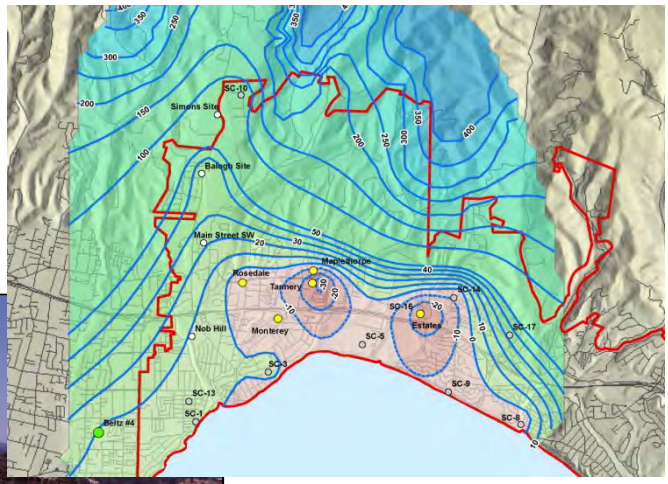
Soquel-Aptos Area Groundwater Management Annual Review and Report Water Year 2010

Prepared for:
Soquel Creek Water District
Central Water District

May 2011



Prepared by:

HydroMetrics WRI

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ABBREVIATIONS

AF ..... acre-feet
ARR .....Annual Review and Report
ASR.....aquifer storage and recovery
BAG.....Groundwater Management Plan Basin Advisory Group
BIG.....Basin Implementation Group
BMO .....basin management objective
CASGEM .....California Statewide Groundwater Elevation .....Monitoring
CDS .....Coastal Distribution System
CWD.....Central Water District
DWSAP.....Drinking Water Source Assessment and Protection
EIR .....environmental impact report
FTP .....file transfer protocol
GAMA .....Groundwater Ambient Monitoring and Assessment Program
GMP .....Groundwater Management Plan
gpd .....gallons per day
IRWMP .....Integrated Regional Water Management Plan
JPA.....Joint Exercise of Powers Agreement
MCL .....maximum contaminant level
mg/L .....milligrams per Liter
msl .....mean sea level
OEHHA .....California Office of Environmental Health Hazard .....Assessment
PDF .....portable document format
PHG.....public health goal
PVWMA .....Pajaro Valley Water Management Agency
RCD.....Resource Conservation District of Santa Cruz County
RWQCB .....Central Coast Regional Water Quality Control Board
SAGMA .....Soquel Aptos Groundwater Management Alliance
SCWD^2 .....Santa Cruz Water Department/Soquel Creek Water District desalination project
SqCWD .....Soquel Creek Water District
SRP .....satellite reclamation plant
TMDL.....total maximum daily load
TDS.....total dissolved solids

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EXECUTIVE SUMMARY – WATER YEAR 2010

INTRODUCTION

This Annual Review and Report (ARR) is part of the implementation of the Groundwater Management Plan (GMP) for the Soquel-Aptos basin approved by Soquel Creek Water District (SqCWD) and Central Water District (CWD) in 2007 (SqCWD and CWD, 2007). The ARR summarizes groundwater conditions in the Soquel-Aptos basin, documents the status of groundwater management activities, and recommends any amendments to the GMP. The report will serve as a living document that has been updated annually starting with the Water Year 2009 report.

GROUNDWATER CONDITIONS

Precipitation in the Soquel-Aptos basin was above average in Water Year 2010. Although SqCWD did not declare a Precautionary Drought Curtailment as it did in Water Year 2009, municipal production in the Soquel-Aptos basin decreased for the second straight year. Annual municipal production (SqCWD, CWD, and the City of Santa Cruz) was the lowest since Water Year 1984 likely due to four factors:

1. Economic conditions that resulted in both residential and commercial vacancies or reduced use; and
2. Within SqCWD, completed water demand offsets for which the corresponding development had not yet been completed.
3. Higher precipitation and a cooler summer reduced demand for outdoor irrigation.

Heightened public awareness about the importance of sustained water conservation.

Starting in Water Year 2005, municipal production in the Soquel-Aptos basin has not significantly exceeded pumping goals stated in the GMP. However, a re-evaluation of sustainable yield estimates suggested that reasonable estimates of the sustainable yield in the Purisima Formation and Aromas Red Sands could be at least hundreds of acre-feet lower than the pumping goals stated in the GMP (HydroMetrics LLC, 2009c).

Coastal groundwater levels in SqCWD monitoring wells screened in productive units remained below elevations that protect the aquifers from seawater

intrusion. The basin remains in overdraft and future pumping must be below the sustainable yield to recover coastal groundwater levels to protective elevations. In general, the groundwater level trend in these coastal wells in the western and central Purisima areas has been increasing over the last 2-3 years. The groundwater level trend in coastal wells in the Aromas area has generally been stable over the last two years after showing declines over the previous several years.

Wells that may provide an indication of basin storage include wells located in upgradient areas of the basin or screened in overlying aquifers. Many of these wells show a declining groundwater level trend over the last five years or greater, but the trend has been stable over the last two years.

There is ongoing risk of seawater intrusion into the productive units of the Soquel-Aptos basin due to coastal groundwater levels being below protective elevations. Observed Total Dissolved Solids (TDS) and chloride concentrations are used to assess seawater intrusion. The occurrence of seawater intrusion varies by area in the Soquel-Aptos basin:

- TDS and chloride concentrations do not suggest seawater intrusion at SqCWD's production wells or monitoring wells in the western Purisima area (A, AA, and Tu-units).
- TDS and chloride concentrations in two of the City of Santa Cruz's monitoring wells suggest seawater intrusion in the westernmost Purisima area (A-unit).
- TDS and chloride concentrations do not suggest seawater intrusion at SqCWD's production wells or monitoring wells in the central Purisima area (BC and DEF-units).
- TDS and chloride concentrations continue to be elevated in deep monitoring wells installed below the freshwater-saltwater interface in the Aromas area (Purisima F-unit and Aromas Red Sands).
- There is a long-term increasing trend in TDS and chloride concentrations at wells installed above the freshwater-saltwater interface in the Aromas area.

Naturally occurring constituents such as iron and manganese in the Purisima Formation and chromium VI in the Aromas Red Sands continue to have high concentrations in groundwater. High nitrate concentrations were detected at the Sells well which caused its removal from service in Water Year 2009. All

delivered water met drinking water standards for constituents found in groundwater.

STATUS OF GROUNDWATER MANAGEMENT

The status of basin management objectives (BMO) is updated through Water Year 2010. The main basin management objective of concern is BMO 1-1, which concerns pumping within the sustainable yield. Re-evaluation of the sustainable yield suggests that SqCWD pumping continues to exceed the sustainable yield, even though annual municipal production was the lowest for records starting in Water Year 1984. Therefore, achieving BMO 1-1 may require fulfilling BMO 1-2 to develop alternative water supplies to achieve a long-term balance between recharge and withdrawals to meet current and future demand.

Achieving BMO 1-1 also affects the ability to achieve other basin management objectives, such as:

- BMO 1-3, Manage groundwater storage for future beneficial uses and drought reserve
- BMO 2-2, Maintain groundwater levels to prevent seawater intrusion.

Basin management elements are specific projects, programs, and policies for meeting basin management objectives. The status of elements is also updated in this report.

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INTRODUCTION

This Annual Review and Report (ARR) is part of the implementation of the Groundwater Management Plan (GMP) for the Soquel-Aptos basin approved by Soquel Creek Water District (SqCWD) and Central Water District (CWD) in 2007 (SqCWD and CWD, 2007). The ARR summarizes groundwater conditions in the Soquel-Aptos basin, documents the status of groundwater management activities, and recommends any amendments to the GMP. The report will serve as a living document that will be updated annually starting with the Water Year 2009 report.

GROUNDWATER CONDITIONS

Both precipitation and production in the Soquel-Aptos basin were lower than average due to continuing drought conditions in Water Year 2009. Water Year 2009 was the third consecutive year with below average rainfall, leading SqCWD to declare a Precautionary Drought Curtailment for water use from May-October 2009. Annual municipal production (SqCWD, CWD, and the City of Santa Cruz) was the lowest since Water Year 1986 due to three factors in the SqCWD service area:

1. the voluntary drought curtailment;
2. economic conditions that resulted in both residential and commercial vacancies or reduced use; and
3. completed water demand offsets for which the corresponding development had not yet been completed.

Starting in Water Year 2005, municipal production in the Soquel-Aptos basin has not significantly exceeded pumping goals stated in the GMP. However, a re-evaluation of sustainable yield estimates suggested that reasonable estimates of the sustainable yield in the Purisima Formation and Aromas Red Sands should be at least hundreds of acre-feet lower than the pumping goals stated in the GMP (HydroMetrics LLC, 2009c).

Coastal groundwater levels in SqCWD monitoring wells screened in productive units remained below elevations that protect the aquifers from seawater intrusion. In general, the groundwater level trend in these coastal wells in the

western and central Purisima areas has been stable over the last several years. The groundwater level trend in coastal wells in the Aromas area has generally been declining over the last several years.

Wells that may provide an indication of basin storage include wells located in upgradient areas of the basin or screened in overlying aquifers. Many of these wells show a declining groundwater level trend.

There is ongoing risk of seawater intrusion into the productive units of the Soquel-Aptos basin due to coastal groundwater levels being below protective elevations. Observed Total Dissolved Solids (TDS) and chloride concentrations are used to assess seawater intrusion. The occurrence of seawater intrusion varies by area in the Soquel-Aptos basin:

- TDS and chloride concentrations do not suggest seawater intrusion at SqCWD's production wells or monitoring wells in the western Purisima area (A, AA, and Tu-units).
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- TDS and chloride concentrations do not suggest seawater intrusion at SqCWD's production wells or monitoring wells in the central Purisima area (BC and DEF-units).
- TDS and chloride concentrations continue to be elevated in deep monitoring wells installed below the freshwater-saltwater interface in the Aromas area (Purisima F-unit and Aromas Red Sands).
- There is a long-term increasing trend in TDS and chloride concentrations at wells installed above the freshwater-saltwater interface in the Aromas area.

Naturally occurring constituents such as iron and manganese in the Purisima and chromium VI in the Aromas continue to have high concentrations in groundwater. High nitrate concentrations were detected at the Sells well which caused its removal from service in Water Year 2009. All delivered water met drinking water standards for constituents found in groundwater.

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SECTION 1
BACKGROUND AND SCOPE

Soquel Creek Water District (SqCWD) and Central Water District (CWD) approved a Groundwater Management Plan (GMP) in 2007 (SqCWD and CWD, 2007). Part of the GMP implementation requires preparation of an Annual Review and Report (ARR) following each water year. The ARR summarizes groundwater conditions in the Soquel-Aptos area, documents the status of groundwater management activities, and recommends amendments to the GMP. Under direction of the Soquel-Aptos area Basin Implementation Group (BIG), a new format for the report has been prepared starting with the Water Year 2009 ARR. The report will serve as a living document and be updated annually. This is the first annual update using the new format, covering Water Year 2010 (October 2009-September 2010).

1.1 LIVING DOCUMENT CONCEPT

The living document is contained in a three-ring binder and portable document format (PDF) electronic file that will be updated with new information on basin conditions each year. Summaries and maps of previous water years will remain in the binder and PDF file, with summaries and maps for the most recent water year successively added. The section reviewing the status of GMP implementation is similar to Section 3 of the Water Year 2008 report, but will be updated through the most recent water year. An executive summary of the entire water year will also be added to the front of the binder and PDF file each year.

1.2 DOCUMENT ORGANIZATION

Sections 2-5 update basin conditions for the water year. Since new Sections 2-5 discussing the latest water year are inserted to the binder and PDF, the sections are labeled with the subject water year. Some figures and tables illustrating basin conditions or current basin understanding, such as multi-year graphs, are replaced when they are updated. Other figures and tables, such as snapshot contour maps, are added when updated and their figure and table numbers labeled with the subject water year.

Section 2 describes conditions for the subject water year such as precipitation and overall pumping that affect the entire basin. The updated Section 2 is inserted in

front of the previous Section 2. Multi-year graphs of precipitation and pumping are replaced each year.

Sections 3-5 describe conditions for three different portions of the Soquel-Aptos area. Section 3 discusses the western portion of the Soquel-Aptos area, where the productive aquifer units are the Purisima A and AA-units and the sub-Purisima Tu-unit. Section 4 discusses the central portion of the Soquel-Aptos area, where the productive aquifer units are the Purisima BC and DEF-units. Section 5 discusses the eastern portion of the Soquel-Aptos area, where the productive aquifer units are the Purisima F-unit and Aromas Red Sands aquifer. The above productive aquifer units are defined by the basin hydrostratigraphy outlined in Johnson et al. (2004). The deep to shallow sequence of productive aquifer units in the Purisima Formation is AA, A, BC, DEF, to F. The Aromas Red Sands overlies the Purisima F-unit.

Each of these sections is organized as follows:

- A description of pumping for the relevant SqCWD service areas and CWD or City of Santa Cruz is summarized and inserted.
- A multi-year graph of the water agencies' pumping for the area is replaced. The estimates of non-agency pumping will also be replaced if there is new information.
- A summary of the overall groundwater condition and groundwater level trends for the water year is inserted.
- SqCWD has established protective groundwater elevations in coastal monitoring wells to protect the basin from seawater intrusion over the long term (HydroMetrics LLC, 2009b). The City of Santa Cruz has also proposed protective groundwater elevations for its coastal monitoring wells. A table comparing coastal groundwater levels in the water year versus protective elevations for the aquifer group is inserted.
- A map showing representative groundwater elevation contours for the spring and fall of the reported water year is inserted. The groundwater elevation contour maps from the water year 2007 report are also included as a baseline.
- A summary of the overall condition and trends of water quality for the water year is inserted.
- The section will include a discussion of any specific issues that arise for the reported water year.
- Hydrographs and chemographs will be replaced.

The current plan is to update all items (summaries, tables, multi-year graphs, and contour maps) in Sections 2-5 each year. However, the BIG may decide that not all items require an update every year. The BIG may also decide that additional items should be added in subsequent years.

Section 6 discusses the updated status of GMP Basin Management Objectives and Basin Management Elements (projects, programs, or policies). This section will be replaced each year, but completion of any objectives or elements in previous years will remain in the description in order to keep an ongoing record of activities.

Section 7 discusses current GMP action priorities, data gaps, and recommendations.

Table 1-1 provides a summary of whether updated items in each report will be inserted or replaced in the binder and PDF.

Table 1-1: Summary of Items to Add or Replace for Each Annual Report

Report Item	**Insert or Replace in Report**
Executive Summary	Insert
Section 1 - Background and Scope	Replace
Section 2 - Basinwide Conditions	
Text	Insert
Precipitation and pumping charts	Replace
Pumping tables	Replace
Section 3 - 5 - Aquifer Conditions	
Text	Insert
Summary tables	Insert
Pumping charts	Replace
Contour maps	Insert
Hydrographs	Replace
Chemographs	Replace
Section 6 - GMP Implementation Status	Replace
Section 7 - Recommendations	Insert

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SECTION 2 – WATER YEAR 2010
BASINWIDE CONDITIONS IN THE SOQUEL-APTOS GROUNDWATER MANAGEMENT AREA

This section presents conditions in the Soquel-Aptos area for Water Year 2010 that affect the entire groundwater basin.

2.1 ANNUAL PRECIPITATION

SqCWD collects rainfall data from two gauges in the Soquel-Aptos area: the Mancarti gauge on Laurel Road and the Kraeger gauge on Longridge Road. Data loggers record rainfall at these gauges at 15-minute intervals. Precipitation at the Mancarti and Kraeger gauges during Water Year 2010 was 44.00 and 40.95 inches respectively. These rainfall totals were above the average (mean) values of 36.5 inches at the Mancarti gauge and 37.4 inches at the Kraeger gauge measured between Water Year 1984 and Water Year 2010.

Annual rainfall totals by Water Year for both gauges are presented on Figure 2-1. Water Year 2010 follows three consecutive years with below average and below median rainfall. Water Year 2010 ranks as the 8th and 10th wettest year in the 27 year record for the Mancarti and Kraeger gauges, respectively.

Figure 2-1 also shows rainfall totals for the NOAA Co-op station in Santa Cruz (station number 047916). Rainfall in Water Year 2010 at this station was 30.83 inches, above the average value of 30.2 inches between Water Year 1984 and Water Year 2010.

Only three of the last ten water years have had above average rainfall. Water Year 1998 was the last year with rainfall above 60 inches per year. The effects of this period of below average rainfall on deep groundwater recharge is currently being evaluated by a recharge study.

2.2 ANNUAL PRODUCTION

Total municipal production for the Soquel-Aptos area in Water Year 2010 was 5,104 acre-feet (AF), the lowest annual total since Water Year 1984. Annual production by water year for SqCWD, CWD, and the City of Santa Cruz is shown on Figure 2-2.

All three water agencies pumped less in Water Year 2010 than the previous year. CWD production of 508 acre-feet was the lowest annual total since Water Year 1995. City of Santa Cruz Water Year 2010 production of 451 acre-feet was within the annual production range of 296 to 594 acre-feet recorded since 1999. SqCWD pumping of 4,100 acre-feet was a historical low for all years back to Water Year 1984. No drought curtailment or additional conservation effort took place in Water Year 2010 so it appears that economic conditions, weather and conservation were likely factors in the reduced demand. The economic conditions resulted in both residential and commercial vacancies. Secondly, reduced demand within the SqCWD service area may have resulted from completed water demand offsets for which the corresponding development had not been completed Thirdly, weather conditions increased surface water supply for the City of Santa Cruz and reduced outdoor irrigation demand for all three agencies as precipitation was higher and the summer was cooler than the previous three years. Lastly, public awareness about the importance of sustained water conservation has been heightened in recent years due in part to ongoing outreach and education programs by the local water agencies.

Starting in Water Year 2005, SqCWD has not pumped more than 2% above its GMP pumping goal of 4,800 acre-feet per year. This goal has been met after averaging 5,375 acre-feet of pumping per year between Water Years 1987 and 2004. Available records starting in Water Year 1974 show that CWD has never pumped more than 1% above its sustainable yield share of 622 acre-feet per year that is implied in the GMP. Starting in Water Year 1995, City of Santa Cruz has not pumped more than 3% above its sustainable yield share of 576 acre-feet per year that is assumed in the GMP.

Sustainable yield estimates in the GMP were re-evaluated in 2009, based on modeled offshore flows required to protect against seawater intrusion (HydroMetrics LLC, 2009c). Using prior assumptions for recharge and consumptive use (Johnson et al., 2004), the evaluation showed that pumping goals in the GMP may not be adequate to protect the basin against seawater intrusion. The evaluation suggested that a reasonable estimate of SqCWD's share of the annual sustainable yield in the Purisima is 500 acre-feet less than SqCWD's pumping goal of 3,000 acre-feet per year stated in the GMP. Water Year 2010 pumping from SqCWD's wells in the Purisima was at a historical low for all years back to Water Year 1984 but was still approximately 12% higher than the revised estimate. The evaluation also concluded that the SqCWD's pumping goal of 1,800 acre-feet per year for the Aromas stated in the GMP was at least hundreds of acre-feet too high. Uncertainty in the calculations for the Aromas led to the recommendation that the USGS model of Pajaro Valley be reviewed before evaluating the concept of sustainable yield for the Aromas. The USGS model of Pajaro Valley is now due to be released in late 2011.

Estimated production by private wells and small water systems, including residential, commercial, and agricultural supply, are also shown on Figure 2-2. Estimated private well production of approximately 2,236 acre-feet per year in the Purisima area and 954 acre-feet per year in the Aromas area have not been updated since Johnson et al. (2004) expanded on estimates developed by Faler (1992) and Wolcott (1999). The exceptions are more recent pumping information provided by the Santa Cruz County Parks Department and Cabrillo College. The Parks Department provided estimates of Polo Grounds park irrigation well pumping (Branham, 2007) and Cabrillo College provided pumping records for calendar year 2009 (Cabrillo College, 2010). Cabrillo College pumping for that year was one-third of the estimate provided by Wolcott (285 acre-feet per year). Figure 2-3 shows the study areas for the Purisima and Aromas used for these estimates presented in Johnson et al. (2004) and how they relate to the Soquel-Aptos groundwater management area. Table 2-1 summarizes water use estimates for the Purisima area. Table 2-2 summarizes water use estimates for the Aromas area.

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SECTION 2 – WATER YEAR 2009
BASINWIDE CONDITIONS IN THE SOQUEL-APTOS GROUNDWATER MANAGEMENT AREA

This section presents conditions in the Soquel-Aptos area for Water Year 2009 that affect the entire groundwater basin.

2.1 ANNUAL PRECIPITATION

SqCWD collects rainfall data from two gauges in the Soquel-Aptos area: the Mancarti gauge and the Kraeger gauge. Data loggers record rainfall at these gauges at 15-minute intervals. Precipitation at the Mancarti and Kraeger gauges during Water Year 2009 was 33.38 and 29.62 inches respectively. These rainfall totals were below the average values of 36.5 inches at the Mancarti gauge and 37.4 inches at the Kraeger gauge measured between Water Year 1984 and Water Year 2009. Annual precipitation totals by Water Year for both gauges are presented on Figure 2-1.

Water Year 2009 was the third consecutive year with below average rainfall. Only two of the last eight water years have had above average rainfall. Water Year 1998 was the last year with rainfall above 60 inches per year. The effects of this period of below average rainfall on deep groundwater recharge has not been fully evaluated, but may partially explain the lack of groundwater recovery despite decreased production over the same period.

2.2 ANNUAL PRODUCTION

Total municipal production for the Soquel-Aptos area in Water Year 2009 was 5,536 acre-feet (AF), the lowest annual total since Water Year 1986. Annual production by water year for SqCWD, CWD, and the City of Santa Cruz is shown on Figure 2-2. The decline in production in Water Year 2009 was achieved primarily by SqCWD. Due to the third consecutive drought year, SqCWD declared a Precautionary Drought Curtailment for a voluntary reduction in water use of 15% from May-October. Approximately 350 acre-feet of SqCWD's total 460 acre-feet annual reduction from the Water Year 2005-2008 average was achieved between May and the end of September, 2009. In addition to the voluntary curtailment, economic conditions that resulted in both residential and commercial vacancies or reduced use and completed water demand offsets for which the corresponding development had not been completed also contributed to the reduced demand.

Starting in Water Year 2005, SqCWD has pumped no greater than 2% higher than its pumping goal of 4,800 acre-feet per year as stated in the GMP. This goal has been met after averaging 5,375 acre-feet per year from Water Years 1987-2004. For available records starting in Water Year 1974, CWD has pumped no greater than 1% higher than its share of sustainable yield of 622 acre-feet per year implied in the GMP. Starting in Water Year 1995, City of Santa Cruz has pumped no greater than 2% higher than its share of sustainable yield of 576 acre-feet per year assumed in the GMP and less than the 645 acre-feet per year planned by the City for normal years according to its *Integrated Water Plan* (Gary Fiske and Associates, 2003).

However, sustainable yield estimates were re-evaluated based on modeled offshore flows required to achieve groundwater elevations protective against seawater intrusion (HydroMetrics LLC, 2009c). Using prior assumptions for recharge and consumptive use (Johnson et al., 2004), the evaluation showed that pumping goals in the GMP may not be adequate to protect the basin against seawater intrusion after the basin recovers to protective elevations. The evaluation suggested that a reasonable estimate of the annual sustainable yield in the Purisima is 500 acre-feet less than the pumping goal of 3,000 acre-feet stated in the GMP. Water Year 2009 pumping from SqCWD's wells in the Purisima were approximately 17% higher than the revised estimate. The evaluation also concluded that the GMP pumping goal of 1,800 acre-feet per year for the Aromas was at least hundreds of acre-feet too high. Uncertainty in the calculations for the Aromas led to the recommendation that the USGS model of Pajaro Valley be reviewed before evaluating the concept of sustainable yield for the Aromas. The USGS model of Pajaro Valley is due to be released in 2010.

Estimates for production by private wells and small water systems, including residential, commercial, and agricultural supply, are also shown on Figure 2-2. Estimates of approximately 2,236 acre-feet per year in the Purisima and 954 acre-feet per year in the Aromas have not been updated since Johnson et al. (2004) documented estimates based on a previous SqCWD study (Faler, 1992) and a Santa Cruz County Environmental Health Services report (Wolcott, 1999), except for more recent information provided by the Santa Cruz County Parks Department and Cabrillo College. The Parks Department provided the estimate of Polo Grounds park irrigation well pumping (Branham, 2007) and Cabrillo College provided pumping records for calendar year 2009 (2010). Figure 2-3 shows the study areas for the Purisima and Aromas used for these estimates presented in Johnson et al. (2004) and how they relate to the Soquel-Aptos groundwater management area. Table 2-1 summarizes water use estimates for the Purisima area. Table 2-2 summarizes water use estimates for the Aromas area.

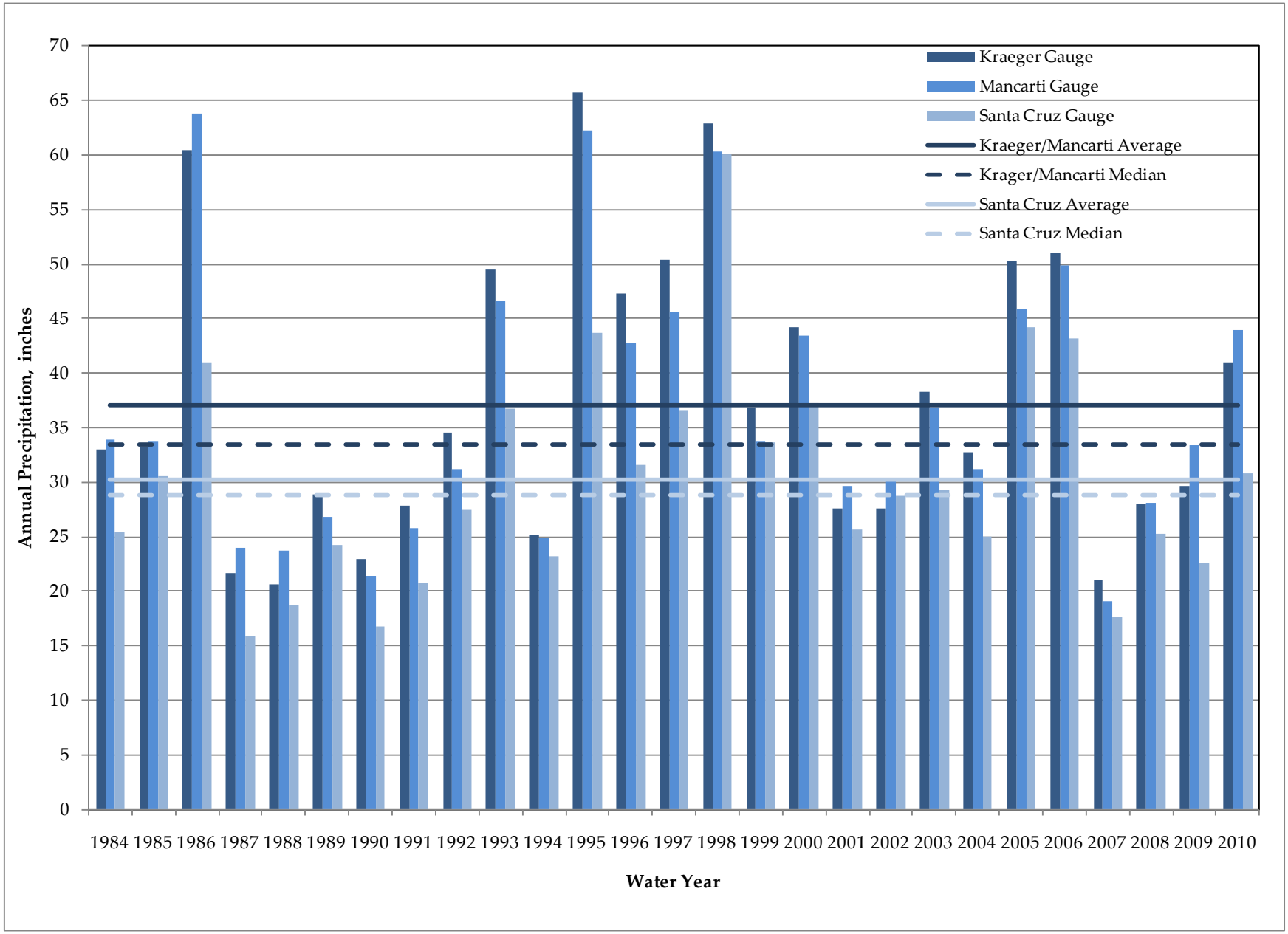


Figure 2-1: Precipitation at Kraeger and Mancarti Gauge

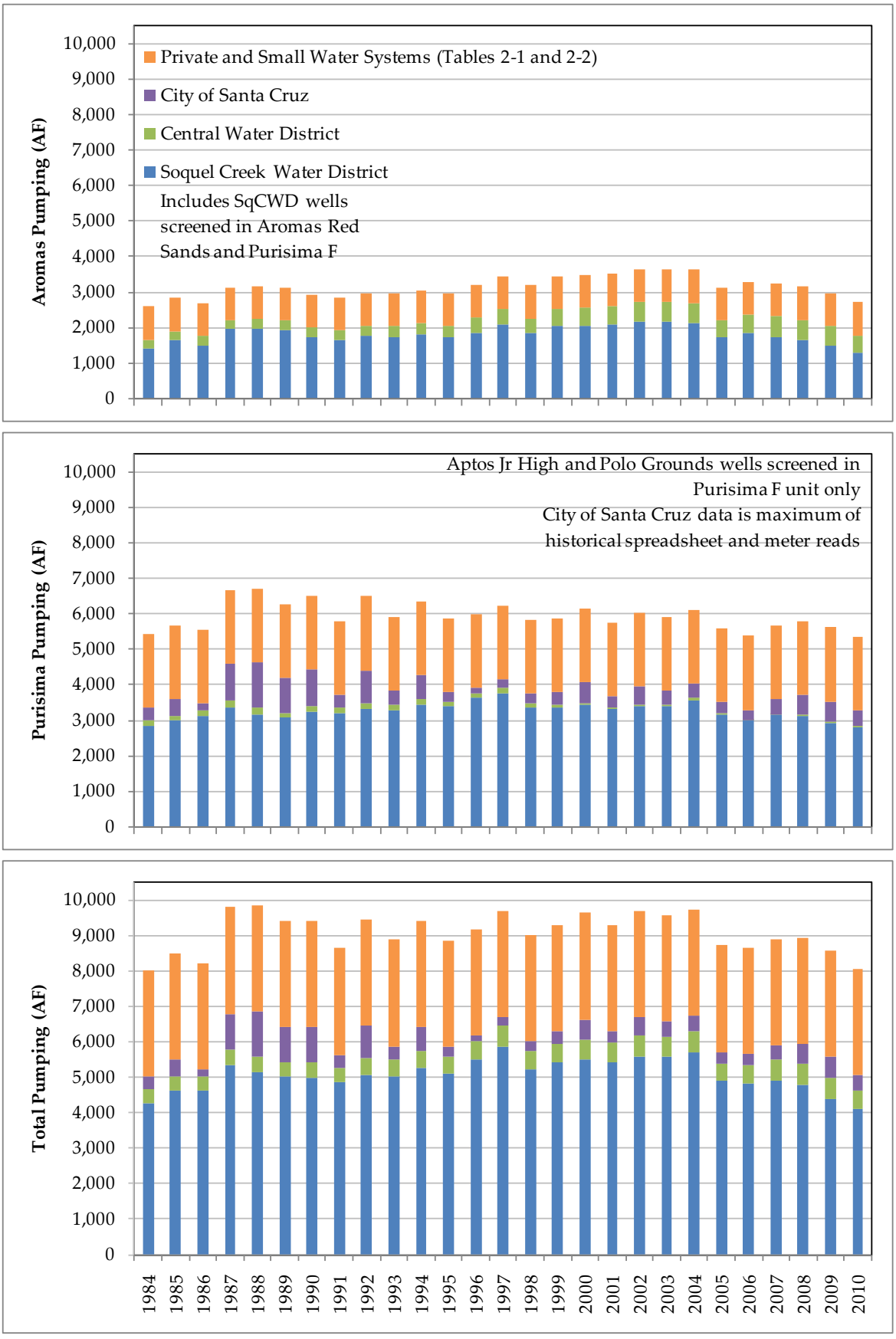


Figure 2-2: Pumping by Water Year in Acre-Feet

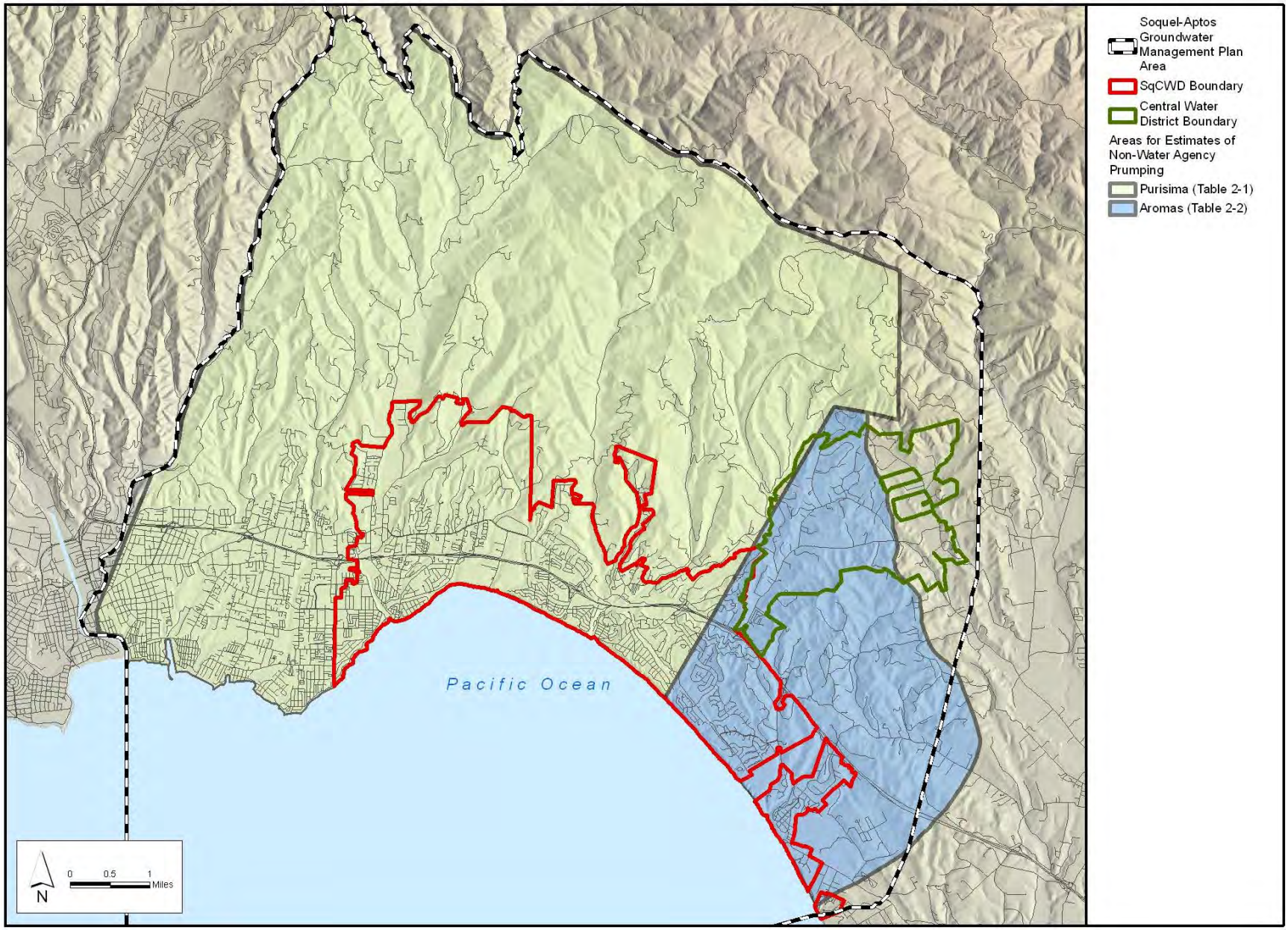


Figure 2-3: Study Area for Estimating Non-Agency Pumping

Table 2-1: Estimates of Non-Water Agency Pumping in the Purisima Area.

	User	Estimated Water Use (AF/year)	Source	Comments
Private Urban	Residential and Commercial	124	Wolcott, 1999	may include stream diversions
	Agriculture	93		
	Seascape Golf Course	232		
Private Rural	Residential and Commercial	1,099	Wolcott, 1999	
	Agriculture	163		
Small Water Systems	Cabrillo College	95	Cabrillo College, 2010	Calendar Year 2009
	Other Urban	29		
	Rural	211		
Total Purisima Area		**2,046**		

Table 2-2: Previous Estimates of Non-Water Agency Pumping in the Aromas Area.

	User	Estimated Water Use (AF/year)	Source	Comments
	Polo Grounds Park	30	Branham, 2007	
Private Rural	Residential and Commercial	557	Johnson et al., 2004	Parcel count and areas from Faler and water use factors from Wolcott
	Agriculture	309		
Small Water Systems	Rural	58	Johnson et al., 2004	Number of connections from Faler and water use factors from Wolcott
Total Aromas Area		**954**		

SECTION 3 - WATER YEAR 2010 AQUIFER CONDITIONS FOR WESTERN PURISIMA AREA (A/AA/TU-UNITS)

This section presents groundwater level and water quality conditions for Water Year 2010 in the western portion of the Soquel-Aptos area where the primary production aquifers are the Purisima A-unit, the Purisima AA-unit, and the sub-Purisima Tu-unit.

3.1 SqCWD Service Area I and City of Santa Cruz Annual Production

In the western portion of the Soquel-Aptos area, groundwater is produced for municipal purposes by SqCWD in its Service Area I and the City of Santa Cruz from its Live Oak well field. SqCWD's Estates well in Service Area II to the east is also partially completed in the A-unit.

SqCWD's Service Area I production was 1,769 acre-feet in Water Year 2010, the lowest annual amount since service area data have been recorded starting in 1984. Production in Service Area I over the last six years has been below the historical average. Water Year 2010 pumping in Service Area I was approximately 71% of the SqCWD's revised estimate of its share of the annual sustainable yield in the Purisima area (HydroMetrics LLC, 2009c). Water Year 2010 production at the Estates well in Service Area II was 306 acre-feet, slightly higher than the 300 acre-feet produced in Water Year 2009. Production at the Estates well in each of the last two years was lower than every other year since 1991.

The City of Santa Cruz's production from the Live Oak well field was 451 acre-feet in Water Year 2010, which is within the annual production range of 296 to 594 acre-feet recorded since 1999. The City of Santa Cruz's groundwater production depends on availability of its surface water supply resulting in larger annual variation in groundwater production than SqCWD. In only two years since 1999 have City production exceeded the City's share of sustainable yield assumed in the GMP and then only by 3%. Figure 3-1 shows production at SqCWD wells in Service Area I, the Estates well, and the Live Oak well field by water year.

3.2 GROUNDWATER LEVEL CONDITIONS AND TRENDS

SqCWD has established protective groundwater elevations in coastal monitoring wells to protect the Purisima A-unit in the western portion of the Soquel-Aptos area from seawater intrusion. Cross-sectional models were used to estimate groundwater elevations that result in the long term freshwater-salt water interface in the Purisima A-unit being seaward of the coast (HydroMetrics LLC, 2009b).

Average coastal groundwater levels in the SqCWD's A-unit monitoring wells remained below protective elevations in Water Year 2010, as shown in Table 3-1. Although maximum groundwater levels exceed protective elevations at SC-1A and SC-3A, average groundwater levels must meet protective elevations to protect against seawater intrusion. Hydrographs for these wells follow at the end of this section. The hydrographs show that average groundwater levels have been below protective elevations since Water Year 2000 at SC-1A and for the entire period of record at SC-3A and SC-5A.

Table 3-1 (2010): Comparison of Water Year 2010 Coastal Groundwater Levels with Protective Levels in Western Purisima Area

Unit A Well	Location	Minimum Groundwater Elevation (feet msl)[1]	Maximum Groundwater Elevation (feet msl)	Average Groundwater Elevation (feet msl)	Protective Elevation (feet msl)
SC-1A	Prospect	4.0	6.5	4.9	4
SC-3A	Escalona	3.4	12.3	8.8	10
SC-5A	New Brighton	-4.8	11.4	3.3	13
Moran Lake Medium		5.2	6.3	5.7	6[2]
Soquel Point Medium		3.0	6.2	5.2	6[2]
Pleasure Point Medium		4.5	8.8	6.8	6[2]

[1] mean sea level

[2] Proposed by City of Santa Cruz (Almond, 2010)

The City of Santa Cruz has proposed a protective groundwater elevation of 6 feet msl for its coastal monitoring wells at Pleasure Point, Soquel Point, and Moran Lake during non-critically dry years and 2 feet msl for critically dry years (Almond, 2010). The City defines critically dry years as years with less than 29,000 acre-feet runoff at the Felton gauge on the San Lorenzo River (Hopkins,

2010). The hydrographs for these wells identify when water years were classified as critically dry and the protective groundwater elevation would have been 2 feet.

Water Year 2010 was not critically dry; and the protective elevation for the City of Santa Cruz coastal monitoring wells was 6 feet. As shown on Table 3-1, average groundwater levels in the Moran Lake and Soquel Point wells were below the City's protective elevation, while the average groundwater level in the Pleasure Point well was above the City's protective elevation in Water Year 2010. Groundwater levels from the Medium completion of these well clusters are used because it is the deepest completion in the A unit, the primary aquifer supplying the Live Oak well field and it has lower groundwater levels than the Deep completion in the AA unit.

The groundwater levels in Table 3-1 are based on monthly measurements at the wells and do not reflect tidal variations. Loggers have been installed in the SqCWD wells to monitor the tidal variation as shown in the hydrographs at the end of this section. Logger measurements from well SC-1A from 2007 and 2008 show a tidal range of approximately 5 feet. With a tidal range of this magnitude, average groundwater elevation based on monthly measurements may not be adequate for comparison with the protective elevation because the monthly measurements are dependent on measurement time and do not represent a tidal average. Monthly measurements at SC-1A for 2007 and 2008 underestimated average groundwater levels when compared to the full tidal range. Although there is some tidal variation at SC-3A and SC-5A, the hydrographs show that the monthly measurements are representative of the time series.

Groundwater levels show increasing trends since Water Year 2008 in SqCWD's coastal monitoring wells completed in the productive A-unit . The increasing trends are likely due to reduced pumping at nearby SqCWD production wells (Figure 3-1).

Groundwater levels at the City of Santa Cruz's coastal monitoring wells completed in the A and AA-units were either slightly higher in Water Year 2010 than Water Years 2008-2009 or relatively stable compared to the previous two years. The overall increase in groundwater levels is likely a result of Live Oak well field production in Water Year 2010 decreasing from the previous two years, when annual pumping was higher than any year since Water Year 2000. The City of Santa Cruz's groundwater production is based on the availability of surface water supply. Weather conditions in Water Year 2010 led to greater

surface water supply, lower demand, and lower groundwater pumping than the previous two years.

Groundwater levels show declining trends since Water Year 1998 in coastal monitoring wells completed in the unconfined B and BC-units . Rainfall was higher in 1998 than in any of the subsequent eleven years. This trend therefore is consistent with a correlation between declining basin storage and reduced precipitation. Groundwater levels in the B and BC units during Water Years 2009 and 2010 were relatively stable compared to the longer-term declining trend.

Groundwater levels continue to fall in deep aquifer units upgradient of the municipal production wells. Multi-year declines of at least six years have been observed in wells completed in the AA and Tu-units. However, groundwater levels over the last two water years (2009 to 2010) have been relatively stable.

Table 3-2 summarizes the important groundwater level trends by monitoring well. Hydrographs for multiple completions of these wells follow at the end of this section. Hydrographs for multiple completions of monitoring wells adjacent to production wells are also included following this section.

Hydrographs for single wells including production wells are included with chemographs. These hydrographs show trendlines for Water Years 2005-2010 when municipal production for the basin has been at or below pumping goals in the Groundwater Management Plan.

Contour maps of groundwater elevations in Spring and Fall 2010 for the Purisima A-unit are shown in Figure 3-2 and Figure 3-3. Figure 3-2 shows that Spring coastal groundwater levels in the A-unit were higher than protective elevations in much of the western Purisima area. Figure 3-3 shows that Fall coastal groundwater levels in the A-unit were lower than protective elevations in much of the western Purisima area. Figure 3-3 shows Fall 2010 pumping depressions below sea level extended from the Main Street well in the western portion of the A-unit to the Estates well in the eastern portion of the A-unit, and included a portion of the coast.

Table 3-2 (2010): Summary of Groundwater Level Trends in Western Purisima Area

Category	Well	Groundwater Level Trend Description	Notes
SqCWD Coastal Monitoring A-unit Wells	SC-1A	Increased 2+ feet from WY 2009 to WY 2010	Reduced pumping at Garnet
	SC-3A	Increasing trend Fall 2009-WY 2010; max up to 6 feet higher in 2010	Reduced pumping at Rosedale in WY 2009-2010
	SC-5A	Increasing trend Fall 2009-WY 2010; max 3-4 feet higher in 2010	Reduced pumping at Estates in WY 2009-2010
City of Santa Cruz Coastal A and AA-unit Wells	Moran Lake Soquel Point	Stable Fall 2008-2010	Reduced pumping at Live Oak in WY 2010 but increase at Beltz #9
	Pleasure Point	Increased 1.5+ feet from WY 2009 to WY 2010	Reduced pumping at Beltz #8
SqCWD Coastal Monitoring B and BC-unit Wells	SC-1B SC-3C	Decline of 5-10 feet in overlying unit since WY 1998	Decreased precipitation since WY 1998
		Stable WY 2009-2010	Increasing precipitation compared to WY 2007-2008
Inland AA and Tu-unit Wells	SC-10AA	Decline of 5-10 feet in inland AA-unit since WY 2002; Stable WY 2009-2010	None
	Thurber Lane Deep	Decline of 50 feet in inland Tu-unit since WY 2005; Stable WY 2009-2010	None

3.3 WATER QUALITY CONDITIONS AND TRENDS

The most significant groundwater quality threat in the Soquel-Aptos basin is seawater intrusion. As discussed above, average groundwater levels generally remain below protective elevations in the A-unit. As a result, there is ongoing risk of seawater intrusion into the productive units of the western Purisima area.

Observed Total Dissolved Solids (TDS) and chloride concentrations in production wells do not suggest any seawater intrusion impacting SqCWD's production wells in the Purisima A and AA-units and sub-Purisima Tu-unit.

Observed TDS and chloride concentrations in SqCWD's monitoring wells also do not indicate incipient seawater intrusion. The maximum contaminant limit (MCL) for chlorides is 250 mg/L and recent chloride concentrations in both production and monitoring wells have been below 100 mg/L or less except for a one-time measurement at SC-3RA (wells replacing SC-3 wells at Escalona in 2009 were labeled SC-3R). Chemographs for SqCWD wells in the area are included at the end of this section.

TDS and chloride concentrations at two City of Santa Cruz monitoring wells near the coast suggest seawater intrusion. Chloride concentrations in the Medium completion (A-unit) of the Moran Lake well cluster has been above 350 mg/L since measurements began in 2004, although concentrations have been decreasing since that time. Chloride concentrations in the Medium completion (A-unit) of the Soquel Point well cluster have remained stable above 1,200 mg/L starting in 2005. Chloride concentrations in the Deep completion (AA-unit) of the Soquel Point well cluster have shown an increasing trend from 67 mg/L to above 100 mg/L since 2004.

Groundwater pumped from the Purisima formation continues to be treated for iron and manganese to meet drinking water standards. In Water Year 2010, color and turbidity were also reduced during treatment to meet drinking water standards.

3.4 STATE OF THE AQUIFER SUMMARY

Seawater intrusion has not been detected in most of the Western Purisima area. However, the productive Purisima A and AA-units remain at risk for seawater intrusion as coastal groundwater levels remain below protective elevations. Due to historically low production, groundwater levels in the Purisima A and AA-units showed recovery in Water Year 2010. A longer period of low production will be required to recover the basin to be protected against the risk for seawater intrusion.

SECTION 3 - WATER YEAR 2009 AQUIFER CONDITIONS FOR WESTERN PURISIMA AREA (A/AA/TU-UNITS)

This section presents groundwater level and water quality conditions for Water Year 2009 in the western portion of the Soquel-Aptos area where the primary production aquifers are the Purisima A-unit, the Purisima AA-unit, and the sub-Purisima Tu-unit.

3.1 SqCWD Service Area I and City of Santa Cruz Annual Production

In the western portion of the Soquel-Aptos area, groundwater is produced for municipal purposes by SqCWD in its Service Area I and the City of Santa Cruz from its Live Oak well field. SqCWD's Estates well in Service Area II to the east is also partially completed in the A-unit.

Service Area I production was 1,824 acre-feet in Water Year 2009, the lowest annual amount since service area data have been recorded starting in 1984. Production in Service Area I over the last five years has been below the historical average. The recent evaluation of the sustainable yield (HydroMetrics LLC, 2009c) did not estimate annual sustainable yield specifically for Service Area I wells, but Water Year 2009 pumping in Service Area I was approximately 73% of the suggested estimate of SqCWD's share of the annual sustainable yield in the Purisima. Water Year 2009 production at the Estates well in Service Area II was 300 acre-feet, the lowest annual total since 1991.

Production at the Live Oak well field was 550 acre-feet in Water Year 2009, the highest amount since Water Year 2000, but still below the City's share of sustainable yield assumed in the GMP. Figure 3-1 shows production at SqCWD wells in Service Area I, the Estates well, and the Live Oak well field by water year.

3.2 Groundwater Level Conditions and Trends

SqCWD has established protective groundwater elevations in coastal monitoring wells to protect the Purisima A-unit in the western portion of the Soquel-Aptos area from seawater intrusion over the long term. Cross-sectional models were

used to estimate groundwater elevations that result in the long term freshwater-salt water interface in the Purisima A-unit being seaward of the coast (HydroMetrics LLC, 2009b).

Coastal groundwater levels in the SqCWD's A-unit monitoring wells remained below protective elevations in Water Year 2009, as shown in Table 3-1. Hydrographs for these wells follow at the end of this section. The hydrographs show that average groundwater levels have been below protective elevations since Water Year 2000 at SC-1A and for the entire period of record at SC-3A and SC-5A. Although maximum groundwater levels exceed protective elevations for brief durations, this is not sufficient to be protective against seawater intrusion.

Table 3-1 (2009): Comparison of Water Year 2009 Coastal Groundwater Levels with Protective Levels in Western Purisima Area

Unit A Well	Location	Minimum Groundwater Elevation (feet msl)	Maximum Groundwater Elevation (feet msl)	Protective Elevation (feet msl)
SC-1A	Prospect	0.5	2.5	4
SC-3A	Escalona	-0.3	6.4	10
SC-5A	New Brighton	-7.0	7.0	13

In general, the groundwater level trend at SqCWD's coastal monitoring wells completed in the productive A-unit in this area has been stable over the last 3-5 years. Groundwater levels at these wells are higher than levels prior to the recent stable trend. The higher levels are likely due to a reduction in pumping at nearby SqCWD production wells.

Likewise, the groundwater level trend at the City of Santa Cruz's coastal monitoring wells completed in the A and AA-units has been stable over the last three years. Groundwater levels at these wells are lower than levels prior to the recent stable trend, likely due to increases in pumping at the nearby Live Oak production wells.

The groundwater level trend at coastal monitoring wells completed in unconfined overlying B and BC-units has been declining since 1998, a year with more precipitation than the subsequent eleven years. This trend is consistent with a correlation between declining basin storage and reduced precipitation.

Groundwater levels continue to fall in deep aquifer units in areas upgradient of the municipal production wells. Multi-year declines have been observed in wells completed in the AA and Tu-units. Low groundwater levels measured at these wells in Water Year 2009 were similar to lows measured the previous year.

Table 3-2 summarizes the important groundwater level trends by well. Hydrographs for these wells follow at the end of this section. Hydrographs for monitoring wells adjacent to production wells, and static groundwater levels in the production wells are also included following this section.

Table 3-2 (2009): Summary of Groundwater Level Trends in Western Purisima Area

Category	Well	Groundwater Level Trend Description	Notes
SqCWD Coastal Monitoring A-unit Wells	SC-1A	Stable WY 2005-2009; higher than prior	Constant pumping at Garnet
	SC-3A	Stable WY 2006-2009; higher than prior	Monterey removed from service in 2005
		Fall 2009 higher than previous years	Reduced pumping at Rosedale in Summer-Fall 2009
	SC-5A	Stable WY 2007-2009; higher than prior	Reduced pumping at Tannery II and Estates since WY 2006
City of Santa Cruz Coastal A and AA-unit Wells	Moran Lake Soquel Point Pleasure Point	Stable WY 2007-2009; lower than prior	Increased pumping at Live Oak since WY 2006
SqCWD Coastal Monitoring B and BC-unit Wells	SC-1B SC-3C	Decline of 5-10 feet in overlying unit since WY 1998	Reduced precipitation since WY 1998
Inland AA and Tu-unit Wells	SC-10AA	Decline of 5-10 feet in inland AA-unit since WY 2002	None
	Thurber Lane Deep	Decline of 50 feet in inland Tu-unit since WY 2005	None

Contour maps of groundwater elevations in spring and fall 2009 for the Purisima A-unit are shown in Figure 3-2 and Figure 3-3. Figure 3-2 shows that groundwater levels in the A-unit were above sea level in spring 2009 but not high enough to bring coastal groundwater levels up to protective elevations. Figure 3-3 shows fall 2009 pumping depressions below sea level were relatively inland at the Main Street well in the western portion of the A-unit. Also, the eastern portion of the A-unit has depressed groundwater levels around the Estates well, and extending out to the coast.

3.3 WATER QUALITY CONDITIONS AND TRENDS

The most significant groundwater quality threat in the Soquel-Aptos basin is seawater intrusion. As discussed above, groundwater levels remain below protective elevations in the A-unit. As a result, there is ongoing risk of seawater intrusion into the productive units of the western Purisima area.

Observed Total Dissolved Solids (TDS) and chloride concentrations do not suggest any seawater intrusion impacting SqCWD's production wells in the Purisima A and AA-units and sub-Purisima Tu-unit. Observed TDS and chloride concentrations at SqCWD's monitoring wells also do not indicate incipient seawater intrusion. Recent chloride concentrations in both production and monitoring wells are at 100 mg/L or less, while the maximum contaminant limit (MCL) for chlorides is 250 mg/L. Chemographs for SqCWD wells in the area are included at the end of this section.

TDS and chloride concentrations at two City of Santa Cruz monitoring wells near the coast suggest seawater intrusion. Chloride concentrations in the A-unit middle screen of the Moran Lake well has been above 400 mg/L since measurements began in 2004, although concentrations have been decreasing since that time. Chloride concentrations in the A-unit middle screen of the Soquel Point well have remained stable above 1,200 mg/L starting in 2005.

Groundwater pumped from the Purisima formation continues to be treated for iron and manganese to meet drinking water standards. In Water Year 2009, color and turbidity were also reduced during treatment to meet drinking water standards.

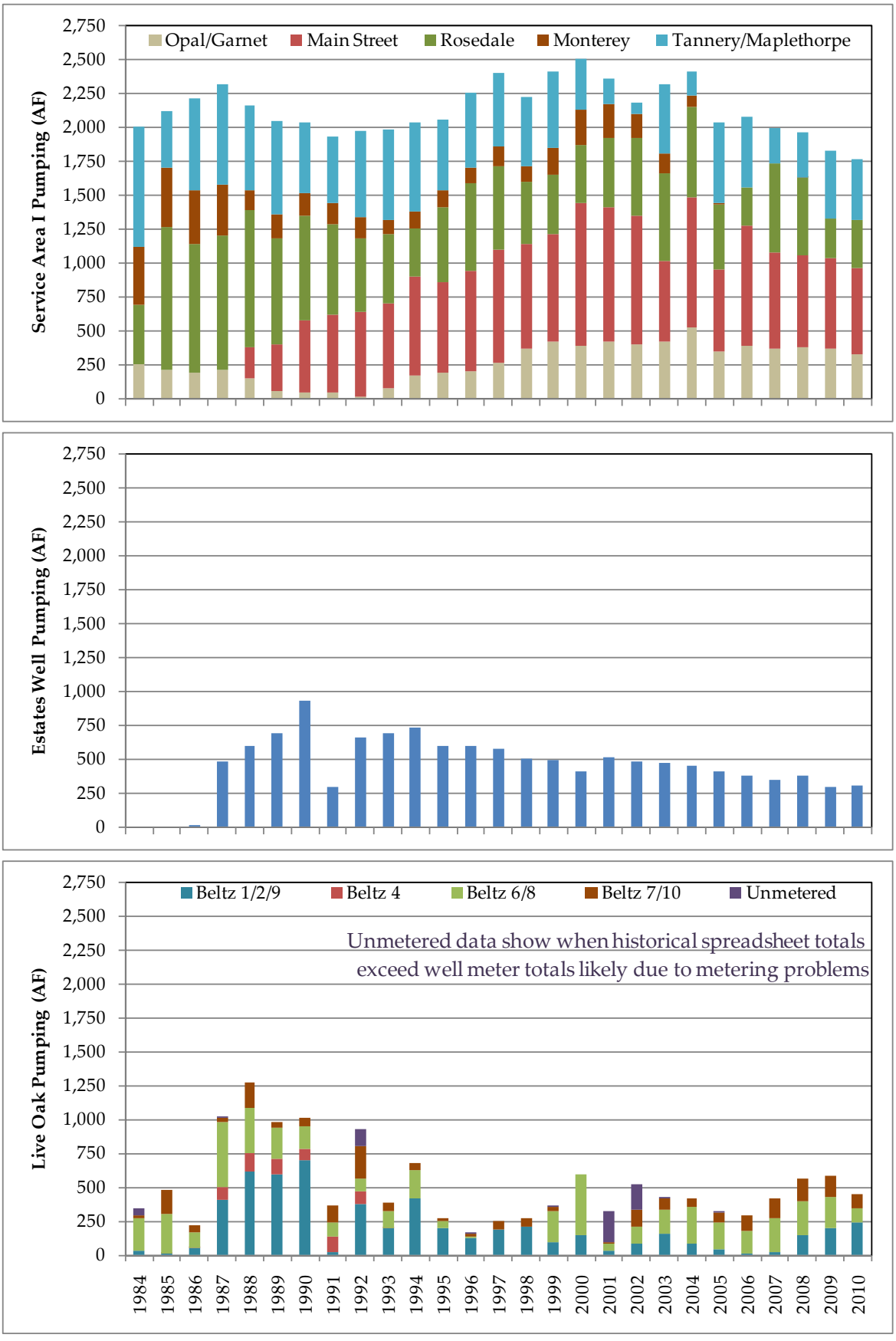


Figure 3-1: Pumping by Water Year in Western Purisima Area

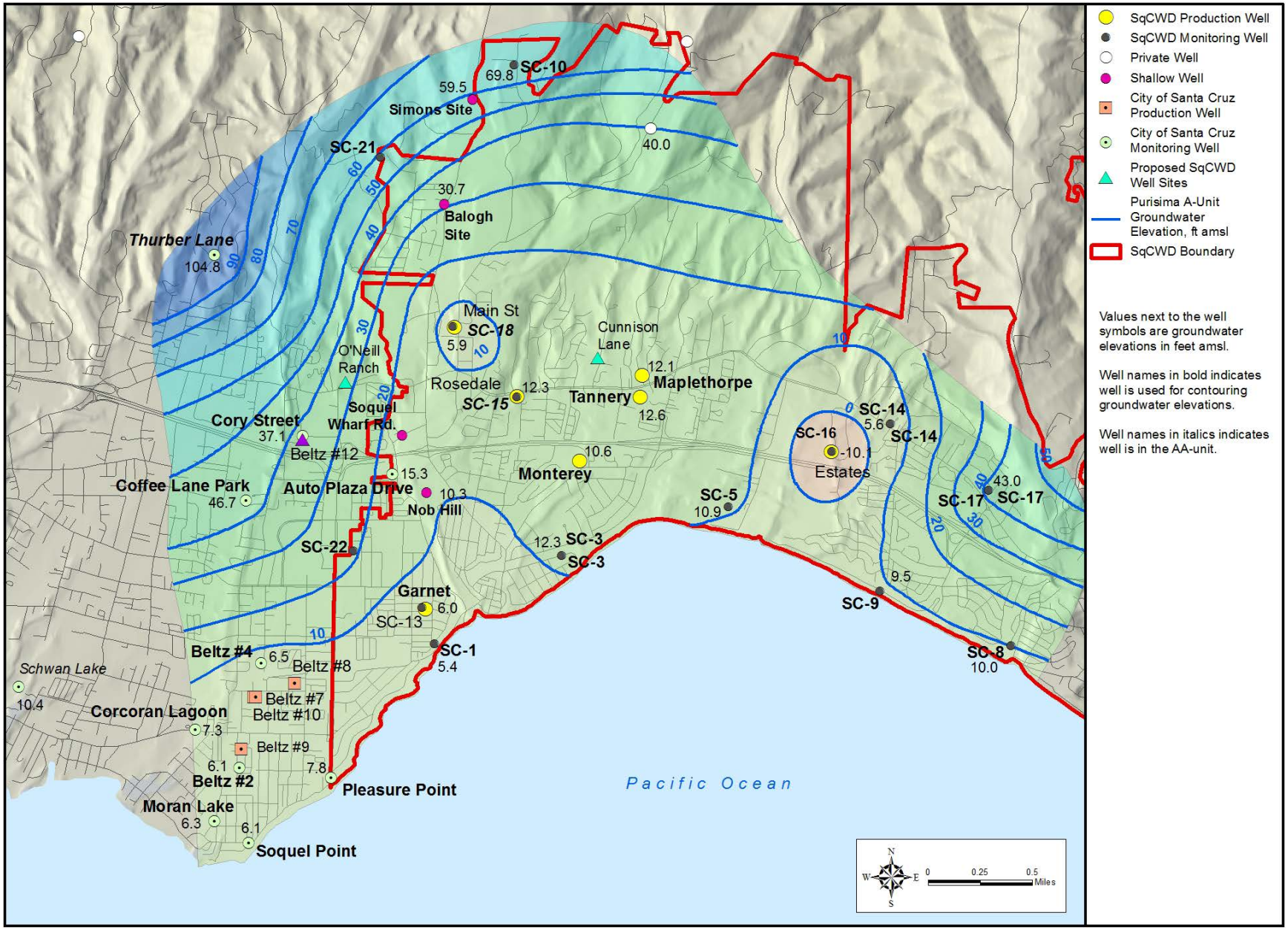


Figure 3-2 (2010): Groundwater Elevation Contours, Purisima A-Unit, Spring 2010

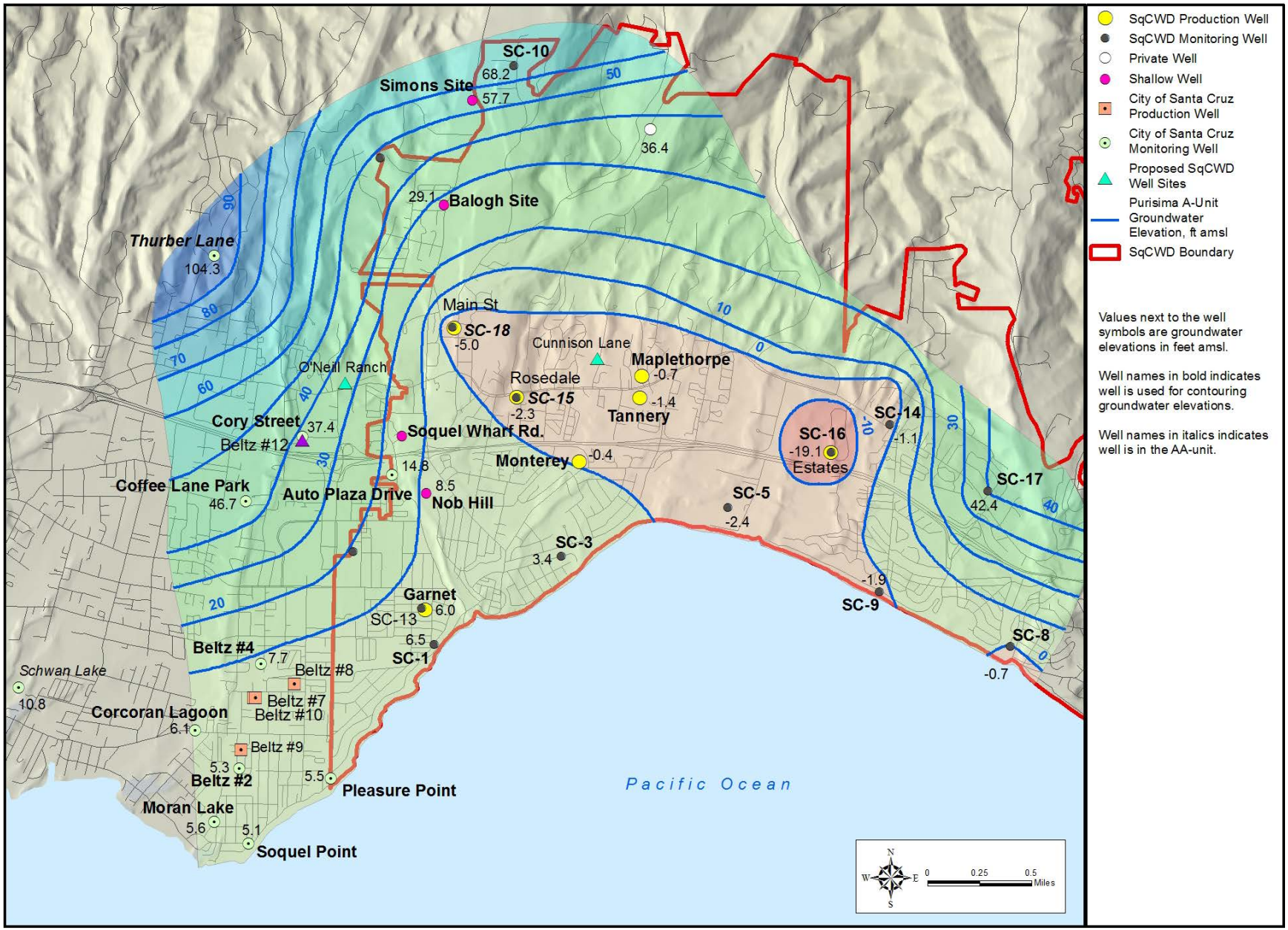


Figure 3-3 (2010): Groundwater Elevation Contours, Purisima A-Unit, Fall 2010

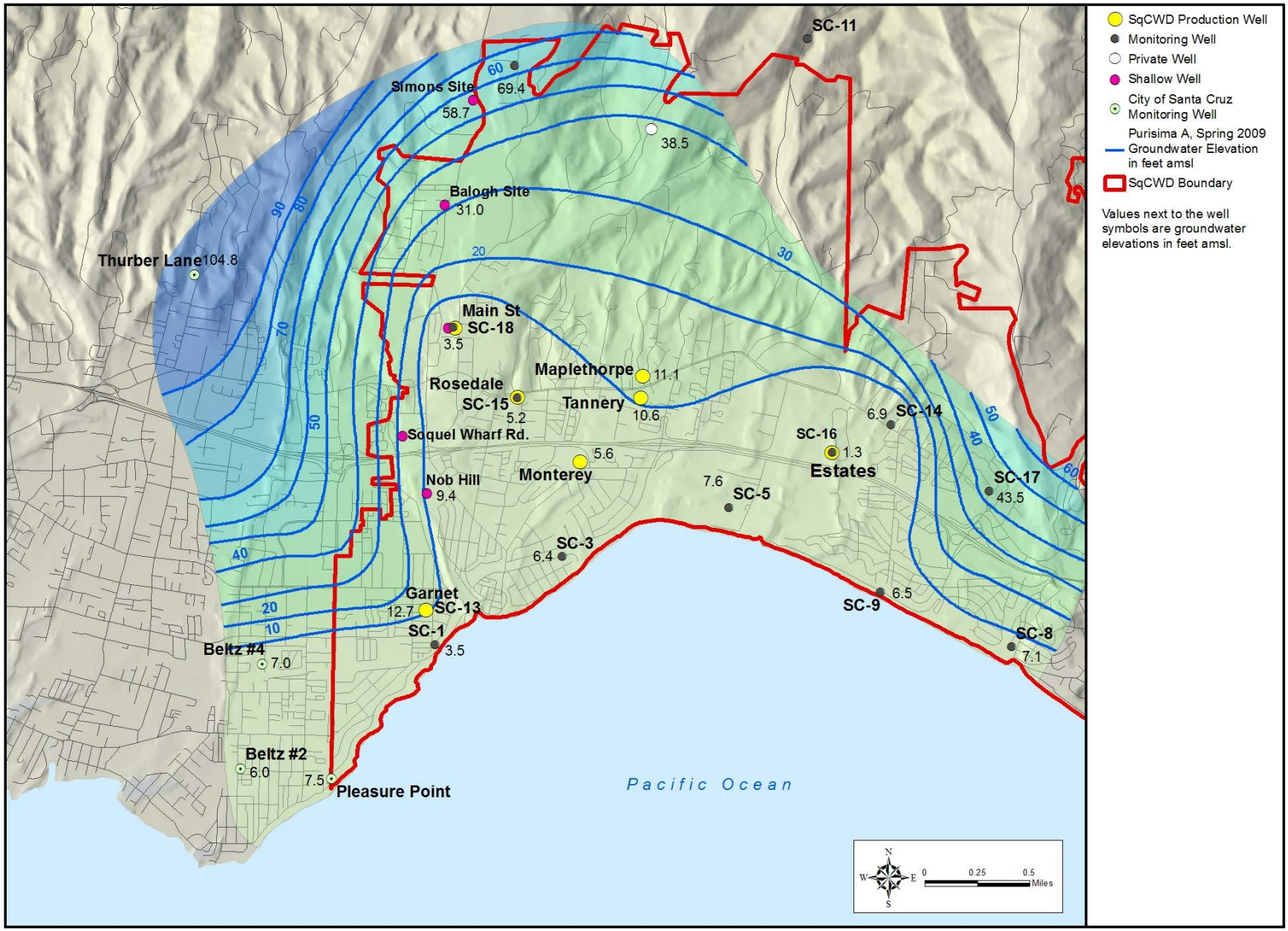


Figure 3-2 (2009): Groundwater Elevation Contours, Purisima A-Unit, Spring 2009

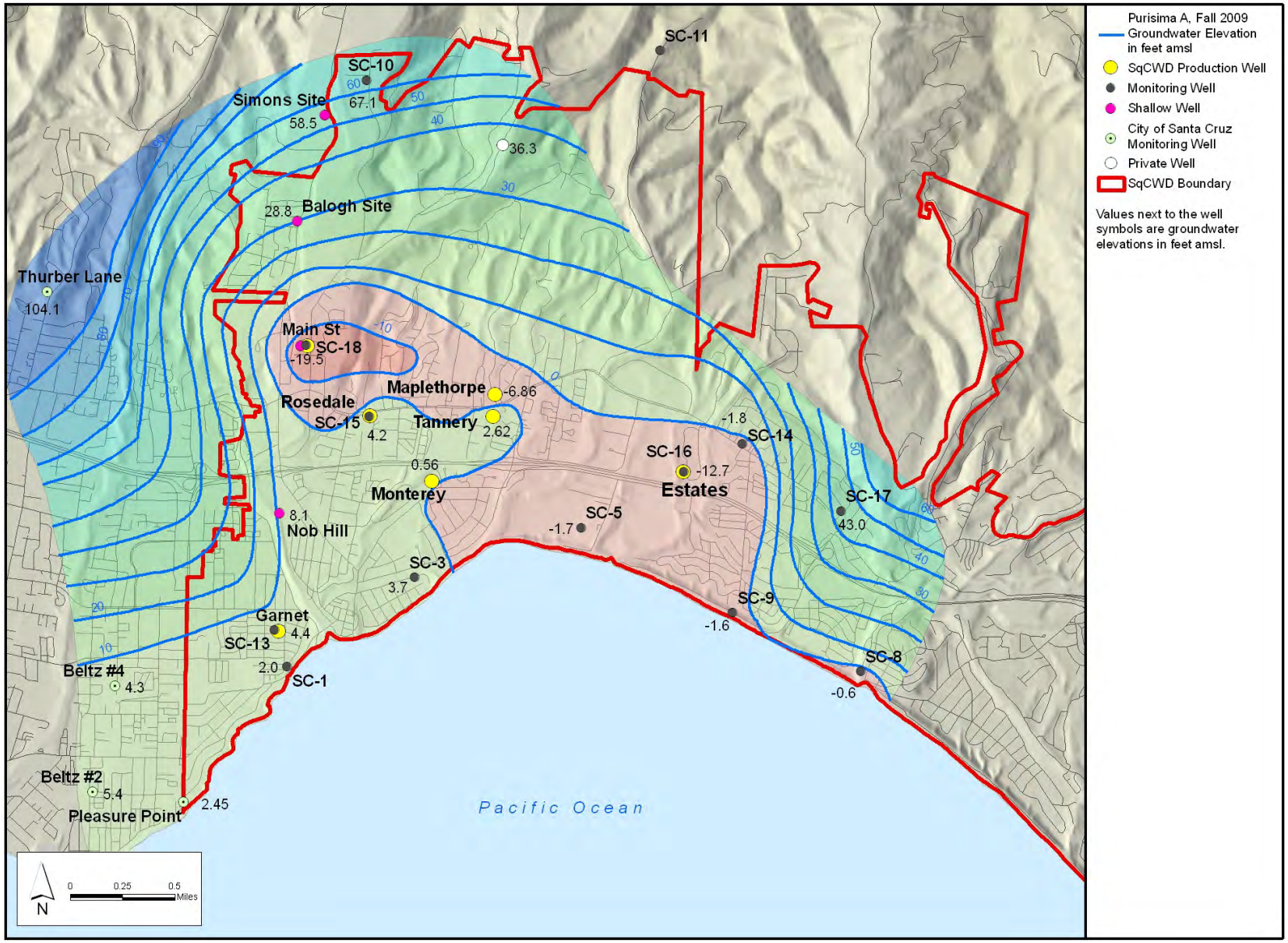


Figure 3-3 (2009): Groundwater Elevation Contours, Purisima A-Unit, Fall 2009

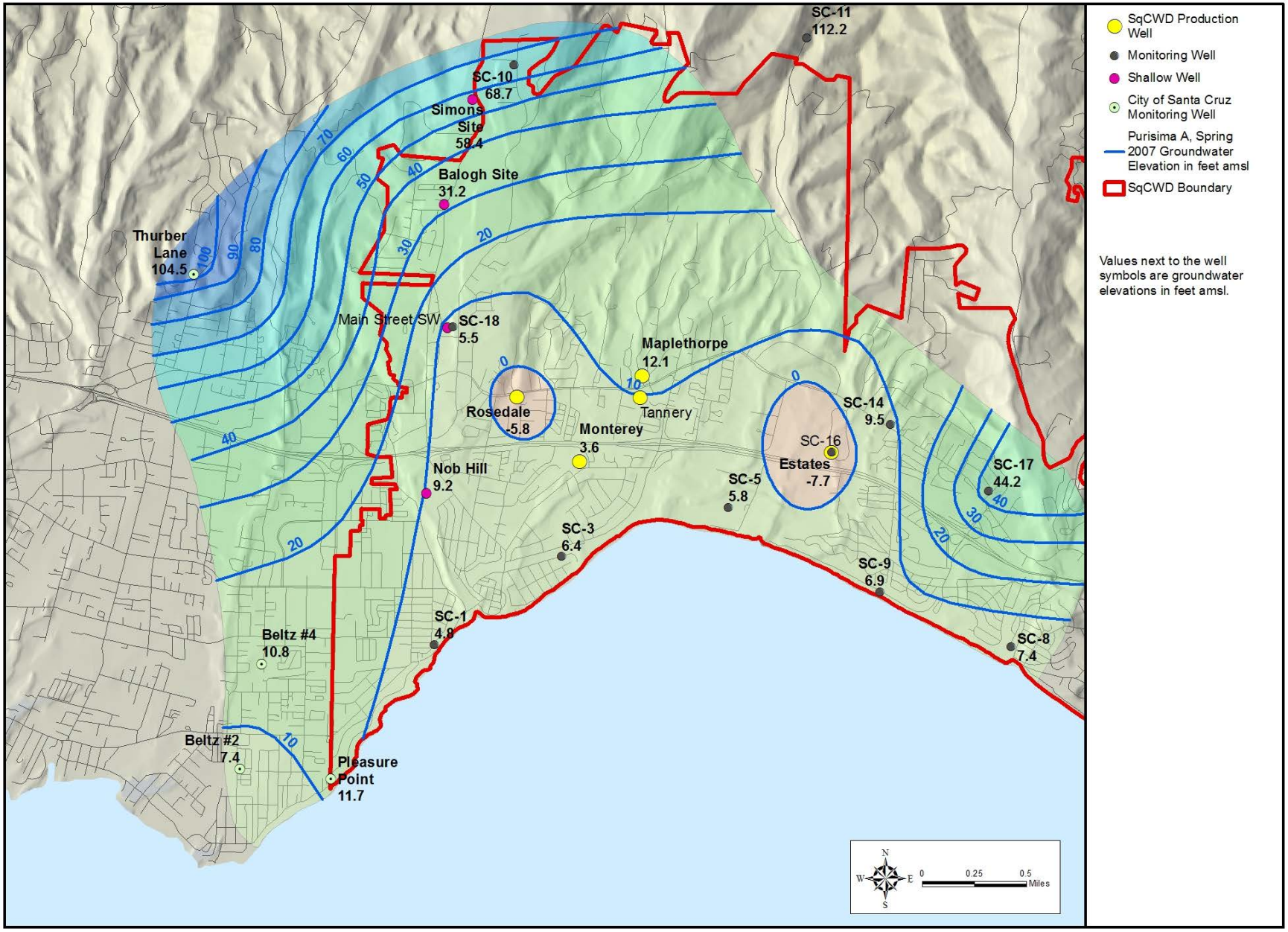


Figure 3-1 (2007): Groundwater Elevation Contours, Purisima A-Unit, Spring 2007

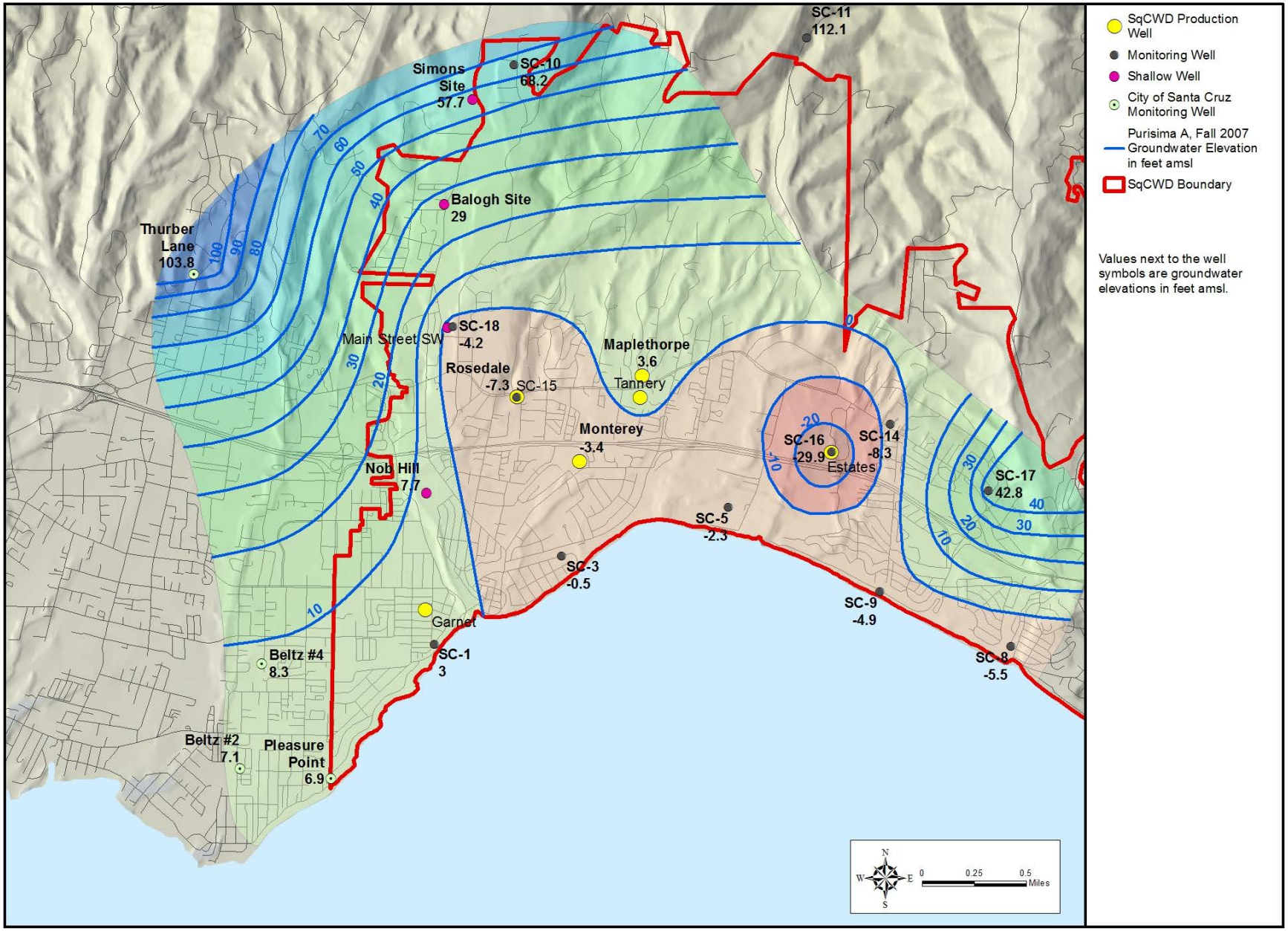


Figure 3-3 (2007): Groundwater Elevation Contours, Purisima A-Unit, Fall 2007

Monitoring Well Hydrographs for Western Purisima Area

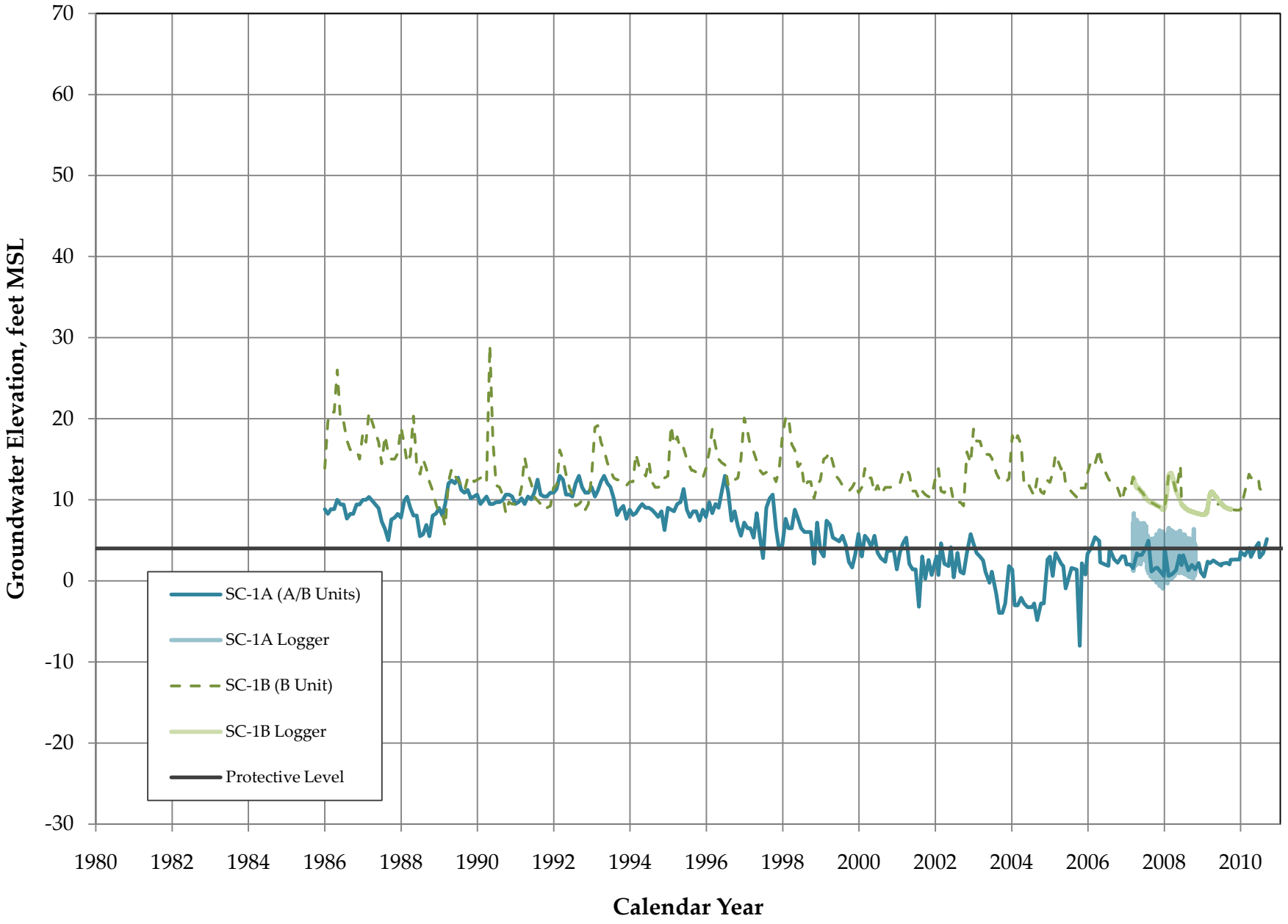
Hydrographs of SqCWD Coastal Monitoring Well Clusters

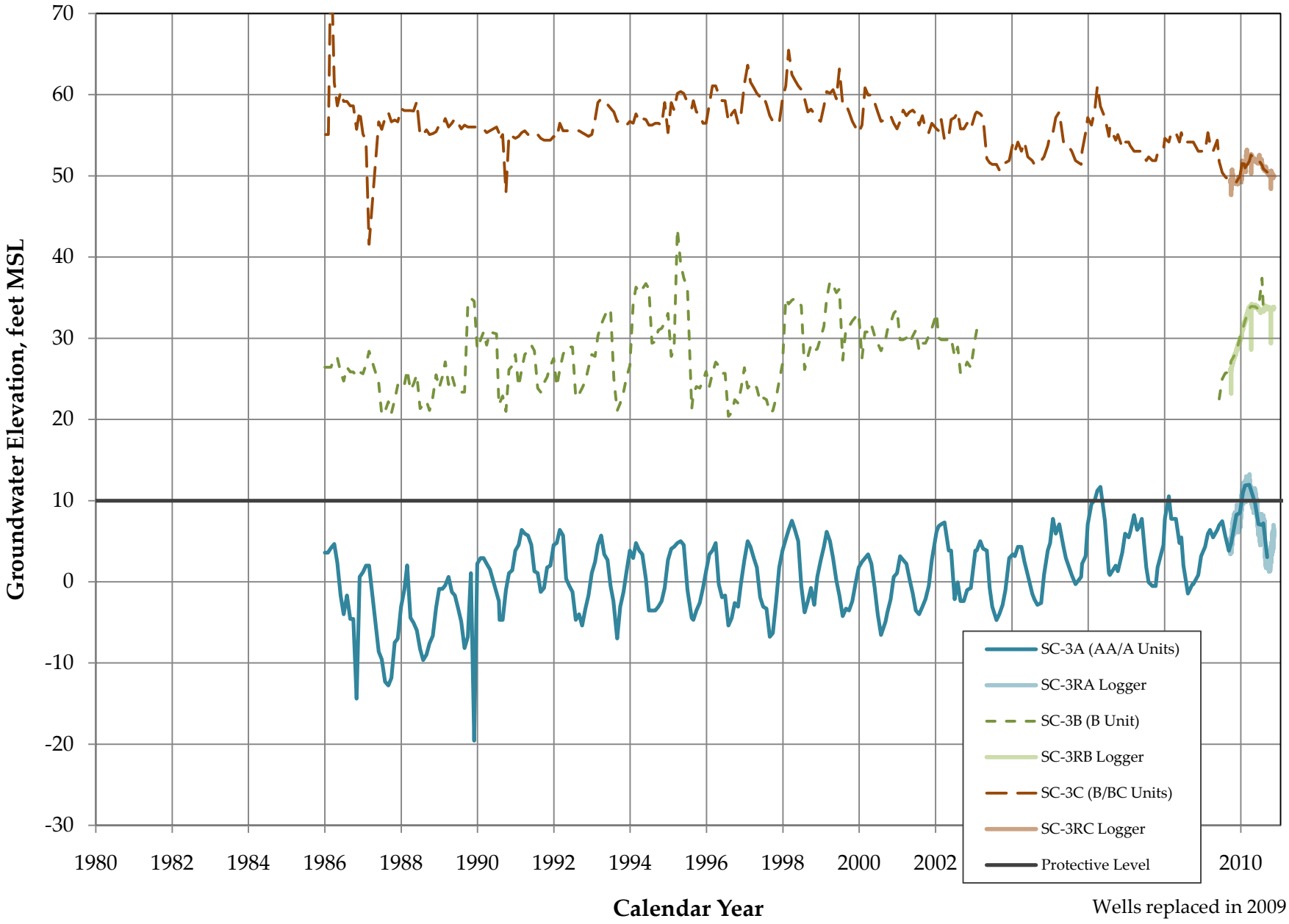
Hydrographs of City of Santa Cruz Coastal Monitoring Well Clusters

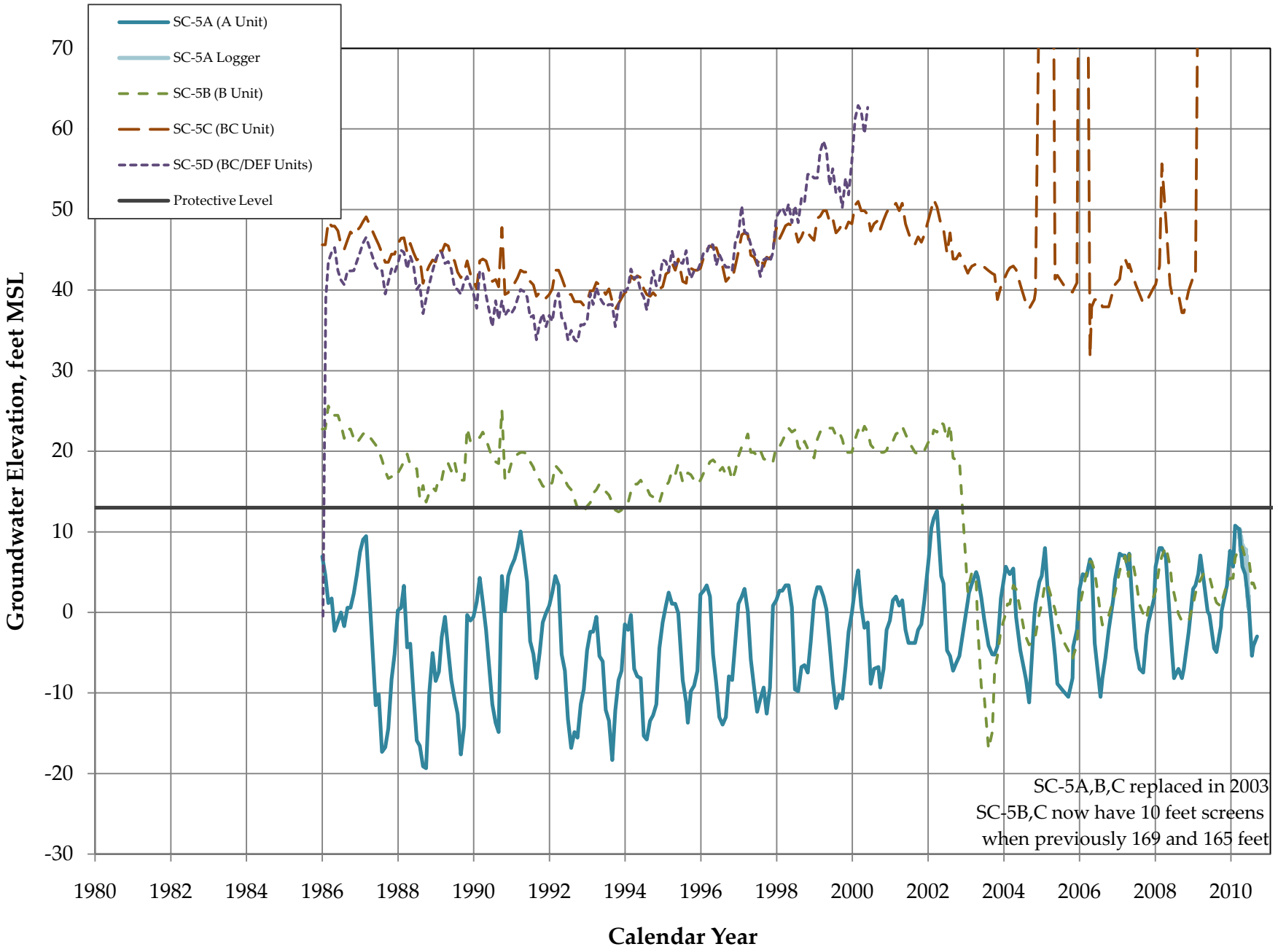
Hydrographs of SqWCD Inland Monitoring Well Clusters

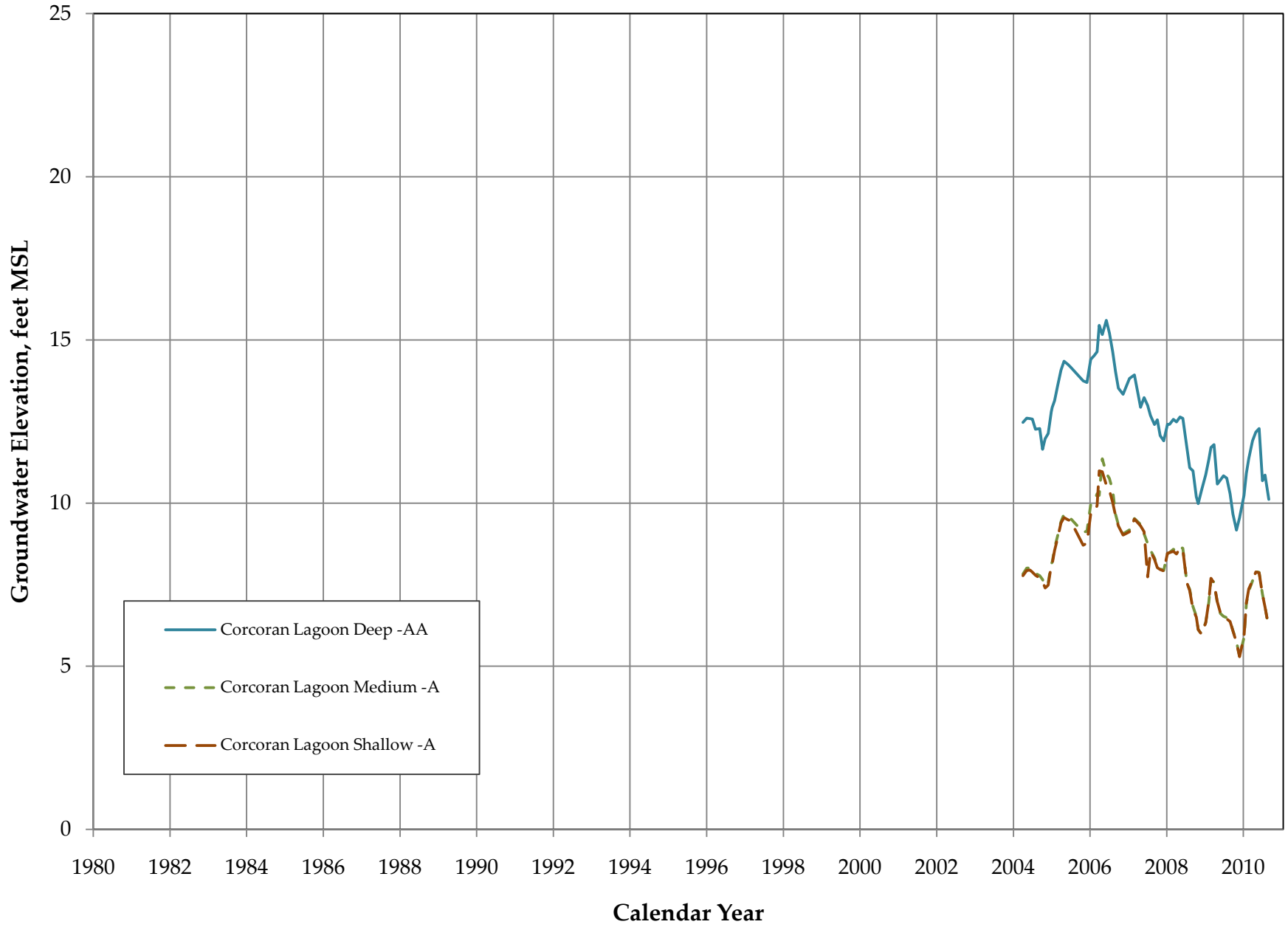
Hydrographs of City of Santa Cruz Inland Monitoring Well Clusters

