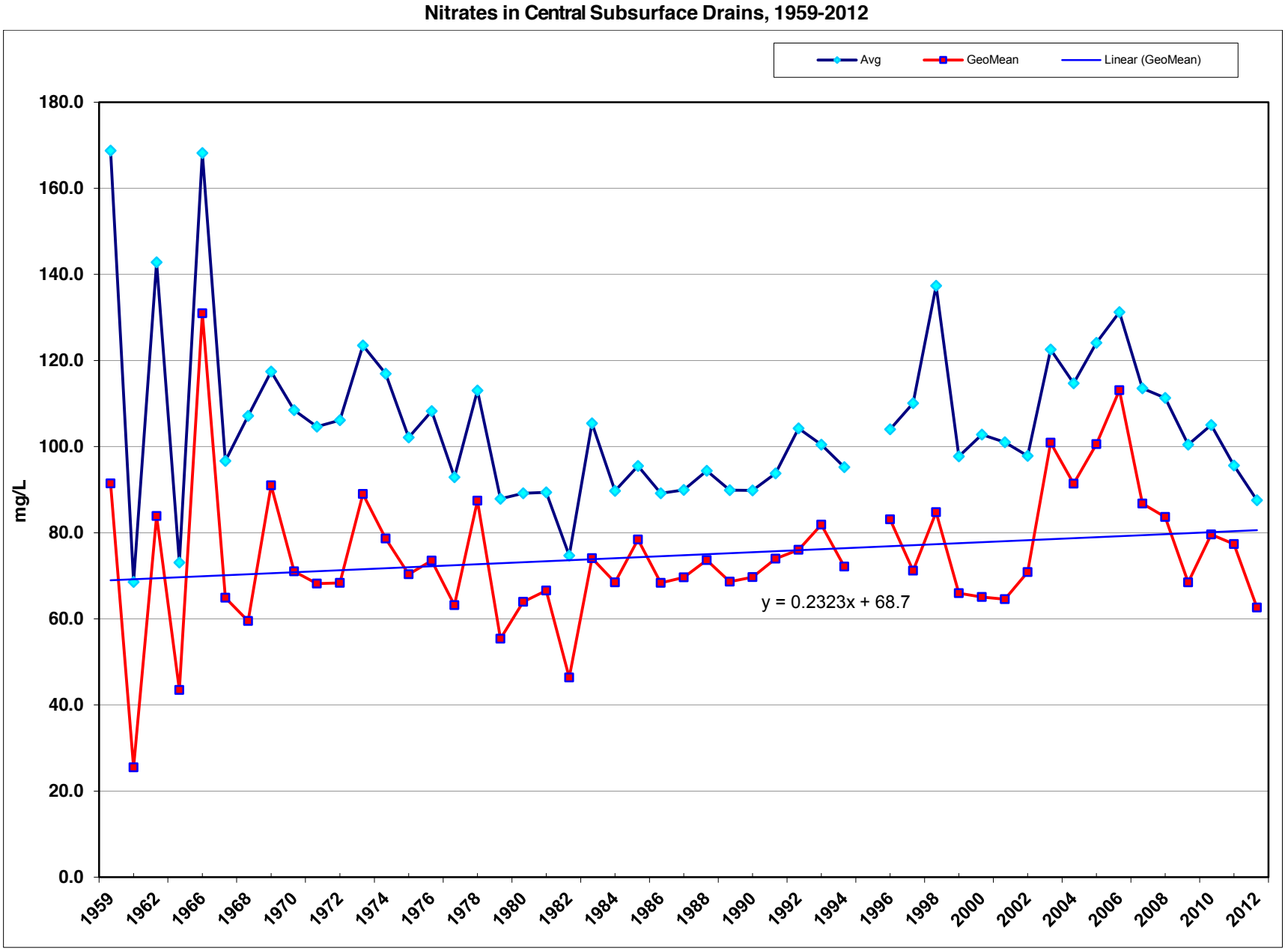
Selenium in Southern Subsurface Drains, Kern Stations, 1986-2012



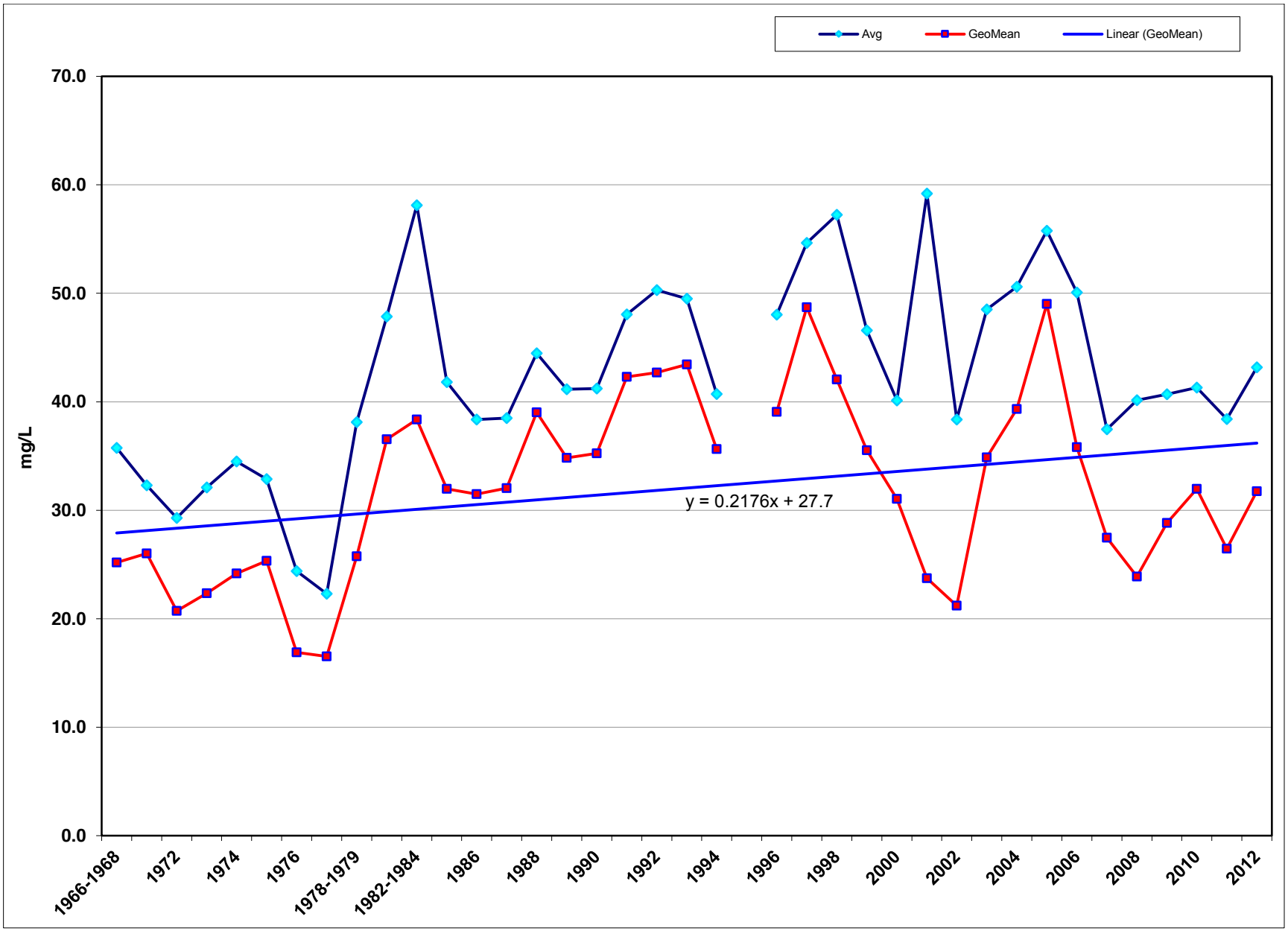
Appendix C
Nitrate Trends in Northern, Central, & Southern Tile Drains through 2012

Nitrates in Northern Subsurface Drains, 1970-1974, 2010-2012

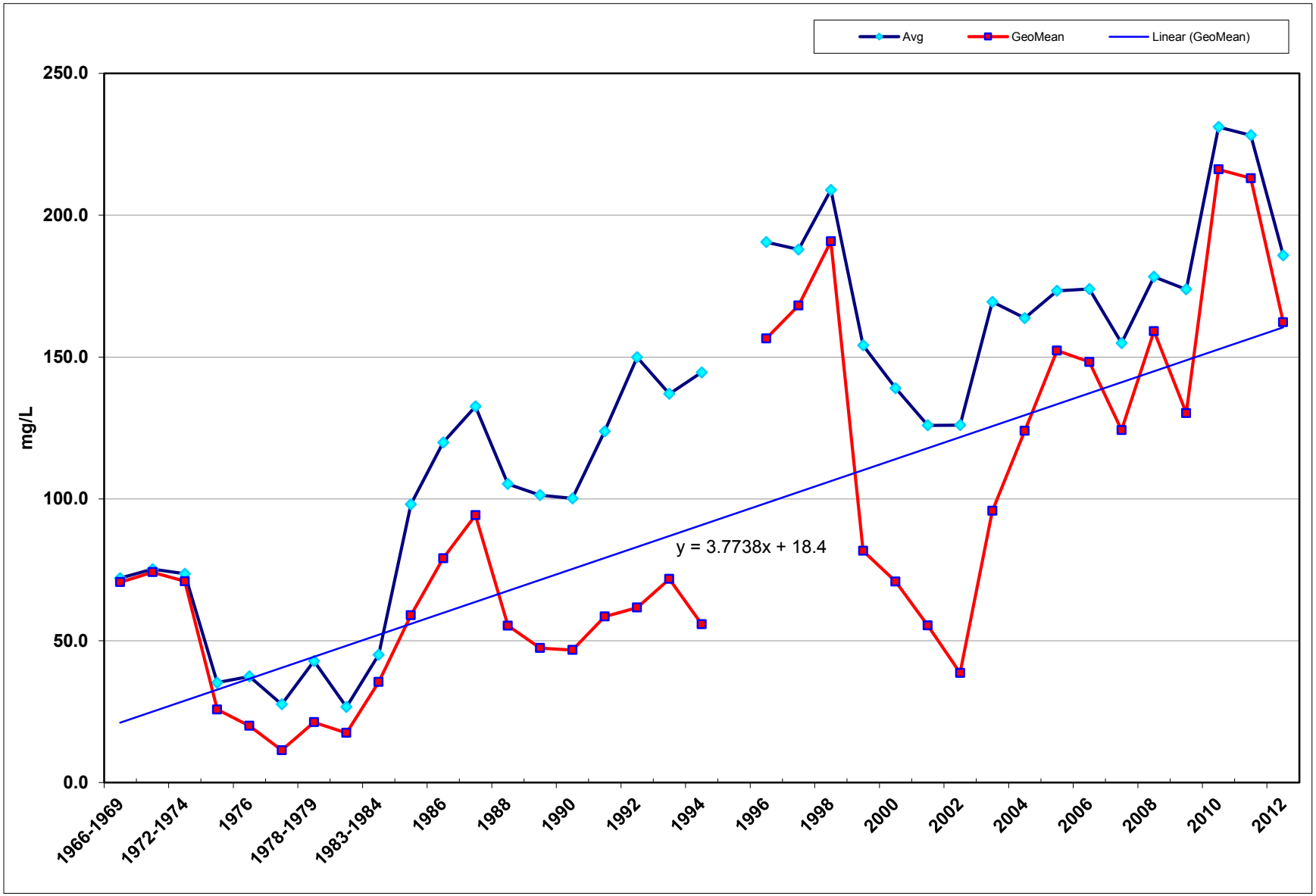



Nitrates in Central Subsurface Drains, 1959-2012
Avg
GeoMean
Linear (GeoMean)
mg/L
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
y = 0.2323x + 68.7
1959
1962
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012

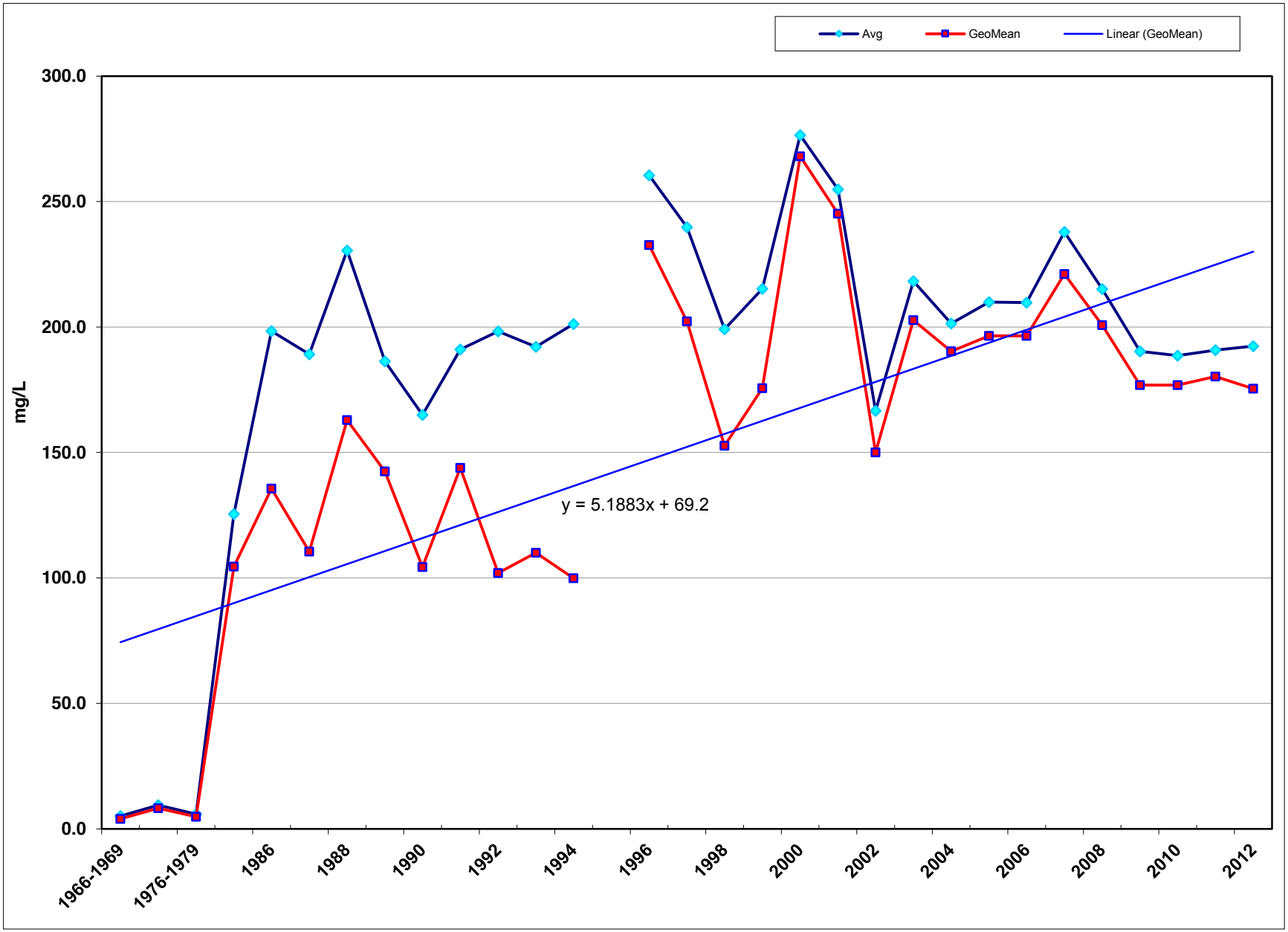
Nitrates in Southern Subsurface Drains, Lemoore-Corcoran Stations, 1966-2012



Nitrates in Southern Subsurface Drains, Lost Hills-Semitropic Stations, 1966-2012



Nitrates in Southern Subsurface Drains, Kern Lakebed Stations, 1966-2012



Appendix D
Mineral Analyses of Northern Area Drains
2011-2012

Appendix D Mineral Analyses of Northern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
VNS 2923												
01/24/11	18	116	41	1.9	209	257	70	301	256	458	1,210	4.3
1330	64	5.8	3.4	0.05	9	7.2	1.13	6	5.1		1,149	5.1
		32	18	0.3	50	37	5.75	32	26			
08/16/11	20	129	48	1.4	234	256	61	284	264	519	1,270	4.5
930	68	6.4	3.9	0.04	10	7.2	0.98	6	5.2		1,172	5.4
		31	19	0.2	49	37	5.07	31	27			
02/06/12	17	123	47	3.5	241	272	62	289	273	499	1,260	4.7
1145	63	6.1	3.8	0.09	10	7.6	1.00	6	5.4		1,201	5.4
		30	19	0.4	51	38	4.97	30	27			
05/15/12	18	134	47	1.6	227	271	67	298	251	528	1,310	4.3
1030	64	6.7	3.9	0.04	10	7.6	1.08	6	5.0		1,196	5.2
		33	19	0.2	48	38	5.41	31	25			
08/20/12	19	133	48	2.6	211	276	71	323	261	530	1,260	4.0
845	66	6.6	3.9	0.07	9	7.8	1.15	7	5.2		1,221	5.0
		33	20	0.3	46	37	5.51	32	25			
11/13/12	19	142	48	1.8	227	263	63	292	254	550	1,250	4.2
930	66	7.1	3.9	0.05	10	7.4	1.02	6	5.0		1,189	5.1
		34	19	0.2	47	38	5.23	31	26			
VNS 3622												
08/21/12	19	130	48	2.8	217	258	64	295	262	522	1,250	4.1
915	66	6.5	3.9	0.07	9	7.2	1.03	6	5.2		1,172	5.2
		33	20	0.4	47	37	5.24	31	27			
VNS 3733												
01/24/11	18	173	67	2.3	332	380	75	583	305	707	1,860	5.4
1345	64	8.6	5.5	0.06	14	10.7	1.22	12	6.1		1,796	7.1
		30	19	0.2	50	35	4.04	40	20			
08/16/11	20	214	93	1.7	338	413	61	698	276	916	2,110	4.9
1030	68	10.7	7.6	0.04	15	11.6	0.98	15	5.5		1,984	6.3
		32	23	0.1	44	36	3.01	45	17			
02/06/12	17	154	64	3.2	288	304	61	485	290	649	1,610	4.9
1215	63	7.7	5.3	0.08	13	8.5	0.98	10	5.8		1,533	6.1
		30	21	0.3	49	34	3.88	40	23			
05/15/12	18	205	84	2.0	354	395	65	720	280	857	2,120	5.3
1050	64	10.2	6.9	0.05	15	11.1	1.05	15	5.6		1,993	6.8
		31	21	0.2	47	34	3.23	46	17			