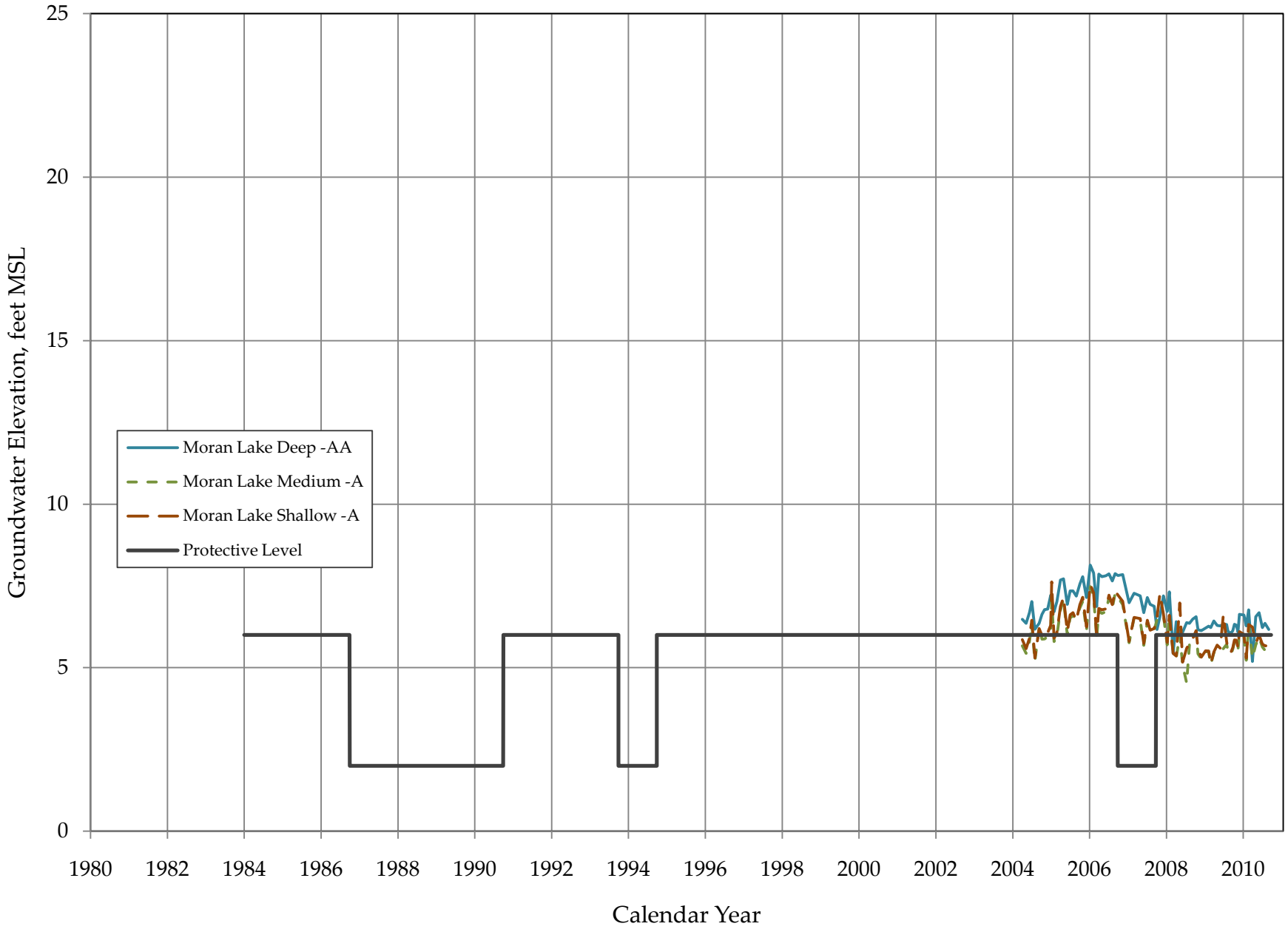
Hydrographs of SqCWD Monitoring Wells Adjacent to Production Wells

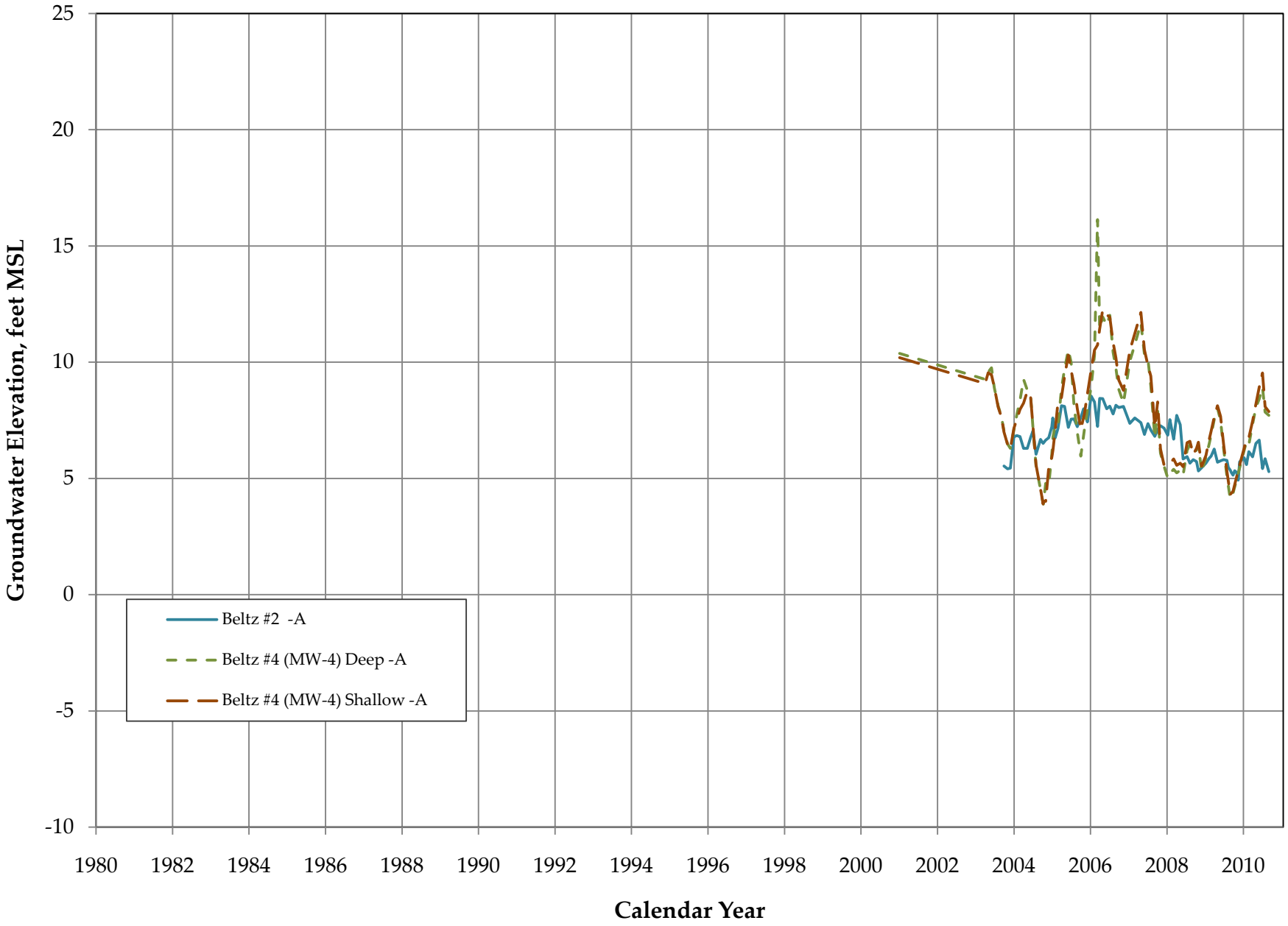

Groundwater Elevation, feet MSL
70
60
50
40
30
20
10
0
-10
-20
-30
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-1A (A/B Units)
SC-1A Logger
SC-1B (B Unit)
SC-1B Logger
Protective Level

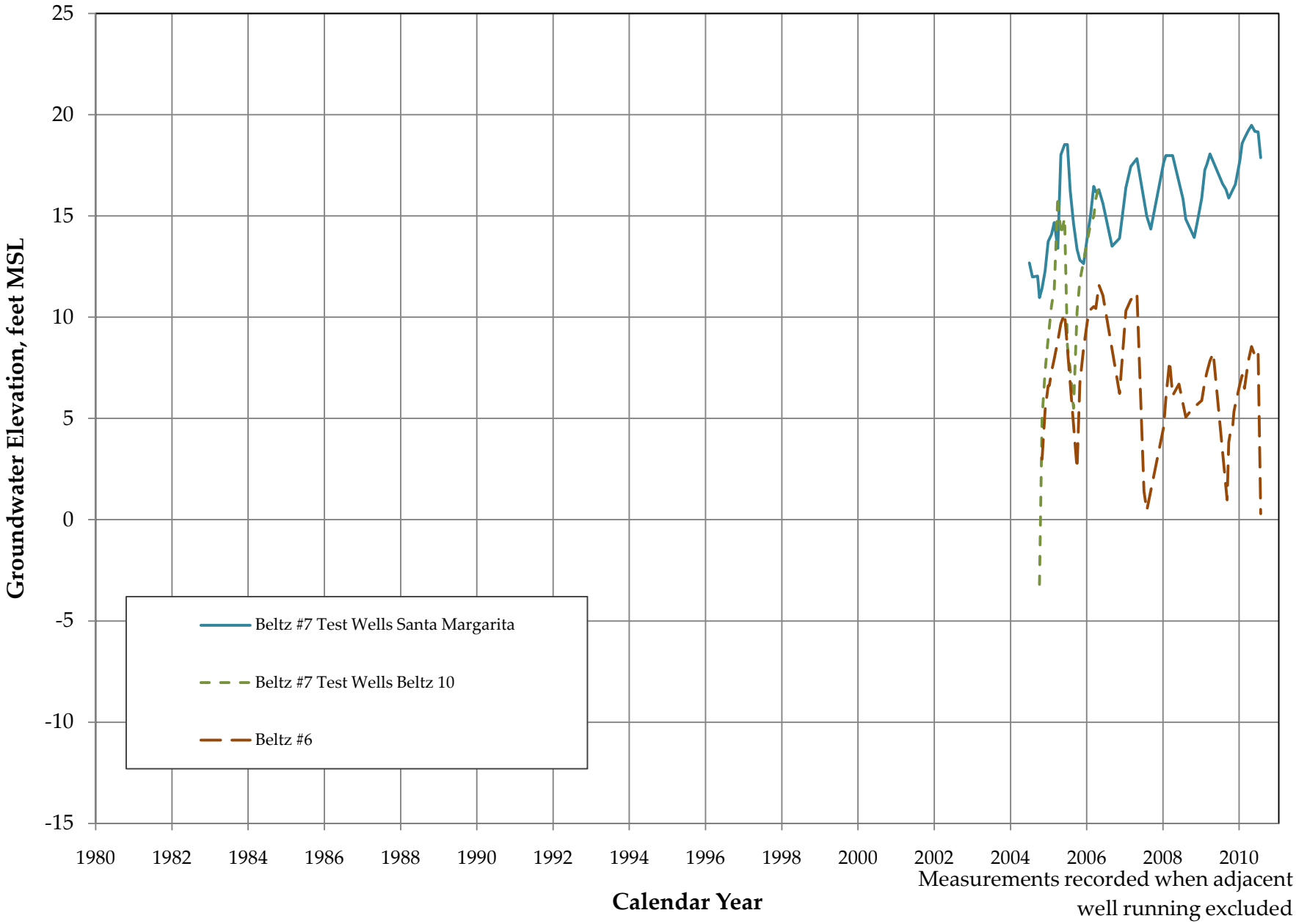

Groundwater Elevation, feet MSL
70
60
50
40
30
20
10
0
-10
-20
-30
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2010
Calendar Year
SC-3A (AA/A Units)
SC-3RA Logger
SC-3B (B Unit)
SC-3RB Logger
SC-3C (B/BC Units)
SC-3RC Logger
Protective Level
Wells replaced in 2009

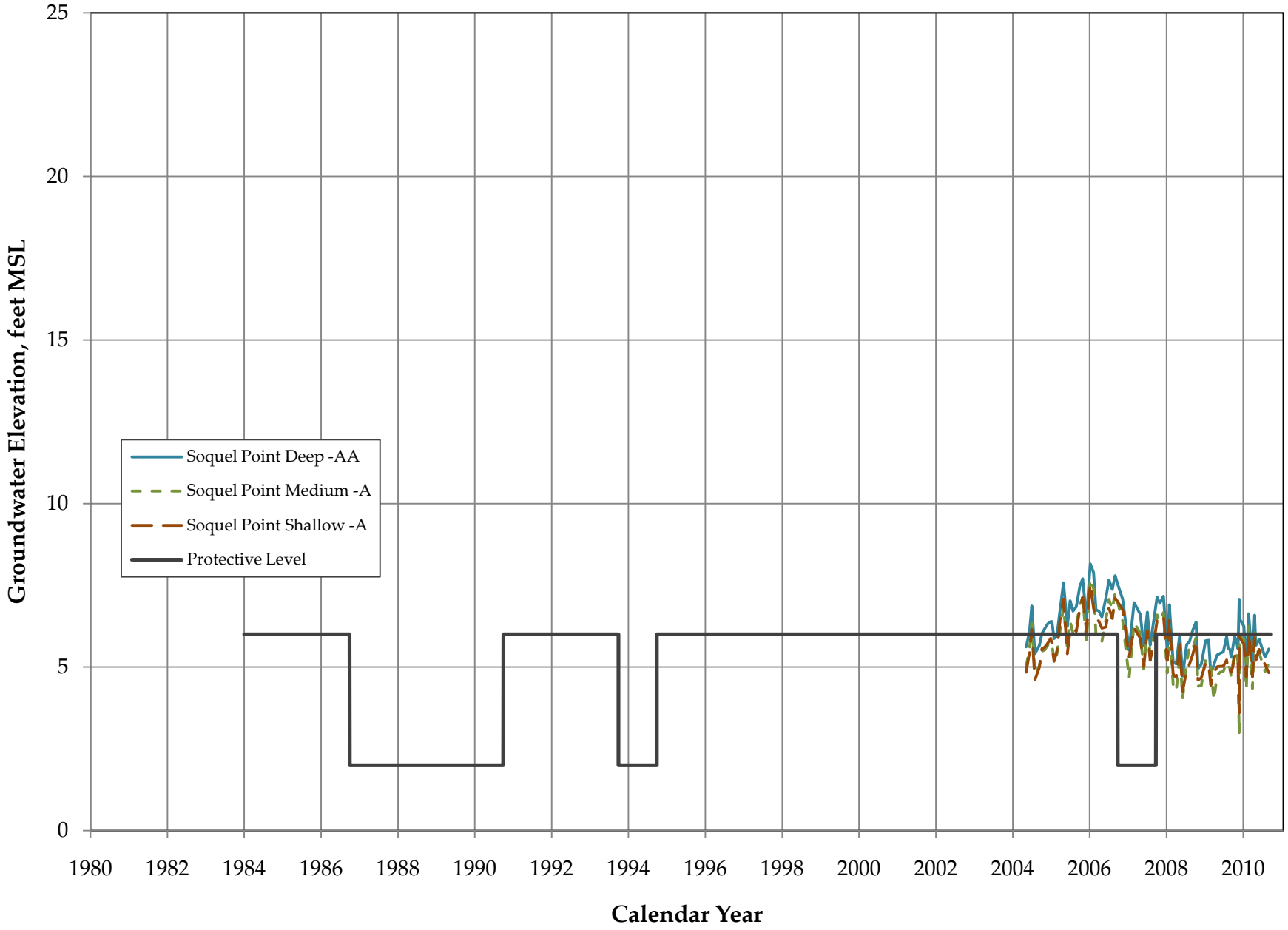

SC-5A (A Unit)
SC-5A Logger
SC-5B (B Unit)
SC-5C (BC Unit)
SC-5D (BC/DEF Units)
Protective Level
Groundwater Elevation, feet MSL
70
60
50
40
30
20
10
0
-10
-20
-30
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-5A,B,C replaced in 2003
SC-5B,C now have 10 feet screens
when previously 169 and 165 feet

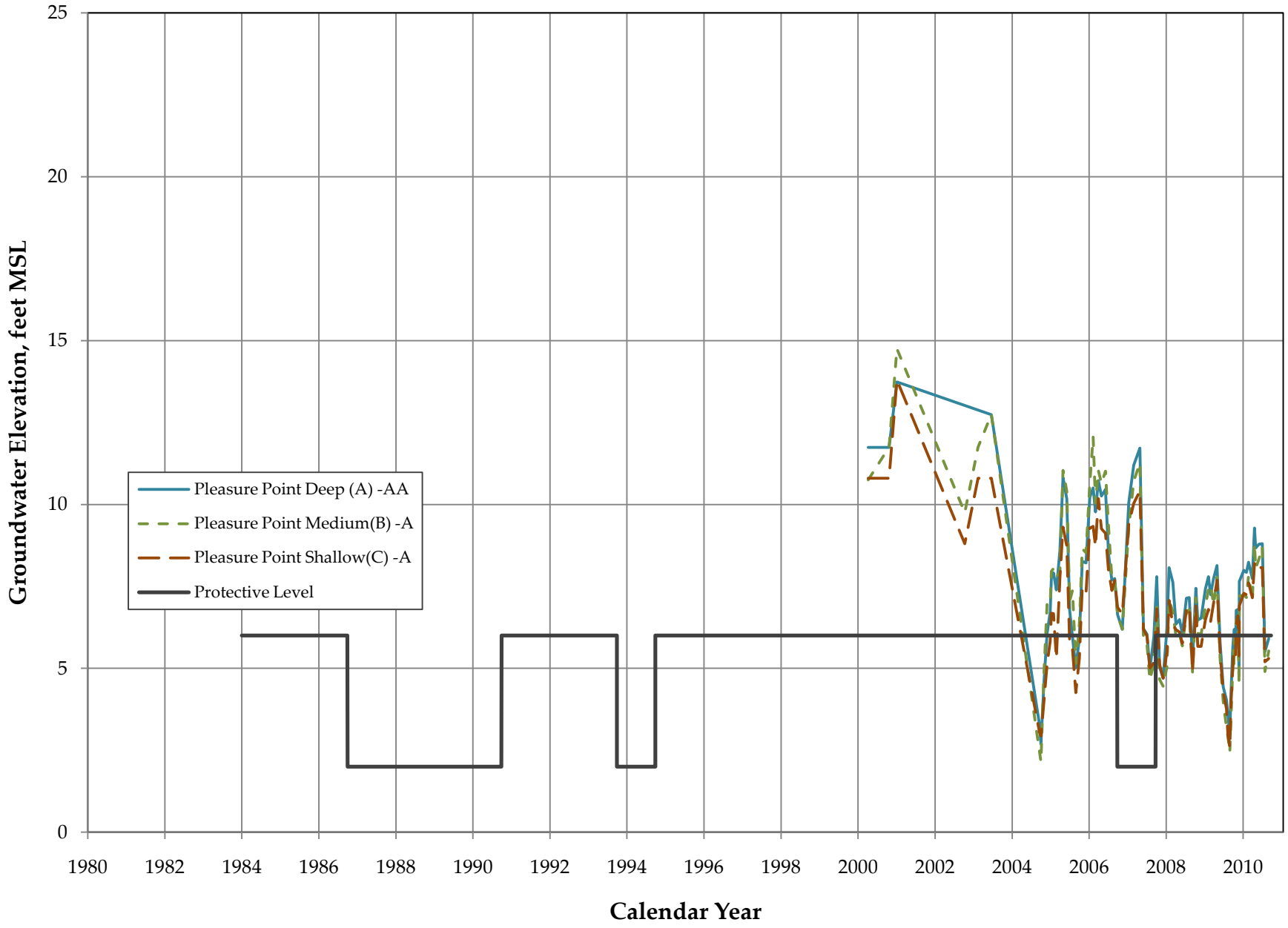

Groundwater Elevation, feet MSL
25
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Corcoran Lagoon Deep -AA
Corcoran Lagoon Medium -A
Corcoran Lagoon Shallow -A

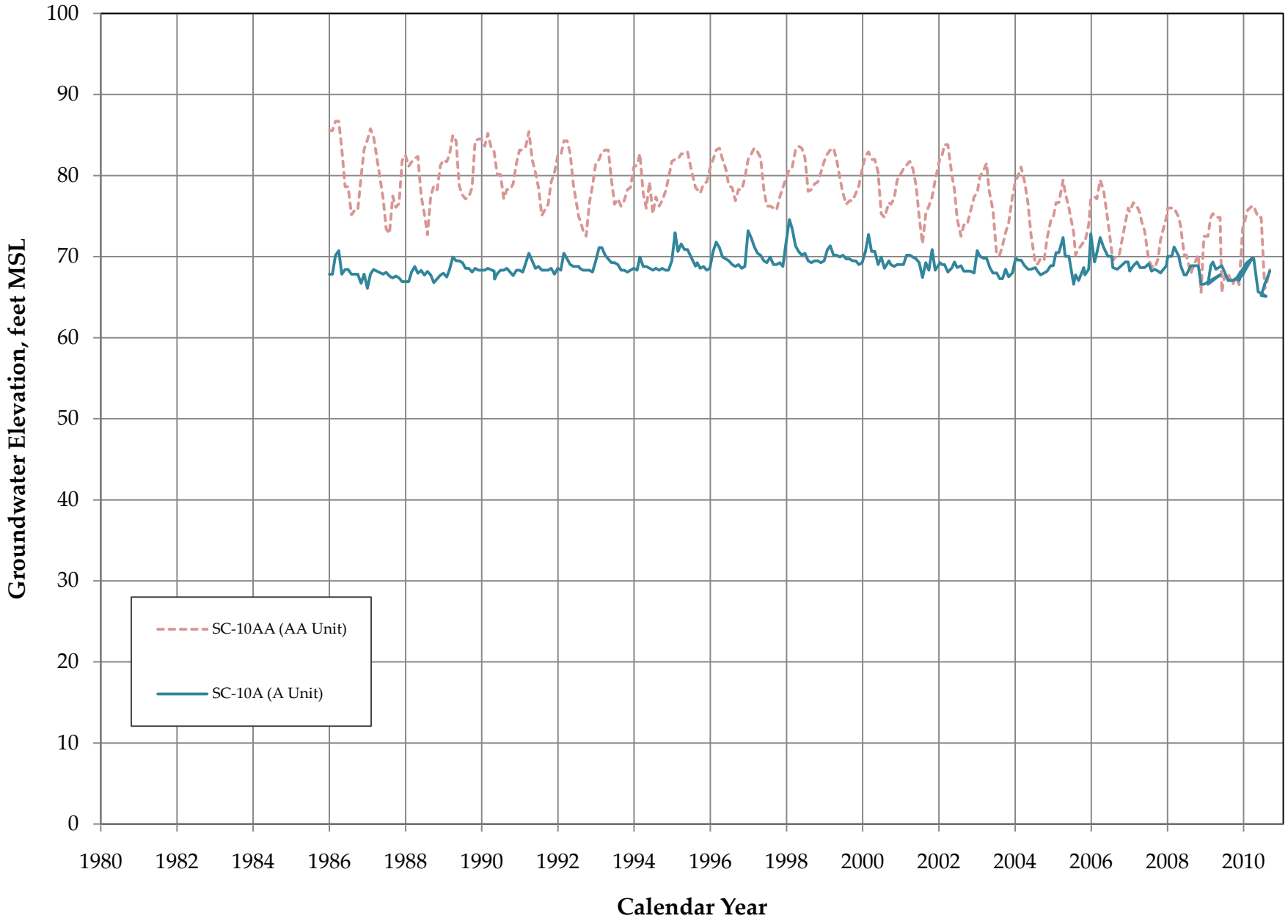

Groundwater Elevation, feet MSL
25
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Moran Lake Deep -AA
Moran Lake Medium -A
Moran Lake Shallow -A
Protective Level


Groundwater Elevation, feet MSL
25
20
15
10
5
0
-5
-10
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Beltz #2 -A
Beltz #4 (MW-4) Deep -A
Beltz #4 (MW-4) Shallow -A

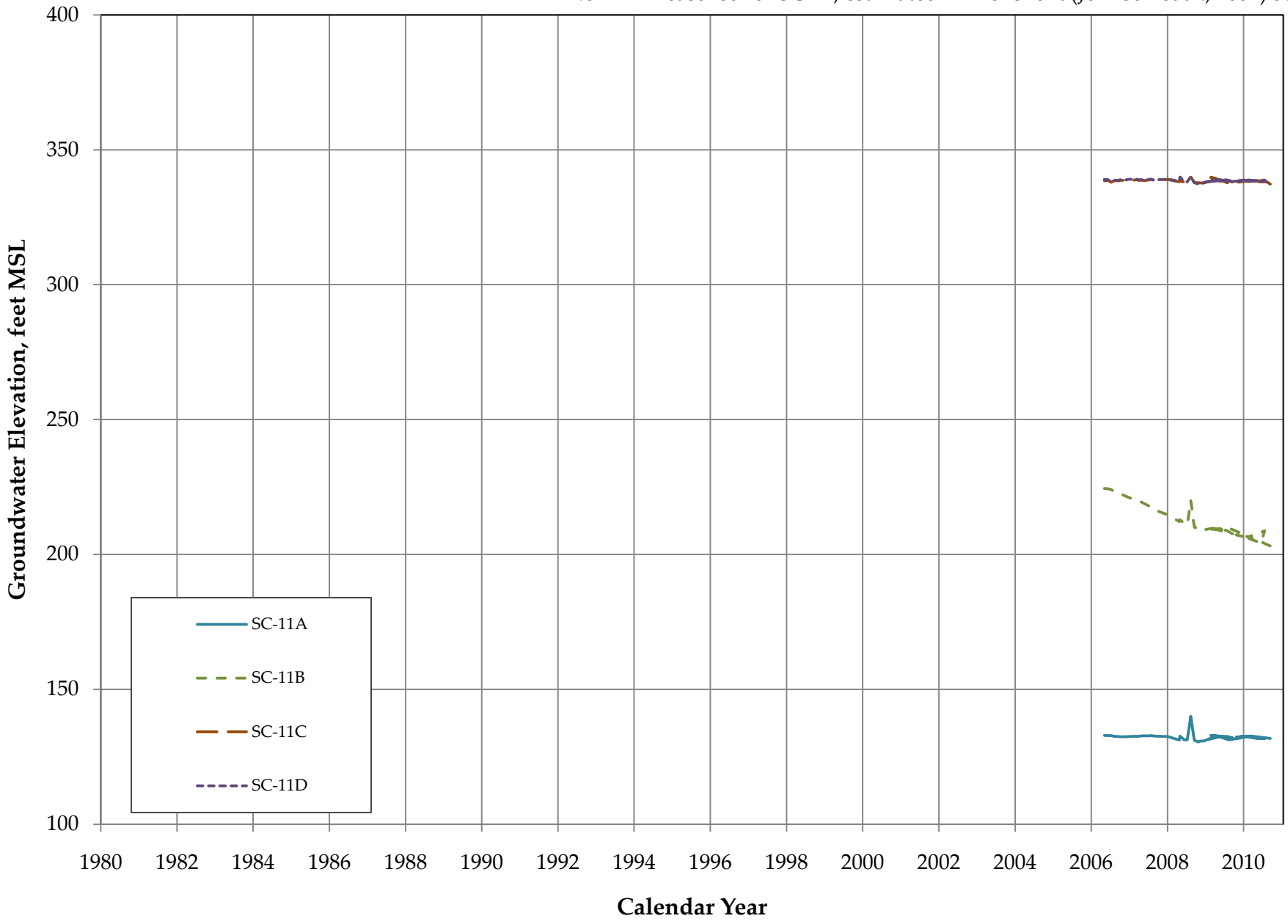

Groundwater Elevation, feet MSL
25
20
15
10
5
0
-5
-10
-15
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Beltz #7 Test Wells Santa Margarita
Beltz #7 Test Wells Beltz 10
Beltz #6
Measurements recorded when adjacent well running excluded

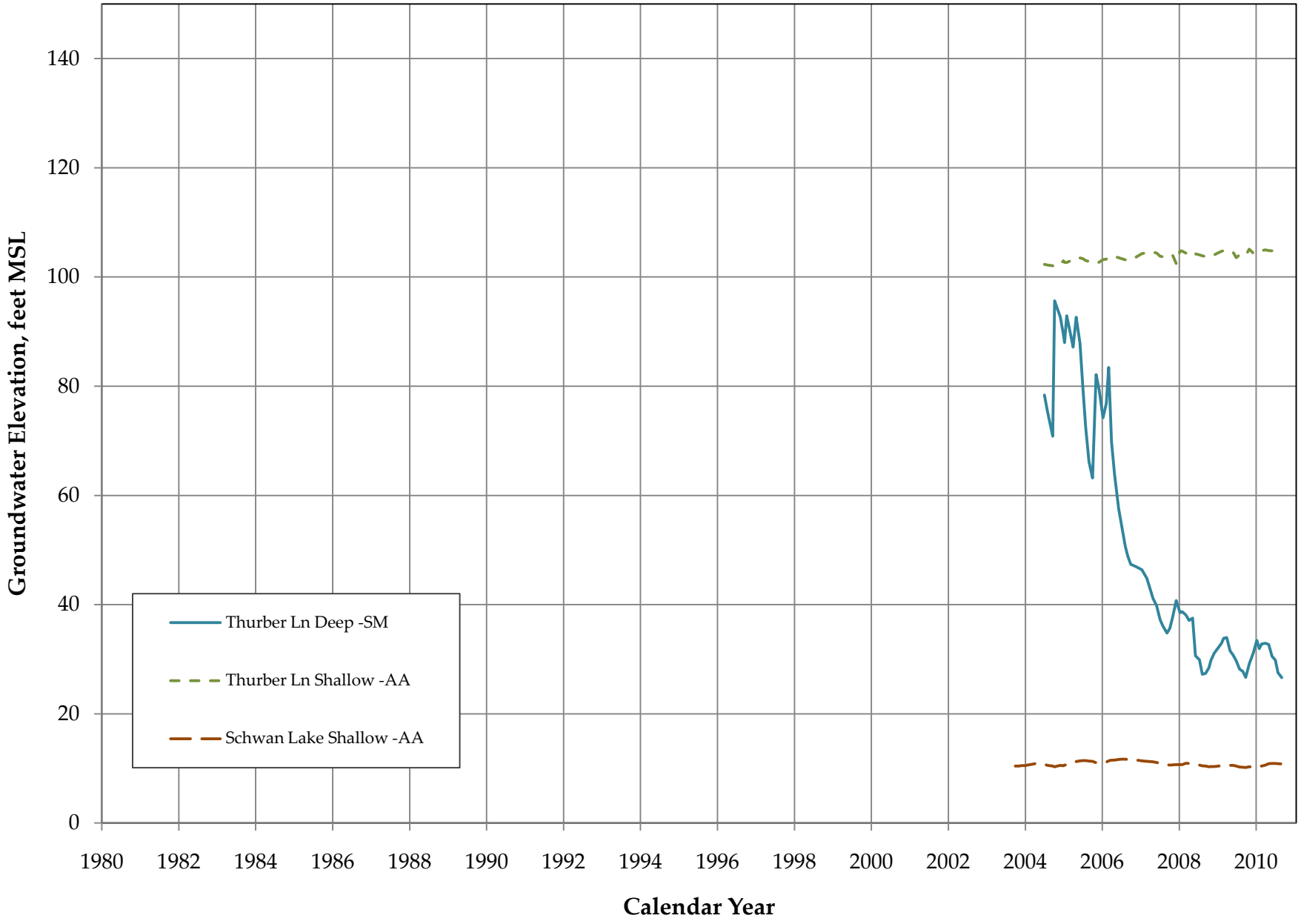

Groundwater Elevation, feet MSL
25
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Soquel Point Deep -AA
Soquel Point Medium -A
Soquel Point Shallow -A
Protective Level

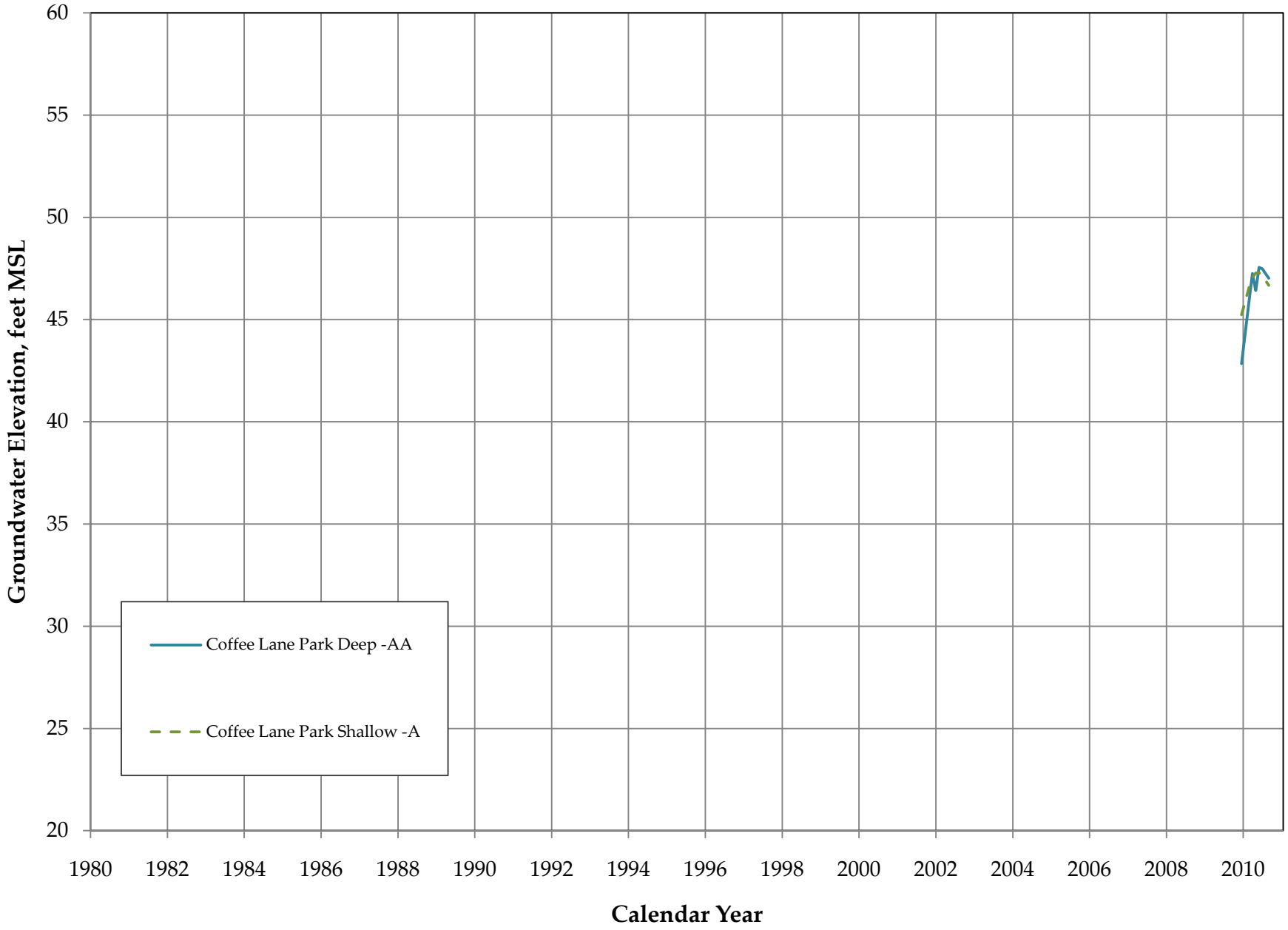

Groundwater Elevation, feet MSL
25
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Pleasure Point Deep (A) -AA
Pleasure Point Medium(B) -A
Pleasure Point Shallow(C) -A
Protective Level

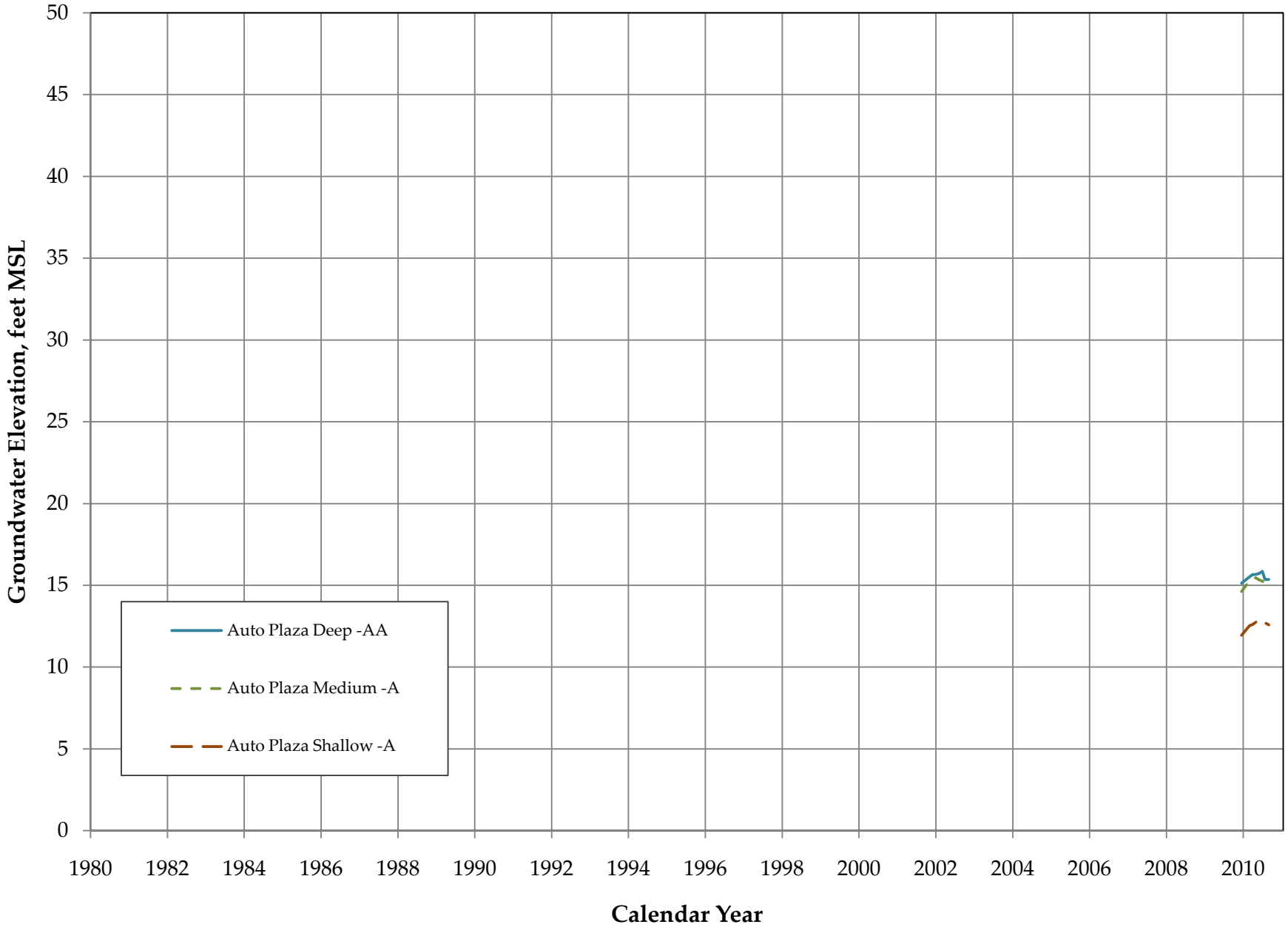

Groundwater Elevation, feet MSL
100
90
80
70
60
50
40
30
20
10
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-10AA (AA Unit)
SC-10A (A Unit)

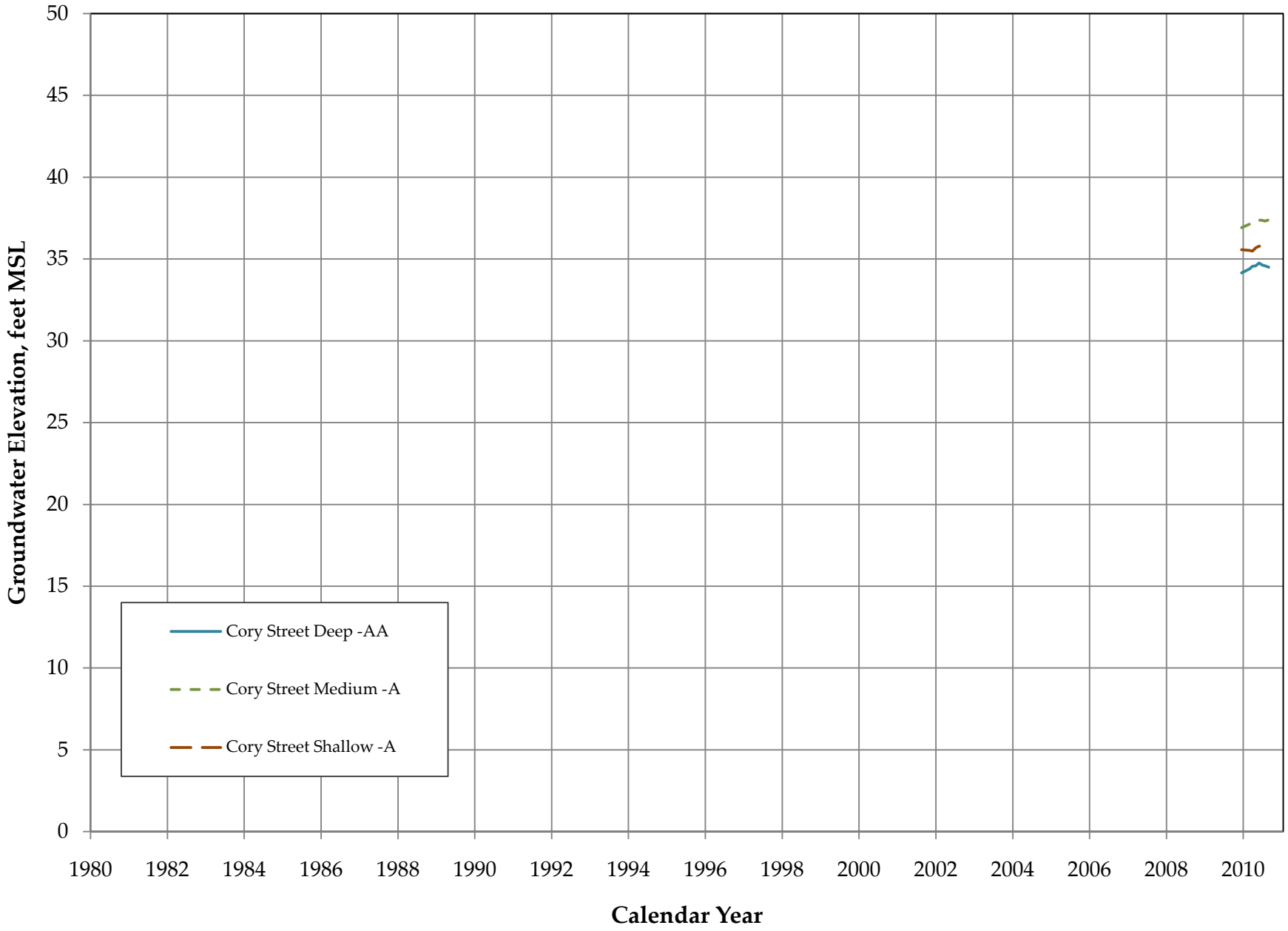
No RPE measured for SC-11, estimated RPE of 520 ft (Johnson et al., 2004) used

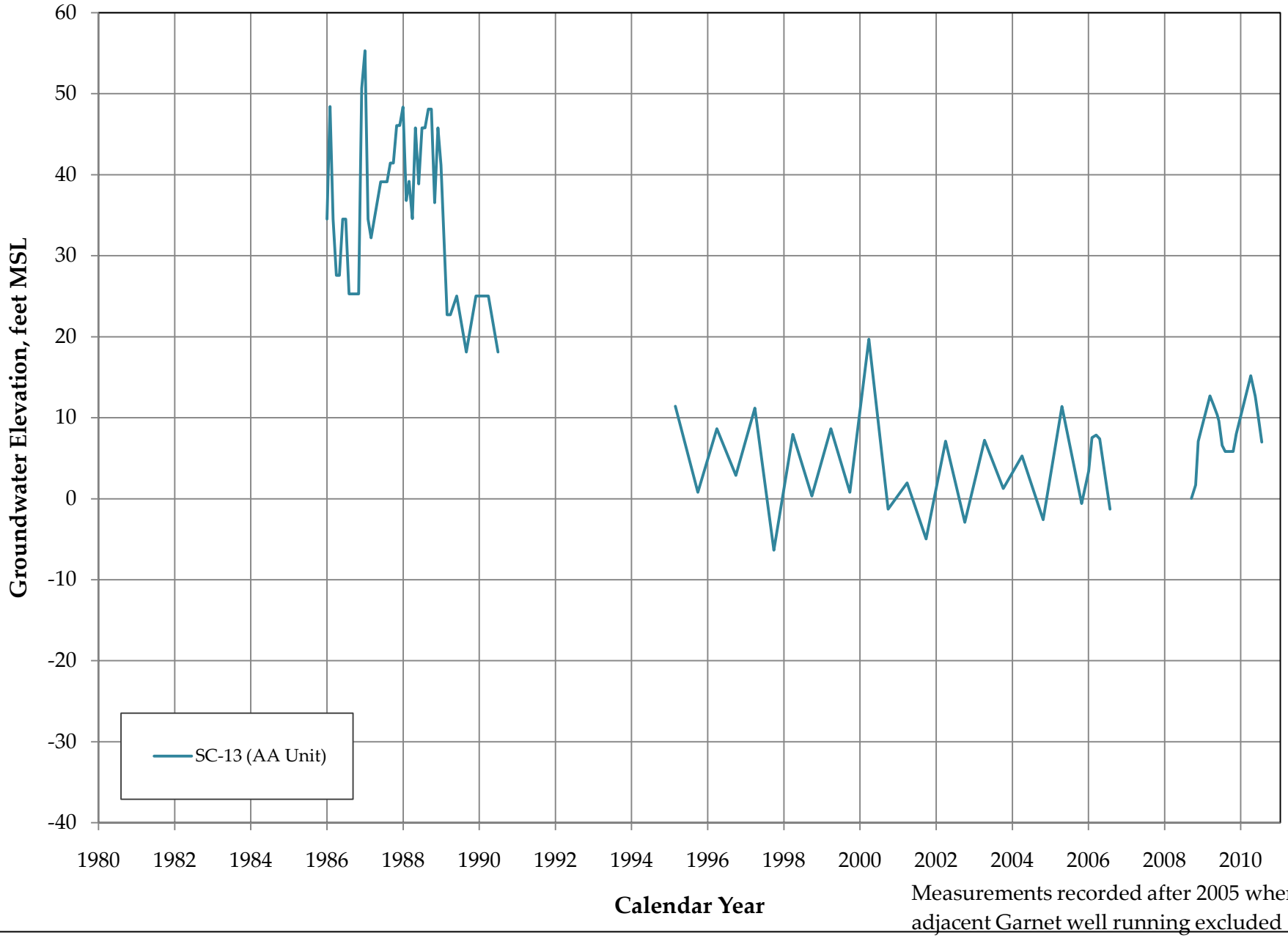



Groundwater Elevation, feet MSL
140
120
100
80
60
40
20
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Thurber Ln Deep -SM
Thurber Ln Shallow -AA
Schwan Lake Shallow -AA

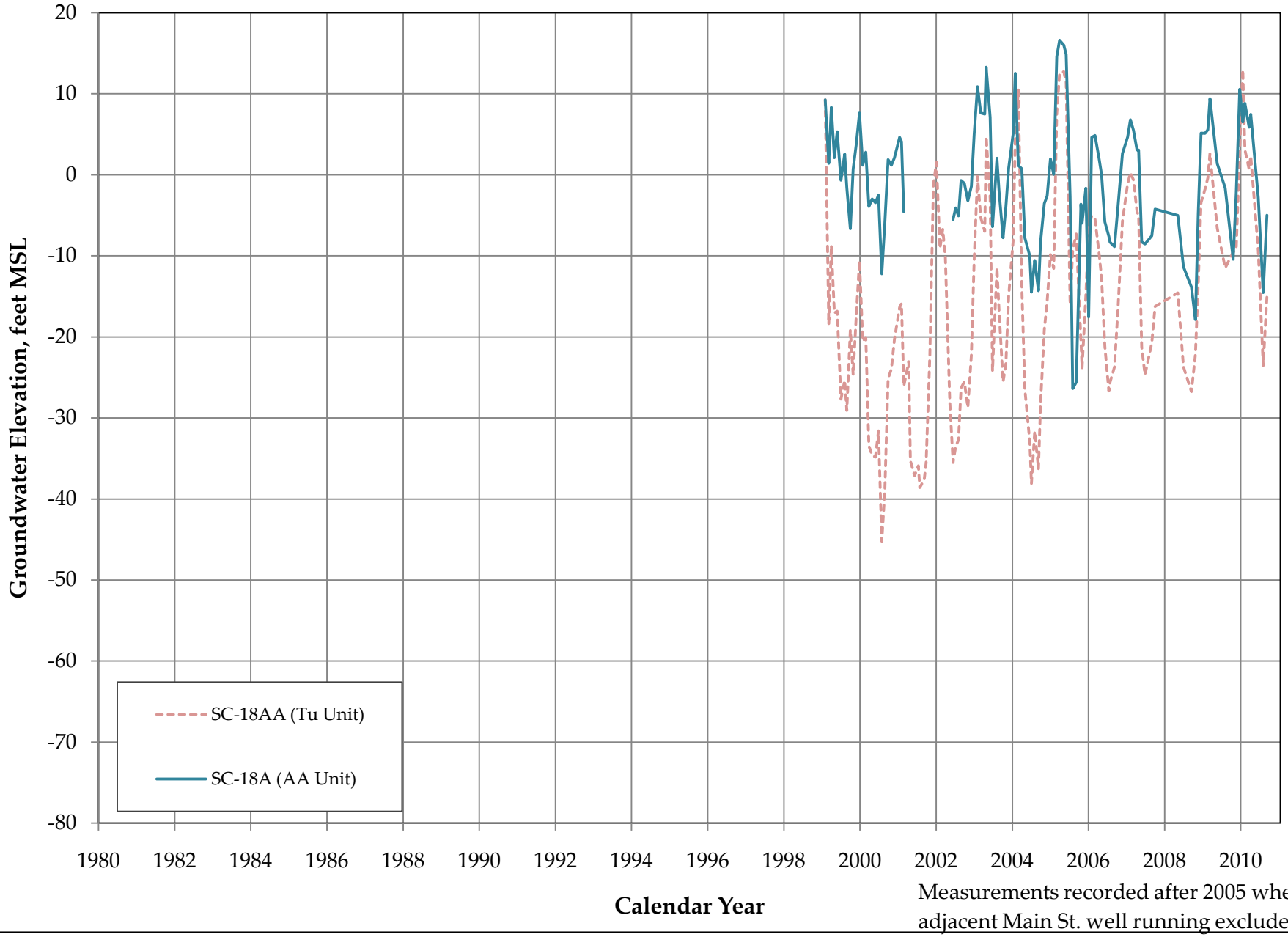

Groundwater Elevation, feet MSL
60
55
50
45
40
35
30
25
20
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Coffee Lane Park Deep -AA
Coffee Lane Park Shallow -A

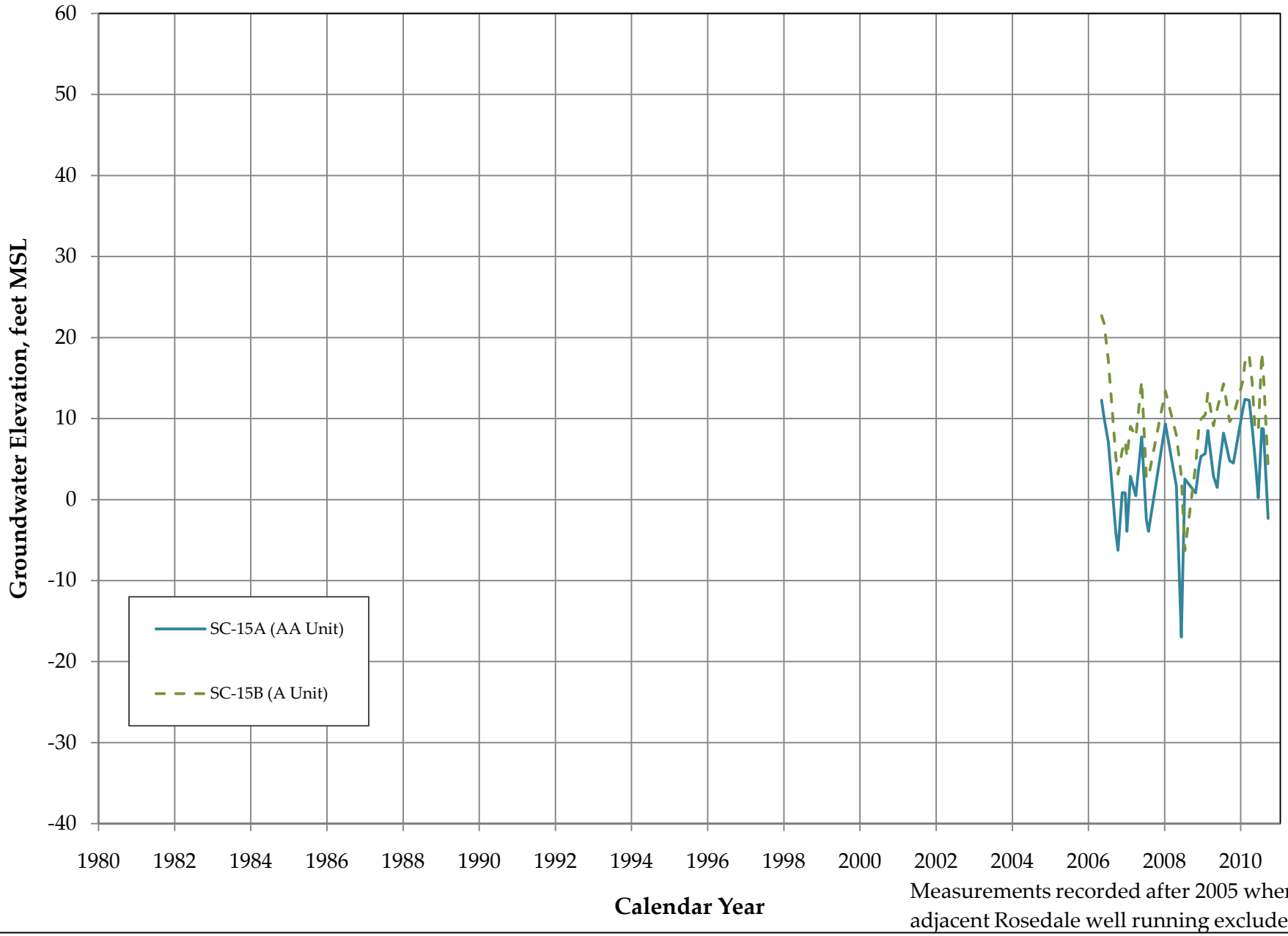

Groundwater Elevation, feet MSL
50
45
40
35
30
25
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Auto Plaza Deep -AA
Auto Plaza Medium -A
Auto Plaza Shallow -A


Groundwater Elevation, feet MSL
50
45
40
35
30
25
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Cory Street Deep -AA
Cory Street Medium -A
Cory Street Shallow -A



Measurements recorded after 2005 when adjacent Garnet well running excluded


Groundwater Elevation, feet MSL
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-18AA (Tu Unit)
SC-18A (AA Unit)
Measurements recorded after 2005 when adjacent Main St. well running excluded


60
50
40
30
20
10
0
-10
-20
-30
-40
Groundwater Elevation, feet MSL
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-15A (AA Unit)
SC-15B (A Unit)
Measurements recorded after 2005 when adjacent Rosedale well running excluded

Chemographs and Single Well Hydrographs for Western Purisima Area

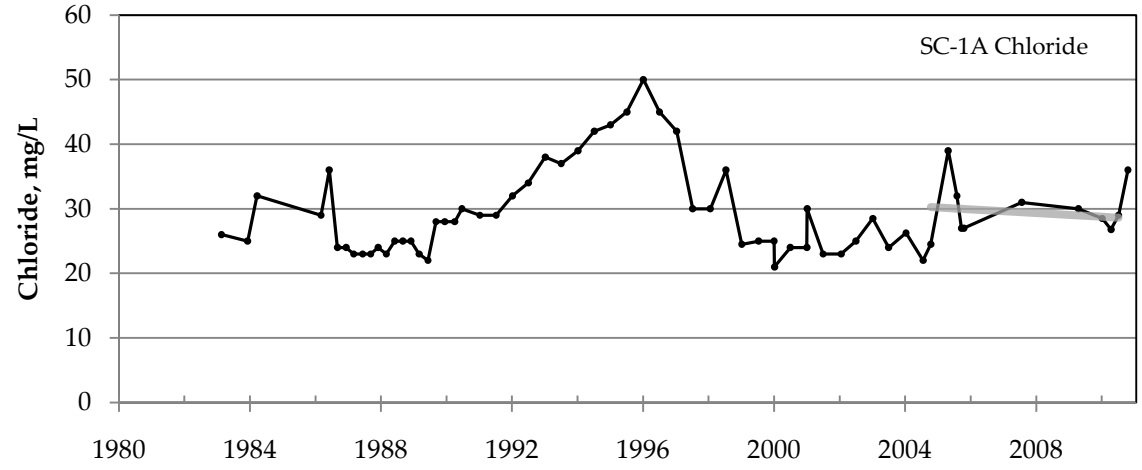
Graphs of SqCWD Coastal Monitoring Well Clusters

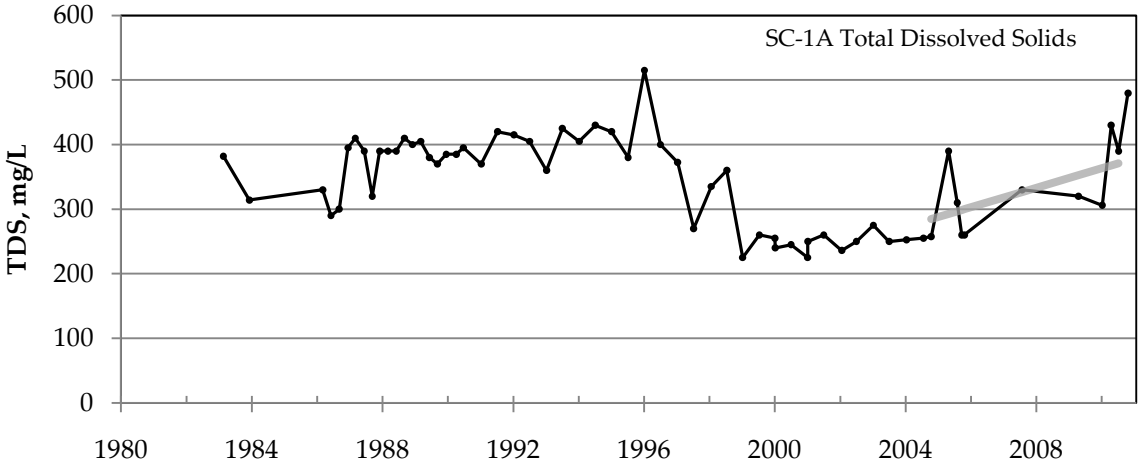
Graphs of City of Santa Cruz Coastal Monitoring Well Clusters

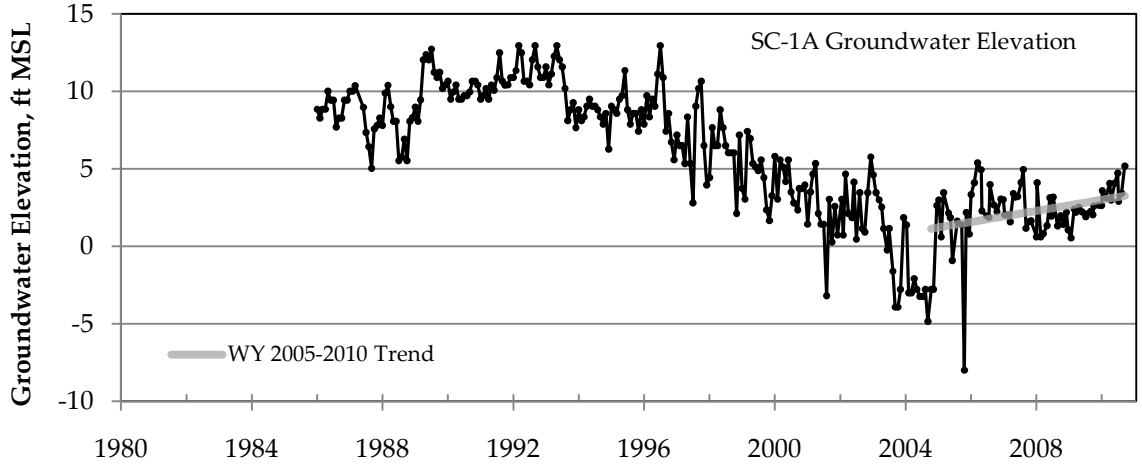
Graphs of SqWCD Inland Monitoring Well Clusters

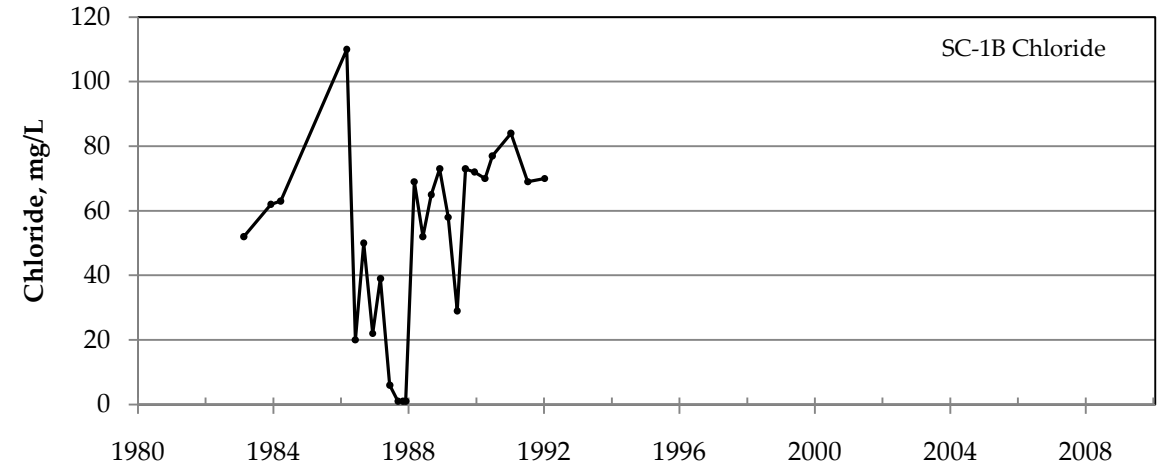
Graphs of City of Santa Cruz Inland Monitoring Well Clusters

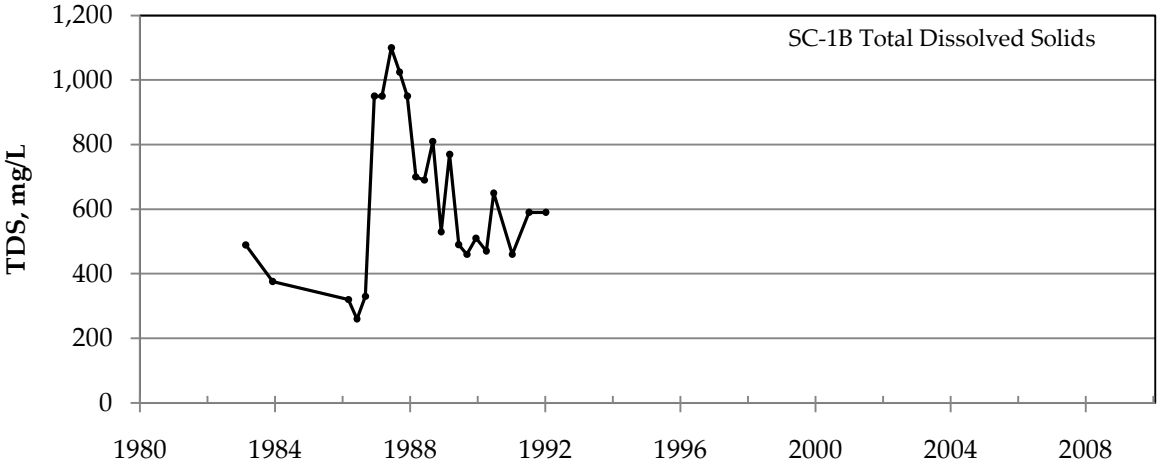
Graphs of SqCWD Production Wells and Monitoring Wells Adjacent to Production Wells

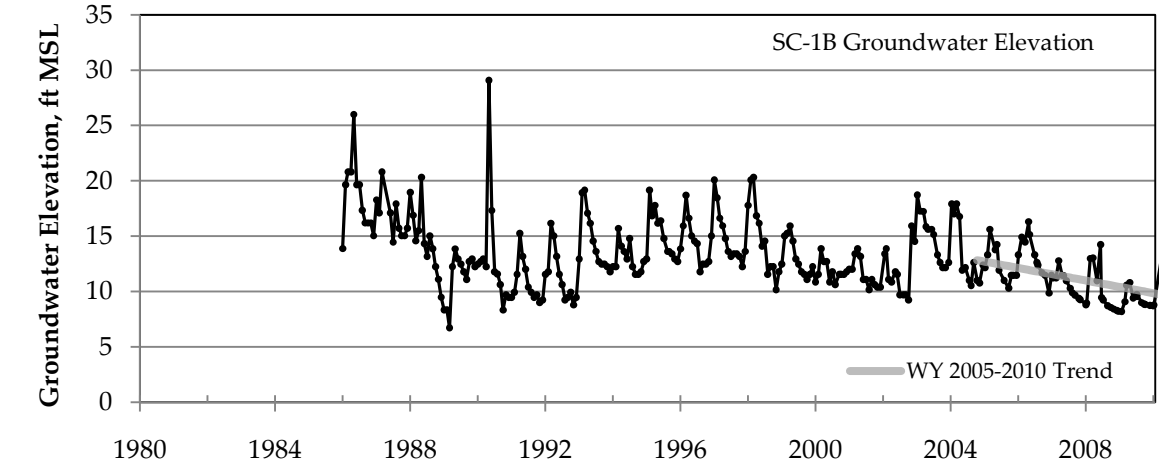

SC-1A Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

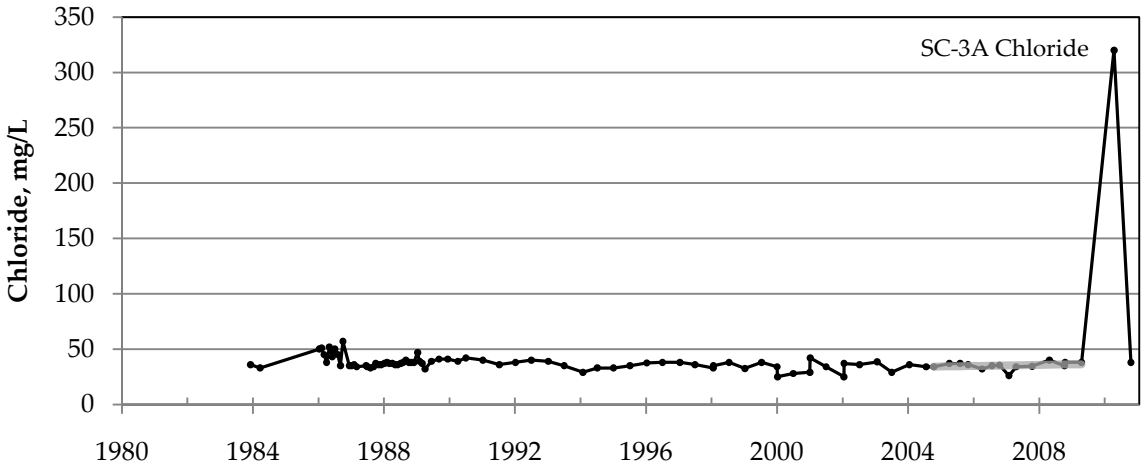

SC-1A Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

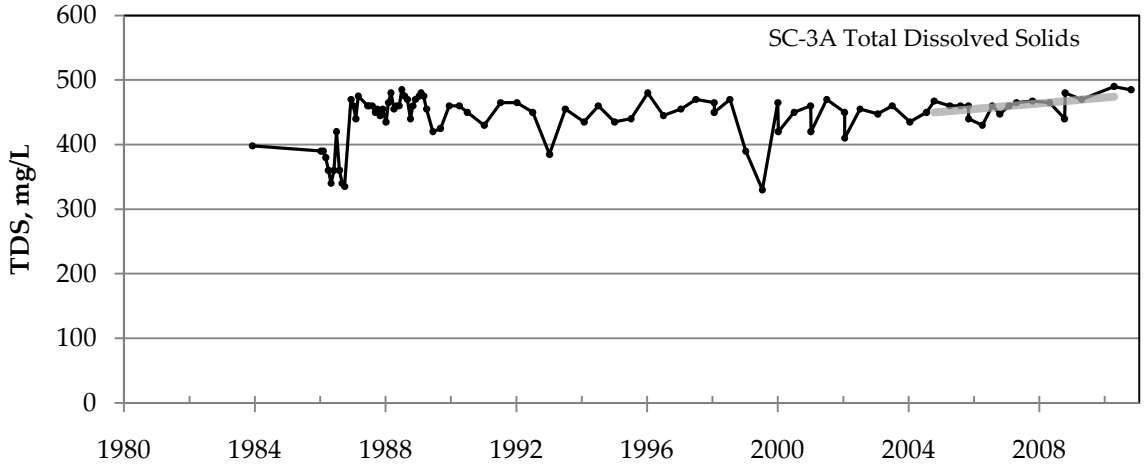

SC-1A Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

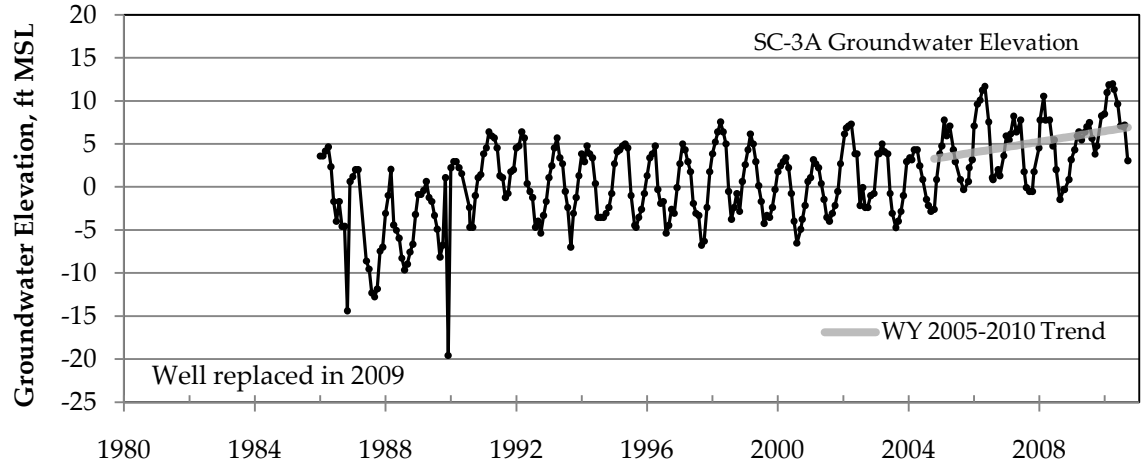

SC-1B Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

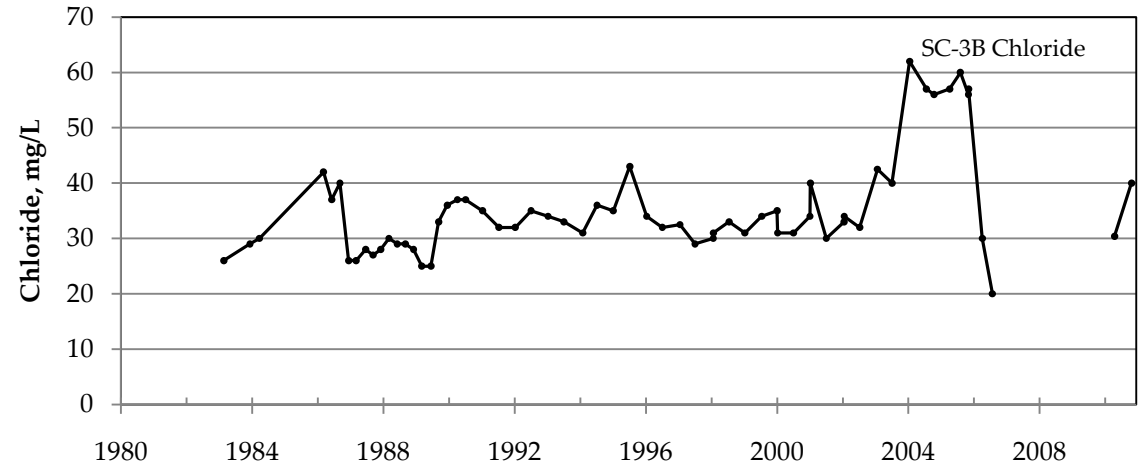

SC-1B Total Dissolved Solids
TDS, mg/L
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

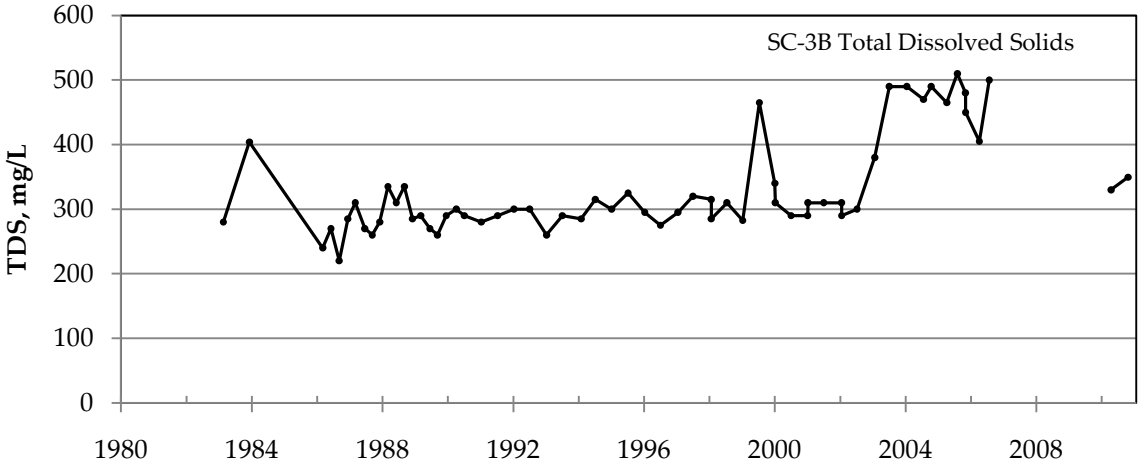

SC-1B Groundwater Elevation
Groundwater Elevation, ft MSL
35
30
25
20
15
10
5
0
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

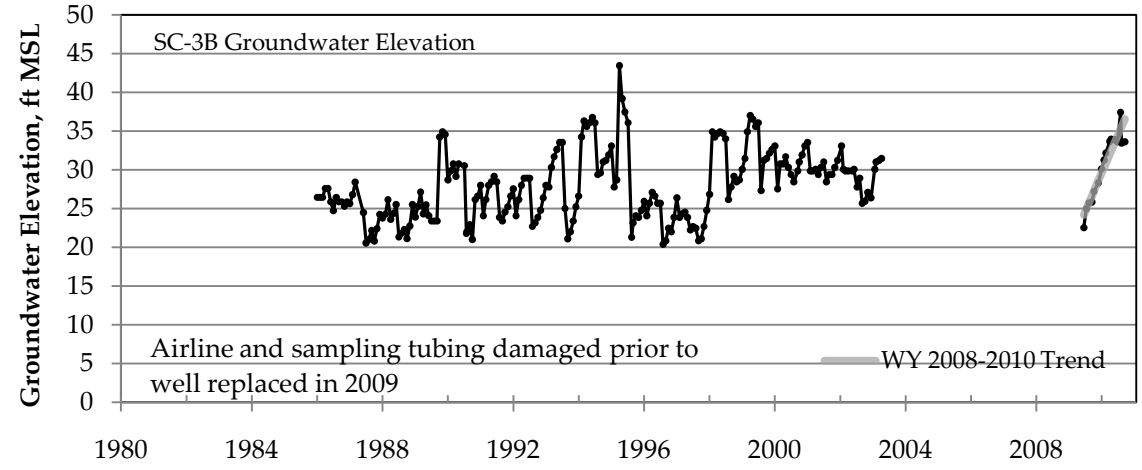

SC-3A Chloride
Chloride, mg/L
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

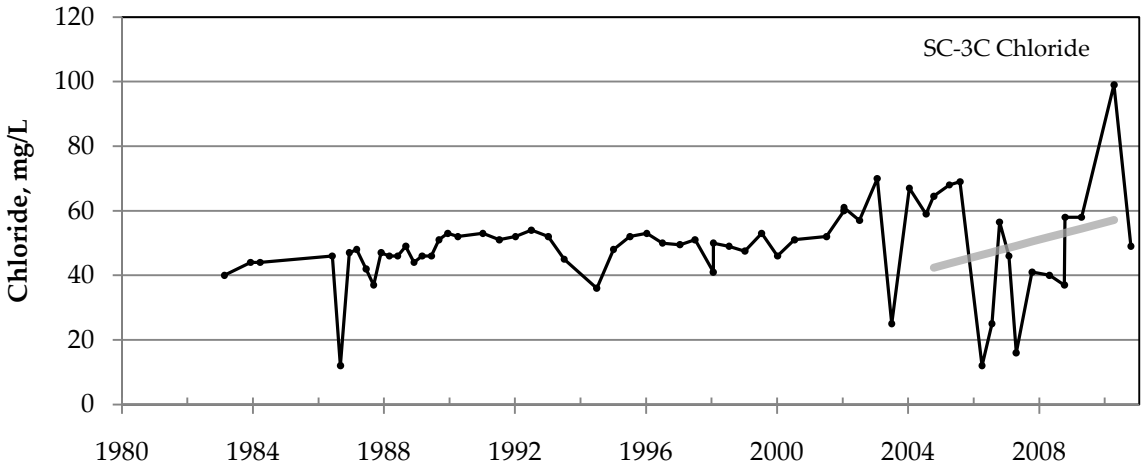

SC-3A Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

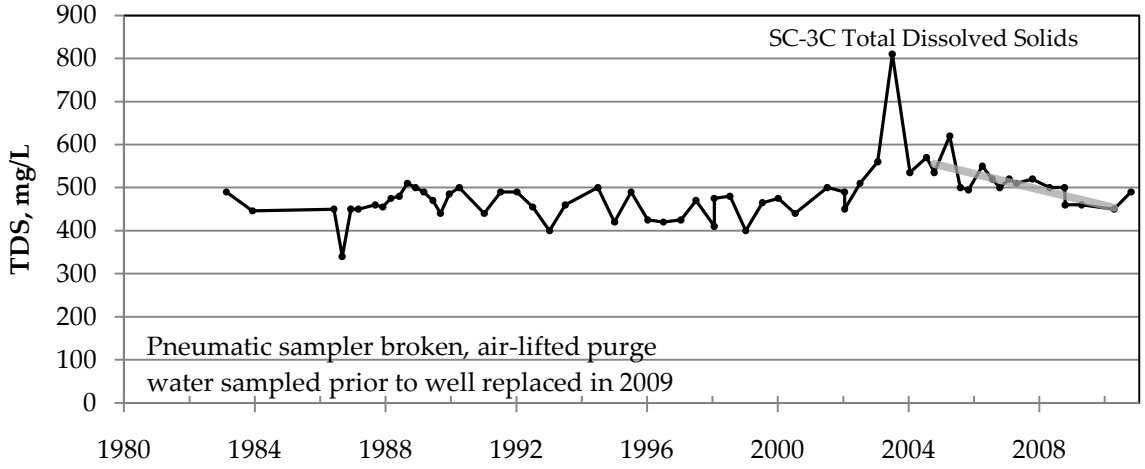

SC-3A Groundwater Elevation
Groundwater Elevation, ft MSL
20
15
10
5
0
-5
-10
-15
-20
-25
WY 2005-2010 Trend
Well replaced in 2009
1980
1984
1988
1992
1996
2000
2004
2008

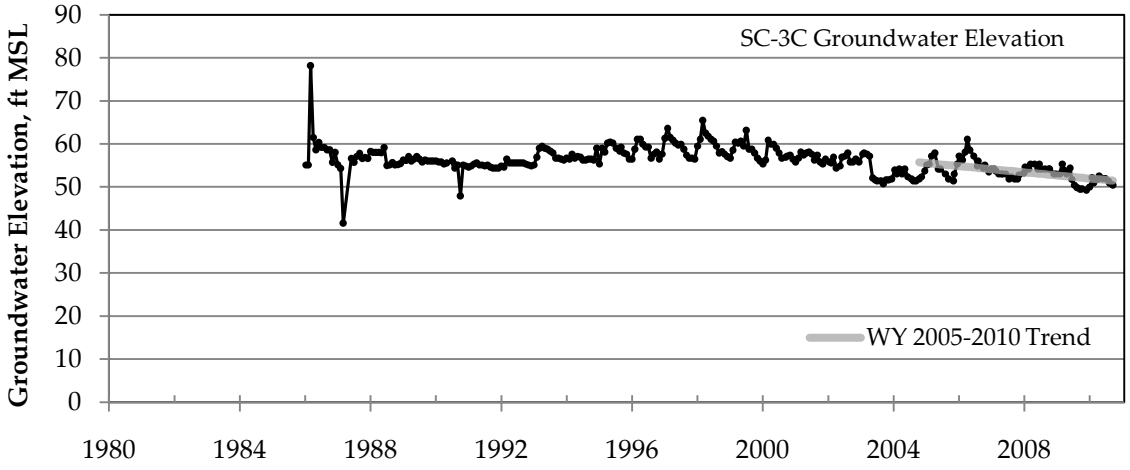

SC-3B Chloride
Chloride, mg/L
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

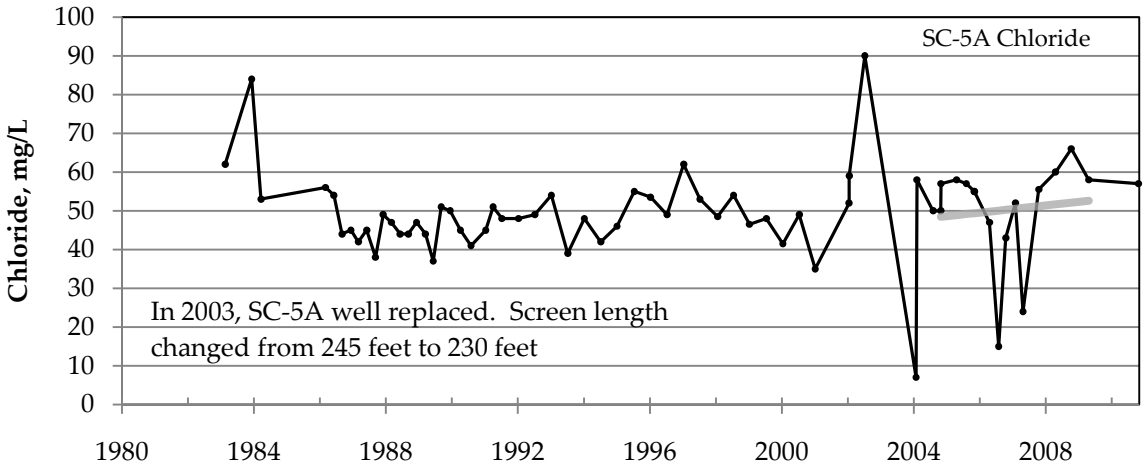

SC-3B Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

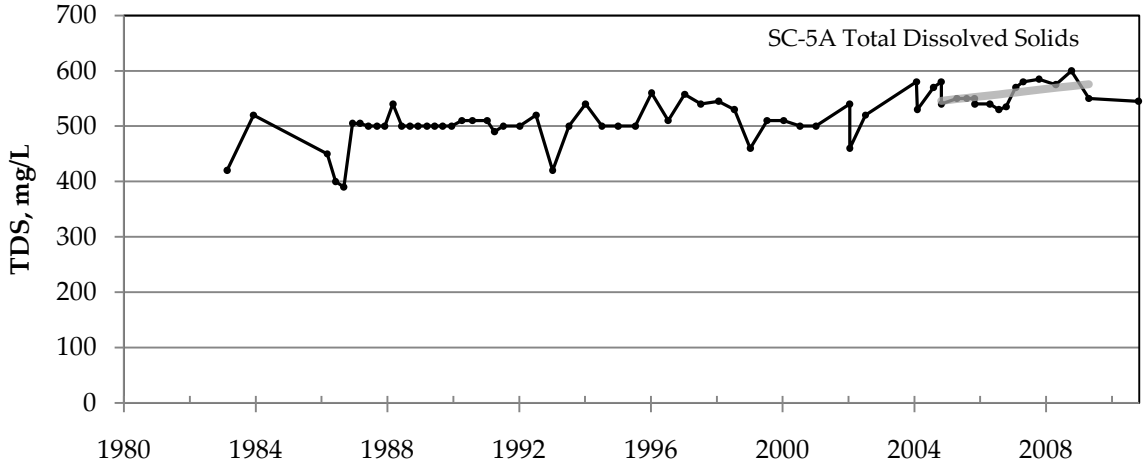

SC-3B Groundwater Elevation
Groundwater Elevation, ft MSL
50
45
40
35
30
25
20
15
10
5
0
Airline and sampling tubing damaged prior to well replaced in 2009
WY 2008-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

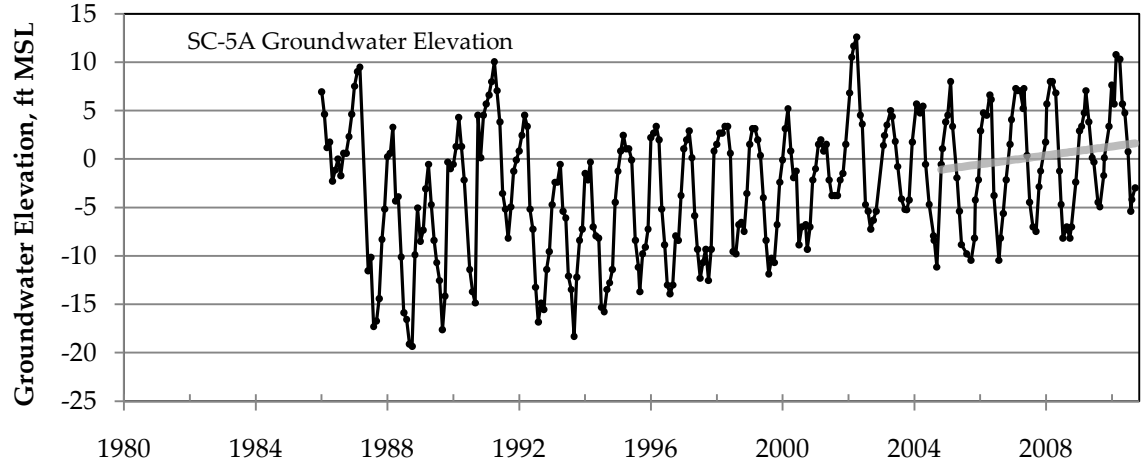

SC-3C Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

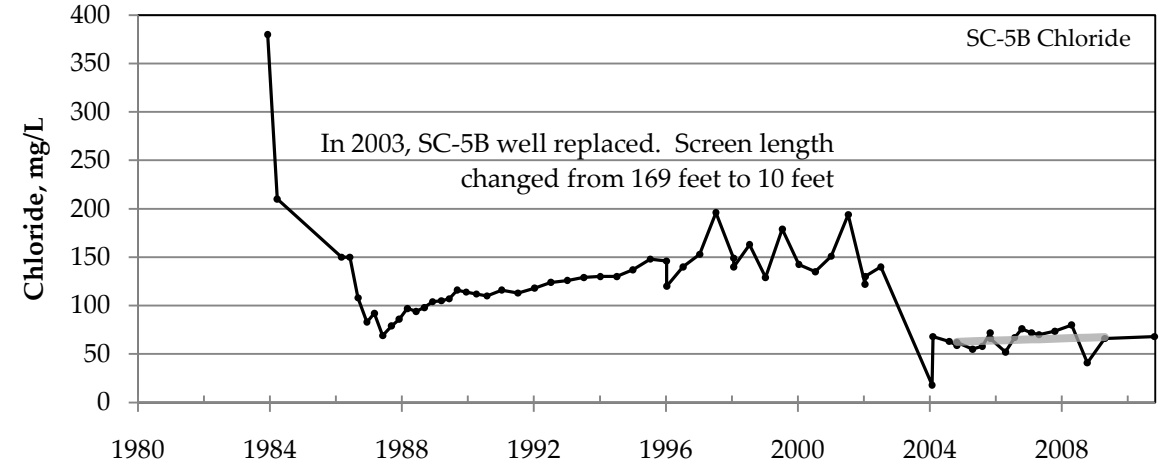

SC-3C Total Dissolved Solids
TDS, mg/L
900
800
700
600
500
400
300
200
100
0
Pneumatic sampler broken, air-lifted purge
water sampled prior to well replaced in 2009
1980
1984
1988
1992
1996
2000
2004
2008

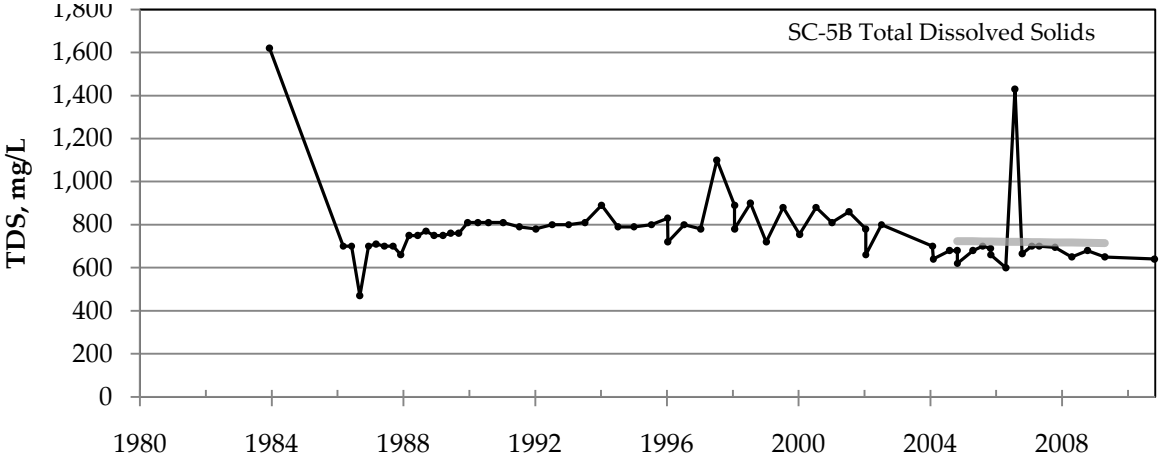

SC-3C Groundwater Elevation
Groundwater Elevation, ft MSL
90
80
70
60
50
40
30
20
10
0
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

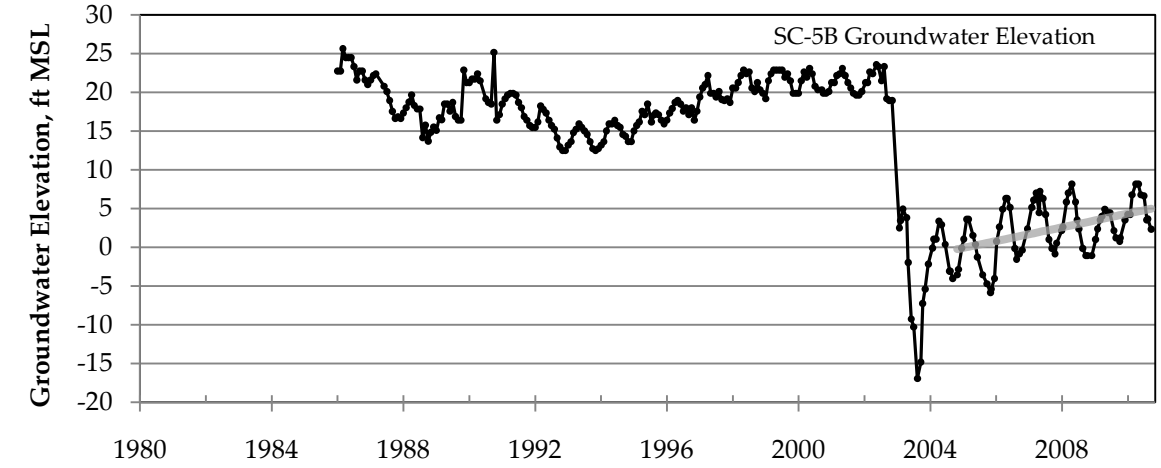

SC-5A Chloride
Chloride, mg/L
In 2003, SC-5A well replaced. Screen length changed from 245 feet to 230 feet
100
90
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

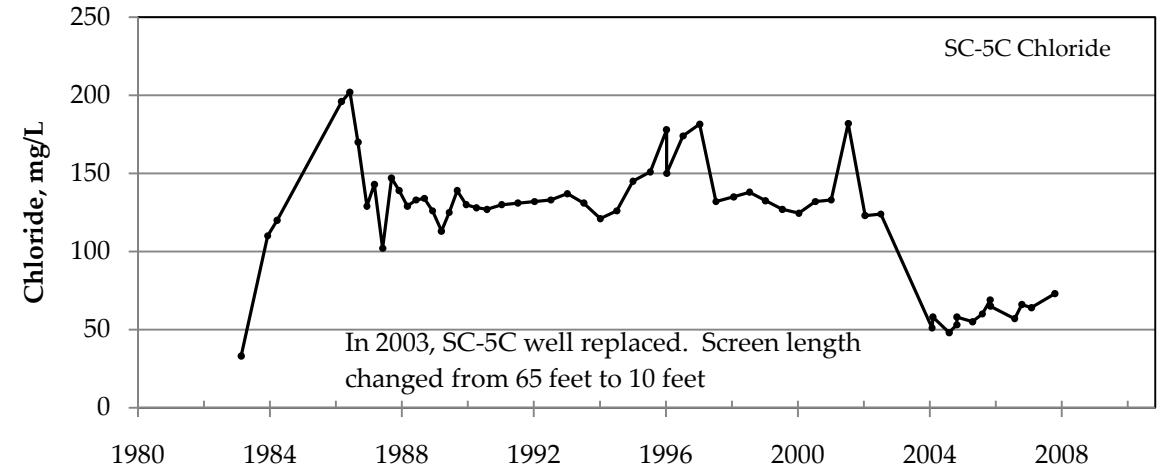

SC-5A Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

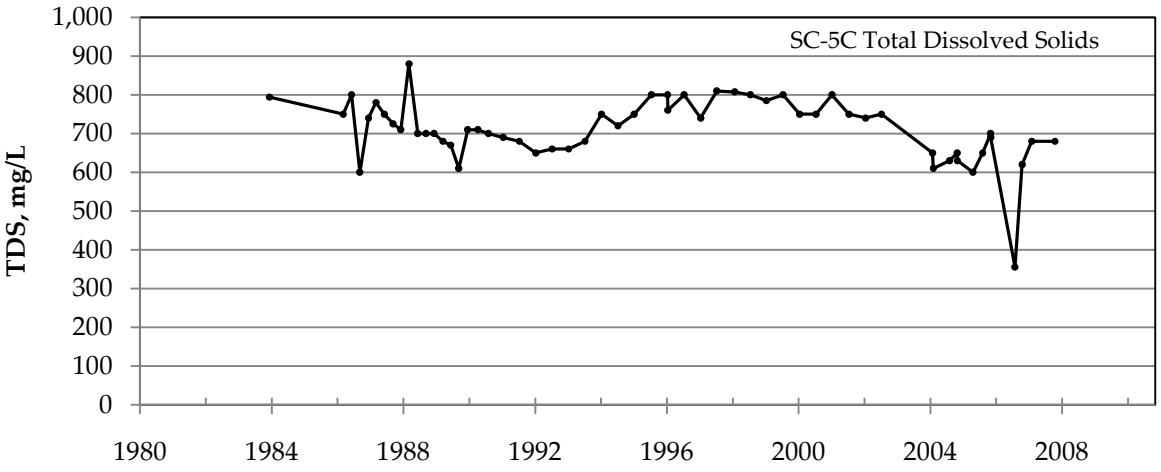

SC-5A Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
-25
1980
1984
1988
1992
1996
2000
2004
2008

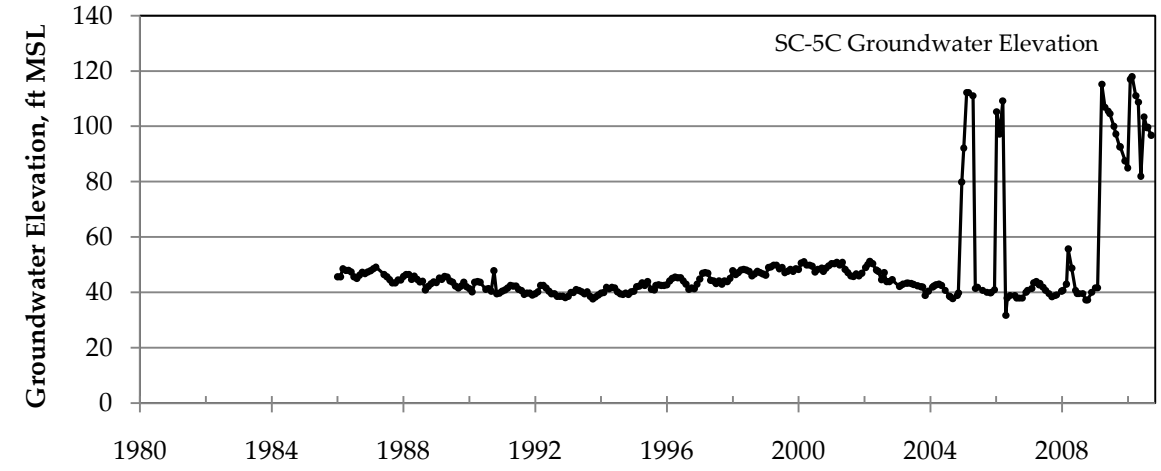

SC-5B Chloride
In 2003, SC-5B well replaced. Screen length changed from 169 feet to 10 feet
Chloride, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

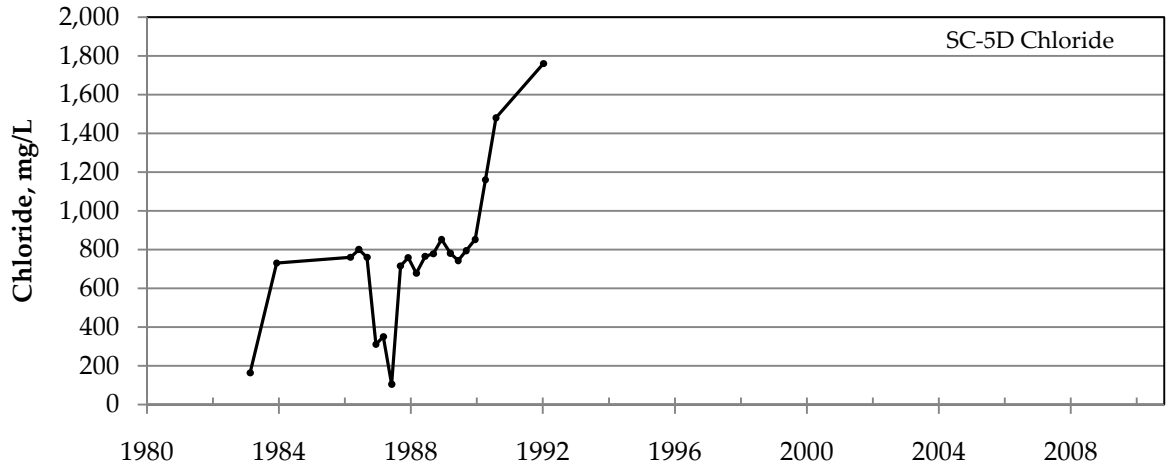

SC-5B Total Dissolved Solids
TDS, mg/L
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

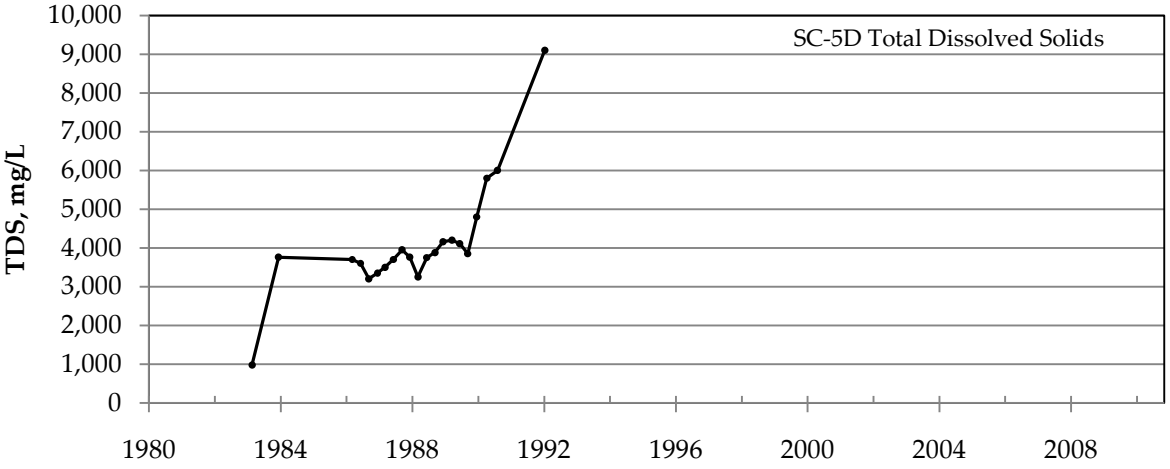

SC-5B Groundwater Elevation
Groundwater Elevation, ft MSL
30
25
20
15
10
5
0
-5
-10
-15
-20
1980
1984
1988
1992
1996
2000
2004
2008

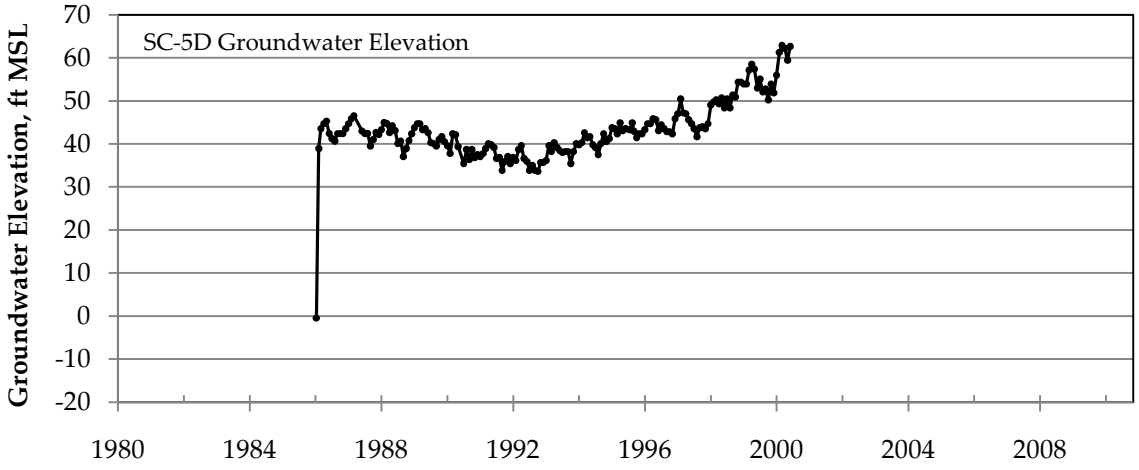

SC-5C Chloride
Chloride, mg/L
250
200
150
100
50
0
In 2003, SC-5C well replaced. Screen length changed from 65 feet to 10 feet
1980
1984
1988
1992
1996
2000
2004
2008

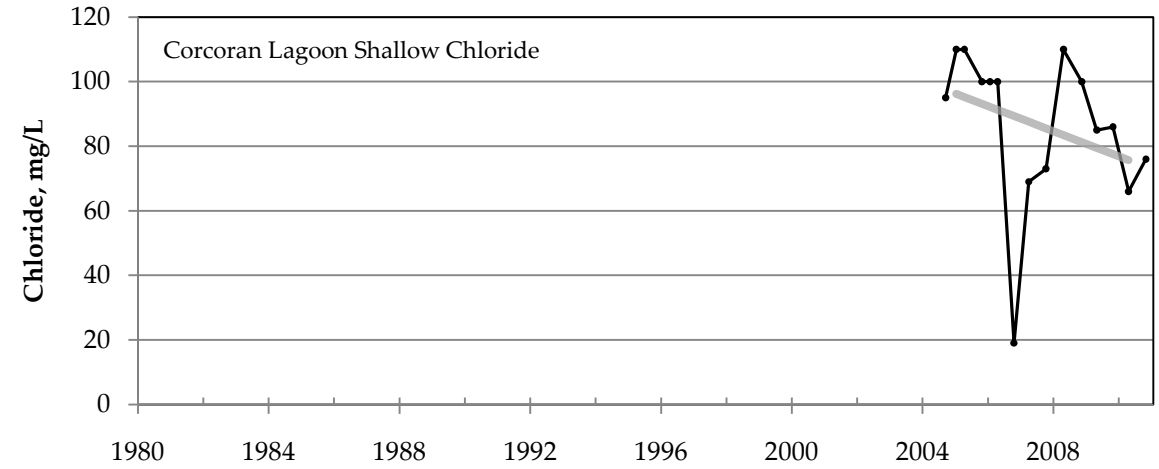

SC-5C Total Dissolved Solids
TDS, mg/L
1,000
900
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

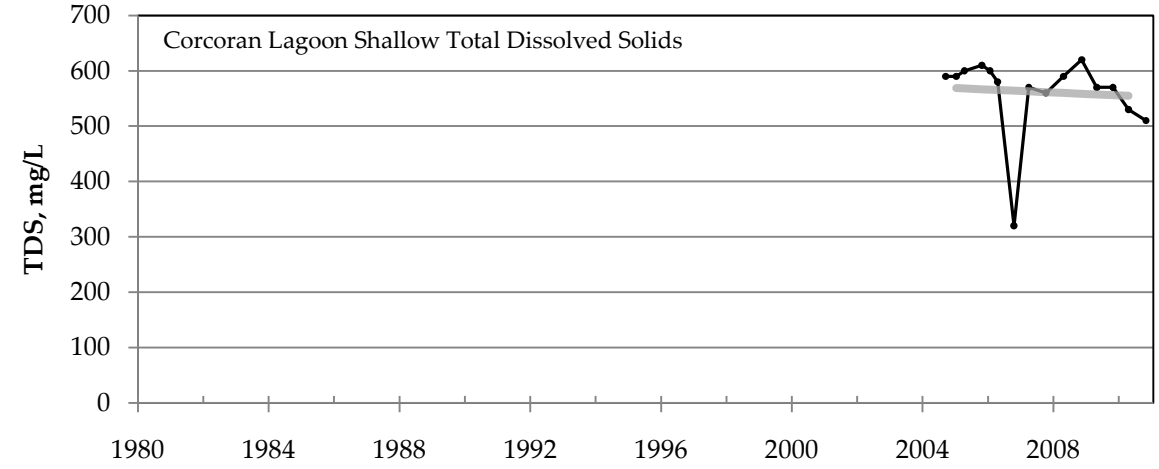

SC-5C Groundwater Elevation
Groundwater Elevation, ft MSL
140
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

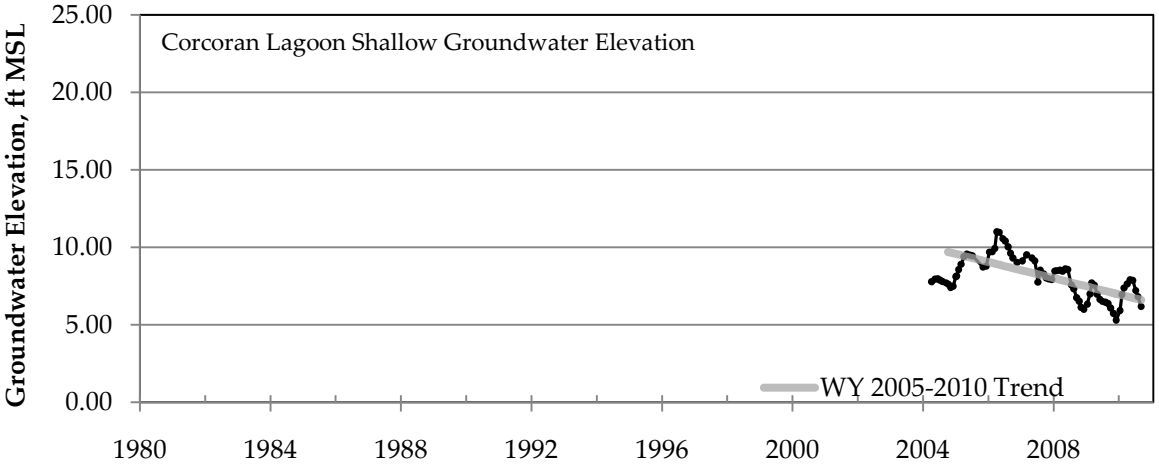

SC-5D Chloride
Chloride, mg/L
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

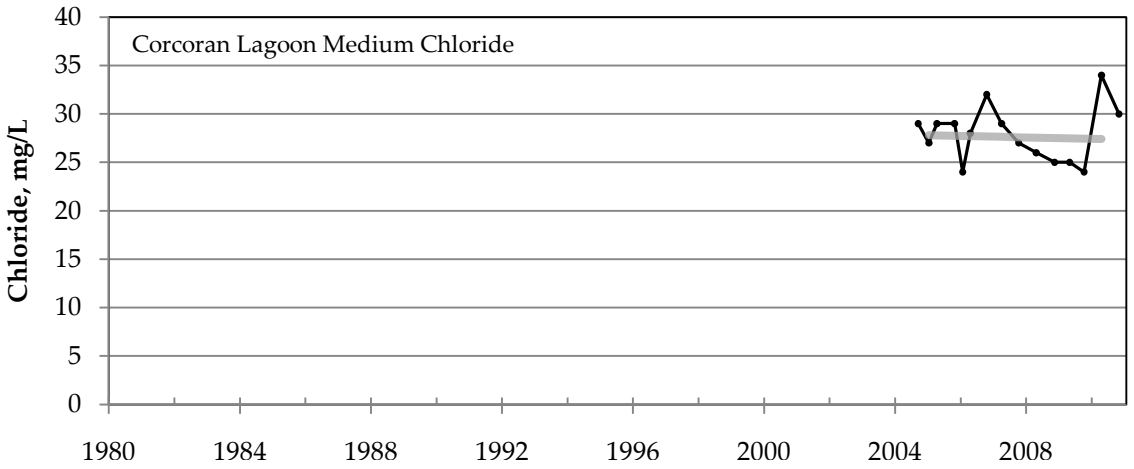

SC-5D Total Dissolved Solids
TDS, mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1984
1988
1992
1996
2000
2004
2008

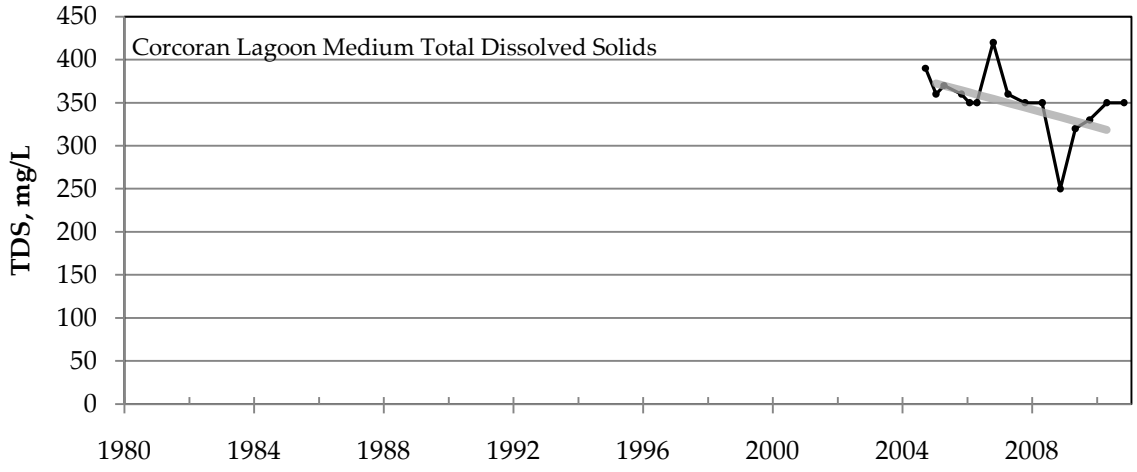

SC-5D Groundwater Elevation
Groundwater Elevation, ft MSL
70
60
50
40
30
20
10
0
-10
-20
1980
1984
1988
1992
1996
2000
2004
2008

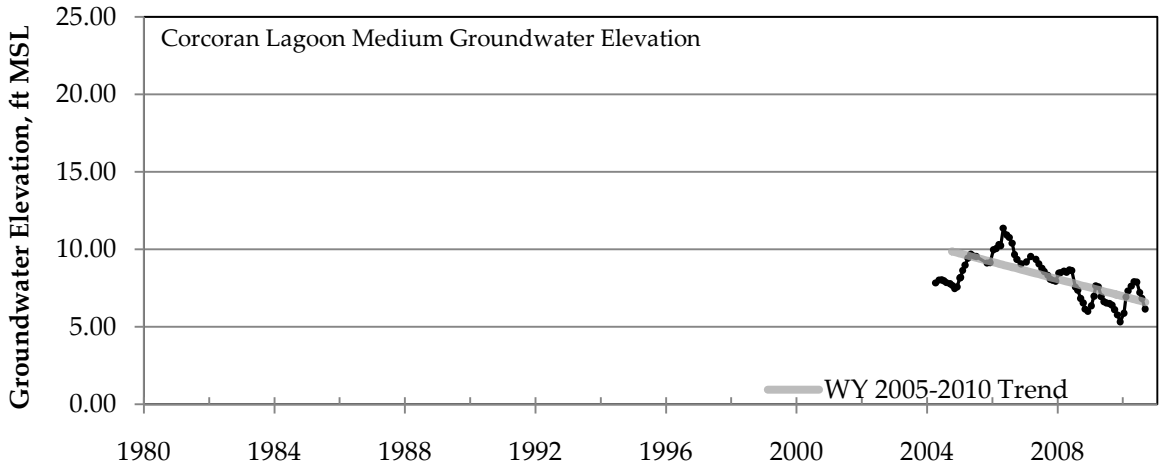

Corcoran Lagoon Shallow Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

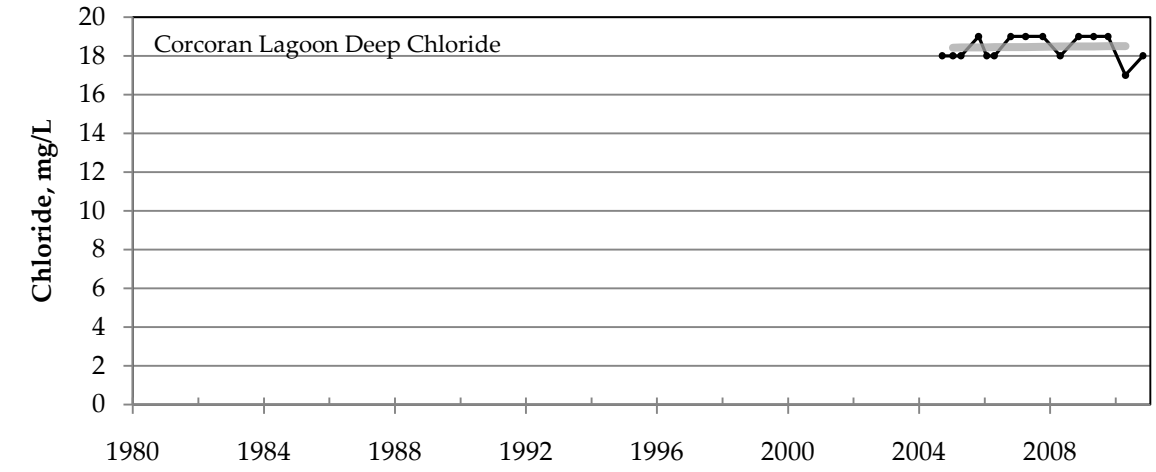

Corcoran Lagoon Shallow Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

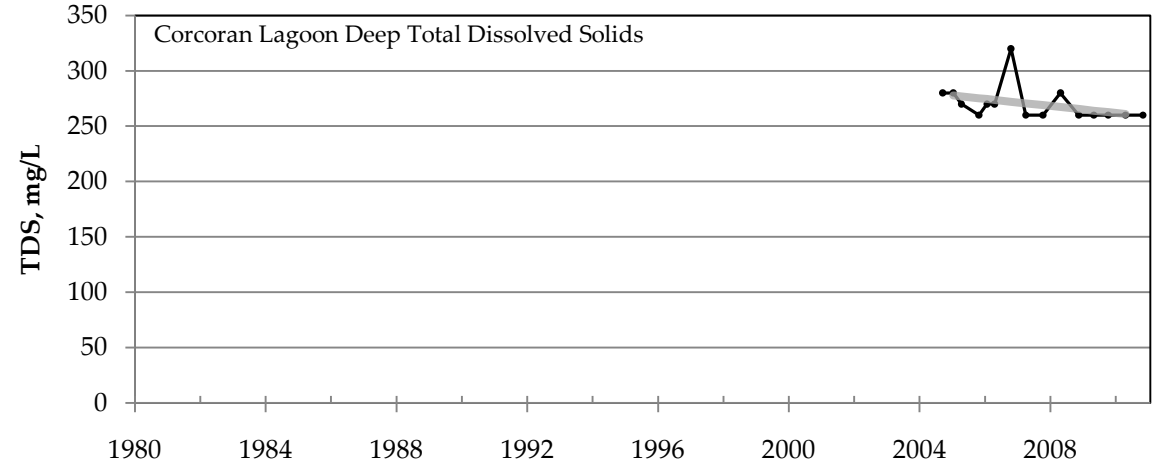

Corcoran Lagoon Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

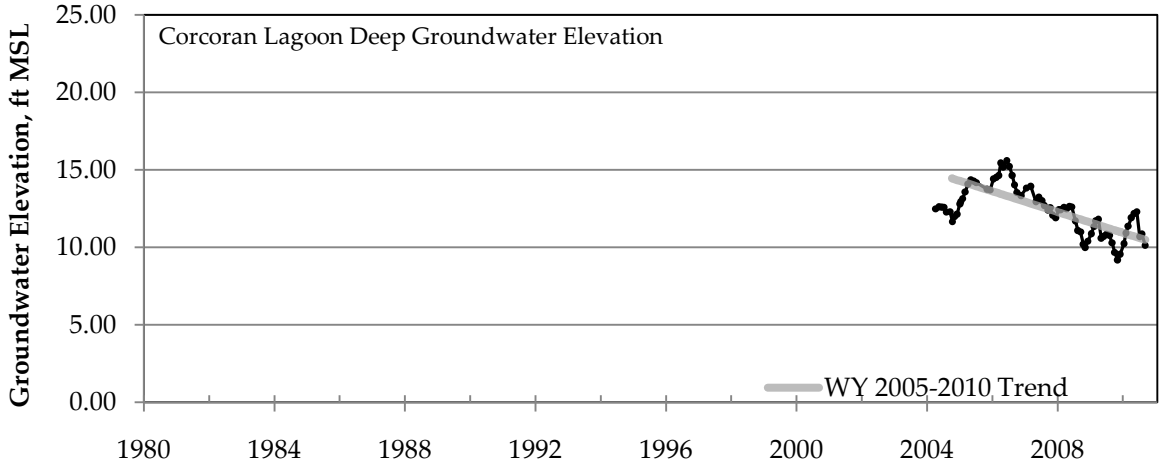

Corcoran Lagoon Medium Chloride
Chloride, mg/L
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

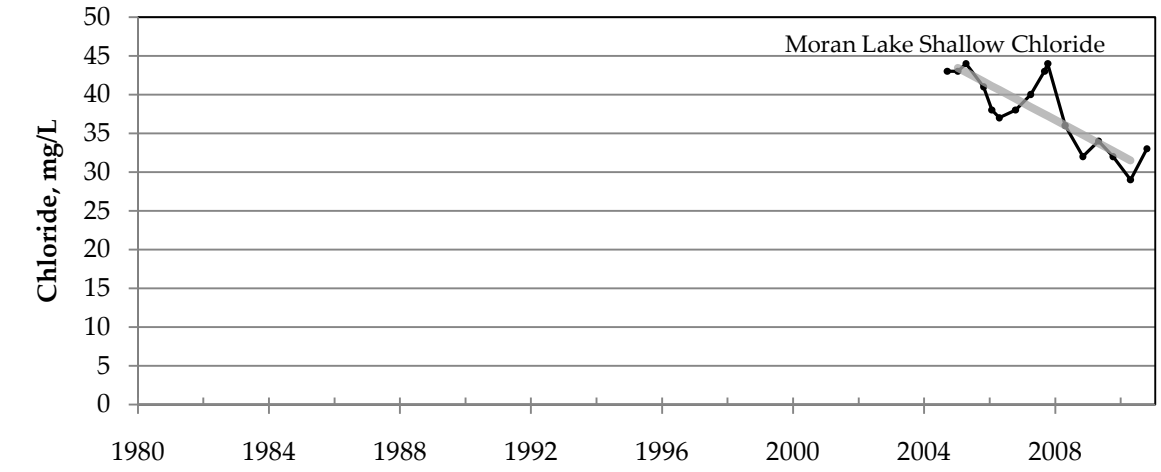

Corcoran Lagoon Medium Total Dissolved Solids
TDS, mg/L
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

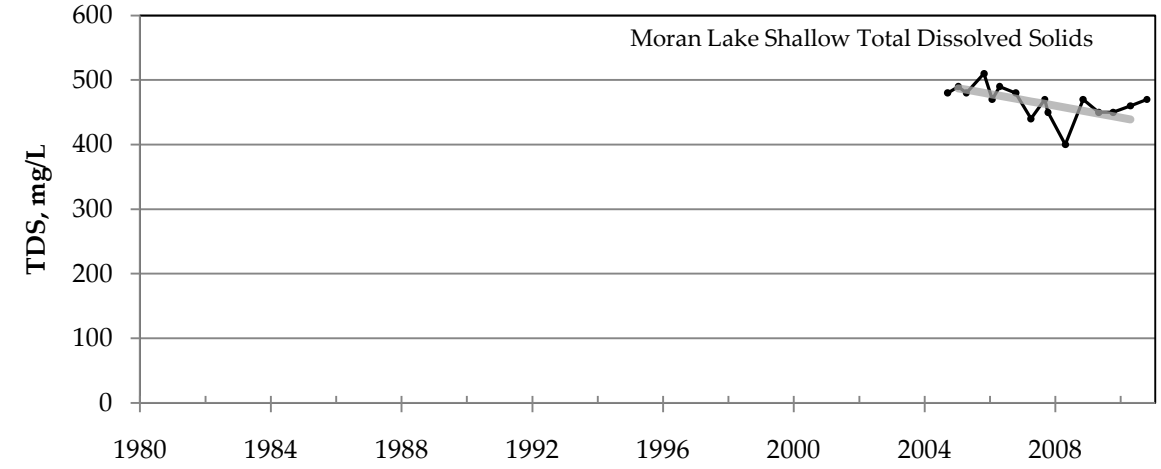

Corcoran Lagoon Medium Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

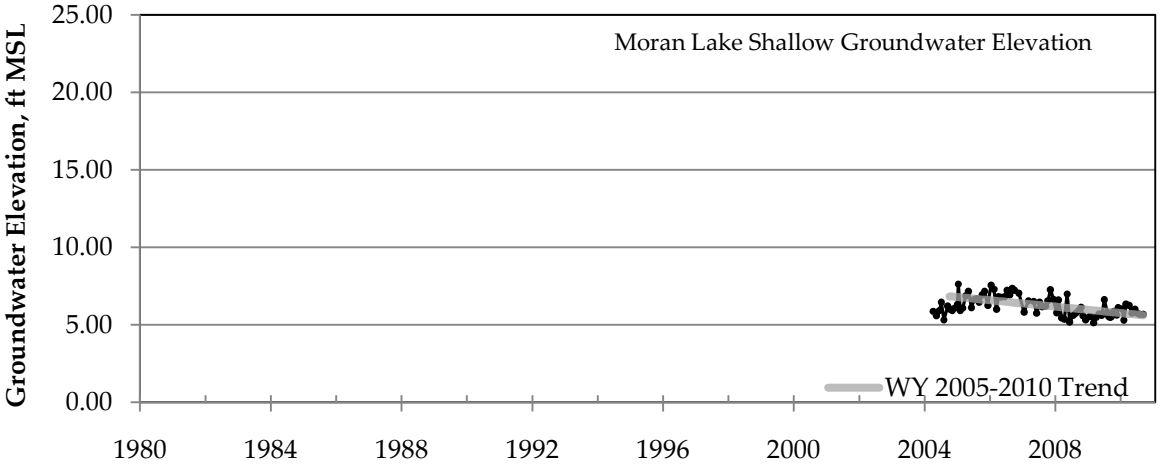

Corcoran Lagoon Deep Chloride
Chloride, mg/L
20
18
16
14
12
10
8
6
4
2
0
1980
1984
1988
1992
1996
2000
2004
2008

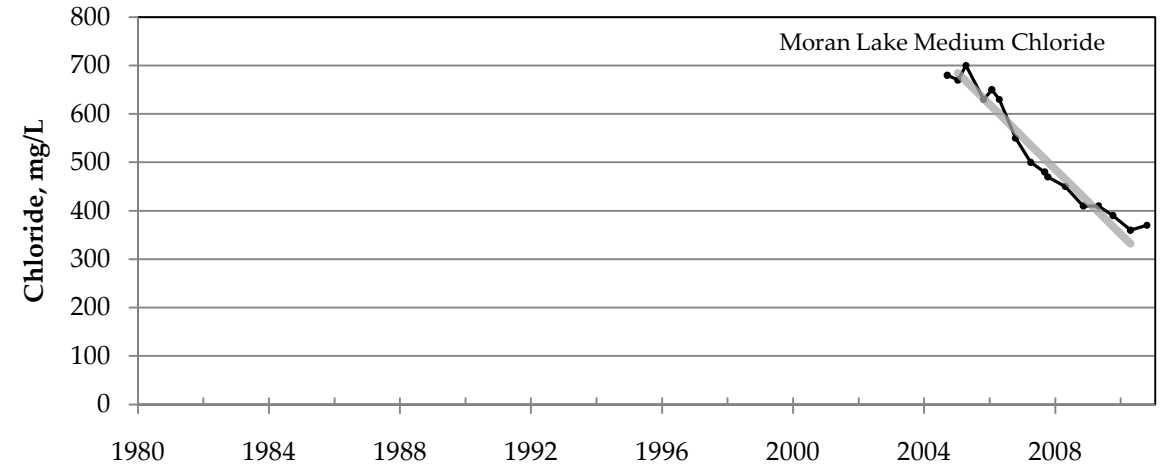

Corcoran Lagoon Deep Total Dissolved Solids
TDS, mg/L
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

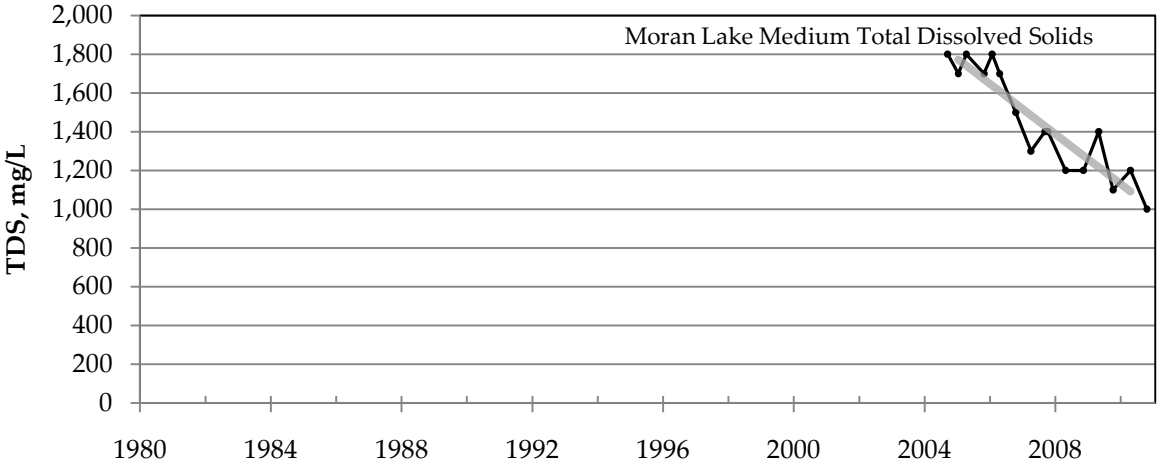

Corcoran Lagoon Deep Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

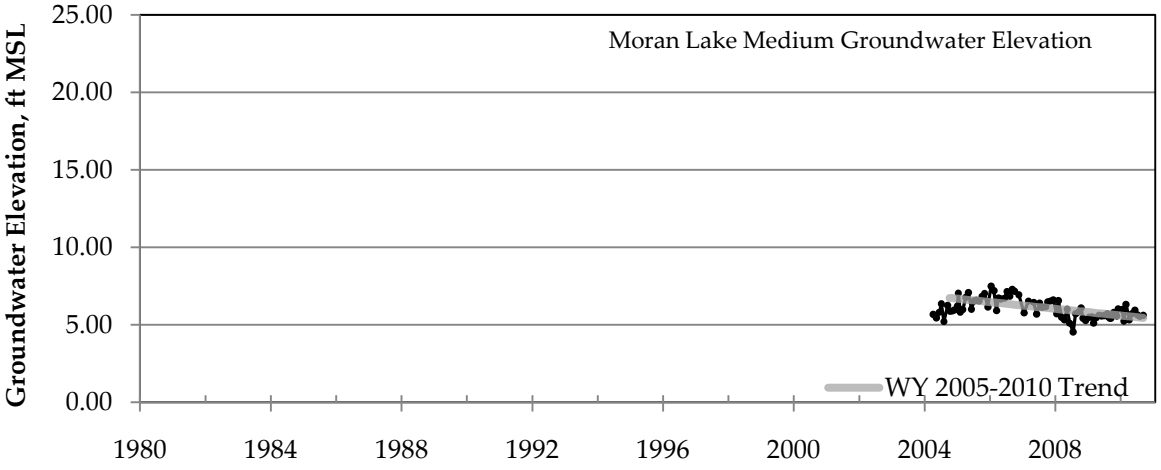

Moran Lake Shallow Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

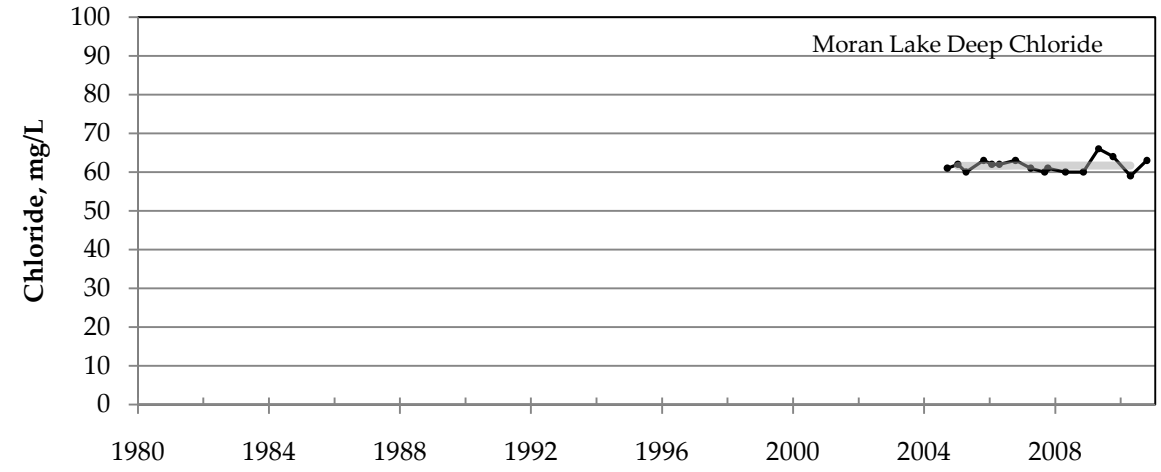

Moran Lake Shallow Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

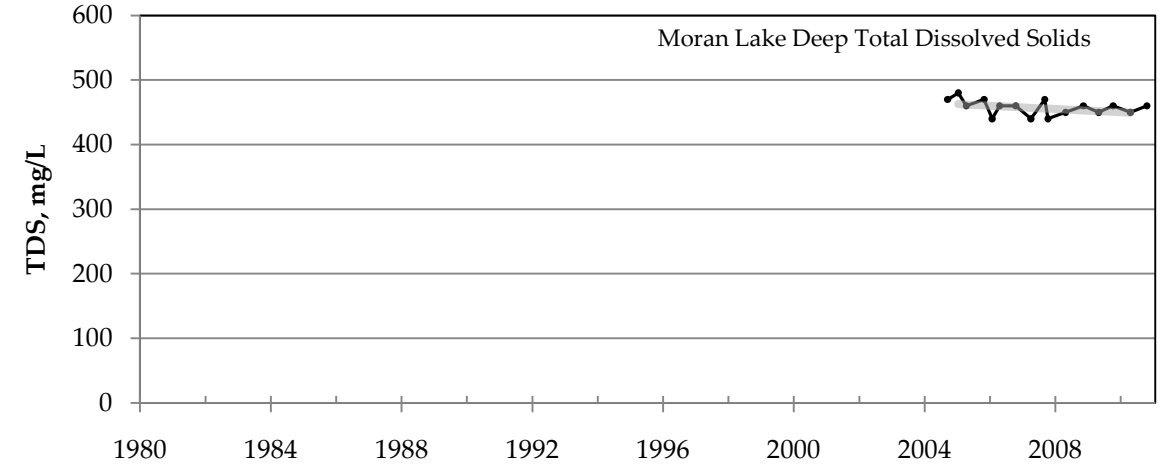

Moran Lake Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

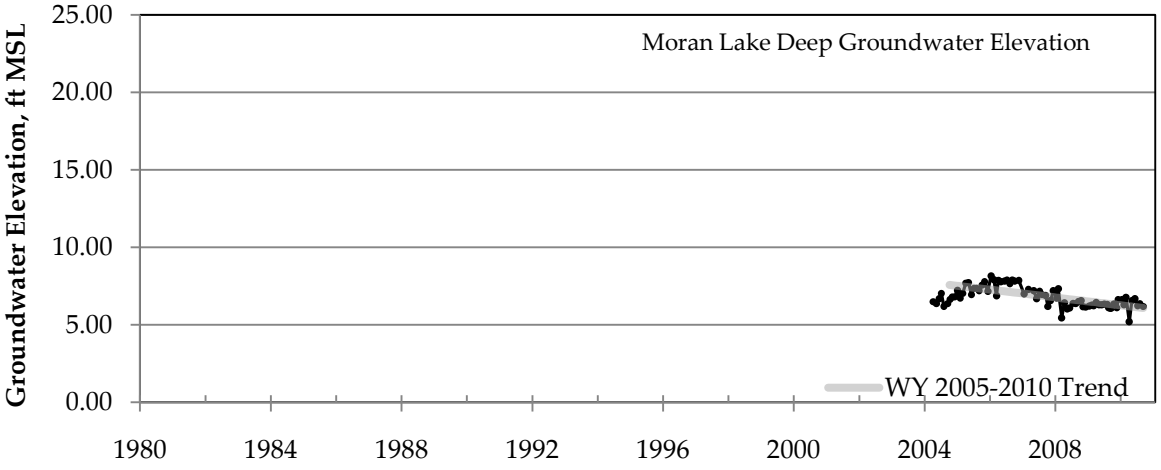

Moran Lake Medium Chloride
Chloride, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

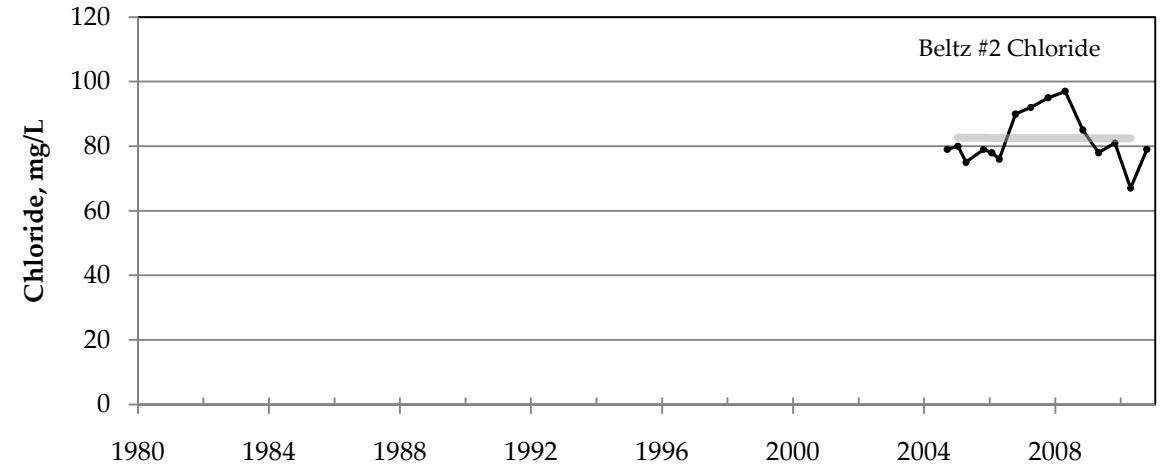

Moran Lake Medium Total Dissolved Solids
TDS, mg/L
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

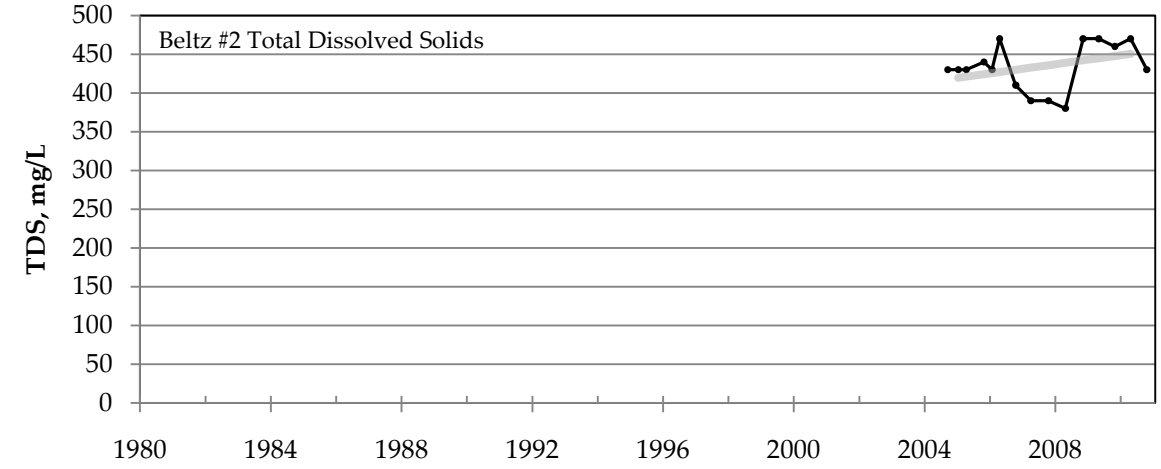

Moran Lake Medium Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

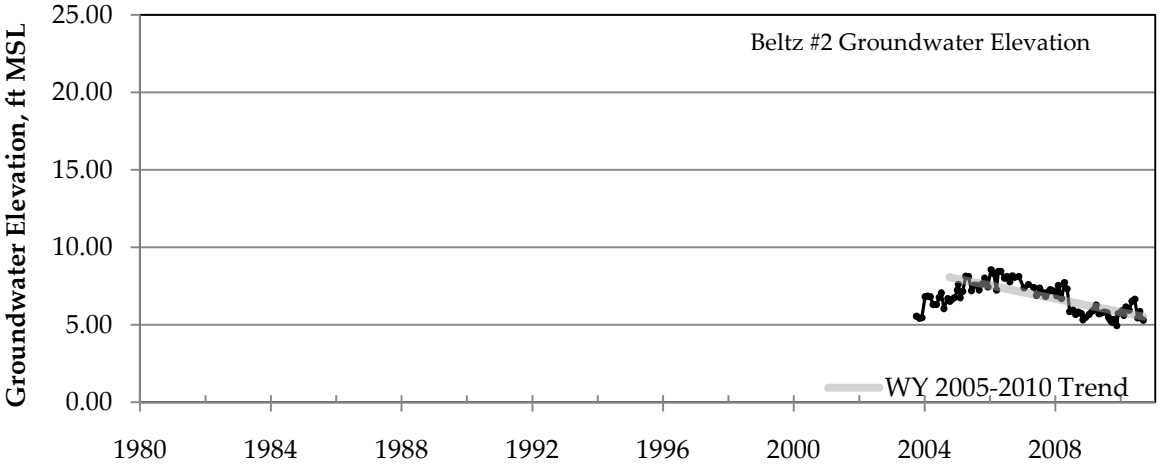

Moran Lake Deep Chloride
Chloride, mg/L
100
90
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

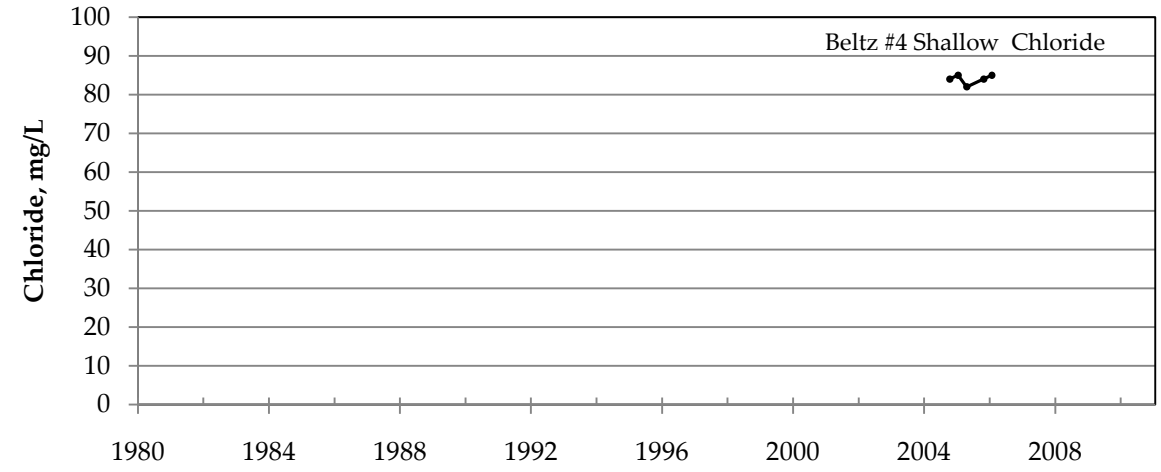

Moran Lake Deep Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

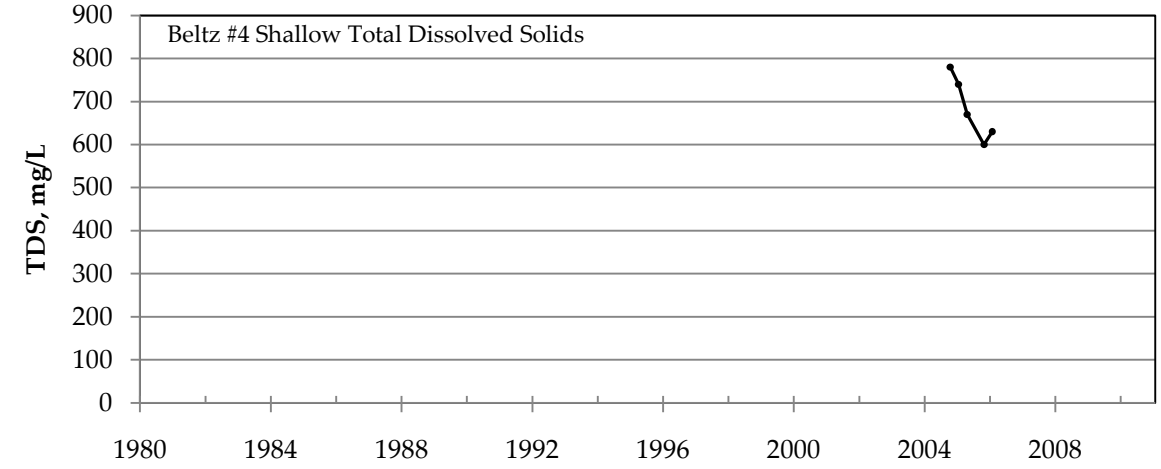

Moran Lake Deep Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

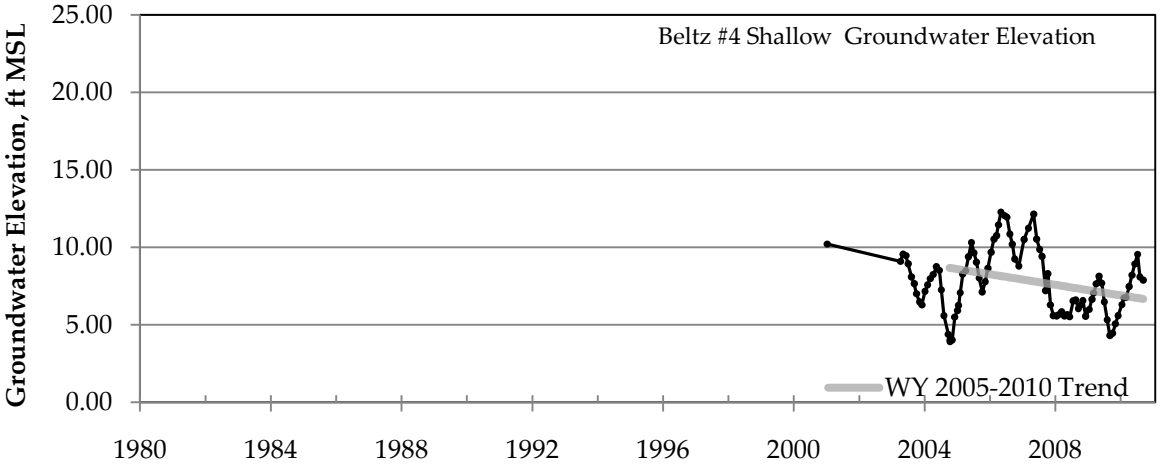

Beltz #2 Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

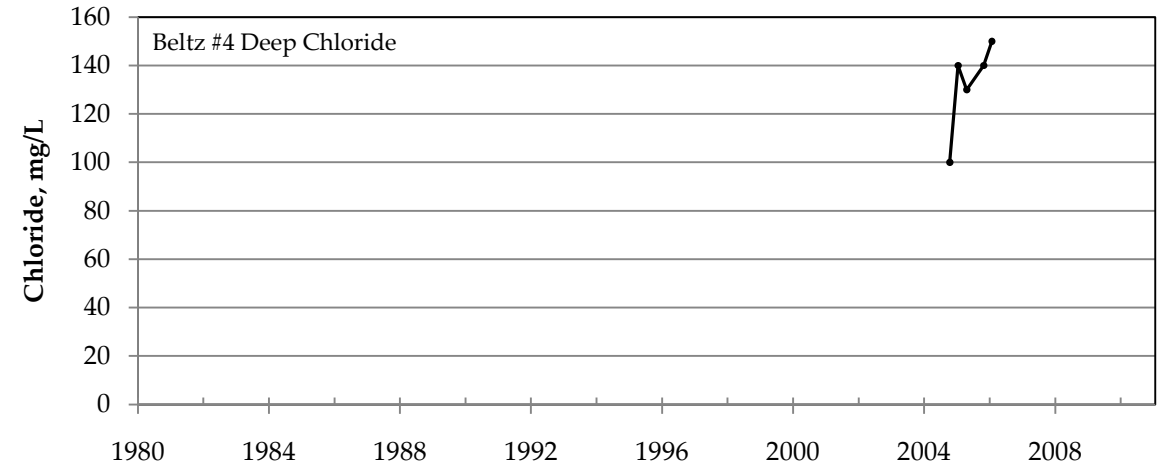

Beltz #2 Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

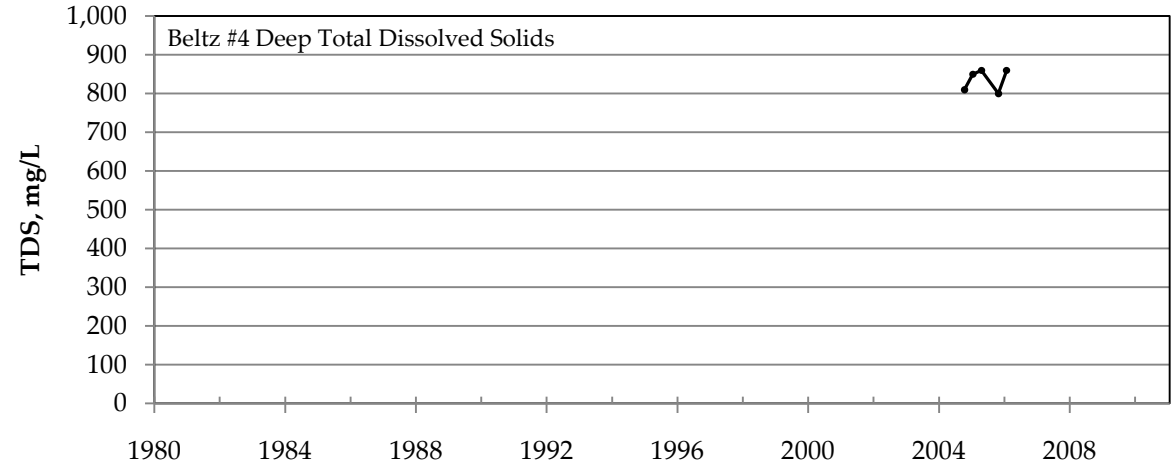

Beltz #2 Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

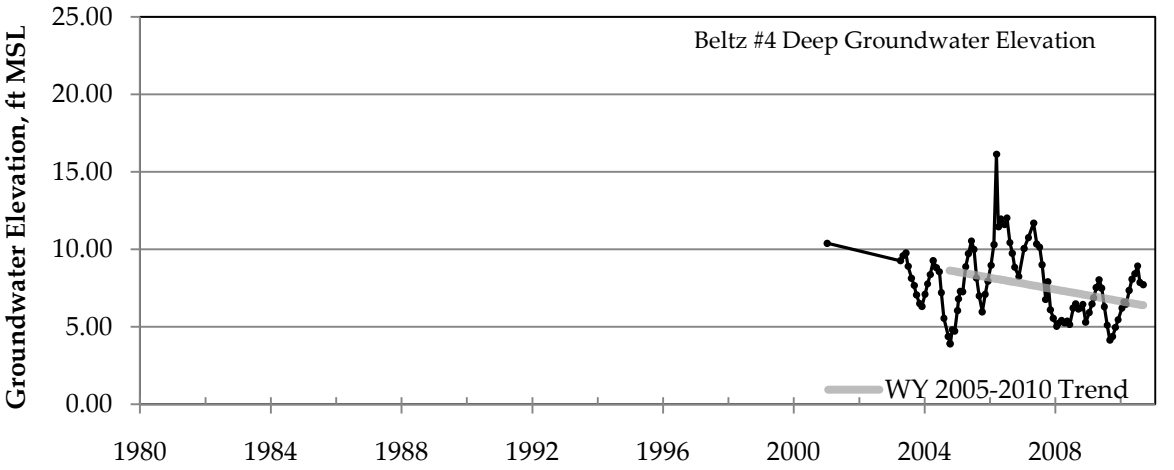

Beltz #4 Shallow Chloride
Chloride, mg/L
100
90
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

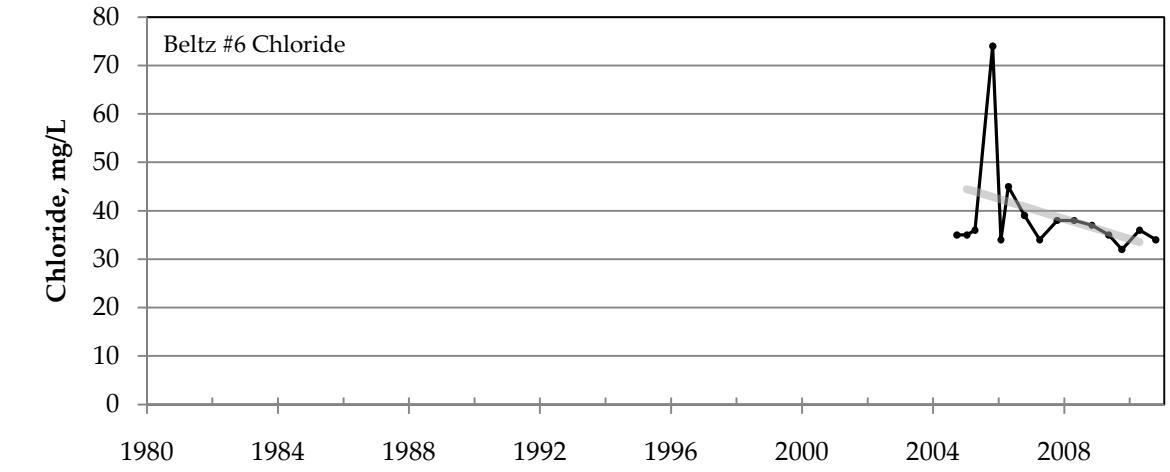

Beltz #4 Shallow Total Dissolved Solids
TDS, mg/L
900
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

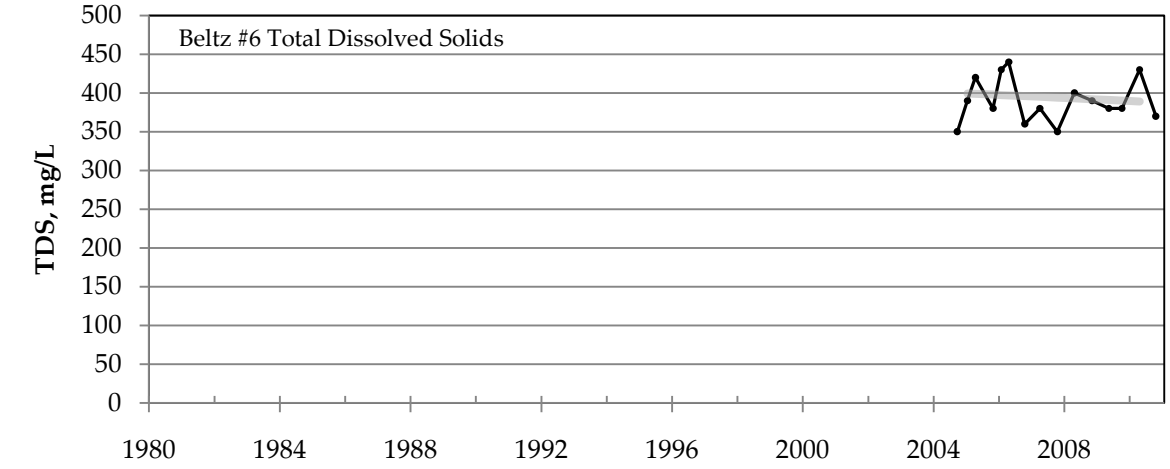

Beltz #4 Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

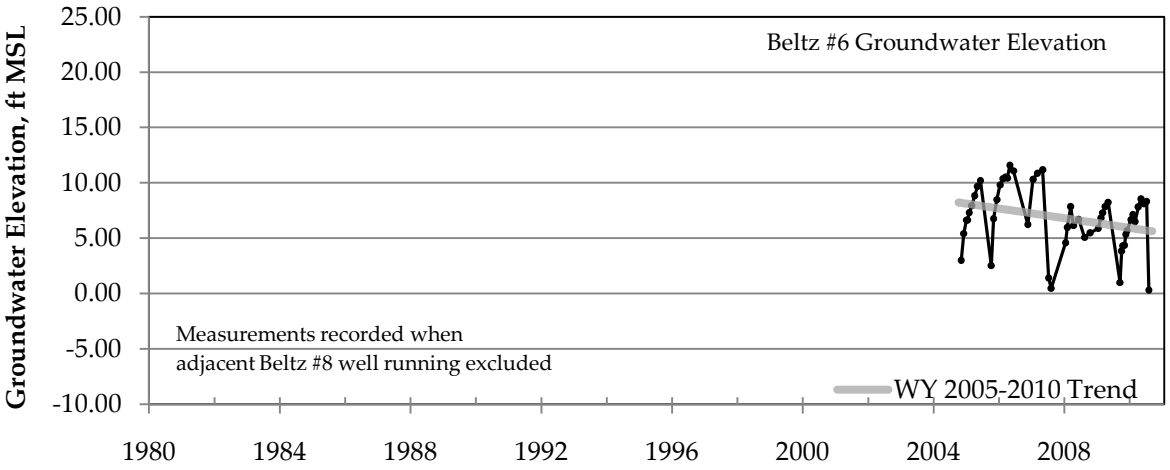

Beltz #4 Deep Chloride
Chloride, mg/L
160
140
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

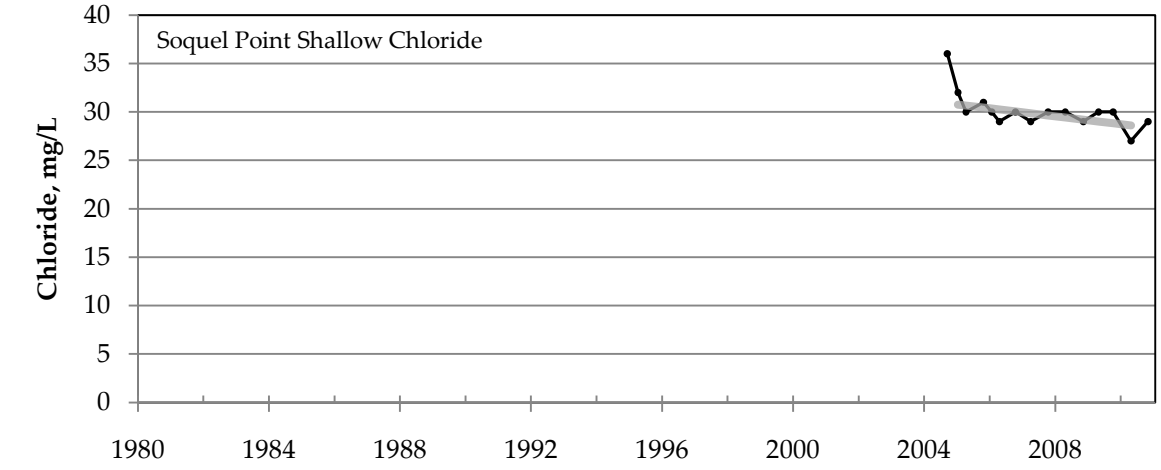

Beltz #4 Deep Total Dissolved Solids
TDS, mg/L
1,000
900
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

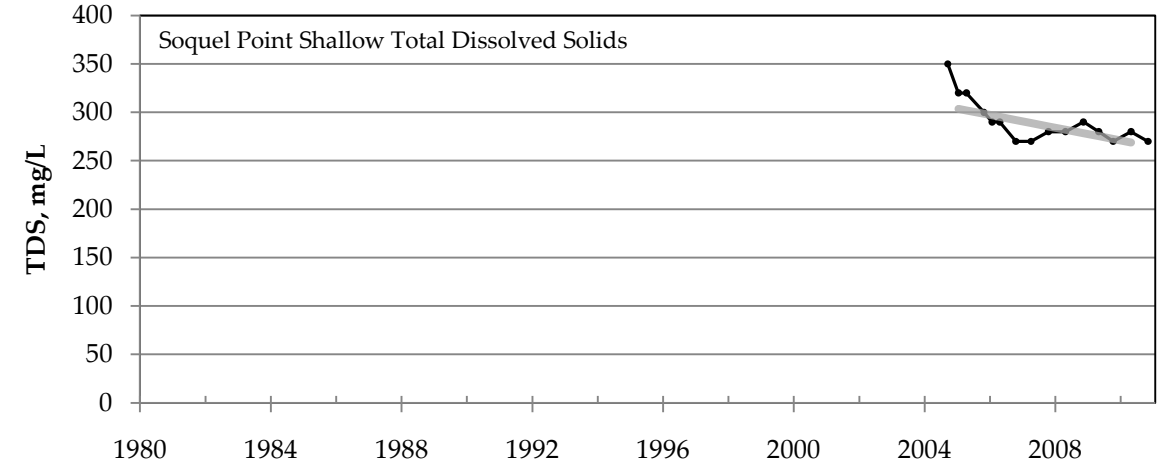

Beltz #4 Deep Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

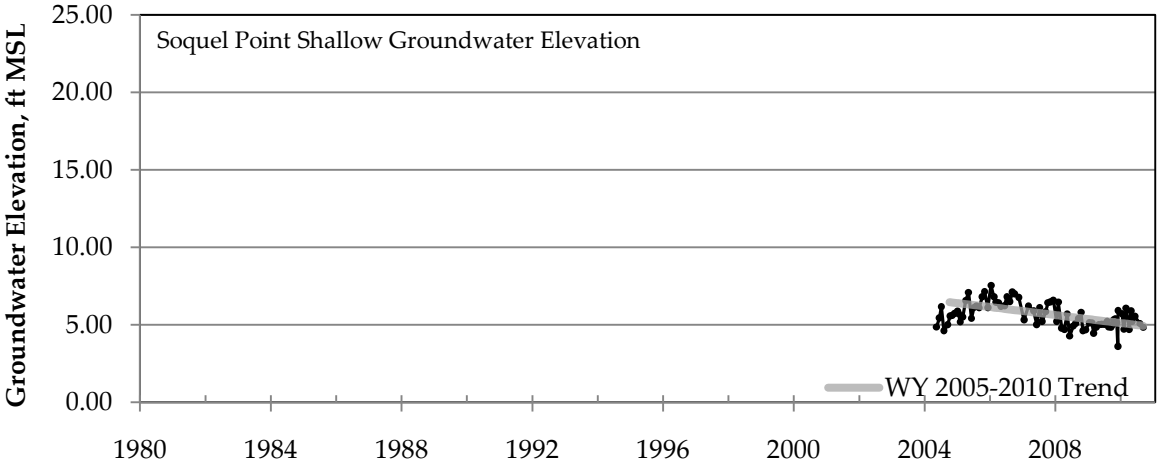

Beltz #6 Chloride
Chloride, mg/L
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

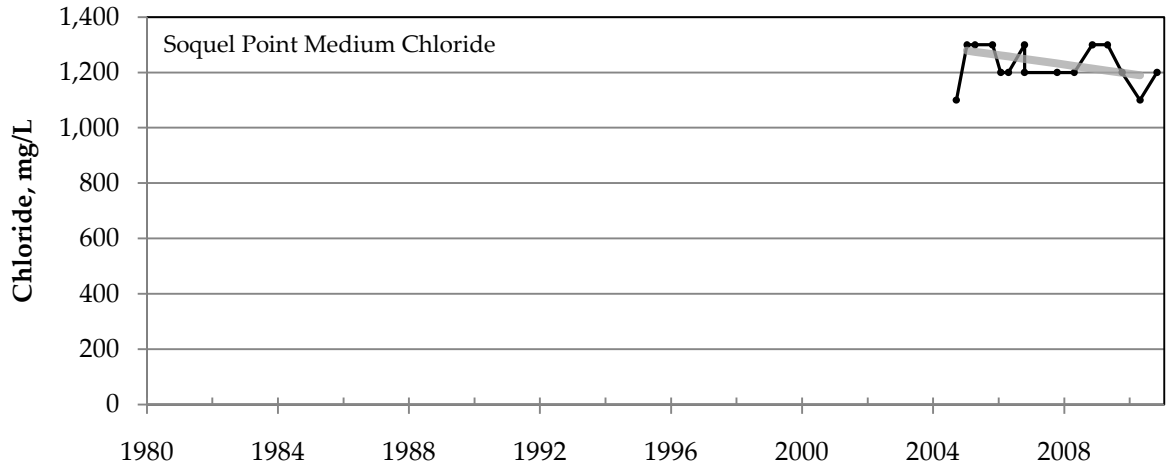

Beltz #6 Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

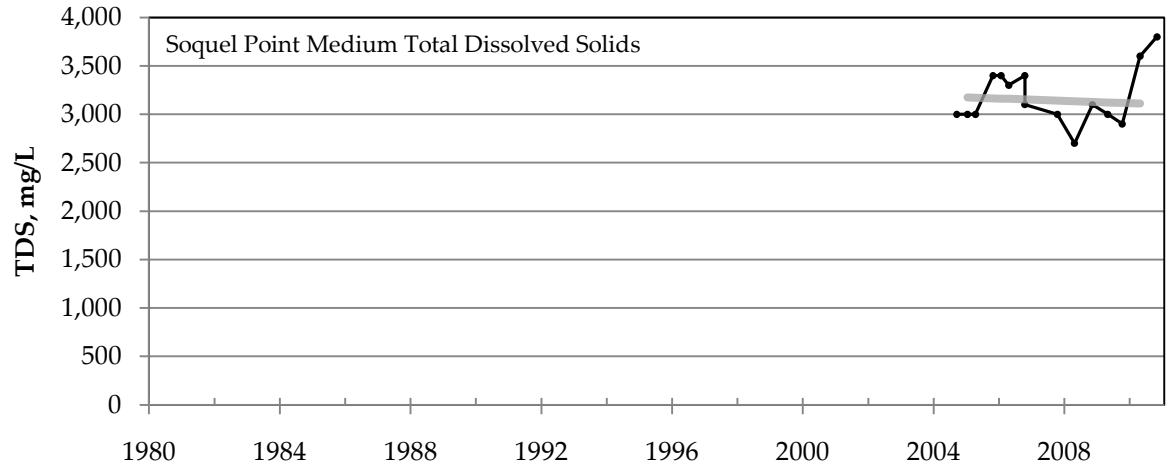

Beltz #6 Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
Measurements recorded when
adjacent Beltz #8 well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

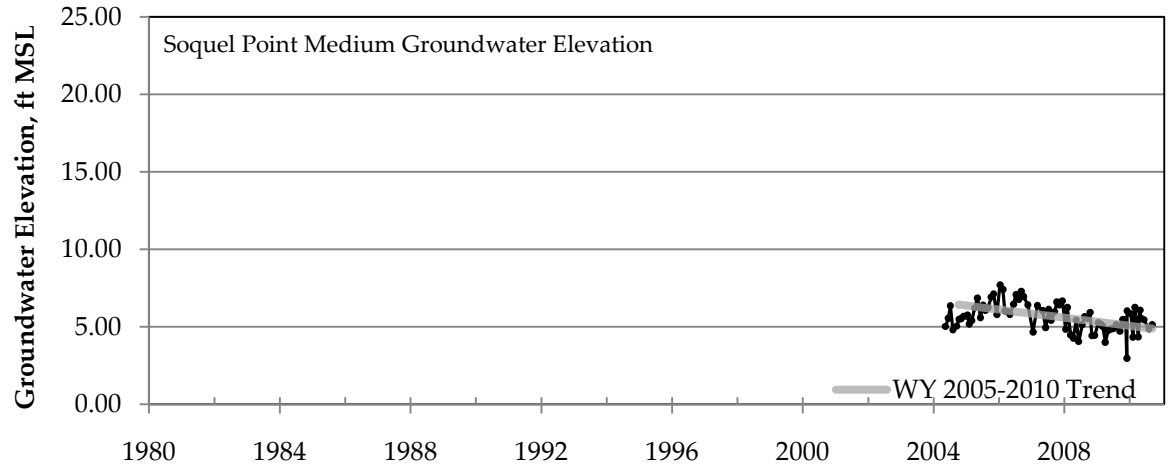

Soquel Point Shallow Chloride
Chloride, mg/L
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

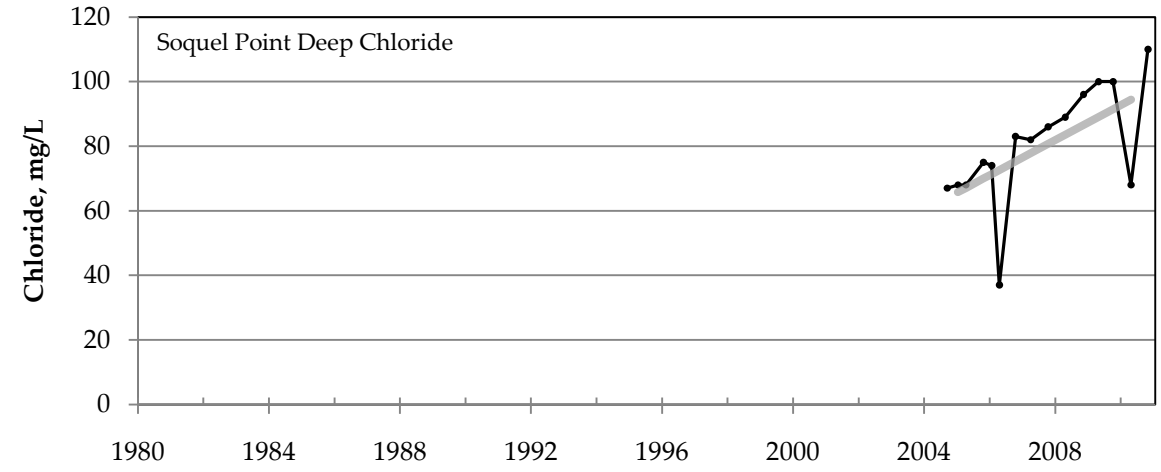

Soquel Point Shallow Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

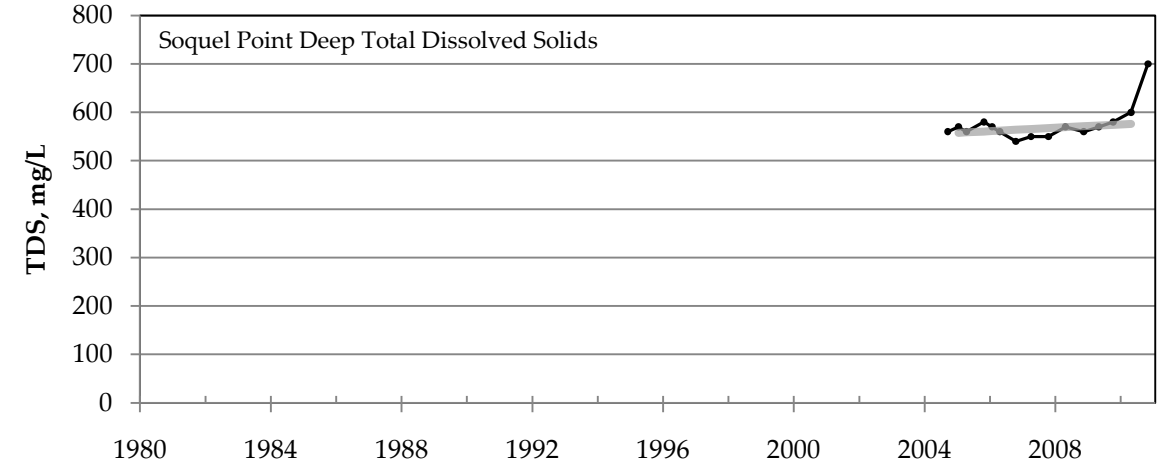

Soquel Point Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

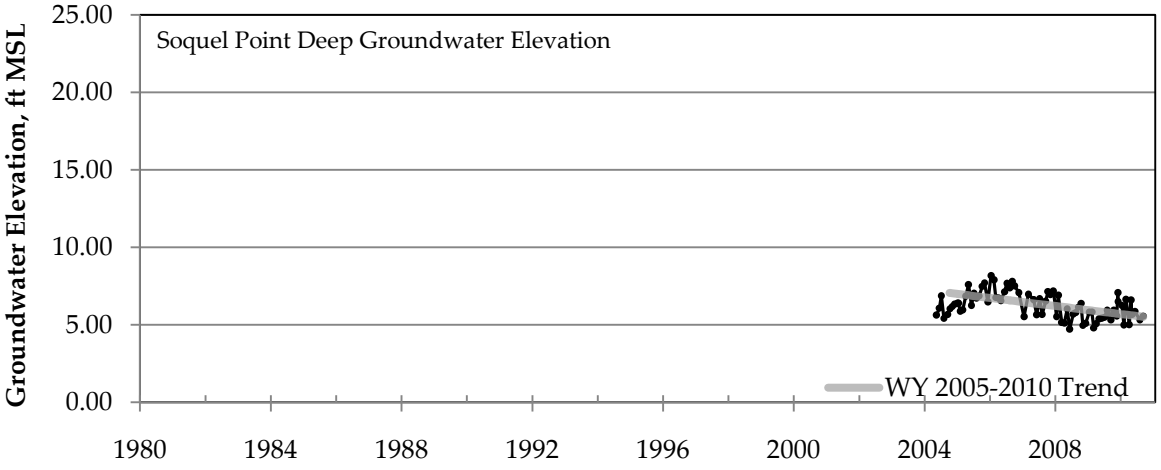

Soquel Point Medium Chloride
Chloride, mg/L
1,400
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

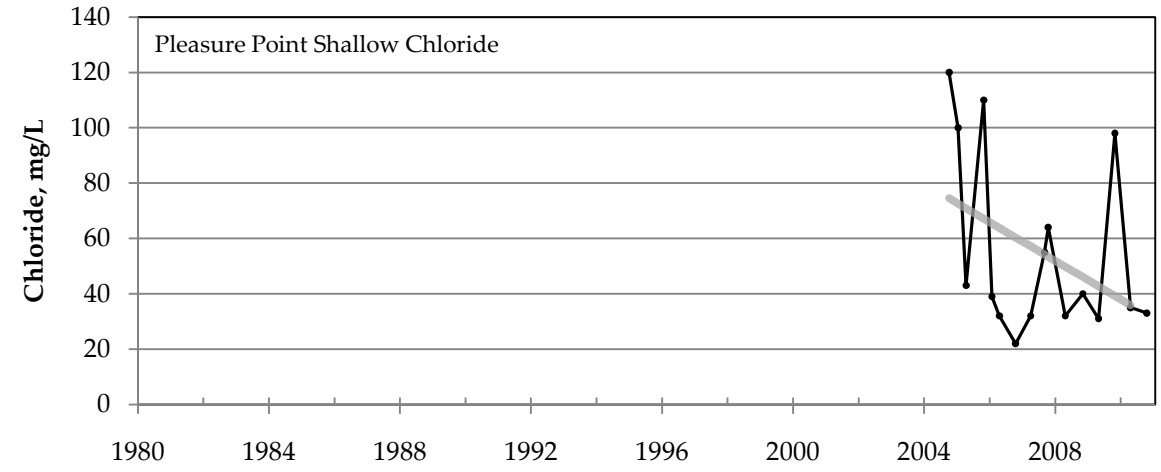

Soquel Point Medium Total Dissolved Solids
TDS, mg/L
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1980
1984
1988
1992
1996
2000
2004
2008

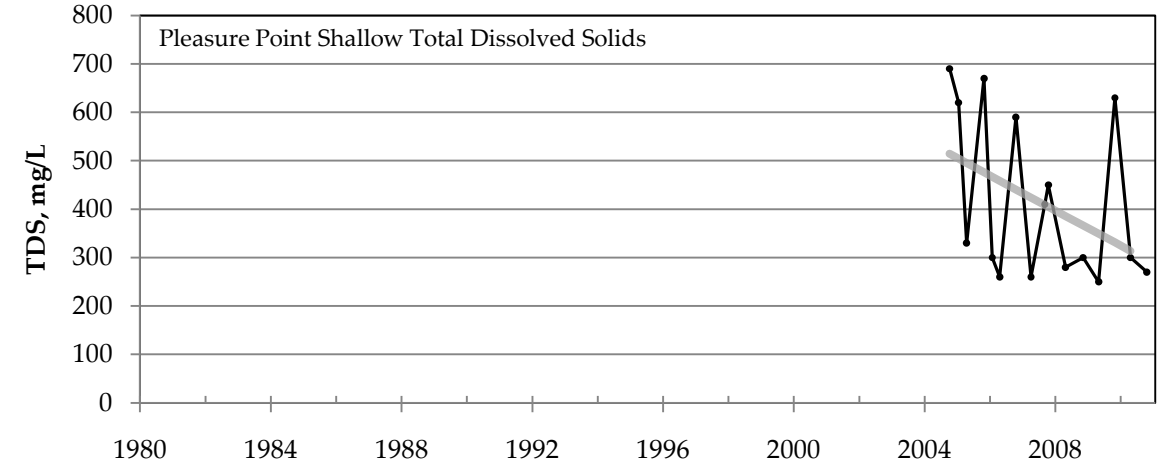

Soquel Point Medium Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

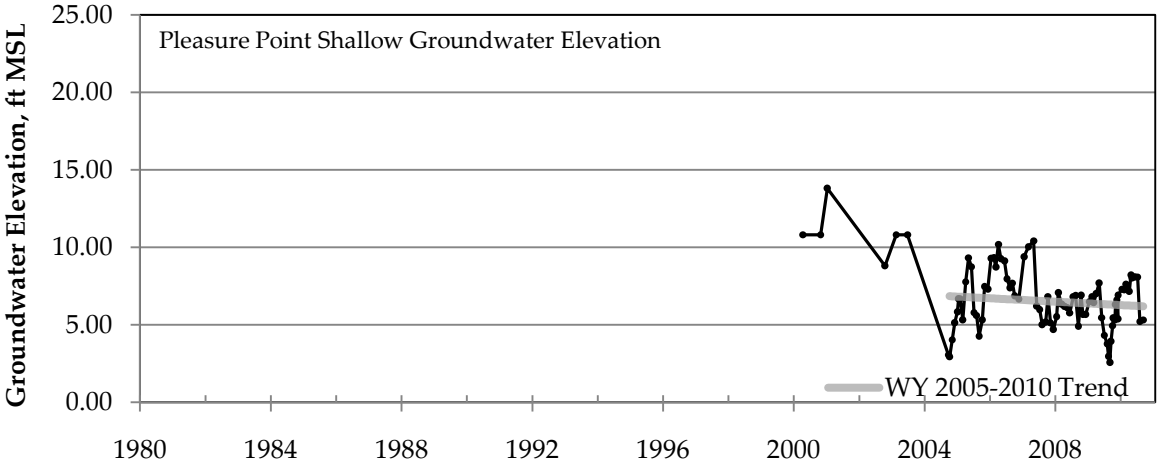

Soquel Point Deep Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

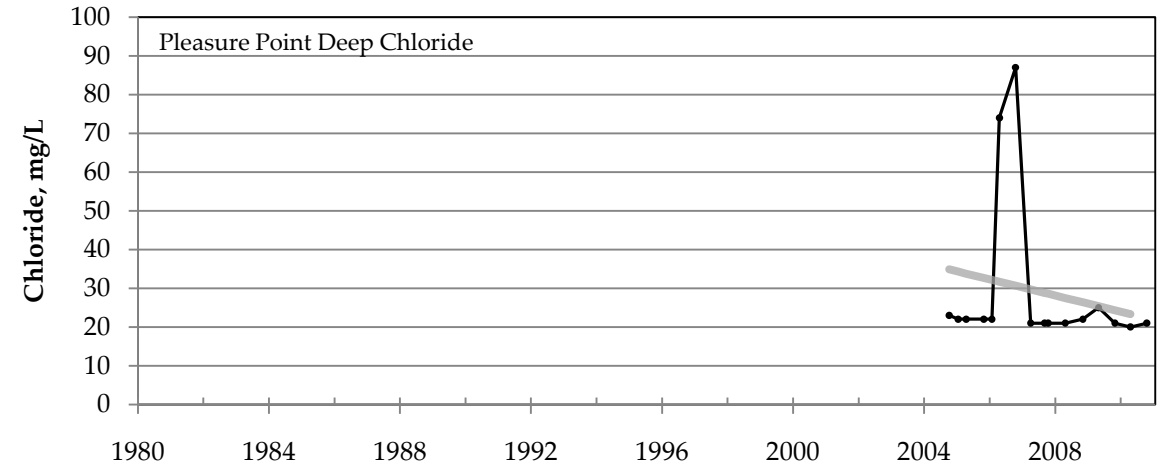

Soquel Point Deep Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

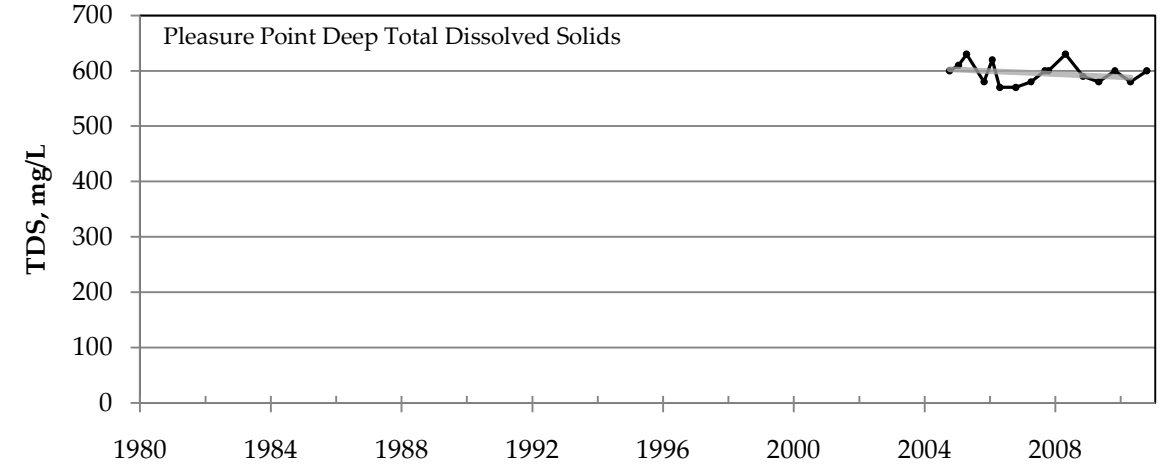

Soquel Point Deep Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

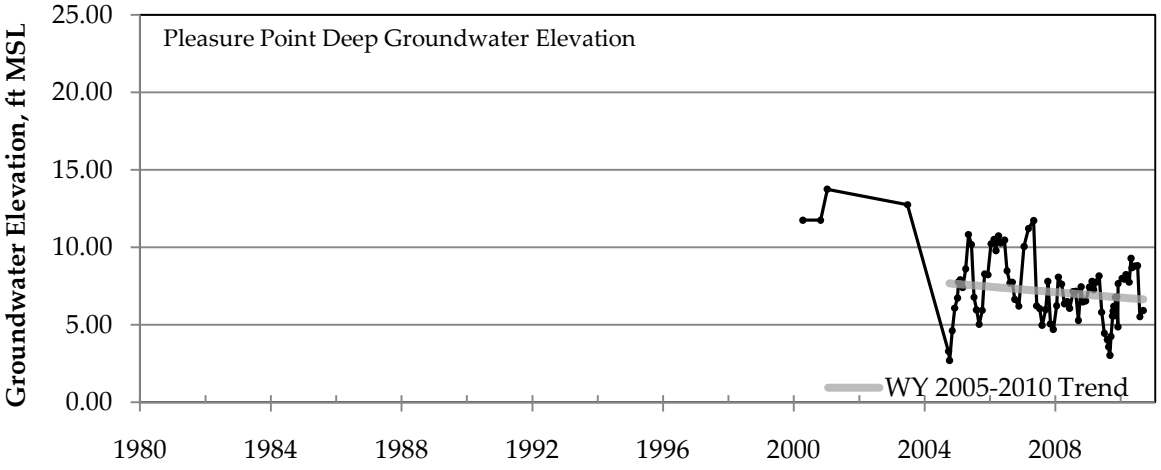

Pleasure Point Shallow Chloride
Chloride, mg/L
140
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

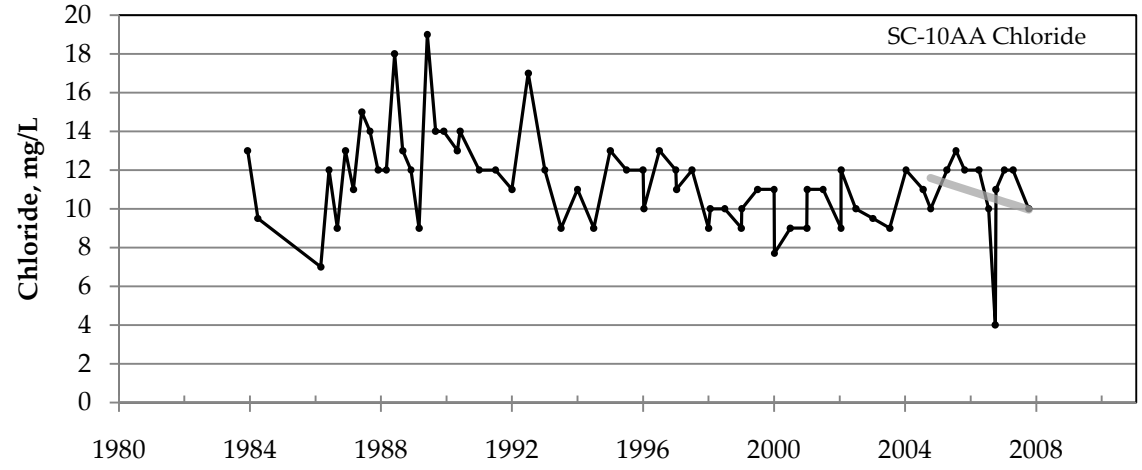

Pleasure Point Shallow Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

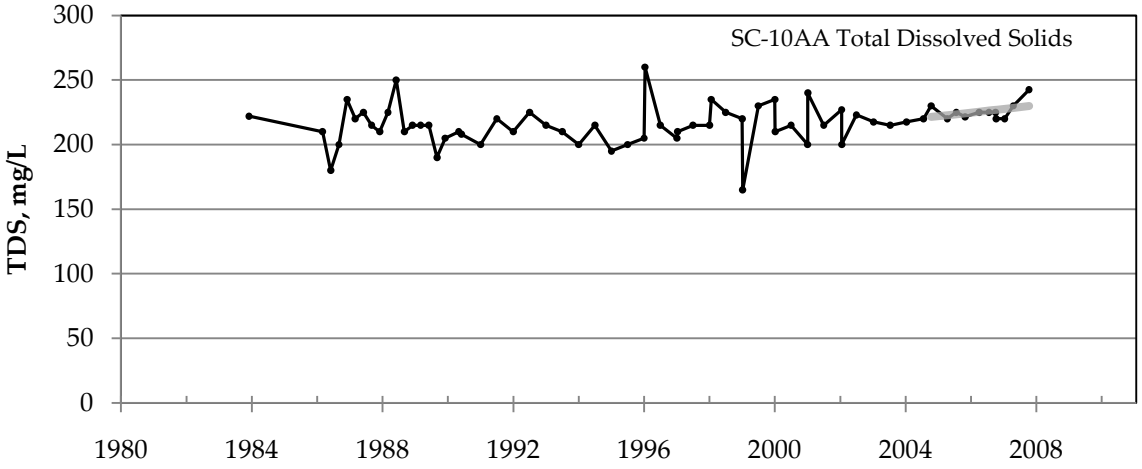

Pleasure Point Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

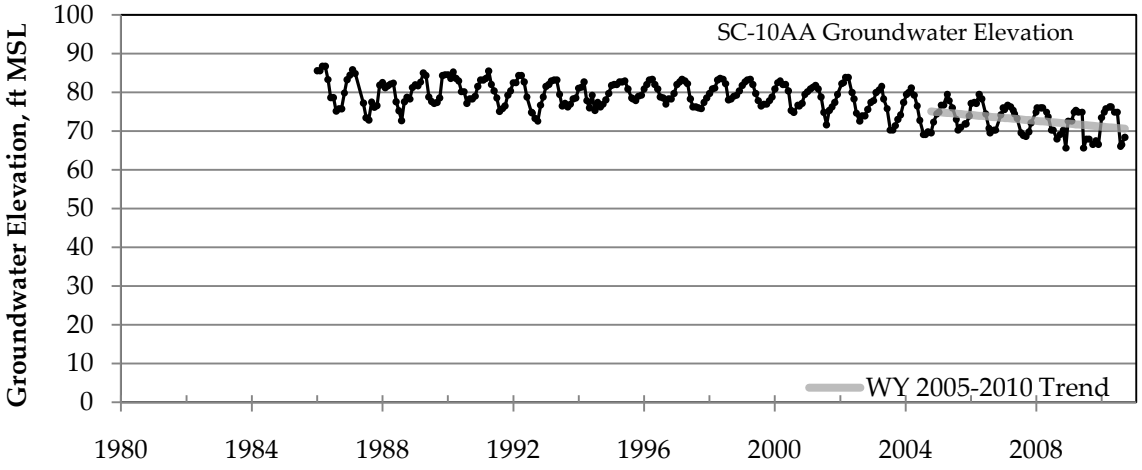

Pleasure Point Deep Chloride
Chloride, mg/L
100
90
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