Appendix D Mineral Analyses of Northern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
08/20/12	20	215	92	3.2	309	447	61	682	300	916	2,010	4.4
945	68	10.7	7.6	0.08	13	12.6	0.98	14	6.0		1,989	5.8
		34	24	0.3	42	37	2.90	42	18			
11/13/12	16	146	56	3.1	247	272	44	393	249	594	1,380	4.4
950	61	7.3	4.6	0.08	11	7.6	0.70	8	4.9		1,310	5.1
		32	20	0.4	47	36	3.27	38	23			
VNS 3848												
08/20/12	23	37	20	4.0	77	98	5	88	116	175	431	2.5
1145	73	1.8	1.6	0.10	3	2.8	0.08	2	2.3		399	2.2
		27	24	1.5	48	40	1.18	26	33			
VNS 4734												
01/24/11	17	233	94	3.0	448	454	56	975	267	969	2,560	6.3
1149	63	11.6	7.7	0.08	19	12.8	0.90	20	5.3		2,423	8.1
		30	20	0.2	50	32	2.28	52	13			
08/16/11	20	232	102	2.3	404	429	50	844	264	1,000	2,330	5.6
1115	68	11.6	8.4	0.06	18	12.1	0.80	18	5.2		2,221	7.2
		31	22	0.2	47	34	2.25	49	15			
02/06/12	16	226	91	3.6	371	388	54	847	268	941	2,230	5.3
1235	61	11.3	7.5	0.09	16	10.9	0.86	18	5.3		2,141	6.8
		32	21	0.3	46	31	2.49	51	15			
05/15/12	18	210	85	2.3	346	350	52	820	238	873	2,120	5.1
1112	64	10.5	7.0	0.06	15	9.8	0.84	17	4.7		2,008	6.4
		32	21	0.2	46	30	2.60	53	15			
08/20/12	19	251	106	4.2	391	553	52	878	259	1,063	2,450	5.2
1015	66	12.5	8.7	0.11	17	15.5	0.84	18	5.1		2,390	7.0
		33	23	0.3	44	39	2.10	46	13			
11/13/12	19	237	101	2.4	393	429	56	881	263	1,008	2,370	5.4
1010	66	11.8	8.3	0.06	17	12.1	0.90	18	5.2		2,257	7.3
		32	22	0.2	46	33	2.47	50	14			
VNS 4931												
01/24/11	17	166	69	2.3	318	385	67	535	286	699	1,810	5.2
1136	63	8.3	5.7	0.06	14	10.8	1.07	11	5.7		1,714	6.5
		30	20	0.2	50	38	3.74	39	20			
08/16/11	20	189	79	1.8	324	374	56	598	260	797	1,900	5.0
1215	68	9.4	6.5	0.05	14	10.5	0.90	12	5.2		1,778	6.5
		31	22	0.2	47	36	3.12	43	18			

Appendix D Mineral Analyses of Northern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
02/06/12	17	160	60	3.5	291	308	60	449	274	647	1,550	5.0
1250	63	8.0	4.9	0.09	13	8.7	0.96	9	5.4		1,496	6.2
		31	19	0.3	49	35	3.95	38	22			
05/15/12	18	183	74	2.1	315	344	58	638	256	763	1,890	5.0
1135	64	9.1	6.1	0.05	14	9.7	0.94	13	5.1		1,768	6.5
		32	21	0.2	47	33	3.24	46	18			
08/20/12	20	205	87	3.3	321	445	53	682	261	870	1,980	4.7
1045	68	10.2	7.2	0.08	14	12.5	0.85	14	5.2		1,953	6.2
		33	23	0.3	44	38	2.60	43	16			
11/13/12	18	164	65	2.5	267	321	50	453	254	676	1,530	4.5
1100	64	8.2	5.3	0.06	12	9.0	0.81	9	5.0		1,475	5.6
		33	21	0.2	46	37	3.34	39	21			
VNS 4951												
01/24/11	18	128	51	2.5	282	297	47	411	345	528	1,520	5.3
1210	64	6.4	4.2	0.06	12	8.3	0.76	9	6.8		1,425	6.7
		28	18	0.3	54	34	3.11	35	28			
08/16/11	21	127	49	1.8	258	252	52	337	318	520	1,370	4.9
1300	70	6.3	4.0	0.05	11	7.1	0.84	7	6.3		1,268	6.2
		29	19	0.2	52	33	3.94	33	30			
02/06/12	17	141	52	3.6	290	279	45	375	347	567	1,480	5.3
1315	63	7.0	4.3	0.09	13	7.8	0.73	8	6.9		1,394	6.6
		29	18	0.4	52	34	3.13	34	30			
05/15/12	18	130	47	2.1	268	256	55	336	310	520	1,380	5.1
1200	64	6.5	3.9	0.05	12	7.2	0.89	7	6.2		1,280	6.4
		29	18	0.2	53	34	4.19	33	29			
08/20/12	19	130	47	2.7	246	252	53	329	329	518	1,300	4.7
1115	66	6.5	3.9	0.07	11	7.1	0.86	7	6.5		1,257	5.9
		31	18	0.3	51	33	4.03	32	31			
11/13/12	19	136	50	2.1	284	266	48	370	325	544	1,420	5.3
1040	66	6.8	4.1	0.05	12	7.5	0.77	8	6.4		1,350	6.6
		29	18	0.2	53	33	3.44	34	29			
VNS 5661												
01/24/11	16	108	28	6.4	176	159	61	188	345	383	991	3.9
1230	61	5.4	2.3	0.16	8	4.5	0.98	4	6.8		933	4.7
		35	15	1.1	49	28	6.05	24	42			
08/16/11	21	110	33	2.4	199	168	57	189	318	412	1,040	4.3
1340	70	5.5	2.7	0.06	9	4.7	0.93	4	6.3		950	5.3
		32	16	0.4	51	30	5.83	25	40			

Appendix D Mineral Analyses of Northern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
02/07/12	16	142	64	4.0	242	280	61	296	339	619	1,380	4.2
1140	61	7.1	5.3	0.10	11	7.9	0.98	6	6.7		1,292	5.3
		31	23	0.4	46	36	4.50	28	31			
05/15/12	20	111	31	2.7	189	173	57	191	306	404	1,010	4.1
1220	68	5.5	2.5	0.07	8	4.9	0.92	4	6.1		938	5.1
		34	16	0.4	50	31	5.79	25	38			
08/21/12	20	104	33	3.2	179	162	56	195	321	396	956	3.9
800	68	5.2	2.7	0.08	8	4.6	0.91	4	6.4		925	4.7
		33	17	0.5	49	29	5.71	26	40			
11/13/12	19	135	42	3.9	198	194	98	205	313	512	1,135	3.8
1130	66	6.7	3.5	0.10	9	5.4	1.58	4	6.2		1,064	5.0
		36	18	0.5	45	31	9.01	24	35			
VNS 5951												
08/21/12	18	111	48	2.9	248	241	76	259	316	475	1,250	5.0
730	64	5.5	3.9	0.07	11	6.8	1.22	5	6.3		1,175	5.9
		27	19	0.4	53	34	6.20	27	32			
VNS 6035												
01/24/11	17	137	56	2.4	294	318	53	450	327	572	1,600	5.4
1119	63	6.8	4.6	0.06	13	8.9	0.86	9	6.5		1,507	6.7
		28	19	0.2	53	35	3.35	37	25			
08/17/11	19	129	54	1.8	272	246	58	344	318	543	1,420	5.1
800	66	6.4	4.4	0.05	12	6.9	0.93	7	6.3		1,295	6.3
		28	20	0.2	52	32	4.35	34	30			
02/07/12	16	143	53	3.0	294	283	49	378	345	576	1,490	5.3
1100	61	7.1	4.4	0.08	13	7.9	0.79	8	6.8		1,410	6.7
		29	18	0.3	52	34	3.38	34	29			
05/16/12	20	135	52	2.2	283	260	64	397	313	551	1,480	5.2
1100	68	6.7	4.3	0.06	12	7.3	1.03	8	6.2		1,381	6.6
		29	18	0.2	53	32	4.52	36	27			
08/21/12	19	137	55	2.9	258	267	58	403	323	569	1,400	4.7
915	66	6.8	4.5	0.07	11	7.5	0.94	8	6.4		1,375	5.9
		30	20	0.3	50	32	4.05	36	28			
11/13/12	18	151	63	2.4	279	292	49	420	271	636	1,480	4.8
1230	64	7.5	5.2	0.06	12	8.2	0.80	9	5.4		1,419	6.0
		30	21	0.2	49	35	3.44	38	23			

Appendix D Mineral Analyses of Northern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
VNS 6927												
08/17/11	20	20	9	1.4	37	39	5	46	57	89	203	1.7
1030	68	1.0	0.7	0.04	2	1.1	0.09	1	1.1		192	0.9
		30	22	1.1	48	33	2.66	29	35			
02/06/12	12	38	22	3.0	99	108	7	108	107	183	466	3.2
1025	54	1.9	1.8	0.08	4	3.0	0.11	2	2.1		448	2.7
		23	22	1.0	54	40	1.52	30	28			
05/16/12	20	18	9	1.4	36	40	4	46	52	81	206	1.7
1130	68	0.9	0.7	0.04	2	1.1	0.07	1	1.0		186	1.0
		28	23	1.1	48	35	2.08	30	32			
08/21/12	23	37	19	2.8	70	90	8	81	110	171	392	2.3
940	73	1.8	1.6	0.07	3	2.5	0.13	2	2.2		374	2.0
		28	24	1.1	47	39	2.00	26	33			
11/14/12	13	41	21	2.9	98	110	9	97	120	190	466	3.1
1100	55	2.0	1.8	0.07	4	3.1	0.14	2	2.4		451	2.5
		25	22	0.9	52	40	1.84	26	31			
VNS 6961												
01/24/11	17	121	55	3.6	227	286	60	290	336	529	1,350	4.3
1246	63	6.0	4.5	0.09	10	8.0	0.96	6	6.7		1,244	5.4
		29	22	0.5	48	37	4.44	28	31			
08/16/11	22	133	59	2.6	236	269	58	273	333	576	1,340	4.3
1410	72	6.6	4.9	0.07	10	7.6	0.93	6	6.6		1,230	5.4
		30	22	0.3	47	36	4.49	27	32			
02/07/12	17	109	34	3.9	197	174	64	198	316	410	1,040	4.2
1130	63	5.4	2.8	0.10	9	4.9	1.03	4	6.3		969	5.3
		32	16	0.6	51	30	6.34	25	38			
05/16/12	18	135	51	2.9	232	249	57	270	326	546	1,270	4.3
1100	64	6.7	4.2	0.07	10	7.0	0.92	6	6.5		1,193	5.4
		32	20	0.4	48	35	4.60	28	32			
08/21/12	19	140	60	3.4	226	290	62	313	318	597	1,330	4.0
830	66	7.0	4.9	0.09	10	8.1	1.00	7	6.3		1,285	5.0
		32	23	0.4	45	37	4.53	30	29			
11/13/12	19	145	67	3.4	238	270	62	296	332	636	1,360	4.1
1200	66	7.2	5.5	0.09	10	7.6	0.99	6	6.6		1,280	5.3
		31	24	0.4	45	36	4.65	29	31			

Appendix D Mineral Analyses of Northern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
VNS 7026												
01/24/11	10	13	6	1.8	29	32	2	36	49	58	179	1.6
1047	50	0.6	0.5	0.05	1	0.9	0.03	1	1.0		149	0.7
		26	22	1.9	51	34	1.10	28	37			
08/17/11	20	14	7	1.2	27	28	3	28	47	62	154	1.5
1115	68	0.7	0.6	0.03	1	0.8	0.04	1	0.9		136	0.7
		28	23	1.2	47	34	1.79	25	40			
02/07/12	11	37	21	3.0	97	108	7	108	105	178	456	3.2
1040	52	1.8	1.7	0.08	4	3.0	0.11	2	2.1		443	2.7
		23	22	1.0	54	41	1.45	30	28			
05/16/12	19	14	7	1.3	28	31	2	32	45	64	172	1.5
1230	66	0.7	0.6	0.03	1	0.9	0.04	1	0.9		143	0.7
		28	23	1.3	48	35	1.57	27	36			
08/21/12	24	35	18	2.8	65	86	7	72	105	162	370	2.2
1000	75	1.7	1.5	0.07	3	2.4	0.12	1	2.1		349	1.9
		29	24	1.2	46	39	1.95	25	34			
11/14/12	12	38	21	3.0	94	108	8	91	118	181	462	3.0
1145	54	1.9	1.7	0.08	4	3.0	0.13	2	2.3		434	2.6
		25	22	1.0	53	41	1.72	26	32			
VNS 7027												
01/24/11	16	145	62	2.4	299	349	60	493	301	615	1,700	5.2
1030	61	7.2	5.1	0.06	13	9.8	0.96	10	6.0		1,590	6.6
		29	20	0.2	51	36	3.56	38	22			
08/17/11	21	155	63	1.8	287	316	58	456	302	647	1,650	4.9
930	70	7.7	5.2	0.05	12	8.9	0.94	9	6.0		1,518	6.4
		30	20	0.2	49	35	3.70	38	24			
02/07/12	16	151	59	2.9	283	291	55	423	301	619	1,530	5.0
1015	61	7.5	4.8	0.07	12	8.2	0.89	9	6.0		1,445	6.2
		30	20	0.3	50	34	3.73	37	25			
05/16/12	19	150	60	2.3	290	291	61	449	297	620	1,570	5.1
1145	66	7.5	4.9	0.06	13	8.2	0.98	9	5.9		1,481	6.1
		30	20	0.2	50	34	4.03	38	24			
08/20/12	19	162	70	3.2	275	324	60	457	305	693	1,600	4.5
1020	66	8.1	5.8	0.08	12	9.1	0.97	10	6.1		1,534	5.9
		31	22	0.3	46	36	3.77	37	24			
11/14/12	18	147	60	2.2	277	301	52	431	277	614	1,480	4.9
1115	64	7.3	4.9	0.06	12	8.5	0.85	9	5.5		1,437	5.8
		30	20	0.2	49	36	3.56	38	23			

Appendix E
Electrical Conductivity, pH, & Trace Elements in Northern Area Drains
2011-2012

Appendix E
Electrical Conductivity, pH, and Trace Elements in Northern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
VNS 2923							
01/24/11	7.6	1,912	0.002	1.6	< 0.050	< 0.005	0.005
	7.7	1,895					
08/16/11	7.4	1,914	0.002	1.5	< 0.050	< 0.005	0.006
	7.6	1,942					
02/06/12	7.0	2,074	< 0.005	1.5	0.033	< 0.025	< 0.005
	7.8	1,991					
05/15/12	6.9	1,978	0.001	1.6	0.030	< 0.005	0.007
	7.7	2,003					
08/20/12	7.4	1,965	0.002	1.5	0.032	< 0.005	0.008
	7.6	1,886					
11/13/12	7.3	1,964	0.001	1.7	0.031	< 0.005	0.005
	7.6	1,973					
VNS 3622							
08/21/12	7.0	1,966	0.002	1.5	0.031	< 0.005	0.007
	7.6	1,977					
VNS 3733							
01/24/11	7.3	2,767	0.002	3.2	< 0.050	< 0.005	0.011
	7.6	2,747					
08/16/11	7.1	3,065	0.003	3.1	< 0.050	< 0.005	0.011
	7.5	2,997					
02/06/12	7.3	2,430	< 0.005	3.0	0.027	< 0.025	0.005
	7.8	2,423					
05/15/12	6.9	3,052	< 0.005	3.6	< 0.025	< 0.025	< 0.005
	7.7	3,048					
08/20/12	6.7	2,971	< 0.005	2.8	0.037	< 0.025	0.012
	7.4	2,891					
11/13/12	7.3	2,088	0.002	2.3	0.063	< 0.005	0.008
	7.6	2,061					
VNS 3848							
08/20/12	7.3	724	0.003	0.4	0.071	< 0.005	0.002
	7.8	732					

Appendix E

Electrical Conductivity, pH, and Trace Elements in Northern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
VNS 4734							
01/24/11	7.4	3,573	0.002	4.5	< 0.050	< 0.005	0.011
	7.9	3,408					
08/16/11	7.3	3,240	0.003	3.7	< 0.050	< 0.005	0.010
	7.6	3,237					
02/06/12	7.4	3,190	< 0.005	3.5	0.027	< 0.025	0.006
	7.8	3,078					
05/15/12	6.9	2,977	0.002	3.5	0.028	< 0.005	0.011
	7.7	2,970					
08/20/12	6.2	3,472	< 0.005	3.9	0.030	< 0.025	0.015
	7.4	3,391					
11/13/12	7.4	3,309	< 0.005	4.0	0.025	< 0.025	0.010
	7.8	3,237					
VNS 4931							
01/24/11	7.5	2,686	0.002	3.0	< 0.050	< 0.005	0.010
	7.9	2,613					
08/16/11	7.4	2,743	0.003	2.7	< 0.050	< 0.005	0.009
	7.6	2,718					
02/06/12	7.5	2,320	< 0.005	2.1	0.031	< 0.025	0.006
	7.9	2,293					
05/15/12	7.0	2,745	0.002	3.0	0.027	< 0.005	0.010
	7.8	2,725					
08/20/12	6.9	2,915	< 0.005	2.9	0.034	< 0.025	0.012
	7.6	2,882					
11/13/12	7.6	2,307	0.002	2.5	0.042	< 0.005	0.008
	7.9	2,284					
VNS 4951							
01/24/11	7.5	2,305	0.002	2.4	< 0.050	< 0.005	0.009
	7.7	2,251					
08/16/11	7.2	2,011	0.003	1.9	< 0.050	< 0.005	0.008
	7.6	2,051					
02/06/12	7.1	2,243	< 0.005	2.2	0.041	< 0.025	0.005
	7.6	2,213					

Appendix E
Electrical Conductivity, pH, and Trace Elements in Northern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
05/15/12	6.9 7.7	2,113 2,096	0.002	2.1	0.034	< 0.005	0.009
08/20/12	6.8 7.6	1,990 1,992	0.003	2.0	0.039	< 0.005	0.009
11/13/12	7.3 7.7	2,162 2,138	0.002	2.4	0.035	< 0.005	0.010
VNS 5661							
01/24/11	7.4 7.6	1,554 1,543	0.002	1.3	0.065	< 0.005	0.004
08/16/11	7.2 7.6	1,568 1,596	0.003	1.3	< 0.050	< 0.005	0.005
02/07/12	7.2 7.7	2,143 2,102	< 0.005	1.7	0.042	< 0.025	< 0.005
05/15/12	6.8 7.7	1,605 1,595	0.002	1.3	0.044	< 0.005	0.004
08/21/12	6.8 7.6	1,489 1,509	0.003	1.2	0.044	< 0.005	0.005
11/13/12	6.9 7.5	1,745 1,720	0.002	1.5	0.063	< 0.005	0.004
VNS 5951							
08/21/12	7.0 7.7	1,971 1,992	0.003	2.1	0.037	< 0.005	0.006
VNS 6035							
01/24/11	7.4 7.9	2,394 1,963	0.002	2.7	< 0.050	< 0.005	0.010
08/17/11	7.5 7.6	2,107 2,081	0.003	2.2	< 0.050	< 0.005	0.008
02/07/12	7.5 7.9	2,232 2,236	0.005	2.2	0.040	< 0.025	0.010
05/16/12	6.9 7.8	2,204 2,230	0.002	2.5	0.034	< 0.005	0.009
08/21/12	7.0 7.7	2,145 2,153	0.003	2.2	0.036	< 0.005	0.010

Appendix E
Electrical Conductivity, pH, and Trace Elements in Northern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
11/13/12	7.4 7.8	2,243 2,202	0.002	2.6	0.041	< 0.005	0.008
VNS 6927							
08/17/11	7.8 7.8	361 353	0.001	0.2	< 0.050	< 0.005	0.001
02/06/12	7.8 7.9	807 808	0.001	0.4	0.045	< 0.005	0.002
05/16/12	7.4 7.9	360 372	0.001	0.2	0.020	< 0.005	0.001
08/21/12	7.9 8.2	670 686	0.003	0.3	0.039	< 0.005	0.002
11/14/12	7.9 8.0	807 805	0.002	0.4	0.044	< 0.005	0.001
VNS 6961							
01/24/11	7.4 7.6	2,091 2,051	0.002	1.8	< 0.050	< 0.005	0.005
08/16/11	7.2 7.6	1,983 2,026	0.003	1.6	< 0.050	< 0.005	0.006
02/07/12	7.2 7.7	1,595 1,611	0.003	1.3	0.053	< 0.005	0.005
05/16/12	6.9 7.8	1,973 1,995	0.002	1.8	0.039	< 0.005	0.006
08/21/12	6.8 7.6	2,046 2,083	0.003	1.7	0.038	< 0.005	0.006
11/13/12	7.1 7.7	2,050 2,044	0.003	1.9	0.041	< 0.005	0.005
VNS 7026							
01/24/11	7.8 7.5	291 284	0.001	0.2	< 0.050	< 0.005	0.001
08/17/11	7.8 7.8	265 250	0.001	0.1	< 0.050	< 0.005	0.001
02/07/12	7.7 7.9	794 801	< 0.005	0.4	0.046	< 0.025	<0.005

Appendix E
Electrical Conductivity, pH, and Trace Elements in Northern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
05/16/12	7.4	288	< 0.001	0.1	0.020	< 0.005	<0.001
	7.9	305					
08/21/12	7.9	633	0.002	0.3	0.038	< 0.005	0.002
	8.3	639					
11/14/12	7.9	790	0.002	0.4	0.045	< 0.005	0.002
	8.0	782					
VNS 7027							
01/24/11	7.7	2,508	0.002	2.8	< 0.050	< 0.005	0.009
	8.1	2,407					
08/17/11	7.6	2,409	0.003	2.3	< 0.050	< 0.005	0.008
	7.8	2,356					
02/07/12	7.7	2,308	< 0.005	2.2	0.035	< 0.025	0.005
	8.0	2,282					
05/16/12	7.0	2,363	0.002	2.6	0.032	< 0.005	0.009
	7.9	2,371					
08/20/12	7.2	2,381	0.003	2.4	0.035	< 0.005	0.010
	7.8	2,428					
11/14/12	7.8	2,261	0.002	2.5	0.040	< 0.005	0.008
	8.0	2,218					

Appendix F
Mineral Analyses of Central Area Drains
2011-2012

Appendix F Mineral Analyses of Central Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
BVS 6001												
03/16/11	15	474	187	3.8	1,200	672	127	2,980	269	1,954	6,180	11.8
945	59	23.7	15.4	0.10	52	18.9	2.05	62	5.3		5,805	16.5
		26	17	0.1	57	21	2.32	70	6			
05/10/11	17	421	169	4.1	1,170	695	151	3,130	261	1,747	6,300	12.2
1100	63	21.0	13.9	0.10	51	19.5	2.44	65	5.2		5,897	17.0
		24	16	0.1	59	21	2.64	71	6			
08/17/11	24	376	155	4.5	1,120	611	112	2,620	251	1,577	5,510	12.3
1137	75	18.8	12.7	0.12	49	17.2	1.81	55	5.0		5,149	17.2
		23	16	0.1	61	22	2.30	69	6			
02/07/12	15	359	134	5.7	833	481	107	2,040	241	1,448	4,100	9.5
1000	59	17.9	11.0	0.14	36	13.5	1.73	42	4.8		4,104	11.9
		27	17	0.2	55	22	2.76	68	8			
05/15/12	20	509	190	7.3	905	562	142	2,880	234	2,054	5,470	8.7
1300	68	25.4	15.6	0.19	39	15.8	2.29	60	4.6		5,336	11.7
		32	19	0.2	49	19	2.77	73	6			
08/21/12	22	506	219	11.1	1,220	791	85	2,790	332	2,166	6,640	11.4
1015	72	25.2	18.0	0.28	53	22.2	1.38	58	6.6		5,822	16.5
		26	19	0.3	55	25	1.56	66	7			
11/05/12	22	338	107	4.7	908	404	84	2,085	297	1,285	4,320	11.0
1211	72	16.9	8.8	0.12	39	11.3	1.35	43	5.9		4,109	14.3
		26	13	0.2	60	18	2.18	70	10			
BVS 7007												
03/15/11	17	432	226	3.8	1,170	697	155	3,020	281	2,010	6,050	11.4
1200	63	21.6	18.6	0.10	51	19.6	2.50	63	5.6		5,872	15.9
		24	20	0.1	56	22	2.76	69	6			
05/10/11	17	420	221	3.8	1,210	646	225	3,510	242	1,959	6,680	11.9
1030	63	21.0	18.2	0.10	53	18.1	3.63	73	4.8		6,381	16.1
		23	20	0.1	57	18	3.64	73	5			

Appendix F Mineral Analyses of Central Area Drains

Station Date Time	T °C °F	Mineral Constituents: mg/L meq/L prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS Sum	SAR ASAR
08/16/11	21	404	205	4.3	1,180	631	179	2,940	224	1,853	5,930	11.9
1100	70	20.2	16.9	0.11	51	17.7	2.89	61	4.4		5,678	16.1
		23	19	0.1	58	21	3.35	71	5			
02/07/12	15	384	177	6.4	1,000	545	154	2,540	229	1,688	5,070	10.6
1015	59	19.2	14.6	0.16	43	15.3	2.48	53	4.5		4,944	14.3
		25	19	0.2	56	20	3.30	70	6			
05/15/12	18	411	193	7.0	1,120	597	250	3,190	232	1,821	5,950	11.4
1230	64	20.5	15.9	0.18	49	16.8	4.03	66	4.6		5,907	15.4
		24	19	0.2	57	18	4.39	72	5			
08/20/12	20	147	69	4.0	473	244	57	1,060	266	651	2,230	8.1
1145	68	7.3	5.7	0.10	21	6.9	0.92	22	5.3		2,214	10.1
		22	17	0.3	61	20	2.63	63	15			
11/05/12	20	497	342	7.2	2,030	1,196	441	4,150	270	2,650	9,160	17.2
1045	68	24.8	28.1	0.18	88	33.6	7.11	86	5.4		8,825	25.7
		18	20	0.1	62	25	5.37	65	4			
BVS 7402												
01/26/11	14	317	128	3.8	781	373	34	2,010	212	1,319	3,880	9.4
1030	57	15.8	10.5	0.10	34	10.5	0.55	42	4.2		3,774	11.7
		26	17	0.2	56	18	0.97	73	7			
03/15/11	16	325	132	3.1	691	384	73	1,880	243	1,355	3,820	8.2
1130	61	16.2	10.9	0.08	30	10.8	1.18	39	4.8		3,634	10.2
		28	19	0.1	53	19	2.10	70	9			
05/10/11	16	291	119	2.9	658	367	39	1,920	209	1,217	3,810	8.2
930	61	14.5	9.8	0.07	29	10.3	0.63	40	4.1		3,523	10.3
		27	18	0.1	54	19	1.15	73	8			
08/17/11	21	349	151	3.2	823	437	52	2,200	271	1,494	4,400	9.3
1115	70	17.4	12.4	0.08	36	12.3	0.83	46	5.4		4,178	12.0
		27	19	0.1	54	19	1.30	71	8			

Appendix F Mineral Analyses of Central Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
BVS 8003												
01/26/11	16	404	177	4.0	1,010	193	22	3,180	216	1,738	4,780	10.5
945	61	20.2	14.6	0.10	44	5.4	0.35	66	4.3		5,119	14.2
		26	18	0.1	56	7	0.46	87	6			
BVS 8915												
02/08/12	16	302	86	4.6	327	231	33	1,150	209	1,107	2,440	4.3
930	61	15.1	7.0	0.12	14	6.5	0.53	24	4.1		2,259	5.6
		41	19	0.3	39	18	1.52	68	12			
08/21/12	20	325	97	4.1	355	237	24	1,370	212	1,211	2,710	4.4
900	68	16.2	8.0	0.10	15	6.7	0.38	29	4.2		2,539	5.8
		41	20	0.3	39	17	0.95	72	11			
11/06/12	21.7	381	109	3.7	331	256	31	1,386	182	1,400	2,930	3.9
1300	71	19.0	9.0	0.10	14	7.2	0.49	29	3.6		2,607	4.8
		45	21	0.2	34	18	1.23	72	9			
CTL 3728												
01/25/11	17	648	119	3.5	851	903	123	2,120	191	2,108	4,790	8.1
1200	63	32.3	9.8	0.09	37	25.4	1.98	44	3.8		4,882	10.5
		41	12	0.1	47	34	2.63	59	5			
03/15/11	17	552	107	2.8	757	809	82	1,950	223	1,819	4,560	7.7
915	63	27.5	8.8	0.07	33	22.7	1.32	41	4.4		4,393	10.4
		40	13	0.1	47	33	1.91	59	6			
05/11/11	18	404	78	5.8	543	635	75	1,430	183	1,330	3,520	6.5
930	64	20.2	6.4	0.15	24	17.8	1.22	30	3.6		3,281	7.8
		40	13	0.3	47	34	2.32	57	7			
08/17/11	22	211	43	3.3	294	313	39	722	118	705	1,870	4.8
917	72	10.5	3.5	0.08	13	8.8	0.62	15	2.3		1,696	5.1
		39	13	0.3	47	33	2.32	56	9			

Appendix F Mineral Analyses of Central Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
02/06/12	16	571	118	4.1	781	857	117	1,950	199	1,912	4,570	7.8
1115	61	28.5	9.7	0.10	34	24.1	1.89	41	3.9		4,517	10.1
		39	13	0.1	47	34	2.68	58	6			
05/16/12	18	508	95	4.7	691	778	96	1,800	183	1,661	4,550	7.4
900	64	25.3	7.8	0.12	30	21.9	1.54	37	3.6		4,082	9.6
		40	12	0.2	47	34	2.39	58	6			
08/20/12	21	501	99	5.9	707	810	108	1,820	188	1,659	4,250	7.6
1045	70	25.0	8.1	0.15	31	22.8	1.74	38	3.7		4,164	9.8
		39	13	0.2	48	34	2.64	57	6			
11/05/12	20	662	118	3.3	816	1,017	123	2,065	200	2,139	5,180	7.7
1000	68	33.0	9.7	0.08	35	28.6	1.98	43	4.0		4,924	10.0
		42	12	0.1	45	37	2.55	55	5			
DPS 1016												
01/25/11	13	479	134	6.5	1,040	1,120	159	1,960	182	1,748	5,180	10.8
915	55	23.9	11.0	0.17	45	31.5	2.56	41	3.6		5,008	14.1
		30	14	0.2	56	40	3.27	52	5			
05/11/11	17	314	95	3.4	665	612	194	1,520	169	1,166	3,680	8.4
1245	63	15.7	7.8	0.09	29	17.2	3.13	32	3.4		3,505	10.1
		30	15	0.2	55	31	5.66	57	6			
08/16/11	23	255	89	2.9	694	564	159	1,430	115	1,091	3,220	9.5
900	73	12.7	7.3	0.07	30	15.8	2.56	30	2.3		3,263	10.5
		25	15	0.1	60	31	5.08	59	5			
02/06/12	13	292	75	4.4	619	565	108	1,270	153	1,037	3,030	8.4
1015	55	14.6	6.1	0.11	27	15.9	1.74	26	3.0		3,025	10.5
		31	13	0.2	56	34	3.70	56	6			
05/16/12	18	524	151	6.4	1,170	1,170	121	2,130	192	1,931	5,750	11.6
945	64	26.1	12.4	0.16	51	32.9	1.95	44	3.8		5,388	15.1
		29	14	0.2	57	40	2.35	53	5			

Appendix F Mineral Analyses of Central Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
08/20/12	23	148	41	4.0	313	310	60	608	116	538	1,610	5.9
915	73	7.4	3.4	0.10	14	8.7	0.96	13	2.3		1,553	5.9
		30	14	0.4	56	35	3.90	51	9			
11/06/12	18	100	44	4.1	224	223	46	426	97	431	1,170	4.7
1230	64	5.0	3.6	0.10	10	6.3	0.74	9	1.9		1,126	4.5
		27	20	0.6	53	35	4.18	50	11			
DPS 1367												
03/15/11	16	671	157	3.5	602	958	177	1,820	166	2,322	4,830	5.4
900	61	33.5	12.9	0.09	26	26.9	2.85	38	3.3		4,488	7.1
		46	18	0.1	36	38	4.02	53	5			
05/11/11	18	617	151	2.8	584	983	189	1,860	163	2,163	4,780	5.5
1000	64	30.8	12.4	0.07	25	27.6	3.05	39	3.2		4,485	7.1
		45	18	0.1	37	38	4.20	53	4			
DPS 2535												
01/25/11	17	432	179	4.4	1,540	1,070	98	2,790	193	1,816	6,500	15.7
1030	63	21.6	14.7	0.11	67	30.1	1.58	58	3.8		6,229	20.4
		21	14	0.1	65	32	1.69	62	4			
03/15/11	17	391	155	3.0	1,310	988	106	2,670	195	1,615	5,900	14.2
1000	63	19.5	12.7	0.08	57	27.8	1.71	56	3.9		5,740	18.4
		22	14	0.1	64	31	1.92	63	4			
05/11/11	18	368	152	3.1	1,320	973	110	2,790	209	1,545	6,160	14.6
1130	64	18.4	12.5	0.08	57	27.3	1.77	58	4.1		5,842	19.7
		21	14	0.1	65	30	1.94	64	5			
08/17/11	22	367	143	2.9	1,290	914	103	2,610	223	1,506	5,800	14.5
1017	72	18.3	11.8	0.07	56	25.7	1.66	54	4.4		5,564	19.5
		21	14	0.1	65	30	1.93	63	5			
02/06/12	15	457	174	5.4	1,550	1,090	90	3,010	205	1,858	6,640	15.7
1145	59	22.8	14.3	0.14	67	30.6	1.45	63	4.1		6,499	21.1
		22	14	0.1	64	31	1.47	63	4			

Appendix F Mineral Analyses of Central Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
05/16/12	18	365	149	5.3	1,290	906	98	2,540	199	1,525	5,620	14.4
830	64	18.2	12.3	0.14	56	25.4	1.59	53	3.9		5,473	18.7
		21	14	0.2	65	30	1.89	63	5			
08/20/12	21	353	163	8.4	1,320	1,020	100	2,670	199	1,553	5,930	14.6
1015	70	17.6	13.4	0.21	57	28.7	1.61	56	3.9		5,754	18.9
		20	15	0.2	65	32	1.80	62	4			
11/06/12	20	504	232	4.6	1,830	1,365	117	3,604	196	2,214	8,090	16.9
1045	68	25.1	19.1	0.12	80	38.3	1.89	75	3.9		7,774	22.0
		20	15	0.1	64	32	1.59	63	3			
DPS 3235												
01/25/11	11	372	108	4.7	678	626	88	1,530	190	1,374	3,640	8.0
1000	52	18.6	8.9	0.12	29	17.6	1.41	32	3.8		3,520	8.8
		33	16	0.2	52	32	2.58	58	7			
03/15/11	17	317	102	3.4	729	644	85	1,490	195	1,212	3,660	9.1
1015	63	15.8	8.4	0.09	32	18.1	1.38	31	3.9		3,488	12.8
		28	15	0.2	57	33	2.53	57	7			
05/11/11	19	293	102	3.1	773	705	76	1,670	175	1,152	3,980	9.9
1100	66	14.6	8.4	0.08	34	19.8	1.23	35	3.5		3,727	12.4
		26	15	0.1	59	33	2.07	59	6			
08/16/11	22	345	111	3.1	744	688	83	1,670	193	1,319	3,920	8.9
1015	72	17.2	9.1	0.08	32	19.3	1.34	35	3.8		3,760	11.1
		29	16	0.1	55	33	2.26	59	6			
02/06/12	11	304	94	5.0	743	668	54	1,460	212	1,146	3,490	9.6
1045	52	15.2	7.7	0.13	32	18.8	0.87	30	4.2		3,455	11.9
		27	14	0.2	58	35	1.60	56	8			
05/16/12	18	310	139	5.5	1,010	863	47	2,080	199	1,347	4,700	12.0
745	64	15.5	11.4	0.14	44	24.2	0.76	43	3.9		4,574	14.4
		22	16	0.2	62	34	1.06	60	5			

Appendix F Mineral Analyses of Central Area Drains

Station Date Time	T °C °F	Mineral Constituents: mg/L meq/L prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS Sum	SAR ASAR
08/20/12	23	203	69	6.0	522	513	44	1,140	132	791	2,640	8.1
945	73	10.1	5.7	0.15	23	14.4	0.70	24	2.6		2,576	9.3
		26	15	0.4	59	35	1.70	57	6			
11/06/12	18	386	156	4.7	1,190	980	15	2,419	178	1,670	5,450	12.9
1200	64	19.3	12.8	0.12	52	27.5	0.24	50	3.5		5,257	16.8
		23	15	0.1	62	34	0.29	62	4			
DPS 3465												
03/15/11	16	533	203	4.7	1,150	1,270	129	2,380	271	2,167	6,140	10.7
930	61	26.6	16.7	0.12	50	35.7	2.08	50	5.4		5,832	14.0
		28	18	0.1	54	38	2.24	53	6			
DPS 4616												
01/25/11	15	558	294	5.6	1,590	1,450	27	3,400	204	2,604	7,864	13.6
945	59	27.8	24.2	0.14	69	40.7	0.44	71	4.0		7,447	19.0
		23	20	0.1	57	35	0.38	61	3			
03/15/11	15	522	623	6.4	3,950	2,680	40	7,100	244	3,870	16,770	27.6
1030	59	26.0	51.2	0.16	172	75.3	0.64	148	4.8		15,068	38.7
		10	21	0.1	69	33	0.28	65	2			
08/16/11	21	489	372	5.0	2,160	1,920	52	4,440	232	2,753	9,710	17.9
945	70	24.4	30.6	0.13	94	53.9	0.84	92	4.6		9,577	25.1
		16	21	0.1	63	36	0.55	61	3			
02/06/12	14	455	213	5.1	1,160	1,020	27	3,100	189	2,014	6,560	11.3
1030	57	22.7	17.5	0.13	50	28.7	0.43	65	3.8		6,093	14.6
		25	19	0.1	56	29	0.44	66	4			
05/16/12	16	496	414	8.5	2,670	1,930	43	6,111	224	2,944	12,270	21.4
700	61	24.8	34.0	0.22	116	54.2	0.70	127	4.4		11,807	31.0
		14	19	0.1	66	29	0.37	68	2			
08/20/12	21	458	244	10.7	1,520	1,200	31	3,340	201	2,149	7,360	14.3
930	70	22.9	20.1	0.27	66	33.7	0.49	70	4.0		6,924	19.3
		21	18	0.3	60	31	0.46	65	4			