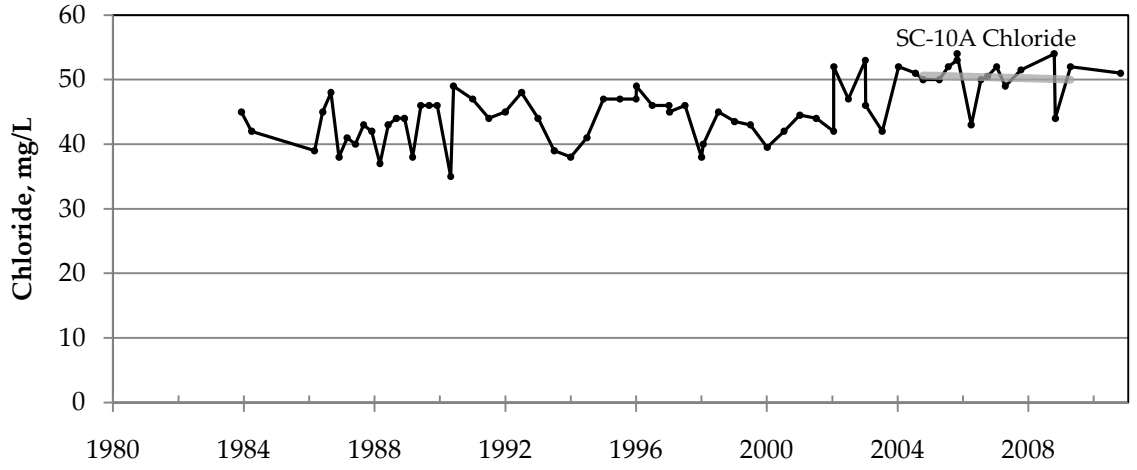

Pleasure Point Deep Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

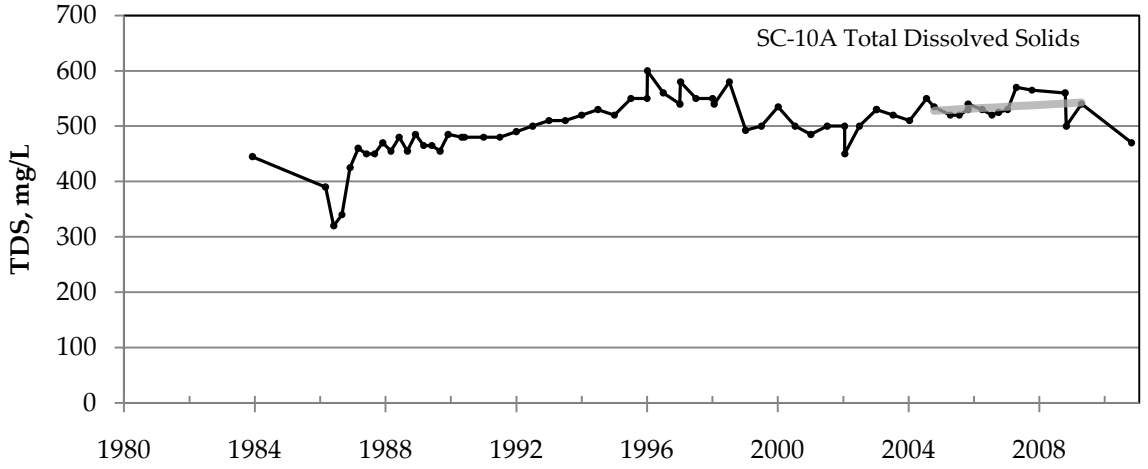

Pleasure Point Deep Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

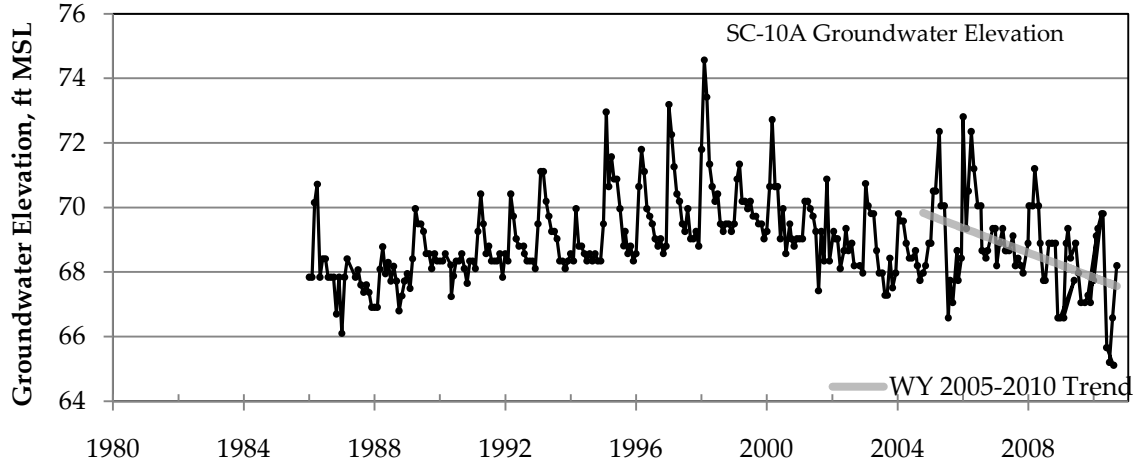

SC-10AA Chloride
Chloride, mg/L
0
2
4
6
8
10
12
14
16
18
20
1980
1984
1988
1992
1996
2000
2004
2008

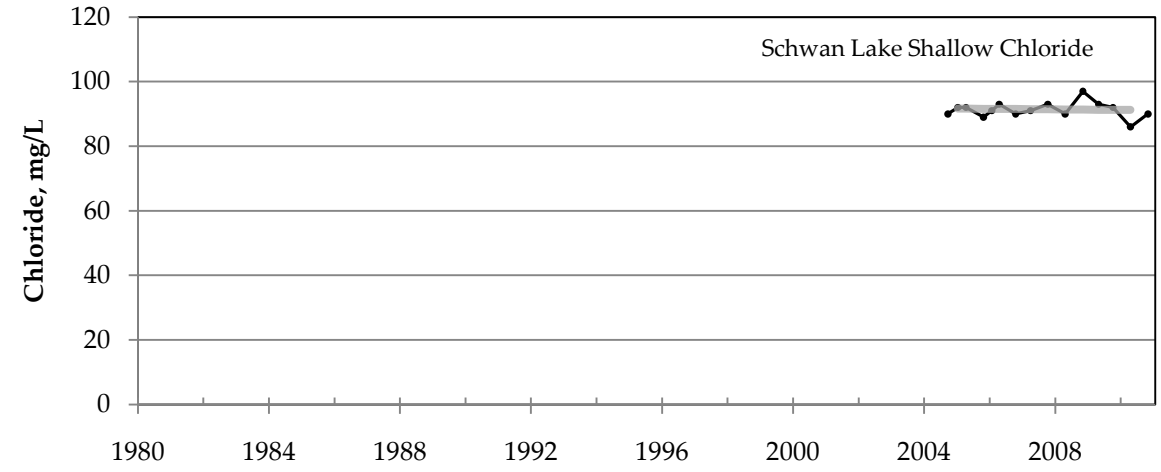

SC-10AA Total Dissolved Solids
TDS, mg/L
0
50
100
150
200
250
300
1980
1984
1988
1992
1996
2000
2004
2008

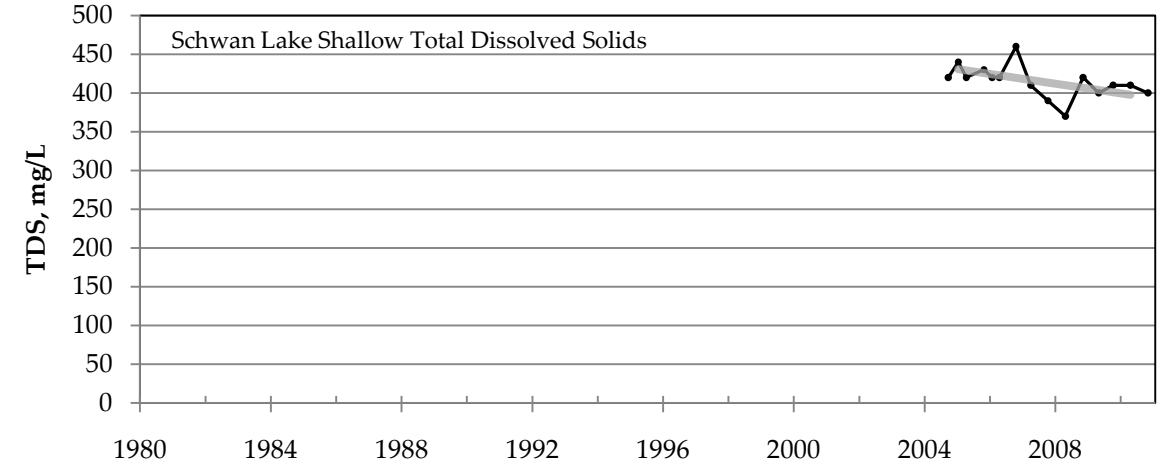

SC-10AA Groundwater Elevation
Groundwater Elevation, ft MSL
0
10
20
30
40
50
60
70
80
90
100
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

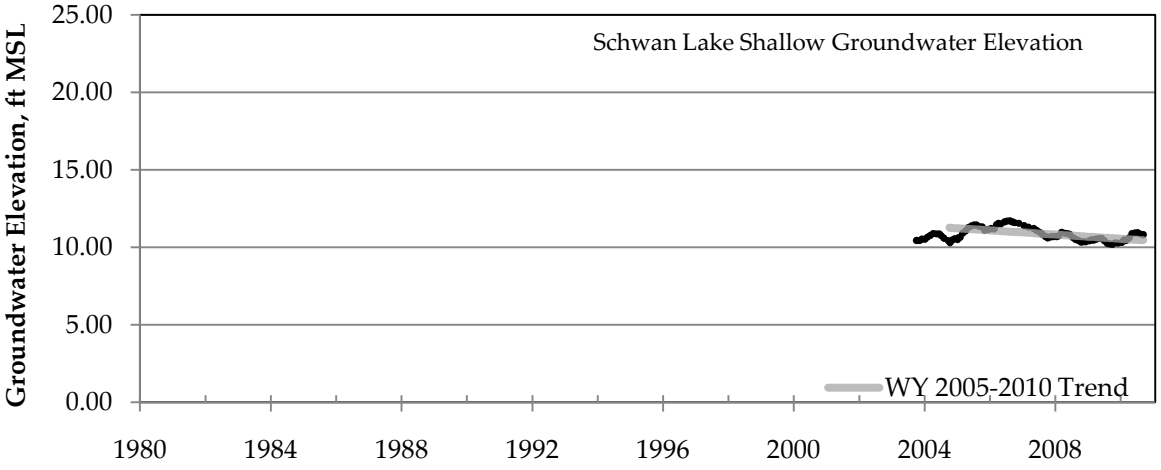

SC-10A Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

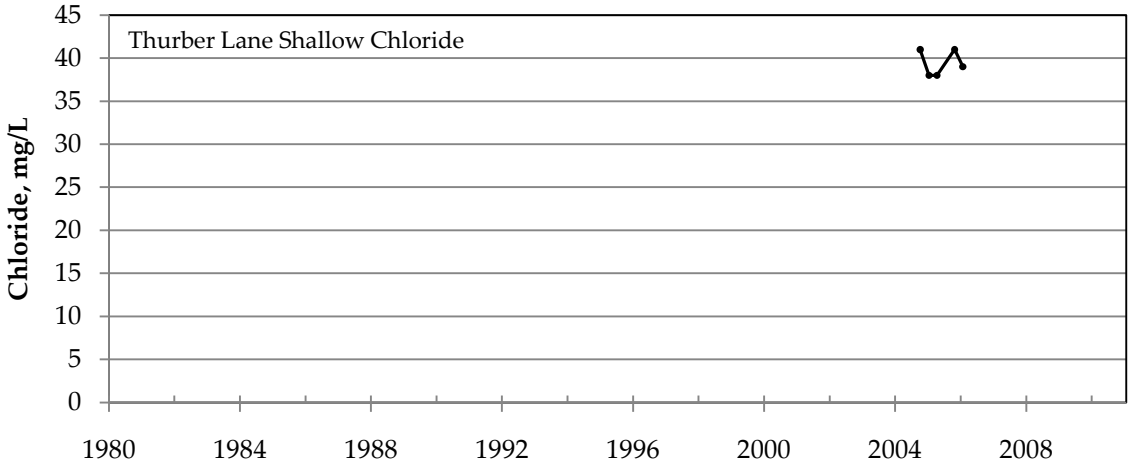

SC-10A Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

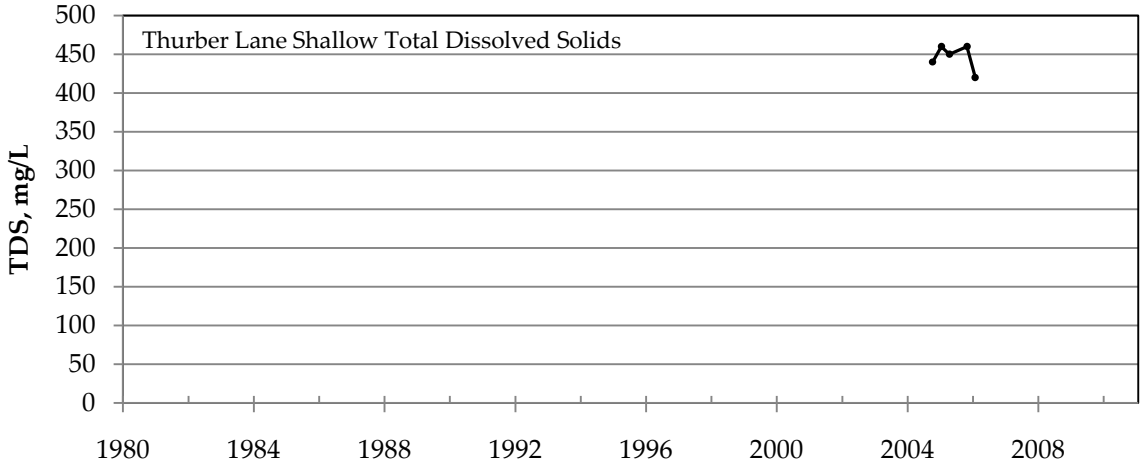

SC-10A Groundwater Elevation
Groundwater Elevation, ft MSL
76
74
72
70
68
66
64
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

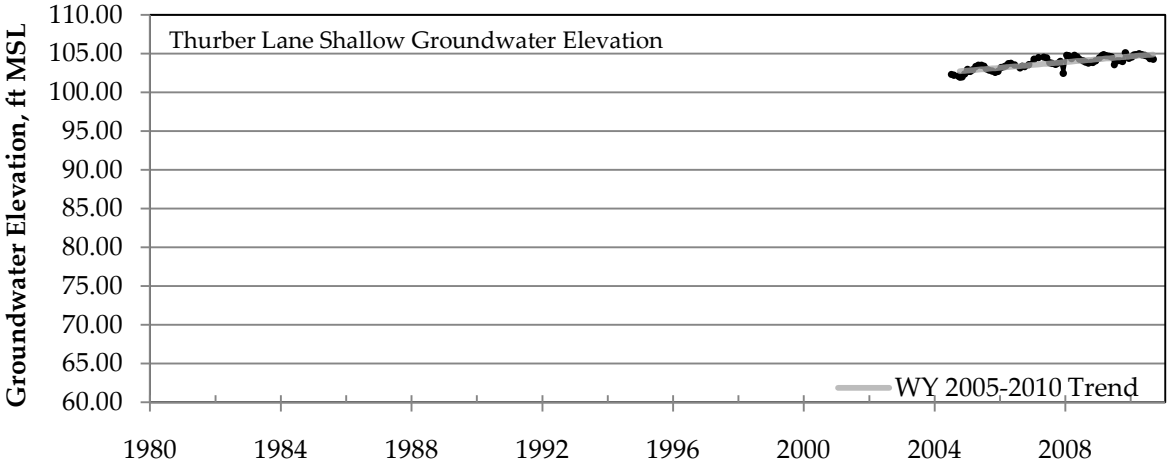

Schwan Lake Shallow Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

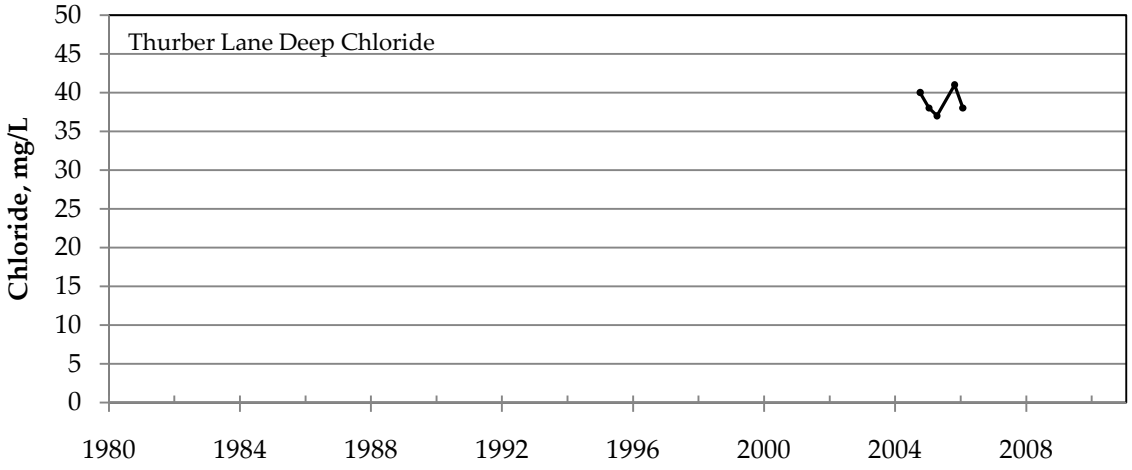

Schwan Lake Shallow Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

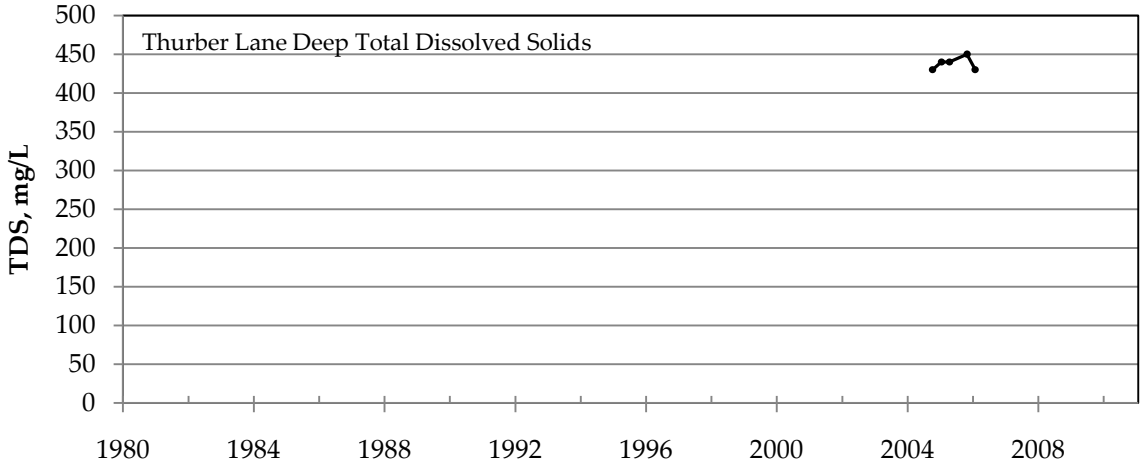

Schwan Lake Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

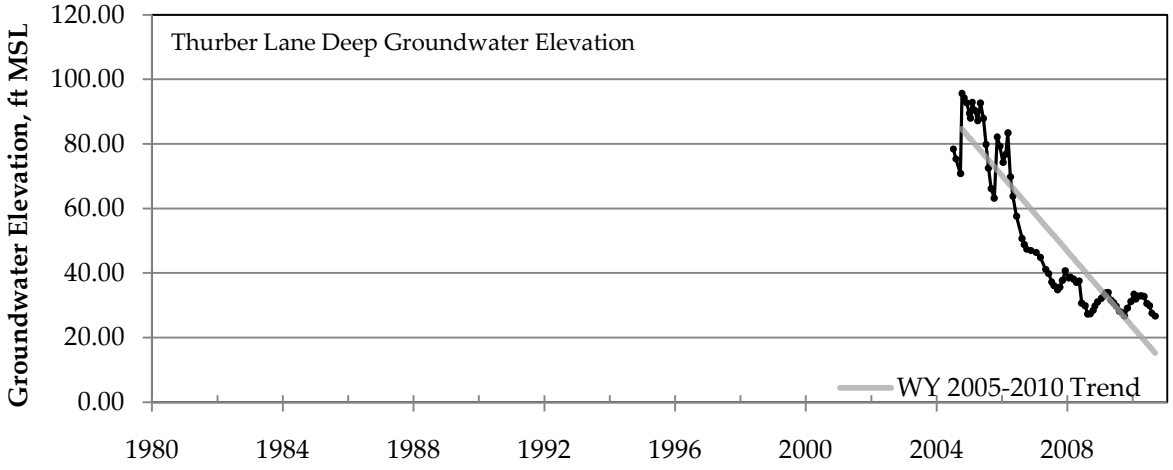

Thurber Lane Shallow Chloride
Chloride, mg/L
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

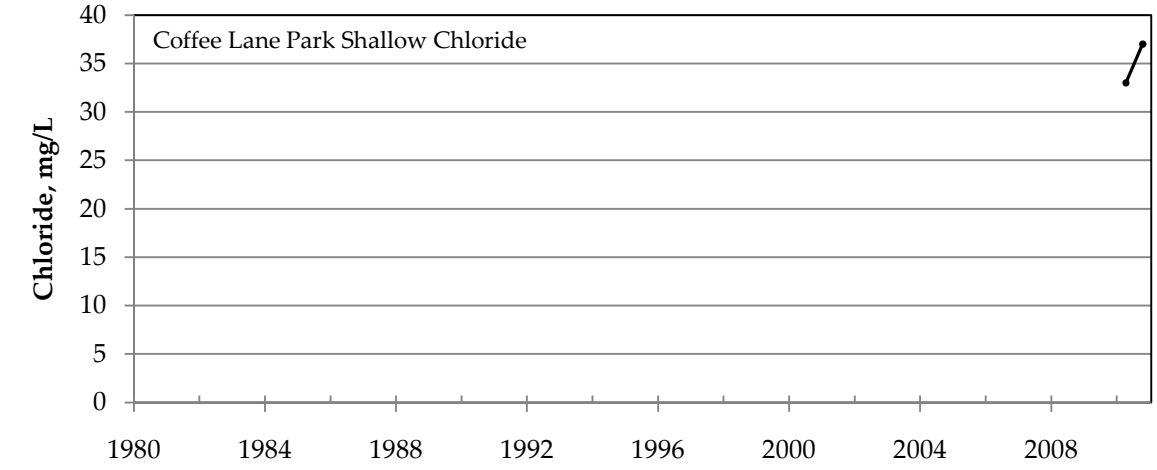

Thurber Lane Shallow Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

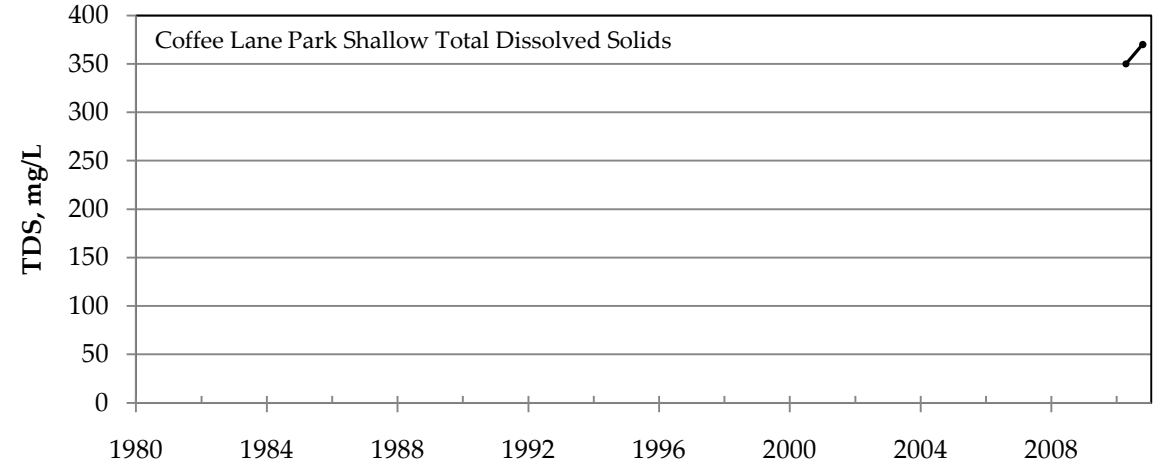

Thurber Lane Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
110.00
105.00
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

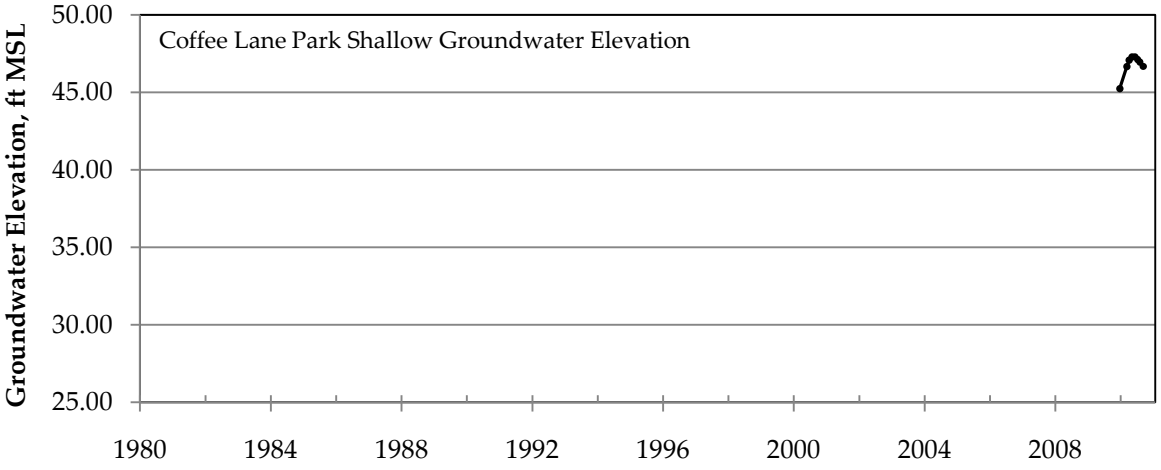

Thurber Lane Deep Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

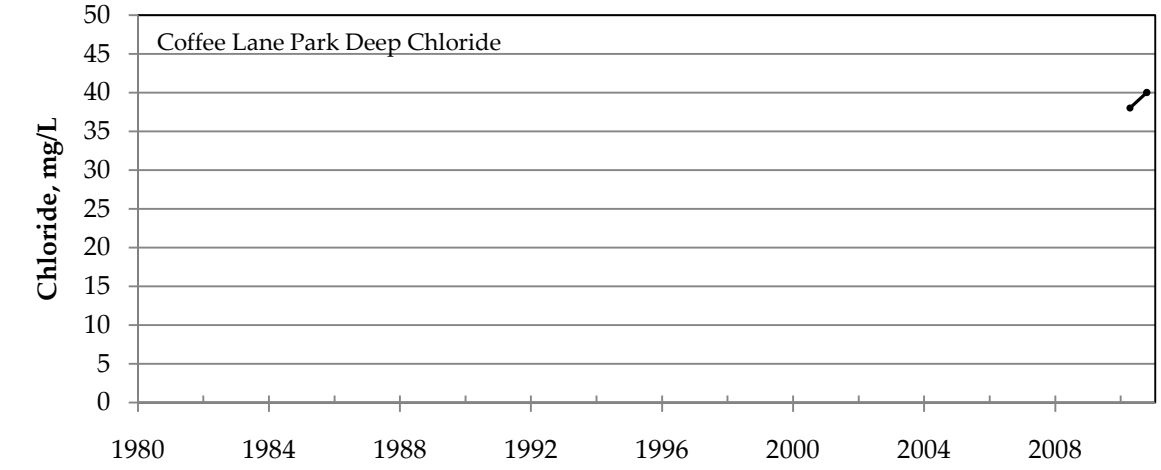

Thurber Lane Deep Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

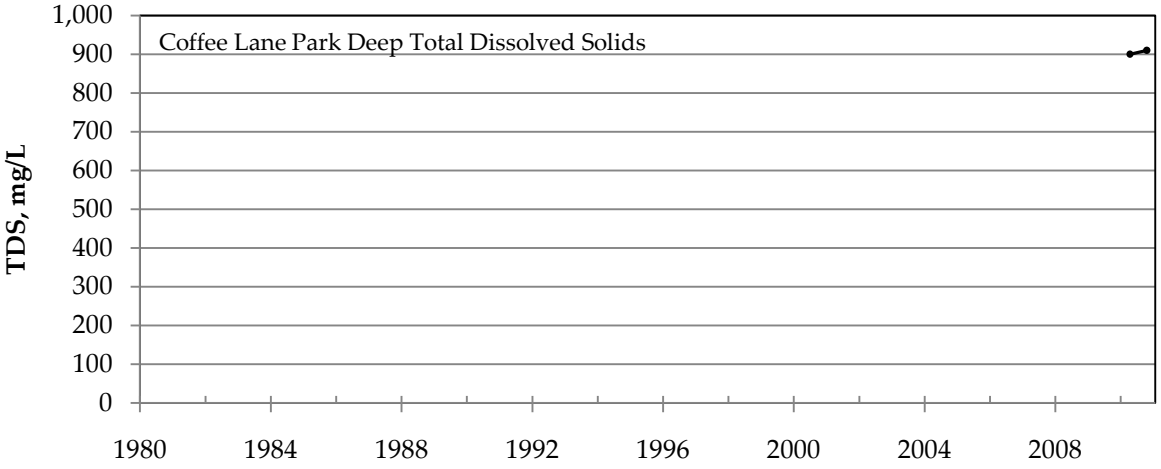

Thurber Lane Deep Groundwater Elevation
Groundwater Elevation, ft MSL
120.00
100.00
80.00
60.00
40.00
20.00
0.00
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

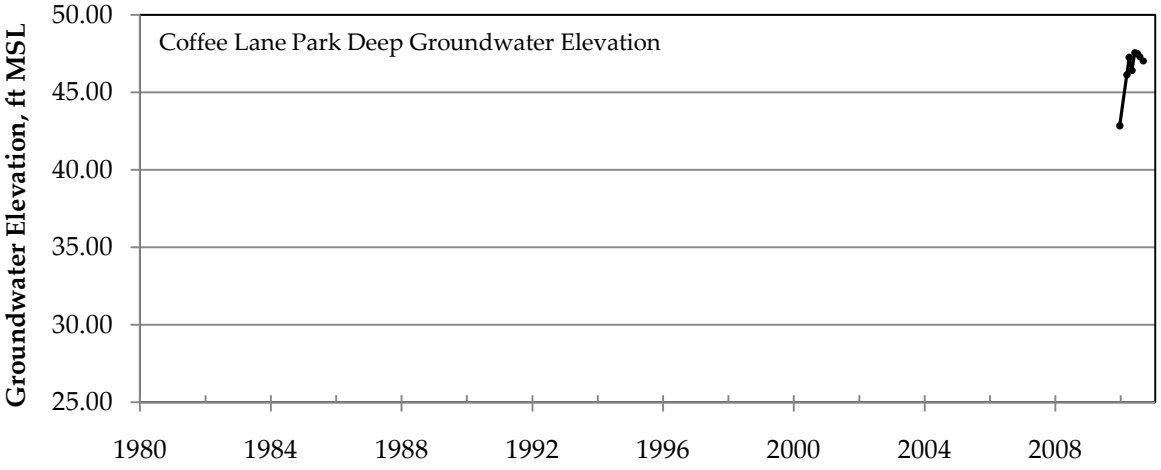

Coffee Lane Park Shallow Chloride
Chloride, mg/L
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

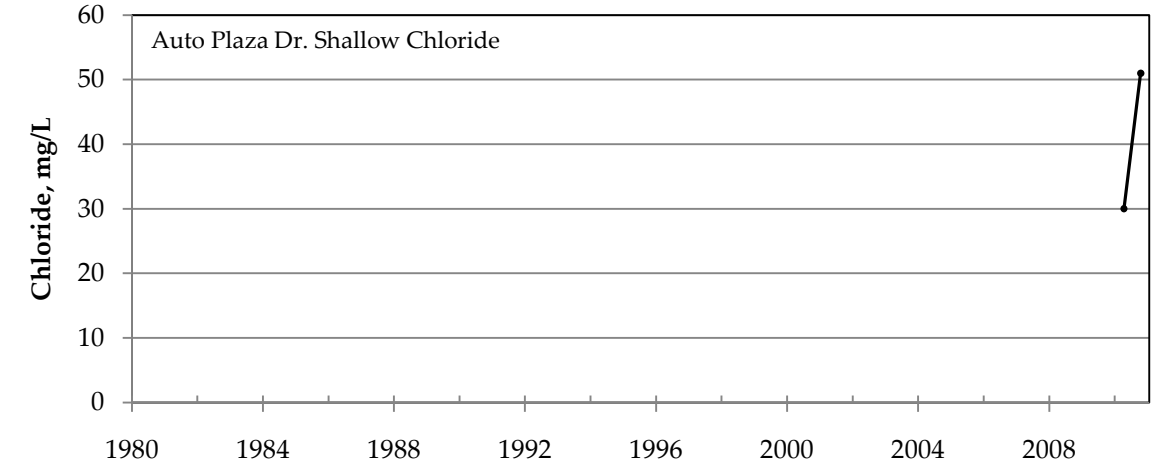

Coffee Lane Park Shallow Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

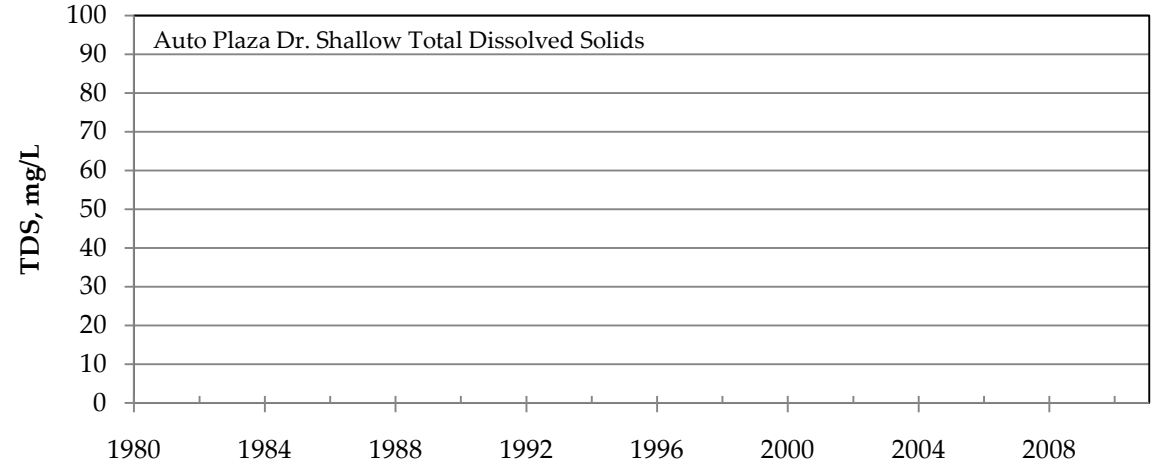

Coffee Lane Park Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
50.00
45.00
40.00
35.00
30.00
25.00
1980
1984
1988
1992
1996
2000
2004
2008

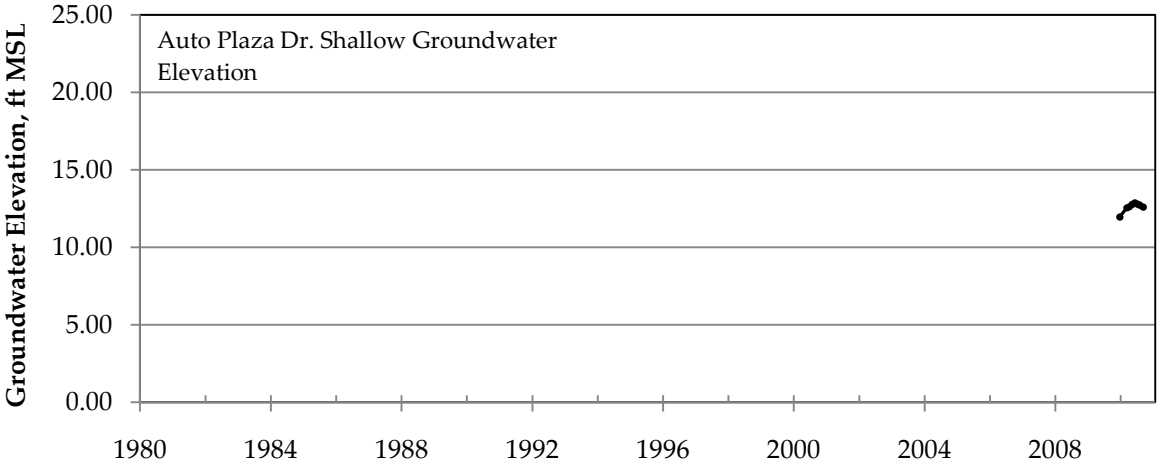

Coffee Lane Park Deep Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

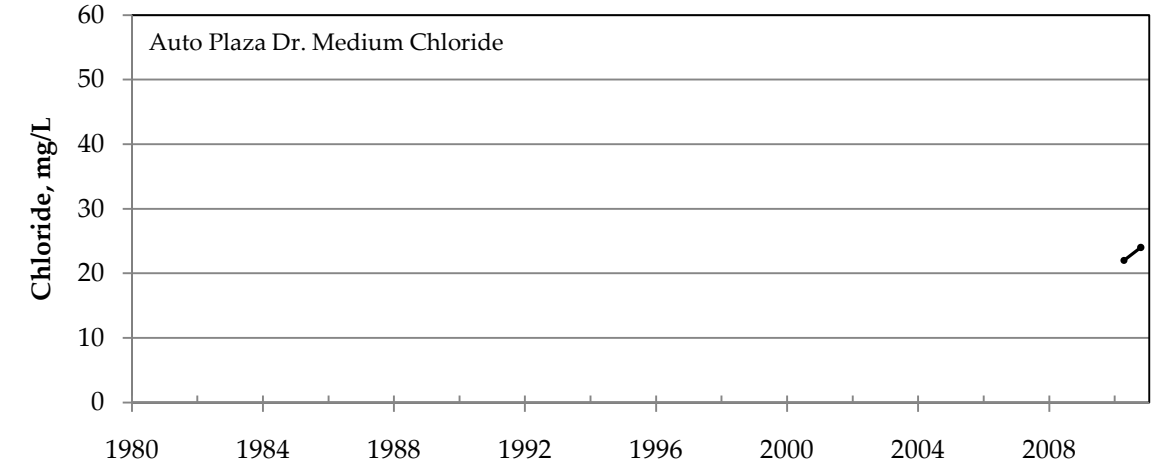

Coffee Lane Park Deep Total Dissolved Solids
TDS, mg/L
1,000
900
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

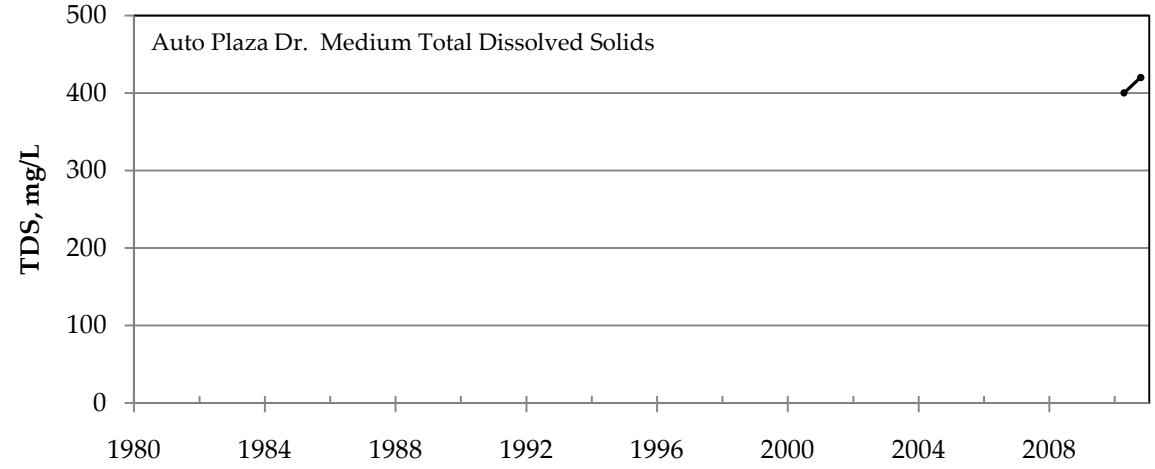

Coffee Lane Park Deep Groundwater Elevation
Groundwater Elevation, ft MSL
50.00
45.00
40.00
35.00
30.00
25.00
1980
1984
1988
1992
1996
2000
2004
2008

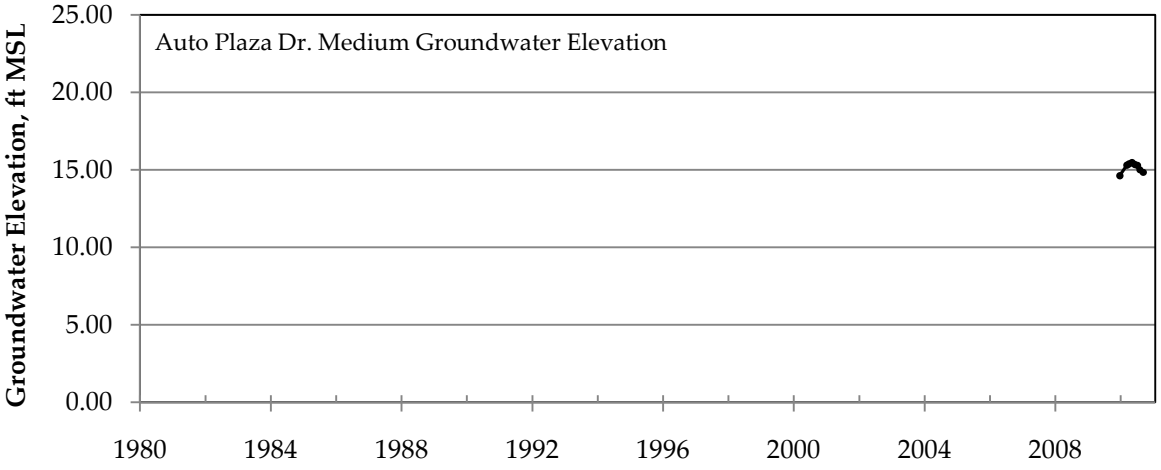

Auto Plaza Dr. Shallow Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

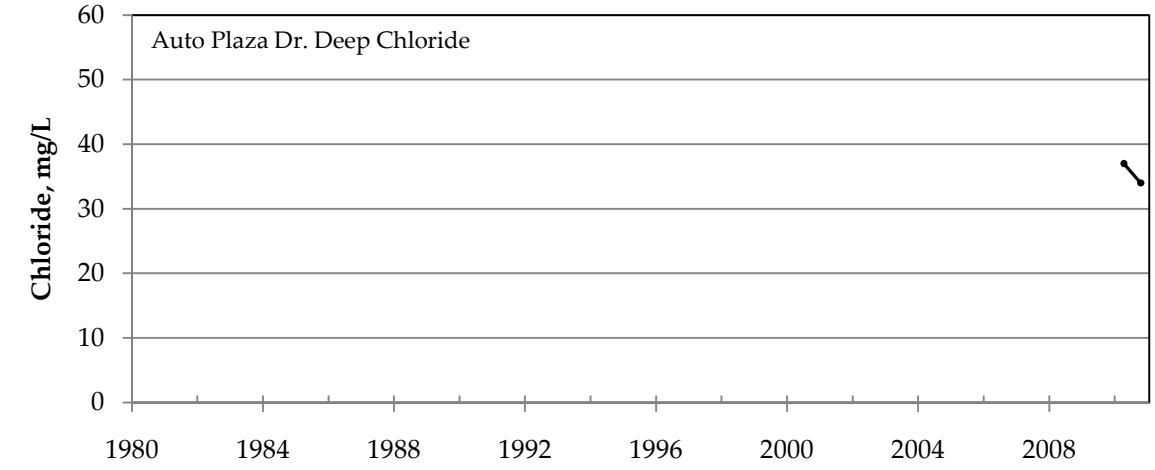

Auto Plaza Dr. Shallow Total Dissolved Solids
TDS, mg/L
100
90
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

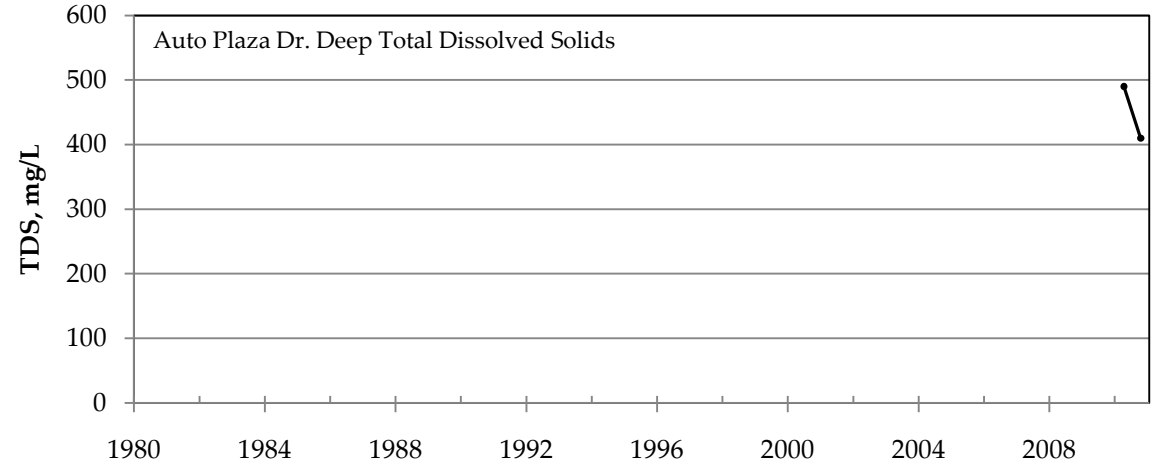

Auto Plaza Dr. Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
1980
1984
1988
1992
1996
2000
2004
2008

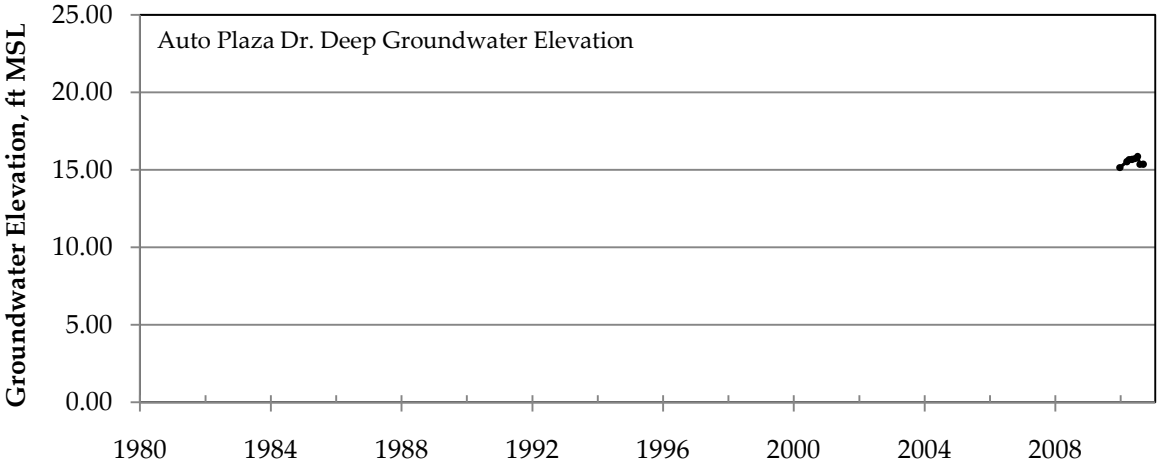

Auto Plaza Dr. Medium Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

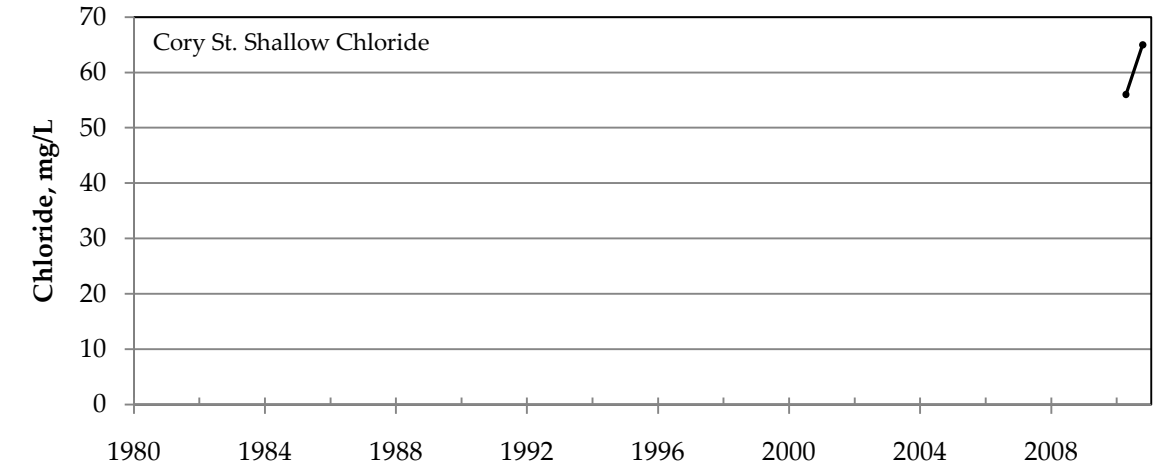

Auto Plaza Dr. Medium Total Dissolved Solids
TDS, mg/L
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

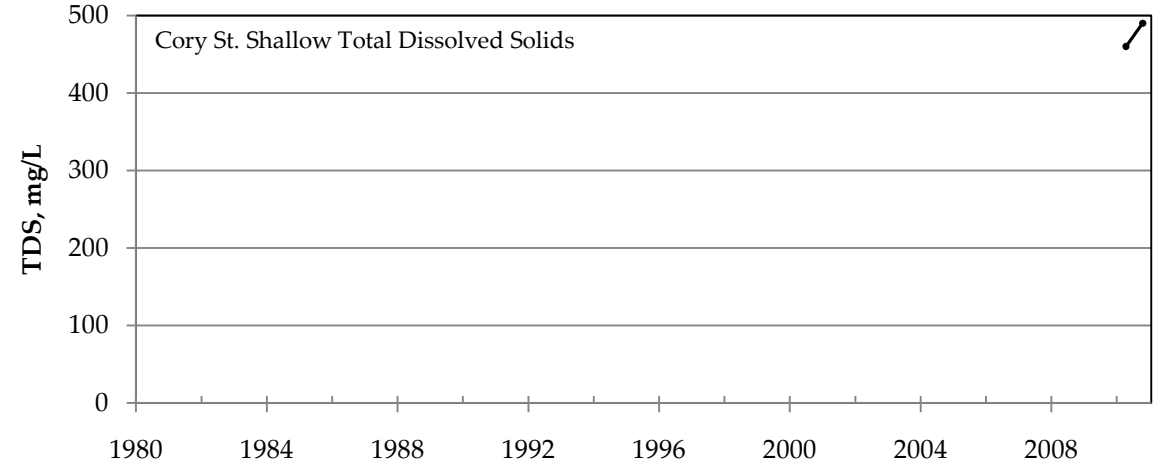

Auto Plaza Dr. Medium Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
1980
1984
1988
1992
1996
2000
2004
2008

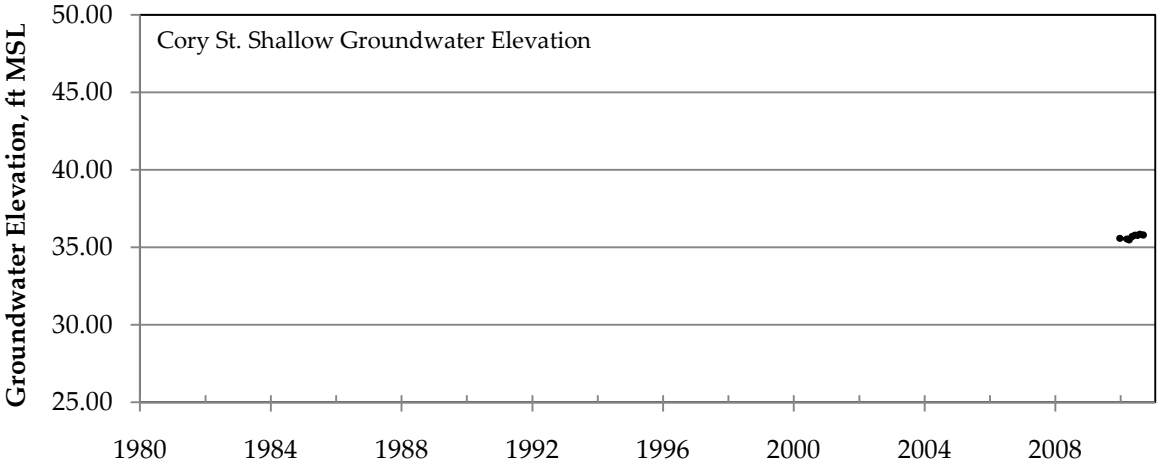

Auto Plaza Dr. Deep Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

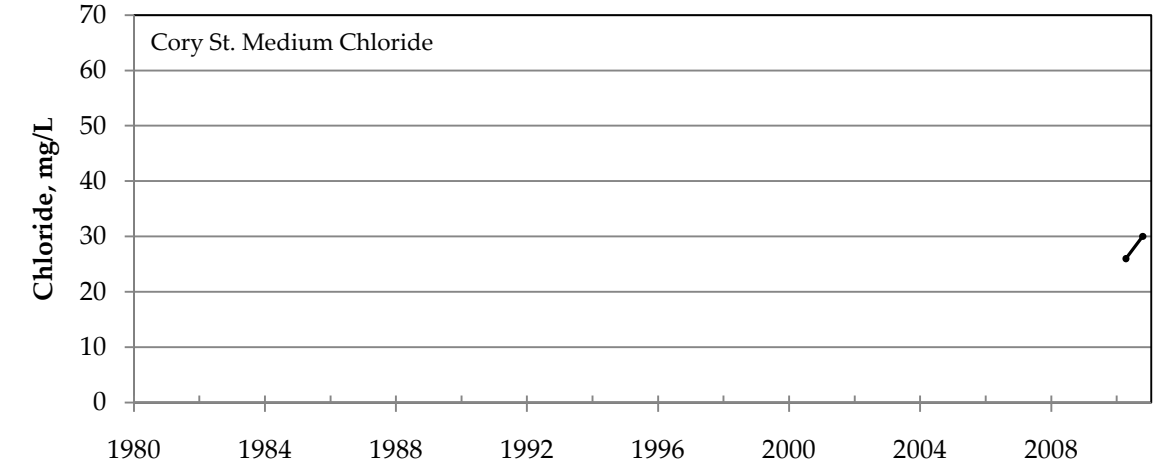

Auto Plaza Dr. Deep Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

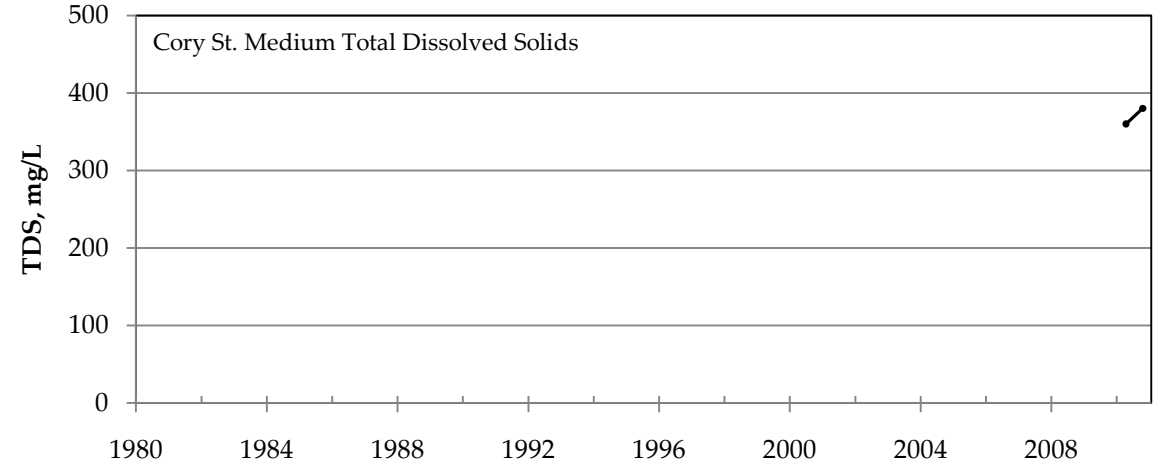

Auto Plaza Dr. Deep Groundwater Elevation
Groundwater Elevation, ft MSL
25.00
20.00
15.00
10.00
5.00
0.00
1980
1984
1988
1992
1996
2000
2004
2008

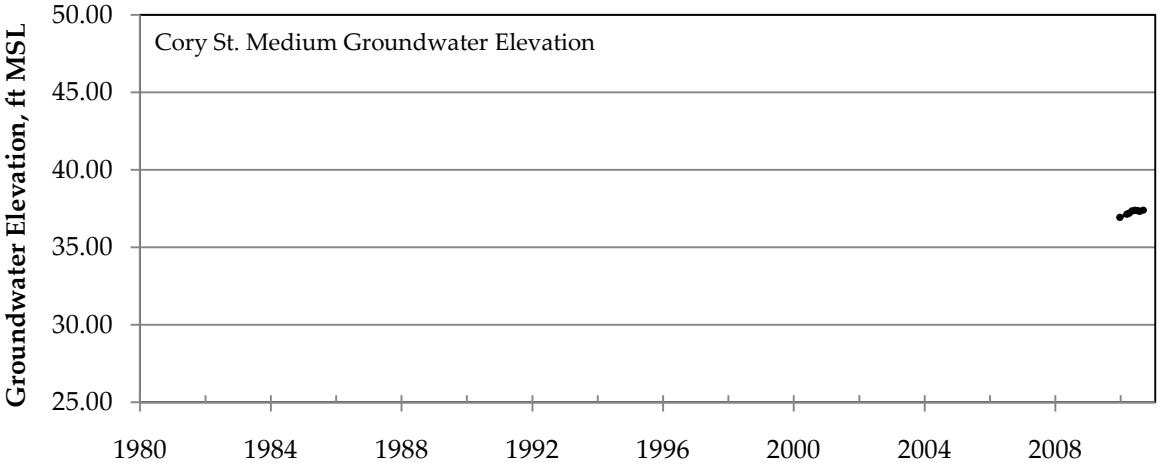

Cory St. Shallow Chloride
Chloride, mg/L
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

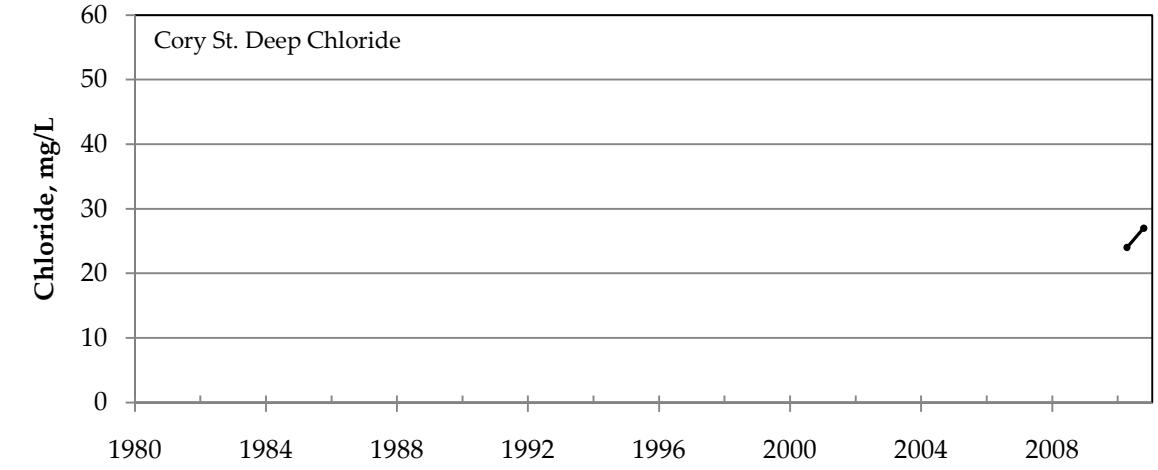

Cory St. Shallow Total Dissolved Solids
TDS, mg/L
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

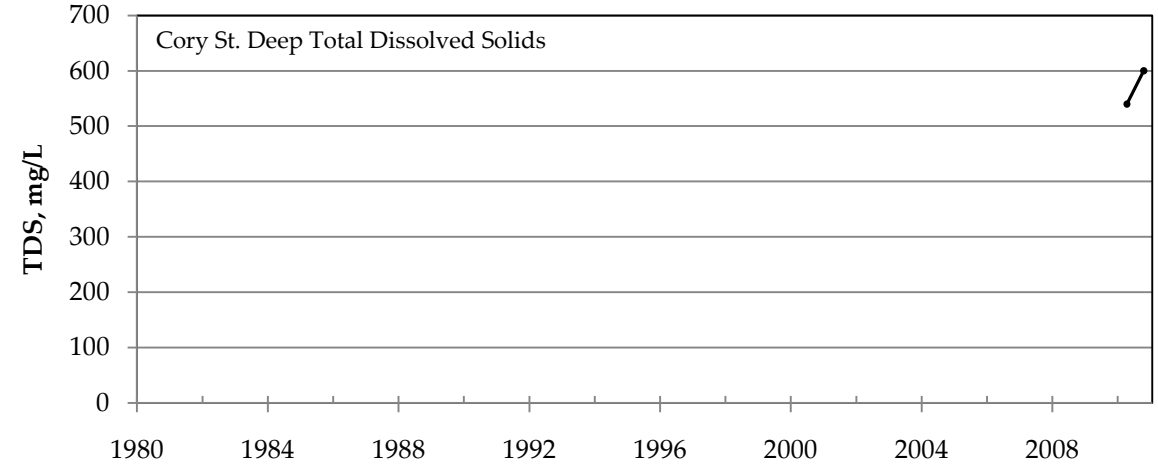

Cory St. Shallow Groundwater Elevation
Groundwater Elevation, ft MSL
50.00
45.00
40.00
35.00
30.00
25.00
1980
1984
1988
1992
1996
2000
2004
2008

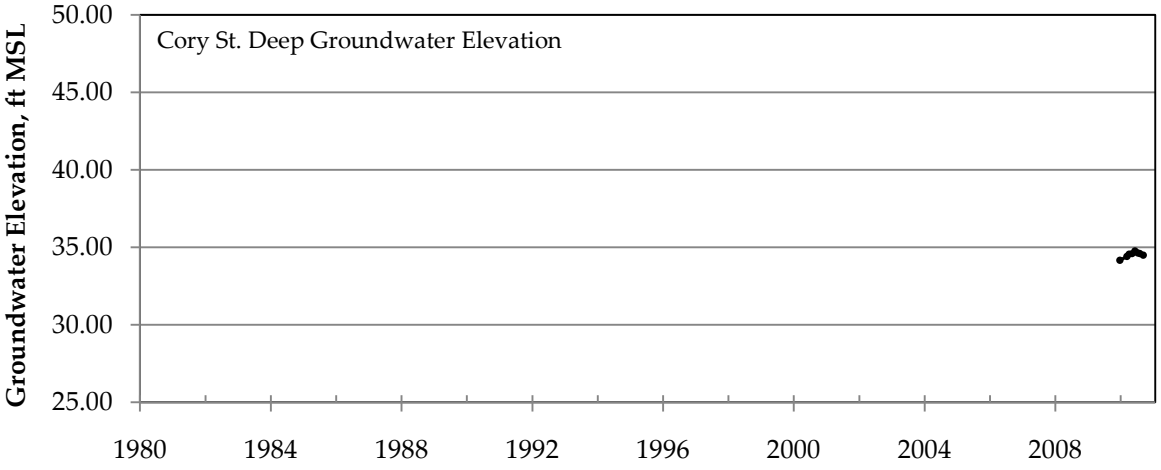

Cory St. Medium Chloride
Chloride, mg/L
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

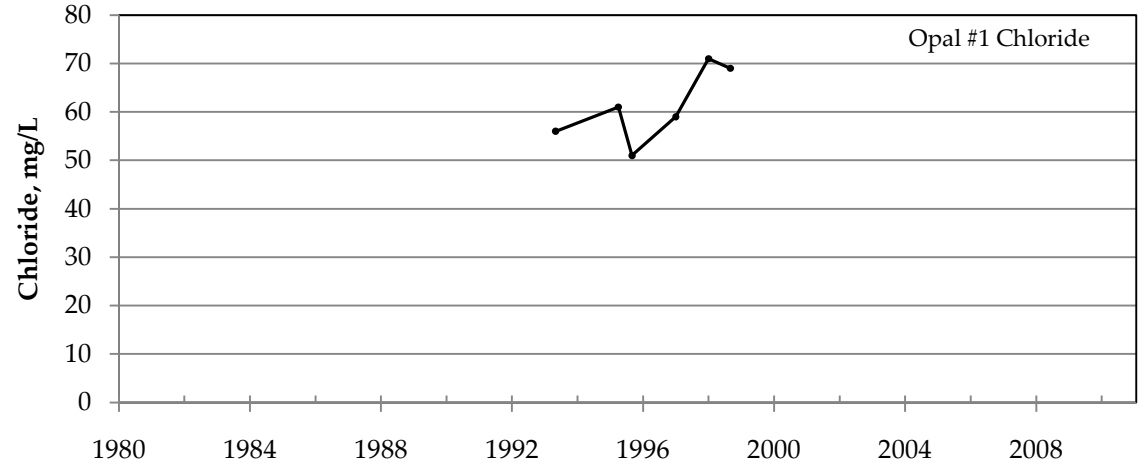

Cory St. Medium Total Dissolved Solids
TDS, mg/L
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

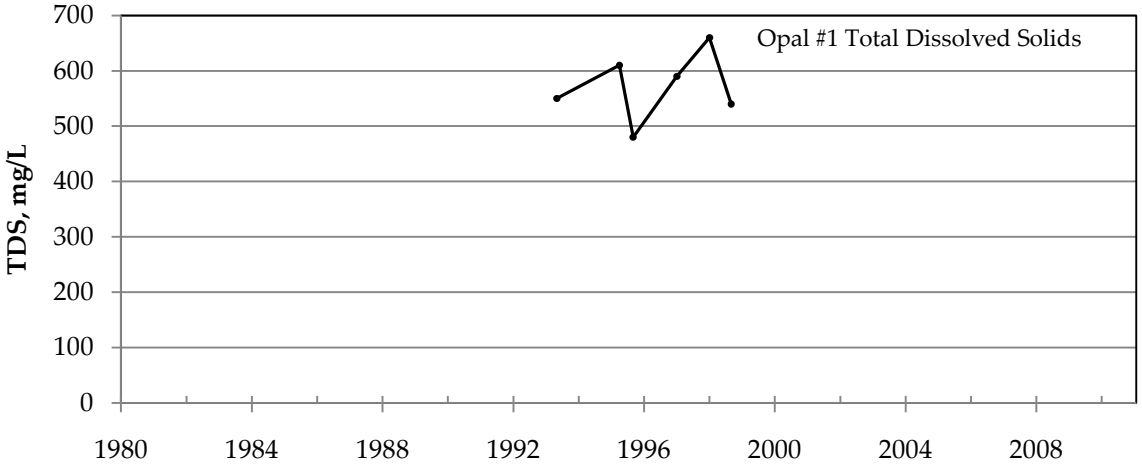

Cory St. Medium Groundwater Elevation
Groundwater Elevation, ft MSL
50.00
45.00
40.00
35.00
30.00
25.00
1980
1984
1988
1992
1996
2000
2004
2008

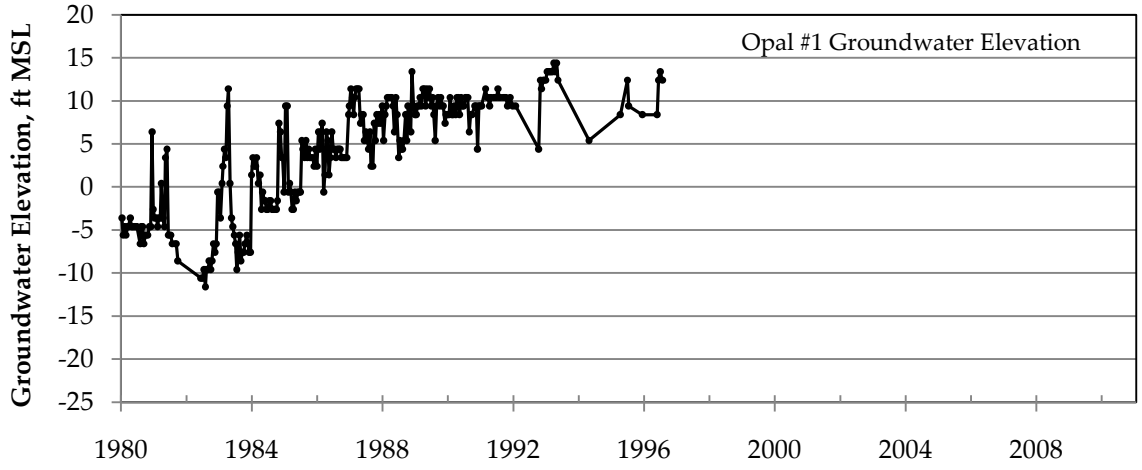

Cory St. Deep Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

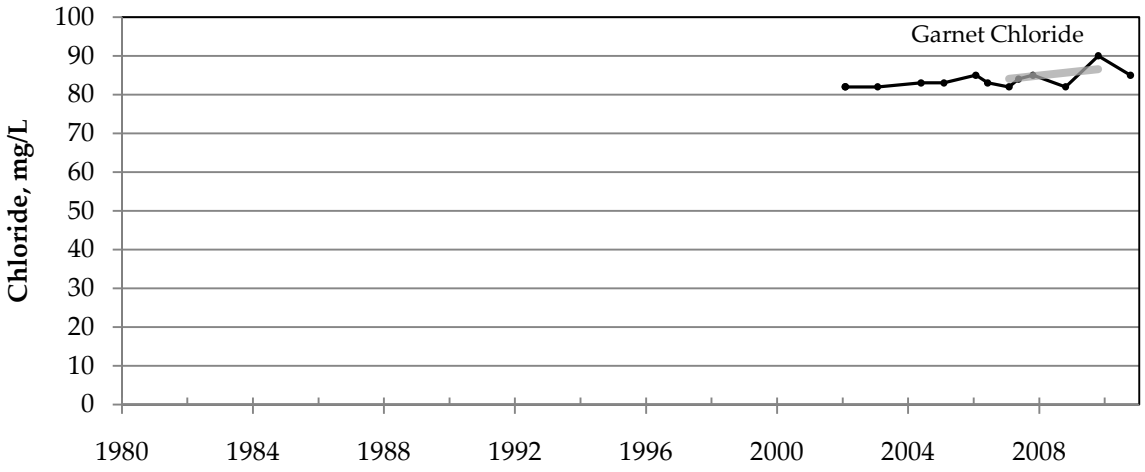

Cory St. Deep Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

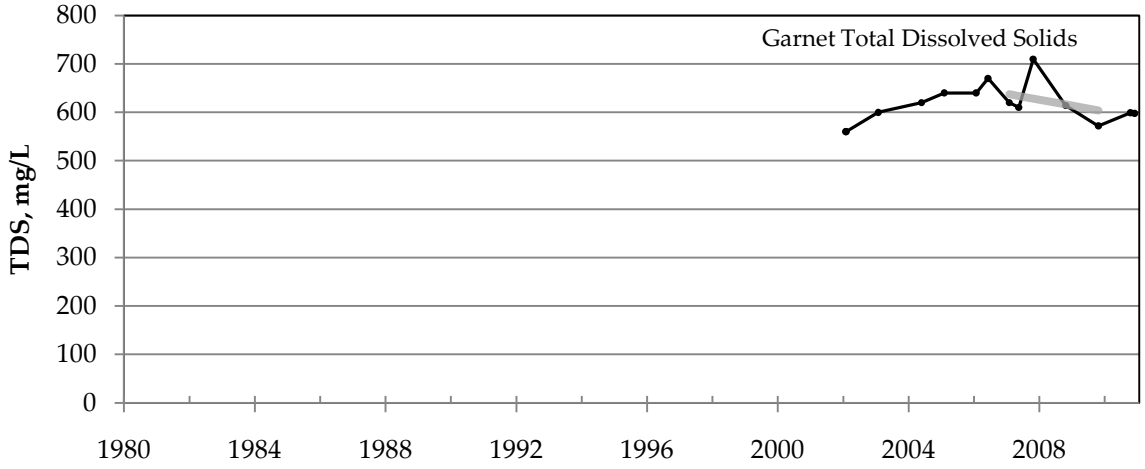

Cory St. Deep Groundwater Elevation
Groundwater Elevation, ft MSL
50.00
45.00
40.00
35.00
30.00
25.00
1980
1984
1988
1992
1996
2000
2004
2008

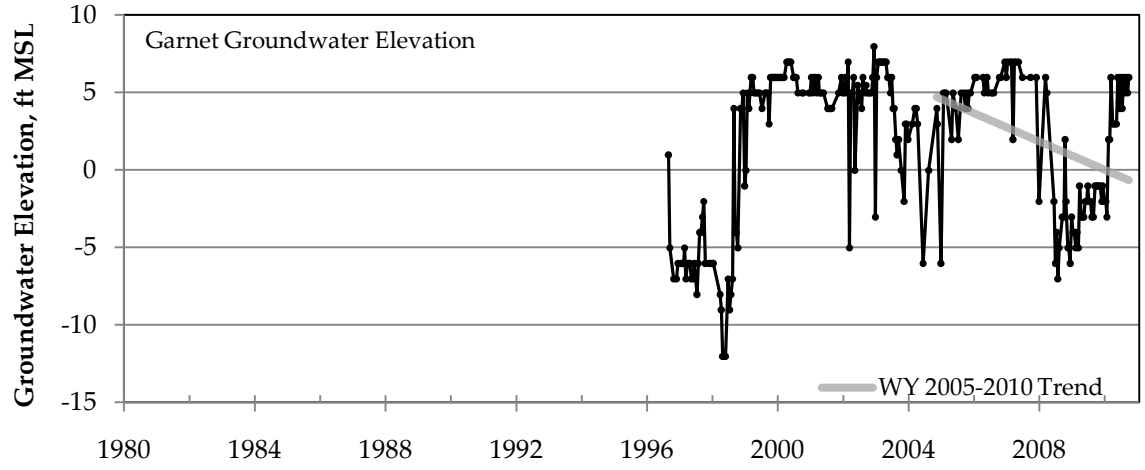

Opal #1 Chloride
Chloride, mg/L
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

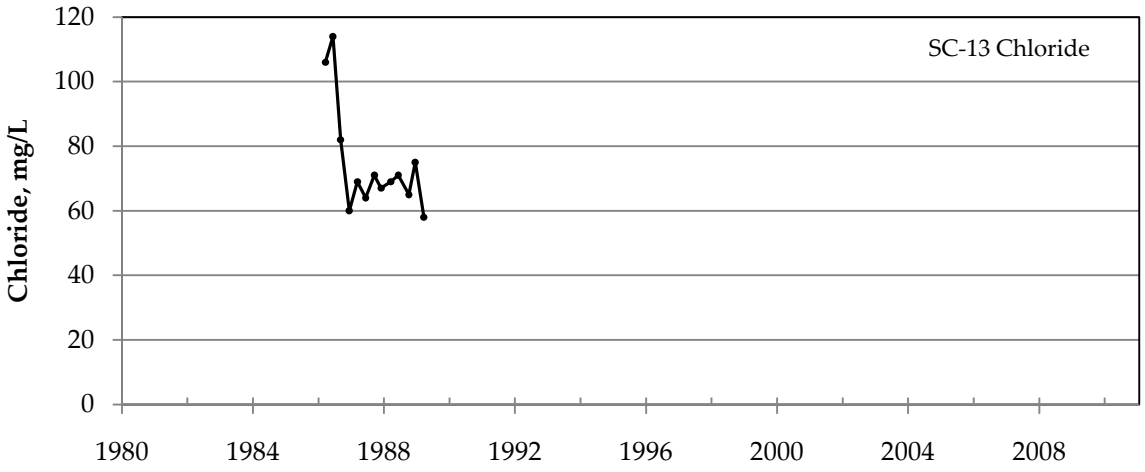

Opal #1 Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

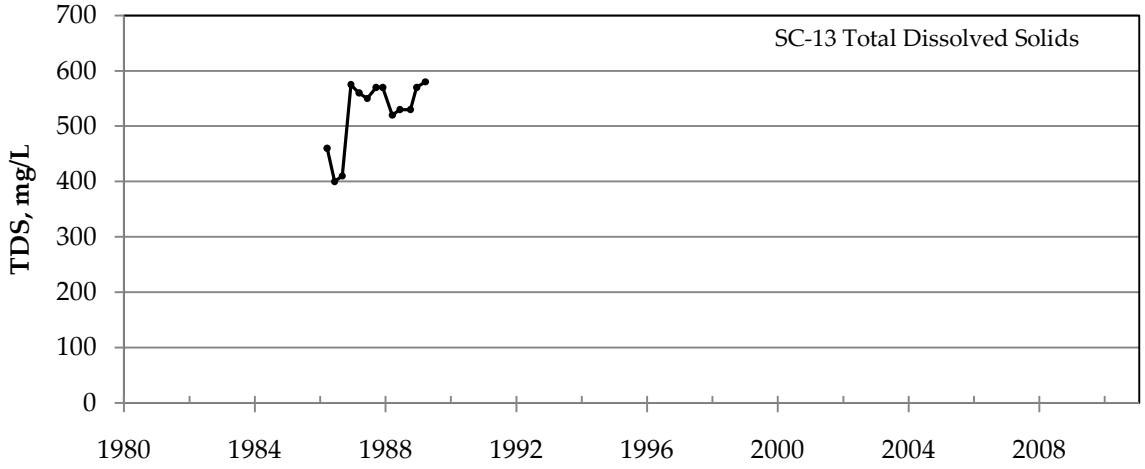

Opal #1 Groundwater Elevation
Groundwater Elevation, ft MSL
20
15
10
5
0
-5
-10
-15
-20
-25
1980
1984
1988
1992
1996
2000
2004
2008

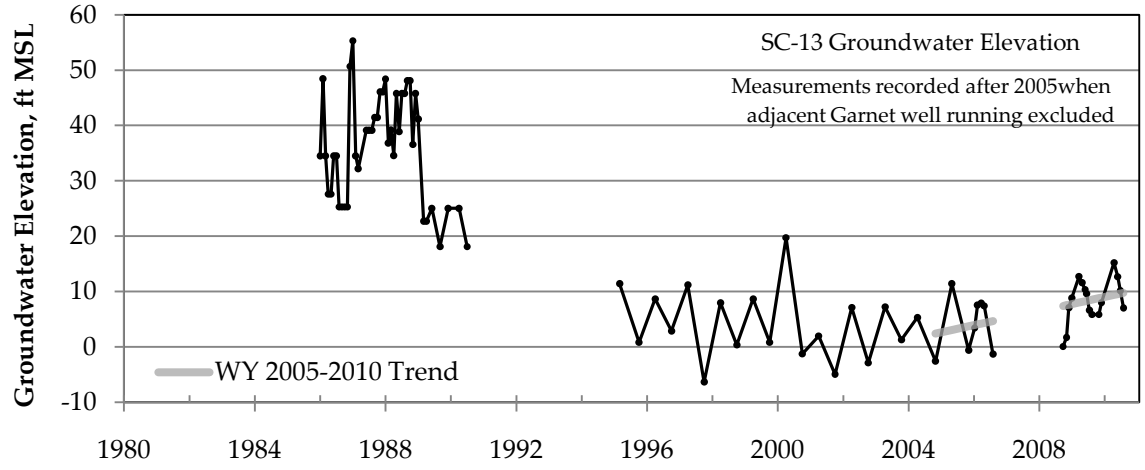

Garnet Chloride
Chloride, mg/L
100
90
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

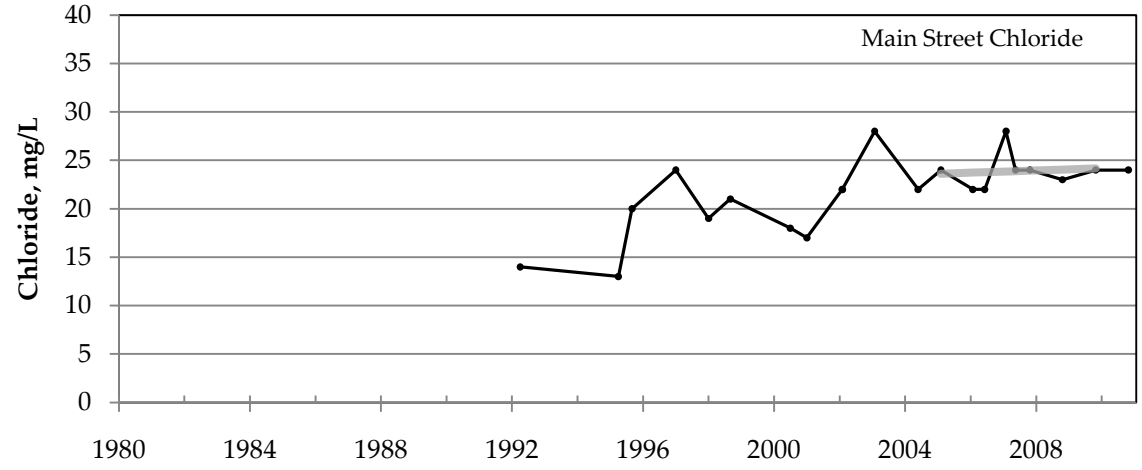

Garnet Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

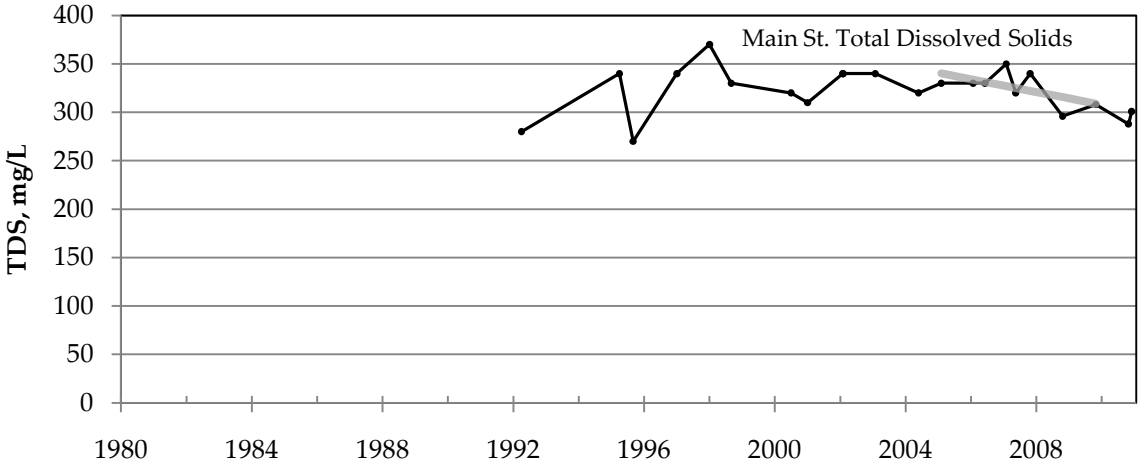

Garnet Groundwater Elevation
Groundwater Elevation, ft MSL
10
5
0
-5
-10
-15
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

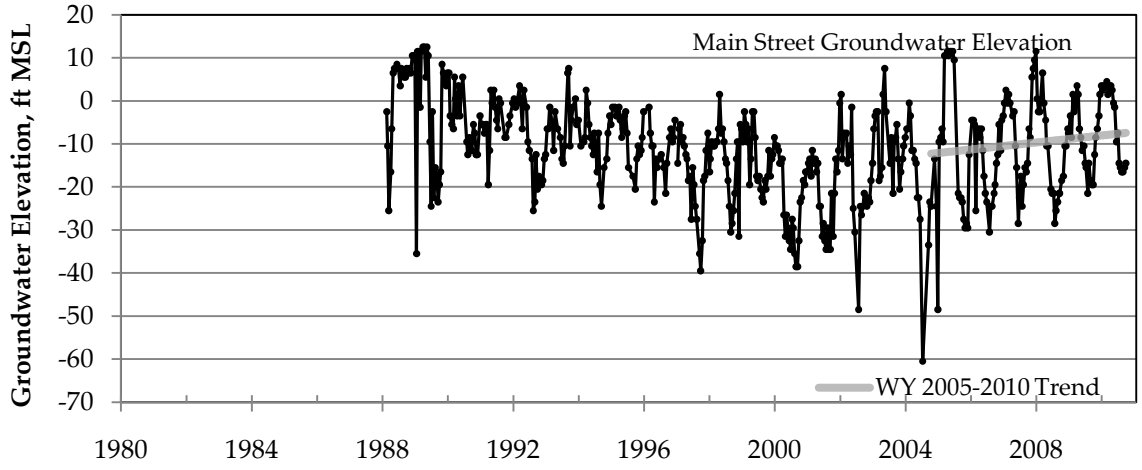

SC-13 Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

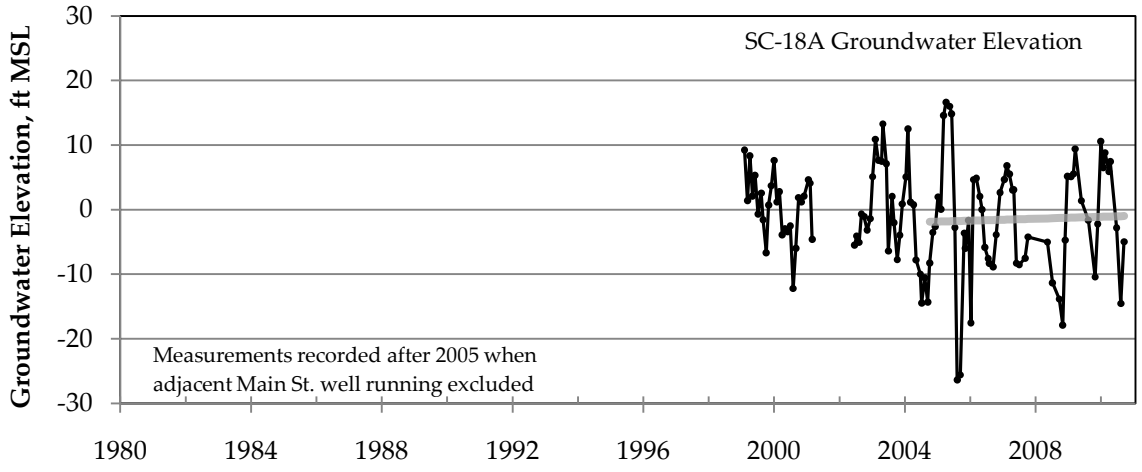

SC-13 Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

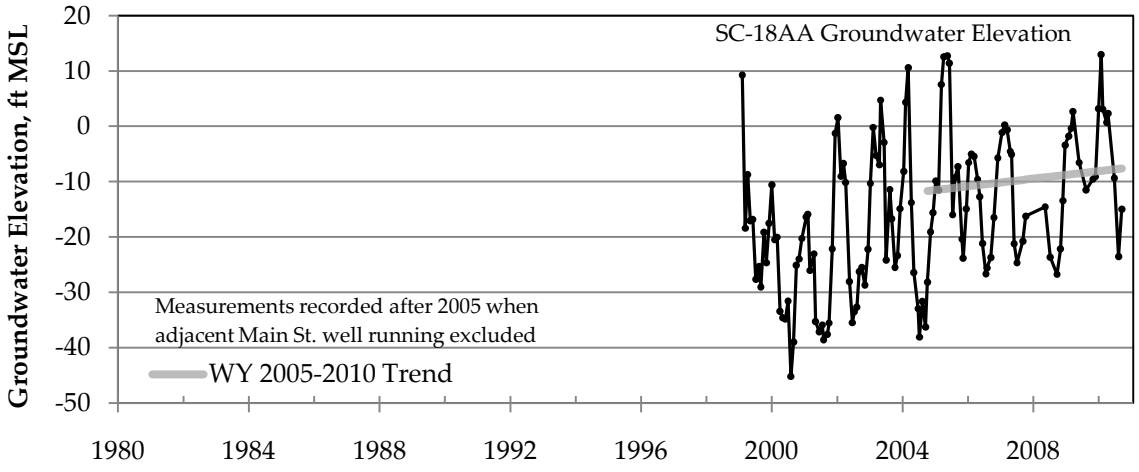

SC-13 Groundwater Elevation
Measurements recorded after 2005when adjacent Garnet well running excluded
Groundwater Elevation, ft MSL
60
50
40
30
20
10
0
-10
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

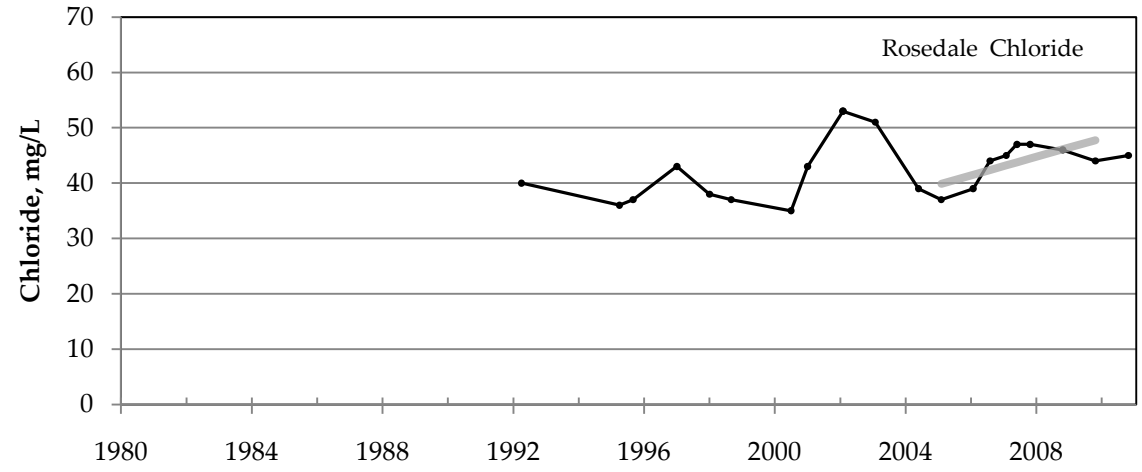

Main Street Chloride
Chloride, mg/L
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

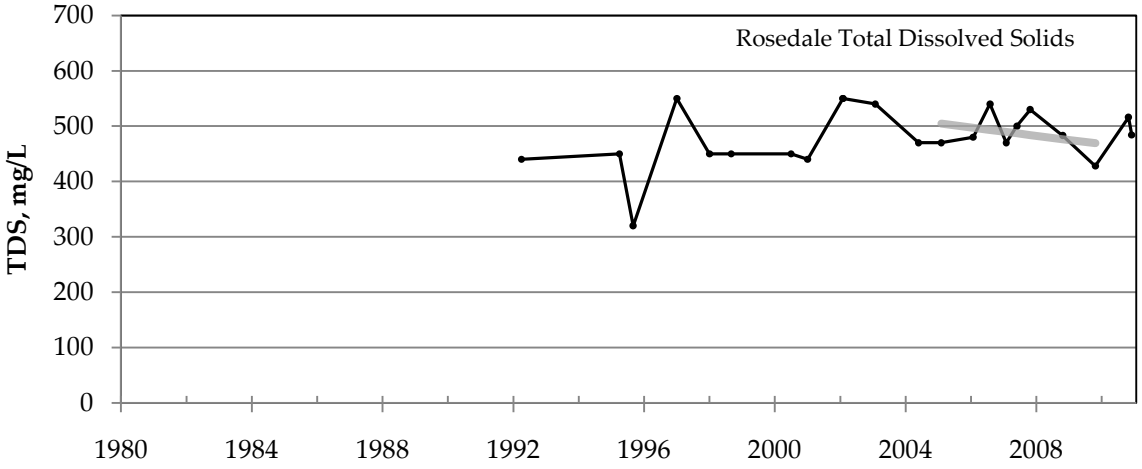

Main St. Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

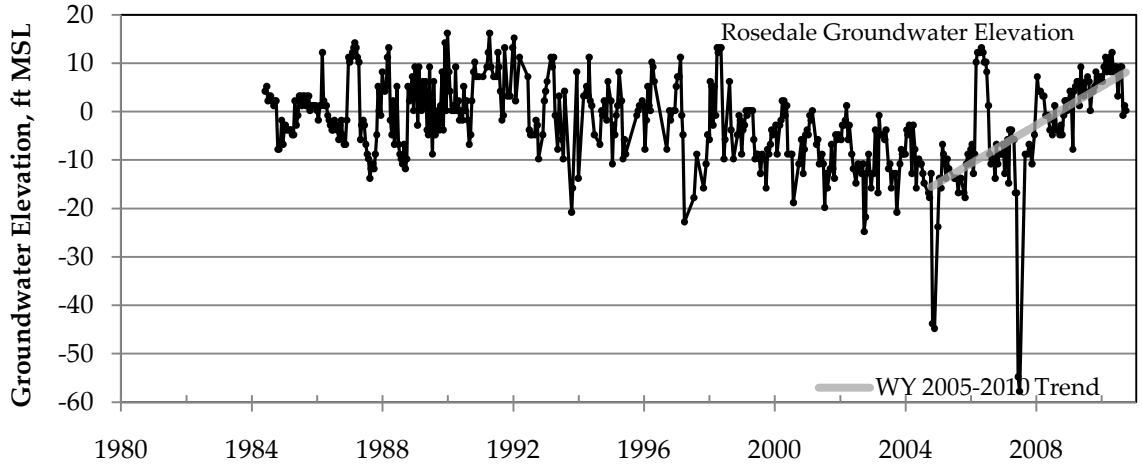

Main Street Groundwater Elevation
Groundwater Elevation, ft MSL
20
10
0
-10
-20
-30
-40
-50
-60
-70
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

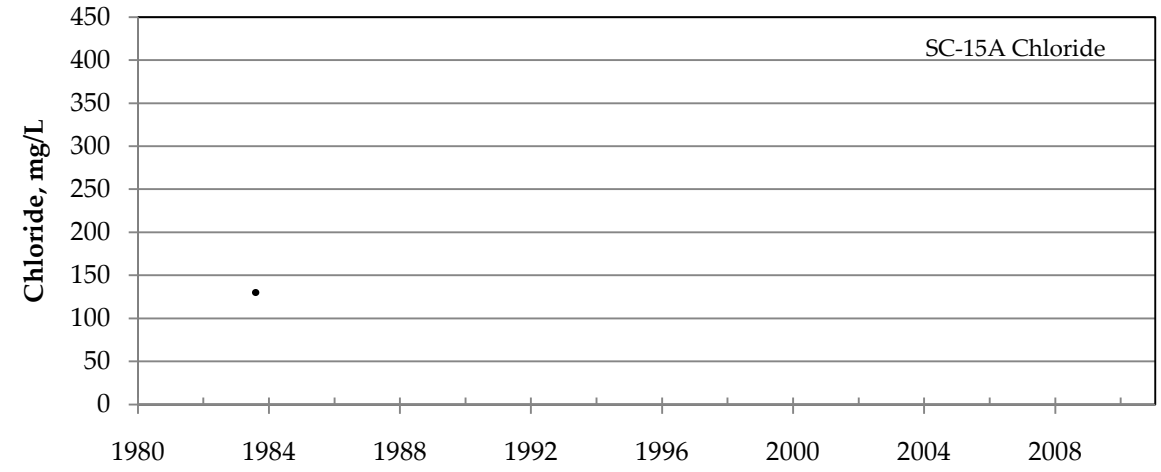

SC-18A Groundwater Elevation
Groundwater Elevation, ft MSL
30
20
10
0
-10
-20
-30
Measurements recorded after 2005 when adjacent Main St. well running excluded
1980
1984
1988
1992
1996
2000
2004
2008