Appendix F Mineral Analyses of Central Area Drains

Station Date Time	T °C °F	Mineral Constituents: mg/L meq/L prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS Sum	SAR ASAR
11/06/12	21	233	72	2.2	128	165	4	757	190	879	1,640	1.9
1130	70	11.6	5.9	0.06	6	4.6	0.06	16	3.8		1,475	2.3
		50	26	0.2	24	19	0.23	65	16			
FBH 2016												
01/26/11	16	377	147	2.4	716	402	59	2,240	152	1,547	4,140	7.9
1315	61	18.8	12.1	0.06	31	11.3	0.95	47	3.0		4,034	10.7
		30	19	0.1	50	18	1.53	75	5			
03/16/11	15	436	235	2.6	1,200	509	69	3,230	137	2,057	5,840	11.5
1100	59	21.8	19.3	0.07	52	14.3	1.11	67	2.7		5,764	15.5
		23	21	0.1	56	17	1.30	79	3			
05/10/11	16	430	266	2.5	1,400	642	93	3,960	118	2,169	7,030	13.1
1245	61	21.5	21.9	0.06	61	18.0	1.50	82	2.3		6,864	18.3
		21	21	0.1	58	17	1.44	79	2			
08/17/11	21	403	202	2.5	1,070	517	71	3,050	146	1,838	5,700	10.9
1307	70	20.1	16.6	0.06	47	14.5	1.15	64	2.9		5,403	14.7
		24	20	0.1	56	18	1.40	77	4			
02/07/12	16	380	157	3.0	763	370	52	2,290	148	1,596	4,230	8.3
900	61	19.0	12.9	0.08	33	10.4	0.84	48	2.9		4,104	10.4
		29	20	0.1	51	17	1.36	77	5			
05/15/12	17	434	267	4.6	1,410	641	82	3,810	138	2,184	6,840	13.1
930	63	21.7	22.0	0.12	61	18.0	1.31	79	2.7		6,731	16.4
		21	21	0.1	58	18	1.30	78	3			
08/21/12	20	374	205	6.4	1,070	511	69	3,030	159	1,778	5,670	11.0
1130	68	18.7	16.9	0.16	47	14.4	1.12	63	3.2		5,361	14.3
		23	21	0.2	57	18	1.37	77	4			
11/05/12	20	440	257	3.0	1,330	610	95	3,668	127	2,157	6,810	12.5
1330	68	22.0	21.1	0.08	58	17.1	1.52	76	2.5		6,479	15.6
		22	21	0.1	57	18	1.56	78	3			

Appendix F Mineral Analyses of Central Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
FBH 4045												
03/16/11	15	340	113	2.3	475	404	81	1,420	226	1,315	3,060	5.7
1045	59	17.0	9.3	0.06	21	11.3	1.30	30	4.5		2,971	6.8
		36	20	0.1	44	24	2.79	63	10			
05/10/11	18	403	157	2.9	584	524	146	1,970	223	1,653	4,090	6.3
1200	64	20.1	12.9	0.07	25	14.7	2.35	41	4.4		3,921	7.5
		34	22	0.1	43	24	3.77	66	7			
08/17/11	21	549	355	2.8	1,110	942	188	3,250	223	2,833	7,080	9.1
1237	70	27.4	29.2	0.07	48	26.5	3.03	68	4.4		6,531	12.7
		26	28	0.1	46	26	2.98	67	4			
02/07/12	16	374	160	4.8	711	488	222	1,650	357	1,593	3,950	7.8
915	61	18.7	13.2	0.12	31	13.7	3.58	34	7.1		3,824	11.2
		30	21	0.2	49	23	6.10	58	12			
05/15/12	18	518	220	4.7	862	723	198	2,690	255	2,200	5,440	8.0
1000	64	25.8	18.1	0.12	37	20.3	3.19	56	5.1		5,369	11.2
		32	22	0.1	46	24	3.78	66	6			
08/21/12	21	516	273	7.1	971	716	144	2,980	274	2,413	6,110	8.6
1115	70	25.7	22.5	0.18	42	20.1	2.32	62	5.4		5,772	12.0
		28	25	0.2	47	22	2.58	69	6			
11/05/12	20	547	268	5.5	990	683	138	2,793	293	2,470	6,060	8.7
1245	68	27.3	22.0	0.14	43	19.2	2.22	58	5.8		5,600	12.1
		30	24	0.2	47	22	2.60	68	7			
FBH 5056												
03/16/11	15	421	220	3.0	938	402	152	2,890	217	1,958	5,350	9.2
1030	59	21.0	18.1	0.08	41	11.3	2.45	60	4.3		5,156	12.5
		26	23	0.1	51	14	3.13	77	6			
05/10/11	17	345	143	2.0	496	380	44	1,600	480	1,451	3,500	5.7
1130	63	17.2	11.8	0.05	22	10.7	0.70	33	9.5		3,298	6.5
		34	23	0.1	43	20	1.30	61	18			

Appendix F Mineral Analyses of Central Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
08/17/11	21	422	187	2.3	761	414	98	2,360	372	1,824	4,710	7.8
1207	70	21.1	15.4	0.06	33	11.6	1.59	49	7.4		4,468	10.5
		30	22	0.1	48	17	2.27	70	11			
02/07/12	15	454	208	3.8	806	412	105	2,580	310	1,991	4,880	7.9
930	59	22.7	17.1	0.10	35	11.6	1.69	54	6.2		4,755	11.4
		30	23	0.1	47	16	2.32	73	8			
05/15/12	18	307	105	2.6	381	278	17	1,090	510	1,199	2,590	4.8
1045	64	15.3	8.6	0.07	17	7.8	0.27	23	10.1		2,487	7.2
		38	21	0.2	41	19	0.67	55	25			
08/21/12	21	421	209	5.6	817	400	110	2,570	302	1,912	4,920	8.1
1100	70	21.0	17.2	0.14	36	11.2	1.77	54	6.0		4,714	11.8
		28	23	0.2	48	15	2.45	74	8			
11/05/12	19	446	215	2.9	821	407	79	2,449	315	1,999	4,880	8.0
1215	66	22.3	17.7	0.07	36	11.4	1.27	51	6.3		4,609	11.6
		29	23	0.1	47	16	1.82	73	9			
FBH 8061												
01/26/11	16	219	48	1.0	148	133	2	689	151	745	1,430	2.4
930	61	10.9	4.0	0.02	6	3.7	0.03	14	3.0		1,330	3.2
		51	19	0.1	30	18	0.12	68	14			
03/16/11	15	414	151	1.7	541	371	66	1,750	227	1,656	3,460	5.8
900	59	20.7	12.4	0.04	24	10.4	1.06	36	4.5		3,431	8.4
		36	22	0.1	42	20	2.02	70	9			
05/10/11	17	331	124	1.8	511	345	61	1,800	208	1,337	3,450	6.1
1000	63	16.5	10.2	0.05	22	9.7	0.98	37	4.1		3,298	7.9
		34	21	0.1	45	19	1.88	72	8			
08/16/11	21	312	100	1.1	317	258	47	1,310	174	1,187	2,690	4.0
1200	70	15.6	8.2	0.03	14	7.2	0.76	27	3.5		2,450	5.2
		41	22	0.1	37	19	1.96	70	9			

Appendix F Mineral Analyses of Central Area Drains

Station	T	Mineral Constituents: mg/L / meq/L / prv								Mineral Constituents (mg/L)		
Date / Time	°C / °F	Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	TH	TDS / Sum	SAR / ASAR
02/07/12	16	178	40	1.2	130	141	17	487	152	611	1,220	2.3
1115	61	8.9	3.3	0.03	6	4.0	0.27	10	3.0		1,085	2.6
		50	19	0.2	32	23	1.54	58	17			
05/15/12	17	301	105	2.8	450	279	64	1,580	196	1,184	2,980	5.7
1130	63	15.0	8.6	0.07	20	7.8	1.03	33	3.9		2,899	7.1
		35	20	0.2	45	17	2.26	72	9			
08/20/12	22	126	30	2.6	117	94	34	380	144	438	945	2.4
1200	72	6.3	2.5	0.07	5	2.6	0.54	8	2.9		870	2.6
		45	18	0.5	37	19	3.90	57	20			
11/05/12	20	183	37	2.4	152	121	22	473	182	607	1,170	2.7
1000	68	9.1	3.0	0.06	7	3.4	0.35	10	3.6		1,099	3.1
		49	16	0.3	35	20	2.02	57	21			
HMH 7516												
01/26/11	17	298	60	3.6	449	452	125	1,000	174	993	2,590	6.2
900	63	14.9	5.0	0.09	20	12.7	2.02	21	3.5		2,492	7.4
		38	13	0.2	49	33	5.17	53	9			
03/15/11	18	287	58	2.8	421	446	116	957	170	956	2,450	5.9
1115	64	14.3	4.8	0.07	18	12.5	1.87	20	3.4		2,390	7.1
		38	13	0.2	49	33	4.96	53	9			
08/16/11	21	342	67	2.8	464	518	145	1,160	154	1,130	3,000	6.0
830	70	17.1	5.5	0.07	20	14.6	2.34	24	3.1		2,791	7.8
		40	13	0.2	47	33	5.30	55	7			
02/06/12	17	301	57	4.3	461	450	121	914	170	986	2,540	6.4
1000	63	15.0	4.7	0.11	20	12.6	1.95	19	3.4		2,410	7.7
		38	12	0.3	50	34	5.27	51	9			
05/16/12	18	346	65	4.0	456	511	155	1,120	173	1,133	2,820	5.9
1030	64	17.3	5.3	0.10	20	14.4	2.50	23	3.4		2,761	7.4
		41	13	0.2	47	33	5.73	53	8			

Appendix F Mineral Analyses of Central Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
11/06/12	21	273	53	3.1	438	419	121	840	176	946	2,450	6.3
1300	70	13.6	4.4	0.08	19	11.8	1.94	17	3.5		2,253	7.6
		37	12	0.2	51	34	5.61	50	10			
OAS 0364												
01/25/11	17	482	202	4.3	1,210	473	88	3,500	167	2,036	5,470	11.7
930	63	24.1	16.6	0.11	53	13.3	1.42	73	3.3		6,060	15.8
		26	18	0.1	56	15	1.56	80	4			
OAS 2548												
01/25/11	13	408	195	3.7	1,440	453	23	3,660	242	1,822	5,080	14.7
1245	55	20.4	16.0	0.09	63	12.7	0.37	76	4.8		6,328	19.1
		21	16	0.1	63	14	0.40	81	5			
03/15/11	16	450	296	5.9	2,920	1,150	75	6,640	241	2,343	11,890	26.3
1300	61	22.5	24.3	0.15	127	32.3	1.21	138	4.8		11,682	34.1
		13	14	0.1	73	18	0.69	78	3			
05/11/11	17	429	381	7.2	3,860	1,700	93	8,880	240	2,641	14,910	32.7
1230	63	21.4	31.3	0.18	168	47.8	1.49	185	4.8		15,494	45.7
		10	14	0.1	76	20	0.63	77	2			
08/16/11	22	285	146	2.5	1,280	479	21	2,810	304	1,313	5,850	15.4
1030	72	14.2	12.0	0.06	56	13.5	0.35	59	6.0		5,206	18.4
		17	15	0.1	68	17	0.44	75	8			
02/06/12	13	178	117	5.3	1,160	484	26	2,360	135	926	4,480	16.6
1200	55	8.9	9.6	0.14	50	13.6	0.41	49	2.7		4,411	18.2
		13	14	0.2	73	21	0.62	75	4			
05/15/12	17	301	198	5.2	1,700	723	41	4,240	283	1,567	7,420	18.7
1400	63	15.0	16.3	0.13	74	20.3	0.66	88	5.6		7,378	26.2
		14	15	0.1	70	18	0.57	77	5			
08/20/12	23	173	97	5.0	906	363	16	1,860	308	832	3,740	13.7
1100	73	8.6	8.0	0.13	39	10.2	0.25	39	6.1		3,605	17.8
		15	14	0.2	70	18	0.46	70	11			

Appendix F Mineral Analyses of Central Area Drains

Station	T	Mineral Constituents: mg/L / meq/L / prv								Mineral Constituents (mg/L)		
Date / Time	°C / °F	Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	TH	TDS / Sum	SAR / ASAR
11/06/12	20	397	236	4.1	1,800	638	29	4,337	331	1,963	7,780	17.7
1330	68	19.8	19.4	0.10	78	17.9	0.46	90	6.6		7,639	25.6
		17	17	0.1	67	16	0.40	78	6			
PFM 6867												
02/08/12	18	31	17	4.6	85	117	8	71	80	148	414	3.0
1300	64	1.6	1.4	0.12	4	3.3	0.12	1	1.6		381	2.3
		23	21	1.8	55	51	1.89	23	25			

Appendix G
Electrical Conductivity, pH, & Trace Elements in Central Area Drains
2011-2012

Appendix G
Electrical Conductivity, pH, and Trace Elements in Central Area Drains

Station / Date	Field Laboratory pH	Field Laboratory EC (µS/cm)	Trace Elements (mg/L) As	B	Ba	Mo	Se
BVS 6001							
03/16/11	7.4	7,570	< 0.005	10.3	< 0.25	0.055	0.226
	7.5	7,316					
05/10/11	7.3	7,510	< 0.010	9.9	< 0.50	< 0.050	0.209
	7.6	7,228					
08/17/11	7.4	6,740	0.006	10.2	< 0.25	0.052	0.221
	7.5	6,629					
02/07/12	7.6	5,210	0.005	6.8	< 0.03	0.050	0.155
	7.6	5,248					
05/15/12	7.6	6,440	0.005	8.5	< 0.03	0.037	0.171
	7.7	6,141					
08/21/12	6.9	7,970	< 0.010	12.5	< 0.05	< 0.050	0.191
	7.4	7,838					
11/05/12	7.2	5,550	< 0.005	9.4	< 0.03	0.049	0.125
	7.6	5,345					
BVS 7007							
03/15/11	7.3	7,450	< 0.005	11.6	< 0.25	0.065	0.239
	7.4	7,298					
05/10/11	7.2	7,940	< 0.010	11.0	< 0.50	0.059	0.241
	7.5	7,508					
08/16/11	7.8	7,210	0.005	10.9	< 0.25	0.068	0.234
	7.9	7,045					
02/07/12	7.5	6,190	0.005	9.4	< 0.03	0.057	0.229
	7.6	6,210					
05/15/12	7.3	7,010	0.005	11.6	< 0.03	0.052	0.220
	7.4	6,834					
08/20/12	7.2	3,116	< 0.005	5.0	< 0.03	0.052	0.079
	7.7	3,137					
11/05/12	6.8	11,120	< 0.010	20.8	< 0.05	0.070	0.578
	7.3	10,570					
BVS 7402							
01/26/11	7.4	4,768	< 0.005	6.8	< 0.25	0.063	0.155
	7.5	4,775					
03/15/11	7.2	4,900	< 0.005	7.0	< 0.25	0.052	0.109
	7.5	4,865					

Appendix G

Electrical Conductivity, pH, and Trace Elements in Central Area Drains

Station Date	Field Laboratory pH	EC (µS/cm)	Trace Elements (mg/L) As	B	Ba	Mo	Se
05/10/11	7.5 7.6	4,685 4,650	< 0.005	6.6	< 0.25	0.054	0.102
08/17/11	6.9 7.2	5,420 5,304	0.005	8.9	< 0.25	0.062	0.075
BVS 8003							
01/26/11	7.4 7.5	5,810 5,712	< 0.005	13.1	< 0.25	0.104	0.060
BVS 8915							
02/08/12	7.6 7.5	2,872 3,100	< 0.005	2.8	0.03	0.039	0.042
08/21/12	7.2 7.4	3,375 3,381	< 0.005	3.5	0.03	0.040	0.035
11/06/12	7.1 7.4	3,630 3,550	< 0.005	3.5	0.03	0.032	0.034
CTL 3728							
01/25/11	7.1 7.3	6,370 5,962	0.005	5.1	< 0.25	< 0.025	0.218
03/15/11	6.8 7.4	5,890 5,906	< 0.005	4.8	< 0.25	< 0.025	0.138
05/11/11	7.2 7.4	4,691 4,677	0.005	3.4	< 0.25	< 0.025	0.132
08/17/11	7.6 7.5	2,550 2,593	0.005	1.9	< 0.25	< 0.025	0.052
02/06/12	7.2 7.4	5,940 5,959	0.006	5.4	< 0.03	< 0.025	0.178
05/16/12	7.2 7.3	5,480 5,326	0.005	5.1	< 0.03	< 0.025	0.149
08/20/12	6.9 7.4	5,520 5,563	0.005	5.3	< 0.03	< 0.025	0.152
11/05/12	6.9 7.2	6,640 6,398	0.005	6.6	< 0.03	< 0.025	0.160
DPS 1016							
01/25/11	7.4 7.5	6,930 6,607	0.006	11.8	< 0.25	< 0.025	0.067

Appendix G
Electrical Conductivity, pH, and Trace Elements in Central Area Drains

Station / Date	Field / Laboratory pH	Field / Laboratory EC (µS/cm)	Trace Elements (mg/L) As	B	Ba	Mo	Se
05/11/11	7.7	5,040	< 0.005	7.4	< 0.25	< 0.025	0.135
	7.9	4,913					
08/16/11	8.3	4,436	0.005	7.9	< 0.25	< 0.025	0.111
	8.4	4,400					
02/06/12	8.0	4,203	< 0.005	7.2	0.03	< 0.025	0.060
	7.9	4,241					
05/16/12	7.4	7,430	0.005	14.5	< 0.03	< 0.025	0.065
	7.4	7,335					
08/20/12	7.6	2,412	< 0.005	4.1	0.04	< 0.025	0.025
	7.8	2,413					
11/06/12	8.2	1,827	0.002	2.9	0.04	0.005	0.031
	8.4	1,767					
DPS 1367							
03/15/11	7.6	6,020	< 0.005	5.2	< 0.25	< 0.025	0.179
	7.4	6,026					
05/11/11	7.2	166	0.005	5.0	< 0.25	< 0.025	0.197
	7.5	6,039					
DPS 2535							
01/25/11	7.4	8,320	< 0.010	19.2	< 0.50	< 0.050	0.052
	7.5	7,943					
03/15/11	7.5	7,830	< 0.005	17.3	< 0.25	< 0.025	0.046
	7.5	7,474					
05/11/11	7.4	7,990	< 0.010	17.7	< 0.50	< 0.050	0.037
	7.7	7,717					
08/17/11	7.4	7,300	0.007	18.0	< 0.25	< 0.025	0.035
	7.5	7,307					
02/06/12	7.6	8,280	< 0.010	20.2	< 0.05	< 0.050	0.055
	7.6	8,310					
05/16/12	7.6	7,200	< 0.005	20.1	< 0.03	< 0.025	0.046
	7.6	7,123					
08/20/12	7.1	7,650	< 0.010	18.1	< 0.05	< 0.050	0.045
	7.6	7,566					
11/06/12	7.1	10,080	< 0.010	25.2	< 0.05	< 0.050	0.052
	7.4	9,662					

Appendix G
Electrical Conductivity, pH, and Trace Elements in Central Area Drains

Station / Date	Field Laboratory pH	Field Laboratory EC (µS/cm)	Trace Elements (mg/L) As	B	Ba	Mo	Se
DPS 3235							
01/25/11	7.9	4,789	< 0.005	8.2	< 0.25	< 0.025	0.038
	7.8	4,794					
03/15/11	8.0	5,040	< 0.005	9.2	< 0.25	< 0.025	0.050
	7.9	4,959					
05/11/11	7.5	5,510	< 0.005	10.3	< 0.25	< 0.025	0.028
	7.9	5,306					
08/16/11	7.4	5,190	0.005	9.5	< 0.25	< 0.025	0.032
	7.8	5,192					
02/06/12	8.0	4,730	< 0.005	9.9	0.03	< 0.025	0.034
	7.9	4,839					
05/16/12	7.7	6,160	0.005	14.9	0.03	< 0.025	0.028
	7.7	6,127					
08/20/12	7.8	3,743	0.005	7.4	0.04	< 0.025	0.030
	8.1	3,735					
11/06/12	7.7	7,190	< 0.010	16.4	< 0.05	< 0.050	0.020
	8.0	6,927					
DPS 3465							
03/15/11	7.7	8,090	< 0.010	15.1	< 0.50	< 0.050	0.036
	7.4	7,861					
DPS 4616							
01/25/11	7.4	9,580	< 0.010	25.4	< 0.50	0.060	0.020
	7.5	9,081					
03/15/11	7.5	19,070	< 0.020	79.7	< 1.00	0.128	0.031
	7.5	18,210					
08/16/11	7.3	12,170	0.013	40.5	< 0.50	0.079	0.028
	7.5	11,890					
02/06/12	7.6	7,890	0.006	20.6	< 0.03	0.066	0.024
	7.6	7,966					
05/16/12	7.6	13,920	< 0.010	63.9	< 0.05	0.103	0.033
	7.6	13,630					
08/20/12	7.3	8,980	< 0.010	27.2	< 0.05	0.063	0.024
	7.6	8,863					
11/06/12	7.8	2,094	0.001	3.0	0.04	0.027	0.002
	8.0	2,128					

Appendix G
Electrical Conductivity, pH, and Trace Elements in Central Area Drains

Station / Date	Field / Laboratory pH	Field / Laboratory EC (µS/cm)	Trace Elements (mg/L) As	B	Ba	Mo	Se
FBH 2016							
01/26/11	7.6	4,974	< 0.005	6.7	< 0.25	0.085	0.158
	7.7	4,909					
03/16/11	7.6	7,040	< 0.005	11.9	< 0.25	0.148	0.249
	7.6	6,859					
05/10/11	7.5	8,050	< 0.010	12.6	< 0.50	0.179	0.314
	7.6	7,896					
08/17/11	7.2	6,550	0.005	10.7	< 0.25	0.129	0.215
	7.5	6,532					
02/07/12	7.8	4,990	< 0.005	7.4	< 0.03	0.098	0.173
	7.7	5,158					
05/15/12	7.6	7,850	< 0.005	15.2	< 0.03	0.156	0.346
	7.6	7,805					
08/21/12	7.2	6,690	< 0.010	10.7	< 0.05	0.112	0.225
	7.6	6,674					
11/05/12	7.2	7,960	< 0.010	14.3	< 0.05	0.137	0.267
	7.4	7,745					
FBH 4045							
03/16/11	7.4	4,110	< 0.005	4.2	< 0.25	0.028	0.095
	7.5	4,014					
05/10/11	7.2	5,110	< 0.005	5.1	< 0.25	0.026	0.148
	7.5	5,021					
08/17/11	6.7	8,280	< 0.010	10.8	< 0.50	< 0.050	0.311
	6.9	8,079					
02/07/12	7.8	4,982	0.006	5.9	< 0.03	0.044	0.131
	7.8	5,092					
05/15/12	7.2	6,440	< 0.005	8.4	< 0.03	0.028	0.205
	7.4	6,448					
08/21/12	6.7	7,160	< 0.010	9.7	< 0.05	< 0.050	0.208
	7.0	7,091					
11/05/12	6.8	7,200	< 0.010	10.1	< 0.05	< 0.050	0.176
	7.3	7,002					
FBH 5056							
03/16/11	7.5	6,430	< 0.005	8.9	< 0.25	0.053	0.160
	7.5	6,306					

Appendix G
Electrical Conductivity, pH, and Trace Elements in Central Area Drains

Station / Date	Field / Laboratory pH	Field / Laboratory EC (µS/cm)	Trace Elements (mg/L) As	B	Ba	Mo	Se
05/10/11	7.1	4,481	< 0.005	4.8	< 0.25	< 0.025	0.066
	7.4	4,294					
08/17/11	7.1	5,580	< 0.005	7.4	< 0.25	0.029	0.071
	7.2	5,498					
02/07/12	7.2	5,720	< 0.005	7.9	< 0.03	0.027	0.106
	7.4	5,760					
05/15/12	6.8	3,372	< 0.005	3.6	0.03	< 0.025	0.035
	7.2	3,372					
08/21/12	7.0	5,780	< 0.005	7.8	< 0.03	0.030	0.113
	7.3	5,754					
11/05/12	7.7	5,750	< 0.005	8.1	< 0.03	0.027	0.097
	8.0	5,626					
FBH 8061							
01/26/11	7.6	1,834	0.003	1.6	< 0.05	0.044	0.005
	7.6	1,872					
03/16/11	7.6	4,402	< 0.005	6.8	< 0.25	0.061	0.027
	7.5	4,327					
05/10/11	7.4	4,353	< 0.005	6.3	< 0.25	0.064	0.023
	7.6	4,212					
08/16/11	7.2	3,321	< 0.005	4.2	< 0.25	0.059	0.015
	7.5	3,305					
02/07/12	7.8	1,642	0.002	1.3	0.02	0.020	0.005
	7.8	1,657					
05/15/12	7.2	3,723	< 0.005	6.1	0.03	0.056	0.023
	7.5	3,704					
08/20/12	7.3	1,370	0.006	1.2	0.04	0.029	0.006
	7.6	1,380					
11/05/12	7.5	1,603	0.002	1.9	0.04	0.029	0.007
	7.6	1,607					
HMH 7516							
01/26/11	7.2	3,558	< 0.005	6.6	< 0.25	< 0.025	0.045
	7.4	3,522					
03/15/11	7.4	3,506	< 0.005	6.2	< 0.25	< 0.025	0.036
	7.6	3,499					

Appendix G
Electrical Conductivity, pH, and Trace Elements in Central Area Drains

Station / Date	Field Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
08/16/11	7.2 7.4	3,912 4,012	< 0.005	6.8	< 0.25	< 0.025	0.046
02/06/12	7.5 7.6	3,454 3,546	< 0.005	6.6	< 0.03	< 0.025	0.039
05/16/12	7.3 7.4	3,859 3,903	< 0.005	7.2	< 0.03	< 0.025	0.048
11/06/12	7.2 7.5	3,578 3,441	< 0.005	7.7	< 0.03	< 0.025	0.031
OAS 0364							
01/25/11	7.3 7.5	6,950 6,572	0.005	12.5	< 0.25	0.105	0.228
OAS 2548							
01/25/11	7.5 7.5	7,710 6,208	0.005	16.1	< 0.25	0.172	0.105
03/15/11	7.6 7.6	13,340 13,420	< 0.010	26.3	< 0.50	0.273	0.214
05/11/11	7.5 7.8	17,610 16,230	< 0.020	33.5	< 1.00	0.336	0.288
08/16/11	7.2 7.5	6,970 7,027	0.005	12.7	< 0.25	0.146	0.081
02/06/12	8.1 7.9	5,840 5,935	0.005	9.9	0.03	0.108	0.090
05/15/12	7.6 7.6	8,840 8,871	< 0.010	18.6	< 0.05	0.146	0.126
08/20/12	7.1 7.5	4,990 4,983	< 0.005	8.6	0.05	0.079	0.052
11/06/12	7.5 7.8	9,320 8,980	< 0.010	20.0	< 0.05	0.135	0.106
PFM 6867							
02/08/12	8.2 7.9	693 717	0.003	0.2	0.05	< 0.005	0.002

Appendix H
Mineral Analyses of Southern Area Drains
2011-2012

Appendix H Mineral Analyses of Southern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
BRL 2235												
01/28/11	16.0	35	17	2.1	199	104	20.7	124	331	157	720	6.8
1230	61	1.7	1.4	0.05	9	2.9	0.33	2.6	6.6		700	7.3
		15	12	0.4	73	24	2.69	21	53			
03/16/11	15.0	13	4	2.8	27	11	3.4	40	60	48	158	1.7
1430	59	0.6	0.3	0.07	1	0.3	0.05	0.8	1.2		137	0.7
		29	15	3.2	53	13	2.30	35	50			
05/11/11	18.0	41	19	1.2	173	96	14.5	146	276	181	701	5.6
1145	64	2.0	1.6	0.03	8	2.7	0.23	3.0	5.5		656	5.6
		18	14	0.3	67	24	2.04	27	48			
08/16/11	21.0	25	10	0.9	98	47	8.1	96	155	103	416	4.2
800	70	1.2	0.8	0.02	4	1.3	0.13	2.0	3.1		378	3.6
		20	13	0.4	67	20	2.00	31	47			
CCN 3550												
01/26/11	15.0	309	135	7.0	839	686	54.0	1,650	413	1,328	4,140	10.0
1215	59	15.4	11.1	0.18	36	19.3	0.87	34.4	8.2		3,928	14.0
		24	18	0.3	58	31	1.39	55	13			
03/16/11	16.0	311	136	6.3	817	666	50.8	1,670	402	1,337	4,050	9.7
945	61	15.5	11.2	0.16	36	18.7	0.82	34.8	8.0		3,898	13.6
		25	18	0.3	57	30	1.32	56	13			
05/10/11	18.0	243	103	5.1	631	454	40.0	1,220	370	1,031	3,150	8.5
1515	64	12.1	8.5	0.13	27	12.8	0.65	25.4	7.3		2,918	12.0
		25	18	0.3	57	28	1.40	55	16			
08/17/11	22.0	251	102	5.3	670	488	35.9	1,280	359	1,047	3,410	9.0
1200	72	12.5	8.4	0.14	29	13.7	0.58	26.7	7.1		3,048	12.2
		25	17	0.3	58	29	1.20	55	15			
02/14/12	15.0	302	131	5.4	810	589	42.2	1,550	399	1,294	3,940	9.8
945	59	15.1	10.8	0.14	35	16.5	0.68	32.3	7.9		3,669	13.2
		25	18	0.2	58	29	1.19	56	14			
05/15/12	19.0	224	90	5.1	600	414	34.2	1,230	351	929	2,840	8.6
1100	66	11.2	7.4	0.13	26	11.6	0.55	25.6	7.0		2,808	11.6
		25	17	0.3	58	26	1.23	57	16			
08/21/12	23.0	262	110	7.6	808	586	36.4	1,590	386	1,107	3,740	10.6
945	73	13.1	9.0	0.19	35	16.5	0.59	33.1	7.7		3,632	14.3
		23	16	0.3	61	28	1.02	57	13			

Appendix H Mineral Analyses of Southern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
11/14/12	20.0	223	97	5.1	624	439	34.2	1,233	360	957	2,980	8.8
1000	68	11.1	8.0	0.13	27	12.3	0.55	25.7	7.1		2,872	11.9
		24	17	0.3	58	27	1.21	56	16			
CNR 0801												
01/25/11	18.0	388	359	75.7	1,890	509	232.0	4,900	286	2,448	7,190	16.6
1300	64	19.4	29.5	1.94	82	14.3	3.74	102.0	5.7		8,525	23.3
		15	22	1.5	62	11	2.98	81	5			
03/16/11	17.0	409	397	58.2	1,950	506	239.0	5,260	265	2,657	9,460	16.5
1230	63	20.4	32.6	1.49	85	14.2	3.85	109.5	5.3		8,978	24.7
		15	23	1.1	61	11	2.90	82	4			
05/10/11	20.0	390	351	57.9	1,810	505	221.0	5,190	259	2,420	8,230	16.0
1030	68	19.5	28.9	1.48	79	14.2	3.56	108.1	5.1		8,680	22.4
		15	22	1.2	61	11	2.72	83	4			
08/17/11	23.0	396	319	56.3	1,750	464	273.0	4,650	250	2,303	8,760	15.9
930	73	19.8	26.2	1.44	76	13.0	4.40	96.8	5.0		8,058	21.4
		16	21	1.2	62	11	3.69	81	4			
02/13/12	17.0	410	327	62.0	1,840	486	217.0	4,820	296	2,371	8,620	16.5
1200	63	20.5	26.9	1.59	80	13.7	3.50	100.4	5.9		8,340	23.0
		16	21	1.2	62	11	2.84	81	5			
05/15/12	19.0	397	272	48.8	1,140	340	332.0	3,400	206	2,112	6,370	10.8
1300	66	19.8	22.4	1.25	50	9.6	5.35	70.8	4.1		6,053	14.6
		21	24	1.3	53	11	5.96	79	5			
08/20/12	22.0	347	264	47.5	950	293	224.0	3,070	232	1,954	5,580	9.4
1330	72	17.3	21.7	1.21	41	8.2	3.61	63.9	4.6		5,335	12.6
		21	27	1.5	51	10	4.49	80	6			
11/13/12	22.0	401	273	51.3	1,040	294	372.6	3,043	179	2,126	5,850	9.8
1045	72	20.0	22.5	1.31	45	8.3	6.01	63.4	3.6		5,582	12.8
		22	25	1.5	51	10	7.40	78	4			
COC 4126												
01/25/11	18.0	526	136	6.8	657	190	242.0	2,570	246	1,874	3,840	6.6
1200	64	26.2	11.2	0.17	29	5.3	3.90	53.5	4.9		4,475	8.9
		40	17	0.3	43	8	5.77	79	7			
03/15/11	18.0	558	124	7.3	512	288	226.0	2,090	232	1,904	4,160	5.1
1030	64	27.8	10.2	0.19	22	8.1	3.64	43.5	4.6		3,945	6.9
		46	17	0.3	37	14	6.09	73	8			

Appendix H Mineral Analyses of Southern Area Drains

Station	T	Mineral Constituents: mg/L meq/L prv								Mineral Constituents (mg/L)		
Date	°C										TDS	SAR
Time	°F	Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	TH	Sum	ASAR
05/10/11	19.0	536	146	5.9	616	176	246.0	2,500	244	1,940	4,520	6.1
1100	66	26.7	12.0	0.15	27	4.9	3.97	52.1	4.8		4,372	8.2
		41	18	0.2	41	8	6.03	79	7			
08/17/11	23.0	500	84	4.7	305	149	135.0	1,720	206	1,595	3,260	3.3
800	73	25.0	6.9	0.12	13	4.2	2.18	35.8	4.1		3,021	4.7
		55	15	0.3	29	9	4.71	77	9			
02/13/12	19.0	478	78	4.7	259	106	89.3	1,540	194	1,515	2,830	2.9
1330	66	23.9	6.4	0.12	11	3.0	1.44	32.1	3.8		2,671	3.9
		57	15	0.3	27	7	3.57	80	10			
05/15/12	20.0	509	126	7.4	570	180	247.0	2,470	251	1,790	4,530	5.9
1200	68	25.4	10.4	0.19	25	5.1	3.98	51.4	5.0		4,260	8.2
		42	17	0.3	41	8	6.09	79	8			
08/20/12	26.0	499	103	9.9	510	375	146.7	1,930	209	1,670	3,760	5.4
1230	79	24.9	8.5	0.25	22	10.5	2.37	40.2	4.1		3,699	7.3
		45	15	0.5	40	18	4.13	70	7			
11/13/12	18.0	521	115	8.0	438	212	181.0	1,961	177	1,775	3,670	4.5
1000	64	26.0	9.5	0.20	19	6.0	2.92	40.8	3.5		3,542	5.9
		48	17	0.4	35	11	5.49	77	7			
COC 8221												
01/25/11	18.0	373	127	14.5	762	181	118.0	2,360	183	1,455	3,940	8.7
1230	64	18.6	10.4	0.37	33	5.1	1.90	49.1	3.6		4,045	10.4
		30	17	0.6	53	9	3.18	82	6			
03/15/11	19.0	408	134	13.4	707	175	105.0	2,390	180	1,571	4,100	7.8
1130	66	20.4	11.0	0.34	31	4.9	1.69	49.8	3.6		4,040	10.1
		33	18	0.5	49	8	2.82	83	6			
05/10/11	19.0	374	127	12.8	653	173	107.0	2,380	180	1,457	3,700	7.4
1145	66	18.7	10.4	0.33	28	4.9	1.73	49.6	3.6		3,935	8.9
		32	18	0.6	49	8	2.89	83	6			
08/17/11	22.0	326	130	13.4	749	187	146.0	2,430	180	1,350	4,340	8.9
830	72	16.3	10.7	0.34	33	5.3	2.35	50.6	3.6		4,089	10.6
		27	18	0.6	54	9	3.81	82	6			
02/13/12	19.0	376	139	13.5	741	178	116.0	2,280	185	1,512	4,080	8.3
1400	66	18.8	11.4	0.35	32	5.0	1.87	47.5	3.7		3,955	10.8
		30	18	0.6	51	9	3.22	82	6			
05/15/12	20.0	373	124	14.2	693	168	121.0	2,510	178	1,442	4,040	7.9
1230	68	18.6	10.2	0.36	30	4.7	1.95	52.3	3.5		4,110	9.5
		31	17	0.6	51	8	3.12	84	6			

Appendix H Mineral Analyses of Southern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
08/20/12	23.0	333	112	15.9	686	158	130.0	2,180	178	1,293	3,860	8.3
1300	73	16.6	9.2	0.41	30	4.4	2.10	45.4	3.5		3,722	10.0
		30	16	0.7	53	8	3.78	82	6			
11/13/12	22.0	375	126	14.6	713	154	132.1	2,177	179	1,456	3,960	8.1
1030	72	18.7	10.4	0.37	31	4.3	2.13	45.3	3.6		3,799	9.8
		31	17	0.6	51	8	3.85	82	6			
ERR 8429												
01/26/11	18.0	157	88	9.0	1,710	805	19.1	2,480	688	754	5,920	27.1
1300	64	7.8	7.2	0.23	74	22.6	0.31	51.6	13.7		5,681	39.3
		9	8	0.3	83	26	0.35	59	15			
03/16/11	17.0	152	88	7.2	1,760	856	19.2	2,600	690	741	6,120	28.1
1115	63	7.6	7.2	0.18	77	24.0	0.31	54.1	13.7		5,896	39.4
		8	8	0.2	84	26	0.34	59	15			
05/11/11	18.0	44	25	4.2	521	184	90.0	304	698	212	1,690	15.5
830	64	2.2	2.1	0.11	23	5.2	1.45	6.3	13.8		1,592	18.5
		8	8	0.4	84	19	5.42	24	52			
08/17/11	22.0	127	80	6.3	1,560	740	65.9	1,930	720	646	5,480	26.7
1230	72	6.3	6.6	0.16	68	20.8	1.06	40.2	14.3		4,941	37.4
		8	8	0.2	84	27	1.39	53	19			
02/14/12	16.0	132	75	5.9	1,530	745	59.8	2,120	733	638	5,320	26.4
1015	61	6.6	6.2	0.15	67	20.9	0.96	44.1	14.5		5,108	36.9
		8	8	0.2	84	26	1.20	55	18			
05/15/12	19.0	190	102	9.2	2,300	1,140	61.2	3,480	724	895	7,750	33.5
1200	66	9.5	8.4	0.24	100	32.0	0.99	72.5	14.4		7,717	48.5
		8	7	0.2	85	27	0.82	60	12			
08/20/12	23.0	42	23	5.4	493	184	101.0	292	659	201	1,640	15.2
1030	73	2.1	1.9	0.14	21	5.2	1.63	6.1	13.1		1,536	17.5
		8	7	0.5	84	20	6.28	23	50			
11/14/12	21.0	117	64	5.7	1,290	552	62.3	1,618	668	555	4,170	23.8
1030	70	5.8	5.2	0.15	56	15.5	1.00	33.7	13.3		4,110	32.2
		9	8	0.2	83	24	1.58	53	21			
ERR 8641												
01/26/11	17.0	208	209	21.7	2,270	972	3.4	3,720	537	1,380	8,150	26.6
1330	63	10.4	17.2	0.56	99	27.3	0.05	77.5	10.7		7,726	38.5
		8	14	0.4	78	24	0.05	67	9			