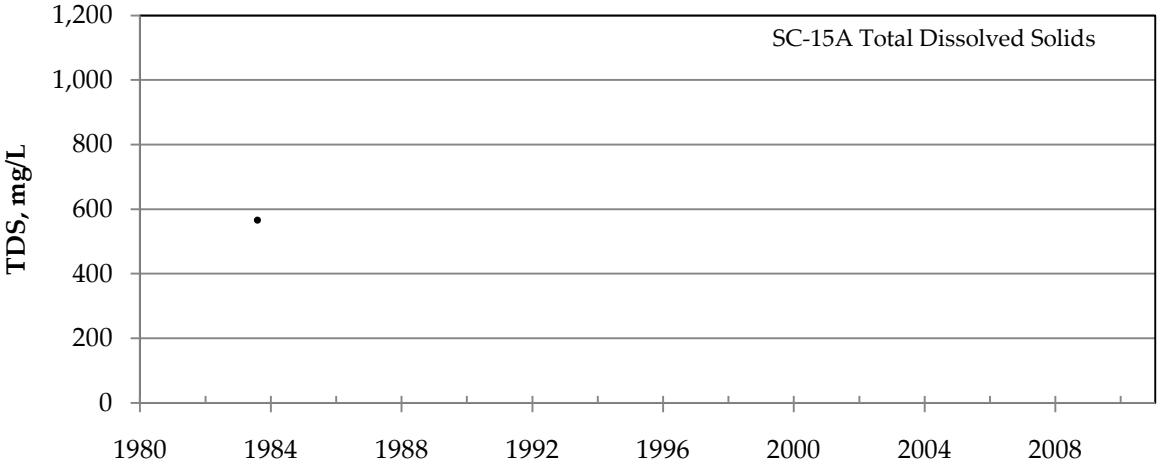

SC-18AA Groundwater Elevation
Groundwater Elevation, ft MSL
20
10
0
-10
-20
-30
-40
-50
Measurements recorded after 2005 when adjacent Main St. well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

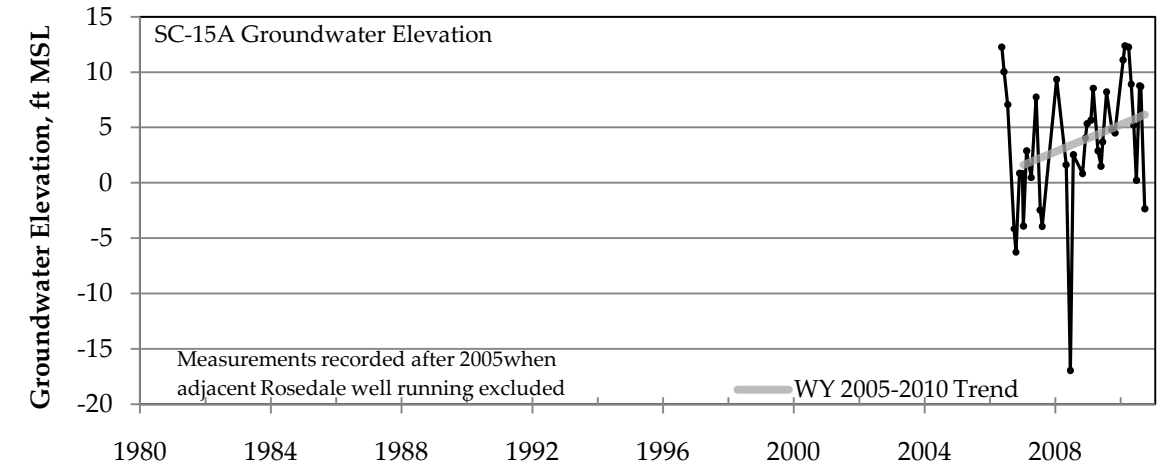

Rosedale Chloride
Chloride, mg/L
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

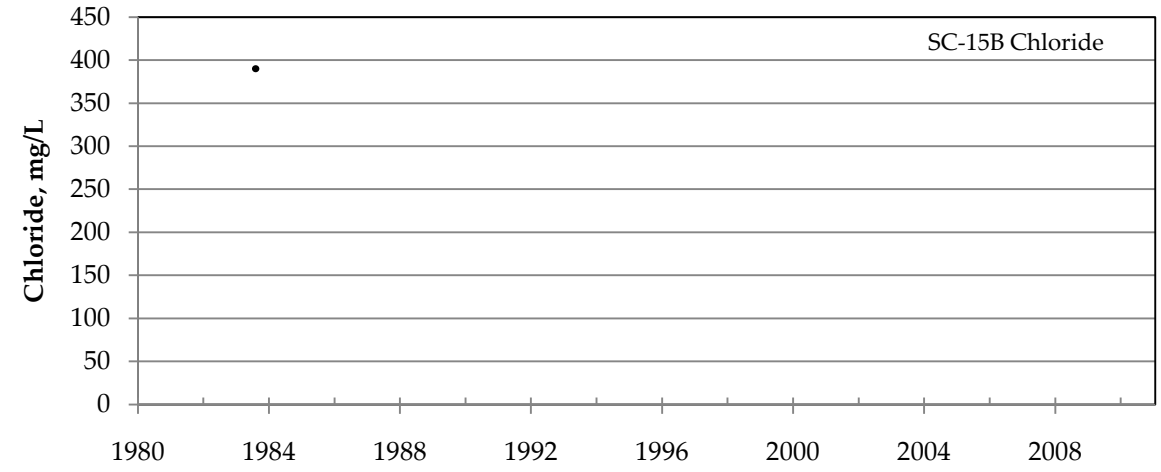

Rosedale Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

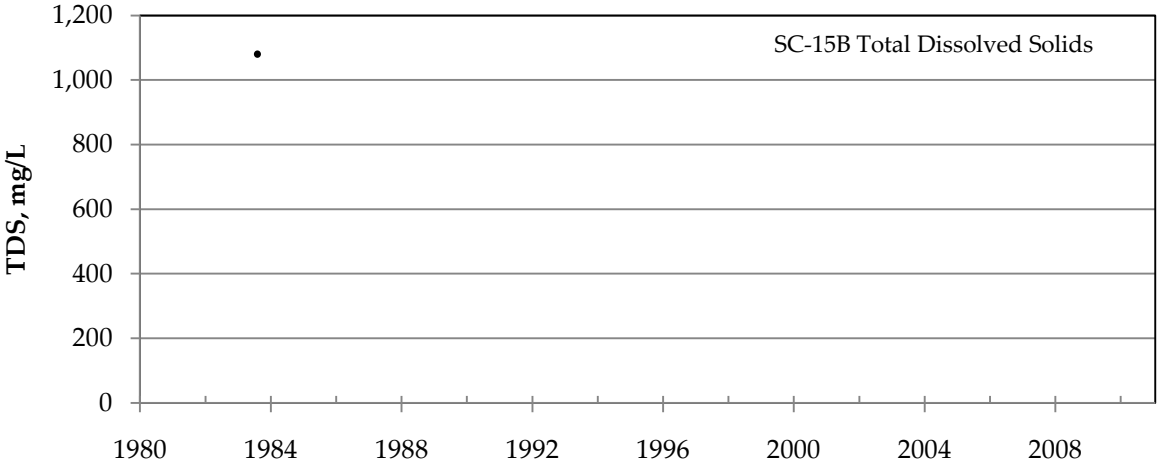

Rosedale Groundwater Elevation
Groundwater Elevation, ft MSL
20
10
0
-10
-20
-30
-40
-50
-60
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

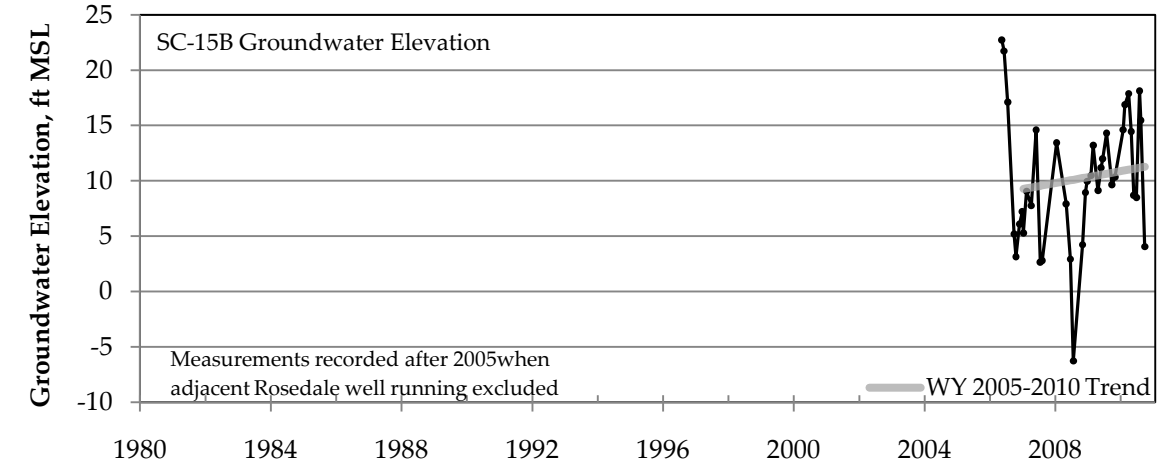

SC-15A Chloride
Chloride, mg/L
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

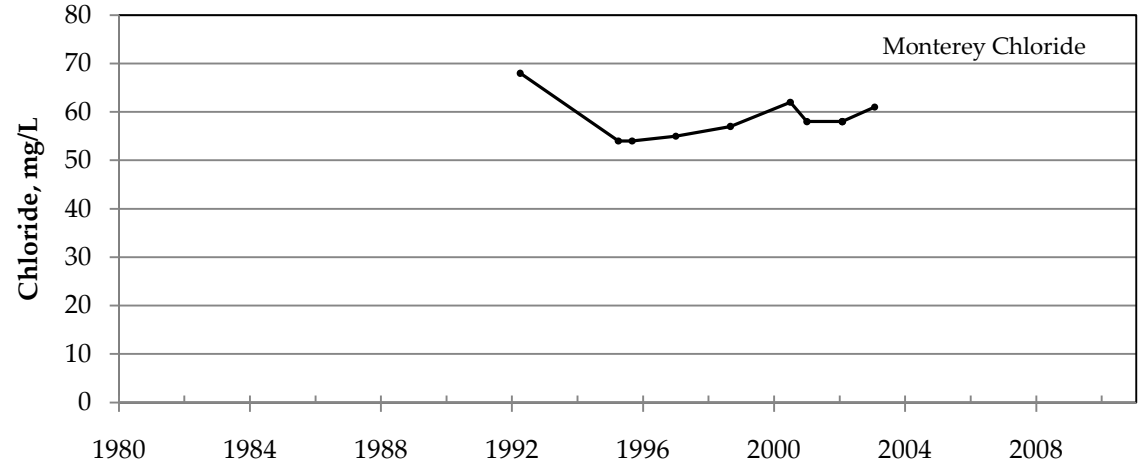

SC-15A Total Dissolved Solids
TDS, mg/L
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

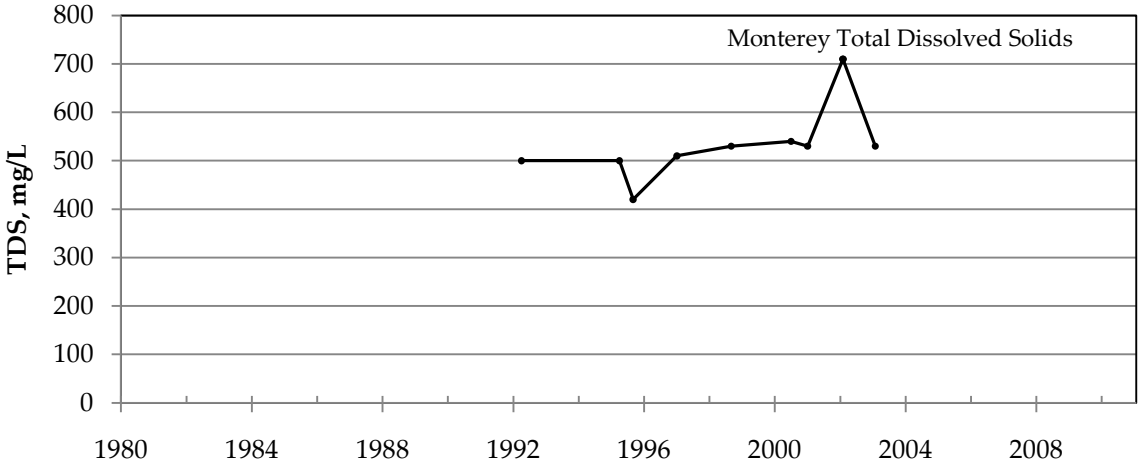

SC-15A Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
Measurements recorded after 2005when
adjacent Rosedale well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

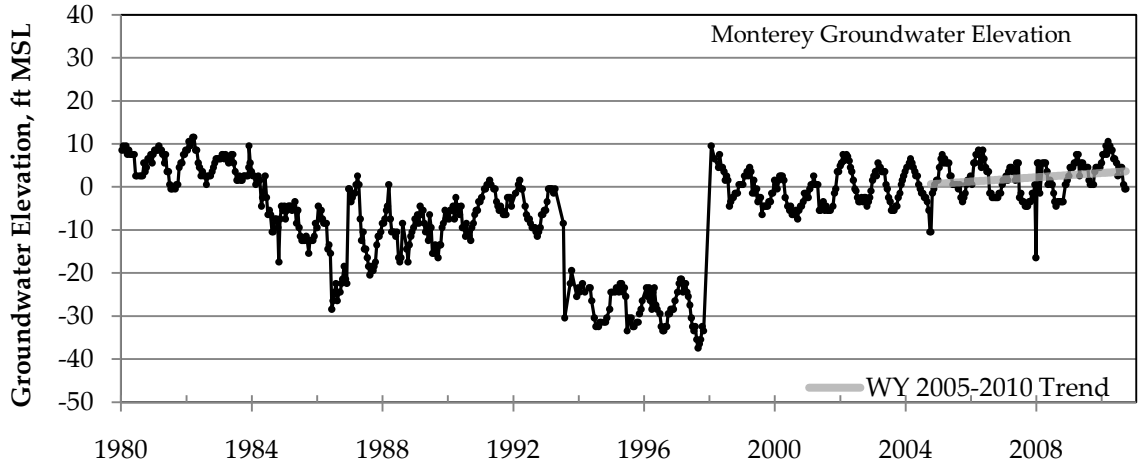

SC-15B Chloride
Chloride, mg/L
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

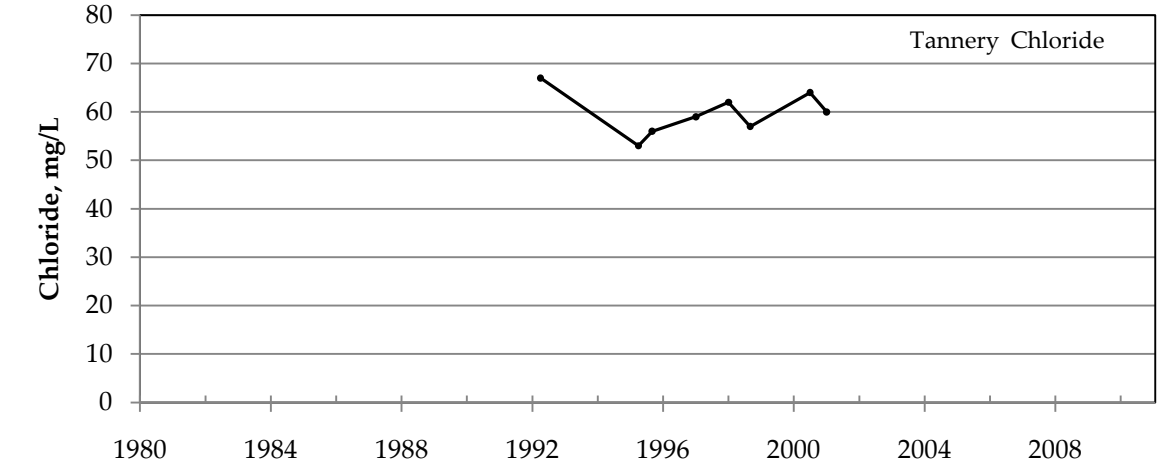

SC-15B Total Dissolved Solids
TDS, mg/L
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

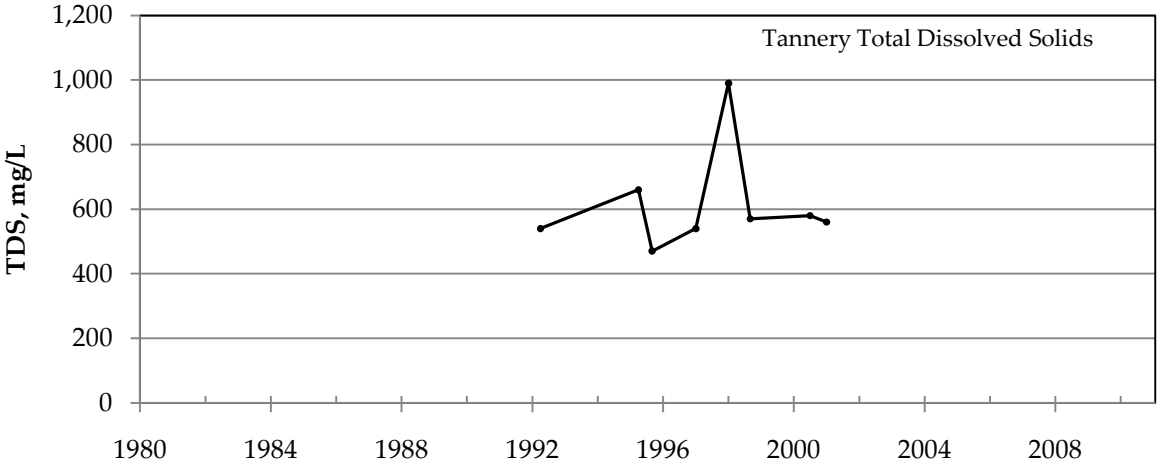

SC-15B Groundwater Elevation
Groundwater Elevation, ft MSL
25
20
15
10
5
0
-5
-10
Measurements recorded after 2005when
adjacent Rosedale well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

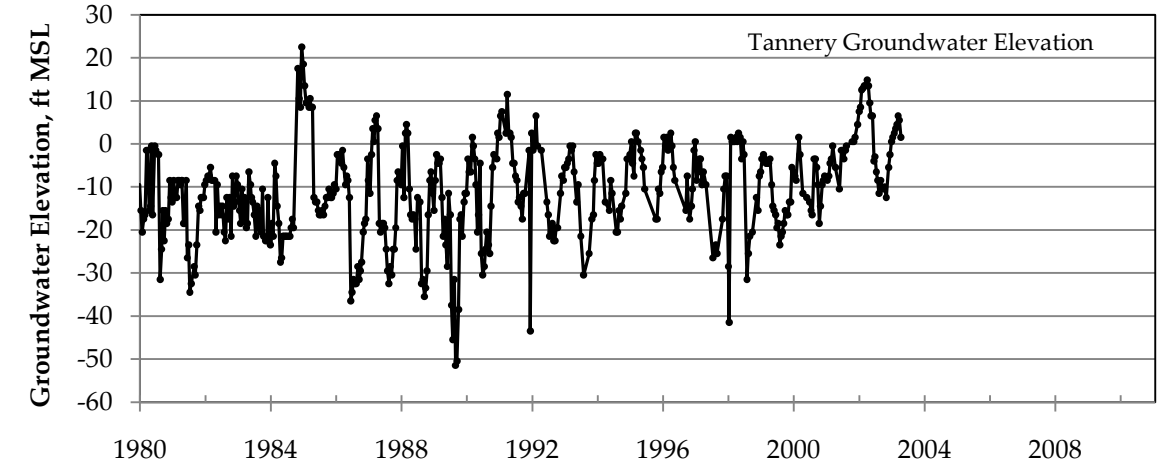

Monterey Chloride
Chloride, mg/L
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

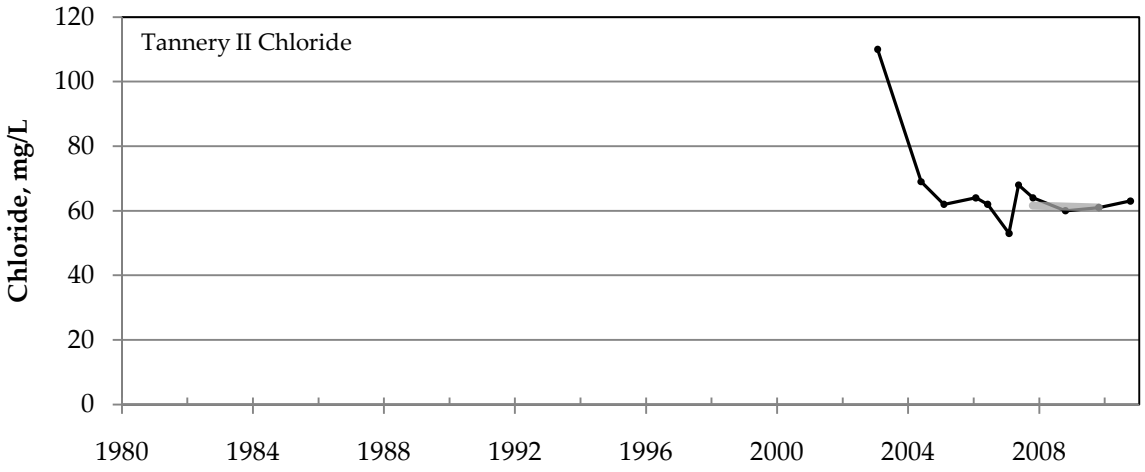

Monterey Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

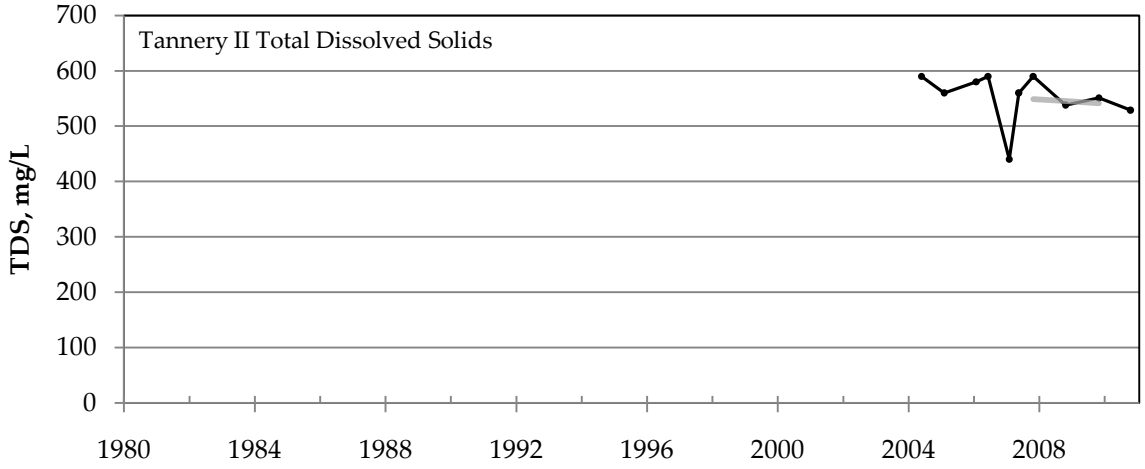

Monterey Groundwater Elevation
Groundwater Elevation, ft MSL
40
30
20
10
0
-10
-20
-30
-40
-50
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

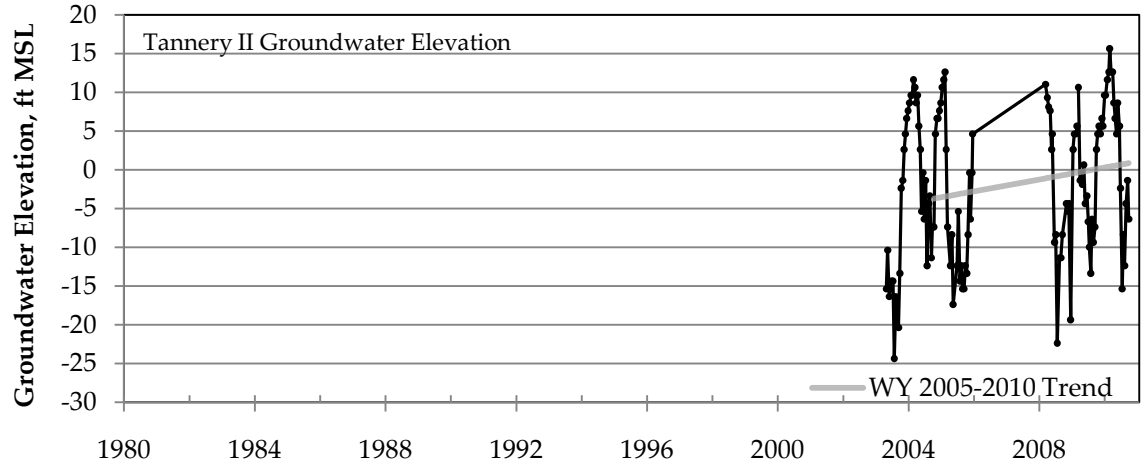

Tannery Chloride
Chloride, mg/L
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

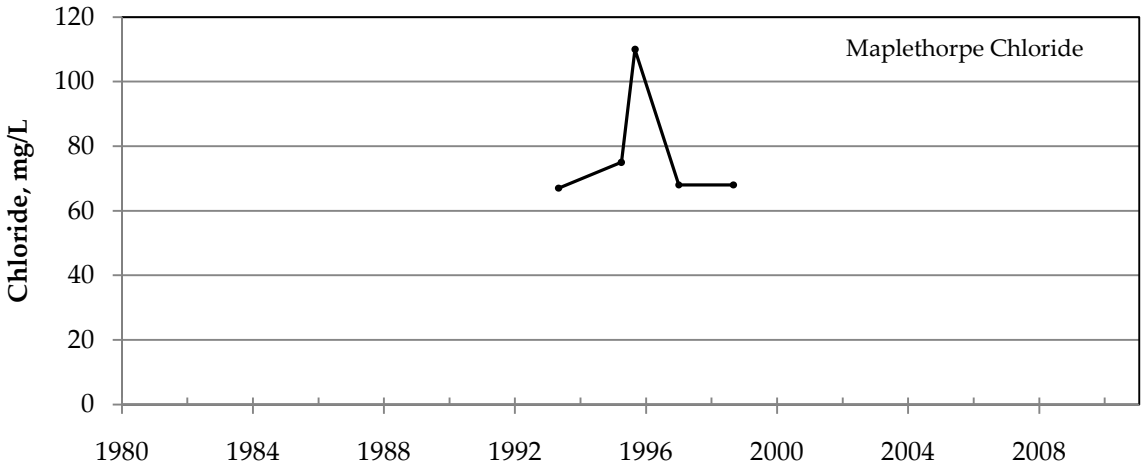

Tannery Total Dissolved Solids
TDS, mg/L
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

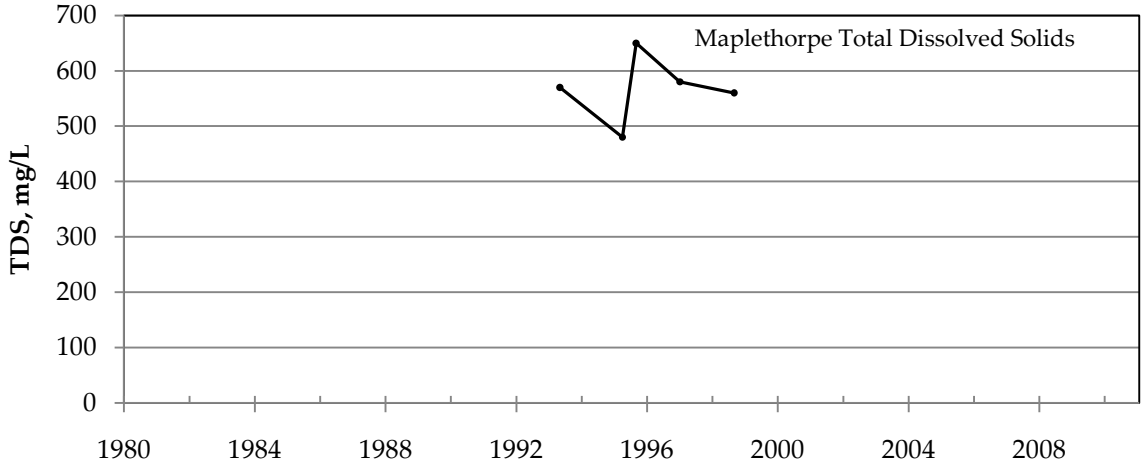

Tannery Groundwater Elevation
Groundwater Elevation, ft MSL
30
20
10
0
-10
-20
-30
-40
-50
-60
1980
1984
1988
1992
1996
2000
2004
2008

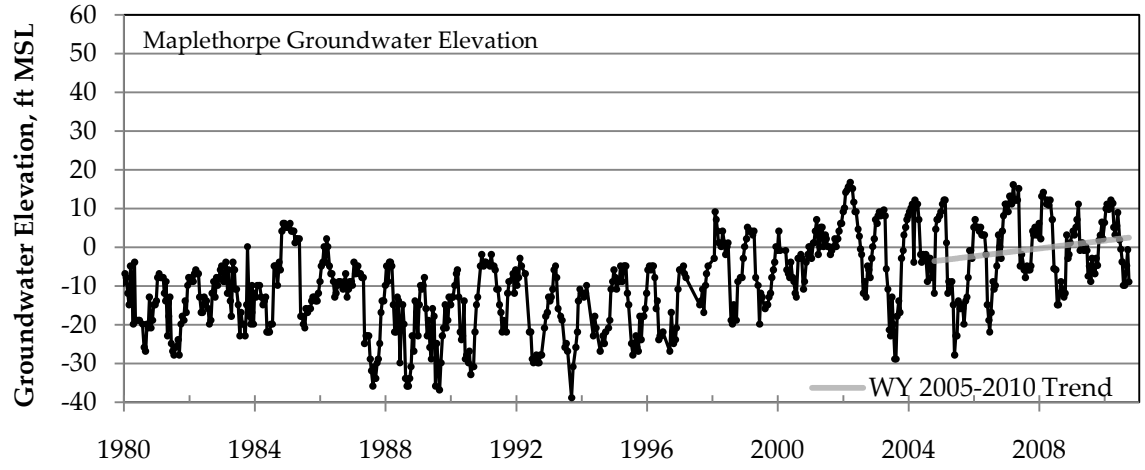

Tannery II Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008


Tannery II Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008


Tannery II Groundwater Elevation
Groundwater Elevation, ft MSL
20
15
10
5
0
-5
-10
-15
-20
-25
-30
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008


Maplethorpe Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008


Maplethorpe Total Dissolved Solids
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008


Maplethorpe Groundwater Elevation
Groundwater Elevation, ft MSL
60
50
40
30
20
10
0
-10
-20
-30
-40
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

SECTION 4 – WATER YEAR 2010 AQUIFER CONDITIONS FOR CENTRAL PURISIMA AREA (BC/DEF-UNITS)

This section presents groundwater level and water quality conditions for Water Year 2010 in the central portion of the Soquel-Aptos area where the primary production aquifers are the Purisima BC-unit and the Purisima DEF-unit.

4.1 SqCWD Service Area II Production

In the central portion of the Soquel-Aptos area, groundwater is produced for municipal purposes by SqCWD in Service Area II. SqCWD's Service Area II production was 814 acre-feet in Water Year 2010, the lowest annual amount since Water Year 1986. Production in Service Area II over the last 5 years has been below the historical average. Figure 4-1 shows the production in Service Area II by Water Year. Figure 4-1 also shows the production by well in Service Area II grouped by aquifer unit. Combined pumping at the wells grouped as BC-unit wells (Estates, Ledyard, and Madeline) was 511 acre-feet. This was higher than the previous year, but lower than every other year since Water Year 1986. Combined pumping at the wells grouped as DEF-unit wells (Aptos Creek and T. Hopkins) was 303 acre-feet, the second lowest amount since Water Year 1990, partly because the T. Hopkins well was out of service for over two months. Water Year 2010 pumping in Service Area II was approximately 33% of SqCWD's revised estimate of its share of the annual sustainable yield in the Purisima area (HydroMetrics LLC, 2009c).

4.2 Groundwater Level Conditions and Trends

SqCWD has established protective groundwater elevations in coastal monitoring wells to protect the Purisima BC-unit and DEF-unit in the central portion of the Soquel-Aptos area from seawater intrusion. Cross-sectional models were used to estimate groundwater elevations that result in the freshwater-salt water interface in the productive aquifer unit being seaward of the coast over the long term (HydroMetrics LLC, 2009b).

Coastal groundwater levels in the SqCWD's BC-unit and DEF-unit monitoring wells remained below protective elevations in Water Year 2010, as shown in Table 4-1. Hydrographs for wells in the SC-9 and SC-8 clusters follow at the end of this section. The hydrographs show that groundwater levels at wells SC-9B,

SC-9C and SC-8D have been below protective elevations for most of the data record, and remained below protective elevations in Water Year 2010.

Table 4-1 (2010): Comparison of Water Year 2010 Coastal Groundwater Levels with Protective Elevations

Well	Location	Unit	Minimum Groundwater Elevation (feet msl)[1]	Maximum Groundwater Elevation (feet msl)	Protective Elevation (feet msl)
SC-9B	Seacliff	B/BC	-20.4	-8.4	10
SC-9C		BC	-29.3	-13.1	
SC-8D	Aptos Creek	DEF	-7.1	3.5	10

[1] mean sea level

In general, groundwater levels show increasing trends over the last 3 years at SqCWD's coastal monitoring wells completed in the BC and DEF-units. Three years ago, groundwater levels at wells SC-9B/C and SC-8D were close to historical lows. The increasing trend since that time has likely been due to reduced pumping at nearby SqCWD production wells.

Groundwater levels in the BC-unit are lower than groundwater levels in the DEF-units. This separation has occurred in the Aptos Creek area since Water Year 2004 even though the pumping at the Aptos Creek and T. Hopkins wells is mostly derived from the DEF-unit. This would suggest that drawdown caused by production wells in the BC-unit spreads farther laterally than drawdown in the DEF-unit.

Groundwater levels in shallower coastal monitoring wells in the DEF-unit declined slightly after Water Year 2006 and have been relatively stable since declining. This decline in the shallow interval of the DEF-unit may reflect a reduction in basin storage correlated with less precipitation.

Table 4-2 summarizes the important groundwater level trends by monitoring well. Hydrographs for multiple completions of these wells follow at the end of this section. Hydrographs for multiple completions of monitoring wells adjacent to production wells, and static groundwater levels in groups of production wells are also included following this section.

Hydrographs for single wells including production wells are included with chemographs. These hydrographs show trendlines for Water Years 2005-2010 when municipal production for the basin has been at or below pumping goals in the Groundwater Management Plan.

Contour maps of groundwater elevations in Spring and Fall 2010 for the Purisima BC-unit are shown in Figure 4-2 and Figure 4-3. Figure 4-2 shows that the Spring 2010 pumping depression in the BC-unit was below sea level, with below sea level groundwater levels extending to the coast. Figure 4-3 shows the below sea level pumping depression deepened in the Fall at some locations, and extended to more of the coast than in the Spring. The pumping depression deepened less in the Fall 2010 than the previous year. This may be related to the T-Hopkins well being out of service for rehabilitation in Fall 2010, but also may be an artifact of the high dependence of static water levels in the area on pumping recovery times.

Table 4-2 (2010): Summary of Groundwater Level Trends in Central Purisima Area

Category	Well	Groundwater Level Trend Description	Notes
SqCWD Coastal Monitoring BC and DEF-unit Wells	SC-9B/C	Increasing WY 2008-2010	Reduced pumping at Estates WY 2009-2010
	SC-8D	Increasing WY 2008-2010	Declining pumping at Aptos Creek and T. Hopkins from WY 2007
	SC-8B	BC-unit higher WY 2010 and > 10 feet below SC-8D	Deeper drawdown from BC-unit pumping
SqCWD Shallow Monitoring Coastal Wells	SC-9E SC-8E	Relatively stable feet in overlying interval of DEF-unit since 1-2 foot drop WY 2007	Increasing precipitation since WY 2007
	SC-8F	Unreliable data	Well filled up to a depth of 106 feet from original 200 feet depth

4.3 WATER QUALITY CONDITIONS AND TRENDS

The most significant groundwater quality threat in the Soquel-Aptos basin is seawater intrusion. As discussed above, groundwater levels remain below

protective elevations in the BC and DEF-units. As a result, there is ongoing risk of seawater intrusion into the productive units of the central Purisima area.

Observed Total Dissolved Solids (TDS) and chloride concentrations do not suggest any seawater intrusion impacting SqCWD's production wells in the Purisima BC and DEF-units. Observed TDS and chloride concentrations in SqCWD's monitoring wells in the BC and DEF-units also do not indicate incipient seawater intrusion. Recent chloride concentrations in both production and monitoring wells are at 100 mg/L or less, while the maximum contaminant limit (MCL) for chlorides is 250 mg/L. Chemographs for SqCWD wells in the area are included following this section.

Chloride concentrations in well SC-8F, completed in the shallow F-unit, were approximately 3,000 mg/L starting in Water Year 2007. Data from this well, however, are not reliable. The well is sanded up to 100 feet and the well is slated for replacement.

Water pumped from the Purisima formation continues to be treated for iron and manganese to meet drinking water standards. In Water Year 2010, color and turbidity were also reduced during treatment to meet drinking water standards.

In Water Years 2009 and 2010, the Aptos Creek and T. Hopkins wells had detections of arsenic that ranged from 1.9-4.7 ug/L, below the MCL of 10 ug/L for arsenic. Water from these wells is treated to reduce arsenic concentrations below 2 ug/L.

4.4 STATE OF THE AQUIFER SUMMARY

Seawater intrusion has not been detected in most of the Central Purisima area. However, the productive Purisima BC and DEF-units remain at risk for seawater intrusion as coastal groundwater levels remain well below protective elevations. Due to historically low production in Water Years 2009 and 2010, groundwater levels in the Purisima BC and DEF-units showed recovery over the last two years. A longer period of low production will be required to recover the basin to be protected against the risk for seawater intrusion.

SECTION 4 – WATER YEAR 2009 AQUIFER CONDITIONS FOR CENTRAL PURISIMA AREA (BC/DEF-UNITS)

This section presents groundwater level and water quality conditions for Water Year 2009 in the central portion of the Soquel-Aptos area where the primary production aquifers are the Purisima BC-unit and the Purisima DEF-unit.

4.1 SqCWD Service Area II Production

In the central portion of the Soquel-Aptos area, groundwater is produced for municipal purposes by SqCWD in Service Area II. Service Area II production was 827 acre-feet in Water Year 2009, the lowest annual amount since Water Year 1985. Production in Service Area II over the last 4 years has been below the historical average. Figure 4-1 shows the production in Service Area II by Water Year. Figure 4-1 also shows the production by well in Service Area II grouped by aquifer unit. Combined pumping at the wells grouped as BC-unit wells (Estates, Ledyard, and Madeline) was less than 500 acre-feet for the first time since Water Year 1986. Combined pumping at the wells grouped as DEF-unit wells (Aptos Creek and T. Hopkins) was 328 acre-feet, the second lowest amount since Water Year 1990. The recent evaluation of the sustainable yield (HydroMetrics LLC, 2009c) did not estimate annual sustainable yield specifically for Service Area II wells, but Water Year 2009 pumping in Service Area II was approximately 33% of the suggested estimate of SqCWD's share of the annual sustainable yield in the Purisima.

4.2 Groundwater Level Conditions and Trends

SqCWD has established protective groundwater elevations in coastal monitoring wells to protect the Purisima BC-unit and DEF-unit in the central portion of the Soquel-Aptos area from seawater intrusion over the long term. Cross-sectional models were used to estimate groundwater elevations that result in the freshwater-salt water interface in the productive aquifer unit being seaward of the coast over the long term (HydroMetrics LLC, 2009b).

Coastal groundwater levels in the SqCWD's BC-unit and DEF-unit monitoring wells remained below protective elevations in Water Year 2009, as shown in Table 4-1. Hydrographs for wells in the SC-9 and SC-8 clusters follow at the end of this section. The hydrographs show that groundwater levels at SC-9B and

SC-8D have been below protective elevations for most of the data record and remained below sea level for most of Water Year 2009.

Table 4-1 (2009): Comparison of Water Year 2009 Coastal Groundwater Levels with Protective Elevations

Well	Location	Unit	Minimum Groundwater Elevation (feet msl)	Maximum Groundwater Elevation (feet msl)	Protective Elevation (feet msl)
SC-9B	Seacliff	BC	-20.4	-9.4	11
SC-8D	Aptos Creek	DEF	-9.4	4.8	10

In general, the groundwater level trend at SqCWD's coastal monitoring wells completed in the BC and DEF-units in this area has been stable or increasing over the last 4-5 years. Four to five years ago, groundwater levels at SC-9B and SC-8D had declined to historic lows. The stable to increasing trend since that time has likely been due to reduced pumping at nearby SqCWD production wells.

Groundwater levels in the BC-unit are lower than levels in the DEF-units. This separation has occurred in the Aptos Creek area since Water Year 2004 even though the pumping at the Aptos Creek and T. Hopkins wells is mostly derived from the DEF-unit. This would suggest that drawdown caused by production wells in the BC-unit spreads farther laterally and deeper than drawdown in the DEF-unit.

Groundwater levels at more shallow coastal monitoring wells in this area have dropped slightly since Water Year 2006. This decline in the shallow interval of the DEF-unit may reflect a reduction in basin storage correlated with less precipitation.

Table 4-2 summarizes the important groundwater level trends by well. Hydrographs for these wells follow at the end of this section. Hydrographs for monitoring wells adjacent to production wells, and static groundwater levels in the production wells are also included following this section.

Contour maps of groundwater elevations in spring and fall 2009 for the Purisima BC-unit are shown in Figure 4-2 and Figure 4-3. Figure 4-2 shows that the spring 2009 pumping depression in the BC-unit was below sea level, with below sea level groundwater levels partially extending to the coast. Figure 4-3 shows the

below sea level pumping depression deepened in the fall and extended closer to the coast.

Table 4-2 (2009): Summary of Groundwater Level Trends in Central Purisima Area

Category	Well	Groundwater Level Trend Description	Notes
SqCWD Coastal Monitoring BC and DEF-unit Wells	SC-9B	Stable WY 2006-2009 after sharp decline in WY 2005	Ledyard well returned to service in WY 2005 and steady pumping WY 2006-2009
	SC-8D	Increasing DEF-unit WY 2005-2009	Reduced pumping at Aptos Creek and T. Hopkins since WY 2004
	SC-8B	BC-unit stable WY 2005-2009 and > 10 feet below SC-8D	Deeper drawdown from BC-unit pumping
SqCWD Shallow Monitoring Coastal Wells	SC-9E SC-8E	Decline of 1-2 feet in overlying interval of DEF-unit since WY 2006	Reduced precipitation since WY 2006
	SC-8F	Unreliable data	Well filled up to a depth of 106 feet from original 200 feet depth

4.3 WATER QUALITY CONDITIONS AND TRENDS

The most significant groundwater quality threat in the Soquel-Aptos basin is seawater intrusion. As discussed above, groundwater levels remain below protective elevations and sea level in the BC and DEF-units. As a result, there is ongoing risk of seawater intrusion into the productive units of the central Purisima area.

Observed Total Dissolved Solids (TDS) and chloride concentrations do not suggest any seawater intrusion impacting SqCWD's production wells in the Purisima BC and DEF-units and sub-Purisima Tu-unit. Observed TDS and chloride concentrations at SqCWD's monitoring wells in the BC and DEF-units also do not indicate incipient seawater intrusion. Recent chloride concentrations in both production and monitoring wells are at 60 mg/L or less, while the maximum contaminant limit (MCL) for chlorides is 250 mg/L. Chemographs for SqCWD wells in the area are included following this section.

Chloride concentrations in well SC-8F completed in the shallow F-unit were measured as approximately 3,000 mg/L starting in Water Year 2007, but these data from this well are not reliable. The well is sanded up to 100 feet and the well is slated for replacement.

Water pumped from the Purisima formation continues to be treated for iron and manganese to meet drinking water standards. In Water Year 2009, color and turbidity were also reduced during treatment to meet drinking water standards.

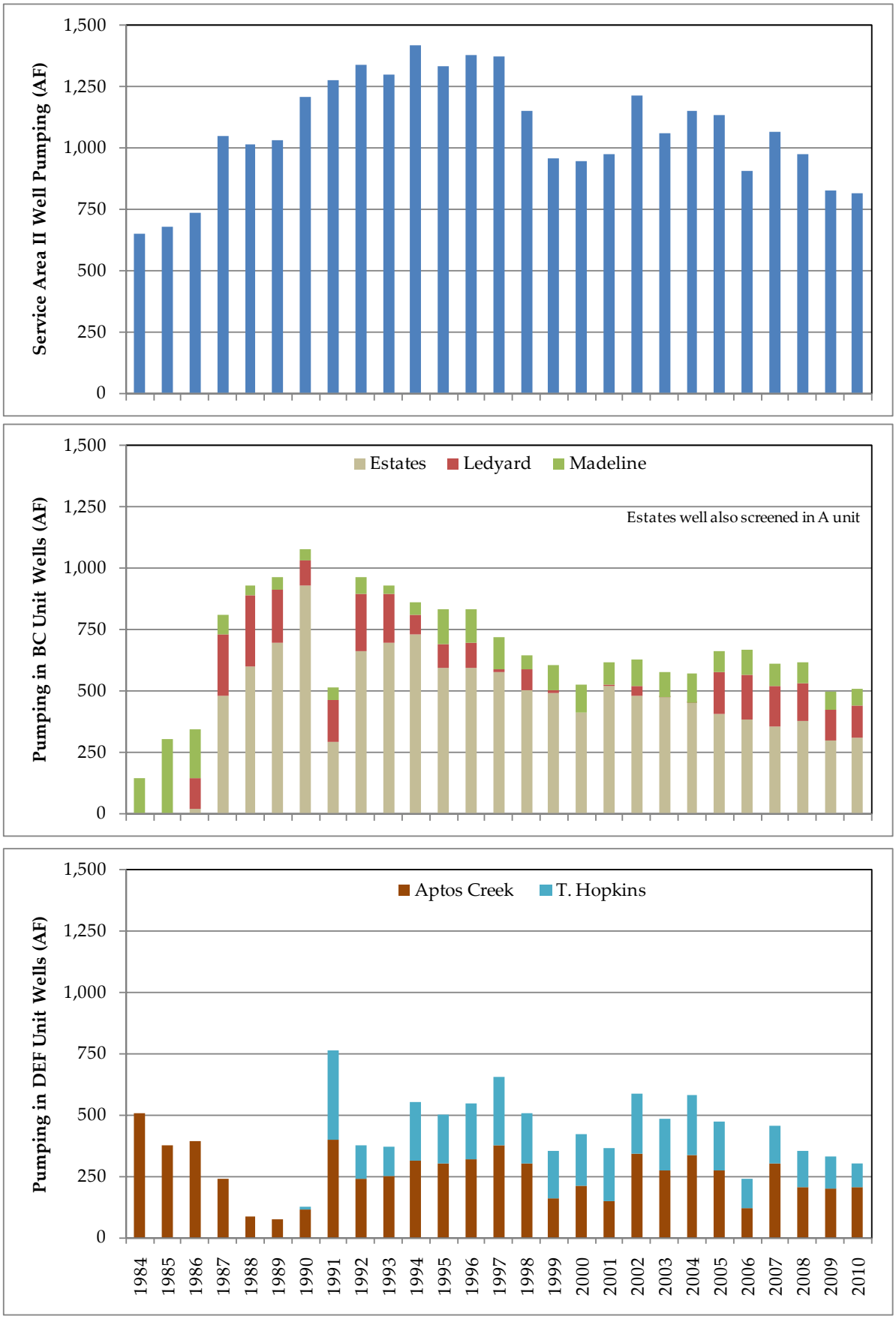


Figure 4-1: Pumping by Water Year in Central Purisima Area

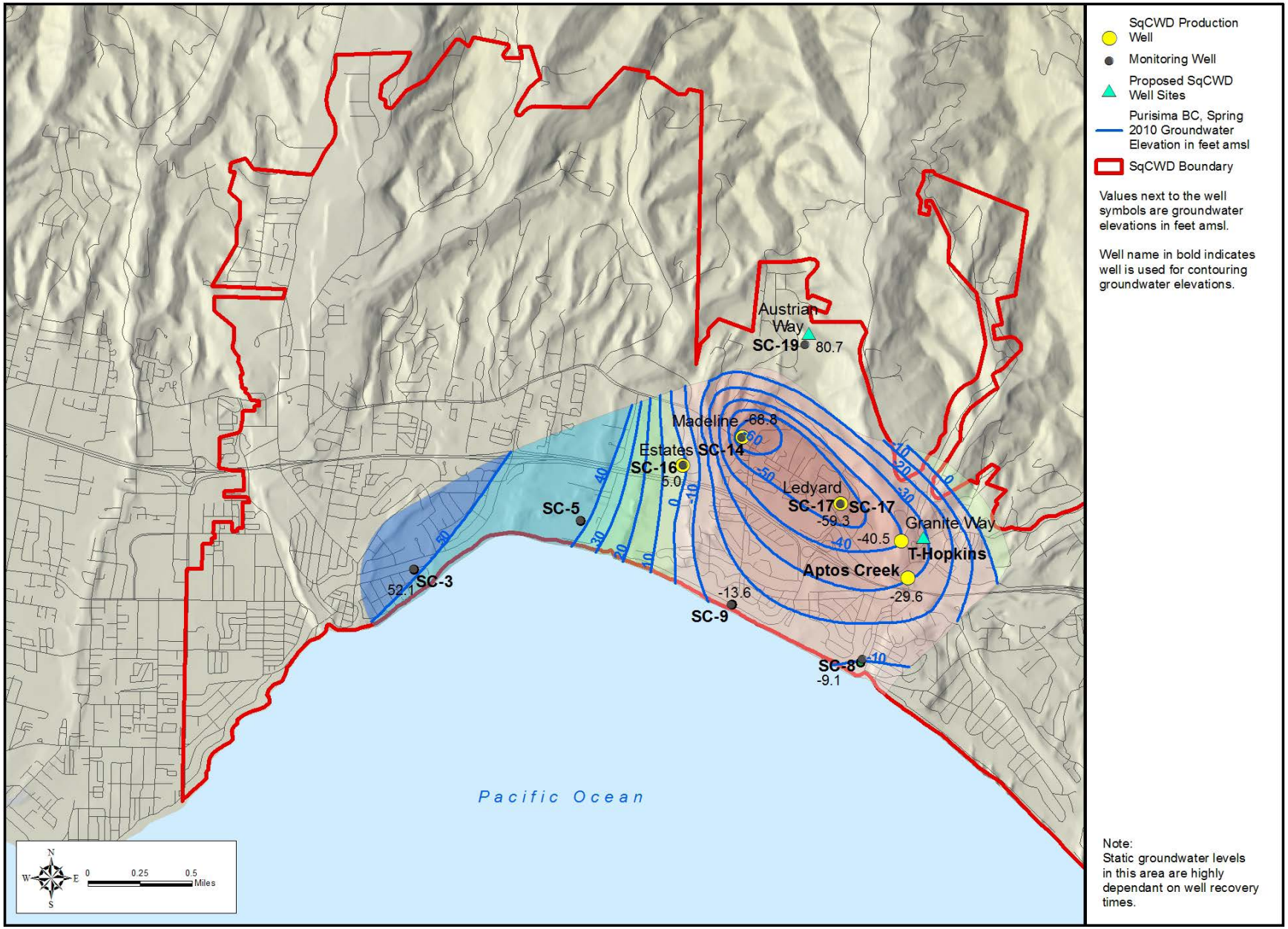


Figure 4-2 (2010): Groundwater Elevation Contours, Purisima BC-Unit, Spring 2010

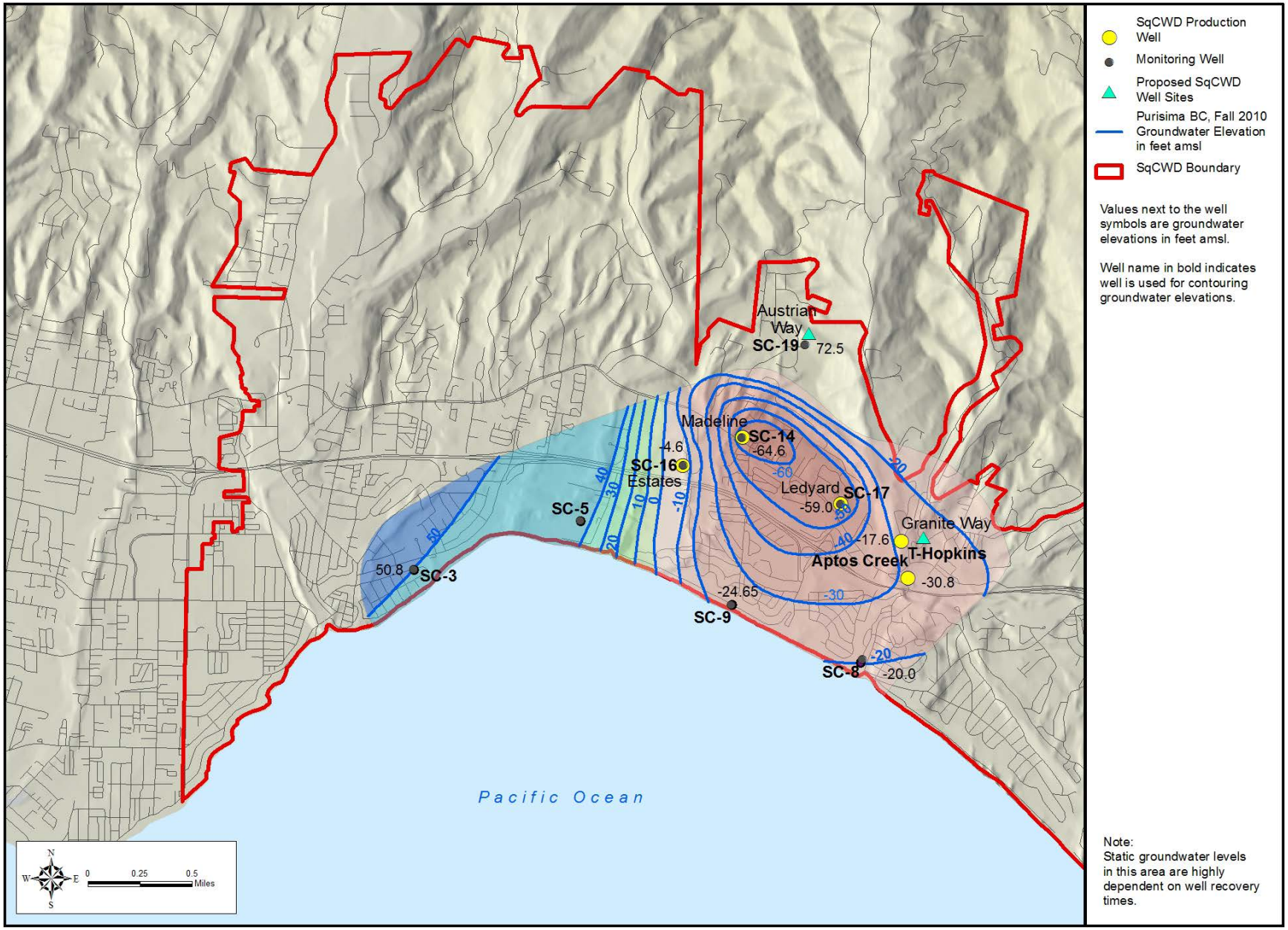


Figure 4-3 (2010): Groundwater Elevation Contours, Pursima BC-Unit, Fall 2010

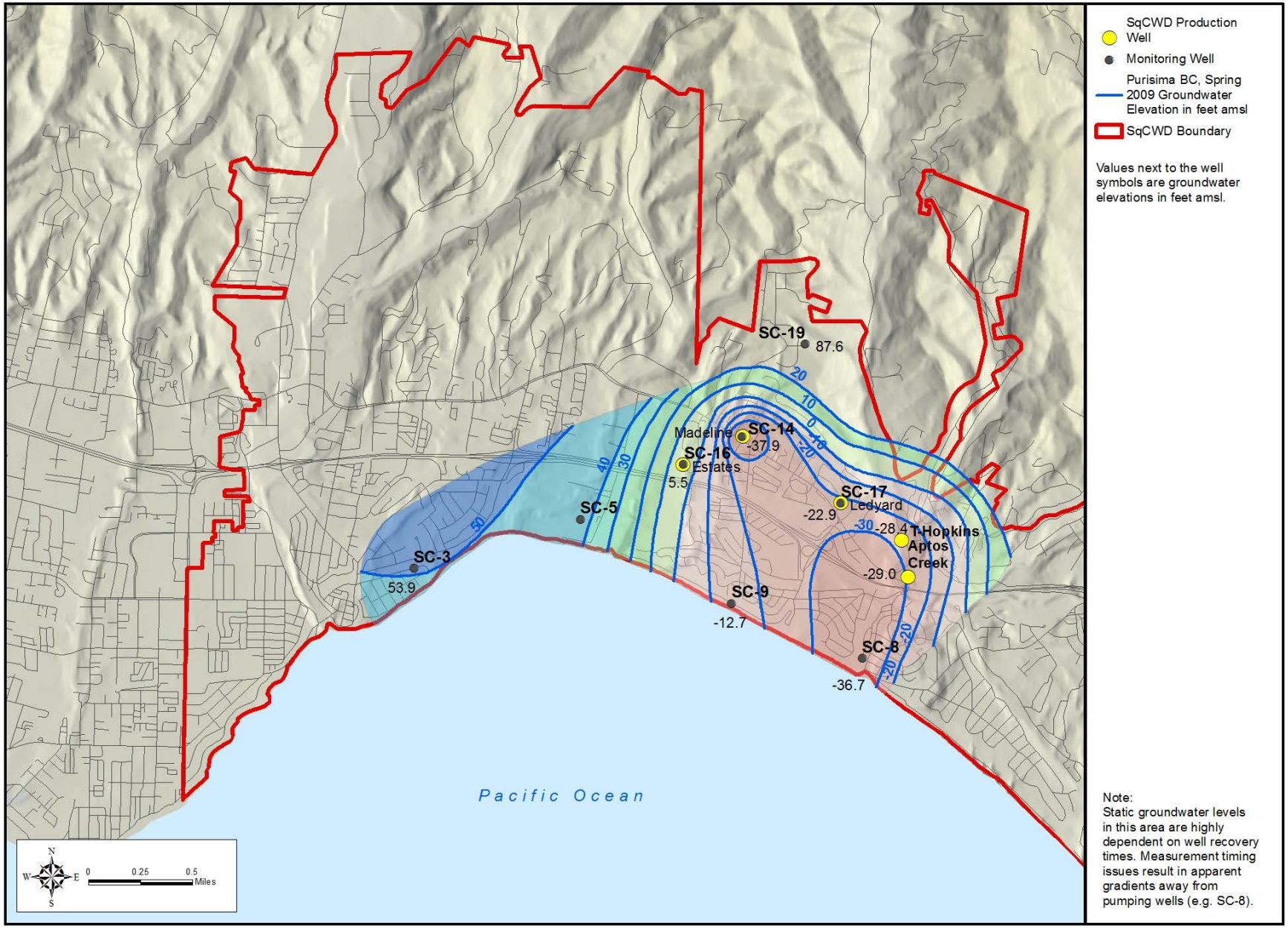


Figure 4-2 (2009): Groundwater Elevation Contours, Purisima BC-Unit, Spring 2009

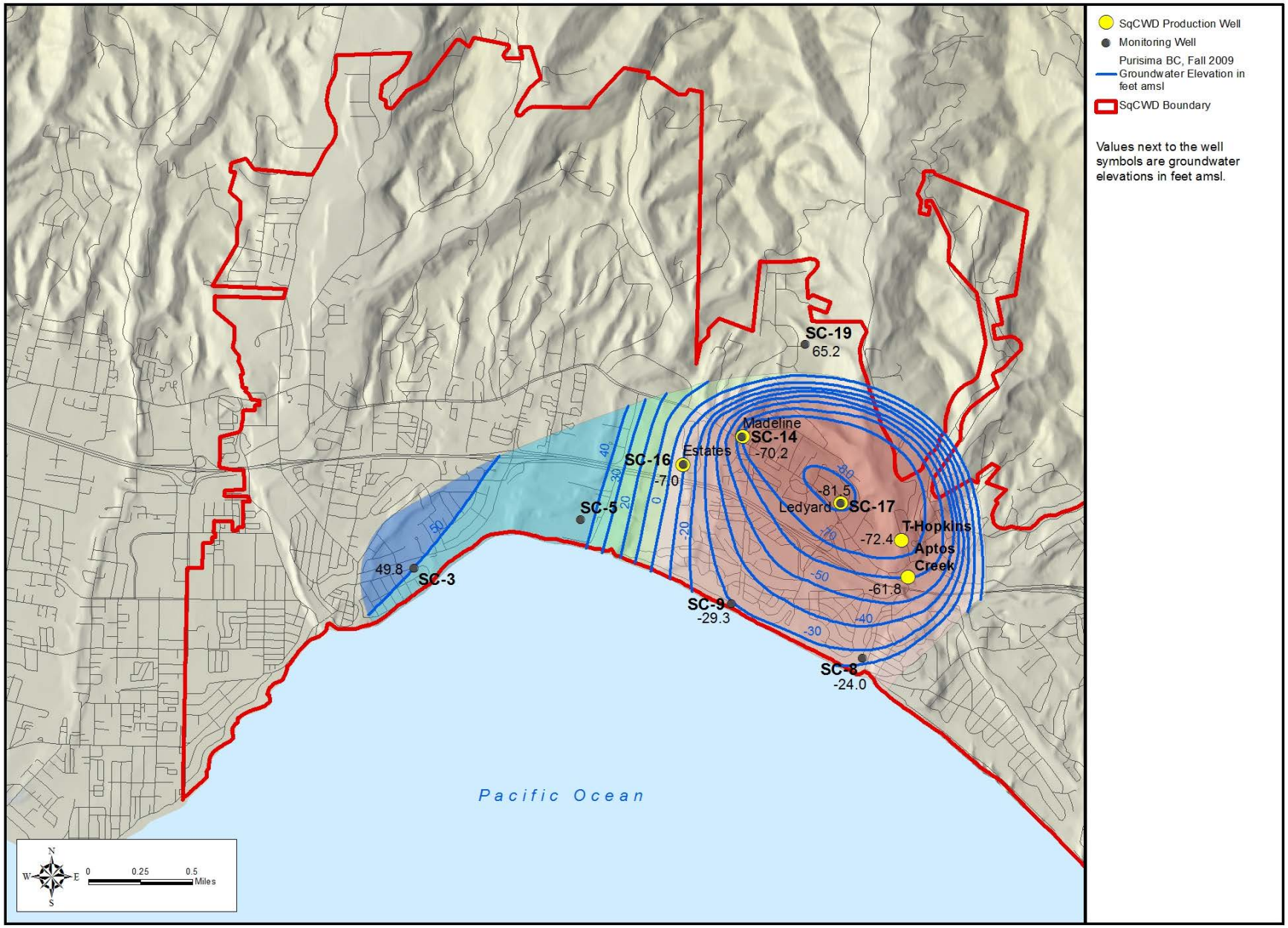


Figure 4-3 (2009): Groundwater Elevation Contours, Pursima BC-Unit, Fall 2009

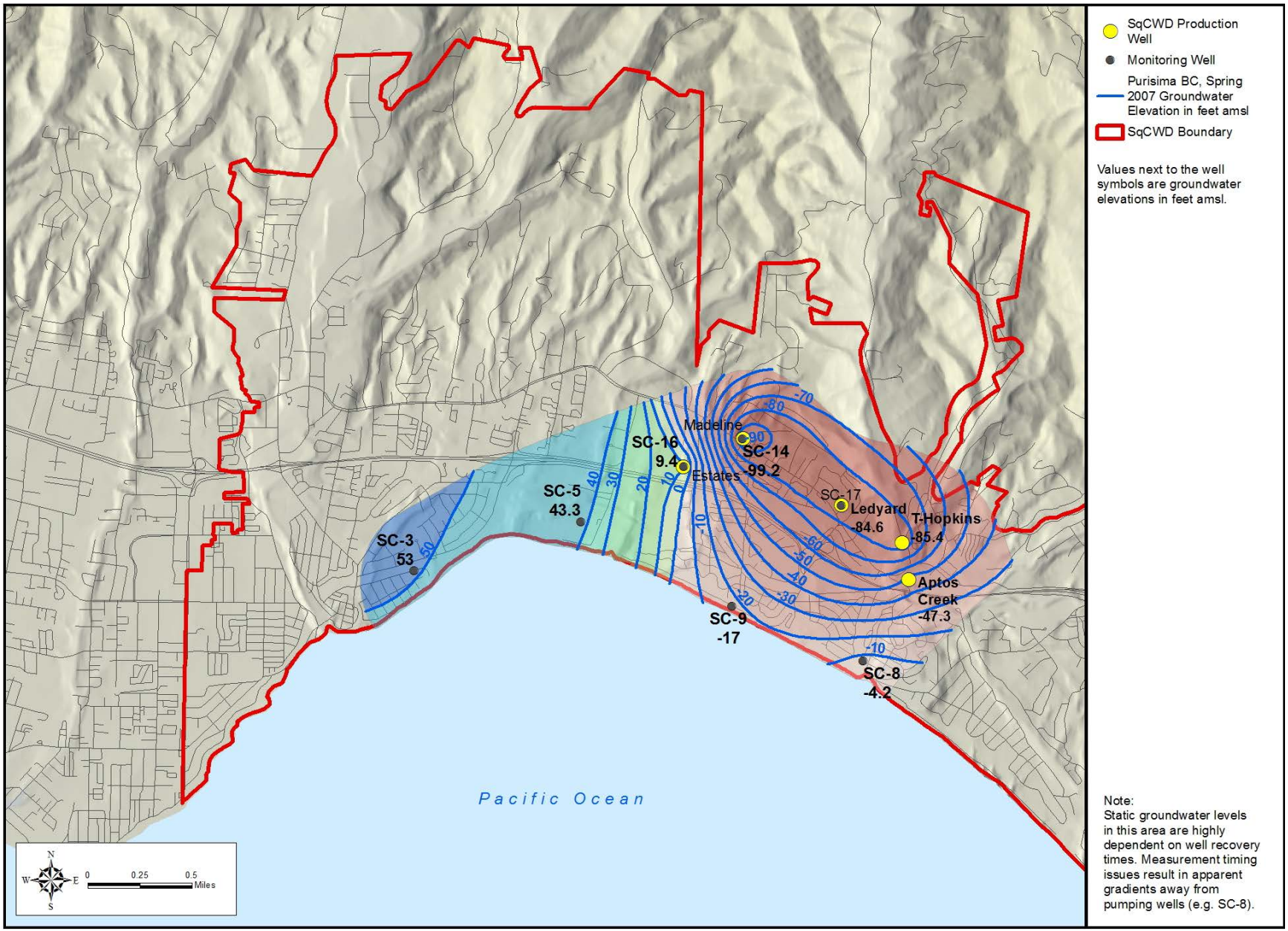


Figure 4-2 (2007): Groundwater Elevation Contours, Purisima BC-Unit, Spring 2007

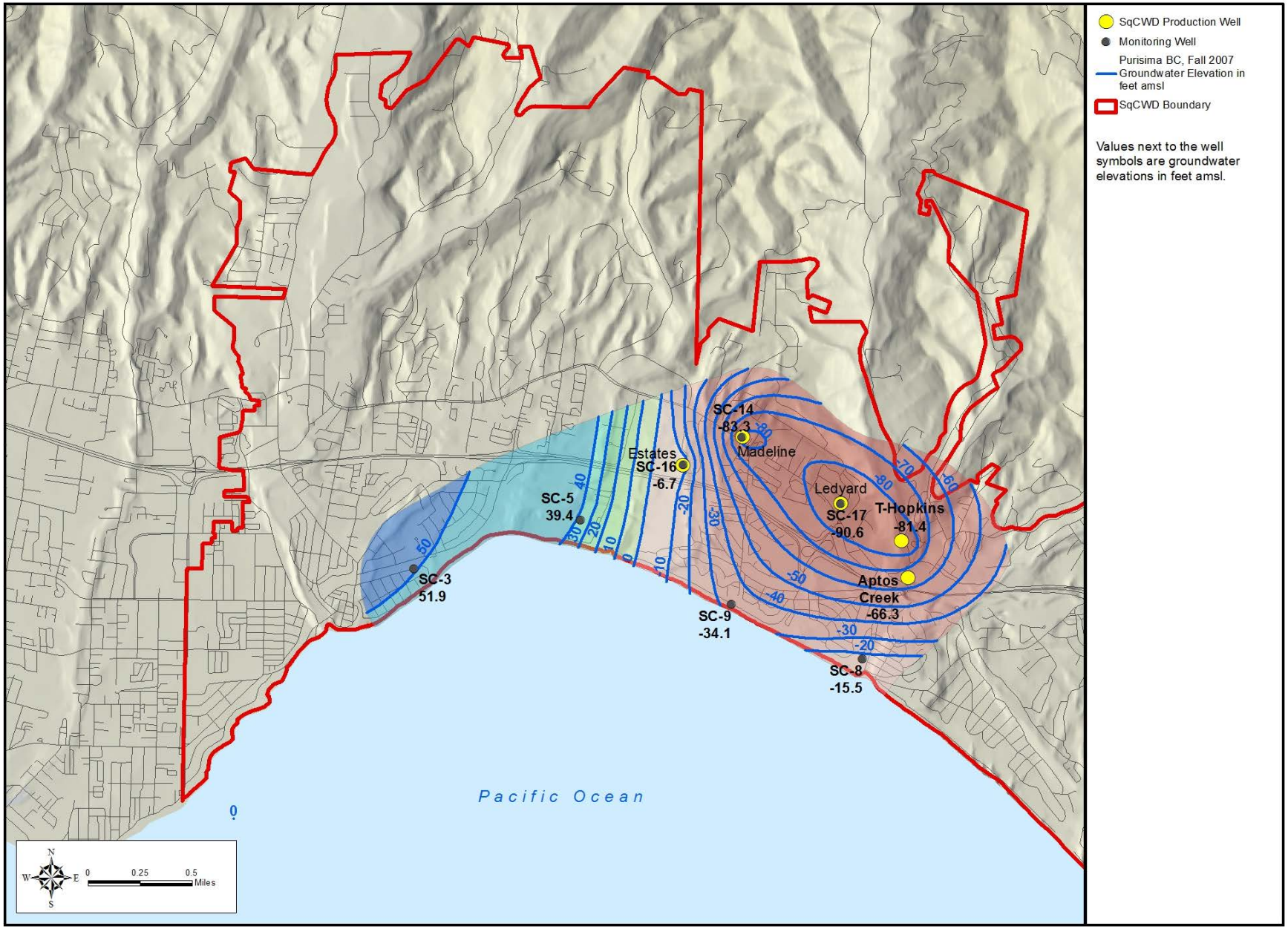


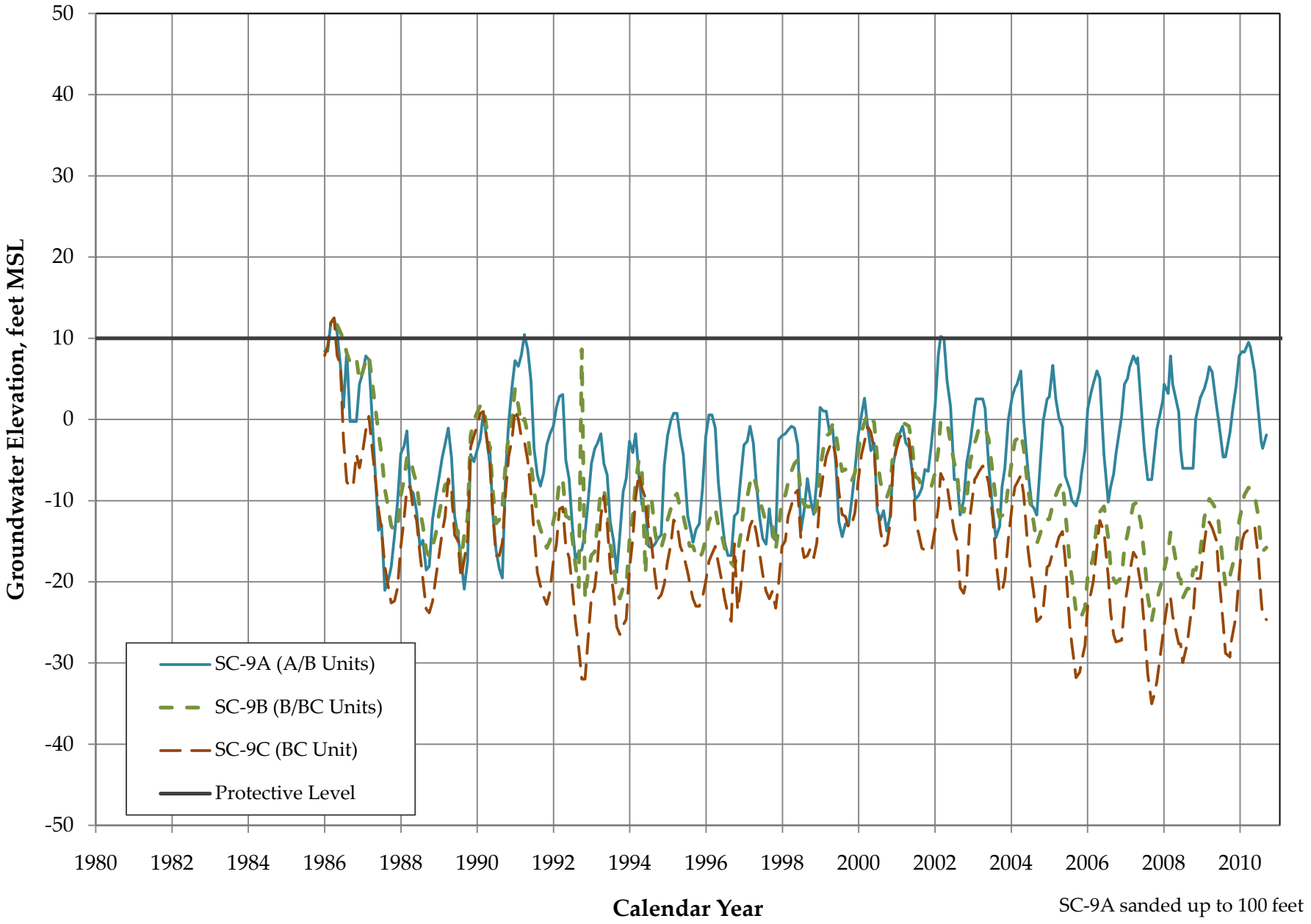
Figure 4-3 (2007): Groundwater Elevation Contours, Purisima BC-Unit, Fall 2007

Monitoring Well Hydrographs for Central Purisima Area

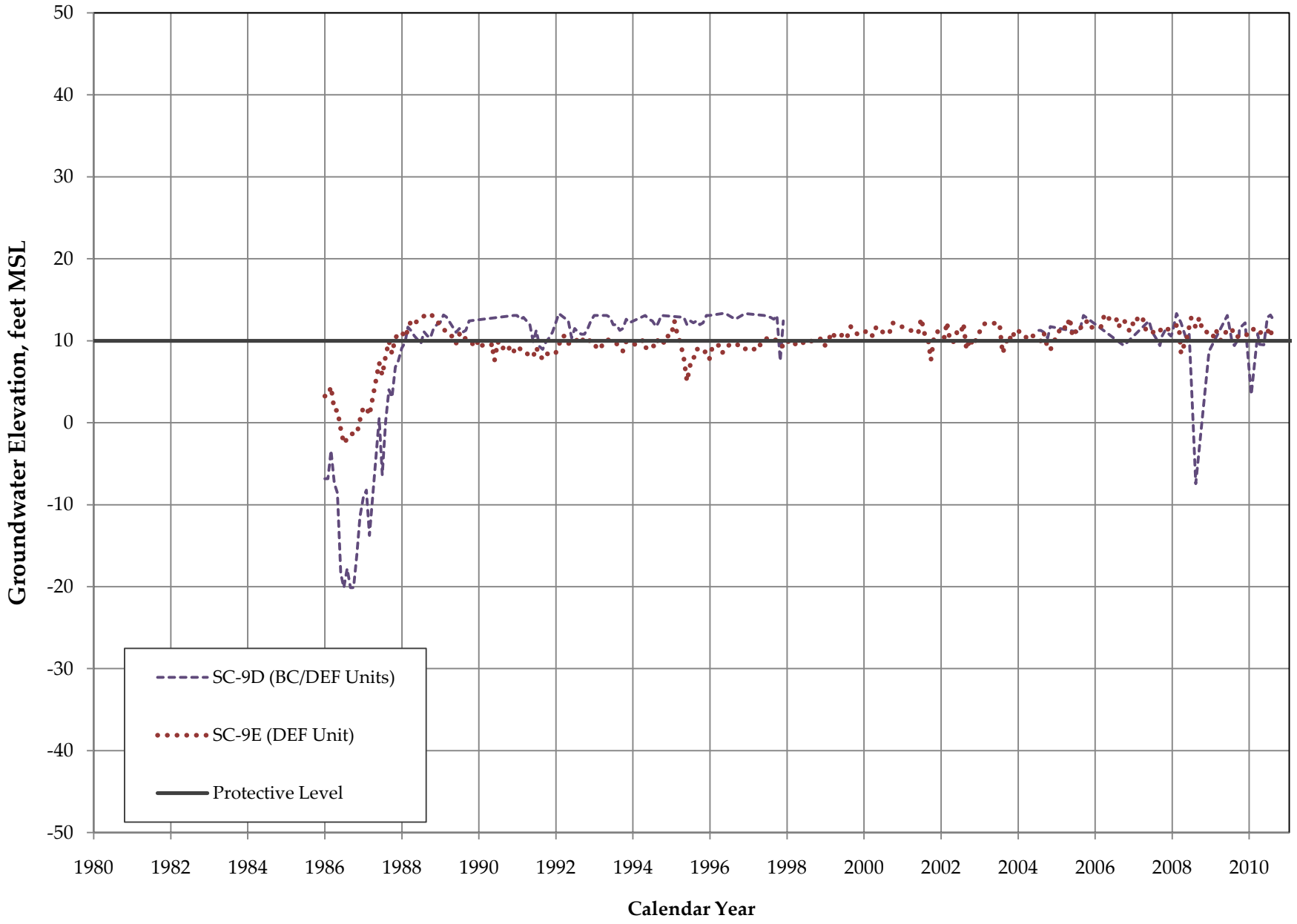
Hydrographs of SqCWD Coastal Monitoring Well Clusters

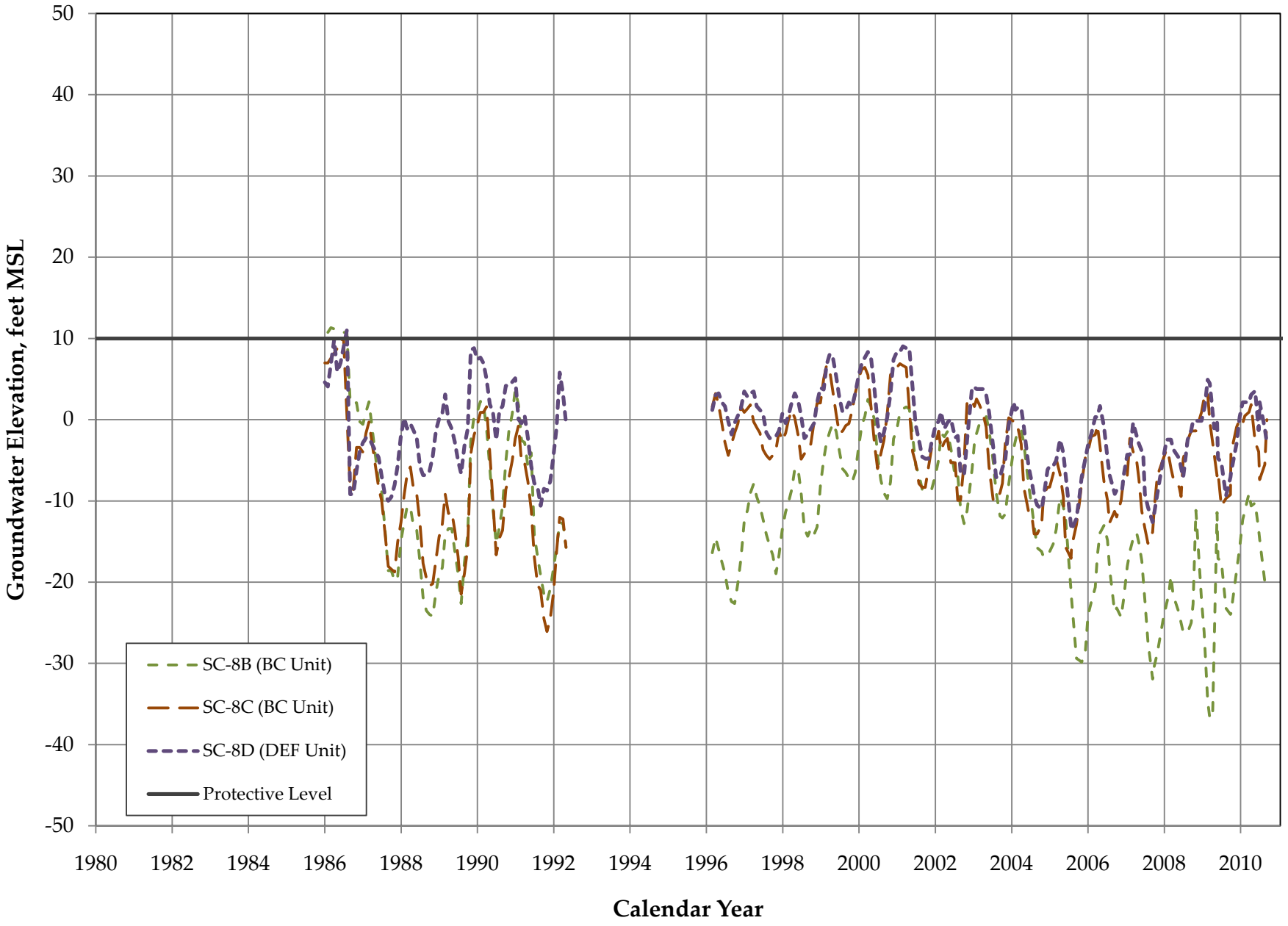
Hydrographs of SqWCD Inland Monitoring Well Clusters

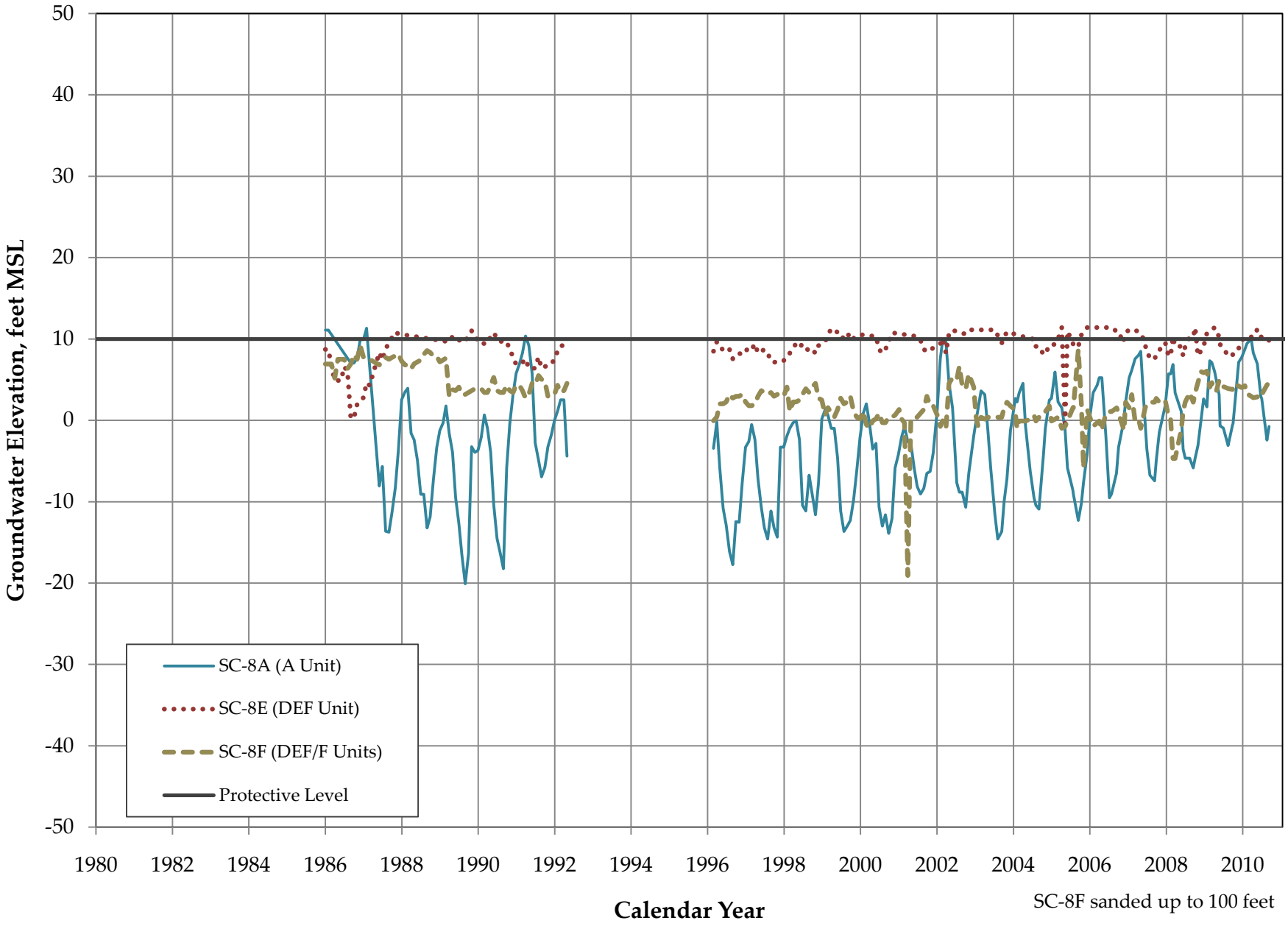
Hydrographs of SqCWD Monitoring Wells Adjacent to Production Wells

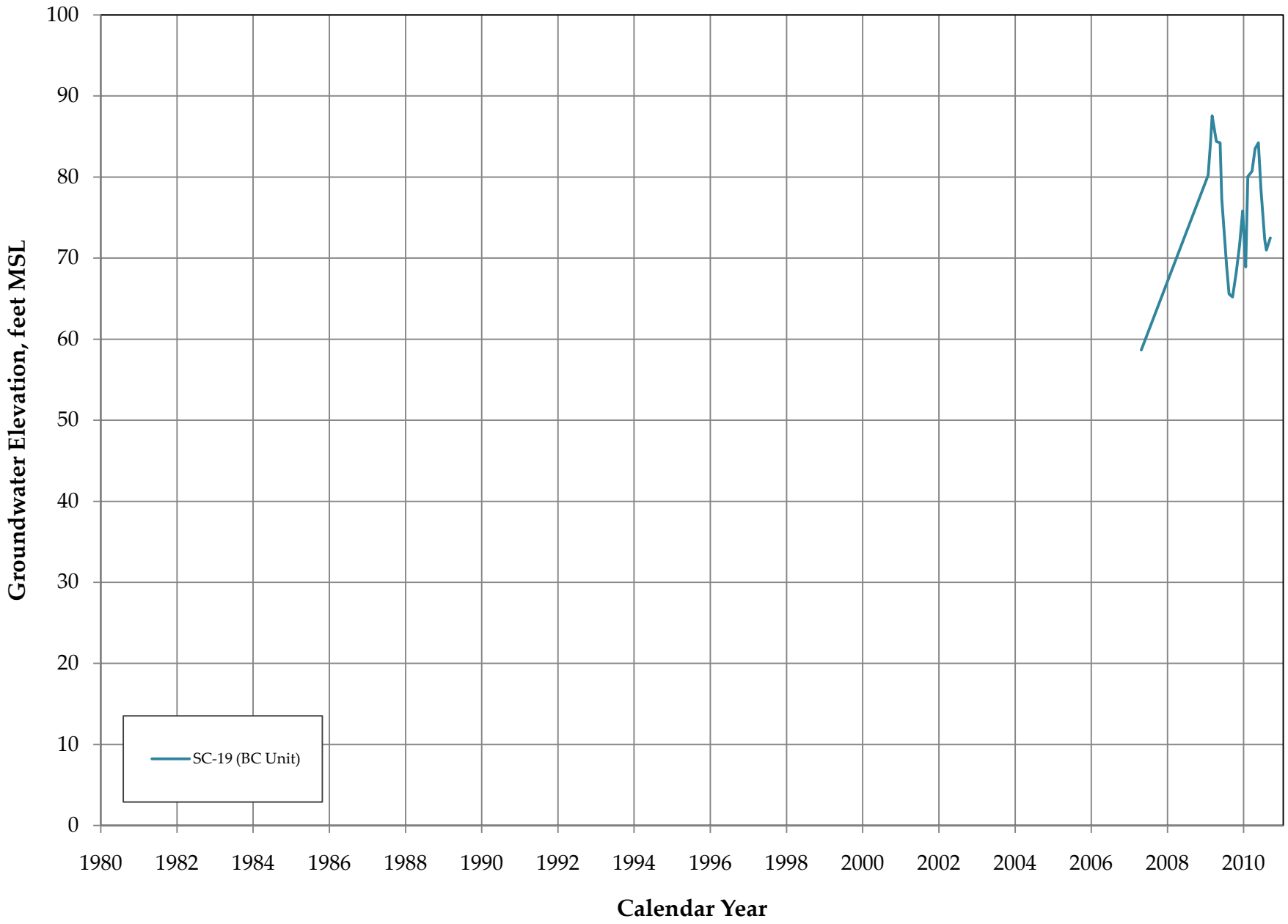


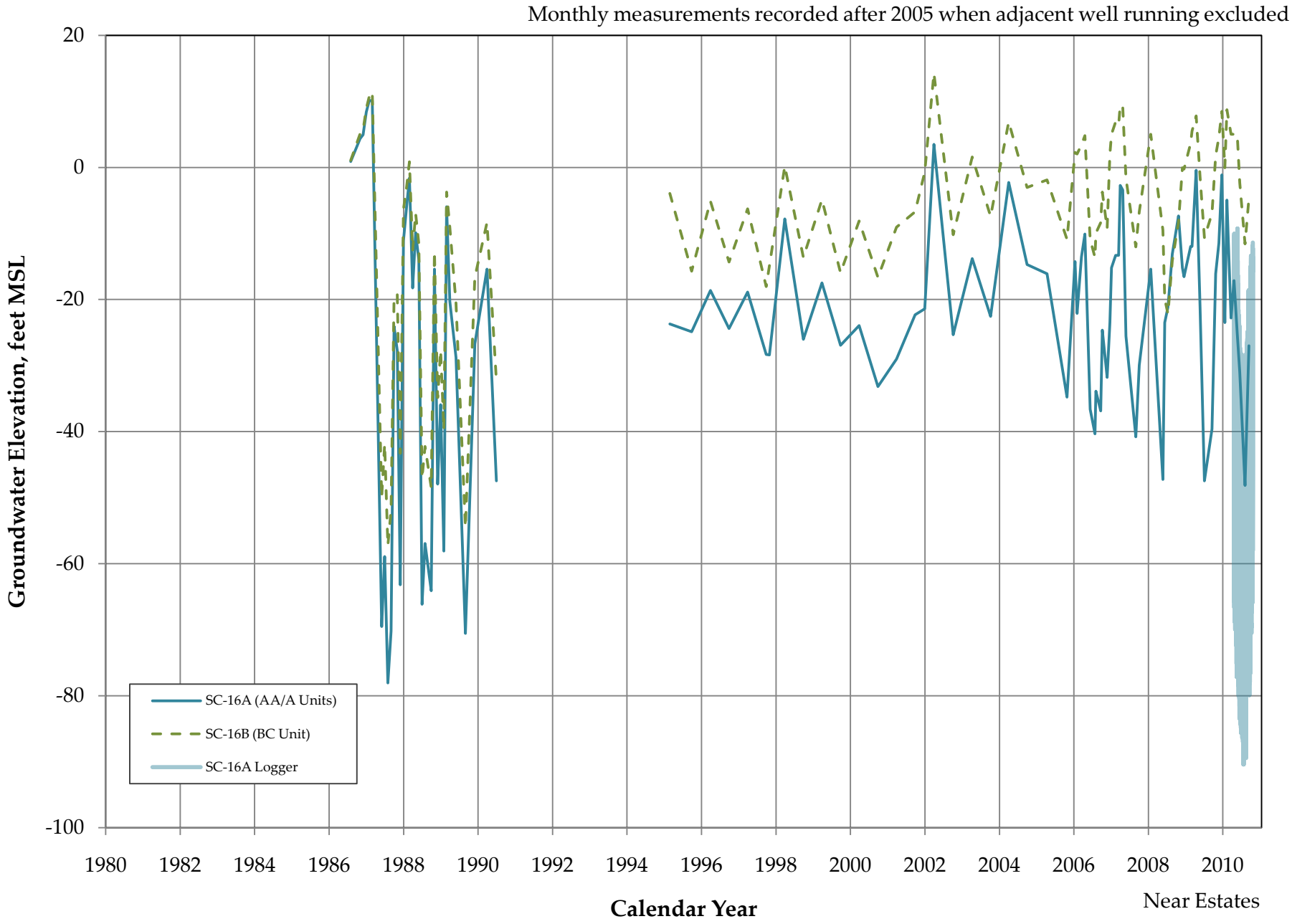
SC-9A sanded up to 100 feet

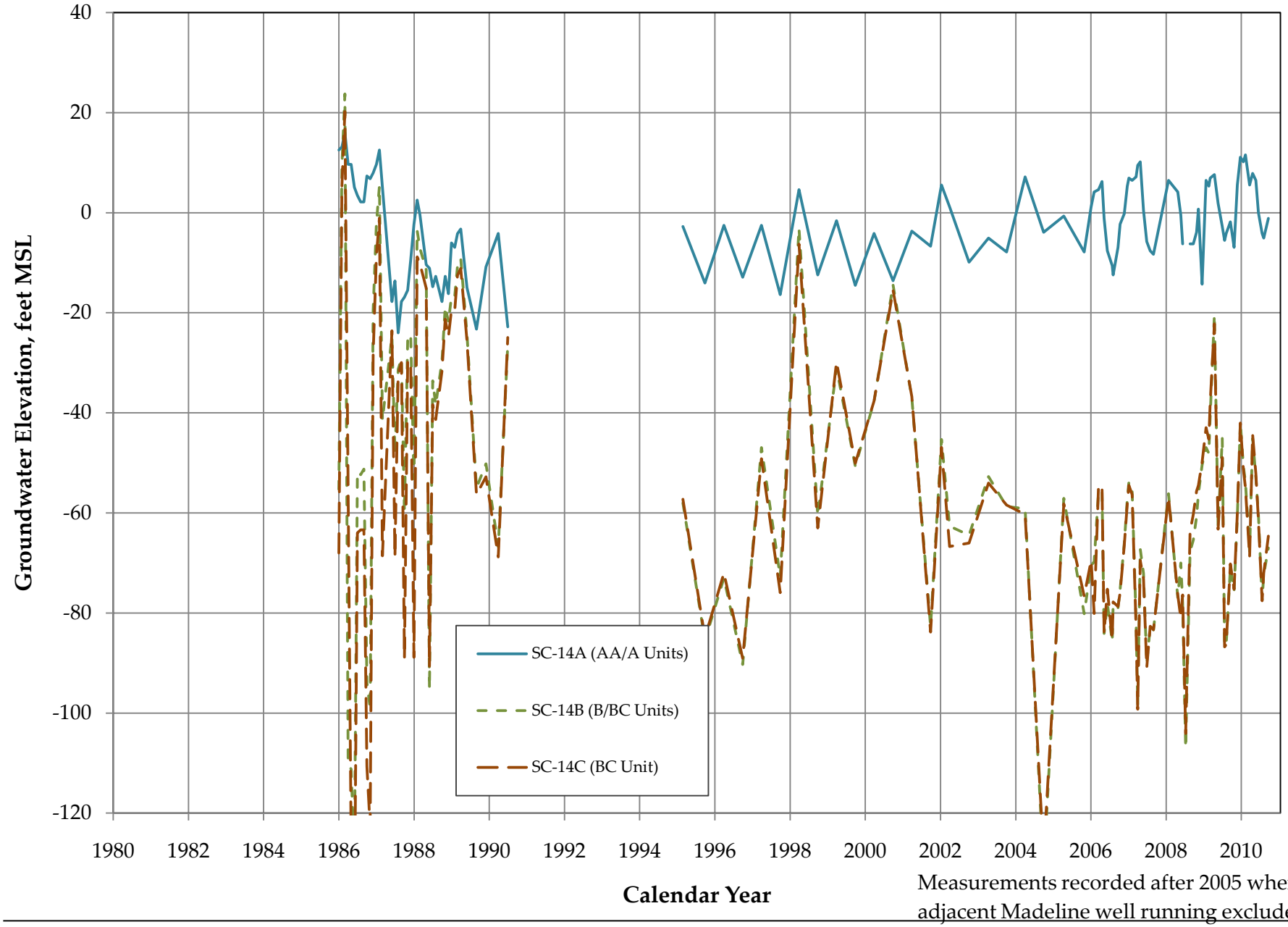

Groundwater Elevation, feet MSL
50
40
30
20
10
0
-10
-20
-30
-40
-50
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-9D (BC/DEF Units)
SC-9E (DEF Unit)
Protective Level