Appendix H Mineral Analyses of Southern Area Drains

Station	T	Mineral Constituents: mg/L meq/L prv								Mineral Constituents (mg/L)		
Date	°C										TDS	SAR
Time	°F	Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	TH	Sum	ASAR
03/16/11	17.0	183	184	15.7	1,860	857	2.5	3,380	494	1,215	7,090	23.2
1030	63	9.1	15.1	0.40	81	24.1	0.04	70.4	9.8		6,779	32.5
		9	14	0.4	77	23	0.04	67	9			
05/11/11	17.0	232	256	18.6	2,260	1,130	4.3	4,660	547	1,634	9,130	24.3
845	63	11.6	21.1	0.48	98	31.7	0.07	97.0	10.9		8,889	37.7
		9	16	0.4	75	23	0.05	69	8			
08/17/11	22.0	204	224	17.5	2,000	976	4.5	4,120	510	1,432	8,150	23.0
1300	72	10.2	18.4	0.45	87	27.4	0.07	85.8	10.1		7,852	33.3
		9	16	0.4	75	22	0.06	70	8			
02/14/12	16.0	365	409	27.0	3,810	1,620	17.1	7,180	694	2,596	14,540	32.6
1030	61	18.2	33.6	0.69	166	45.5	0.28	149.5	13.8		13,845	55.3
		8	15	0.3	76	22	0.13	72	7			
05/15/12	19.0	212	232	18.5	2,260	1,030	4.2	4,260	485	1,485	8,240	25.5
1230	66	10.6	19.1	0.47	98	28.9	0.07	88.7	9.6		8,308	35.7
		8	15	0.4	77	23	0.05	70	8			
08/21/12	20.4	199	208	25.7	2,080	925	16.1	3,940	484	1,354	8,080	24.6
1000	69	9.9	17.1	0.66	90	26.0	0.26	82.0	9.6		7,684	34.5
		8	14	0.6	77	22	0.22	70	8			
11/14/12	20.0	58	33	6.1	477	224	0.6	642	258	277	1,660	12.5
1045	68	2.9	2.7	0.16	21	6.3	0.01	13.4	5.1		1,594	13.1
		11	10	0.6	78	25	0.04	54	21			
GSY 0935												
01/26/11	17.0	101	44	7.2	529	216	88.9	732	454	432	2,020	11.1
1400	63	5.0	3.6	0.18	23	6.1	1.43	15.2	9.0		1,991	13.8
		16	11	0.6	72	19	4.52	48	28			
03/16/11	16.0	53	26	5.2	473	169	87.8	421	531	238	1,660	13.3
1145	61	2.6	2.1	0.13	21	4.7	1.42	8.8	10.5		1,554	15.3
		10	8	0.5	81	19	5.56	34	41			
05/11/11	17.0	39	21	4.6	386	136	72.3	313	495	184	1,380	12.4
800	63	1.9	1.7	0.12	17	3.8	1.17	6.5	9.8		1,269	13.0
		9	8	0.6	82	18	5.47	31	46			
08/17/11	22.0	56	27	5.1	404	146	86.9	386	495	250	1,510	11.1
1400	72	2.8	2.2	0.13	18	4.1	1.40	8.0	9.8		1,408	12.8
		12	10	0.6	77	18	6.00	34	42			
02/14/12	15.0	23	12	2.0	350	91	66.9	194	446	108	1,070	14.7
1100	59	1.1	1.0	0.05	15	2.6	1.08	4.0	8.8		1,007	14.7
		7	6	0.3	87	15	6.53	24	54			

Appendix H Mineral Analyses of Southern Area Drains

Station	T	Mineral Constituents: mg/L meq/L prv								Mineral Constituents (mg/L)		
Date	°C									TH	TDS	SAR
Time	°F	Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk		Sum	ASAR
08/21/12	21.3	49	27	7.7	428	152	81.4	375	536	235	1,560	12.2
1100	70	2.4	2.2	0.20	19	4.3	1.31	7.8	10.6		1,442	14.0
		10	9	0.8	79	18	5.46	32	44			
11/14/12	20.0	76	34	11.9	528	187	73.9	480	594	329	1,820	12.7
1100	68	3.8	2.8	0.30	23	5.3	1.19	10.0	11.8		1,747	15.8
		13	9	1.0	77	19	4.22	35	42			
HCH 7841												
01/26/11	15.0	99	107	10.0	1,890	1,280	114.0	1,890	627	688	6,080	31.4
1130	59	4.9	8.8	0.26	82	36.0	1.84	39.4	12.4		5,766	43.9
		5	9	0.3	85	40	2.05	44	14			
03/16/11	16.0	119	101	8.4	1,600	1,190	114.0	1,800	555	713	5,540	26.1
900	61	5.9	8.3	0.21	70	33.4	1.84	37.5	11.0		5,265	35.2
		7	10	0.3	83	40	2.20	45	13			
08/17/11	22.0	93	58	7.9	980	722	107.0	1,190	466	473	3,600	19.7
1100	72	4.6	4.8	0.20	43	20.3	1.73	24.8	9.2		3,438	23.6
		9	9	0.4	82	36	3.08	44	17			
02/14/12	15.0	86	69	7.1	1,290	871	157.0	1,340	523	497	4,280	25.1
1130	59	4.3	5.7	0.18	56	24.5	2.53	27.9	10.4		4,134	31.4
		6	9	0.3	85	37	3.88	43	16			
05/15/12	18.0	134	113	9.4	1,720	1,360	127.0	1,990	512	800	6,070	26.5
1015	64	6.7	9.3	0.24	75	38.2	2.05	41.4	10.2		5,761	37.1
		7	10	0.3	82	42	2.23	45	11			
08/21/12	22.4	62	49	9.6	931	640	115.0	1,100	416	355	3,190	21.5
900	72	3.1	4.0	0.25	40	18.0	1.85	22.9	8.3		3,156	25.8
		6	8	0.5	85	35	3.64	45	16			
11/13/12	20.0	87	79	9.9	1,340	882	76.6	1,520	450	543	4,120	25.0
1230	68	4.4	6.5	0.25	58	24.8	1.24	31.6	8.9		4,265	31.3
		6	9	0.4	84	37	1.86	48	13			
HNE 3160												
11/13/12	20.0	306	229	28.3	2,350	1,698	60.6	3,314	560	1,707	8,580	24.8
1300	68	15.3	18.8	0.72	102	47.7	0.98	69.0	11.1		8,322	38.4
		11	14	0.5	75	37	0.76	54	9			
HNW 3111												
11/14/12	19.0	129	111	26.3	1,420	686	122.5	2,018	485	779	4,920	22.1
945	66	6.4	9.1	0.67	62	19.3	1.98	42.0	9.6		4,804	29.9
		8	12	0.9	79	26	2.71	58	13			

Appendix H Mineral Analyses of Southern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
LME 1546												
08/21/12	25.4	20	4	3.2	47	15	18.6	97	40	68	254	2.5
1200	78	1.0	0.3	0.08	2	0.4	0.30	2.0	0.8		229	1.1
		29	10	2.4	59	12	8.49	57	22			
LNW 5467												
01/26/11	18.0	519	230	7.1	3,640	2,680	270.0	5,630	122	2,243	11,480	33.5
1000	64	25.9	18.9	0.18	158	75.3	4.35	117.2	2.4		13,049	40.1
		13	9	0.1	78	38	2.18	59	1			
03/15/11	18.0	510	229	5.7	3,490	2,610	260.0	5,600	117	2,217	12,990	32.3
830	64	25.4	18.8	0.15	152	73.3	4.19	116.6	2.3		12,775	38.7
		13	10	0.1	77	37	2.13	59	1			
05/10/11	20.0	506	245	5.4	3,660	2,830	293.0	5,880	118	2,273	12,940	33.4
1300	68	25.2	20.1	0.14	159	79.5	4.73	122.4	2.3		13,490	40.1
		12	10	0.1	78	38	2.26	59	1			
08/16/11	24.0	471	235	5.7	3,740	2,690	300.0	6,720	120	2,144	14,800	35.2
1300	75	23.5	19.3	0.15	163	75.6	4.84	139.9	2.4		14,234	42.2
		11	9	0.1	79	34	2.17	63	1			
02/13/12	17.0	489	207	4.0	3,350	1,850	255.0	5,710	111	2,074	12,520	32.0
1130	63	24.4	17.0	0.10	146	52.0	4.11	118.9	2.2		11,932	38.4
		13	9	0.1	78	29	2.32	67	1			
11/13/12	19.0	568	258	17.0	4,300	3,076	226.0	6,561	170	2,481	16,730	37.6
1200	66	28.3	21.2	0.43	187	86.4	3.64	136.6	3.4		15,108	48.9
		12	9	0.2	79	38	1.58	59	1			
LNW 6467												
01/26/11	18.0	665	365	9.7	5,760	6,290	265.0	6,150	152	3,164	16,190	44.6
1030	64	33.2	30.0	0.25	250	176.7	4.27	128.0	3.0		19,596	62.4
		11	10	0.1	80	57	1.37	41	1			
03/15/11	18.0	664	385	8.3	5,380	6,440	264.0	5,980	140	3,244	19,490	41.1
900	64	33.1	31.7	0.21	234	180.9	4.26	124.5	2.8		19,205	55.5
		11	11	0.1	78	58	1.36	40	1			
05/10/11	19.0	630	405	7.0	5,460	6,540	270.0	6,770	154	3,241	20,460	41.7
1330	66	31.4	33.3	0.18	237	183.7	4.35	141.0	3.1		20,174	58.4
		10	11	0.1	79	55	1.31	42	1			
08/16/11	24.0	594	396	9.1	6,070	6,400	253.0	7,730	185	3,114	22,340	47.4
1230	75	29.6	32.6	0.23	264	179.8	4.08	160.9	3.7		21,563	66.2
		9	10	0.1	81	52	1.17	46	1			

Appendix H Mineral Analyses of Southern Area Drains

Station	T	Mineral Constituents: mg/L meq/L prv								Mineral Constituents (mg/L)		
Date	°C									TH	TDS	SAR
Time	°F	Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk		Sum	ASAR
02/13/12	17.0	692	538	7.0	6,020	7,570	290.0	6,440	137	3,944	22,560	41.7
1100	63	34.5	44.2	0.18	262	212.6	4.68	134.1	2.7		21,639	56.3
		10	13	0.1	77	60	1.32	38	1			
05/15/12	19.0	689	521	11.6	6,180	8,170	317.0	6,840	133	3,867	23,300	43.3
100	66	34.4	42.8	0.30	269	229.5	5.11	142.4	2.6		22,808	58.4
		10	12	0.1	78	60	1.35	38	1			
08/20/12	28.0	631	505	26.4	6,910	8,280	298.0	6,980	151	3,656	23,720	49.8
1000	82	31.5	41.5	0.68	300	232.6	4.81	145.3	3.0		23,721	69.7
		8	11	0.2	80	60	1.25	38	1			
SFD 2944												
11/14/12	19.0	116	63	7.2	211	112	3.5	534	218	548	1,280	3.9
1145	66	5.8	5.1	0.18	9	3.1	0.06	11.1	4.3		1,177	4.5
		29	25	0.9	45	17	0.30	60	23			
SFD 3027												
11/13/12	20.0	239	193	5.7	588	168	19.9	1,905	215	1,392	3,520	6.9
1215	68	11.9	15.9	0.15	26	4.7	0.32	39.7	4.3		3,248	8.6
		22	30	0.3	48	10	0.66	81	9			
VGD 3906												
01/28/11	15.0	367	519	14.1	6,160	906	15.1	14,100	379	3,054	15,940	48.5
1030	59	18.3	42.7	0.36	268	25.4	0.24	293.6	7.5		22,309	75.2
		6	13	0.1	81	8	0.07	90	2			
03/16/11	16.0	359	395	8.2	4,630	686	18.1	10,600	362	2,523	16,840	40.1
1245	61	17.9	32.5	0.21	201	19.3	0.29	220.7	7.2		16,914	62.1
		7	13	0.1	80	8	0.12	89	3			
05/11/11	17.0	357	343	6.4	3,810	622	36.8	9,370	361	2,304	12,580	34.6
1100	63	17.8	28.2	0.16	166	17.5	0.59	195.1	7.2		14,762	50.1
		8	13	0.1	78	8	0.27	89	3			
08/16/11	19.0	302	277	7.5	3,600	574	14.8	8,550	366	1,895	14,000	36.0
1000	66	15.1	22.8	0.19	157	16.1	0.24	178.0	7.3		13,545	52.2
		8	12	0.1	80	8	0.12	88	4			
02/14/12	14.0	406	229	3.9	2,700	337	22.3	6,240	462	1,957	9,840	26.6
1300	57	20.3	18.8	0.10	117	9.5	0.36	129.9	9.2		10,215	39.8
		13	12	0.1	75	6	0.24	87	6			
11/13/12	19.0	415	462	19.7	5,500	776	15.8	12,291	386	2,939	18,420	44.2
1345	66	20.7	38.0	0.50	239	21.8	0.25	255.9	7.7		19,711	68.4
		7	13	0.2	80	8	0.09	90	3			

Appendix H Mineral Analyses of Southern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
VGD 4406												
01/25/11	16.0	342	361	10.2	4,620	661	62.8	9,760	350	2,341	13,000	41.6
1045	61	17.1	29.7	0.26	201	18.6	1.01	203.2	6.9		16,027	60.2
		7	12	0.1	81	8	0.44	88	3			
03/16/11	16.0	356	366	5.8	4,100	617	62.6	9,870	346	2,397	14,560	36.5
1300	61	17.8	30.1	0.15	178	17.3	1.01	205.5	6.9		15,585	52.8
		8	13	0.1	79	8	0.44	89	3			
05/11/11	17.0	326	358	5.6	4,190	644	64.6	9,800	357	2,289	13,030	38.1
1045	63	16.3	29.4	0.14	182	18.1	1.04	204.0	7.1		15,602	55.2
		7	13	0.1	80	8	0.45	89	3			
08/16/11	20.0	339	440	7.8	4,860	911	54.3	12,200	370	2,659	18,600	41.0
1030	68	16.9	36.2	0.20	211	25.6	0.88	254.0	7.3		19,034	63.6
		6	14	0.1	80	9	0.30	88	3			
02/14/12	15.0	373	272	4.2	3,560	446	62.5	8,080	338	2,052	13,570	34.2
1245	59	18.6	22.4	0.11	155	12.5	1.01	168.2	6.7		13,001	49.6
		10	11	0.1	79	7	0.53	89	4			
05/15/12		271	595	10.1	4,350	650	50.4	10,100	347	3,127	16,250	33.9
1400		13.5	48.9	0.26	189	18.3	0.81	210.3	6.9		16,235	52.5
		5	19	0.1	75	8	0.34	89	3			
08/21/12	20.8	329	409	20.2	5,200	814	51.0	11,900	353	2,506	18,180	45.2
1300	69	16.4	33.6	0.52	226	22.9	0.82	247.8	7.0		18,935	70.1
		6	12	0.2	82	8	0.30	89	3			
VGD 4806												
01/28/11	16.0	293	837	16.6	6,300	1,690	8.8	15,000	464	4,179	17,900	42.4
1100	61	14.6	68.8	0.42	274	47.5	0.14	312.3	9.2		24,424	72.1
		4	19	0.1	77	13	0.04	85	2			
03/16/11	17.0	242	607	8.2	4,610	1,170	12.0	10,900	437	3,104	17,140	36.0
1315	63	12.1	49.9	0.21	200	32.9	0.19	226.9	8.7		17,811	57.6
		5	19	0.1	76	12	0.07	84	3			
05/11/11	18.0	336	954	10.7	6,450	1,860	9.0	16,600	467	4,768	20,170	40.7
1030	64	16.8	78.5	0.27	280	52.2	0.15	345.6	9.3		26,500	69.1
		4	21	0.1	75	13	0.04	85	2			
08/16/11	20.0	326	855	13.0	6,070	1,710	26.9	15,000	-	4,336	23,700	40.1
1100	68	16.3	70.3	0.33	264	48.0	0.43	312.3	-		-	
		5	20	0.1	75	-	-	-	-			

Appendix H Mineral Analyses of Southern Area Drains

Station Date Time	T °C °F	Mineral Constituents: mg/L meq/L prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS Sum	SAR ASAR
02/14/12	16.0	315	703	8.2	4,920	1,340	38.2	12,300	447	3,682	19,620	35.3
1230	61	15.7	57.8	0.21	214	37.6	0.62	256.1	8.9		19,893	56.5
		5	20	0.1	74	12	0.20	84	3			
05/15/12	20.0	349	373	22.8	4,430	1,130	17.6	10,400	410	2,282	17,320	39.3
1345	68	17.4	30.7	0.58	193	31.7	0.28	216.5	8.1		16,968	59.0
		7	13	0.2	80	12	0.11	84	3			
08/21/12	23.4	199	305	9.9	2,310	566	59.5	5,230	434	1,753	9,280	24.0
1330	74	9.9	25.1	0.25	100	15.9	0.96	108.9	8.6		8,940	36.0
		7	18	0.2	74	12	0.71	81	6			
11/14/12	20.0	238	500	14.4	3,900	920	34.4	8,176	407	2,654	13,890	33.0
1330	68	11.9	41.1	0.37	170	25.8	0.55	170.2	8.1		14,027	52.7
		5	18	0.2	76	13	0.27	83	4			
VGD 5412												
01/28/11	16.0	341	377	9.5	4,200	700	42.1	8,670	440	2,404	12,900	37.3
1130	61	17.0	31.0	0.24	183	19.7	0.68	180.5	8.7		14,604	55.9
		7	13	0.1	79	9	0.32	86	4			
03/16/11	16.0	346	389	8.0	4,170	752	29.2	10,200	440	2,466	15,900	36.6
1345	61	17.3	32.0	0.20	181	21.1	0.47	212.4	8.7		16,158	54.8
		7	14	0.1	79	9	0.19	88	4			
05/11/11	17.0	344	437	7.1	4,230	861	28.4	10,800	442	2,659	14,420	35.7
1000	63	17.2	35.9	0.18	184	24.2	0.46	224.9	8.8		16,973	57.1
		7	15	0.1	78	9	0.18	87	3			
08/16/11	20.0	361	317	5.7	3,860	600	47.6	8,310	434	2,207	13,500	35.8
930	68	18.0	26.1	0.15	168	16.9	0.77	173.0	8.6		13,762	53.6
		8	12	0.1	79	8	0.39	87	4			
08/21/12	21.0	321	272	14.5	3,590	541	55.7	8,190	423	1,922	13,330	35.7
1400	70	16.0	22.4	0.37	156	15.2	0.90	170.5	8.4		13,238	53.5
		8	11	0.2	80	8	0.46	87	4			
11/14/12	19.0	357	472	15.7	4,940	831	47.6	11,778	466	2,836	18,110	40.4
1315	66	17.8	38.8	0.40	215	23.3	0.77	245.2	9.2		18,721	64.6
		7	14	0.1	79	8	0.28	88	3			
VGD 5509												
01/28/11	16.0	275	329	7.3	1,870	479	67.2	4,420	456	2,042	7,290	18.0
1145	61	13.7	27.1	0.19	81	13.5	1.08	92.0	9.0		7,721	27.0
		11	22	0.2	66	12	0.94	80	8			