Groundwater Elevation, feet MSL
50
40
30
20
10
0
-10
-20
-30
-40
-50
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-8B (BC Unit)
SC-8C (BC Unit)
SC-8D (DEF Unit)
Protective Level

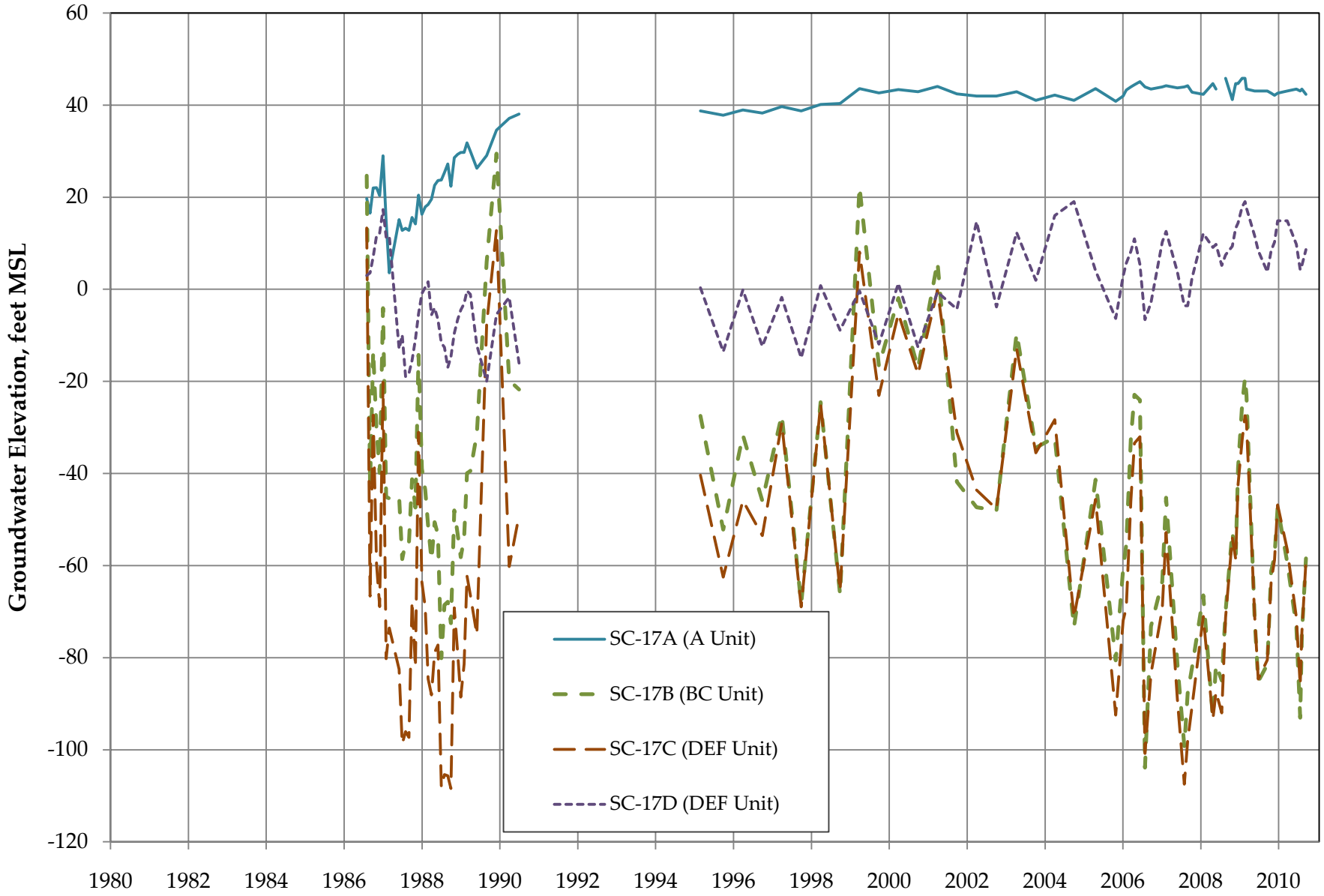

Groundwater Elevation, feet MSL
50
40
30
20
10
0
-10
-20
-30
-40
-50
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-8A (A Unit)
SC-8E (DEF Unit)
SC-8F (DEF/F Units)
Protective Level
SC-8F sanded up to 100 feet


Groundwater Elevation, feet MSL
100
90
80
70
60
50
40
30
20
10
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-19 (BC Unit)


Monthly measurements recorded after 2005 when adjacent well running excluded
Groundwater Elevation, feet MSL
20
0
-20
-40
-60
-80
-100
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-16A (AA/A Units)
SC-16B (BC Unit)
SC-16A Logger
Near Estates



Measurements recorded after 2005 when adjacent Madeline well running excluded



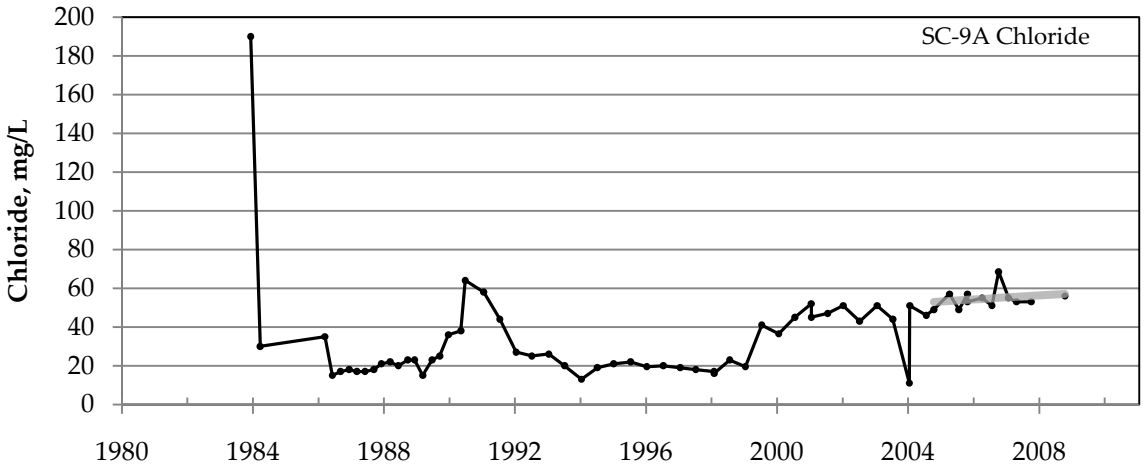
Measurements recorded after 2005 when adjacent Ledyard well running excluded

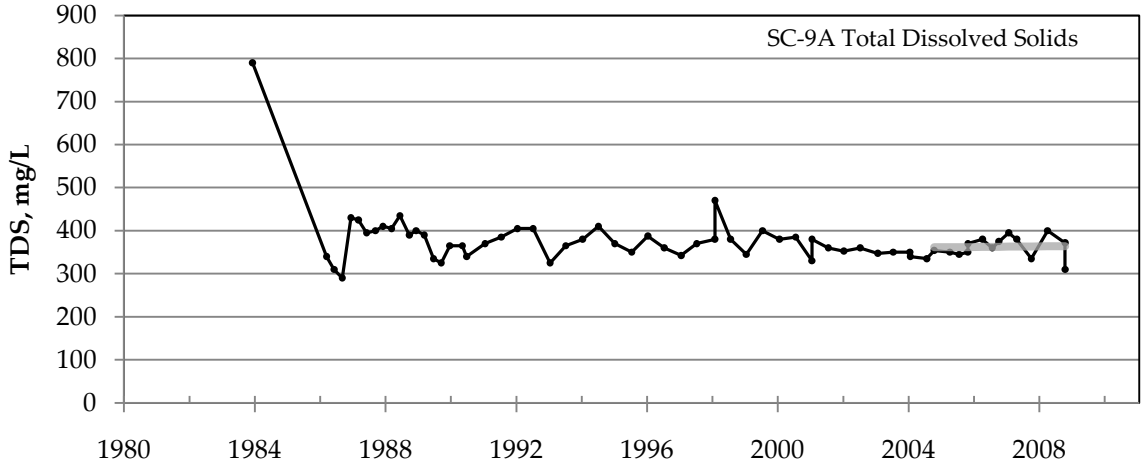
Chemographs and Single Well Hydrographs for Central Purisima Area

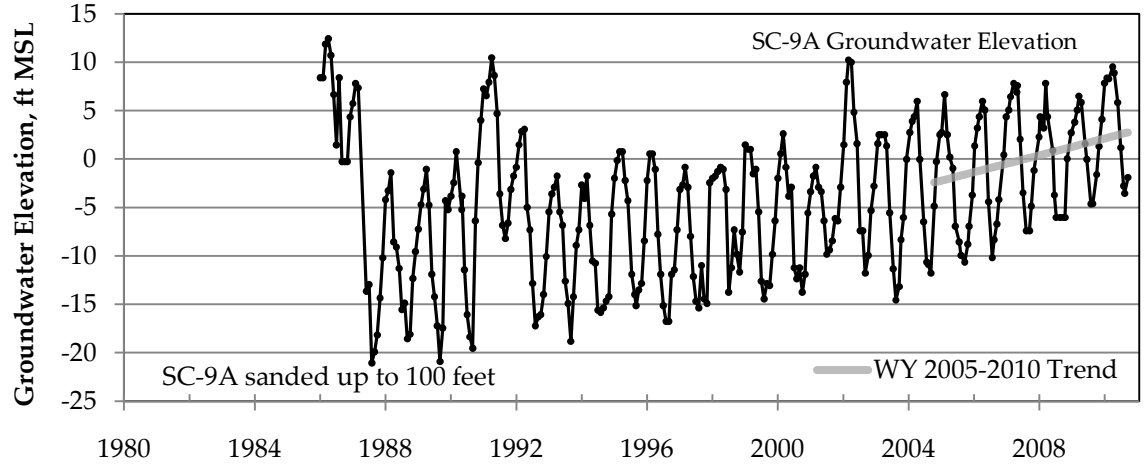
Graphs of SqCWD Coastal Monitoring Well Clusters

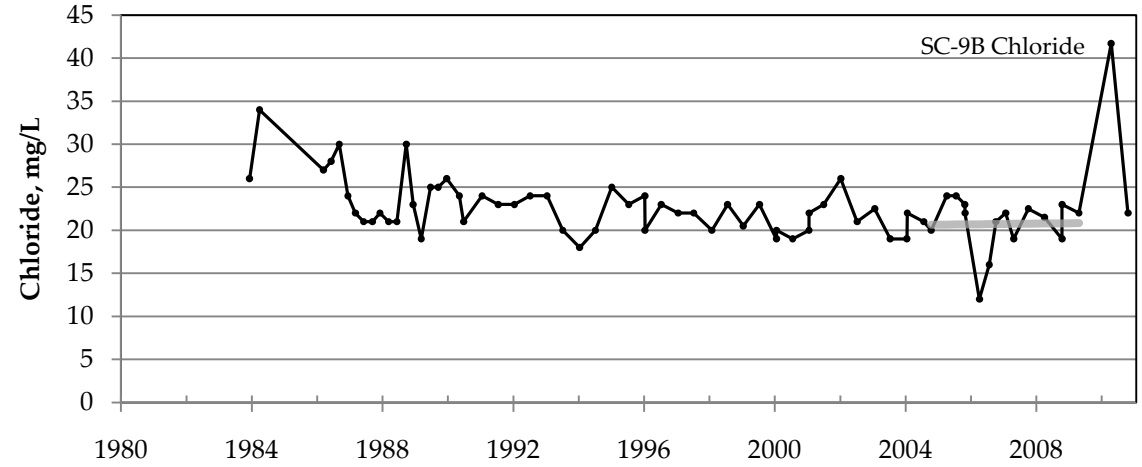
Graphs of SqWCD Inland Monitoring Well Clusters

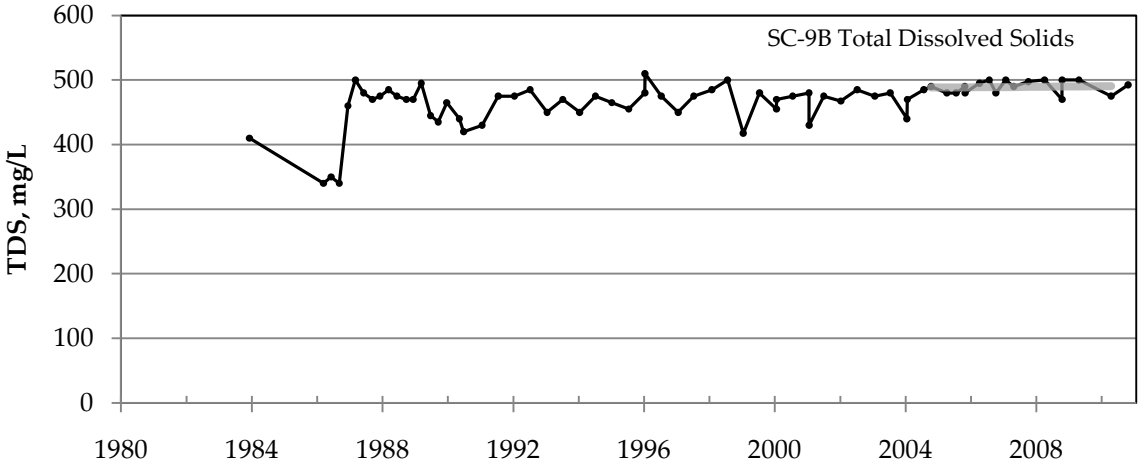
Graphs of SqWCD Production Wells and Monitoring Wells Adjacent to Production Wells

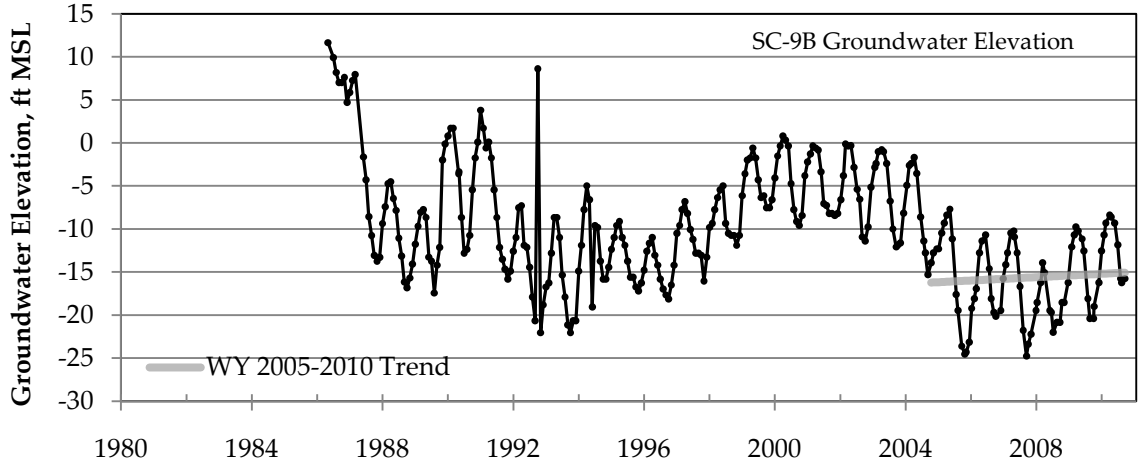

SC-9A Chloride
Chloride, mg/L
200
180
160
140
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

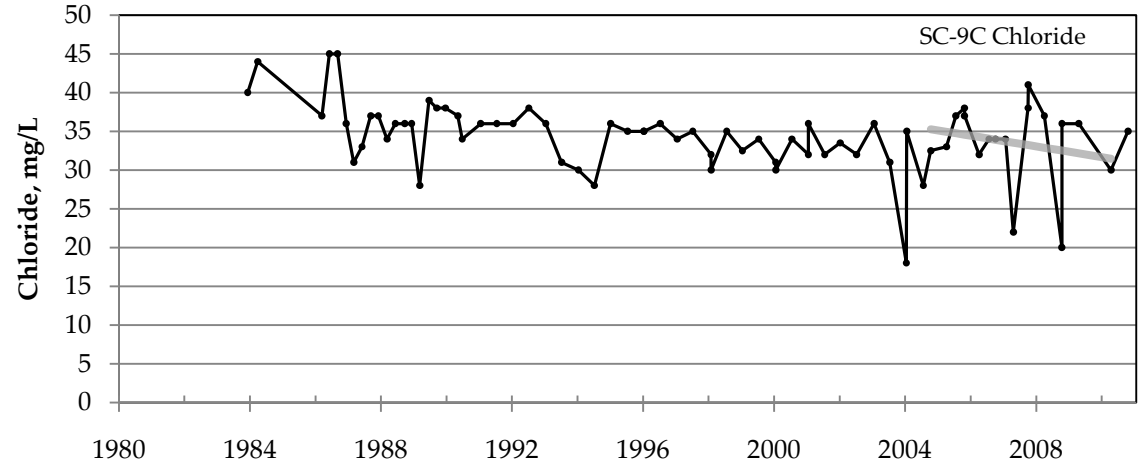

SC-9A Total Dissolved Solids
TDS, mg/L
900
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

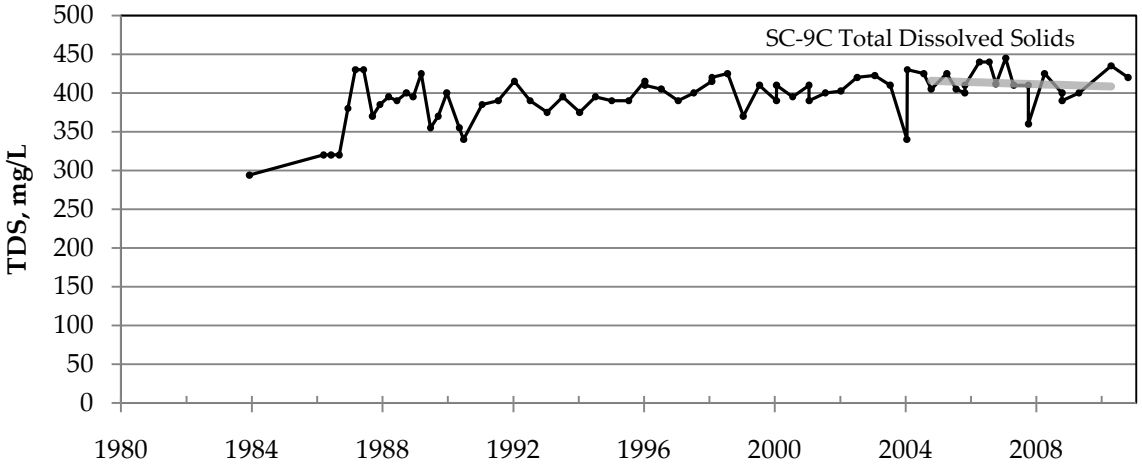

SC-9A Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
-25
SC-9A sanded up to 100 feet
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

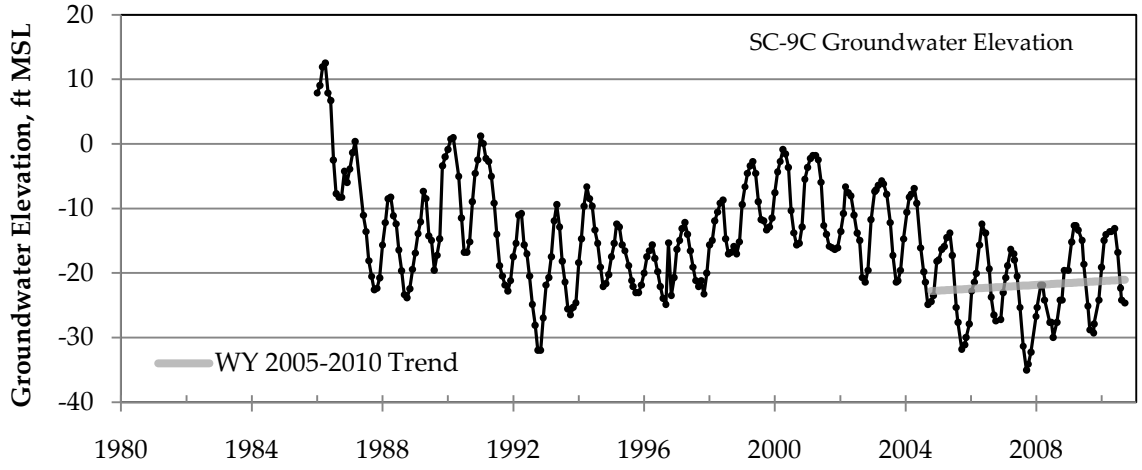

SC-9B Chloride
Chloride, mg/L
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

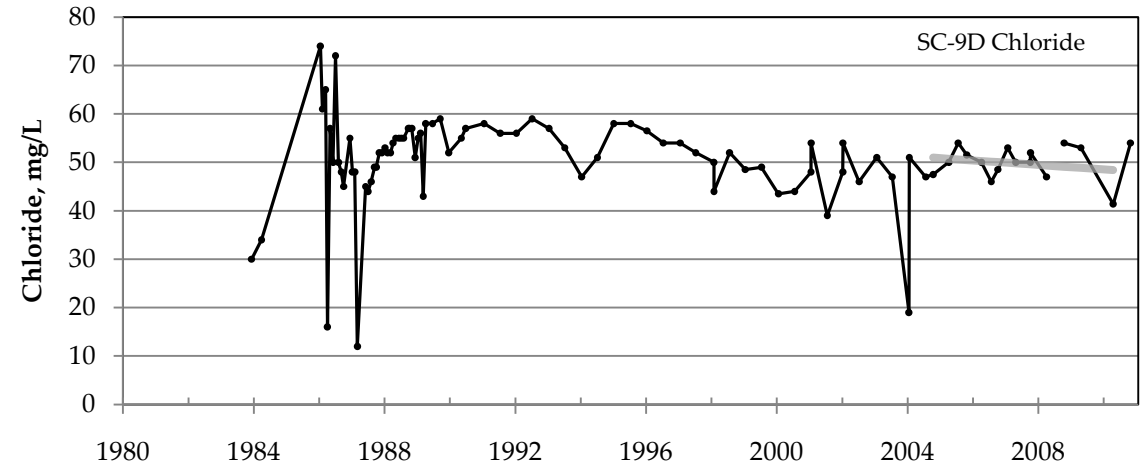

SC-9B Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

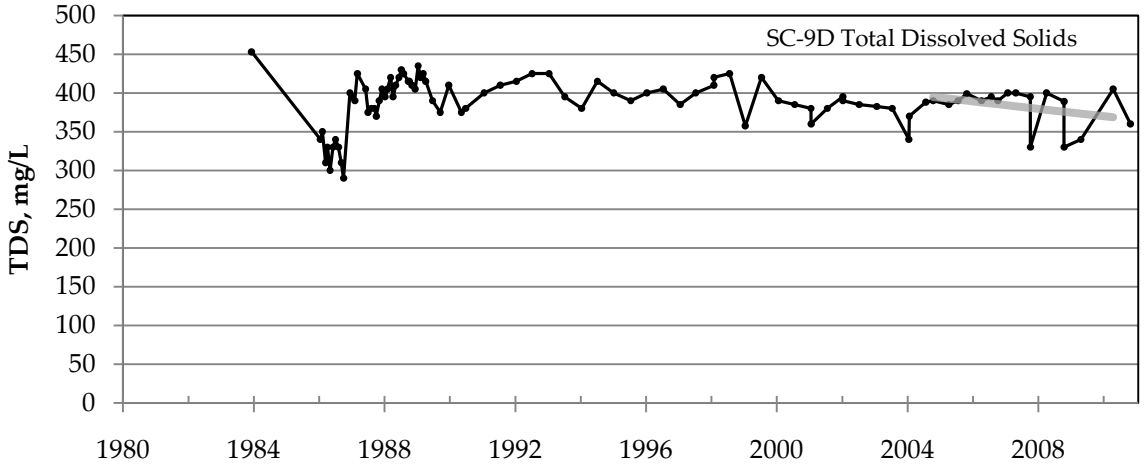

SC-9B Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
-25
-30
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

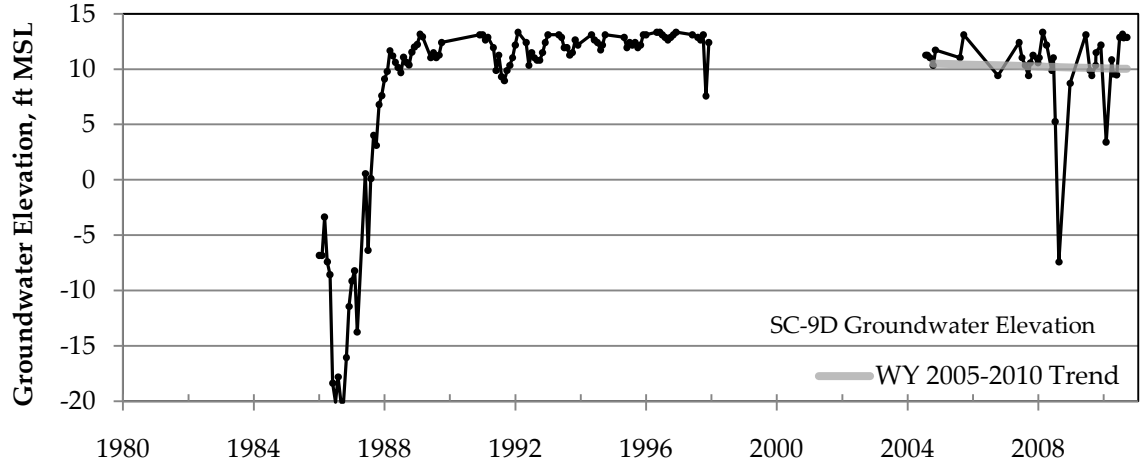

SC-9C Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

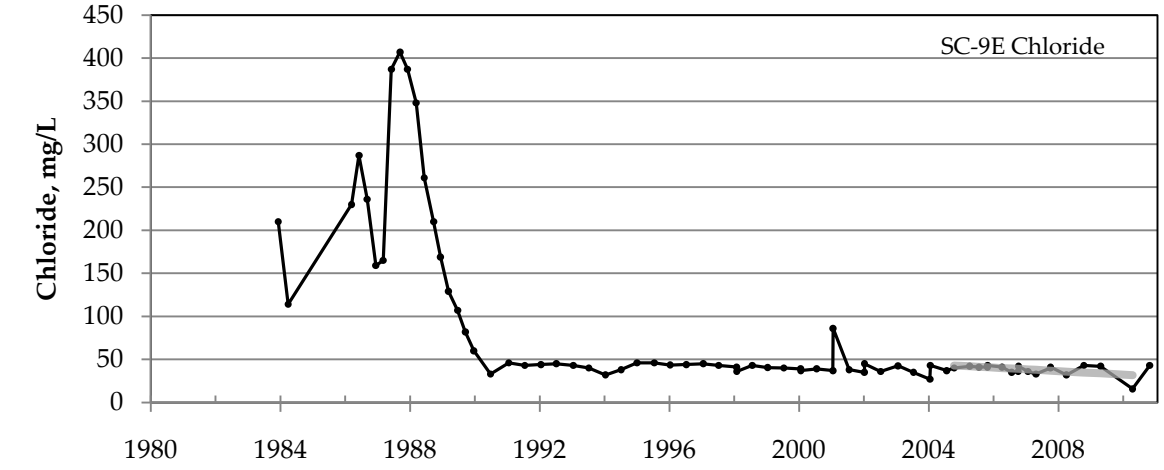

SC-9C Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

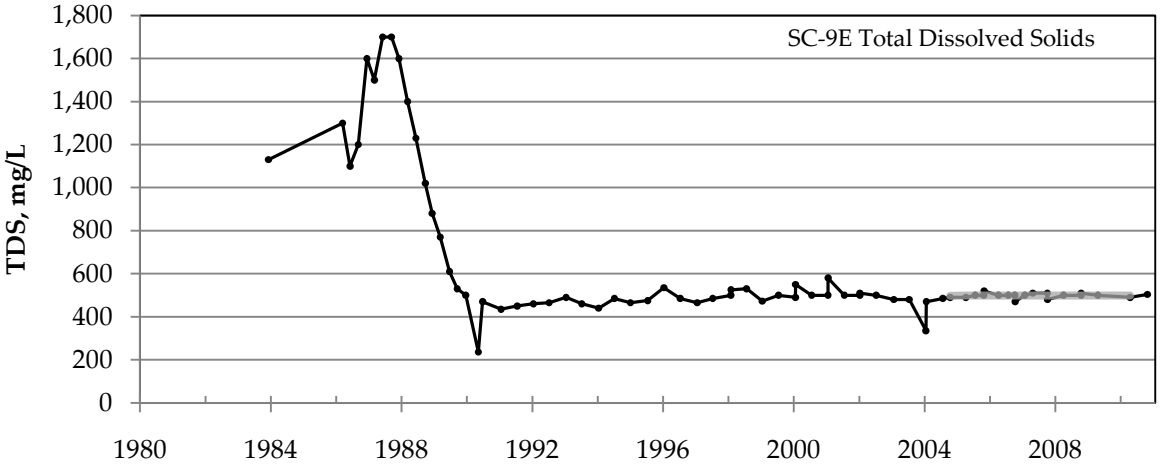

SC-9C Groundwater Elevation
Groundwater Elevation, ft MSL
20
10
0
-10
-20
-30
-40
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

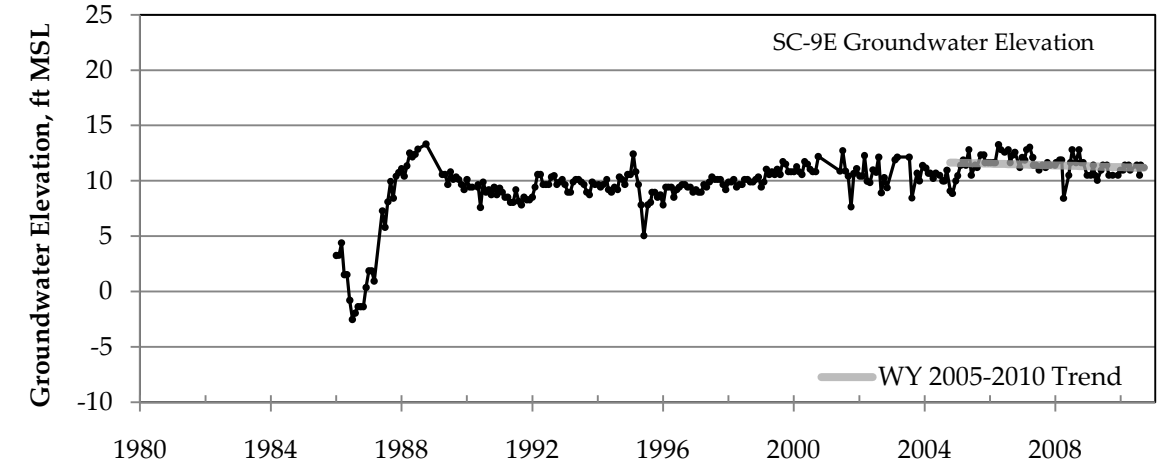

SC-9D Chloride
Chloride, mg/L
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

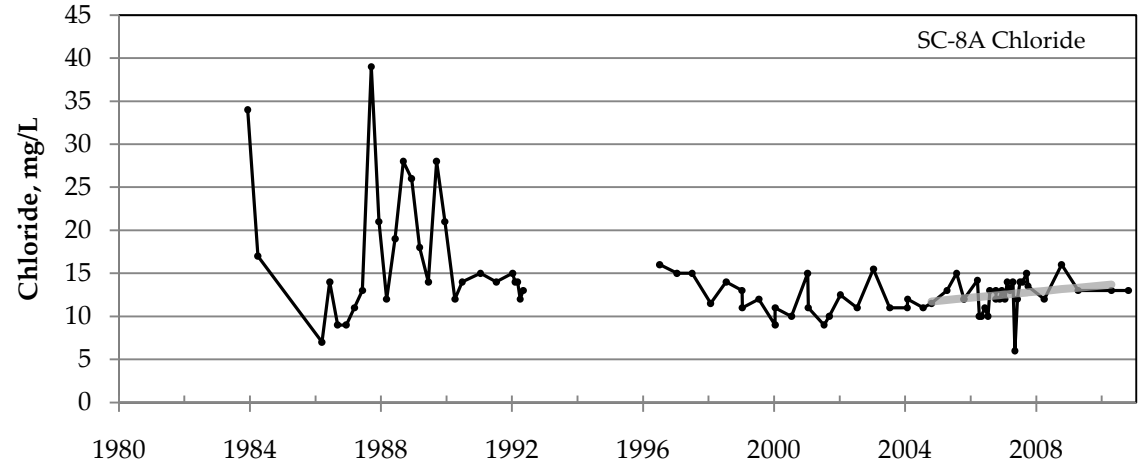

SC-9D Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

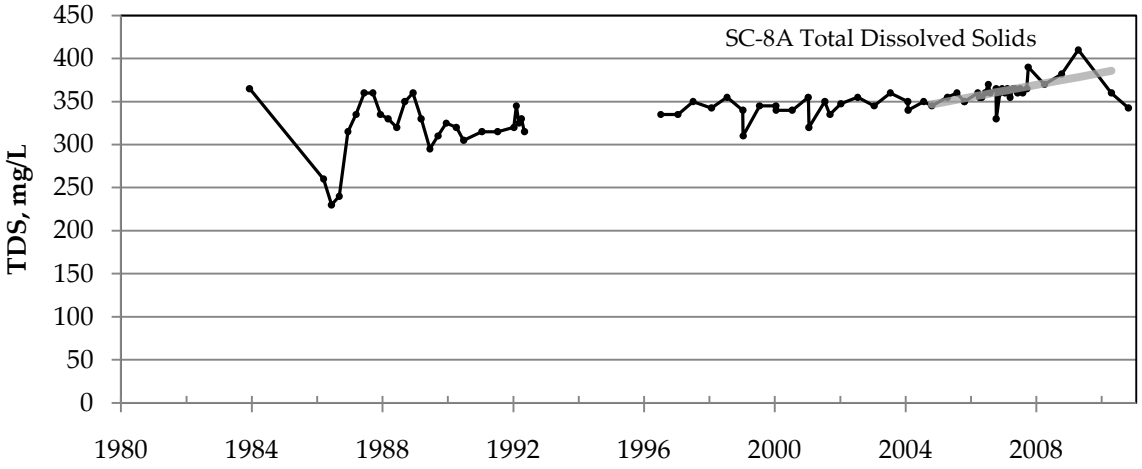

Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
SC-9D Groundwater Elevation
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

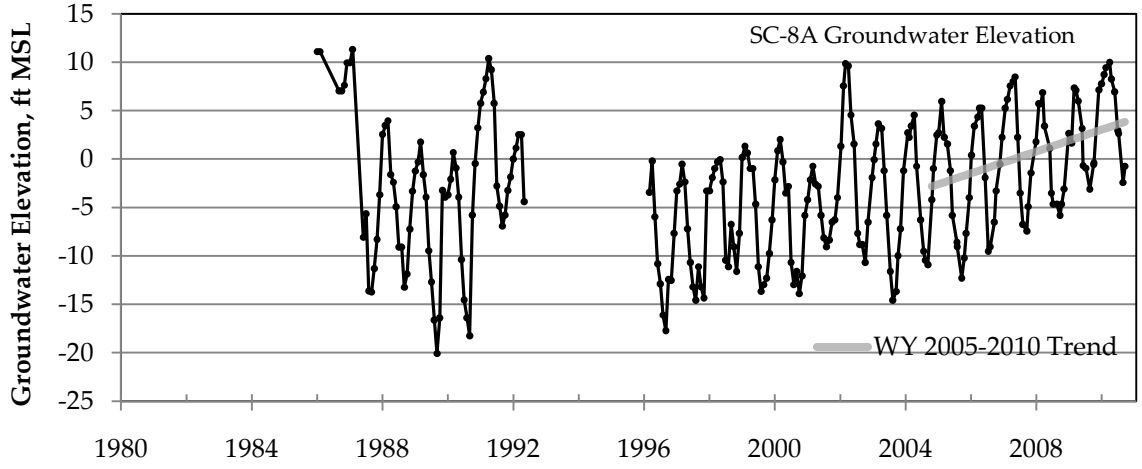

SC-9E Chloride
Chloride, mg/L
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

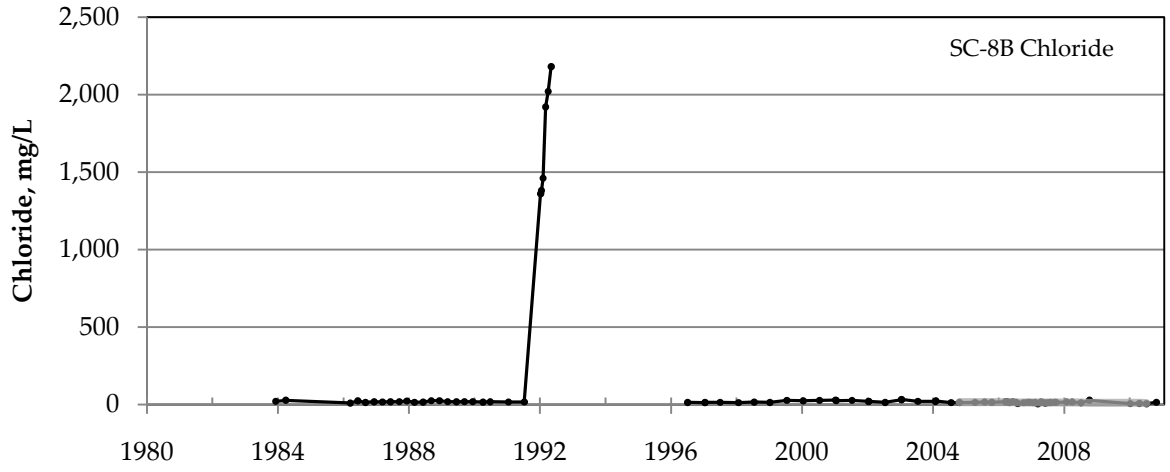

SC-9E Total Dissolved Solids
TDS, mg/L
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

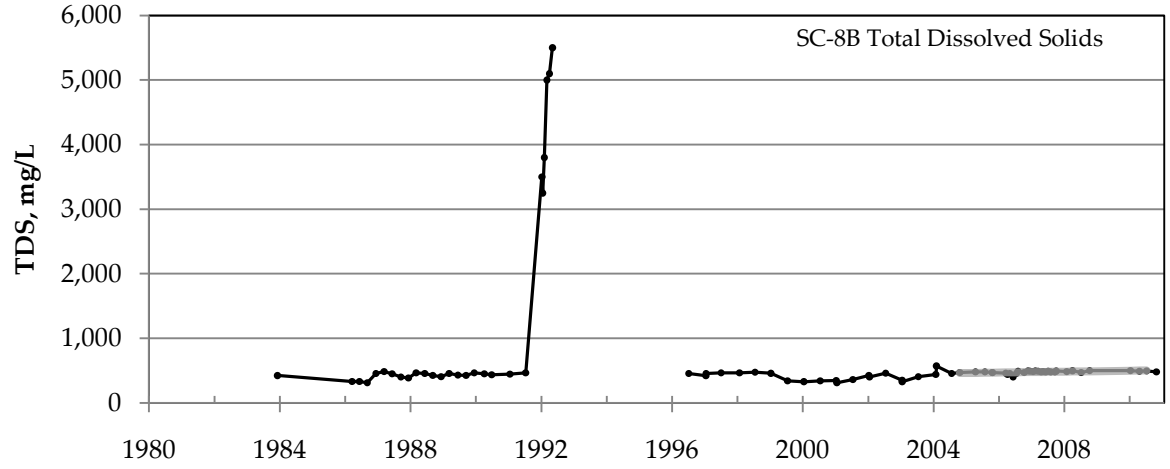

SC-9E Groundwater Elevation
Groundwater Elevation, ft MSL
25
20
15
10
5
0
-5
-10
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

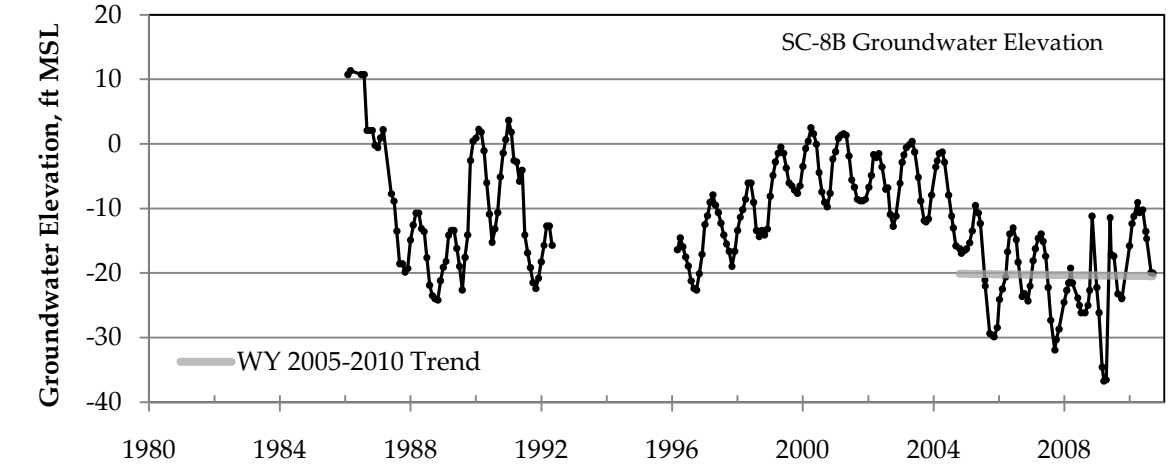

SC-8A Chloride
Chloride, mg/L
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

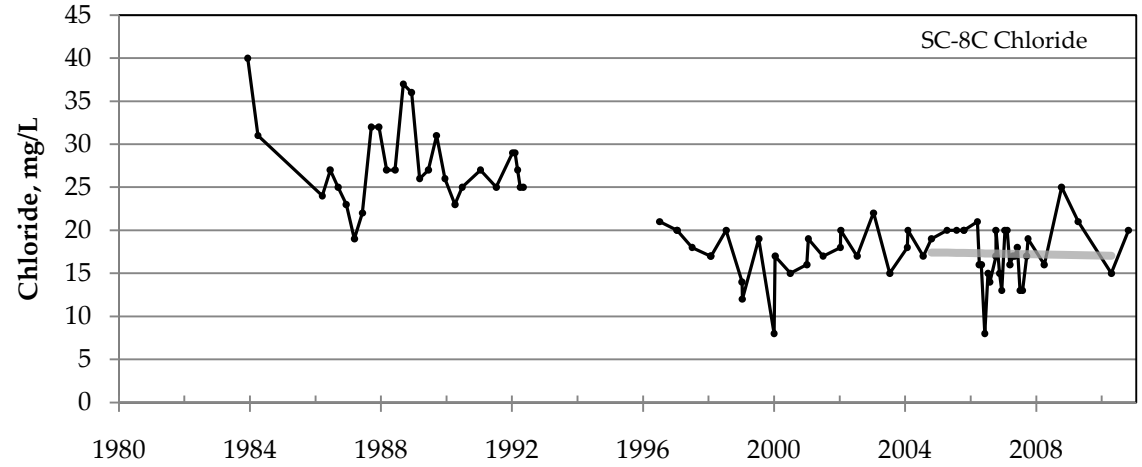

SC-8A Total Dissolved Solids
TDS, mg/L
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

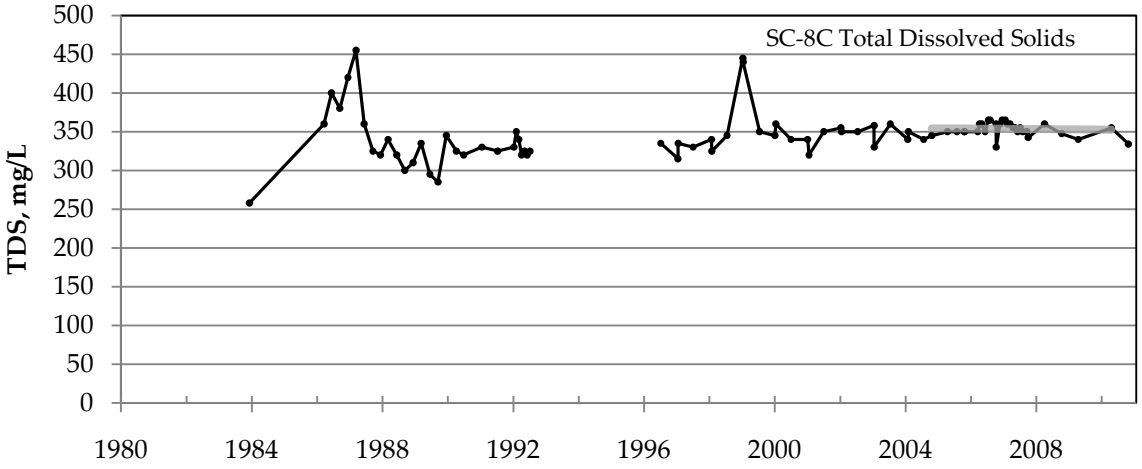

SC-8A Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
-25
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

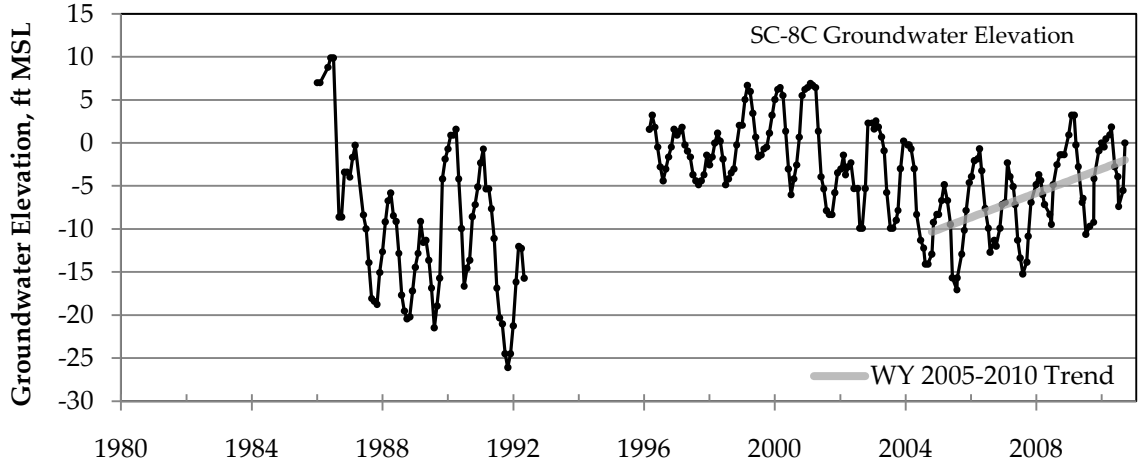

SC-8B Chloride
Chloride, mg/L
2,500
2,000
1,500
1,000
500
0
1980
1984
1988
1992
1996
2000
2004
2008

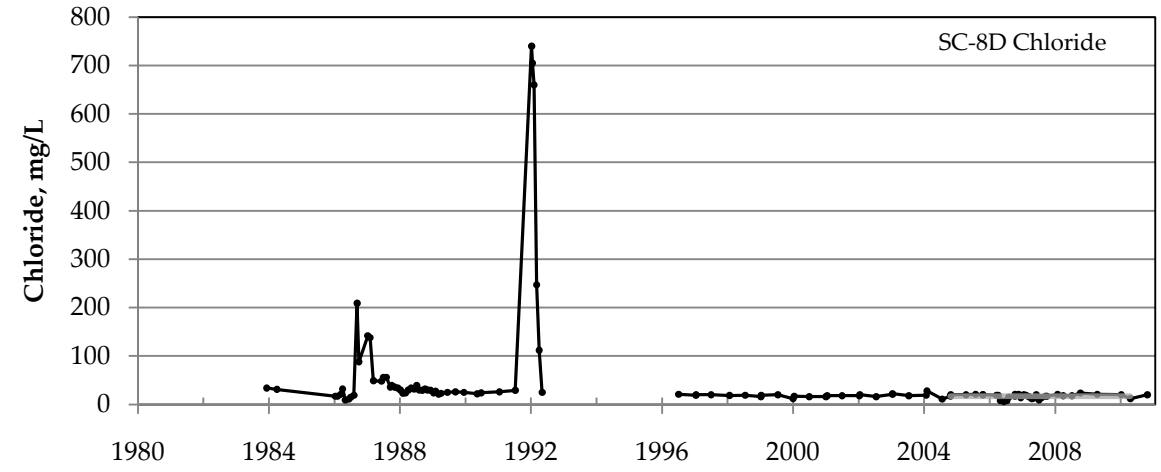

SC-8B Total Dissolved Solids
TDS, mg/L
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1984
1988
1992
1996
2000
2004
2008

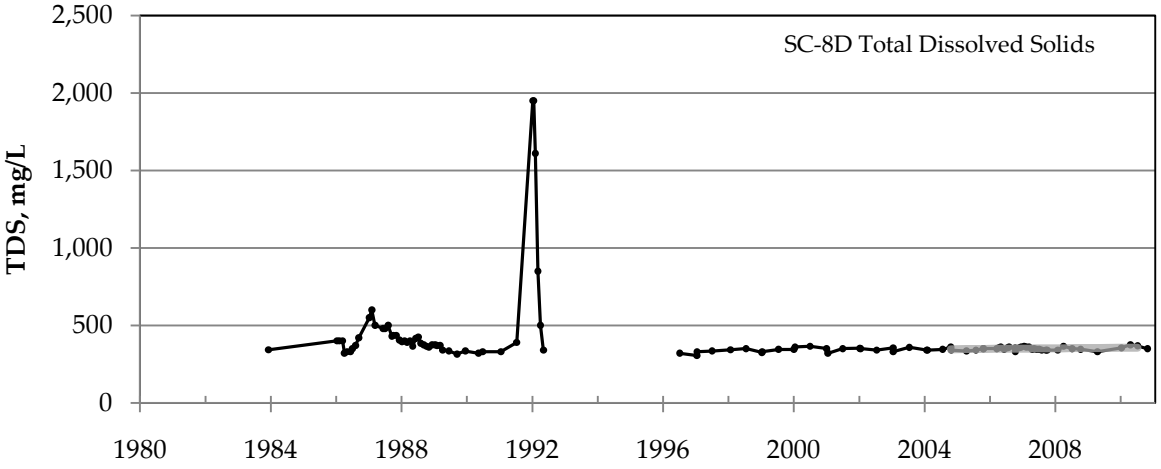

SC-8B Groundwater Elevation
Groundwater Elevation, ft MSL
20
10
0
-10
-20
-30
-40
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

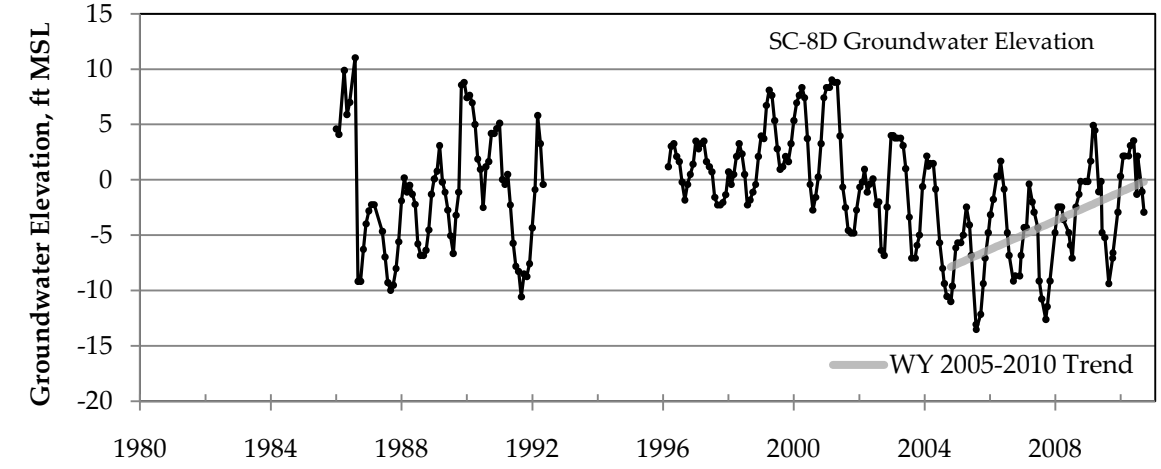

SC-8C Chloride
Chloride, mg/L
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

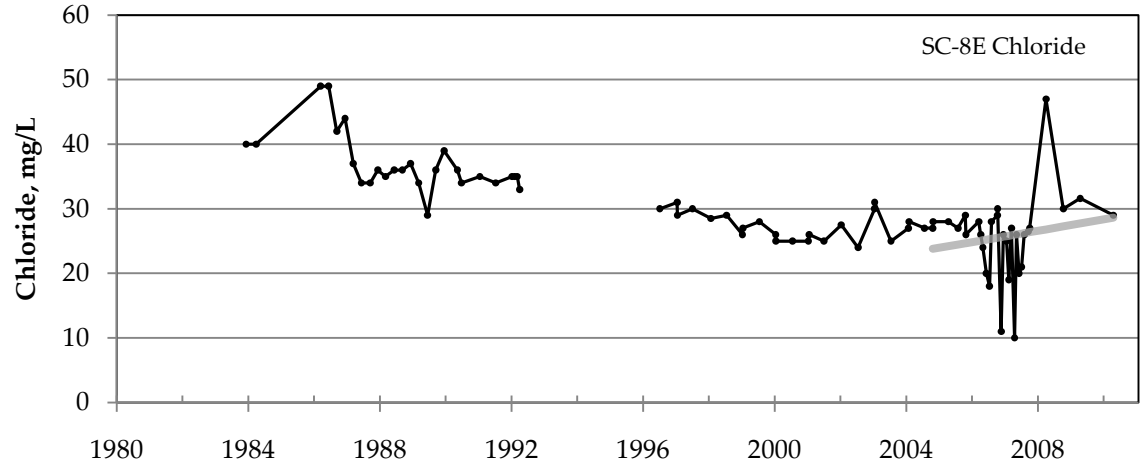

SC-8C Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

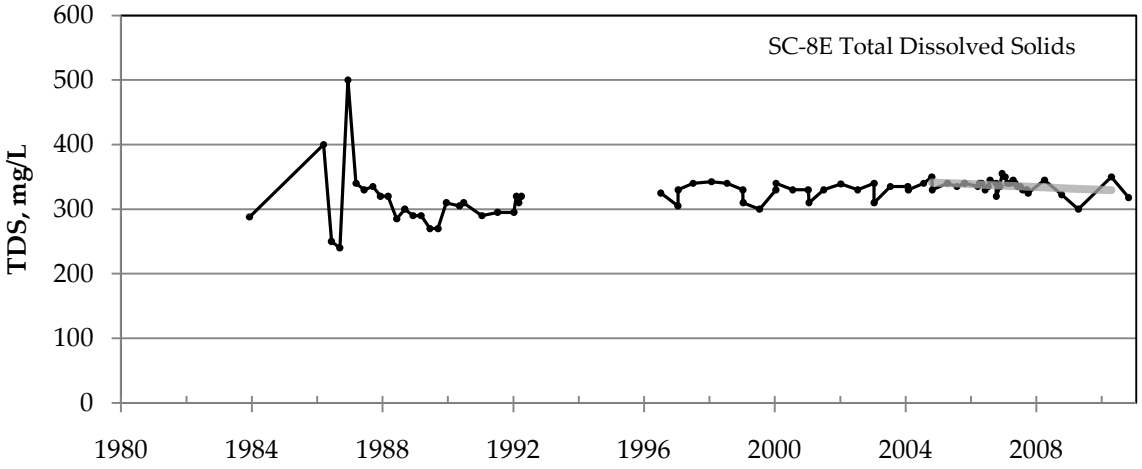

SC-8C Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
-25
-30
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

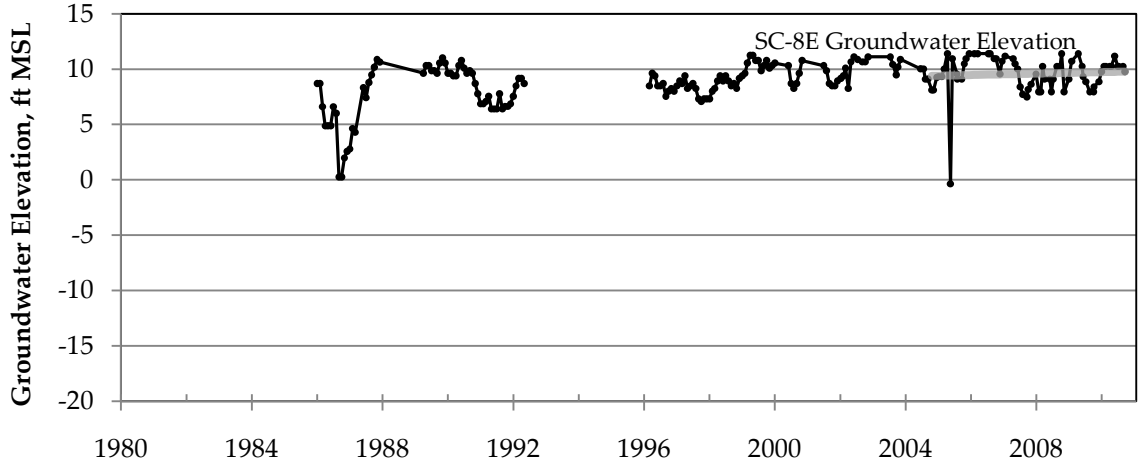

SC-8D Chloride
Chloride, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

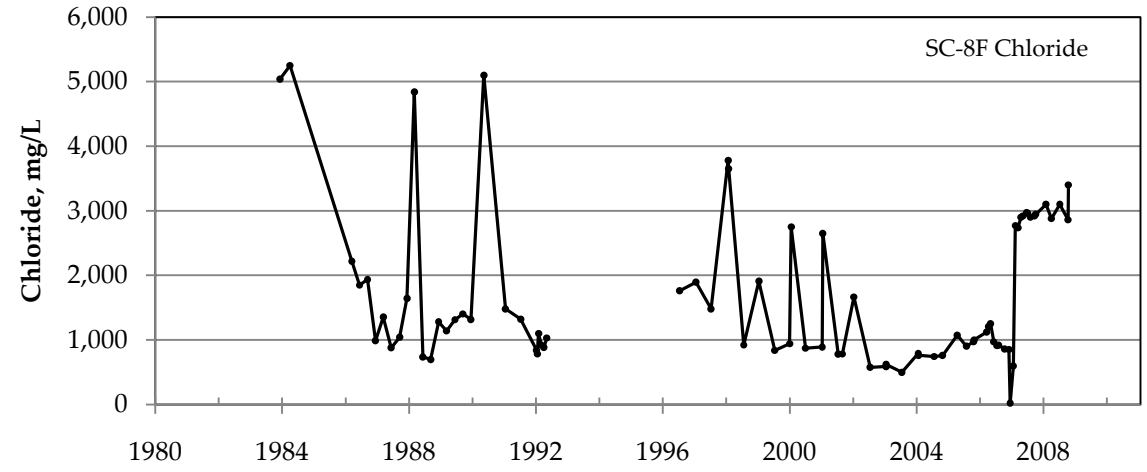

SC-8D Total Dissolved Solids
TDS, mg/L
2,500
2,000
1,500
1,000
500
0
1980
1984
1988
1992
1996
2000
2004
2008

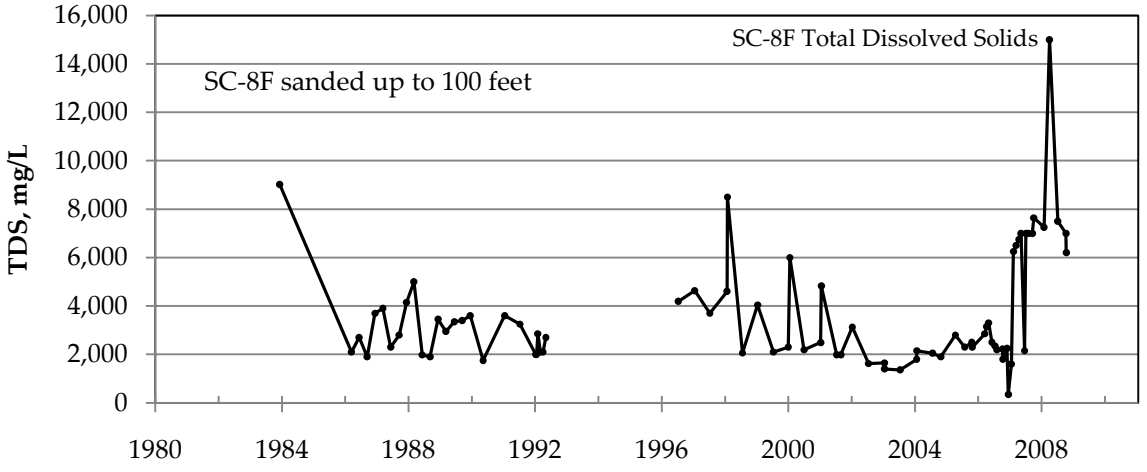

SC-8D Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

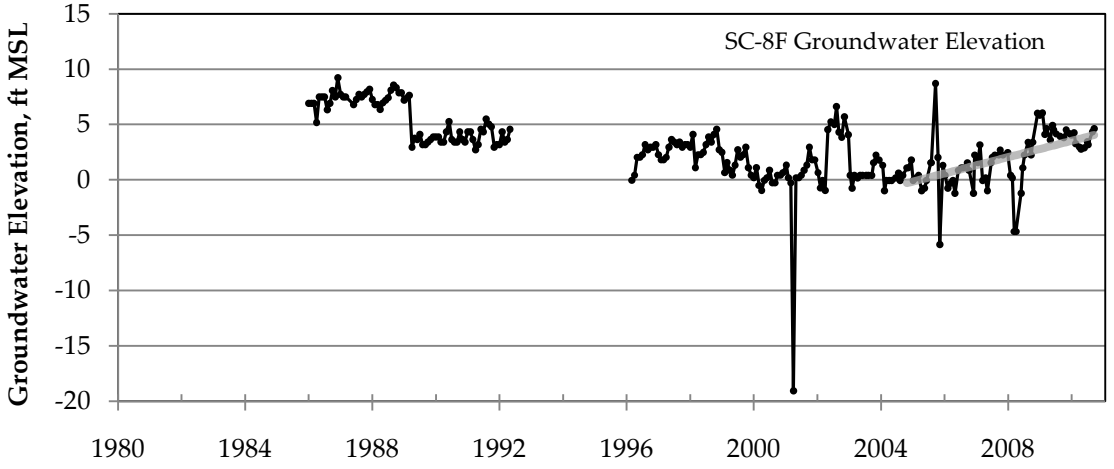

SC-8E Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

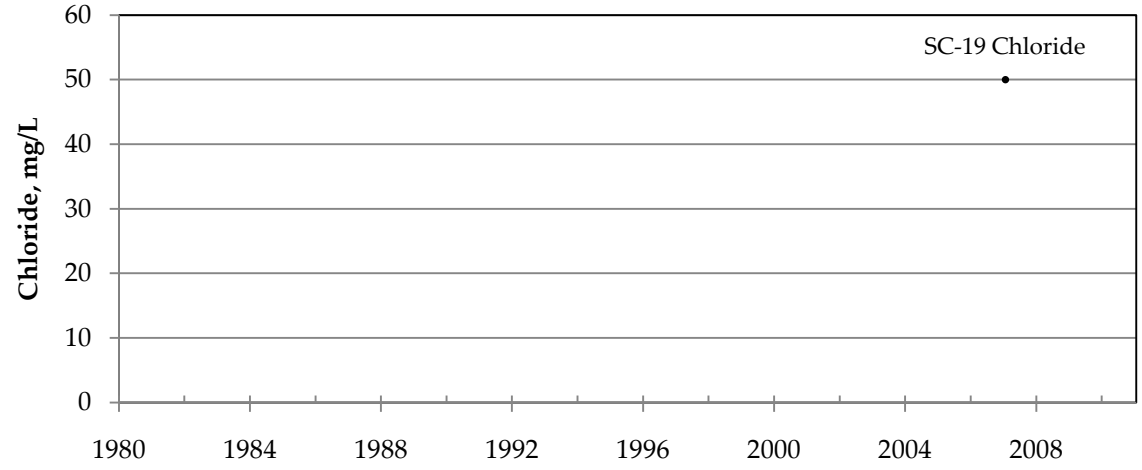

SC-8E Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

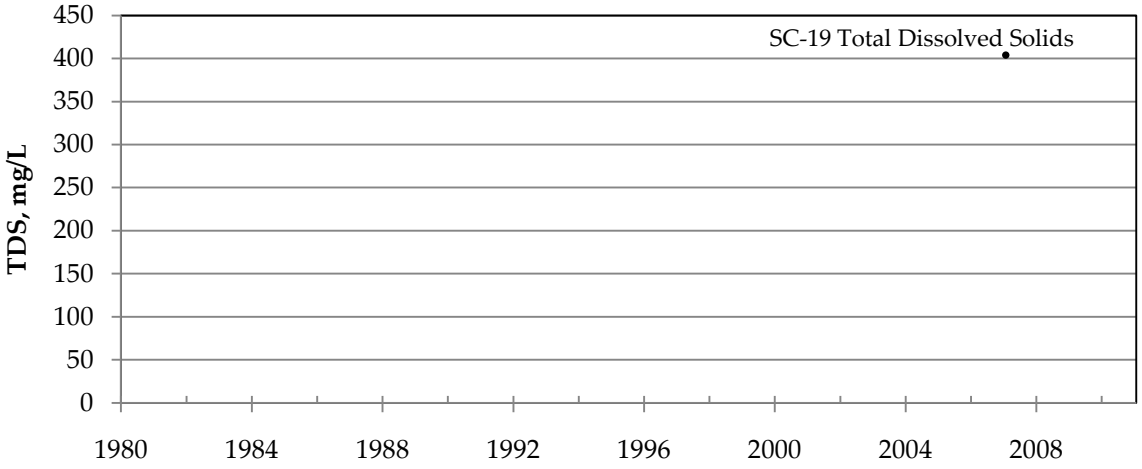

SC-8E Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
1980
1984
1988
1992
1996
2000
2004
2008

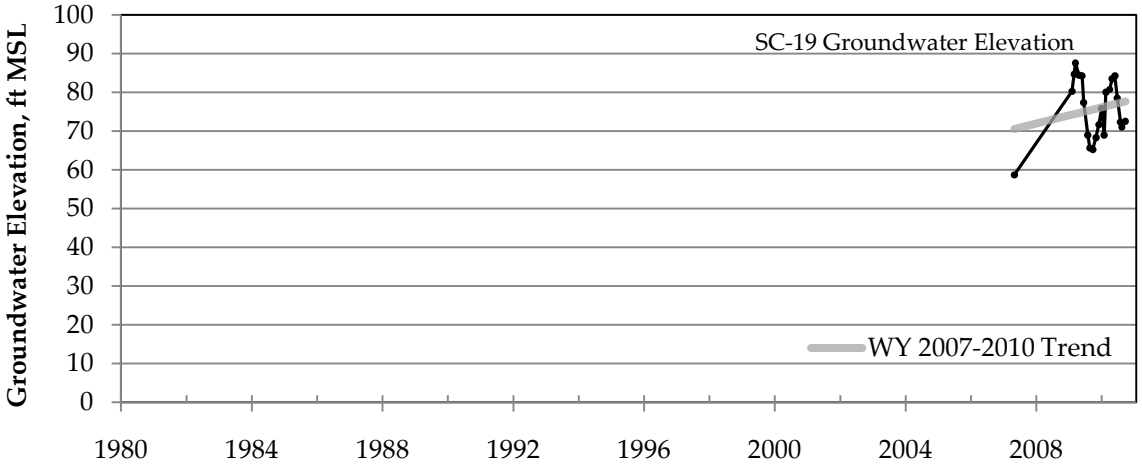

SC-8F Chloride
Chloride, mg/L
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1984
1988
1992
1996
2000
2004
2008

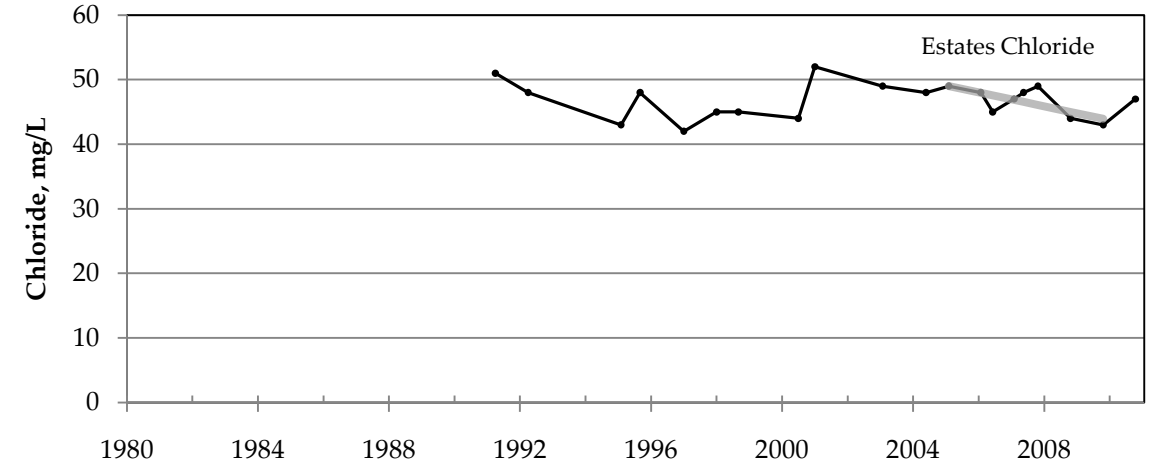

SC-8F Total Dissolved Solids
SC-8F sanded up to 100 feet
TDS, mg/L
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1980
1984
1988
1992
1996
2000
2004
2008

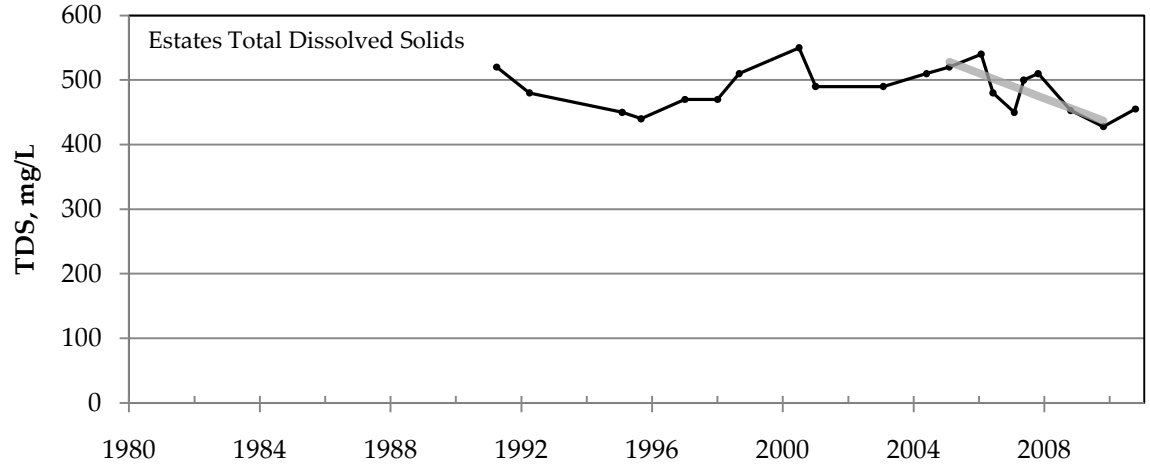

SC-8F Groundwater Elevation
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
1980
1984
1988
1992
1996
2000
2004
2008

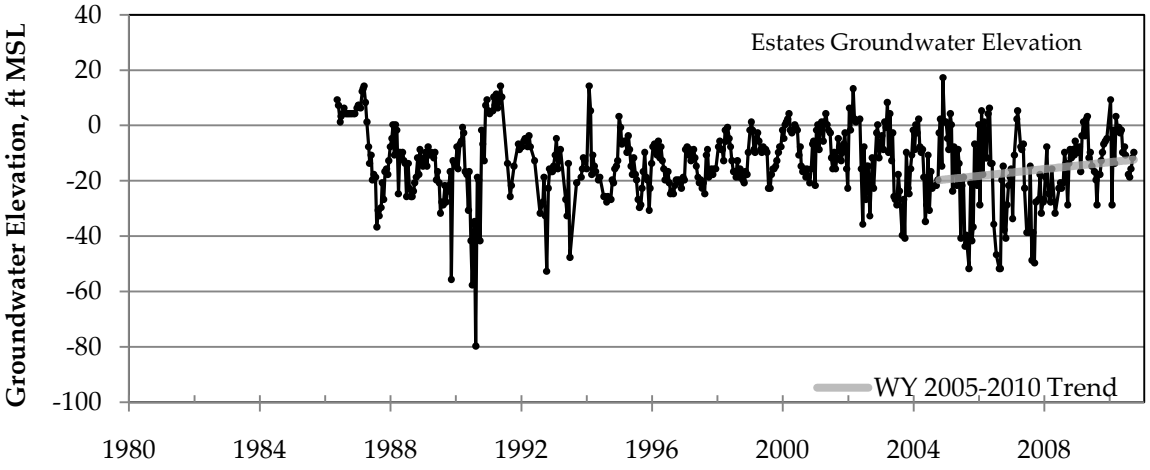

SC-19 Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

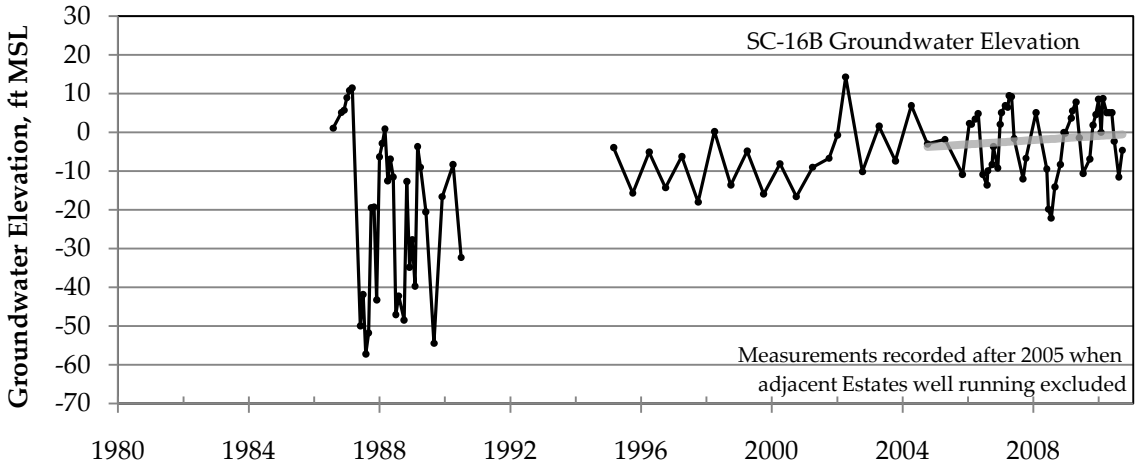

SC-19 Total Dissolved Solids
TDS, mg/L
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

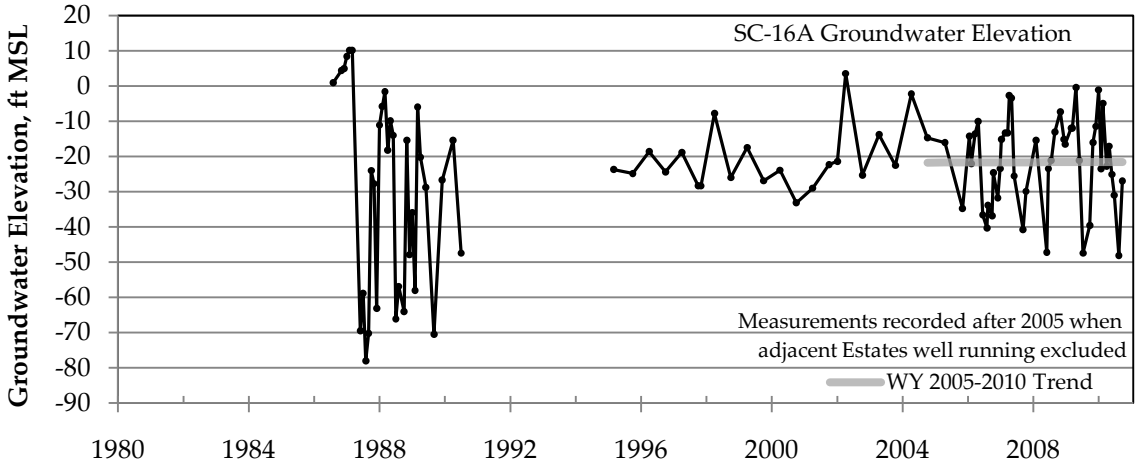

SC-19 Groundwater Elevation
WY 2007-2010 Trend
Groundwater Elevation, ft MSL
100
90
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

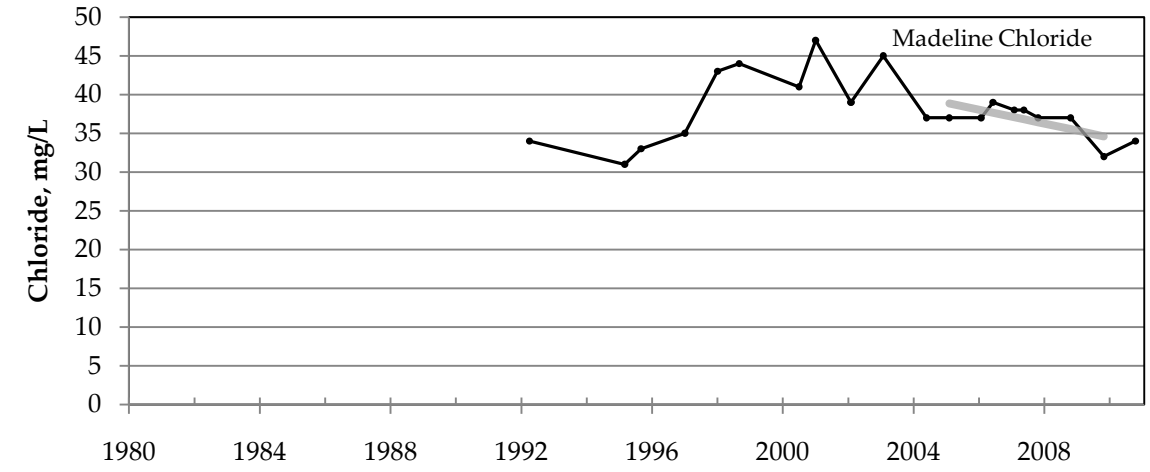

Estates Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

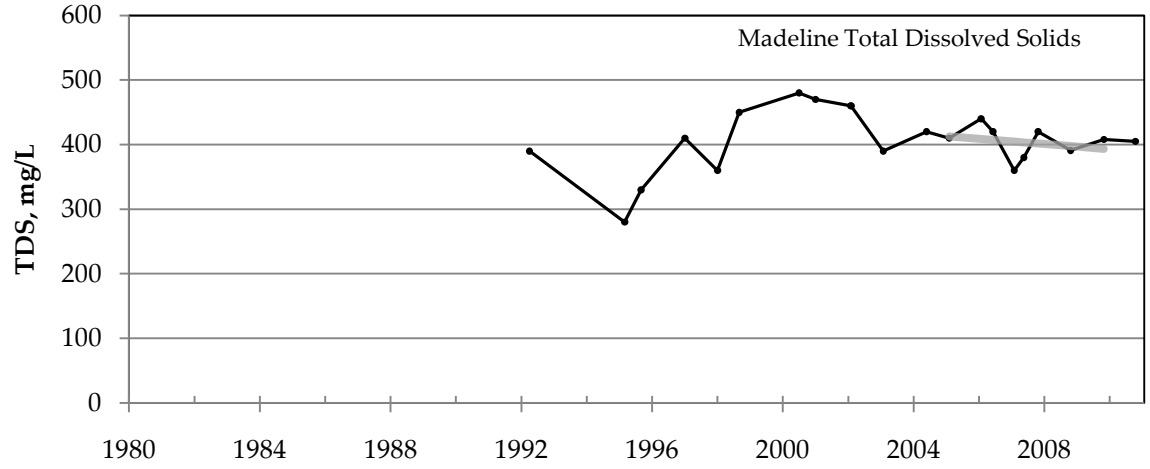

Estates Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

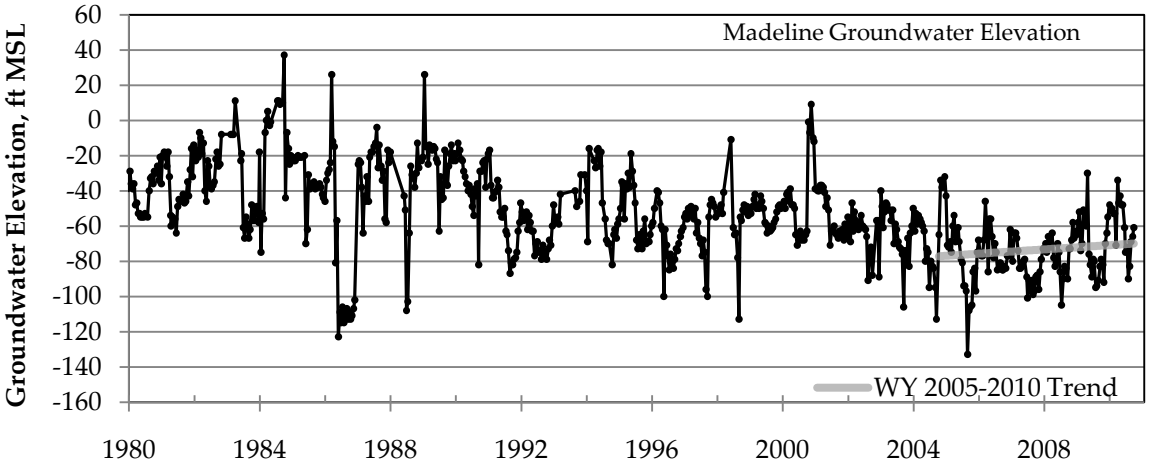

Estates Groundwater Elevation
Groundwater Elevation, ft MSL
40
20
0
-20
-40
-60
-80
-100
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

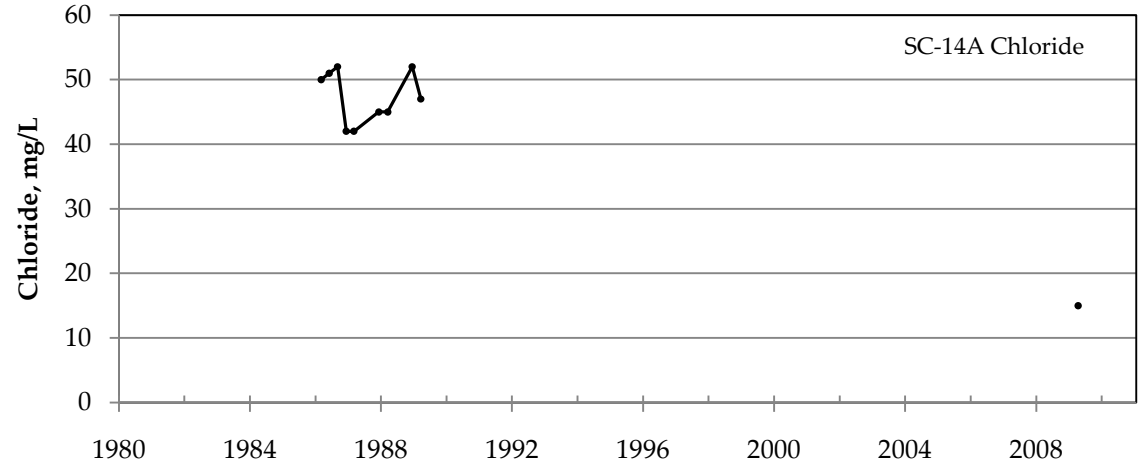

SC-16B Groundwater Elevation
Groundwater Elevation, ft MSL
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
1980
1984
1988
1992
1996
2000
2004
2008
Measurements recorded after 2005 when
adjacent Estates well running excluded

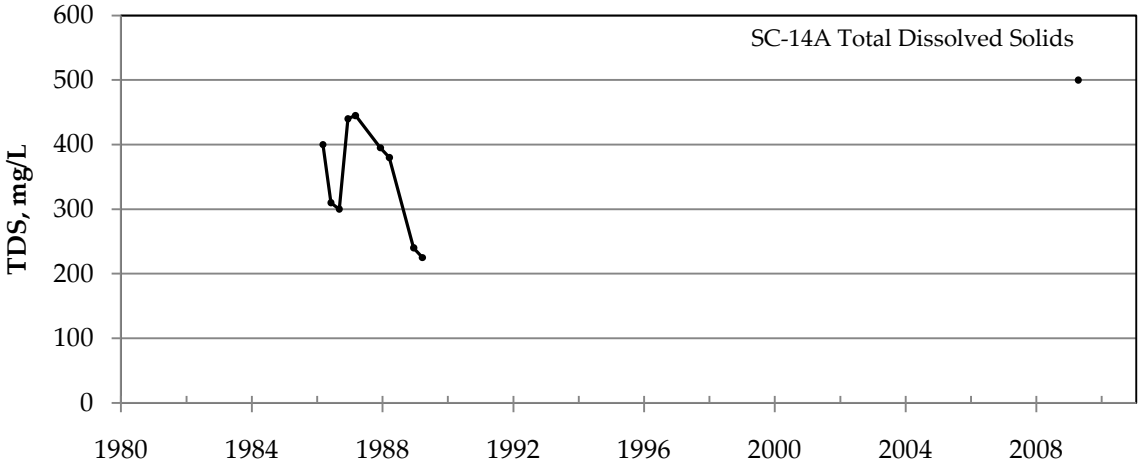

SC-16A Groundwater Elevation
Groundwater Elevation, ft MSL
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1980
1984
1988
1992
1996
2000
2004
2008
Measurements recorded after 2005 when
adjacent Estates well running excluded
WY 2005-2010 Trend

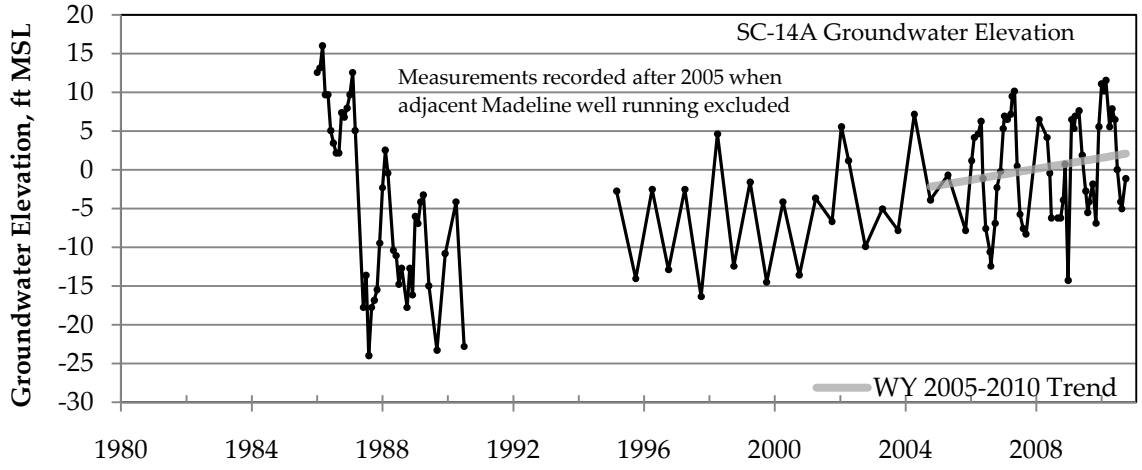

Madeline Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

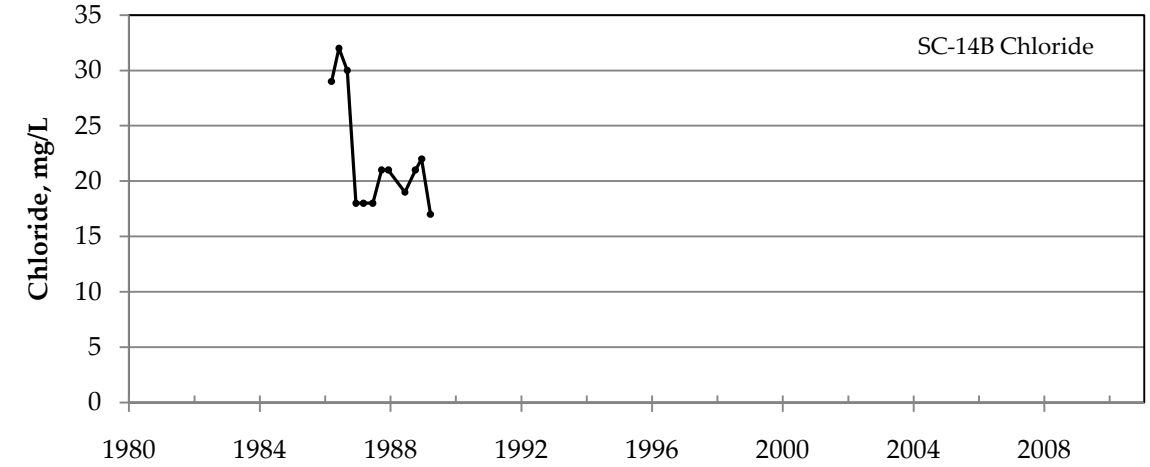

Madeline Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

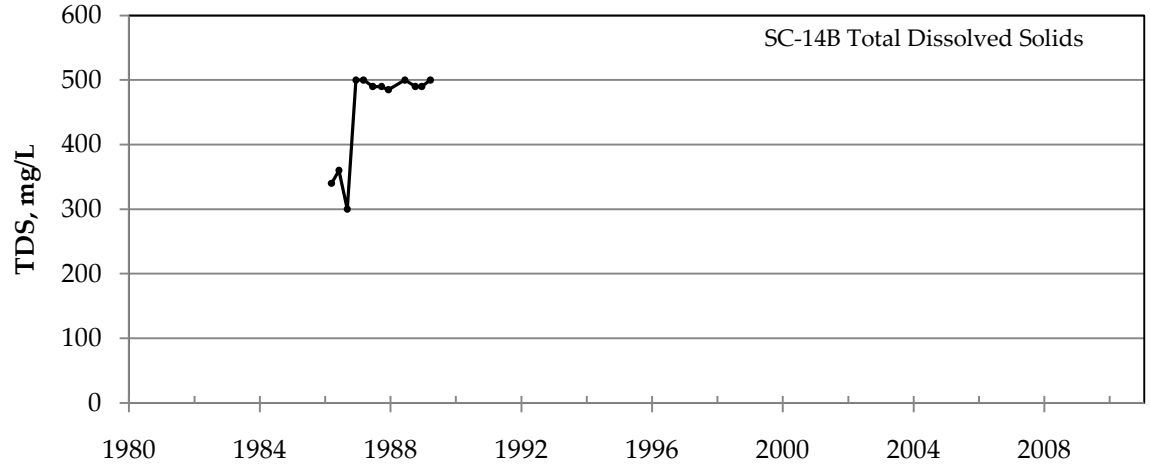

Madeline Groundwater Elevation
Groundwater Elevation, ft MSL
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

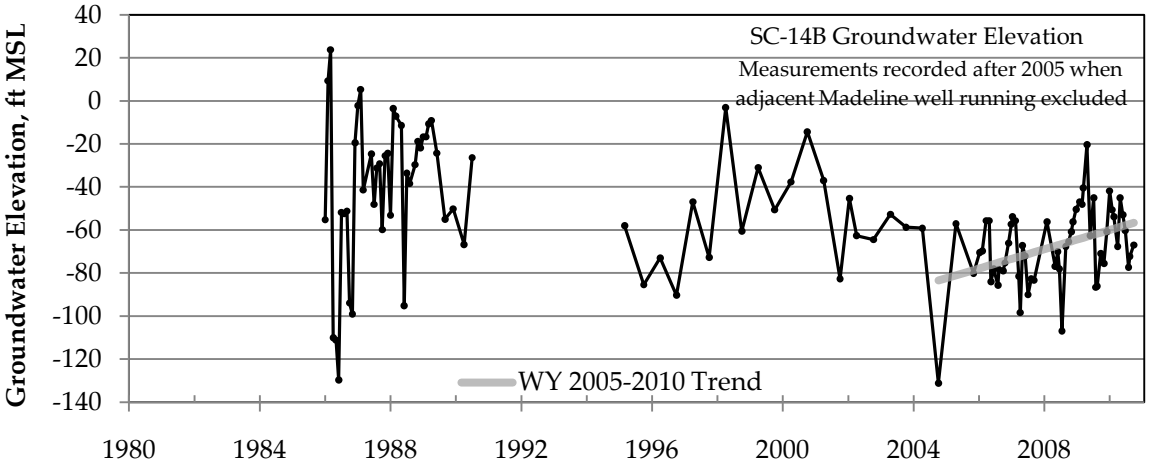

SC-14A Chloride
Chloride, mg/L
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

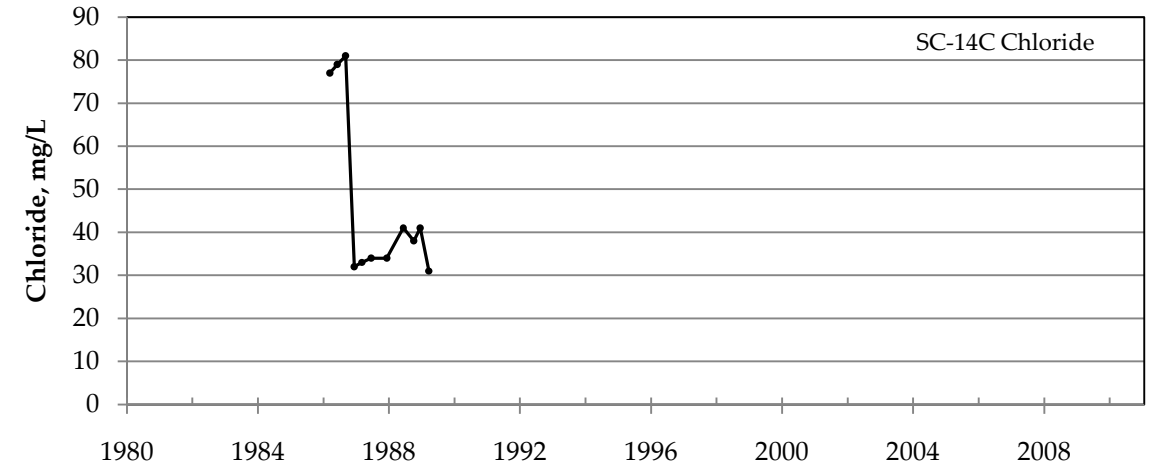

SC-14A Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

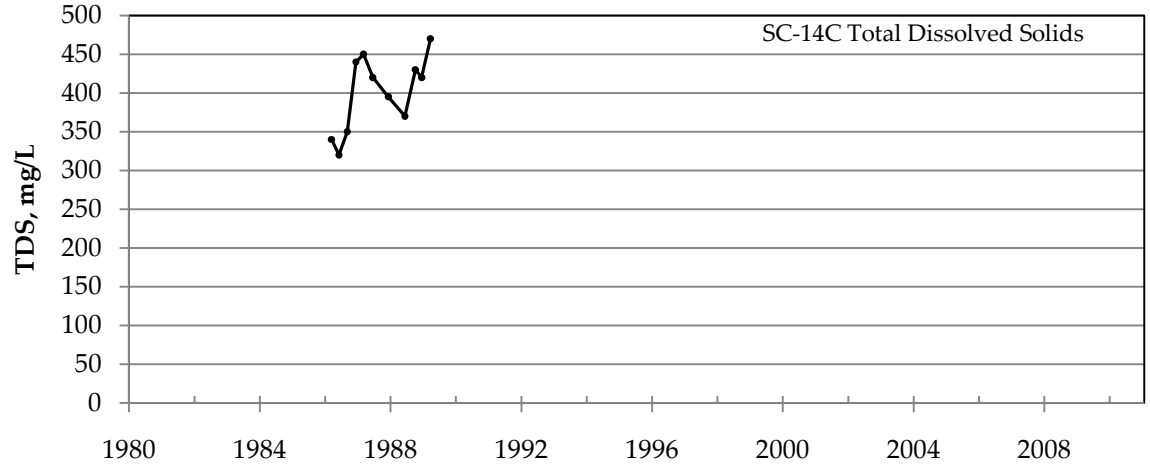

SC-14A Groundwater Elevation
Measurements recorded after 2005 when
adjacent Madeline well running excluded
WY 2005-2010 Trend
Groundwater Elevation, ft MSL
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1980
1984
1988
1992
1996
2000
2004
2008

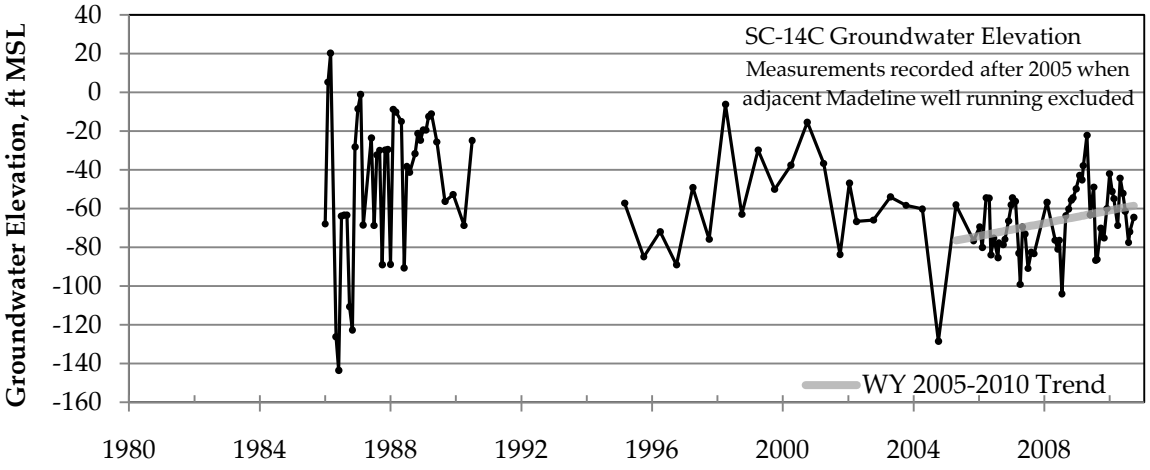

SC-14B Chloride
Chloride, mg/L
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

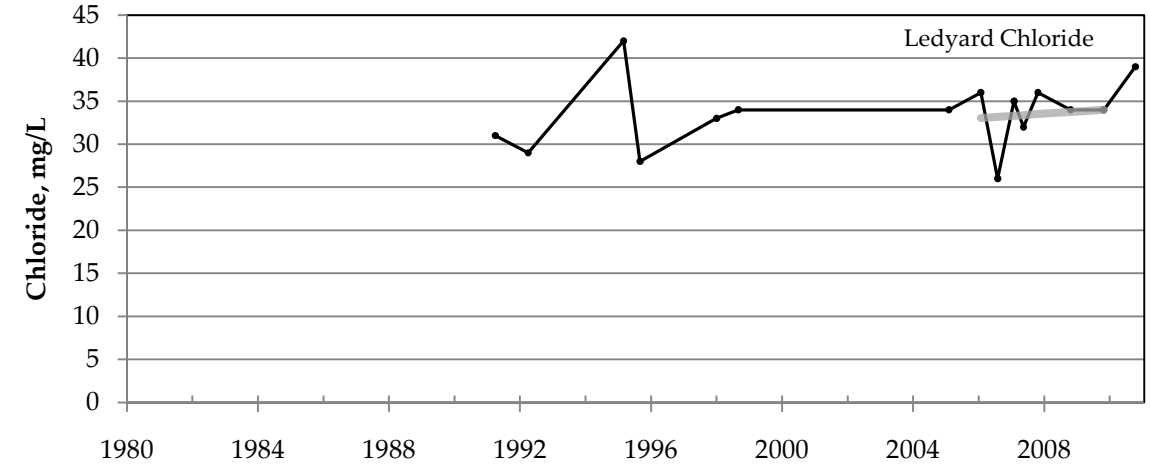

SC-14B Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

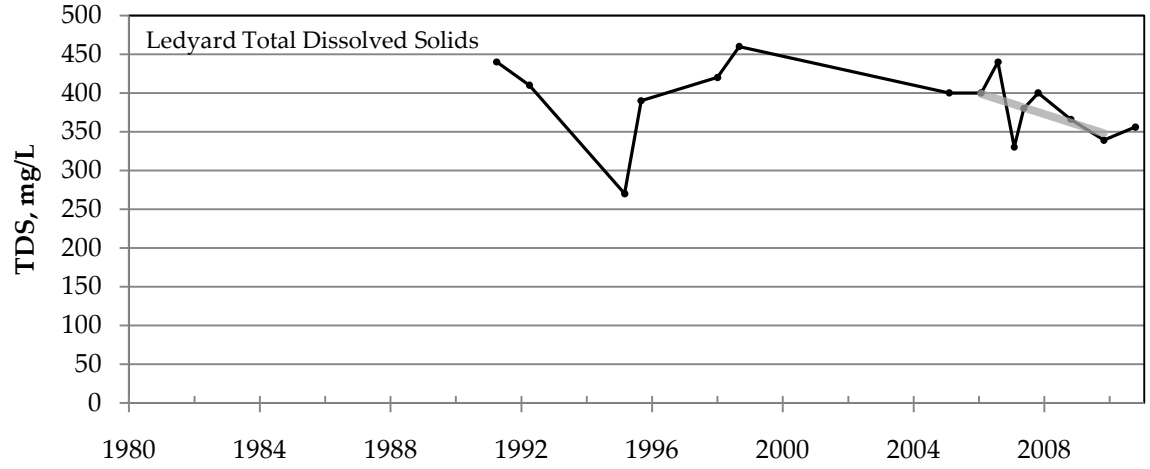

SC-14B Groundwater Elevation
Measurements recorded after 2005 when adjacent Madeline well running excluded
Groundwater Elevation, ft MSL
40
20
0
-20
-40
-60
-80
-100
-120
-140
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

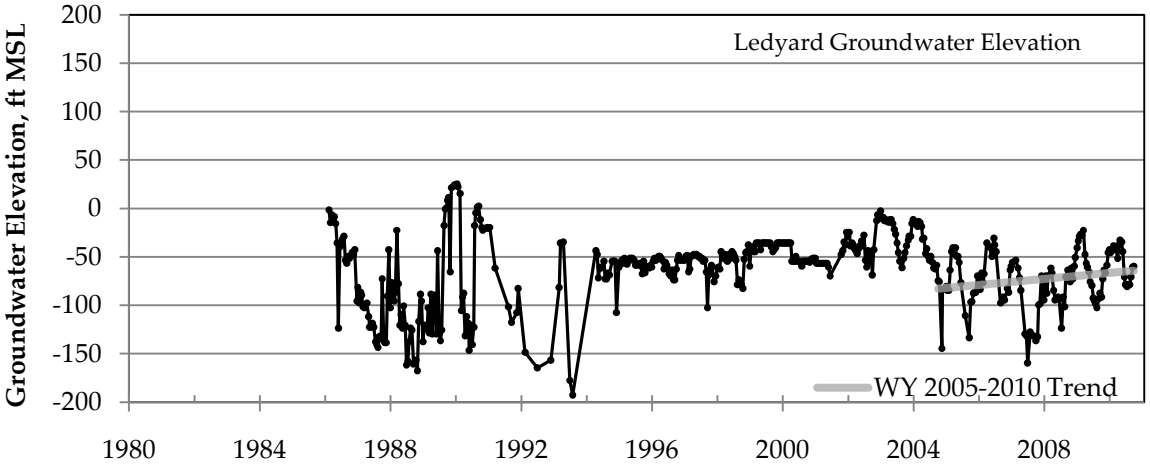

SC-14C Chloride
Chloride, mg/L
90
80
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

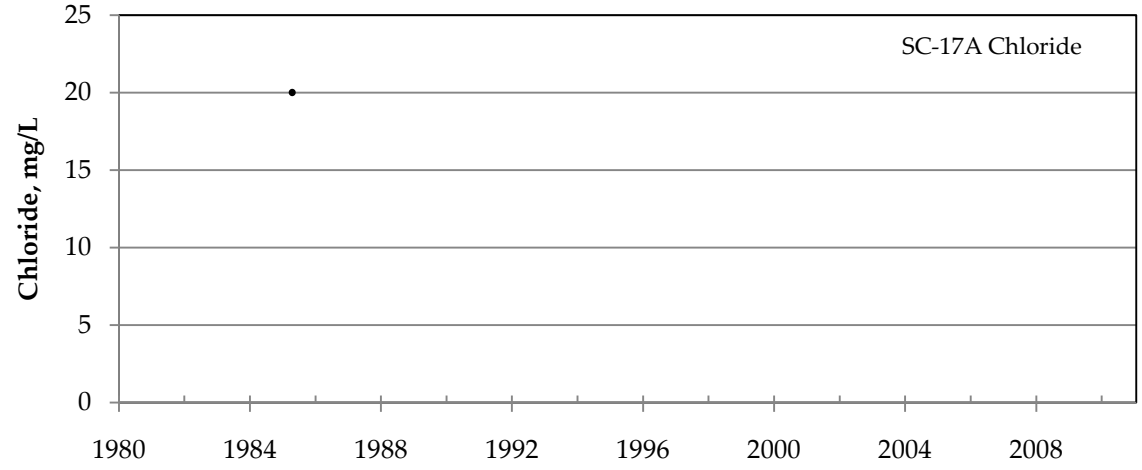

SC-14C Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

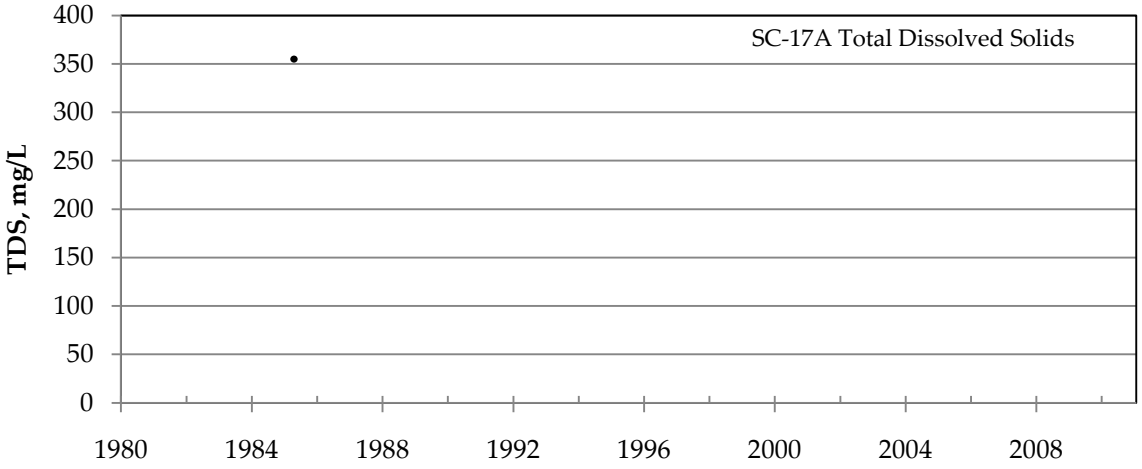

SC-14C Groundwater Elevation
Measurements recorded after 2005 when adjacent Madeline well running excluded
WY 2005-2010 Trend
Groundwater Elevation, ft MSL
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
1980
1984
1988
1992
1996
2000
2004
2008

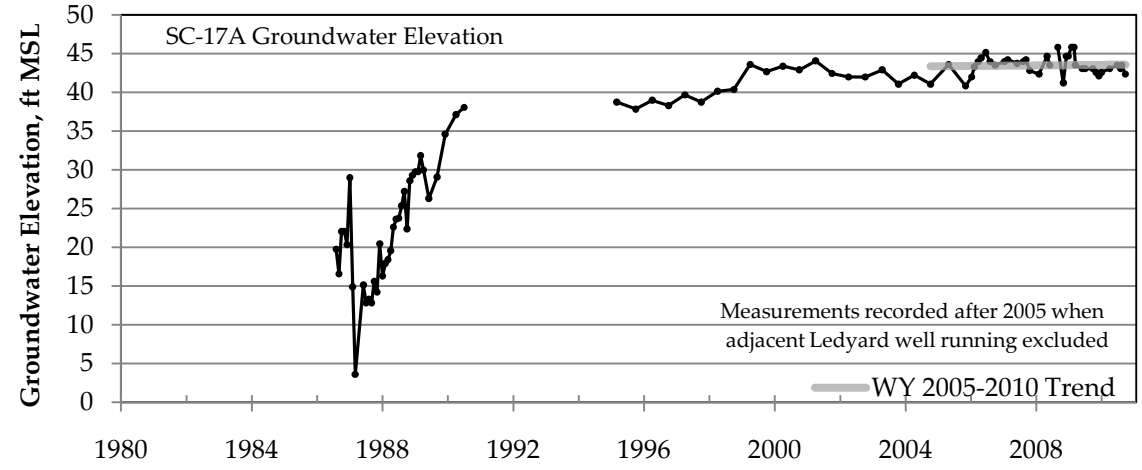

Ledyard Chloride
Chloride, mg/L
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

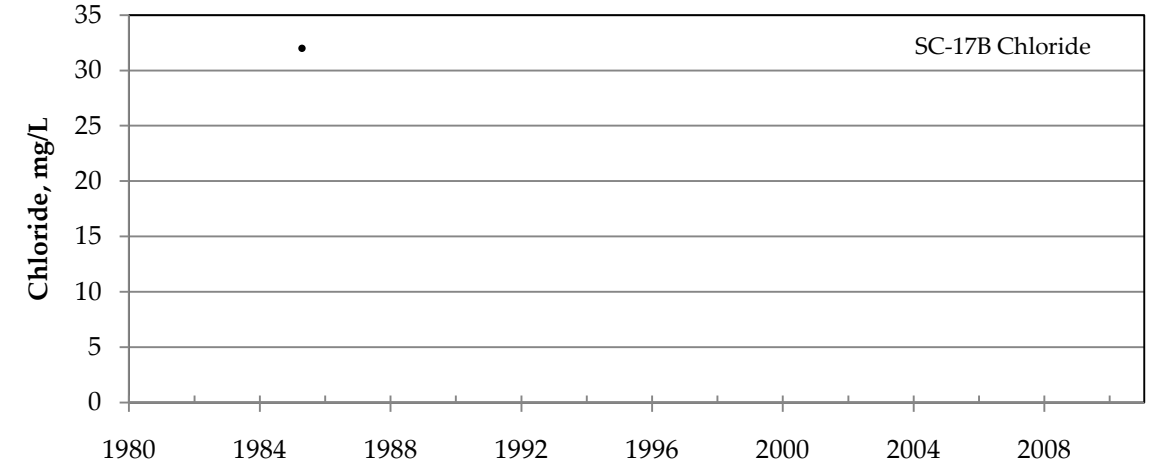

Ledyard Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

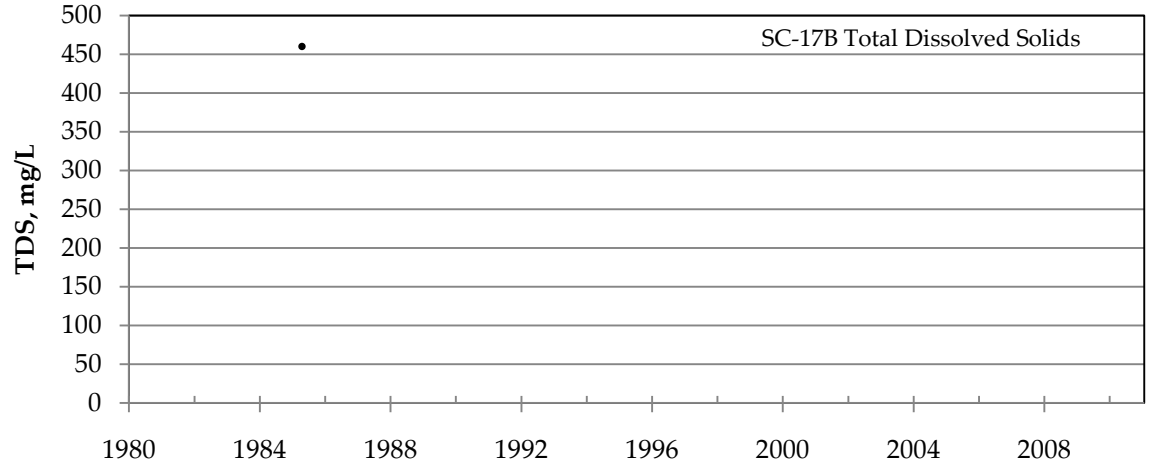

Ledyard Groundwater Elevation
Groundwater Elevation, ft MSL
200
150
100
50
0
-50
-100
-150
-200
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

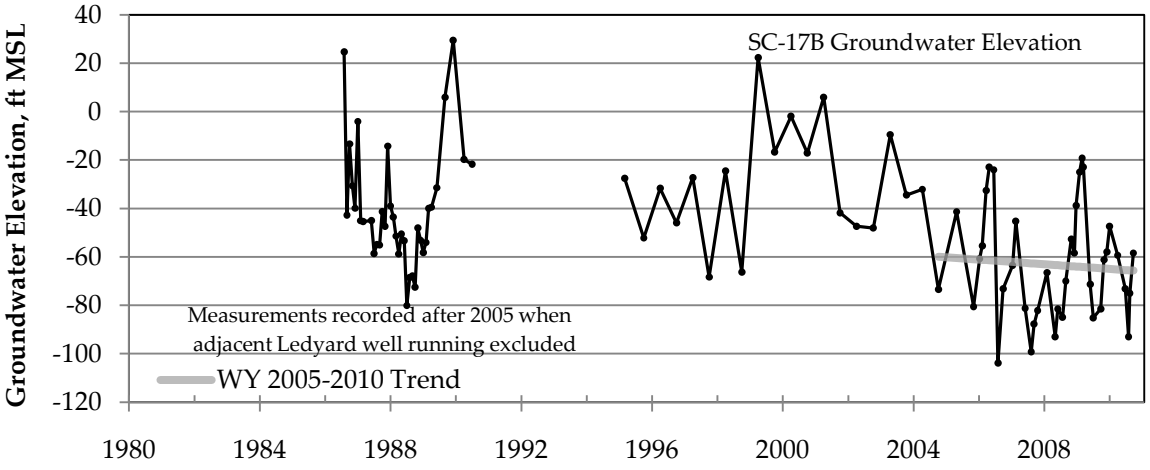

SC-17A Chloride
Chloride, mg/L
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

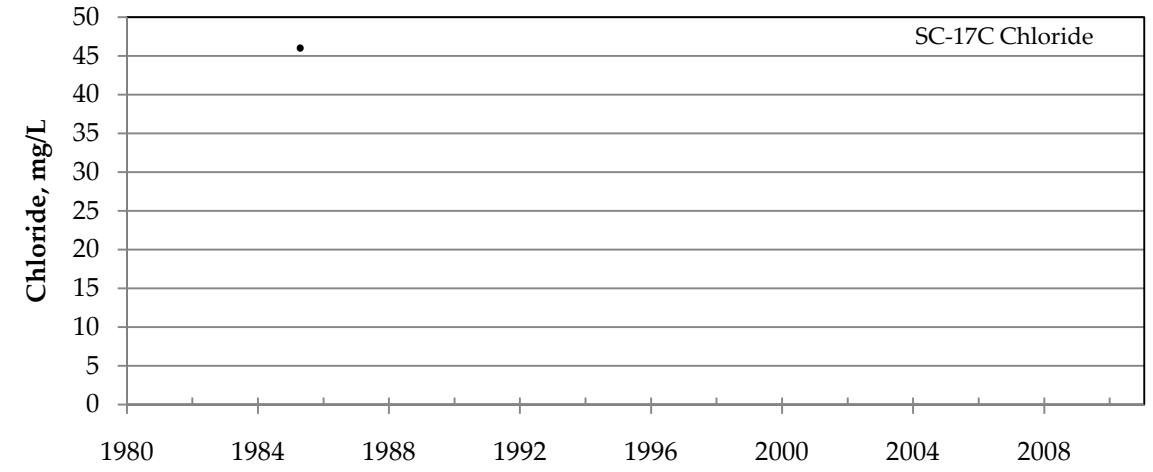

SC-17A Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

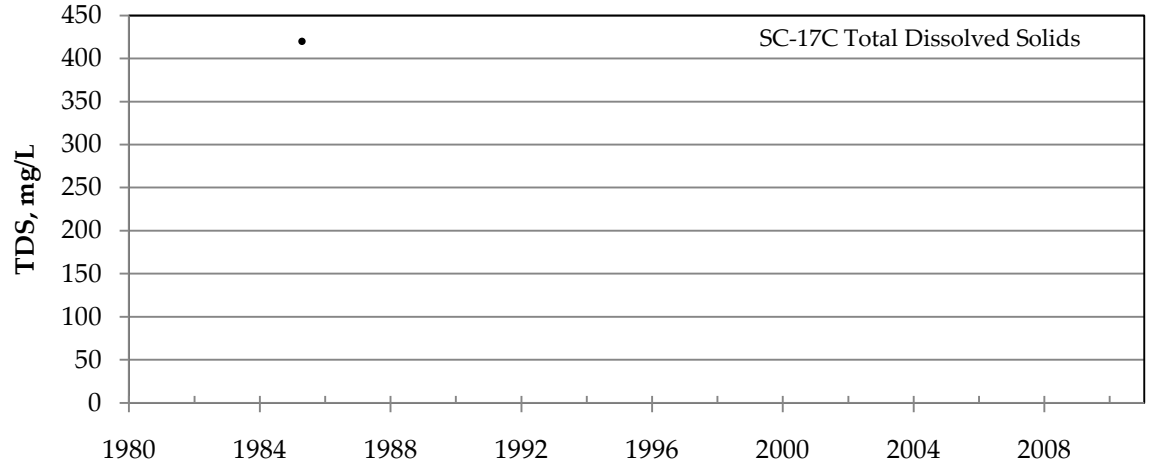

SC-17A Groundwater Elevation
Groundwater Elevation, ft MSL
50
45
40
35
30
25
20
15
10
5
0
Measurements recorded after 2005 when adjacent Ledyard well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

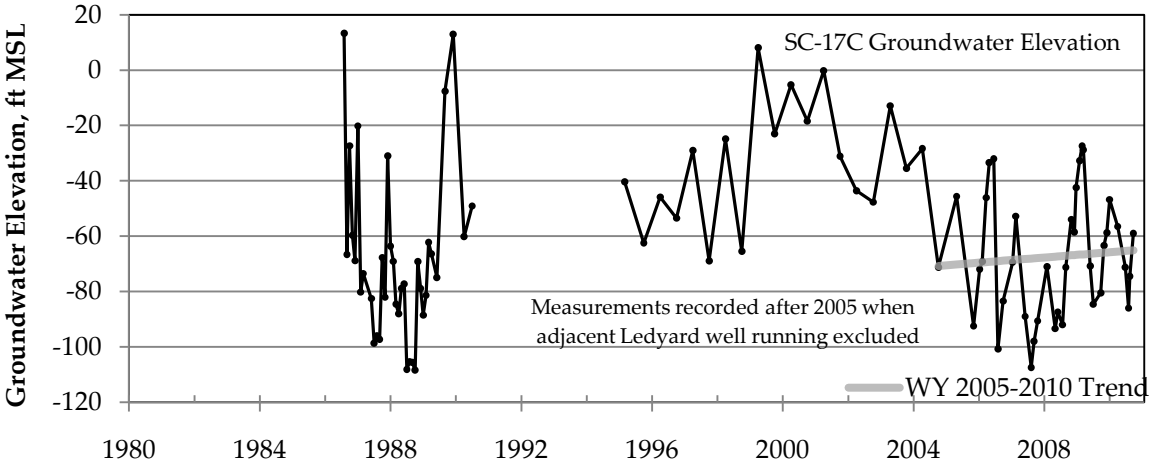

SC-17B Chloride
Chloride, mg/L
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

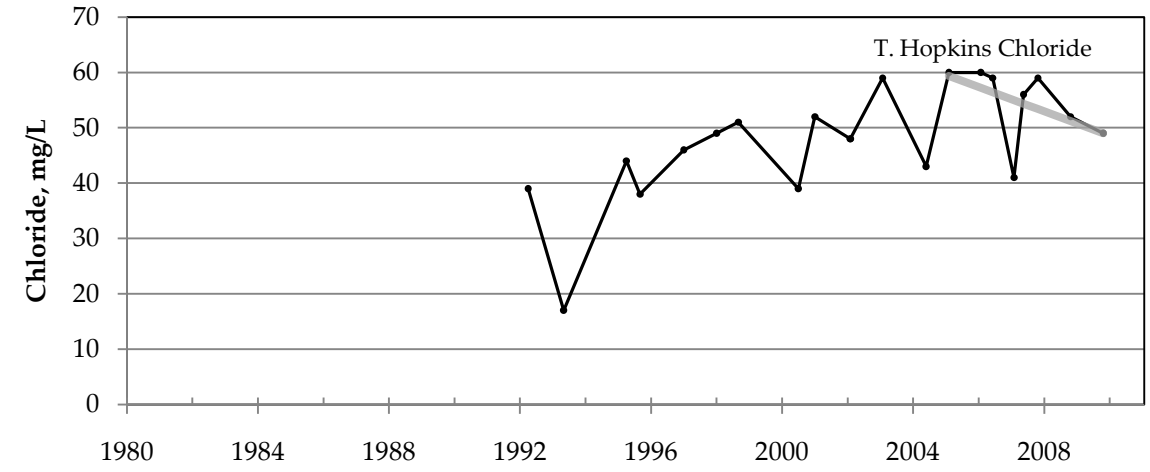

SC-17B Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

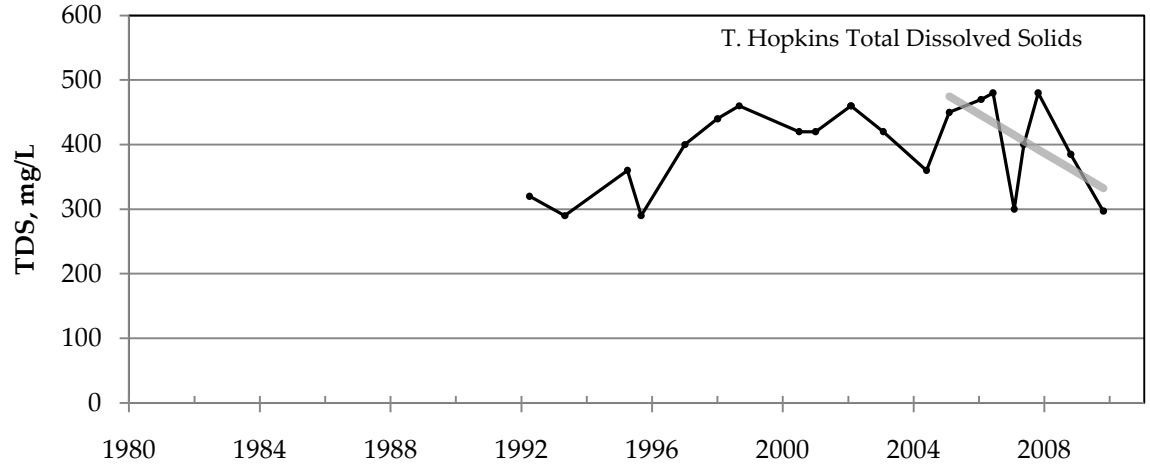

SC-17B Groundwater Elevation
Groundwater Elevation, ft MSL
40
20
0
-20
-40
-60
-80
-100
-120
Measurements recorded after 2005 when adjacent Ledyard well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

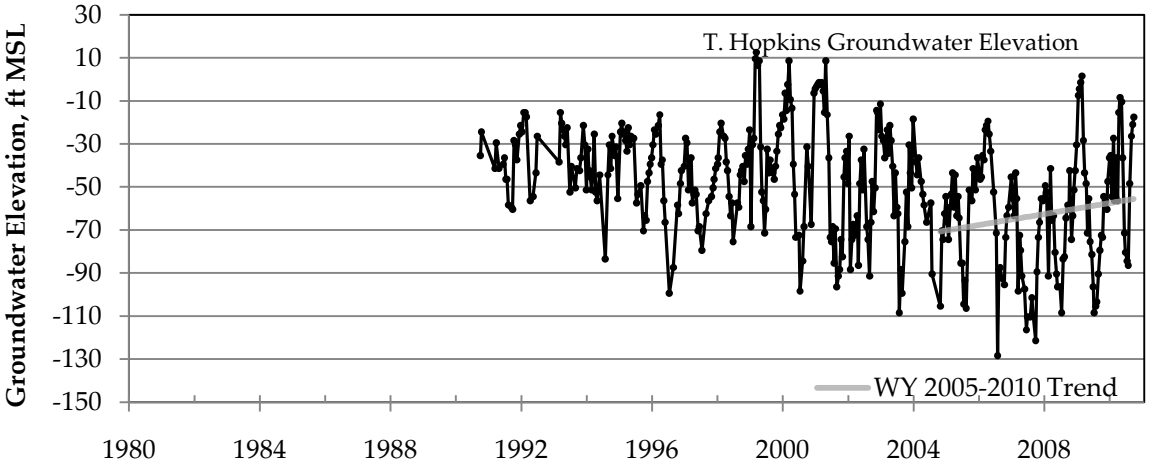

SC-17C Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

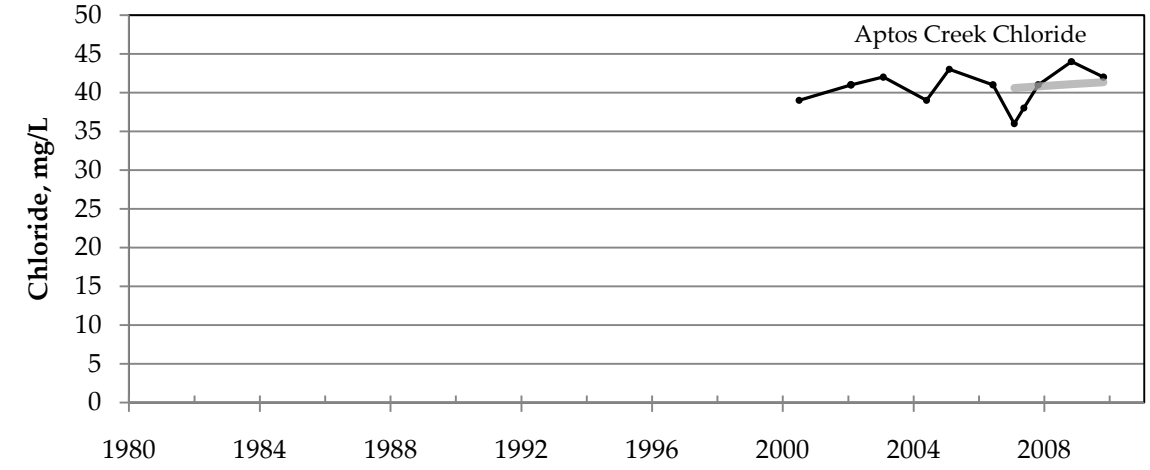

SC-17C Total Dissolved Solids
TDS, mg/L
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

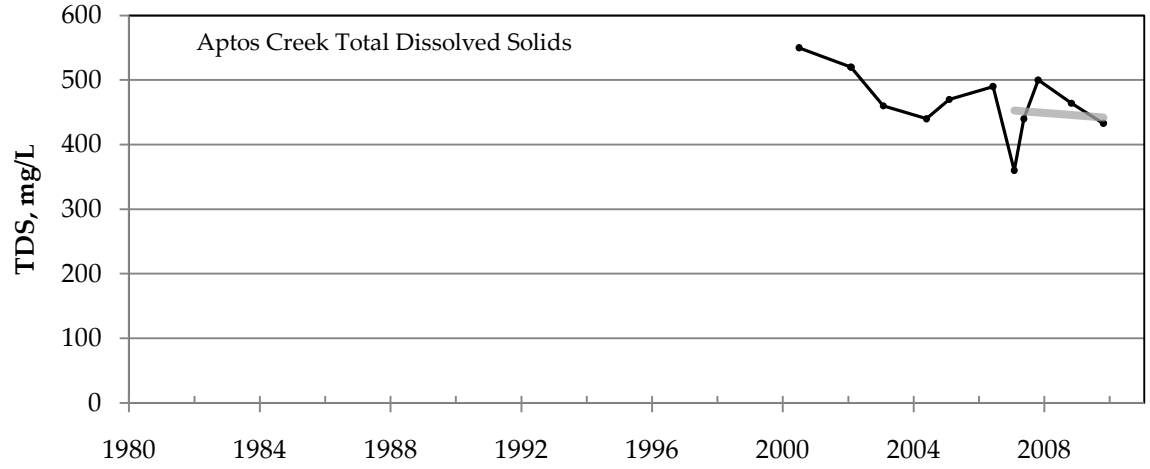

SC-17C Groundwater Elevation
Groundwater Elevation, ft MSL
20
0
-20
-40
-60
-80
-100
-120
Measurements recorded after 2005 when
adjacent Ledyard well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

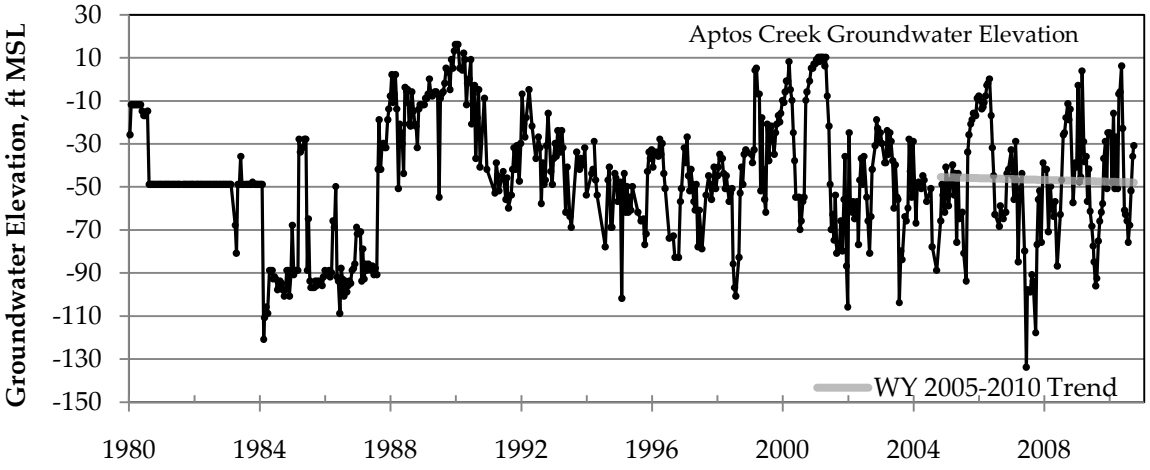

T. Hopkins Chloride
Chloride, mg/L
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008


T. Hopkins Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008


T. Hopkins Groundwater Elevation
Groundwater Elevation, ft MSL
30
10
-10
-30
-50
-70
-90
-110
-130
-150
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008


Aptos Creek Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008


Aptos Creek Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008


Aptos Creek Groundwater Elevation
Groundwater Elevation, ft MSL
30
10
-10
-30
-50
-70
-90
-110
-130
-150
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

SECTION 5 – WATER YEAR 2010 AQUIFER CONDITIONS FOR AROMAS AREA (PURISIMA F-UNIT/AROMAS RED SANDS)

This section presents groundwater level and water quality conditions for Water Year 2010 in the eastern portion of the Soquel-Aptos area where the primary production aquifers are the Purisima F-unit and the Aromas Red Sands.

5.1 SqCWD SERVICE AREAS III AND IV AND CWD PRODUCTION

In the eastern portion of the Soquel-Aptos area, groundwater is produced for municipal purposes by SqCWD in Service Area III and IV, and by CWD at its Cox and Rob Roy well fields. SqCWD's Service Area III production was 1,478 acre-feet in Water Year 2010, the lowest annual total since Water Year 1995. Service Area IV production in the La Selva Beach area was 40 acre-feet in Water Year 2010, the lowest annual total going back to Water Year 1984. The Sells well was taken out of service in April 2009 due to high nitrate concentrations. CWD production at its Cox well field completed in the Purisima F-unit was 20 acre-feet in Water Year 2010, while production at its Rob Roy well field completed in the Aromas Red Sands was 488 acre-feet. This distribution of CWD production between the two well fields is consistent with the previous twelve years. The Rob Roy production was similar to minimum annual totals over that time period.

Figure 5-1 shows production in the Aromas area by water year, grouped into three geographical areas. The Valencia watershed area includes the SqCWD's Aptos Jr. High well and CWD's Cox wells, which are screened in the Purisima F-unit. Annual municipal pumping in this area has been less than 300 acre-feet starting in Water Year 1986. Pumping increased in Water Year 2007 when the Aptos Jr. High well was put back into service. Water Year 2009 pumping at the Aptos Jr. High well was approximately 9% of SqCWD's revised estimate of its share of the annual sustainable yield in the Purisima area.

The wells in the other two areas are screened in both the Purisima F-unit and the Aromas Red Sands. The Seascape and Rob Roy area includes most of SqCWD's Service Area III wells and CWD's Rob Roy wells. This area has the largest portion of municipal production in the Aromas area, although production has declined since Water Year 2005. SqCWD production in the Seascape area was

1,255 acre-feet in Water Year 2010, the lowest total since Water Year 1986. This production decline is partly because the Bonita and Country Club wells were out of service 2-3 months. Seascape and Rob Roy total pumping in Water Year 2010 was 1,815 acre-feet, the lowest total since Water Year 1995; CWD production at Rob Roy has been relatively steady over the last fifteen years.

The La Selva Beach area consists of SqCWD's Service Area IV wells, where pumping has declined since Water Year 2008 after the Sells well was taken out of service. Water Year 2010 pumping of 40 acre-feet in Service Area IV was the lowest total going back to Water Year 1984.

The recent evaluation of sustainable yield concluded that the GMP goal of 1,800 acre-feet per year for SqCWD pumping in the Aromas was at least hundreds of acre-feet too high (HydroMetrics LLC, 2009c). Therefore, SqCWD's pumping of 1,295 acre-feet in Water Year 2010 from wells screened in the Aromas Red Sands may not be within a reasonable estimate of SqCWD's share of sustainable yield.

5.2 GROUNDWATER LEVEL CONDITIONS AND TRENDS

SqCWD has established protective groundwater elevations in coastal monitoring wells to protect the Purisima F-unit and Aromas Red Sands in the eastern portion of the Soquel-Aptos area from seawater intrusion. Cross-sectional models were used to estimate groundwater elevations that result in the freshwater-salt water interface at the historical depth being seaward of the coast over the long term (HydroMetrics LLC, 2009b).

Coastal groundwater levels in the SqCWD's F-unit and Aromas Red Sands monitoring wells remained below protective elevations in Water Year 2010, as shown in Table 5-1. In the Aromas area, protective elevations are established for the B completion of each well cluster because its screen was above the freshwater-salt water interface when installed. Hydrographs for multiple completions of monitoring wells in the Aromas area follow at the end of this section The hydrographs show coastal groundwater levels have been below protective elevations since the early 1990s or longer.

Table 5-1 (2010):
Comparison of Water Year 2010 Coastal Groundwater Levels with Protective Elevations

Well	Location	A Screen Unit/ B Screen Unit	Average Equivalent Freshwater Head A screen (feet msl) [1]	Average Equivalent Freshwater Head B screen (feet msl) [1]	Protective Elevation (feet msl) [1]
SC-A1B	Cliff	DEF/F	6.3	5.2	3
SC-A8B	Dolphin & Sumner	F/ Aromas	5.3	6.6	6
SC-A2B	Sumner	F/F	1.9	4.2	3
SC-A3B	Playa & Vista	Aromas/Aromas	-0.4	1.6	3
SC-A4B	Canon del Sol	F/F	1.0	5.0	3

[1] msl = mean sea level

In general, groundwater levels at SqCWD's coastal monitoring wells in the area have stabilized over the last two years after showing a declining trend over previous years. The recent stable water levels correspond with historically low production by SqCWD in the area. However, the previous declines occurred despite reductions in pumping at some nearby municipal production wells. The lack of correlation between groundwater levels and local pumping may indicate that non-municipal pumping and/or lower precipitation had a more immediate effect on groundwater levels in the Aromas area than the Purisima area. The Pajaro Valley Hydrologic Model covers part of the Aromas area and may provide more information on this subject. The model report is due to be released in 2011.

Hydrographs for multiple completions of monitoring wells near the SqCWD and CWD production wells are included at the end of this section. Some inland, upgradient wells, including the Black monitoring well, have a stable groundwater level trend. Table 5-2 summarizes the important groundwater level trends by well.

Hydrographs for single wells including production wells are included with chemographs. These hydrographs show trendlines for Water Years 2005-2010 when municipal production for the basin has been at or below pumping goals in the Groundwater Management Plan.

Table 5-2 (2010): Summary of Groundwater Level Trends in Aromas Area

Category	Well	Groundwater Level Trend Description	Notes
SqCWD Coastal Monitoring Wells	SC-A1	Increasing up to 3 feet WY 2009-2010; Relatively stable since decline in WY 2002	Reduced pumping at Country Club in WY 2010; Bonita and Seascape Golf Course also pumping nearby
	SC-A2	Decline of up to 6 feet since WY 2006; relatively stable WY 2009-2010	Combined pumping at San Andreas and Seascape WY 2005-2010 lowest since WY 1996 Increased pumping at Seascape in WY 2009-2010
	SC-A3	Decline of 1-2 feet since WY 2006; relatively stable WY 2009-2010	Historical low SA IV pumping in WY 2010
	SC-A4	Relatively stable WY 2009-2010	Nearest SqCWD wells are in SA IV
SqCWD Monitoring Wells near Production Wells	SC-A6A	Recovery in WY 2010 from WY 2009decline	Bonita pumping decreased in WY 2009
	SC-A5	Relatively stable WY 2009-2010	Seascape pumping decreased in WY 2010 but not to WY 2004-2008 totals
	SC-A7A	Decline of 5 feet in WY 2010	Historical low SA IV pumping in WY 2010
	SC-A7B,C	Increase of 4-7 feet in WY 2010	
CWD Monitoring Wells in Rob Roy Field	CWD-A,B	Stable trend since WY 2006, but increase in WY 2010	Steady pumping at Rob Roy since WY 2006
	CWD-C	Decline of 1 foot since WY 2006 but stable trend WY 2008-2010	Reduced precipitation since WY 2006
Inland Wells	Aptos Jr. High well	Decline of at least 10 feet since WY 2007, stable trend WY 2009-2010, increases August	Well returned to service in WY 2007; well out of service late Aug-Sep 2010
	Black Monitoring Well	Stable WY 2007-2009; higher than prior	None

Contour maps of groundwater elevations in spring and fall 2010 for the Purisima F-unit and Aromas Red Sands are shown in Figure 5-2 and Figure 5-3. Both spring and fall 2010 contours (Figure 5-2) show that groundwater levels were above sea level, although coastal groundwater levels are below protective elevations.

5.3 WATER QUALITY CONDITIONS AND TRENDS

Seawater intrusion has been consistently detected at deep monitoring wells along the coast of the Aromas area. At all coastal monitoring clusters in the Aromas area except SC-A1, the deepest completion was installed to be below the freshwater-saltwater interface. As discussed above, groundwater levels continue to be below protective elevations in the Aromas area. As a result, there is risk of seawater intrusion advancing toward production wells in the Aromas area.

Observed Total Dissolved Solids (TDS) and chloride concentrations continue to be elevated at the deep coastal monitoring wells installed below the freshwater-saltwater interface. Chloride concentrations are above 6,000 mg/L in these wells. Concentrations are generally increasing in these wells.

The freshwater-saltwater interface has apparently moved shallower and landward over the long term at the coastal monitoring clusters near SqCWD's southernmost production wells. There is a long-term increasing trend in TDS and chloride concentrations at wells SC-A2B and SC-A3B, where the interface is most shallow. This apparent landward movement of seawater has put the nearby Seascape, Altivo, and Sells wells at the highest risk to be impacted by seawater intrusion. The recent trend at these wells show concentrations stabilizing. However, concentrations at the SC-A5 wells near the Seascape well continue to indicate that seawater has advanced to just below that production well.

Chemographs of TDS and chloride for SqCWD monitoring wells in the Aromas area are included at the end of this section. Table 5-3 summarizes the important water quality trends by well.

Table 5-3 (2010): Summary of TDS and Chloride Concentration Trends in Aromas Area

Category	Well	Concentration Trend Description	Notes
SqCWD Coastal Monitoring Wells	SC-A1	Chloride consistently <40 mg/L	No completions (deepest to -455 ft msl[1]) installed below interface
	SC-A2A	Long-term increasing trend, but stable WY 2009-2010; chloride = 13,000 mg/L in WY 2010	Installed below fresh water/seawater interface; near Seascape
	SC-A2B	Long-term increasing trend, but stable WY 2009-2010; chloride ~ 400 mg/L in WY 2010	Installed (-293 to -313 ft msl[1]) above interface when chloride ~ 30 mg/L in WY 1987
	SC-A3A	Stable trend; chloride > 17,000 mg/L (near full strength seawater)	Installed below fresh water/seawater interface; near Sells and Bonita
	SC-A3B	Long-term increasing trend, but relatively stable WY 2005-2010; chloride 2,660-4,220 mg/L in WY 2010	Installed (-127 to -167 ft msl[1]) above fresh water/seawater interface when chloride < 10 mg/L in WY 1987
	SC-A4A	Increasing trend; chloride > 8,000 mg/L in WY 2010	Installed (-334 to -354 ft msl[1]) below fresh water/seawater interface
	SC-A4B	Increasing trend; chloride 29-53mg/L in WY 2010	Installed above fresh water/seawater interface
SqCWD Monitoring Wells near Production Wells	SC-A5A	Increasing trend; chloride > 6,000 mg/L in WY 2010	Installed (-475 to -495 ft msl[1]) below fresh water/seawater interface; screened 100 feet below Seascape well
	SC-A5B	Increasing trend; Chloride ~ 50 mg/L in WY 2010	Installed above fresh water/seawater interface; screened 30 feet below Seascape well

[1] mean sea level. Screen elevations shown for shallowest well in cluster with current chloride concentrations above 250 mg/L. SC-A8A has approximately 7,000 mg/L chloride and is installed at -388 to -408 ft msl.

Observed Total Dissolved Solids (TDS) and chloride concentrations in SqCWD's production wells do not suggest any seawater intrusion impact on municipal production in the Purisima F-unit and Aromas Red Sands. Recent chloride concentrations in the production wells are at 60 mg/L or less, while the maximum contaminant level(MCL) for chlorides is 250 mg/L. Chemographs for SqCWD production wells in the area are included at the end of this section.

Nitrate at SqCWD's Sells well showed concentrations at or just under the maximum contaminant limit of 45 mg/L. The well was removed from service in April 2009. Concentrations from the offline well continued to be above the maximum contaminant limit in 2010.

California Office of Environmental Health Hazard Assessment (OEHHA) released a revised draft public health goal (PHG) for Chromium VI in December 2010, however, the PHG has not been finalized and is only one step in developing an enforceable drinking water standard set by the California Department of Public Health. Chromium VI concentrations in SqCWD production wells screened in the Aromas Red Sands ranged from 7 to 39 ug/L in 2010. Chromium VI concentrations in CWD production wells screened in the Aromas Red Sands ranged from 4 to 11 ug/L in 2009. Concentrations for total chromium met current drinking water standards for all wells. A report on depth discrete testing of flows and Chromium VI concentrations at the Bonita, San Andreas, and Altivo wells was issued in 2009 (HydroMetrics LLC, 2009d).

OEHHA established a PHG for 1,2,3-trichloropropane of 0.0007 ug/L in August 2009, but an enforceable drinking water standard has not yet been set by the California Department of Public Health. 1,2,3-trichloropropane has been detected at 0.013 ug/L in the Country Club well in 2009 and 2010. However, this constituent has not been detected at other wells or in the drinking water distribution system.

In 2009 and 2010, arsenic was detected at the Aptos Jr. High (1.2-1.3 ug/L) and Country Club (0.7-0.8 ug/L) well, but at levels below the MCL of 10 ug/L for arsenic. Water from the Aptos Jr. High well is treated to reduce arsenic concentrations.

5.4 STATE OF THE AQUIFER SUMMARY

Seawater intrusion has been detected along the coast of the Aromas area. Groundwater levels have been below protective elevations indicating risk for continued seawater intrusion into the productive Purisima F unit and the Aromas aquifer. The long-term water quality trend indicates that seawater intrusion has advanced over the last 25 years, though the recent trend shows a possible slowing in the advancement. Despite historically low municipal production in the Aromas area, groundwater levels have not shown recovery. Reducing the risk of seawater intrusion by raising groundwater levels may not be achieved by continued low municipal production in the Aromas area.

SECTION 5 – WATER YEAR 2009 AQUIFER CONDITIONS FOR AROMAS AREA (PURISIMA F-UNIT/AROMAS RED SANDS)

This section presents groundwater level and water quality conditions for Water Year 2009 in the eastern portion of the Soquel-Aptos area where the primary production aquifers are the Purisima F-unit and the Aromas Red Sands.

5.1 SqCWD Service Areas III and IV and CWD Production

In the eastern portion of the Soquel-Aptos area, groundwater is produced for municipal purposes by SqCWD in Service Area III and IV, and by CWD at its Cox and Rob Roy well fields. Service Area III production was 1,612 acre-feet in Water Year 2009, an increase in pumping from the previous four years as production was shifted from Service Area IV. Service Area IV production in the La Selva Beach area was 124 acre-feet in Water Year 2009, a decrease in pumping from the previous five years as the Sells well was taken out of service in April 2009 due to high nitrate concentrations. CWD production at its Cox well field completed in the Purisima F-unit was 45 acre-feet in Water Year 2009, while production at its Rob Roy well field completed in the Aromas Red Sands was 556 acre-feet. This pattern of CWD production is consistent with the previous 10 years.

Figure 5-1 shows production in the Aromas area by water year grouped by three geographical areas. The Valencia watershed area includes the SqCWD's Aptos Jr. High well and CWD's Cox wells, which are screened in the Purisima F-unit. Annual municipal pumping in this area has been less than 300 acre-feet starting in Water Year 1986, but pumping has increased starting in Water Year 2007 when the Aptos Jr. High well was put back into service. The recent evaluation of the sustainable yield (HydroMetrics LLC, 2009c) did not estimate annual sustainable yield specifically for SqCWD's pumping in the Valencia watershed, but Water Year 2009 pumping at the Aptos Jr. High well was approximately 11% of the suggested estimate of SqCWD's share of the annual sustainable yield in the Purisima.

The wells in the other two areas are screened in both the Purisima F-unit and the Aromas Red Sands. The Seascape and Rob Roy area includes most of SqCWD's

Service Area III and CWD's Rob Roy wells. This area has the largest portion of municipal pumping in the Aromas area, although production has declined since Water Year 2005. The La Selva Beach area consists of SqCWD's Service Area IV where pumping increased from Water Year 2002-2008, but declined in Water Year 2009 as the Sells well was taken out of service. The recent evaluation of sustainable yield concluded that the GMP goal of 1,800 acre-feet per year for SqCWD pumping in the Aromas was at least hundreds of acre-feet too high. Therefore, SqCWD's pumping of 1,468 acre-feet in Water Year 2009 from wells screened in the Aromas Red Sands may not be within a reasonable estimate of SqCWD's share of sustainable yield.

Also, SqCWD and CWD formed an agreement that allowed CWD to sell SqCWD water as an emergency supply during SqCWD's Precautionary Drought Curtailment through October 2009. In Water Year 2009, a total of 16 acre-feet were transferred from CWD to SqCWD through the Huntington Drive intertie from August to September.

5.2 GROUNDWATER LEVEL CONDITIONS AND TRENDS

SqCWD has established protective groundwater elevations in coastal monitoring wells to protect the Purisima F-unit and Aromas Red Sands in the eastern portion of the Soquel-Aptos area from seawater intrusion over the long term. Cross-sectional models were used to estimate groundwater elevations that result in the freshwater-salt water interface at the historical depth being seaward of the coast over the long term (HydroMetrics LLC, 2009b).

Coastal groundwater levels in the SqCWD's F-unit and Aromas Red Sands monitoring wells remained below protective elevations in Water Year 2009, as shown in Table 5-1. In the Aromas area, protective elevations are established for the B completion because its screen was above the freshwater-salt water interface when installed. Hydrographs for wells in the Aromas area monitoring well clusters follow at the end of this section The hydrographs show coastal groundwater levels have been below protective elevations since the early 1990s or longer.

Table 5-1 (2009): Comparison of Water Year 2009 Coastal Groundwater Levels with Protective Elevations

Well	Location	A Screen Unit/ B Screen Unit	Average Equivalent Freshwater Head A screen (feet msl) [1]	Average Equivalent Freshwater Head B screen (feet msl) [1]	Protective Elevation (feet msl) [1]
SC-A1B	Cliff	DEF/F	5.4	4.4	3
SC-A8B	Dolphin & Sumner	F/ Aromas	5.0	6.6	6
SC-A2B	Sumner	F/F	1.0	3.9	3
SC-A3B	Playa & Vista	Aromas/Aromas	-0.8	1.7	3
SC-A4B	Canon del Sol	F/F	2.1	4.6	3

In general, the groundwater level trend at SqCWD's coastal monitoring wells in the area is declining. These declines have occurred despite reductions in pumping at some nearby municipal production wells. The lack of correlation between groundwater levels and local pumping may indicate that non-municipal pumping has increased in the area and/or lower precipitation has a more immediate effect on groundwater levels in the Aromas area than the Purisima area.

Hydrographs for monitoring wells near the SqCWD and CWD production wells and all SqCWD and CWD production wells are included at the end of this section. Many of these wells show declines in groundwater levels. Some inland, upgradient wells, including the Black monitoring well, have a stable groundwater level trend. Table 5-2 summarizes the important groundwater level trends by well.

Contour maps of groundwater elevations in spring and fall 2009 for the Purisima F-unit and Aromas Red Sands are shown in Figure 5-2 and Figure 5-3. Spring 2009 contours (Figure 5-2) show that, except in the area of the Seascape well, groundwater levels were above sea level. Groundwater level contours for fall 2009 (Figure 5-3) are very similar to those in spring with the exception of an increase in levels at the Seascape well to above sea level.

Table 5-2 (2009): Summary of Groundwater Level Trends in Aromas Area

Category	Well	Groundwater Level Trend Description	Notes
SqCWD Coastal Monitoring Wells	SC-A1	Decline of up to 4 feet since WY 2007	Reduced pumping at Country Club and Bonita Seascape Golf Course also pumping nearby
	SC-A2	Decline of up to 6 feet since WY 2006	Combined pumping at San Andreas and Seascape WY 2005-2009 lowest since WY 1996 Increased pumping at Seascape in WY 2009
	SC-A3	Decline of 1-2 feet since WY 2006	Sells well removed from service in WY 2009
	SC-A4	Decline of up to 4 feet in WY 2009	Nearest SqCWD wells are Sells and Altivo where pumping declined
SqCWD Monitoring Wells near Production Wells	SC-A6A	Decline of 5 feet in WY 2009	Bonita pumping declined in WY 2009
	SC-A5	Decline of 3-4 feet in WY 2009	Seascape pumping increased in WY 2009
	SC-A7	Decline of 6-8 feet in WY 2009	Sells well removed from service in WY 2009
CWD Monitoring Wells in Rob Roy Field	CWD-A,B	Stable trend since WY 2006	Steady pumping at Rob Roy since WY 2006
	CWD-C	Decline of 1 foot since WY 2006	Reduced precipitation since WY 2006
Inland Wells	Aptos Jr. High well	Decline of at least 10 feet since WY 2007	Well returned to service in WY 2007
	Black Monitoring Well	Stable WY 2007-2009; higher than prior	None

5.3 WATER QUALITY CONDITIONS AND TRENDS

Seawater intrusion has been consistently detected at deep monitoring wells along the coast of the Aromas area. At all coastal monitoring clusters in the Aromas area except SC-A1, the deepest completion was installed to be below the freshwater-saltwater interface. As discussed above, groundwater levels continue to be below protective elevations in the Aromas area. As a result, there is risk of seawater intrusion advancing toward production wells in the Aromas area.

Observed Total Dissolved Solids (TDS) and chloride concentrations continue to be elevated at the deep coastal monitoring wells installed below the freshwater-saltwater interface. Chloride concentrations are above 6,000 mg/L in these wells. Concentrations are generally increasing in these wells.

The freshwater-saltwater interface appears to be moving shallower and landward at the coastal monitoring clusters near SqCWD's southernmost production wells. There is a long-term increasing trend in TDS and chloride concentrations at wells SC-A2B and SC-A3B. This apparent landward movement of seawater puts the nearby Seascape, Altivo, and Sells wells at the highest risk to be impacted by seawater intrusion. Concentrations at the SC-A5 wells near the Seascape well also continue to indicate that seawater has advanced to just below that production well.

Chemographs of TDS and chloride for SqCWD monitoring wells in the Aromas area are included at the end of this section. Table 5-3 summarizes the important water quality trends by well.

Table 5-3 (2009): Summary of TDS and Chloride Concentration Trends in Aromas Area

Category	Well	Concentration Trend Description	Notes
SqCWD Coastal Monitoring Wells	SC-A1	Stable trend; chloride < 40 mg/L	No completions installed below interface
	SC-A2A	Increasing trend; chloride = 13,000 mg/L in WY 2009	Installed below fresh water/seawater interface; near Seascape
	SC-A2B	Increasing trend; chloride ~ 400 mg/L in WY 2009	Installed above interface when chloride ~ 30 mg/L in WY 1987
	SC-A3A	Stable trend; chloride > 17,000 mg/L (near full strength seawater)	Installed below fresh water/seawater interface; near Sells and Bonita
	SC-A3B	Increasing trend; chloride > 4,000 mg/L in WY 2009	Installed above fresh water/seawater interface when chloride < 10 mg/L in WY 1987
	SC-A4A	Increasing trend; chloride > 8,000 mg/L in WY 2009	Installed below fresh water/seawater interface
	SC-A4B	Increasing trend; chloride ~ 30 mg/L in WY 2009	Installed above fresh water/seawater interface
SqCWD Monitoring Wells near Production Wells	SC-A5A	Increasing trend; chloride > 6,000 mg/L in WY 2009	Installed below fresh water/seawater interface; screened 100 feet below Seascape well
	SC-A5B	Increasing trend; Chloride ~ 50 mg/L in WY 2009	Installed above fresh water/seawater interface; screened 30 feet below Seascape well

Observed Total Dissolved Solids (TDS) and chloride concentrations in SqCWD's production wells do not suggest any seawater intrusion impact on municipal production in the Purisima F-unit and Aromas Red Sands. Recent chloride concentrations in the production wells are at 60 mg/L or less, while the maximum contaminant limit (MCL) for chlorides is 250 mg/L. Chemographs for SqCWD production wells in the area are included at the end of this section.

Nitrate at SqCWD's Sells well has a concentration at or just under the maximum contaminant limit of 45 mg/L. The well was removed from service in April 2009.

California Office of Environmental Health Hazard Assessment released a draft public health goal (PHG) for Chromium VI in August 2009, however, the PHG has not been finalized and is only one step in developing an enforceable drinking water standard set by the California Department of Public Health. Chromium VI concentrations in SqCWD and CWD production wells screened in the Aromas Red Sands ranged from 4 to 39 ug/L. Concentrations for total chromium met current drinking water standards for all wells. A report on depth discrete testing of flows and Chromium VI concentrations at the Bonita, San Andreas, and Altivo wells was issued in 2009 (HydroMetrics LLC, 2009d).

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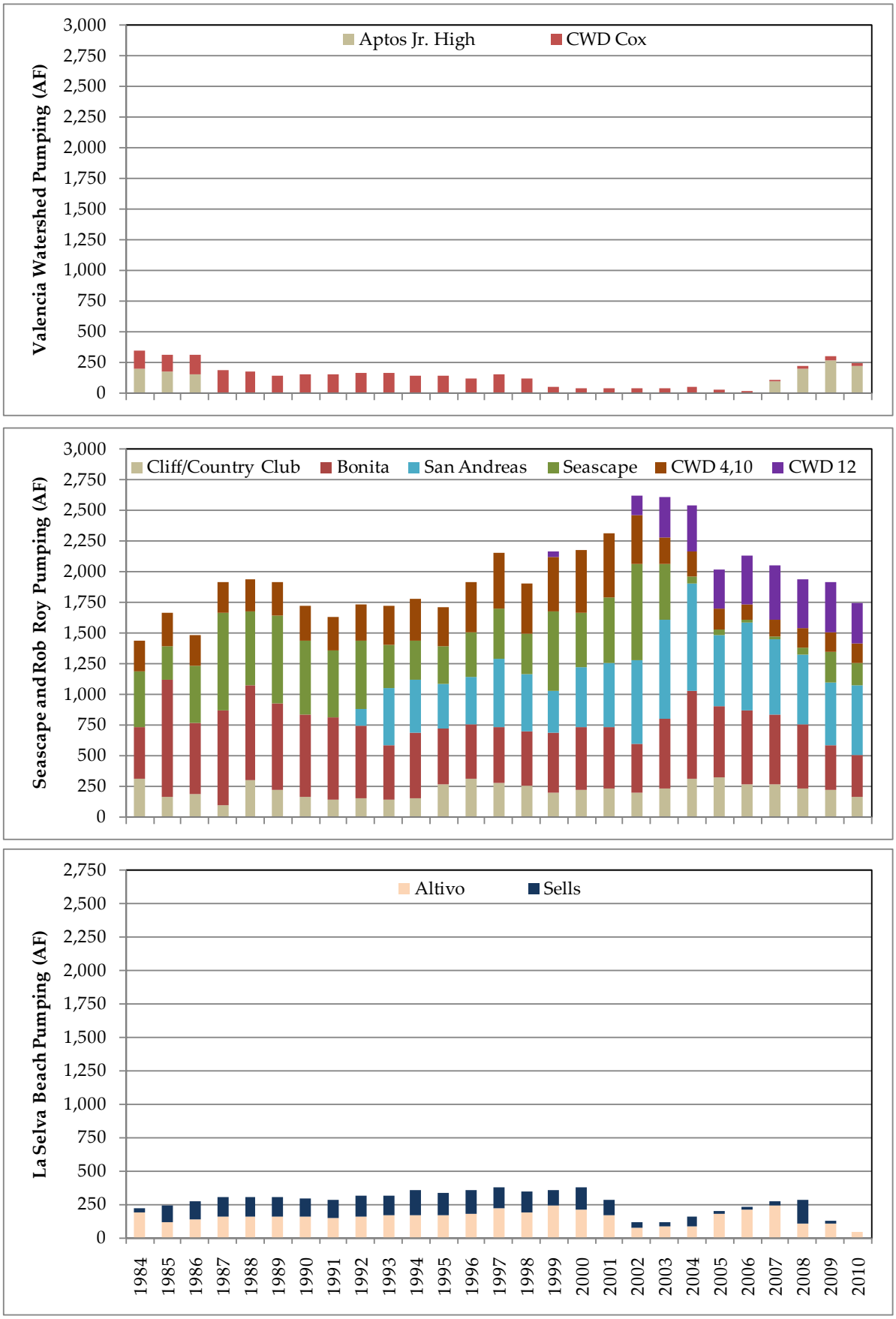


Figure 5-1: Pumping By Water Year in the Aromas Area

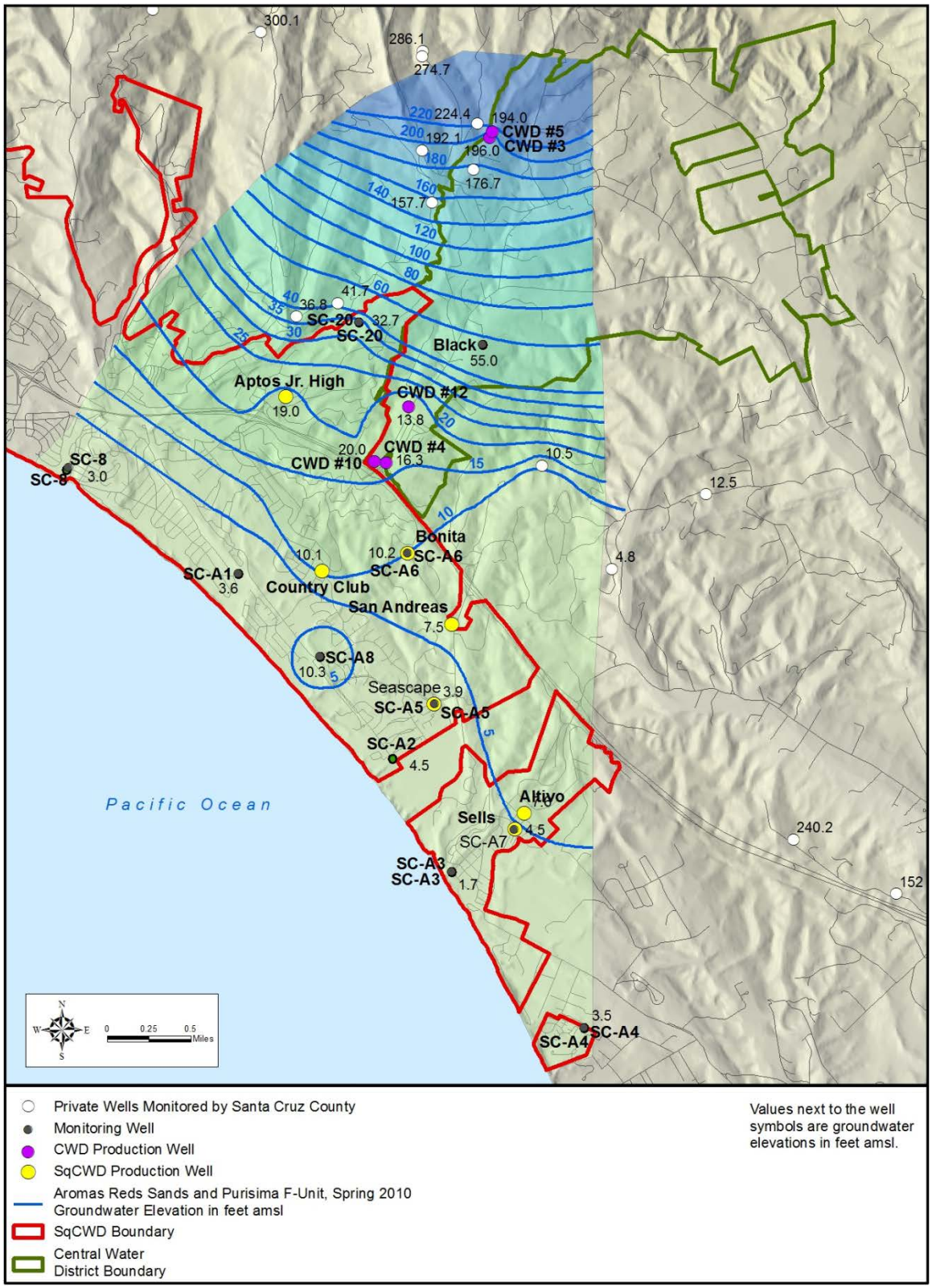


Figure 5-2 (2010): Groundwater Elevation Contours, Aromas Area, Spring 2010

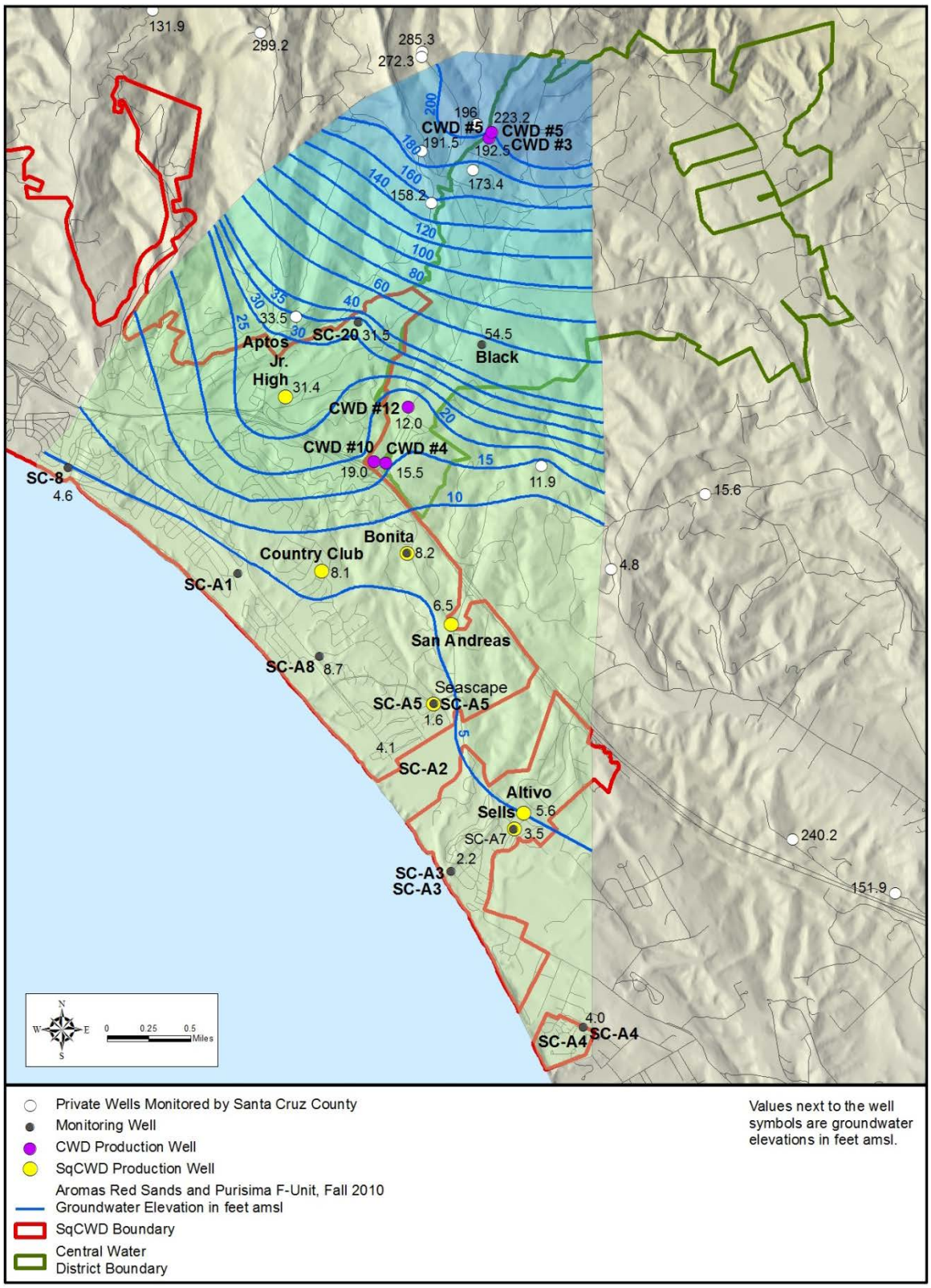


Figure 5-3 (2010): Groundwater Elevation Contours, Aromas Area, Fall 2010

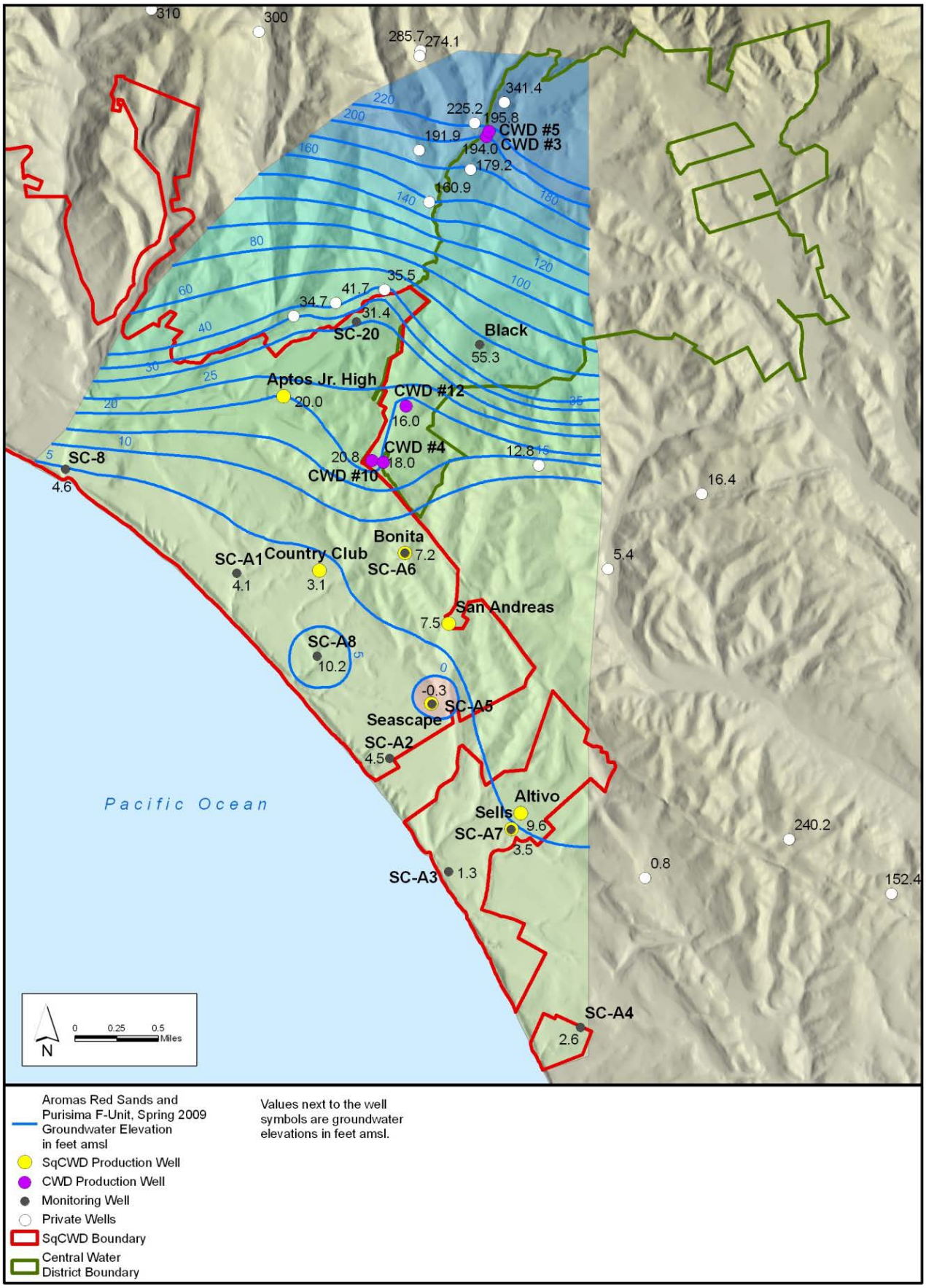


Figure 5-2 (2009): Groundwater Elevation Contours, Aromas Area, Spring 2009

Figure 5-3 (2009): Groundwater Elevation Contours, Aromas Area, Fall 2009

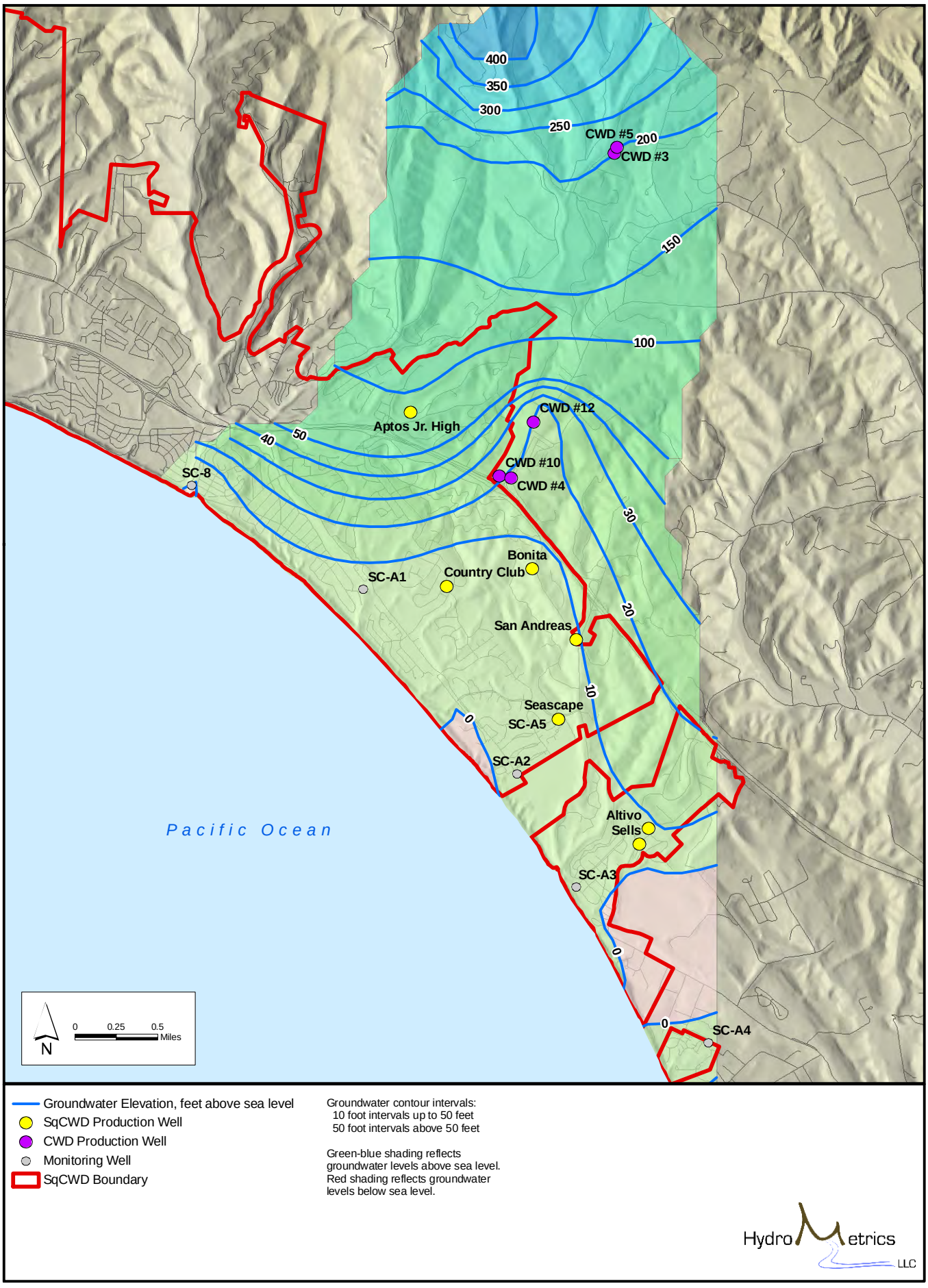


Figure 5-2 (2007): Groundwater Elevation Contours, Aromas Area, Spring 2007

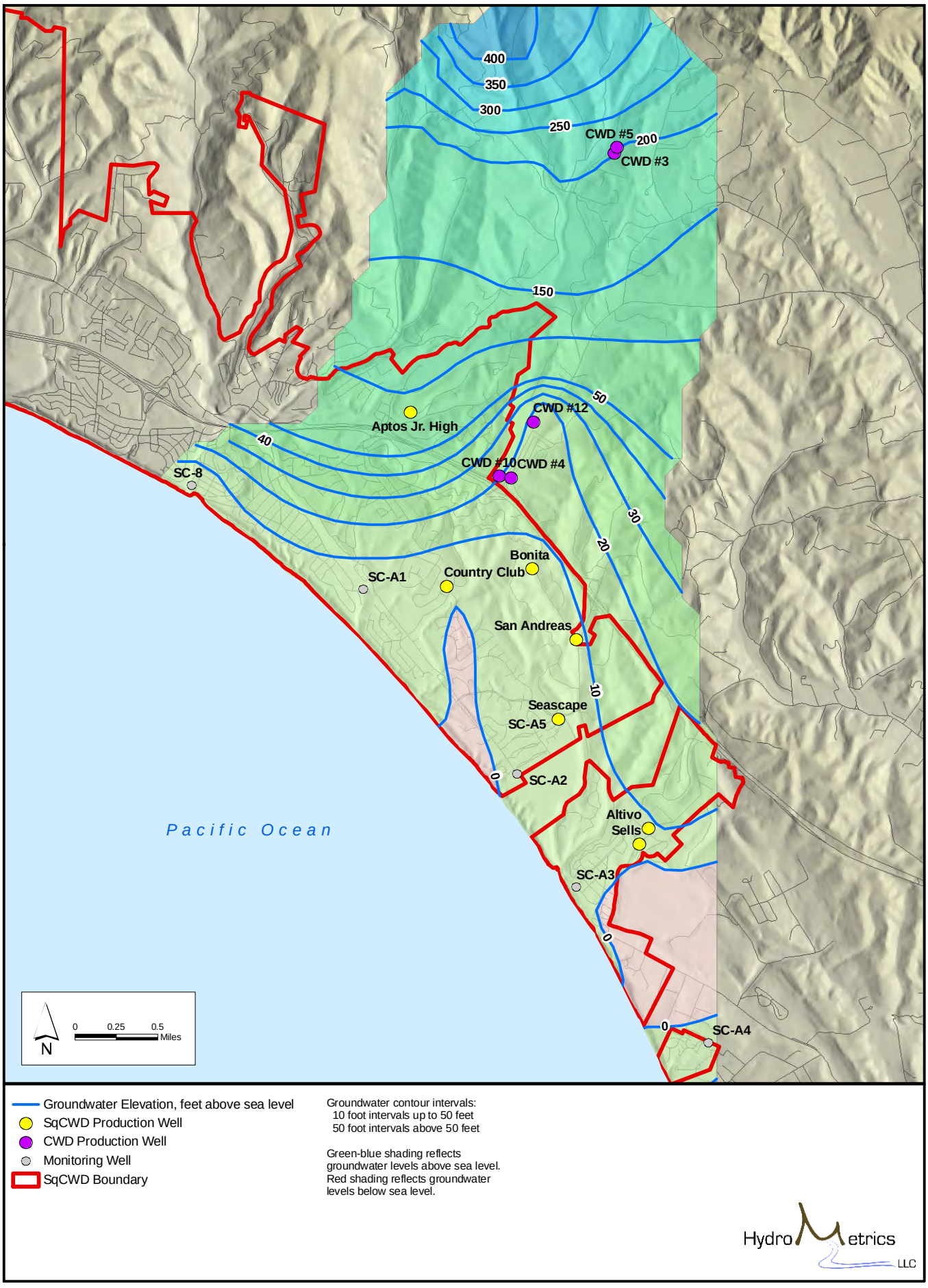


Figure 5-3 (2007): Groundwater Elevation Contours, Aromas Area, Fall 2007

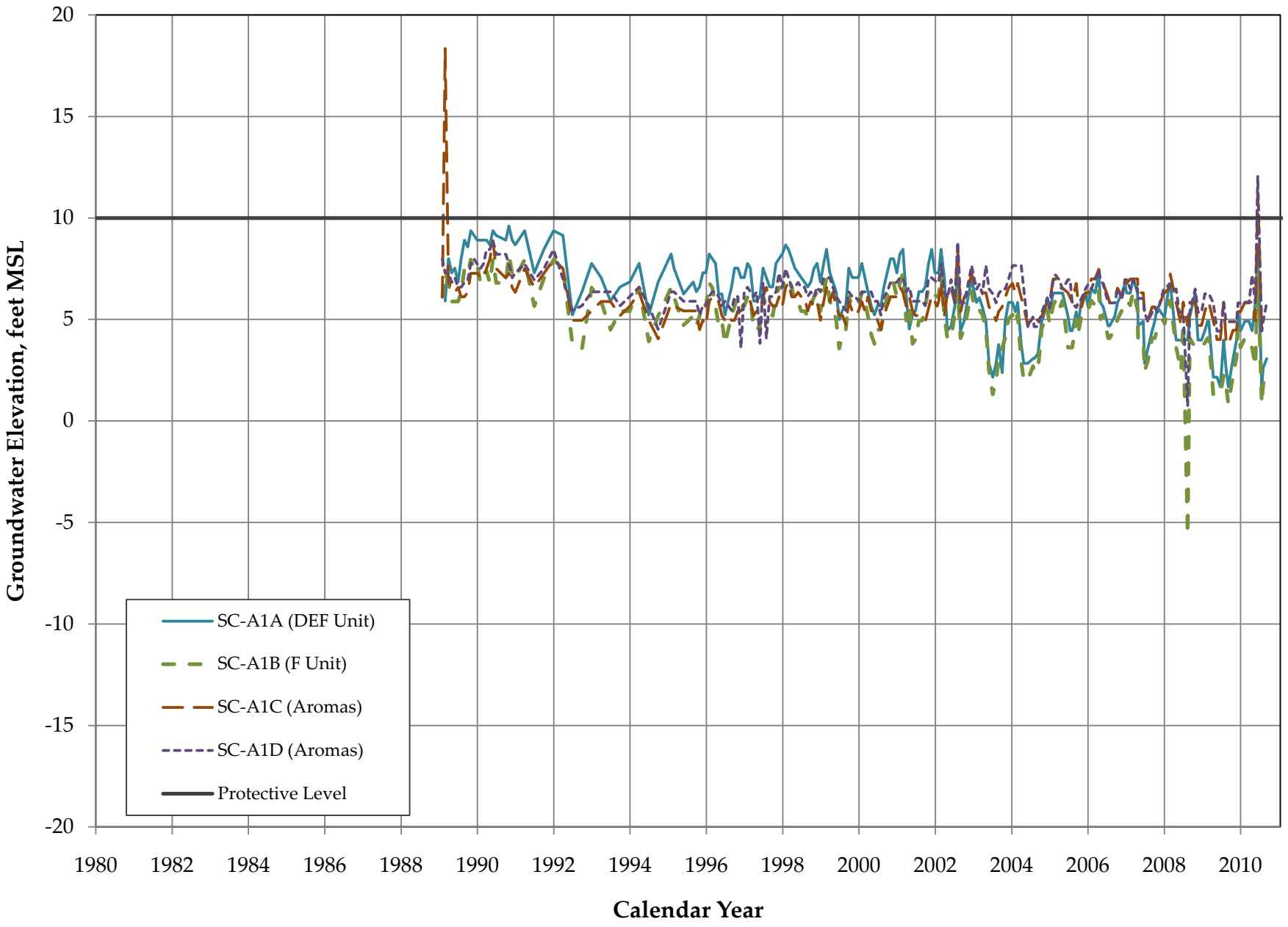
Hydrographs for Aromas Area

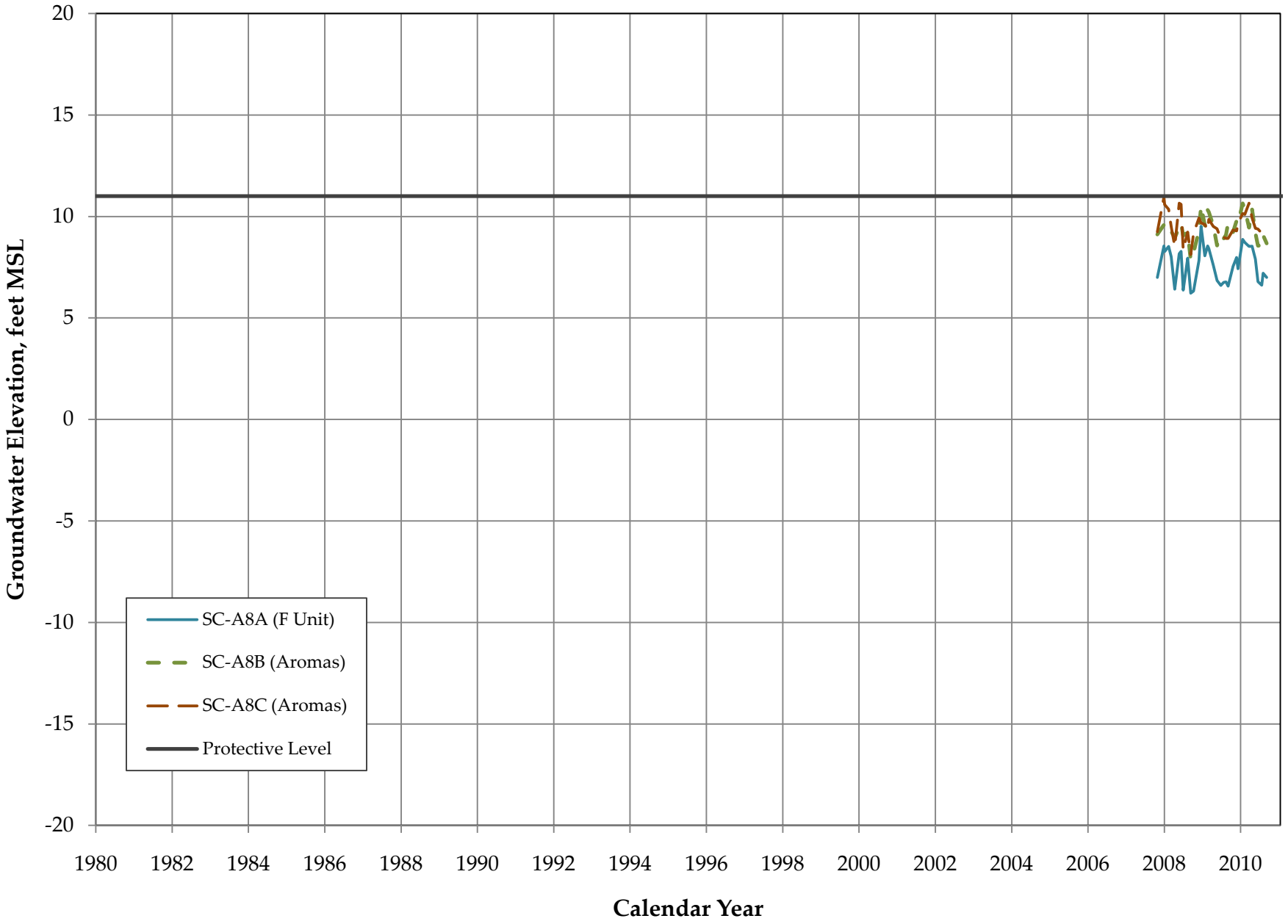
Hydrographs of SqCWD Coastal Monitoring Well Clusters

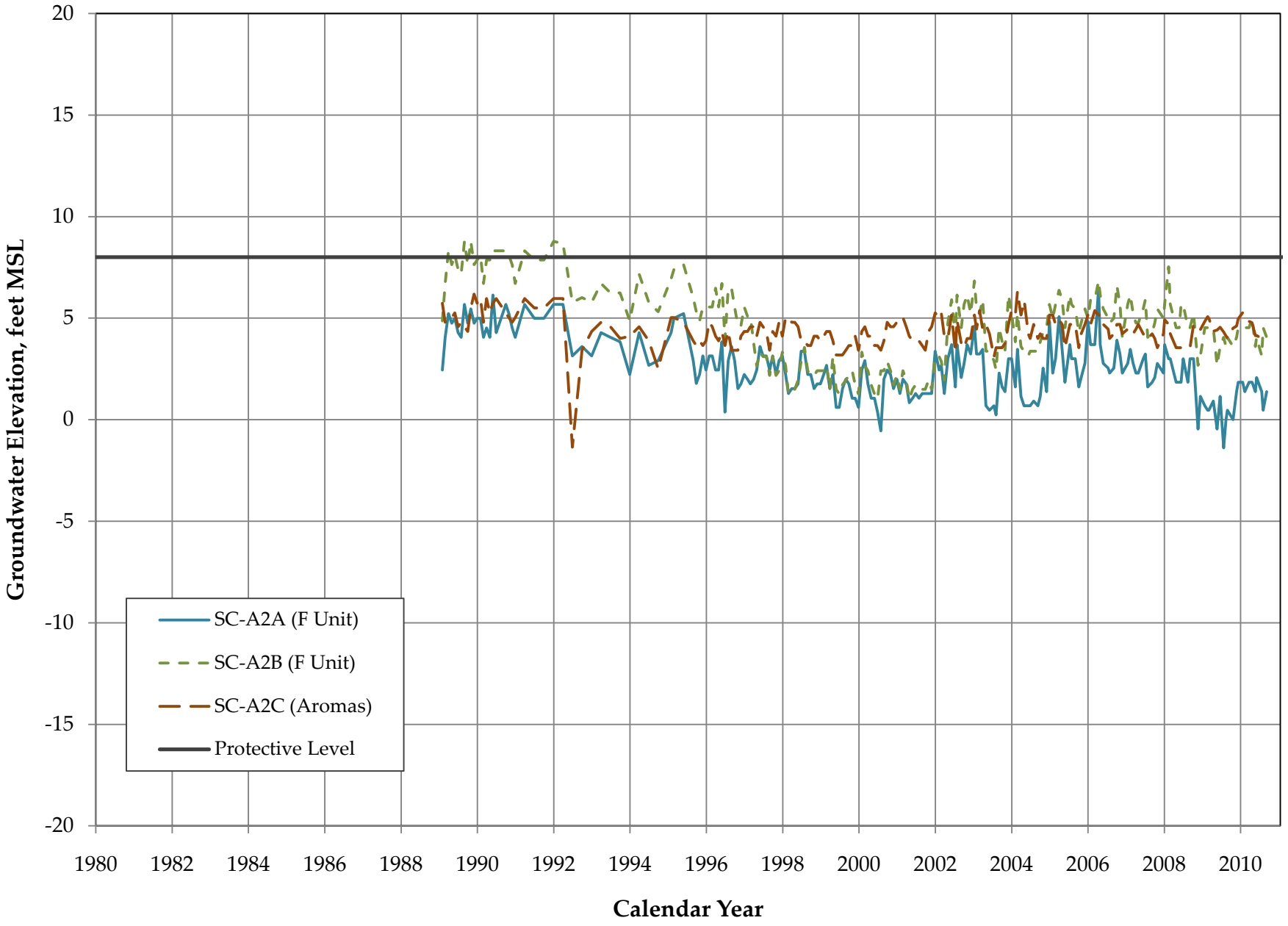
Hydrographs of SqCWD Monitoring Wells Adjacent to Production Wells