Appendix H Mineral Analyses of Southern Area Drains

Station / Date / Time	T °C / °F	Mineral Constituents: mg/L / meq/L / prv Ca	Mg	K	Na	Cl	NO3	SO4	T. Alk	Mineral Constituents (mg/L) TH	TDS / Sum	SAR / ASAR
03/16/11	16.0	376	433	4.8	1,860	605	43.9	5,310	414	2,722	9,260	15.5
1400	61	18.8	35.6	0.12	81	17.0	0.71	110.6	8.2		8,881	24.8
		14	26	0.1	60	12	0.52	81	6			
05/11/11	17.0	328	381	4.1	1,610	562	42.4	4,900	416	2,388	8,610	14.3
945	63	16.4	31.3	0.10	70	15.8	0.68	102.0	8.3		8,077	21.5
		14	27	0.1	59	12	0.54	80	7			
08/16/11	19.0	274	272	5.2	1,550	340	61.6	3,840	415	1,805	6,800	15.9
900	66	13.7	22.4	0.13	67	9.6	0.99	80.0	8.2		6,592	23.8
		13	22	0.1	65	10	1.01	81	8			
02/14/12	16.0	236	131	2.4	780	112	54.1	2,100	328	1,129	3,750	10.1
1200	61	11.8	10.8	0.06	34	3.1	0.87	43.7	6.5		3,612	13.6
		21	19	0.1	60	6	1.61	81	12			
05/15/12	19.0	270	222	5.0	1,300	268	57.7	3,420	395	1,589	5,950	14.2
1330	66	13.5	18.3	0.13	57	7.5	0.93	71.2	7.8		5,780	20.6
		15	21	0.1	64	9	1.06	81	9			
08/21/12	21.2	248	228	7.0	1,300	273	51.6	3,380	389	1,558	6,060	14.3
1415	70	12.4	18.8	0.18	57	7.7	0.83	70.4	7.7		5,721	20.8
		14	21	0.2	64	9	0.96	81	9			
11/13/12	20.0	263	325	8.8	1,660	410	73.1	4,405	491	1,995	7,670	16.2
1300	68	13.1	26.7	0.22	72	11.5	1.18	91.7	9.7		7,439	24.3
		12	24	0.2	64	10	1.03	80	9			

Appendix I
Electrical Conductivity, pH, & Trace Elements in Southern Area Drains
2011-2012

Appendix I
Electrical Conductivity, pH, and Trace Elements in Southern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
BRL 2235							
01/28/11	7.2 7.7	1,165 1,223	0.005	0.9	< 0.05	0.037	0.002
03/16/11	7.2 7.7	234 270	0.001	0.1	< 0.05	0.005	< 0.001
05/11/11	6.7 7.3	1,225 1,136	0.006	0.6	0.07	0.023	< 0.001
08/16/11	8.1 7.4	688 680	0.002	0.4	< 0.05	0.015	< 0.001
CCN 3550							
01/26/11	7.7 7.8	5,580 5,404	0.033	1.2	< 0.25	0.214	0.006
03/16/11	7.6 7.7	5,470 5,473	0.030	1.1	< 0.25	0.215	0.007
05/10/11	6.9 7.5	4,637 4,241	0.030	0.9	< 0.25	0.183	< 0.005
08/17/11	7.0 7.4	4,438 4,608	0.028	1.0	< 0.25	0.196	0.007
02/14/12	7.2 7.5	5,250 4,944	0.036	1.2	0.03	0.211	0.005
05/15/12	7.0 7.4	3,916 3,935	0.031	1.0	0.03	0.161	0.007
08/21/12	6.9 7.5	5,110 5,094	0.032	1.2	0.03	0.212	0.008
11/14/12	7.3 7.4	4,139 4,027	0.029	1.1	0.03	0.174	< 0.005
CNR 0801							
01/25/11	7.4 7.5	9,960 8,536	< 0.010	17.7	< 0.50	0.529	0.031
03/16/11	7.3 7.4	10,540 10,430	< 0.010	18.7	< 0.50	0.564	0.035
05/10/11	7.0 7.4	10,310 9,484	< 0.010	17.6	< 0.50	0.519	0.028
08/17/11	6.8 7.4	9,520 9,618	< 0.010	16.8	< 0.50	0.538	0.035

Appendix I

Electrical Conductivity, pH, and Trace Elements in Southern Area Drains

Station Date	Field Laboratory		Trace Elements (mg/L)				
	pH	EC (μS/cm)	As	B	Ba	Mo	Se
02/13/12	7.1 7.5	9,730 9,229	0.010	20.9	< 0.05	0.585	0.026
05/15/12	7.1 7.6	7,370 7,288	< 0.005	13.4	< 0.03	0.410	0.034
08/20/12	6.7 7.4	6,450 6,397	0.010	10.0	< 0.03	0.335	0.030
11/13/12	7.4 7.5	6,740 6,551	< 0.005	11.3	< 0.03	0.372	0.029
COC 4126							
01/25/11	7.7 7.6	5,210 4,605	< 0.005	3.0	< 0.25	0.178	0.030
03/15/11	7.4 7.6	4,908 4,853	< 0.005	2.9	< 0.25	0.137	0.026
05/10/11	7.1 7.5	5,420 4,974	0.005	2.9	< 0.25	0.167	0.030
08/17/11	6.7 7.3	3,542 3,611	< 0.005	1.8	< 0.25	0.121	0.021
02/13/12	7.7 7.9	3,247 3,146	< 0.005	1.7	< 0.03	0.115	0.012
05/15/12	7.0 7.5	5,020 5,132	< 0.005	3.2	< 0.03	0.150	0.031
08/20/12	7.0 7.5	3,717 4,560	< 0.005	2.3	< 0.03	0.108	0.022
11/13/12	7.9 7.8	3,559 4,160	< 0.005	3.4	< 0.03	0.150	0.023
COC 8221							
01/25/11	7.5 7.6	4,943 4,443	0.017	4.1	< 0.25	0.092	0.019
03/15/11	7.6 7.6	4,665 4,865	0.020	3.4	< 0.25	0.103	0.014
05/10/11	7.2 7.6	5,180 4,702	0.026	3.4	< 0.25	0.098	0.014
08/17/11	7.1 7.6	5,040 5,003	0.008	4.3	< 0.25	0.088	0.021
02/13/12	7.3 7.6	4,926 4,774	0.016	4.1	< 0.03	0.090	0.015

Appendix I

Electrical Conductivity, pH, and Trace Elements in Southern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
05/15/12	7.2 7.6	4,725 4,799	0.015	4.1	< 0.03	0.083	0.015
08/20/12	7.1 7.7	4,590 4,660	0.012	3.8	< 0.03	0.084	0.018
11/13/12	7.6 7.6	4,745 4,675	0.009	4.7	< 0.03	0.070	0.014
ERR 8429							
01/26/11	7.5 7.7	7,840 7,307	0.088	3.1	< 0.25	0.417	0.008
03/16/11	7.5 7.7	8,130 8,131	0.081	3.2	< 0.50	0.496	0.013
05/11/11	7.3 7.8	2,747 2,527	0.111	1.6	< 0.25	0.103	< 0.005
08/17/11	7.1 7.8	7,470 7,421	0.066	2.8	< 0.25	0.433	0.012
02/14/12	7.4 7.7	7,430 7,299	0.118	3.6	0.05	0.563	0.012
05/15/12	7.1 7.7	10,140 10,060	0.098	5.0	0.05	0.749	0.016
08/20/12	7.2 7.8	2,487 2,543	0.080	1.6	0.03	0.075	0.005
11/14/12	7.6 7.7	5,920 5,842	0.066	3.3	0.04	0.250	0.009
ERR 8641							
01/26/11	7.3 7.5	10,380 9,632	0.050	2.5	< 0.50	0.463	0.011
03/16/11	7.4 7.6	8,990 8,980	0.040	2.1	< 0.50	0.415	0.017
05/11/11	6.8 7.3	12,150 10,280	0.046	2.7	< 0.50	0.448	0.012
08/17/11	7.9 7.7	9,720 9,817	0.037	2.4	< 0.50	0.413	0.018
02/14/12	7.1 7.5	16,500 15,950	0.079	4.9	< 0.05	0.885	0.037
05/15/12	6.9 7.5	10,230 10,250	0.029	2.9	< 0.05	0.398	0.019

Appendix I

Electrical Conductivity, pH, and Trace Elements in Southern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
08/21/12	7.0 7.6	10,110 10,030	0.030	2.7	< 0.05	0.388	0.024
11/14/12	7.5 7.6	2,504 2,493	0.035	1.1	< 0.03	0.085	< 0.005
GSY 0935							
01/26/11	7.6 7.8	2,903 2,903	0.115	1.5	< 0.25	0.132	0.005
03/16/11	7.9 8.0	2,478 2,515	0.175	1.4	< 0.05	0.108	0.009
05/11/11	7.7 8.0	2,104 2,054	0.190	1.2	< 0.05	0.088	0.009
08/17/11	7.8 8.1	2,192 2,241	0.128	1.3	< 0.05	0.087	0.007
02/14/12	8.4 8.4	1,628 1,629	0.228	1.2	0.02	0.054	0.005
08/21/12	7.3 8.0	2,363 2,378	0.187	1.3	0.04	0.088	0.009
11/14/12	7.7 7.8	2,706 2,702	0.133	1.9	0.05	0.100	0.005
HCH 7841							
01/26/11	7.7 7.9	8,620 7,885	0.258	5.0	< 0.50	0.785	0.023
03/16/11	7.9 7.9	7,540 7,848	0.186	4.3	< 0.25	0.773	0.021
08/17/11	7.5 8.0	5,170 5,206	0.163	3.0	< 0.25	0.435	0.015
02/14/12	7.8 8.0	6,260 6,310	0.235	4.1	0.04	0.510	0.019
05/15/12	7.4 7.9	8,720 8,599	0.183	5.2	< 0.05	0.846	0.026
08/21/12	7.6 8.1	4,756 4,853	0.168	2.8	0.03	0.398	0.013
11/13/12	8.0 8.0	6,280 6,232	0.174	4.0	< 0.03	0.610	0.017

Appendix I
Electrical Conductivity, pH, and Trace Elements in Southern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
HNE 3160							
11/13/12	7.6	11,280	0.036	5.3	< 0.05	0.871	0.040
	7.7	11,100					
HNW 3111							
11/14/12	7.5	6,110	0.082	5.4	0.03	0.311	0.015
	7.6	6,668					
LME 1546							
08/21/12	7.5	396	0.003	0.2	0.02	0.011	< 0.001
	7.7	420					
LNW 5467							
01/26/11	7.6	16,820	0.020	26.9	< 1.00	0.974	0.276
	7.6	13,090					
03/15/11	7.6	16,090	< 0.020	25.3	< 1.00	0.982	0.236
	7.6	16,230					
05/10/11	7.3	18,200	0.025	26.3	< 1.00	0.274	0.296
	7.6	15,320					
08/16/11	7.1	16,780	0.022	27.6	< 1.00	1.140	0.260
	7.6	16,880					
02/13/12	7.4	15,350	0.020	26.5	< 0.05	1.160	0.305
	7.7	14,950					
11/13/12	8.2	19,650	< 0.020	39.5	< 0.10	1.220	0.276
	8.0	19,310					
LNW 6467							
01/26/11	7.4	25,350	0.038	36.3	< 1.00	0.710	0.400
	7.5	18,680					
03/15/11	7.4	25,690	0.027	32.8	< 1.00	0.760	0.348
	7.5	24,970					
05/10/11	7.1	28,640	0.042	36.3	< 1.00	0.430	0.484
	7.5	22,710					
08/16/11	7.0	27,280	0.046	41.8	< 1.00	0.990	0.548
	7.6	26,060					
02/13/12	7.6	29,430	0.054	42.6	< 0.10	0.934	0.530
	7.8	27,940					
05/15/12	7.1	28,700	0.025	43.5	< 0.10	0.804	0.380
	7.4	28,470					

Appendix I

Electrical Conductivity, pH, and Trace Elements in Southern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
08/20/12	7.0 7.4	30,190 29,210	0.032	45.0	< 0.10	0.812	0.392
SFD 2944							
11/14/12	6.9 7.1	1,774 1,774	0.006	0.8	0.02	0.030	0.002
SFD 3027							
11/13/12	7.0 7.0	4,168 4,180	0.020	1.6	< 0.03	0.065	< 0.005
VGD 3906							
01/28/11	7.3 7.7	22,470 17,750	< 0.020	35.2	< 1.00	0.880	< 0.020
03/16/11	7.5 7.6	18,660 18,530	< 0.020	28.8	< 1.00	0.842	< 0.020
05/11/11	7.1 7.6	17,780 14,800	< 0.020	24.5	< 1.00	0.706	< 0.020
08/16/11	7.0 7.7	15,240 14,830	< 0.020	24.6	< 1.00	0.692	0.026
02/14/12	7.6 7.8	11,970 11,840	0.010	25.0	< 0.05	0.561	< 0.010
11/13/12	7.4 7.5	20,590 19,650	< 0.020	34.7	< 0.10	0.736	0.020
VGD 4406							
01/25/11	7.5 7.8	17,780 14,660	< 0.020	28.7	< 1.00	0.750	< 0.020
03/16/11	7.6 7.7	16,850 16,650	< 0.020	25.0	< 1.00	0.720	< 0.020
05/11/11	7.2 7.7	18,170 15,350	< 0.020	24.6	< 1.00	0.714	< 0.020
08/16/11	7.0 7.7	20,010 19,600	< 0.020	28.1	< 1.00	0.734	0.024
02/14/12	7.4 7.6	14,890 14,570	0.013	27.6	< 0.05	0.848	< 0.010
05/15/12	7.0 7.6	17,330 17,040	< 0.020	21.2	< 0.10	0.808	< 0.020

Appendix I
Electrical Conductivity, pH, and Trace Elements in Southern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (µS/cm)	As	B	Ba	Mo	Se
08/21/12	6.9 7.6	19,830 19,430	< 0.020	30.1	< 0.10	0.734	< 0.020
VGD 4806							
01/28/11	7.1 7.6	24,560 19,770	< 0.020	23.3	< 1.00	0.170	< 0.020
03/16/11	7.2 7.4	19,320 19,090	< 0.020	18.1	< 1.00	0.248	0.020
05/11/11	6.7 7.3	28,430 22,510	< 0.020	25.3	< 1.00	0.182	< 0.020
08/16/11	6.7	24,800	< 0.020	21.4	< 1.00	0.164	0.020
02/14/12	7.0 7.4	20,970 20,480	< 0.020	20.8	< 0.10	0.173	< 0.020
05/15/12	6.8 7.5	18,540 18,230	< 0.020	28.4	< 0.10	0.206	< 0.020
08/21/12	7.1 7.8	10,840 10,710	0.012	9.7	< 0.05	0.153	< 0.010
11/14/12	7.3 7.4	16,330 15,600	< 0.020	16.3	< 0.10	0.192	< 0.020
VGD 5412							
01/28/11	7.4 7.8	16,830 14,390	< 0.020	27.6	< 1.00	0.514	< 0.020
03/16/11	7.5 7.6	17,800 17,560	< 0.020	26.1	< 1.00	0.578	< 0.020
05/11/11	7.1 7.6	20,120 16,610	< 0.020	26.7	< 1.00	0.528	< 0.020
08/16/11	7.1 7.8	14,890 14,570	< 0.010	26.6	< 0.50	0.483	0.014
08/21/12	7.0 7.7	14,920 14,560	< 0.010	24.4	< 0.05	0.445	0.010
11/14/12	7.4 7.5	19,920 19,350	< 0.020	29.7	< 0.10	0.488	< 0.020
VGD 5509							
01/28/11	7.2 7.7	9,390 8,248	< 0.010	8.9	< 0.50	0.219	< 0.010

Appendix I

Electrical Conductivity, pH, and Trace Elements in Southern Area Drains

Station / Date	Field / Laboratory		Trace Elements (mg/L)				
	pH	EC (μS/cm)	As	B	Ba	Mo	Se
03/16/11	7.1	10,130	< 0.010	7.6	< 0.50	0.127	< 0.010
	7.5	10,330					
05/11/11	6.8	10,490	0.010	7.2	< 0.50	0.125	< 0.010
	7.4	9,111					
08/16/11	7.0	7,660	< 0.010	8.6	< 0.50	0.239	< 0.010
	7.6	7,674					
02/14/12	7.2	4,667	0.005	6.2	< 0.03	0.238	< 0.005
	7.6	4,769					
05/15/12	6.9	6,910	< 0.010	8.6	< 0.05	0.244	< 0.010
	7.6	6,952					
08/21/12	6.9	7,080	< 0.010	7.2	< 0.05	0.186	< 0.010
	7.6	7,138					
11/13/12	7.5	8,870	< 0.010	10.4	< 0.05	0.266	< 0.010
	7.5	8,685					

Appendix J
Pesticides in Area Drains
2011-2012

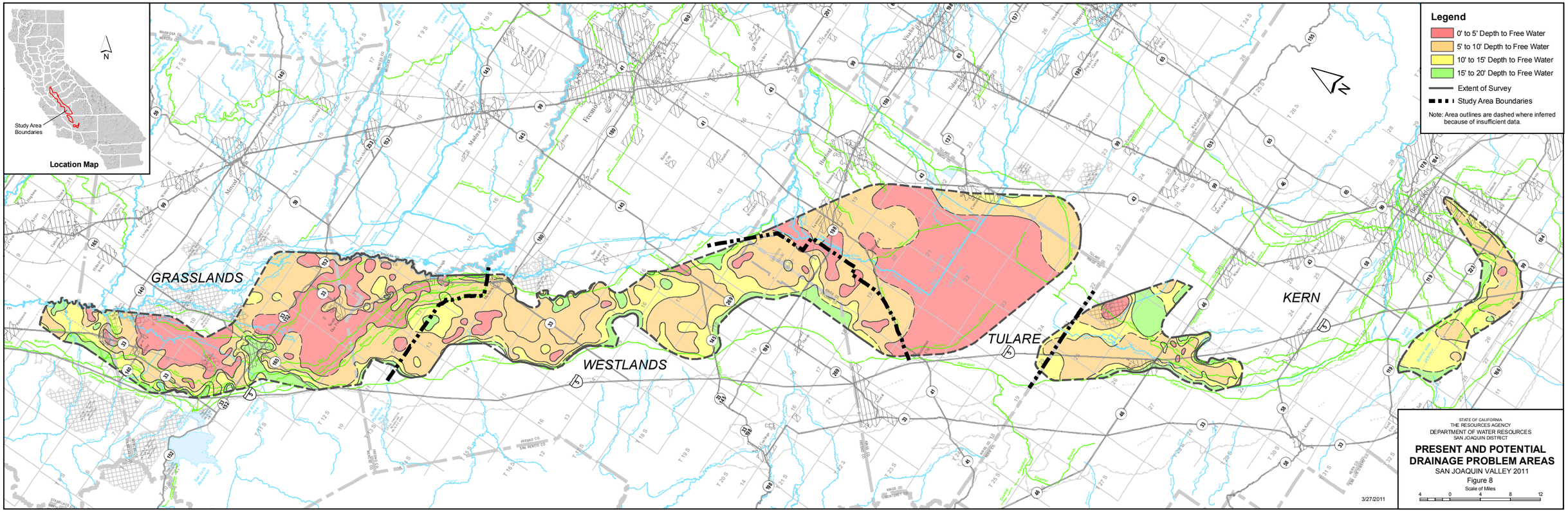
Appendix J

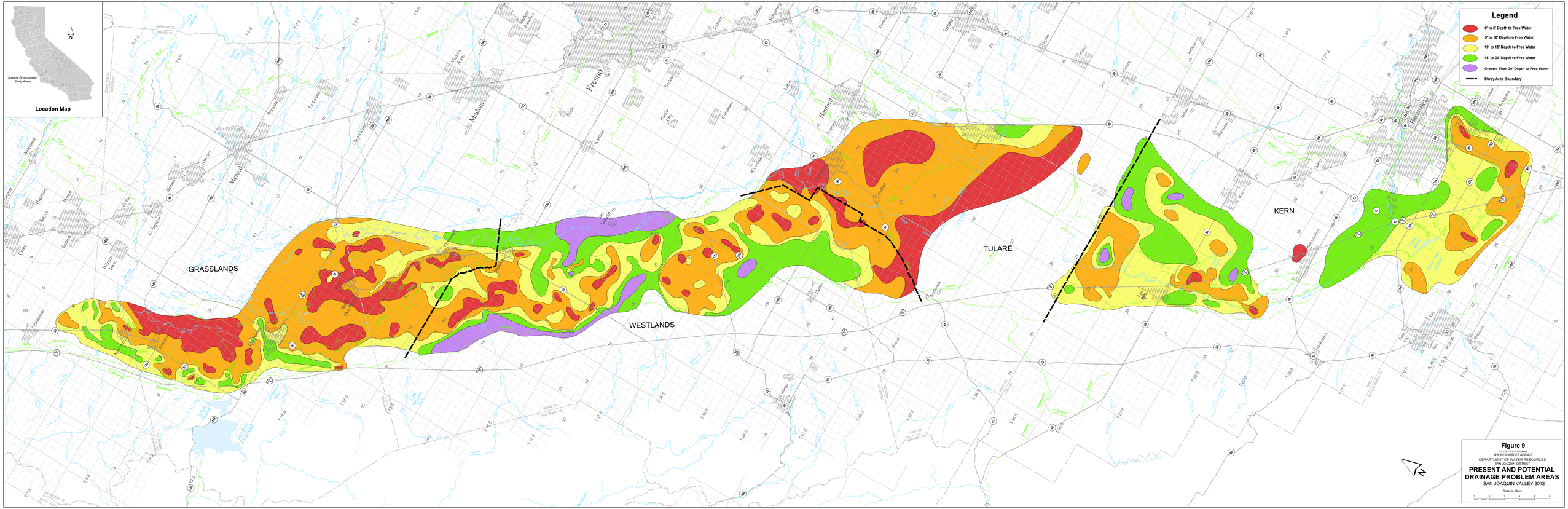
Pesticide Analyses Performed, 2011

Analyte	Rpt Limit	Units	Method [*]	Analyte	Rpt Limit	Units	Method [*]
Sulfur pesticides				**Chlorinated Phenoxy Acid Herbicides**			
Propargite	1	µg/L	DWR Sulfur Pesticides	2,4,5-T	0.1	µg/L	EPA 615
Carbamate Pesticides				2,4,5-TP (Silvex)	0.1	µg/L	EPA 615
3-Hydroxycarbofuran	2	µg/L	EPA 531.1	2,4-D	0.1	µg/L	EPA 615
Aldicarb	2	µg/L	EPA 531.1	2,4-DB	0.5	µg/L	EPA 615
Aldicarb sulfone	2	µg/L	EPA 531.1	Dacthal (DCPA)	0.5	µg/L	EPA 615
Aldicarb sulfoxide	2	µg/L	EPA 531.1	Dicamba	0.1	µg/L	EPA 615
Carbaryl	2	µg/L	EPA 531.1	Dichlorprop	0.1	µg/L	EPA 615
Carbofuran	2	µg/L	EPA 531.1	Dinoseb (DNPB)	0.5	µg/L	EPA 615
Methiocarb	4	µg/L	EPA 531.1	MCPA	0.1	µg/L	EPA 615
Methomyl	2	µg/L	EPA 531.1	MCPP	0.1	µg/L	EPA 615
Oxamyl	2	µg/L	EPA 531.1	Pentachlorophenol (PCP)	0.1	µg/L	EPA 615
Propoxur	2	µg/L	EPA 531.1	Picloram	0.5	µg/L	EPA 615
Glyphosate				Triclopyr	0.1	µg/L	EPA 615
Glyphosate	25	µg/L	EPA 547	**Phosphorus/Nitrogen Pesticides**			
Chlorinated Organic Pesticides				Azinphos methyl (Guthion)	0.05	µg/L	EPA 614
Alachlor	0.05	µg/L	EPA 608	Benfluralin	0.01	µg/L	EPA 614
Aldrin	0.01	µg/L	EPA 608	Bromacil	0.1	µg/L	EPA 614
Atrazine	0.02	µg/L	EPA 608	Carbophenothion (Trithion)	0.02	µg/L	EPA 614
BHC-alpha	0.01	µg/L	EPA 608	Chlorpyrifos	0.01	µg/L	EPA 614
BHC-beta	0.01	µg/L	EPA 608	Cyanazine	0.1	µg/L	EPA 614
BHC-delta	0.01	µg/L	EPA 608	Demeton (Demeton O + Demeton	0.1	µg/L	EPA 614
BHC-gamma (Lindane)	0.01	µg/L	EPA 608	Diazinon	0.02	µg/L	EPA 614
Captan	0.1	µg/L	EPA 608	Dimethoate	0.01	µg/L	EPA 614
Chlordane	0.05	µg/L	EPA 608	Disulfoton	0.1	µg/L	EPA 614
Chlorothalonil	0.01	µg/L	EPA 608	Esfenvalerate	0.02	µg/L	EPA 614
Chlorpropham	0.02	µg/L	EPA 608	Ethion	0.01	µg/L	EPA 614
Chlorpyrifos	0.01	µg/L	EPA 608	Malathion	0.01	µg/L	EPA 614
Cyanazine	0.1	µg/L	EPA 608	Methidathion	0.02	µg/L	EPA 614
Dacthal (DCPA)	0.01	µg/L	EPA 608	Mevinphos	0.01	µg/L	EPA 614
Dichloran	0.01	µg/L	EPA 608	Molinate	0.02	µg/L	EPA 614
Dicofol	0.1	µg/L	EPA 608	Naled	0.05	µg/L	EPA 614
Dieldrin	0.01	µg/L	EPA 608	Napropamide	0.05	µg/L	EPA 614
Diuron	0.25	µg/L	EPA 608	Norflurazon	0.05	µg/L	EPA 614
Endosulfan sulfate	0.05	µg/L	EPA 608	Parathion (Ethyl)	0.01	µg/L	EPA 614
Endosulfan-I	0.05	µg/L	EPA 608	Parathion, Methyl	0.01	µg/L	EPA 614
Endosulfan-II	0.05	µg/L	EPA 608	Pendimethalin	0.05	µg/L	EPA 614
Endrin	0.05	µg/L	EPA 608	Phorate	0.05	µg/L	EPA 614
Endrin aldehyde	0.05	µg/L	EPA 608	Phosalone	0.05	µg/L	EPA 614
Heptachlor	0.01	µg/L	EPA 608	Phosmet	0.05	µg/L	EPA 614
Heptachlor epoxide	0.01	µg/L	EPA 608	Profenofos	0.01	µg/L	EPA 614
Methoxychlor	0.05	µg/L	EPA 608	Prometryn	0.1	µg/L	EPA 614
Metolachlor	0.05	µg/L	EPA 608	Propetamphos	0.1	µg/L	EPA 614
Oxyfluorfen	0.1	µg/L	EPA 608	Thiobencarb	0.02	µg/L	EPA 614
PCB-1016	0.1	µg/L	EPA 608	Trifluralin	0.01	µg/L	EPA 614
PCB-1221	0.1	µg/L	EPA 608	s,s,s-Tributyl Phosphorotrithioate	0.01	µg/L	EPA 614
PCB-1232	0.1	µg/L	EPA 608				
PCB-1242	0.1	µg/L	EPA 608				
PCB-1248	0.1	µg/L	EPA 608				
PCB-1254	0.1	µg/L	EPA 608				
PCB-1260	0.1	µg/L	EPA 608				
Pentachloronitrobenzene	0.01	µg/L	EPA 608				
Permethrin	0.02	µg/L	EPA 608				
Simazine	0.02	µg/L	EPA 608				
Thiobencarb	0.02	µg/L	EPA 608				
Toxaphene	0.4	µg/L	EPA 608				
o,p'-DDE	0.01	µg/L	EPA 608				
p,p'-DDD	0.01	µg/L	EPA 608				
p,p'-DDE	0.01	µg/L	EPA 608				
p,p'-DDT	0.05	µg/L	EPA 608				

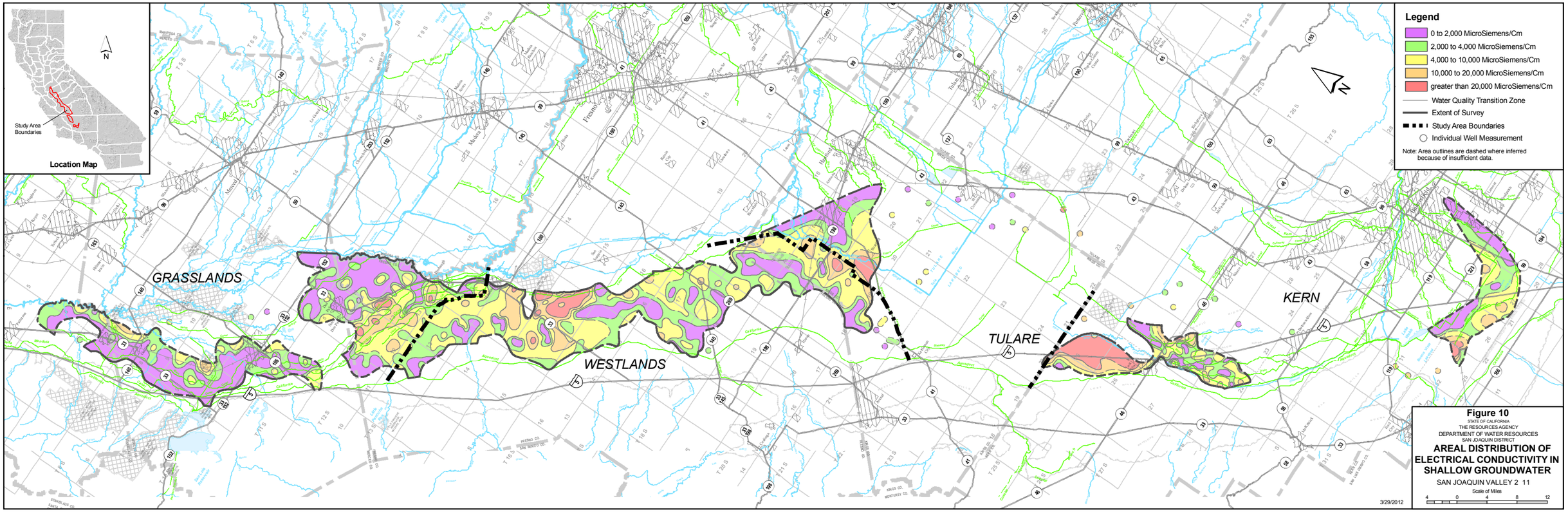
Appendix J
Detected Pesticide Properties

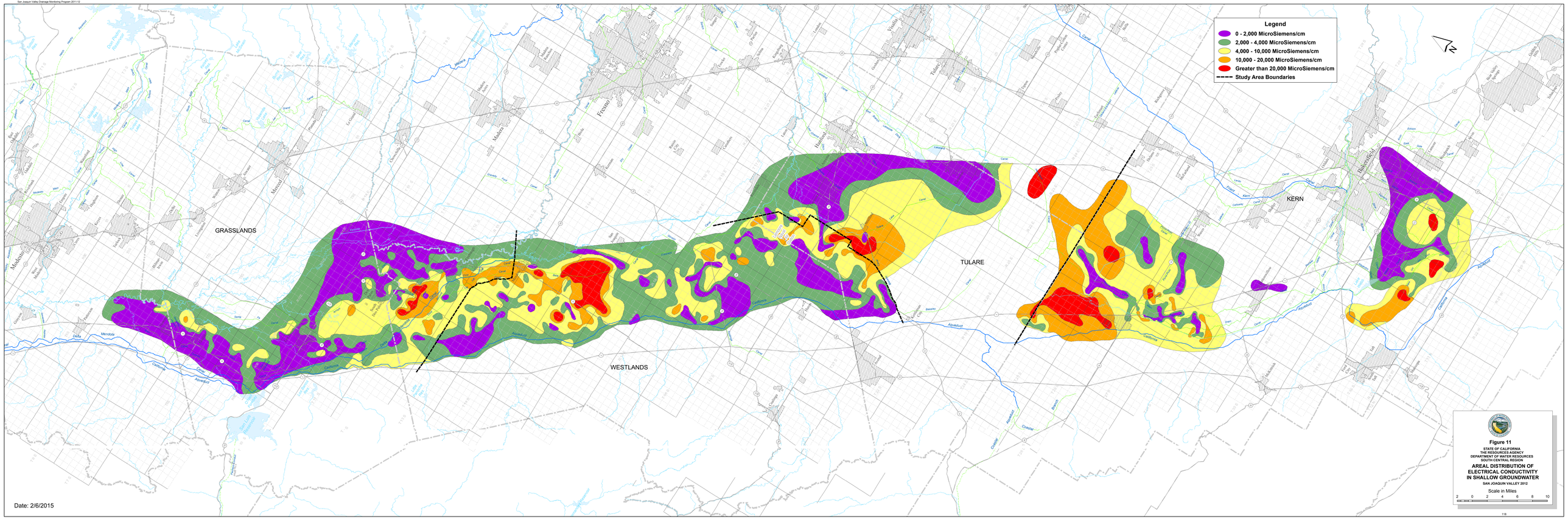
Pesticide	Solubility in Water	Environmental Degradation and Metabolism
Aldicarb sulfoxide is a breakdown product of aldicarb	6 g/L at 25°C for aldicarb	In soil, the sulfur atom of aldicarb is oxidized to sulfoxide and sulfone by chemical processes, possibly mediated biologically in some cases. Various oximes, nitriles, amides, acids, and alcohols are also formed. The duration of activity for aldicarb is about 10 weeks.
Atrazine	28 mg/L at 20°C	In soil, microbial degradation occurs, with a half-life of about 6-10 weeks. Hydroxyatrazine is the principal metabolite. The duration of residual activity in soil is approximately 5-7 months.
Bromacil	815 mg/L at 25°C	The duration of residual activity in soil is approximately 7 months.
Chlorothalonil	0.6 mg/L at 25°C	Half-life in soil is about 1.5 to 3 months, depending on moisture content and temperature
Chlorpyrifos	Approximately 2 mg/L at 25°C	In soil, chlorpyrifos is slowly degraded, with a half-life of about 80-100 days, to 3,5,6-trichloro-2-pyridinol, which is subsequently degraded to organochlorine compounds and carbon dioxide.
Dacthal	Approximately 0.5 mg/L at 25°C	In soil, microbial degradation leads to monomethyl tetrachloroterephthalate and 2,3,5,6-tetrachloroterephthalic acid (chlorthal). The duration of residual activity in soil is about 3 months.
Dimethoate	25 g/L at 21°C	
Diuron	42 mg/L at 25°C	In soil, enzymic and demethylation of the nitrogen atom and hydroxylation at position 2 of the benzene ring occur; duration of activity in soil is about 4 to 8 months, depending on soil type and humidity
Glyphosate	12 g/L at 25°C	Strongly adsorbed to soil. Microbial degradation is the major cause of loss from soil, with liberation of carbon dioxide. The half-life in soil is normally less than 60
Metolachlor	530 mg/L at 20°C	
Norflurazon	28 mg/L at 23°C	Dissipated in soil by photodegradation and volatilization
Pendimethalin	0.3 mg/L at 20°C	The half-life in soil is 3-4 months. The 4-methyl group on the benzene ring is oxidized to the carboxylic acid via the alcohol, and the amino nitrogen is also oxidized.
Simazine	3.5 mg/L at 20°C	In soil, microbial activity probably accounts for degradation of a significant amount of simazine. Loss by photodecomposition or volatilization is insignificant. The low water solubility of simazine limits its downward movement or leaching. Several months after application, the greatest portion is found in the upper 2 inches of soil.
Thiobencarb	30 mg/L at 20°C	It is rapidly adsorbed by soil, and is not readily leached. Degradation is primarily by microbial breakdown, with little loss from volatilization and photodegradation. Its half-life in soil varies from 2-3 weeks under aerobic conditions to 6-8 months under anaerobic conditions.
Triclopyr	440 mg/L at 25°C	In soil, triclopyr is degraded fairly rapidly by microbial activity, with an average half-life of 46 days, depending on soil and climatic conditions. The major degradation product is 3,5,6-trichloro-2-pyridinol, which has a soil half- life of 30-90 days, and further degrades to carbon dioxide and soil organic matter. 3,5,6-Trichloro-2-methoxypyridine is also a degradation product.


Location Map
Study Area Boundaries
N
GRASSLANDS
WESTLANDS
TULARE
KERN
Legend
0' to 5' Depth to Free Water
5' to 10' Depth to Free Water
10' to 15' Depth to Free Water
15' to 20' Depth to Free Water
Extent of Survey
Study Area Boundaries
Note: Area outlines are dashed where inferred because of insufficient data.
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN DISTRICT
PRESENT AND POTENTIAL DRAINAGE PROBLEM AREAS
SAN JOAQUIN VALLEY 2011
Figure 8
Scale of Miles
4 0 4 8 12
3/27/2011


Location Map
Shallow Groundwater Study Areas
Legend
0' to 5' Depth to Free Water
5' to 10' Depth to Free Water
10' to 15' Depth to Free Water
15' to 20' Depth to Free Water
Greater Than 20' Depth to Free Water
Study Area Boundary
GRASSLANDS
WESTLANDS
TULARE
KERN
Fresno
Madera
Bakersfield
Figure 9
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN DISTRICT
PRESENT AND POTENTIAL
DRAINAGE PROBLEM AREAS
SAN JOAQUIN VALLEY 2012
Scale in Miles

Date: 3/9/2015


Study Area Boundaries
Location Map
N
GRASSLANDS
WESTLANDS
TULARE
KERN
Legend
0 to 2,000 MicroSiemens/Cm
2,000 to 4,000 MicroSiemens/Cm
4,000 to 10,000 MicroSiemens/Cm
10,000 to 20,000 MicroSiemens/Cm
greater than 20,000 MicroSiemens/Cm
Water Quality Transition Zone
Extent of Survey
Study Area Boundaries
Individual Well Measurement
Note: Area outlines are dashed where inferred because of insufficient data.
3/29/2012
Figure 10
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN DISTRICT
AREAL DISTRIBUTION OF ELECTRICAL CONDUCTIVITY IN SHALLOW GROUNDWATER
SAN JOAQUIN VALLEY 2 11
Scale of Miles
4 0 4 8 12


Legend
0 - 2,000 MicroSiemens/cm
2,000 - 4,000 MicroSiemens/cm
4,000 - 10,000 MicroSiemens/cm
10,000 - 20,000 MicroSiemens/cm
Greater than 20,000 MicroSiemens/cm
Study Area Boundaries
GRASSLANDS
WESTLANDS
TULARE
KERN
Date: 2/6/2015
Figure 11
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTH CENTRAL REGION
AREAL DISTRIBUTION OF
ELECTRICAL CONDUCTIVITY
IN SHALLOW GROUNDWATER
SAN JOAQUIN VALLEY 2012
Scale in Miles
2 0 2 4 6 8 10