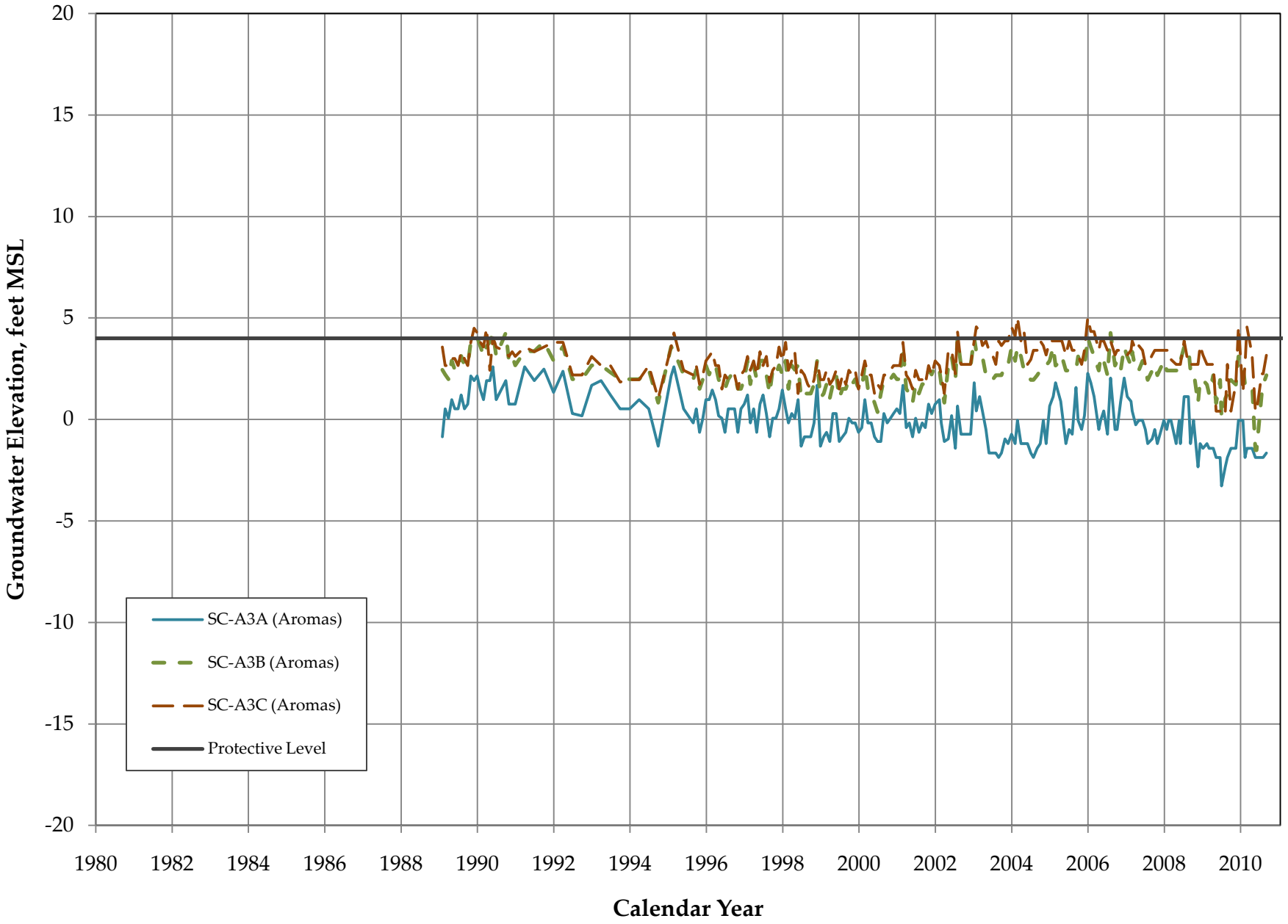
Hydrographs of CWD Monitoring Wells Adjacent to Production Wells

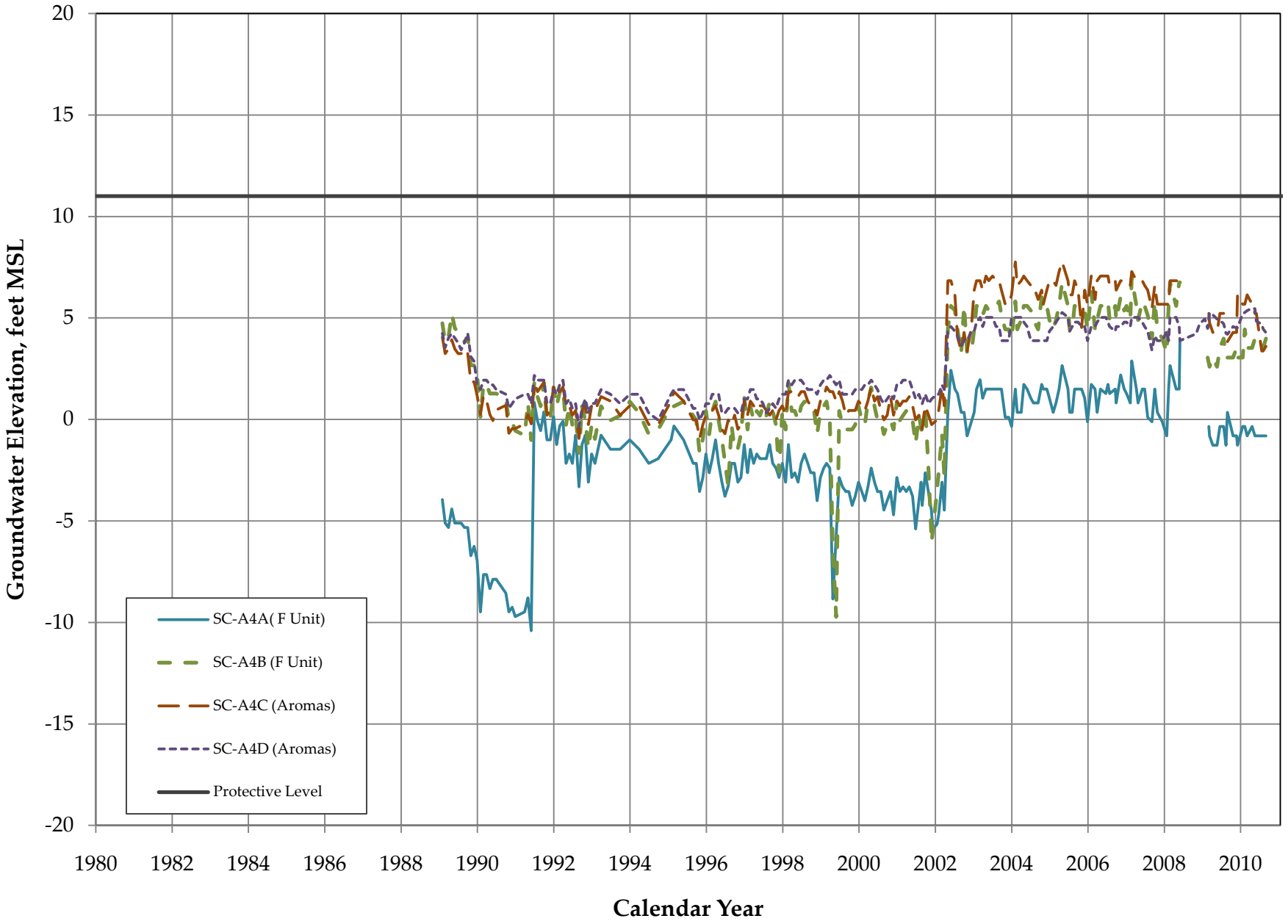
Hydrograph of Inland Monitoring Wells


Groundwater Elevation, feet MSL
20
15
10
5
0
-5
-10
-15
-20
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-A1A (DEF Unit)
SC-A1B (F Unit)
SC-A1C (Aromas)
SC-A1D (Aromas)
Protective Level

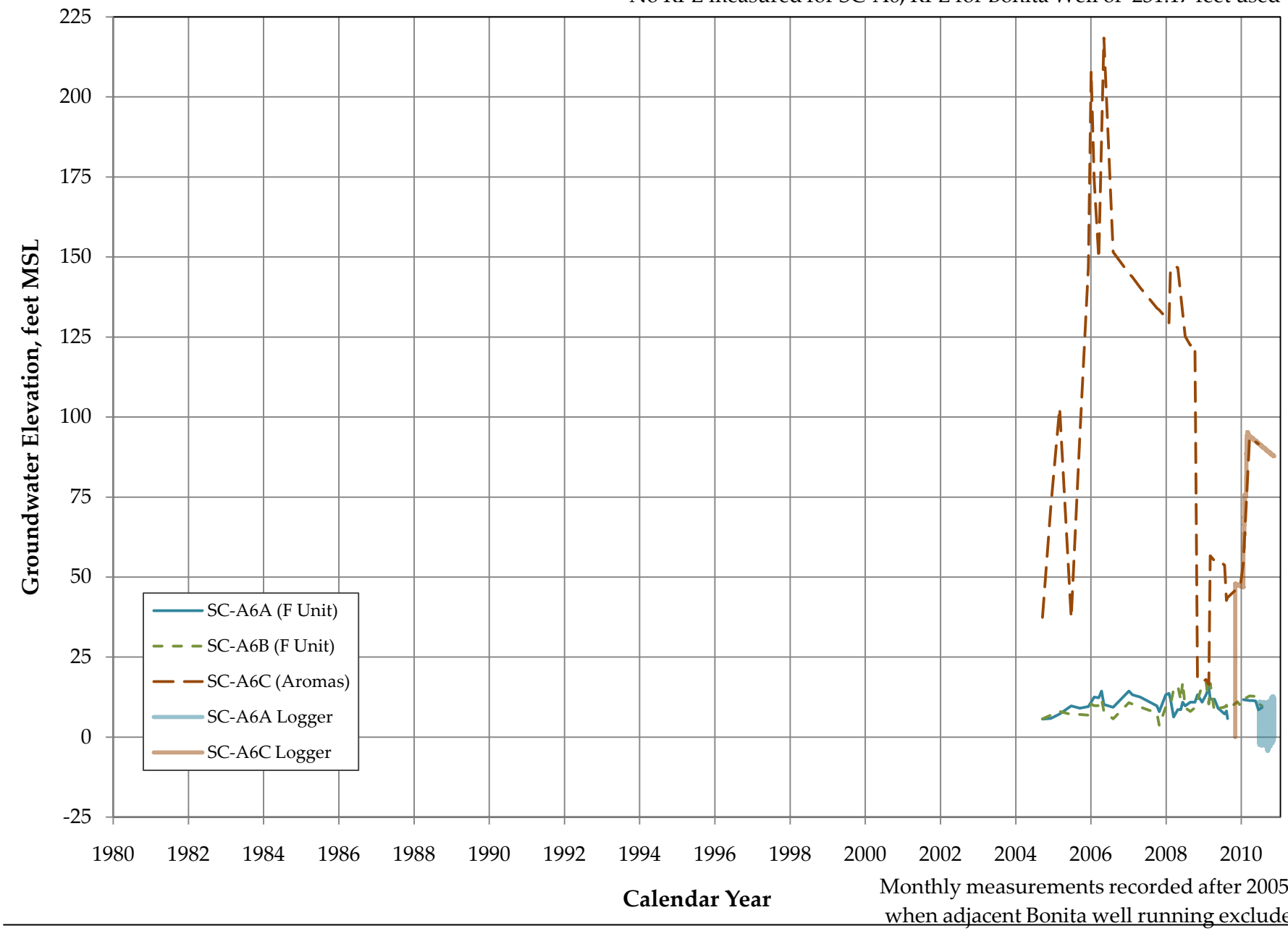

Groundwater Elevation, feet MSL
20
15
10
5
0
-5
-10
-15
-20
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-A8A (F Unit)
SC-A8B (Aromas)
SC-A8C (Aromas)
Protective Level


Groundwater Elevation, feet MSL
20
15
10
5
0
-5
-10
-15
-20
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-A2A (F Unit)
SC-A2B (F Unit)
SC-A2C (Aromas)
Protective Level

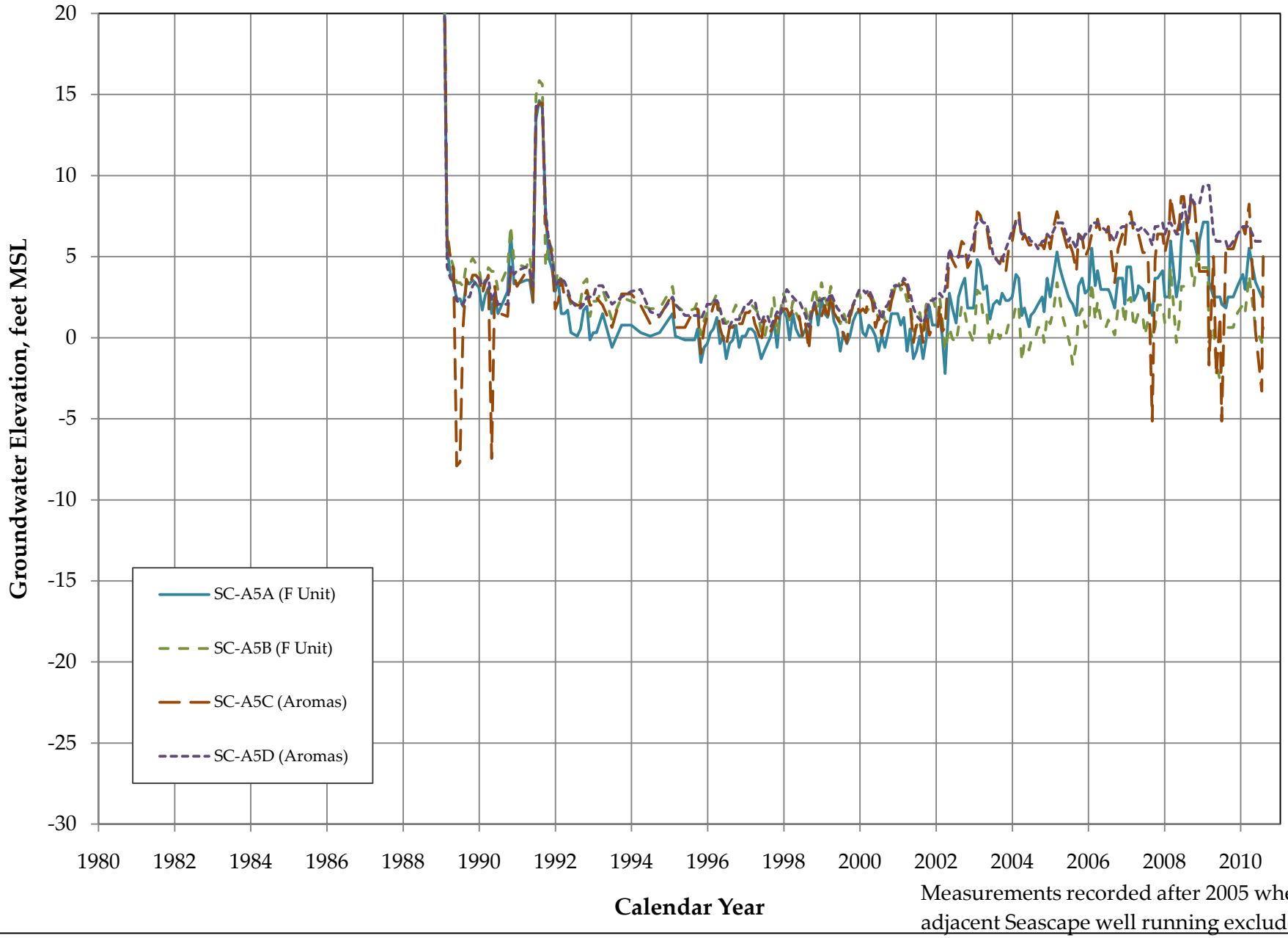

Groundwater Elevation, feet MSL
20
15
10
5
0
-5
-10
-15
-20
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-A3A (Aromas)
SC-A3B (Aromas)
SC-A3C (Aromas)
Protective Level


Groundwater Elevation, feet MSL
20
15
10
5
0
-5
-10
-15
-20
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-A4A(F Unit)
SC-A4B (F Unit)
SC-A4C (Aromas)
SC-A4D (Aromas)
Protective Level

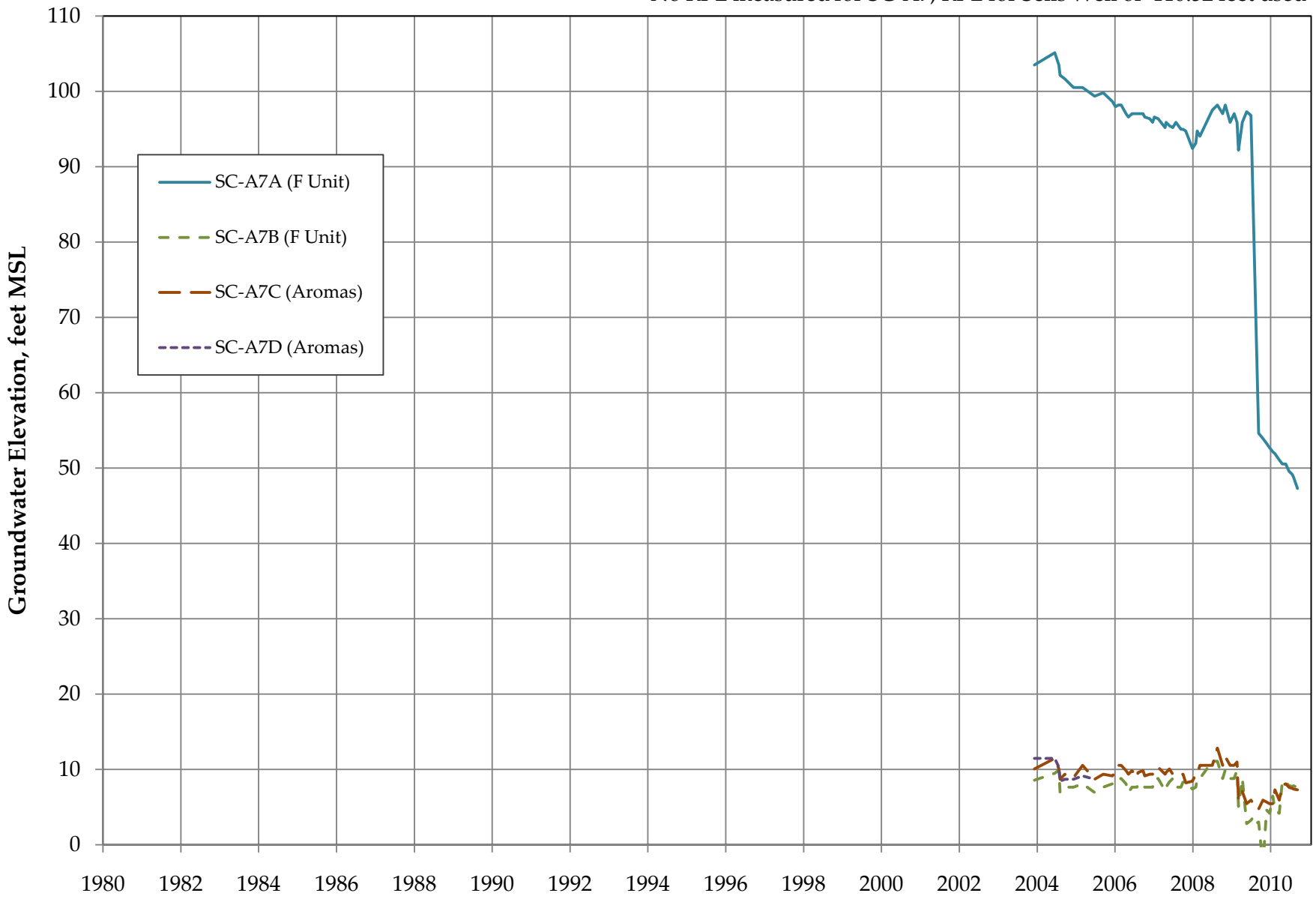
No RPE measured for SC-A6, RPE for Bonita Well of 231.17 feet used



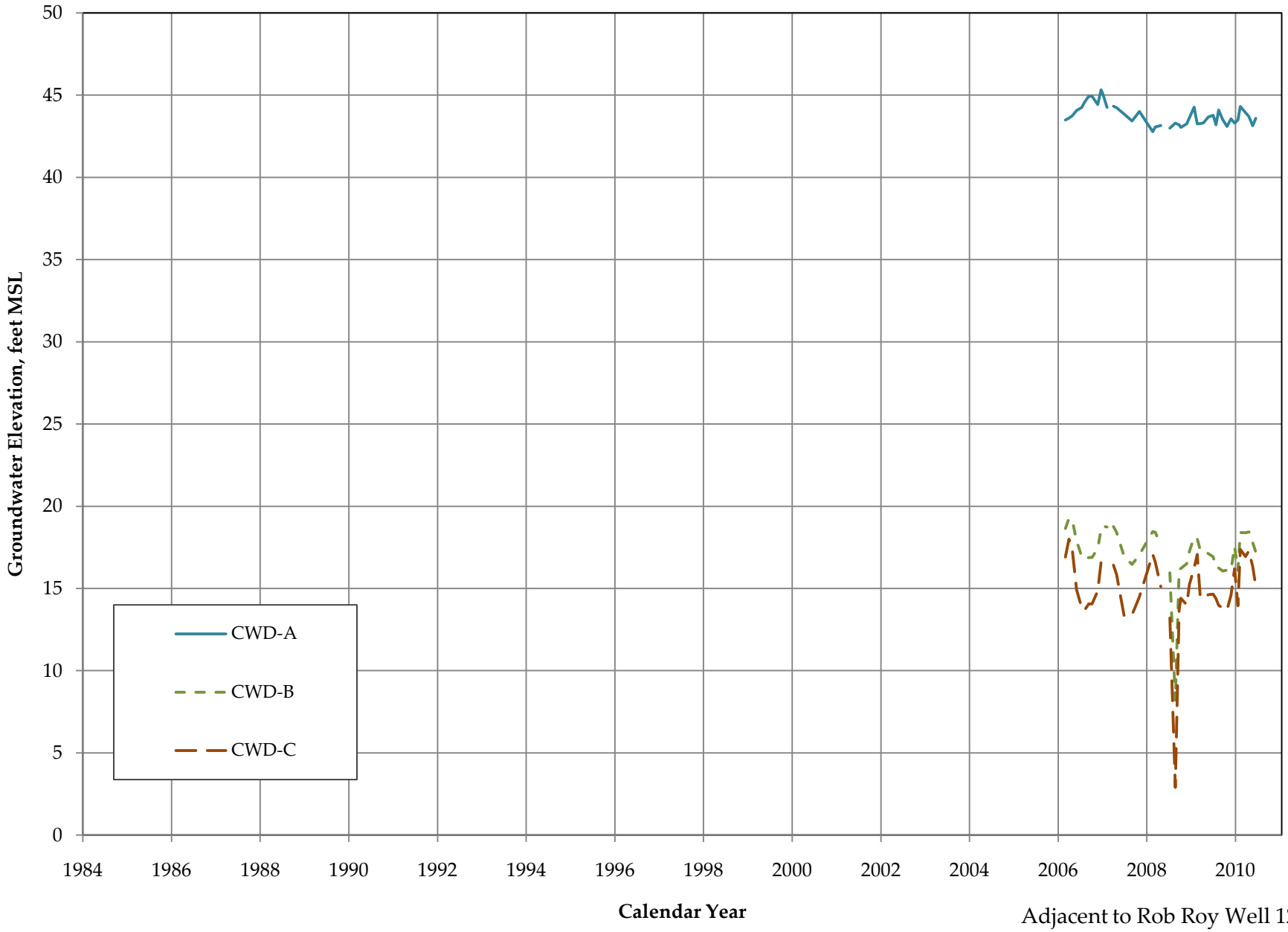
Monthly measurements recorded after 2005 when adjacent Bonita well running excluded

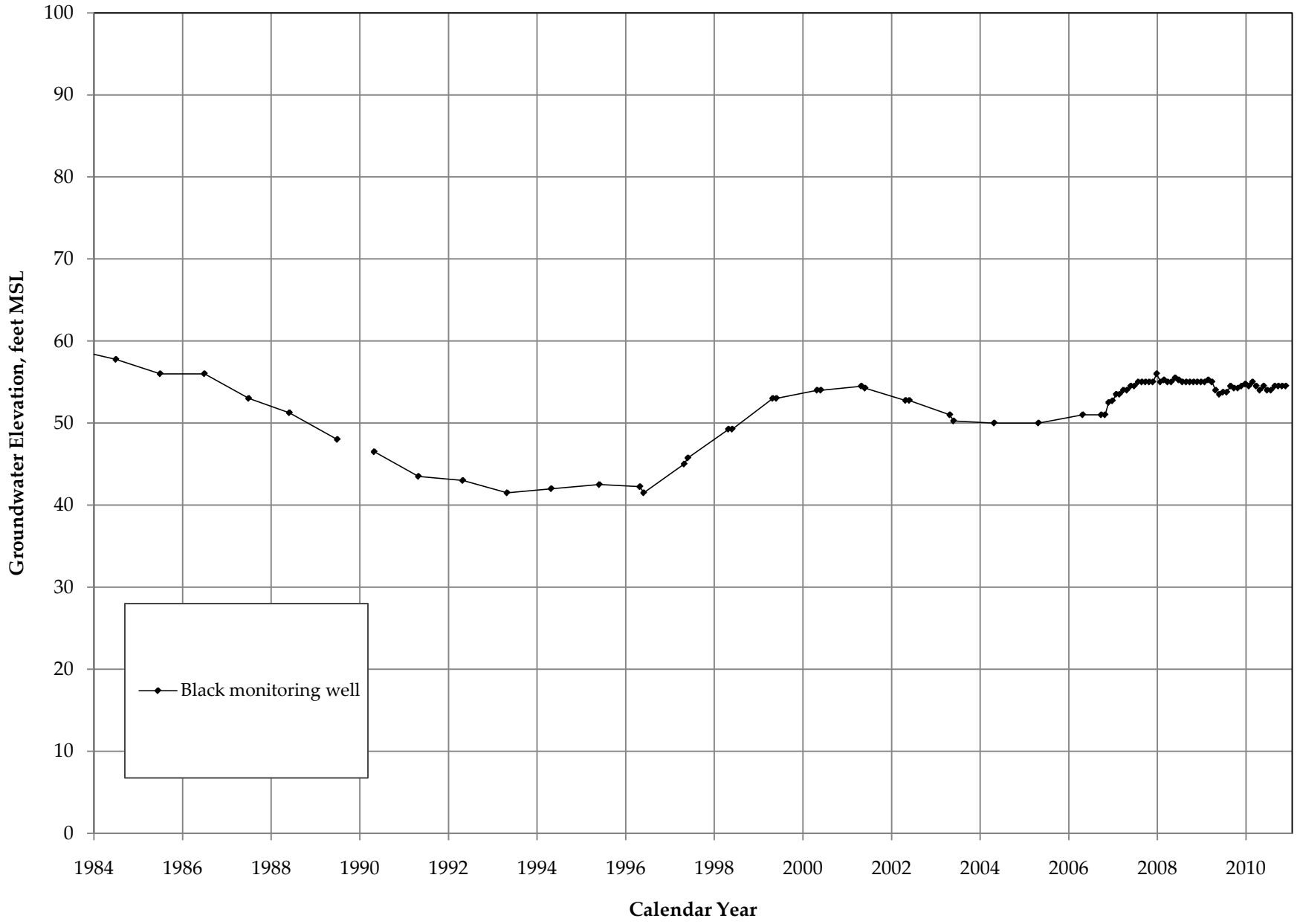

Groundwater Elevation, feet MSL
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
SC-A5A (F Unit)
SC-A5B (F Unit)
SC-A5C (Aromas)
SC-A5D (Aromas)
Measurements recorded after 2005 when adjacent Seascape well running excluded

No RPE measured for SC-A7, RPE for Sells Well of 110.52 feet used



Measurements recorded after 2005 when adjacent Sells well running excluded


Groundwater Elevation, feet MSL
50
45
40
35
30
25
20
15
10
5
0
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
CWD-A
CWD-B
CWD-C
Adjacent to Rob Roy Well 12

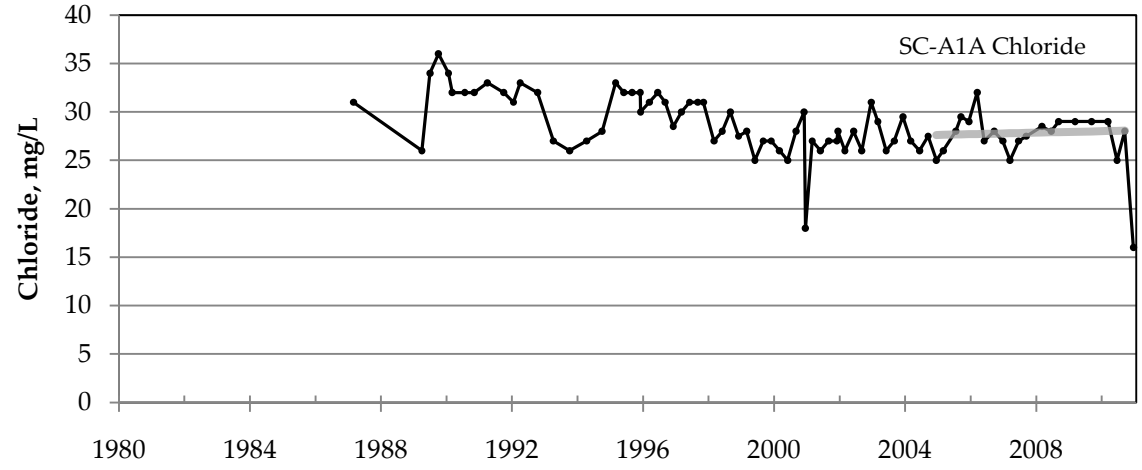

Groundwater Elevation, feet MSL
100
90
80
70
60
50
40
30
20
10
0
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Calendar Year
Black monitoring well

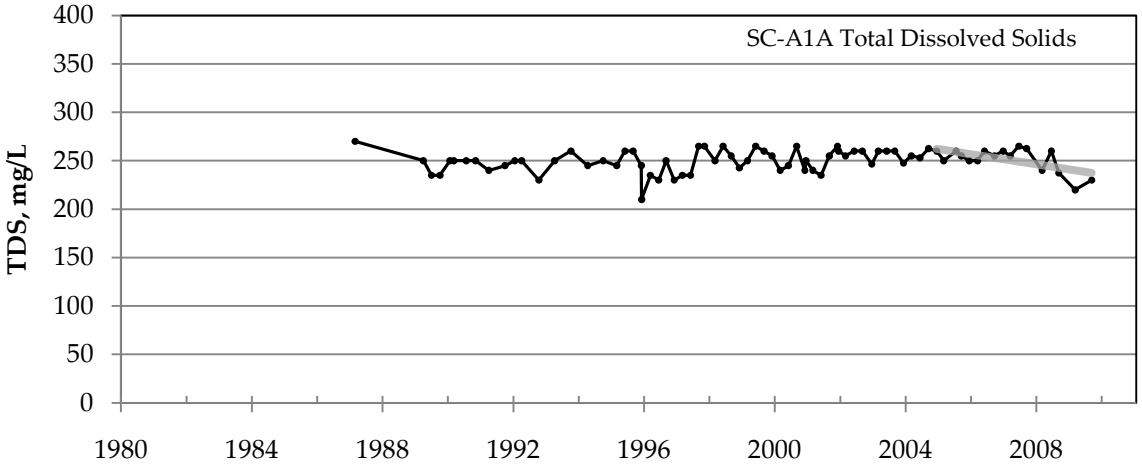
Chemographs and Single Well Hydrographs for Aromas Area

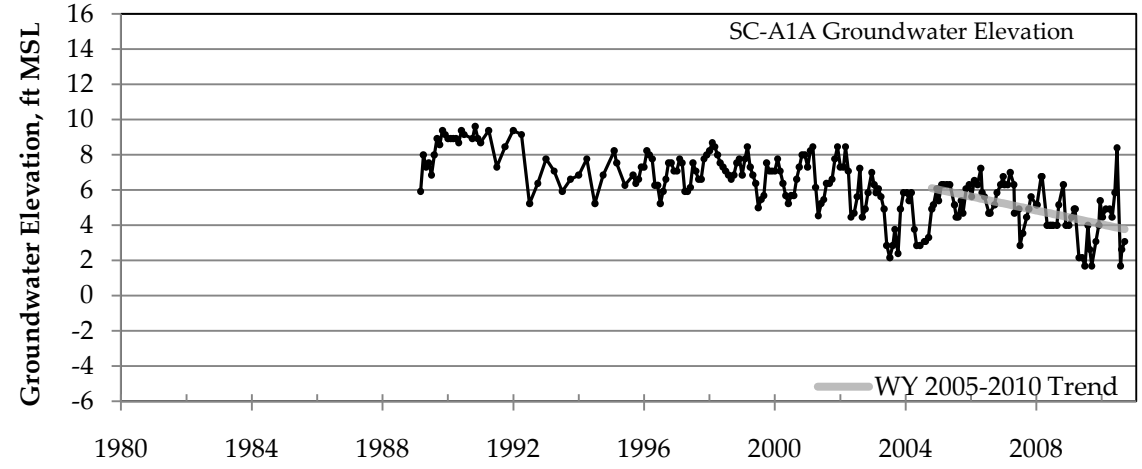
Graphs of SqCWD Coastal Monitoring Well Clusters

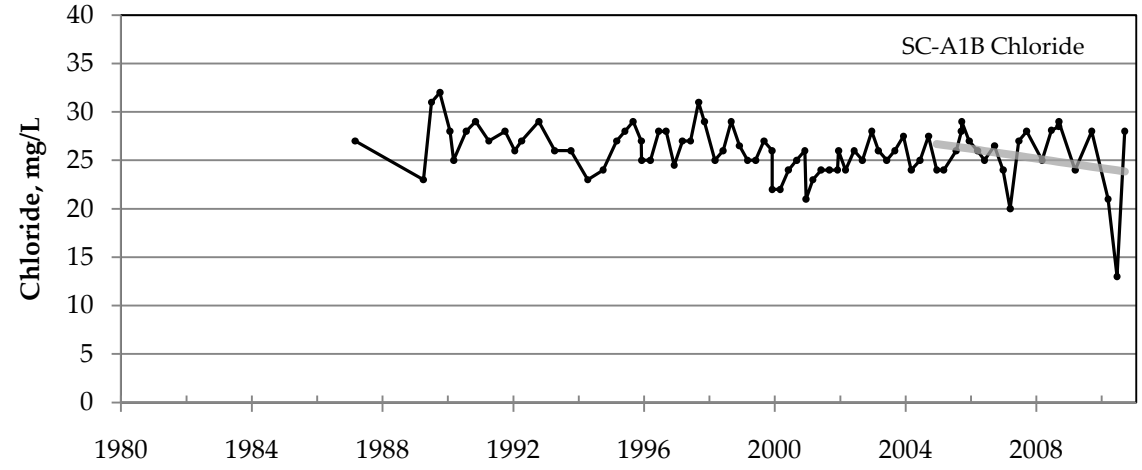
Graphs of SqWCD Production Wells and Adjacent Monitoring Wells

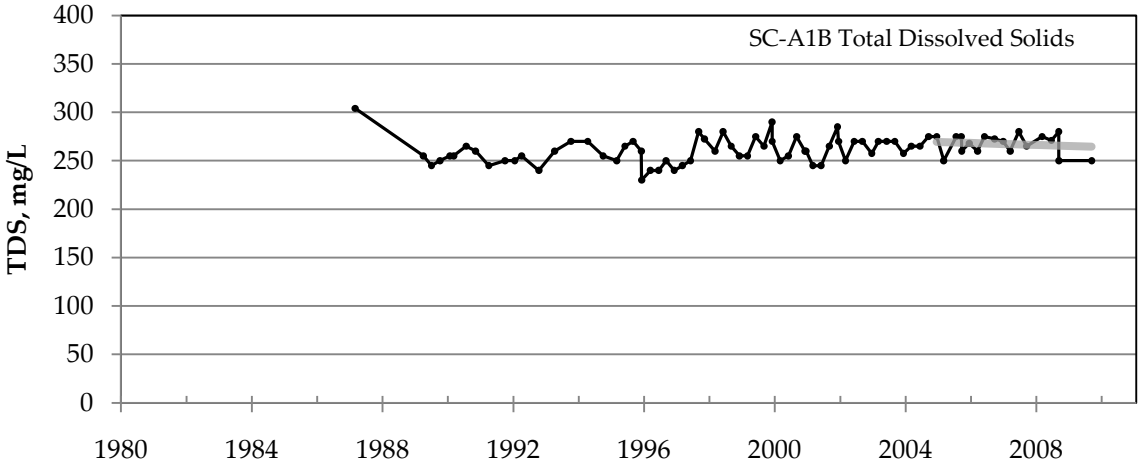
Graphs of CWD Production Wells and Monitoring Wells

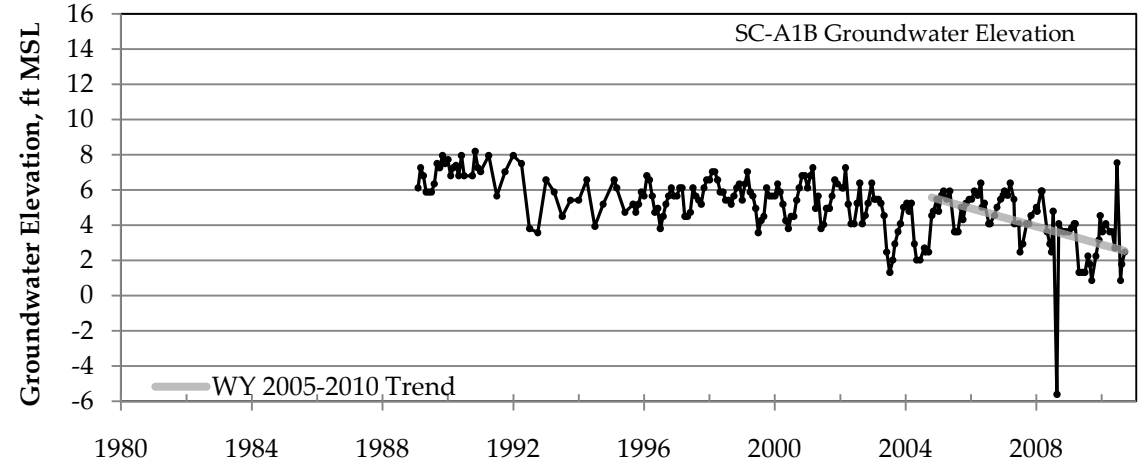

SC-A1A Chloride
Chloride, mg/L
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

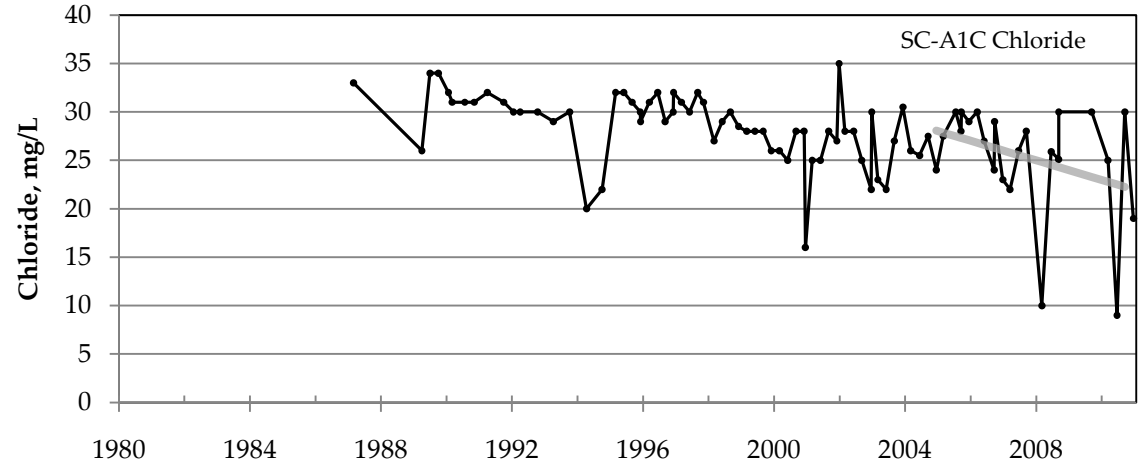

SC-A1A Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

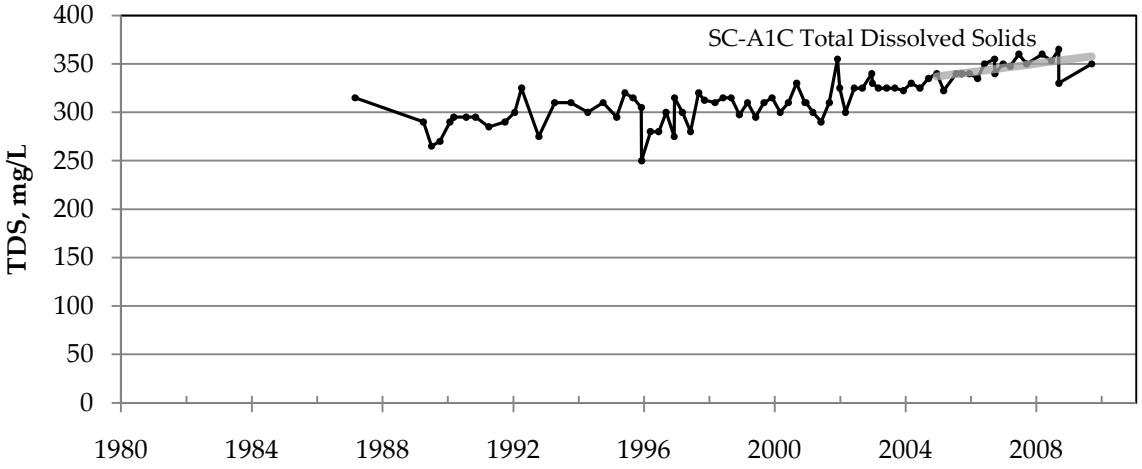

SC-A1A Groundwater Elevation
Groundwater Elevation, ft MSL
16
14
12
10
8
6
4
2
0
-2
-4
-6
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

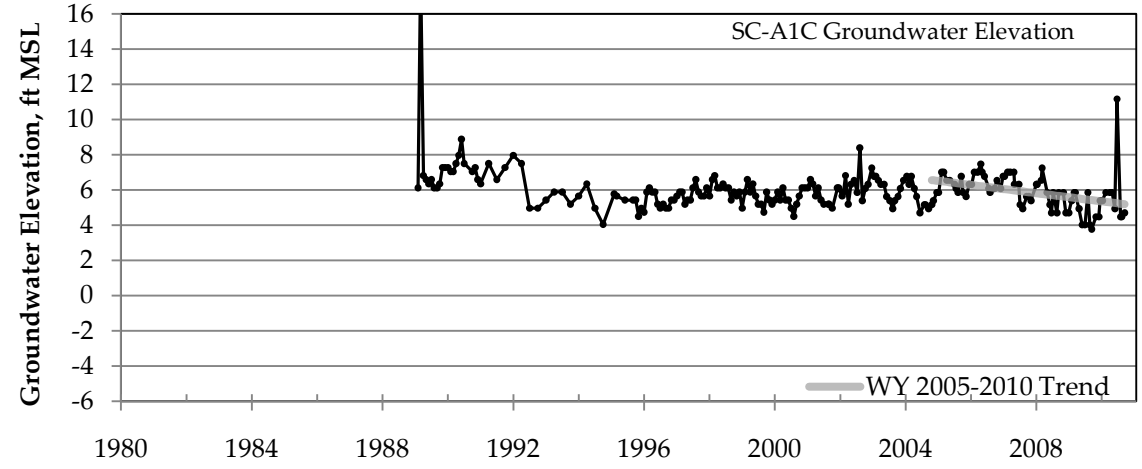

SC-A1B Chloride
Chloride, mg/L
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

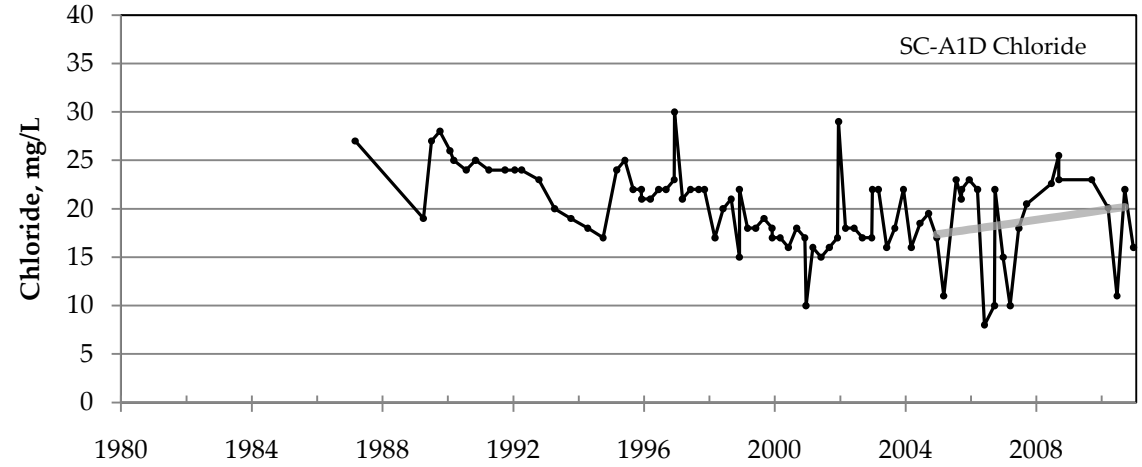

SC-A1B Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

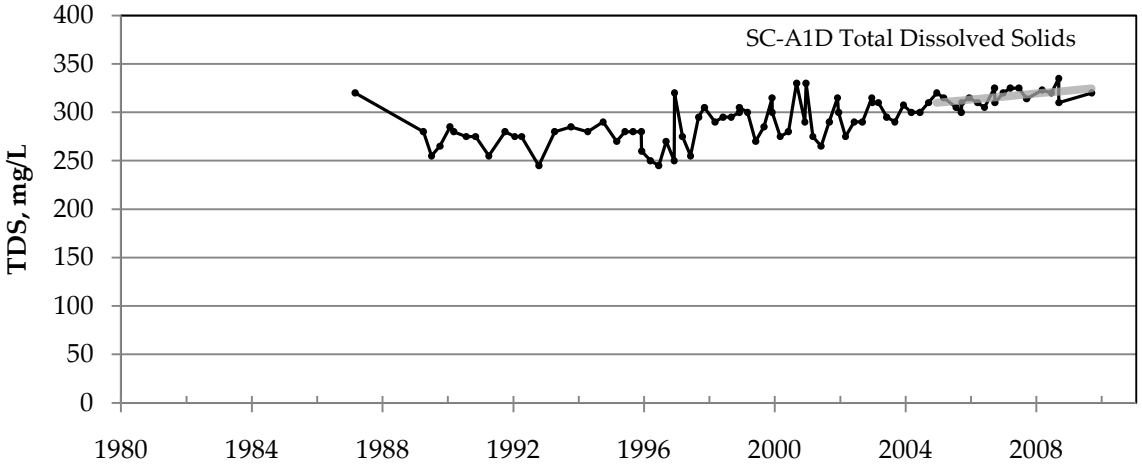

SC-A1B Groundwater Elevation
Groundwater Elevation, ft MSL
16
14
12
10
8
6
4
2
0
-2
-4
-6
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

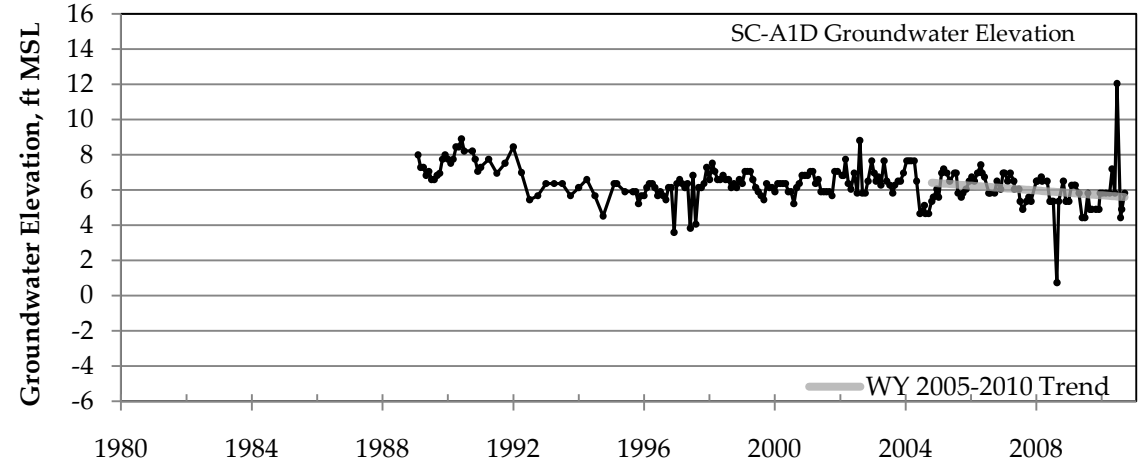

SC-A1C Chloride
Chloride, mg/L
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

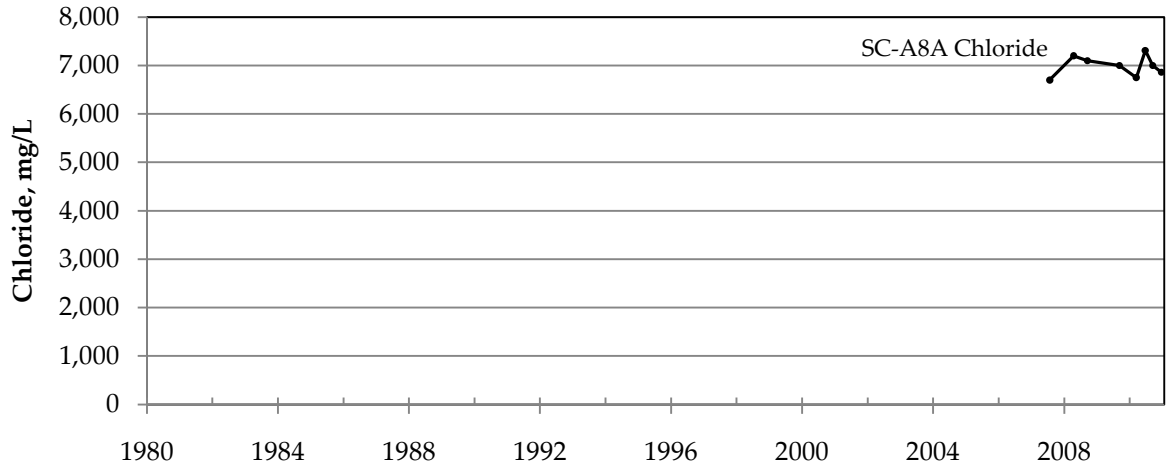

SC-A1C Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

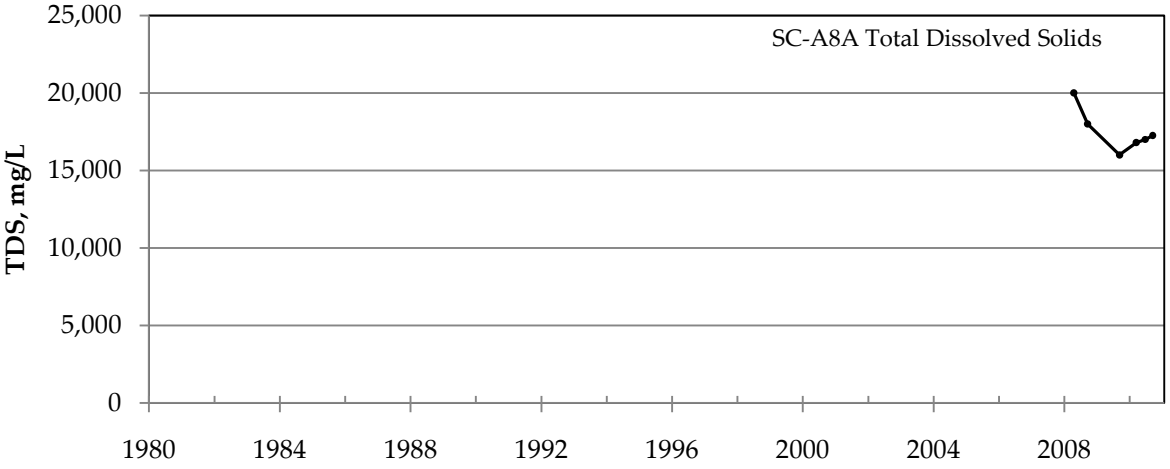

SC-A1C Groundwater Elevation
Groundwater Elevation, ft MSL
16
14
12
10
8
6
4
2
0
-2
-4
-6
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

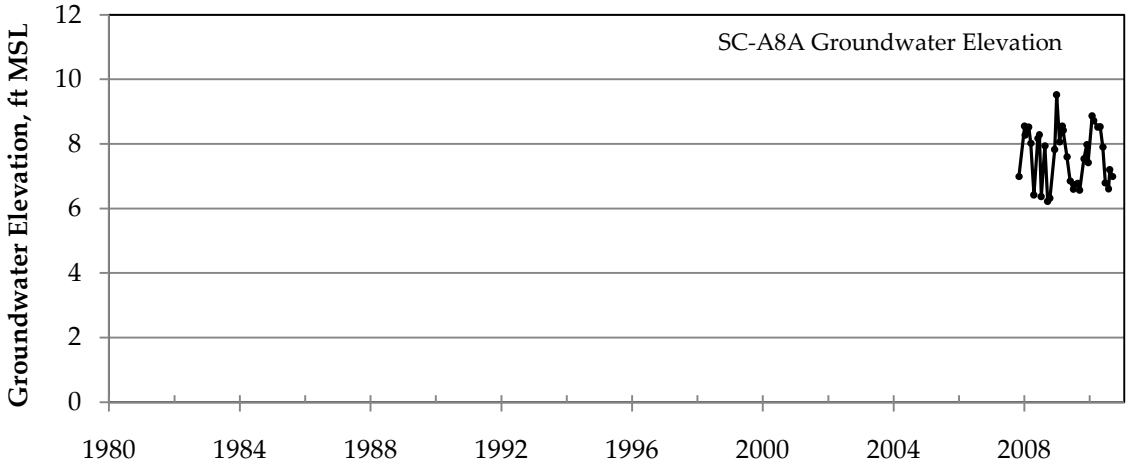

SC-A1D Chloride
Chloride, mg/L
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

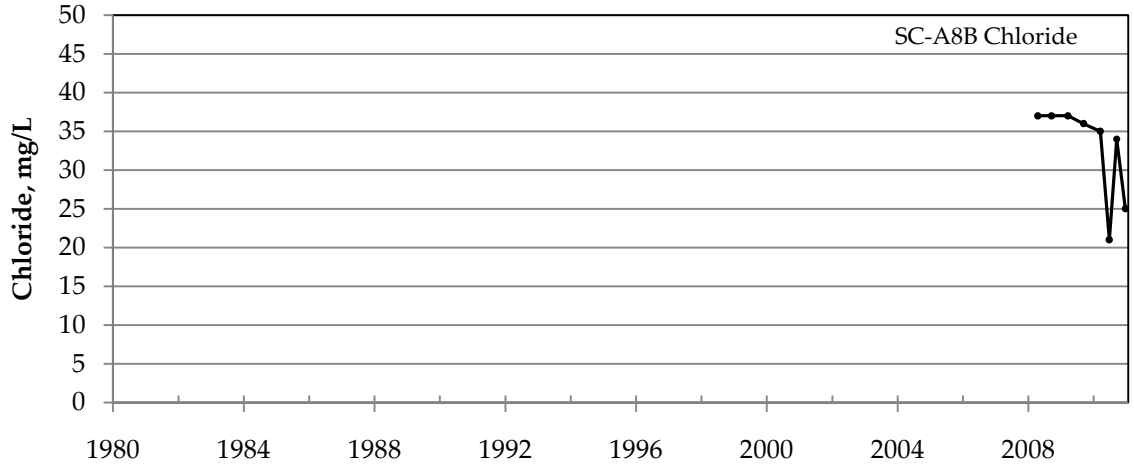

SC-A1D Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

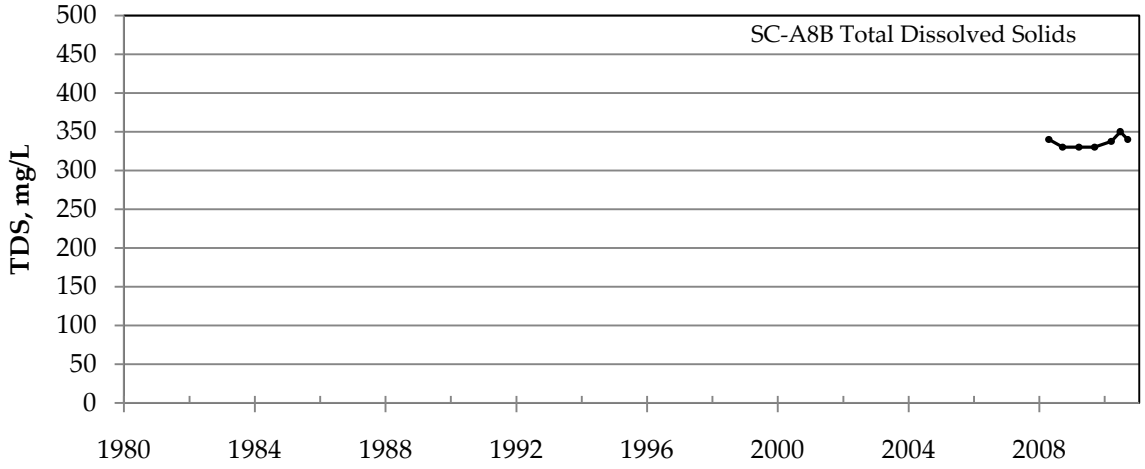

SC-A1D Groundwater Elevation
Groundwater Elevation, ft MSL
16
14
12
10
8
6
4
2
0
-2
-4
-6
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

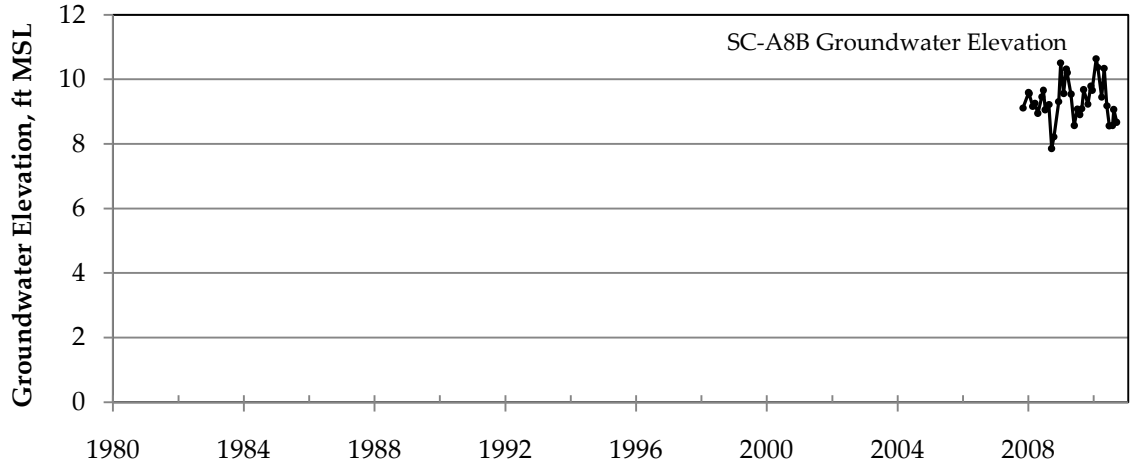

SC-A8A Chloride
Chloride, mg/L
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1984
1988
1992
1996
2000
2004
2008

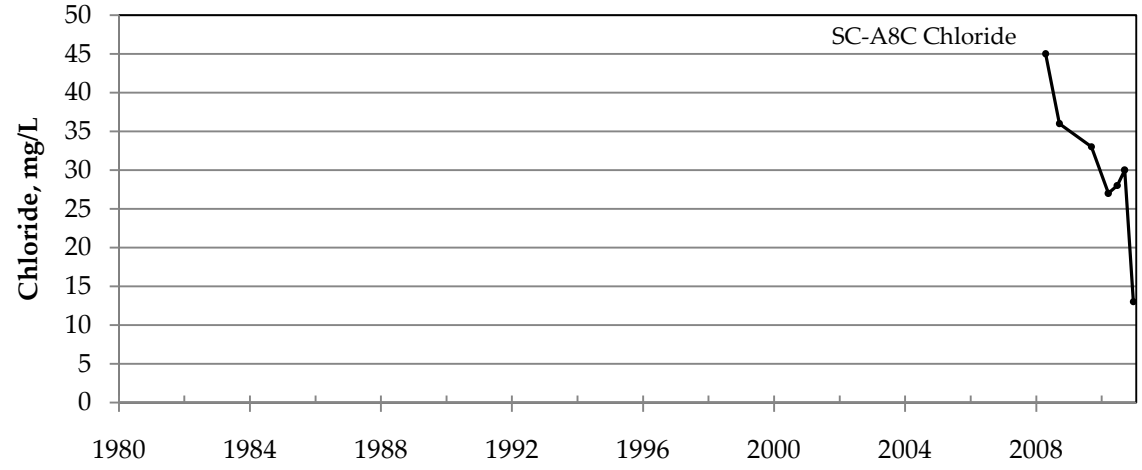

SC-A8A Total Dissolved Solids
TDS, mg/L
25,000
20,000
15,000
10,000
5,000
0
1980
1984
1988
1992
1996
2000
2004
2008

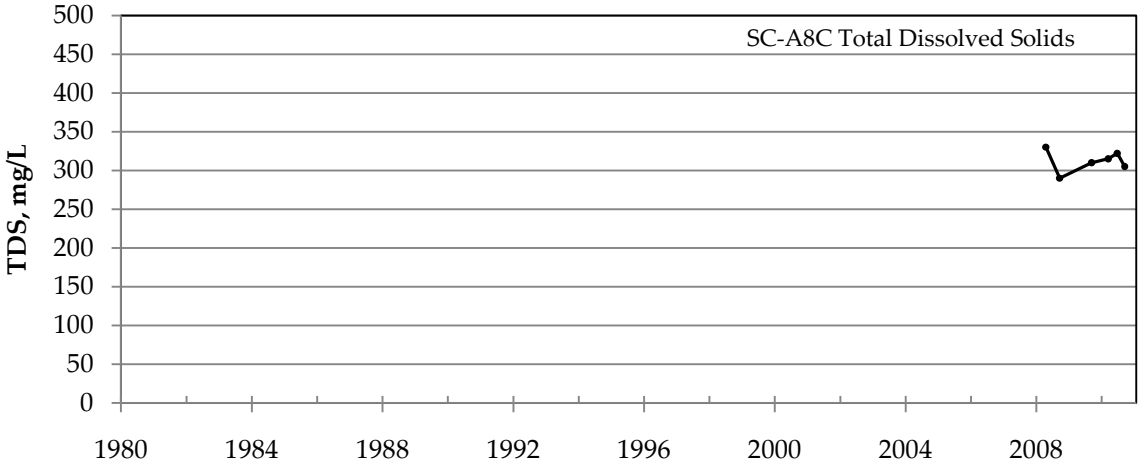

SC-A8A Groundwater Elevation
Groundwater Elevation, ft MSL
12
10
8
6
4
2
0
1980
1984
1988
1992
1996
2000
2004
2008

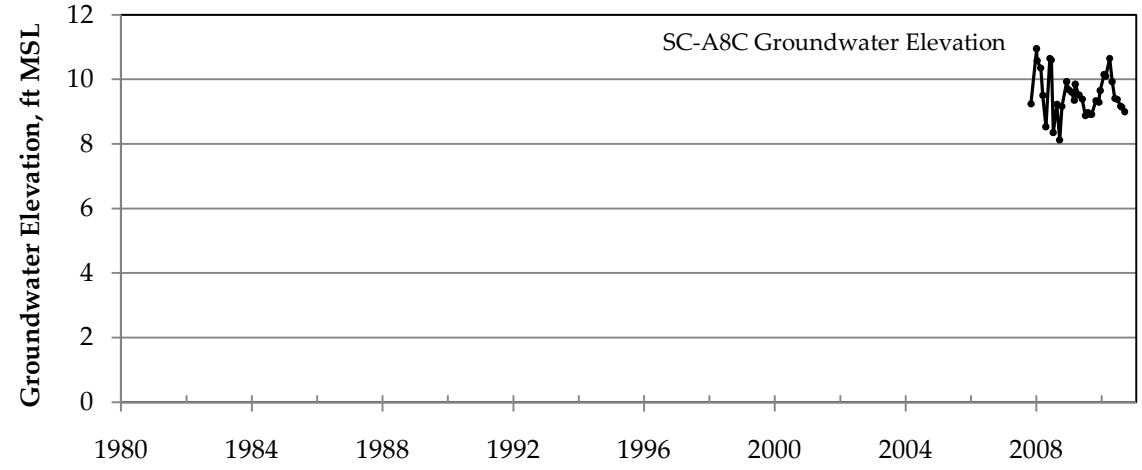

SC-A8B Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

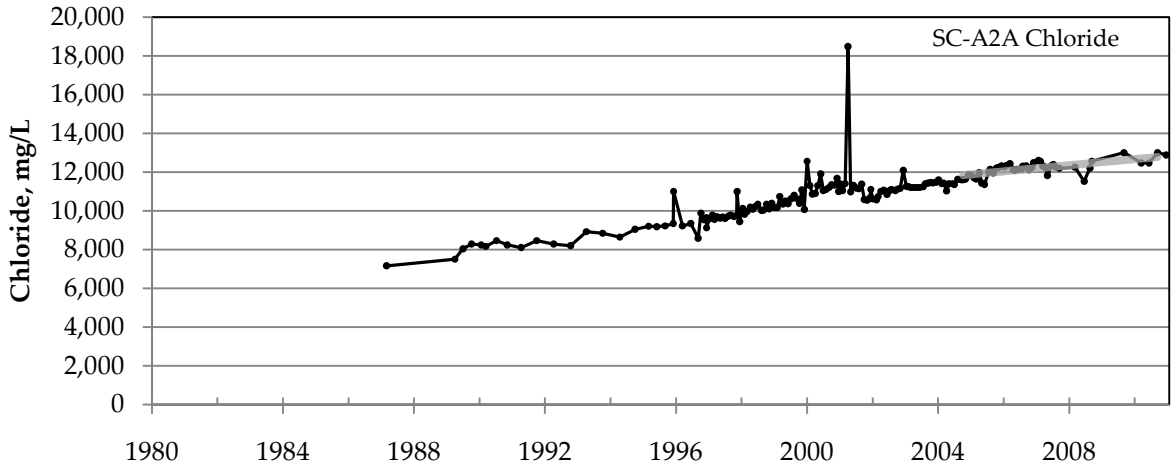

SC-A8B Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

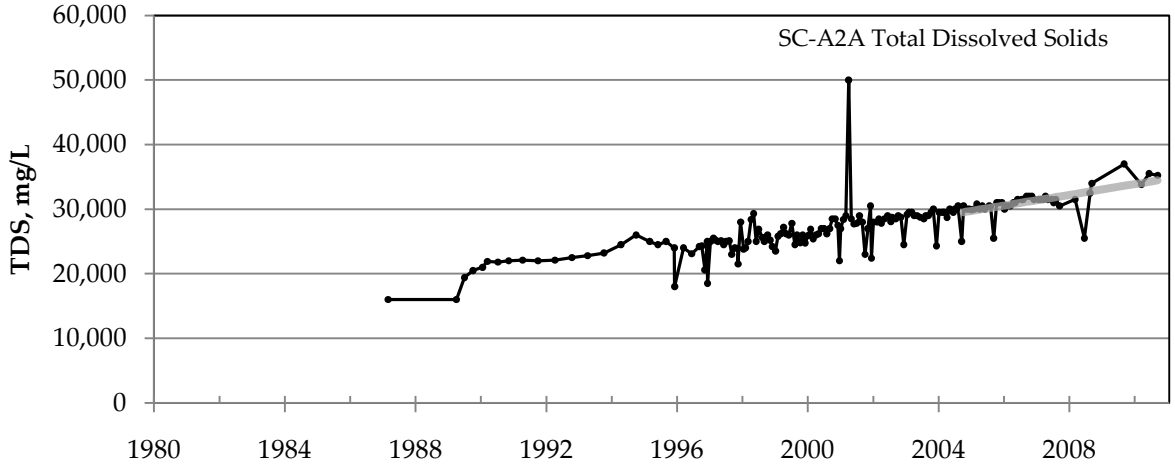

SC-A8B Groundwater Elevation
Groundwater Elevation, ft MSL
12
10
8
6
4
2
0
1980
1984
1988
1992
1996
2000
2004
2008

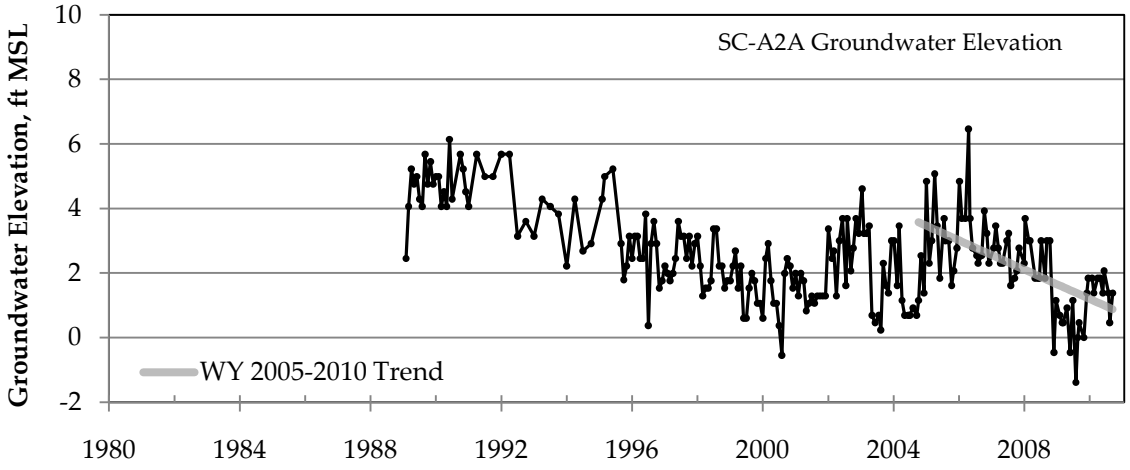

SC-A8C Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

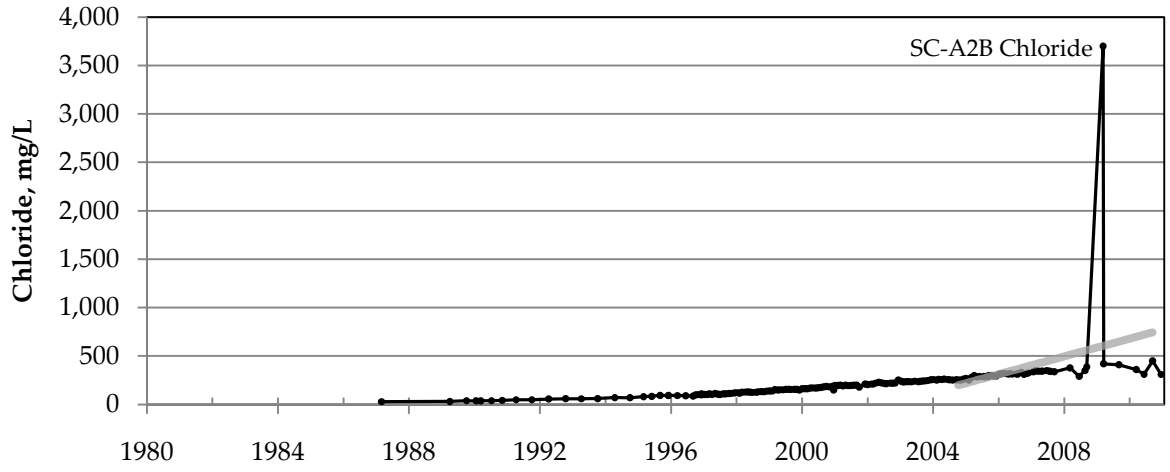

SC-A8C Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

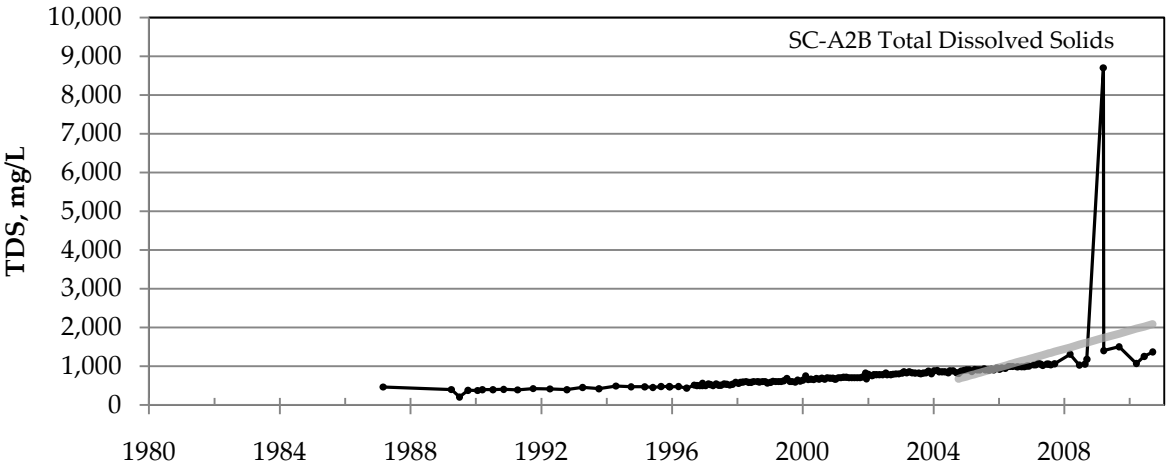

SC-A8C Groundwater Elevation
Groundwater Elevation, ft MSL
12
10
8
6
4
2
0
1980
1984
1988
1992
1996
2000
2004
2008

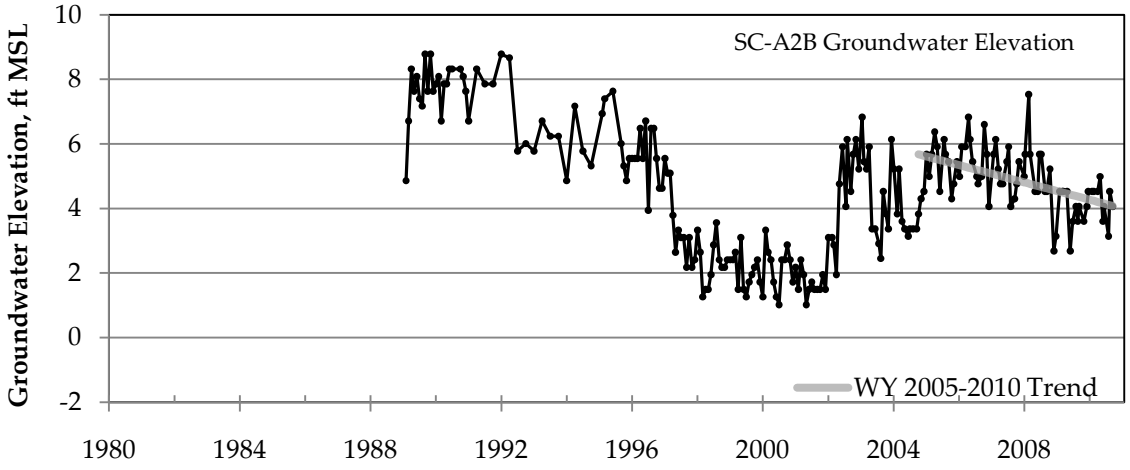

SC-A2A Chloride
Chloride, mg/L
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1980
1984
1988
1992
1996
2000
2004
2008

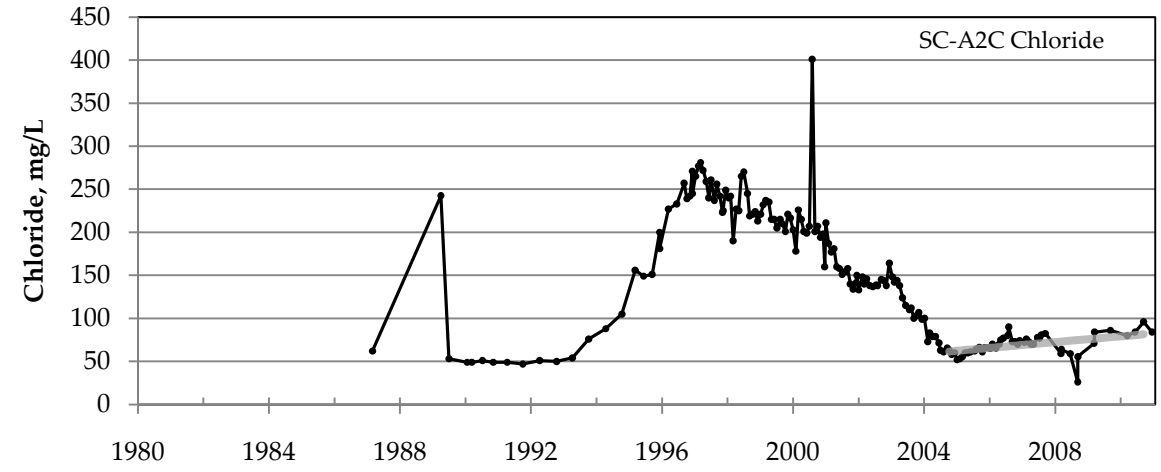

SC-A2A Total Dissolved Solids
TDS, mg/L
60,000
50,000
40,000
30,000
20,000
10,000
0
1980
1984
1988
1992
1996
2000
2004
2008

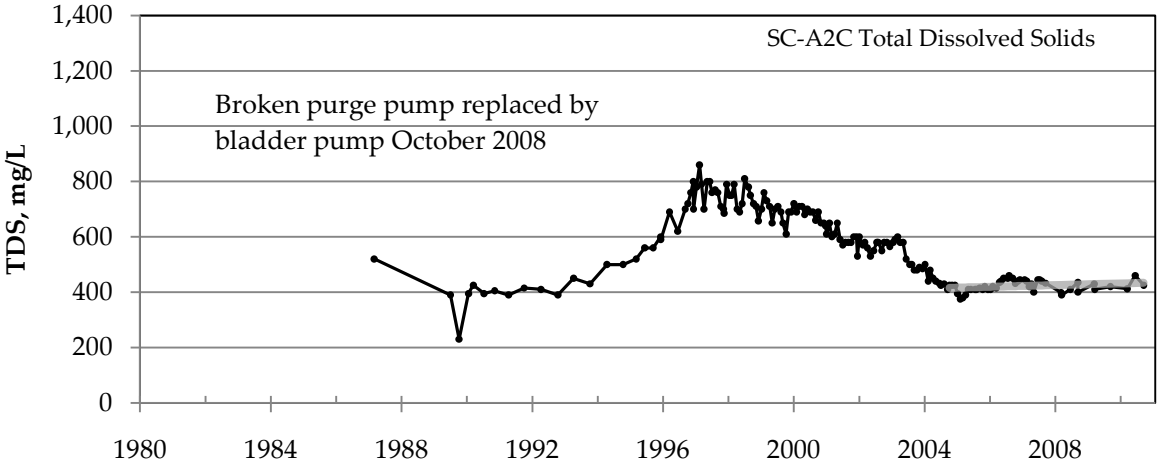

SC-A2A Groundwater Elevation
Groundwater Elevation, ft MSL
10
8
6
4
2
0
-2
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

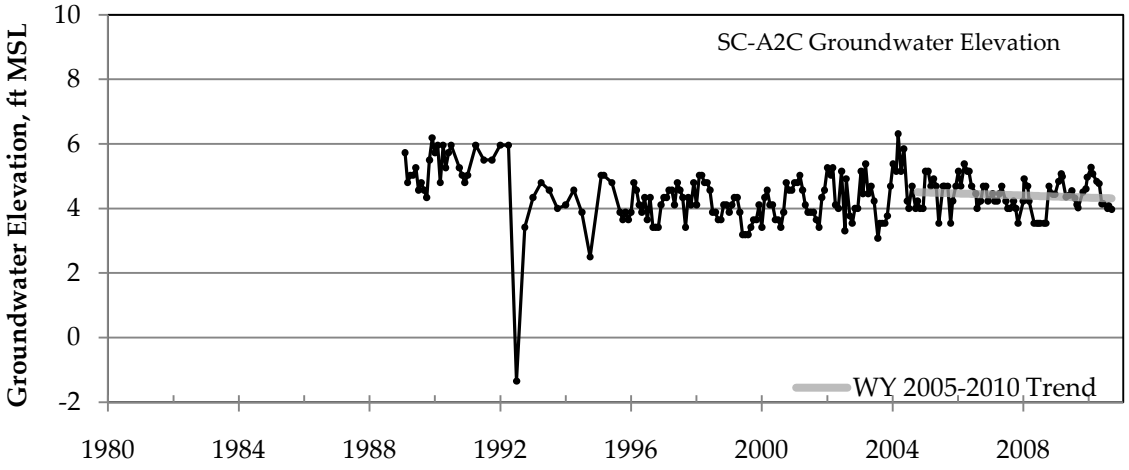

SC-A2B Chloride
Chloride, mg/L
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1980
1984
1988
1992
1996
2000
2004
2008

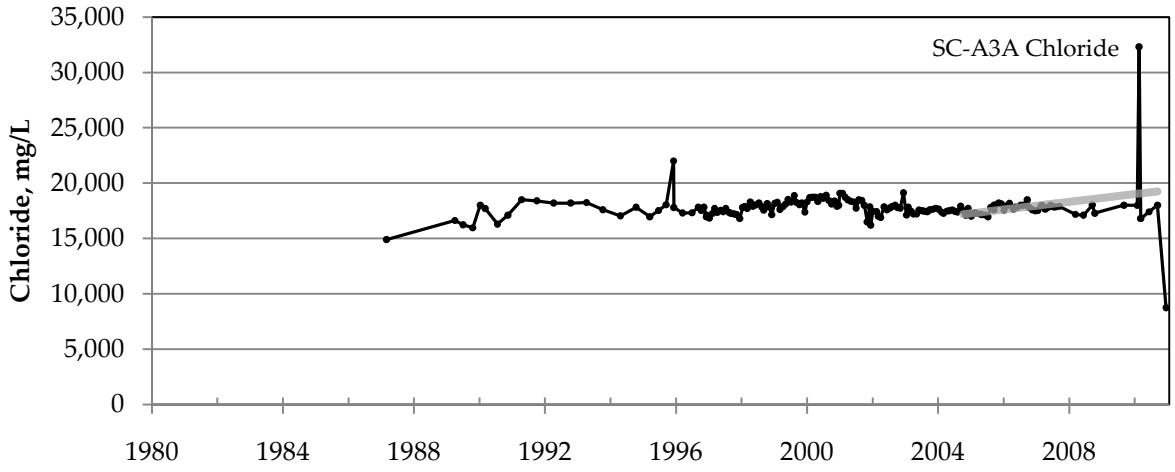

SC-A2B Total Dissolved Solids
TDS, mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1984
1988
1992
1996
2000
2004
2008

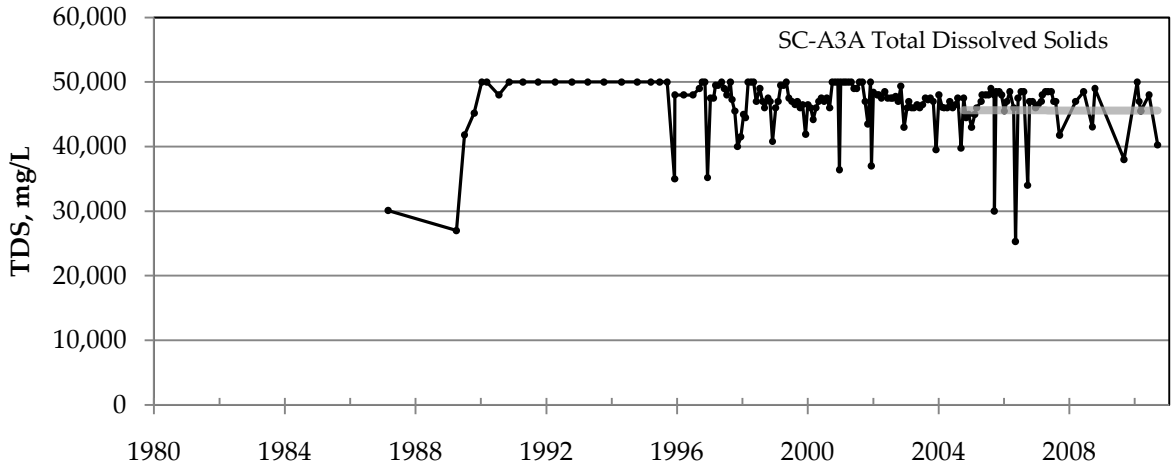

SC-A2B Groundwater Elevation
Groundwater Elevation, ft MSL
10
8
6
4
2
0
-2
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

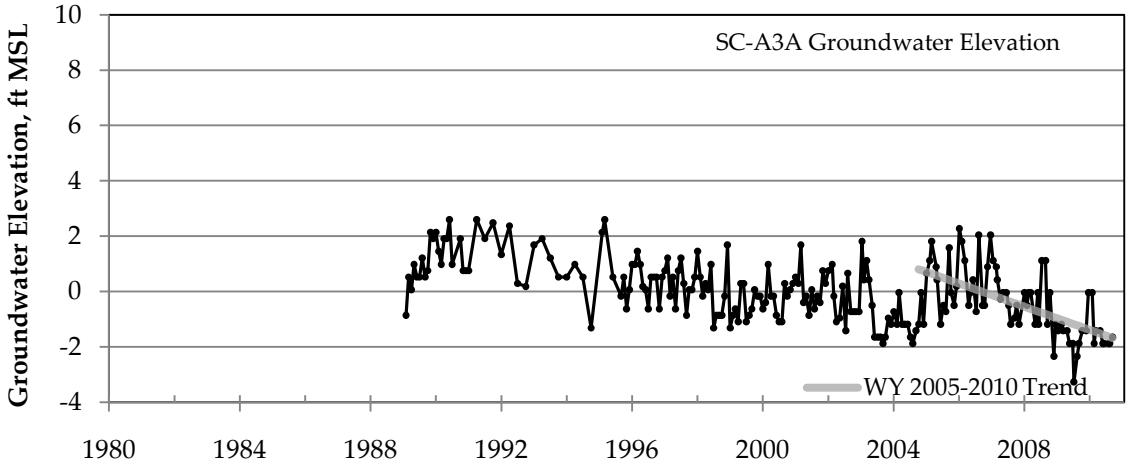

SC-A2C Chloride
Chloride, mg/L
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

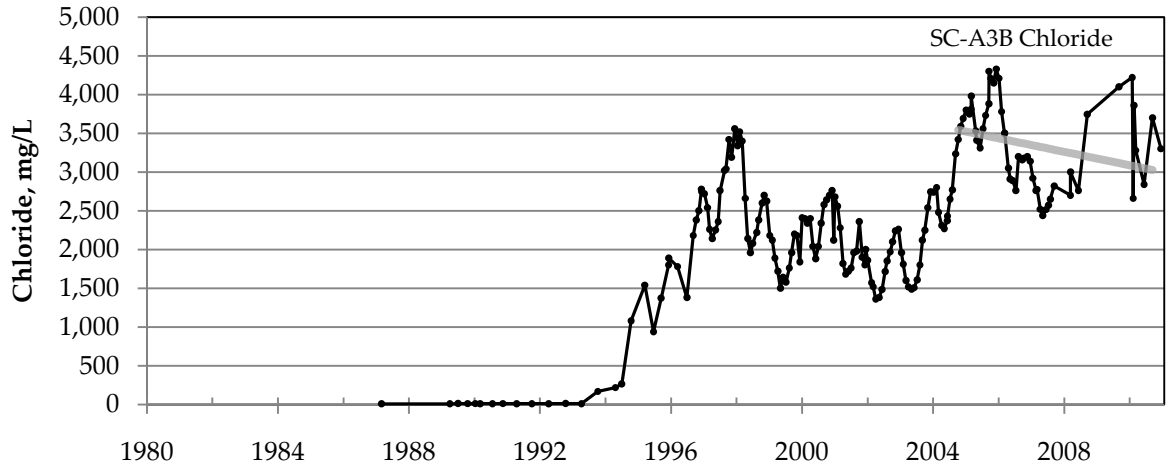

SC-A2C Total Dissolved Solids
Broken purge pump replaced by
bladder pump October 2008
TDS, mg/L
1,400
1,200
1,000
800
600
400
200
0
1980
1984
1988
1992
1996
2000
2004
2008

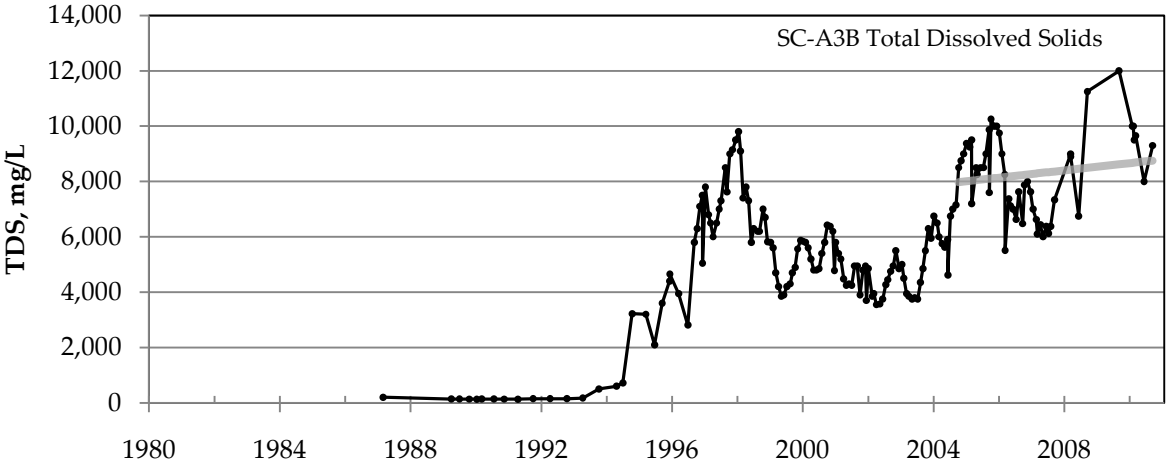

SC-A2C Groundwater Elevation
Groundwater Elevation, ft MSL
10
8
6
4
2
0
-2
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

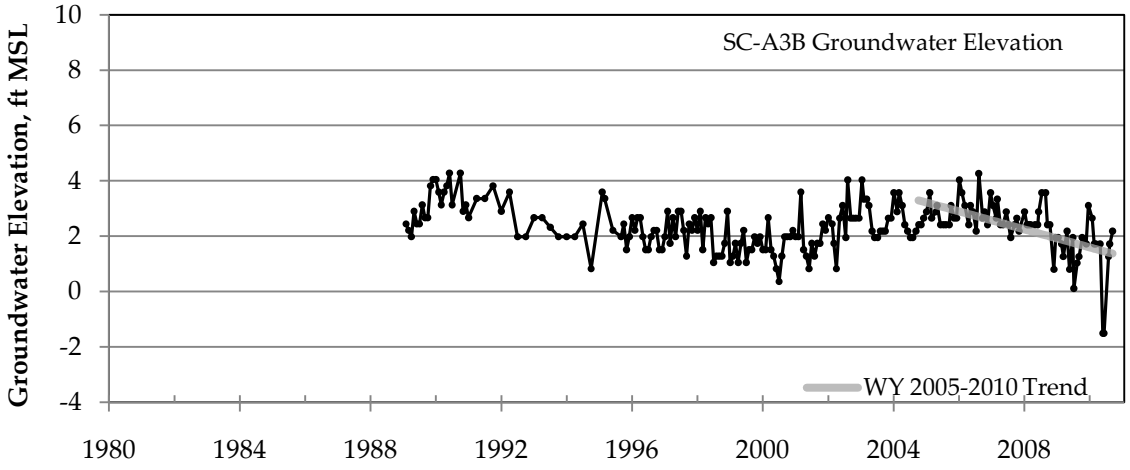

SC-A3A Chloride
Chloride, mg/L
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1980
1984
1988
1992
1996
2000
2004
2008

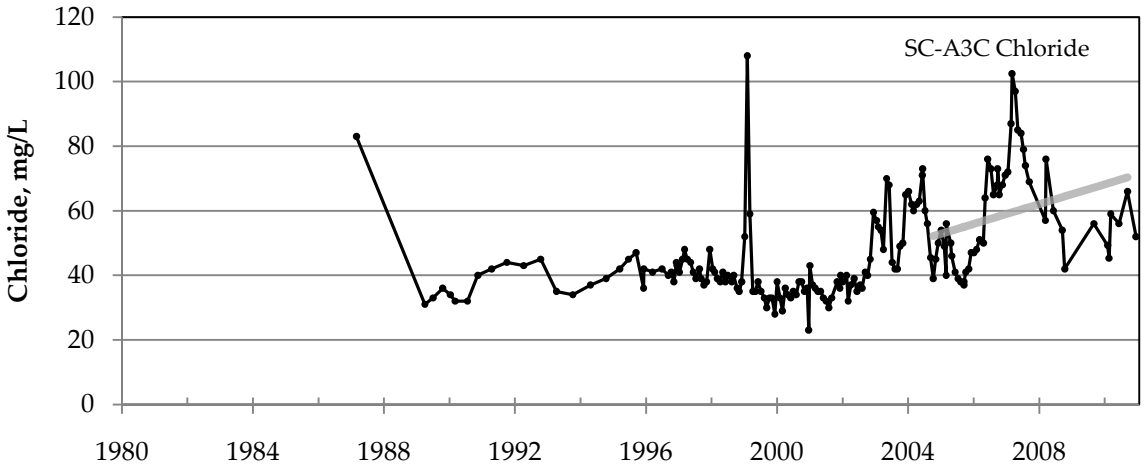

SC-A3A Total Dissolved Solids
TDS, mg/L
60,000
50,000
40,000
30,000
20,000
10,000
0
1980
1984
1988
1992
1996
2000
2004
2008

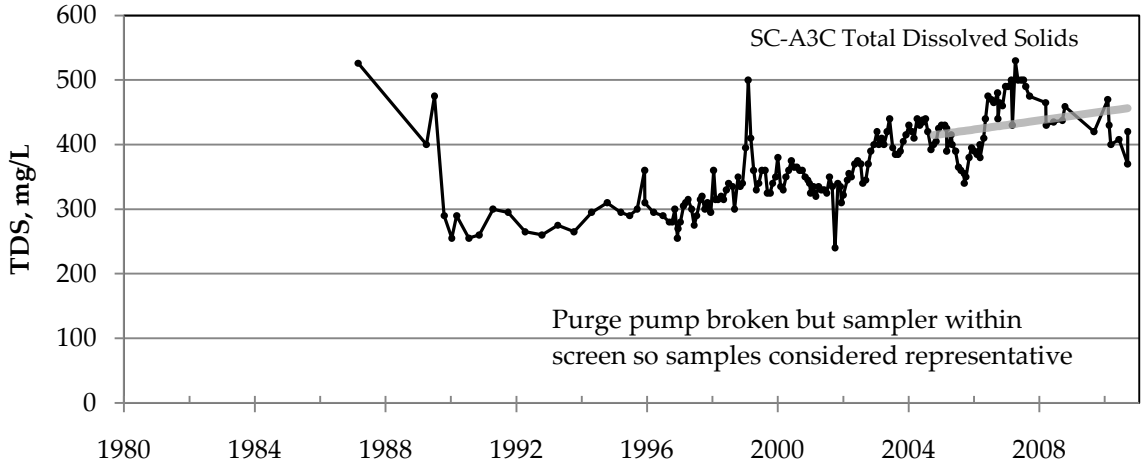

SC-A3A Groundwater Elevation
Groundwater Elevation, ft MSL
10
8
6
4
2
0
-2
-4
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

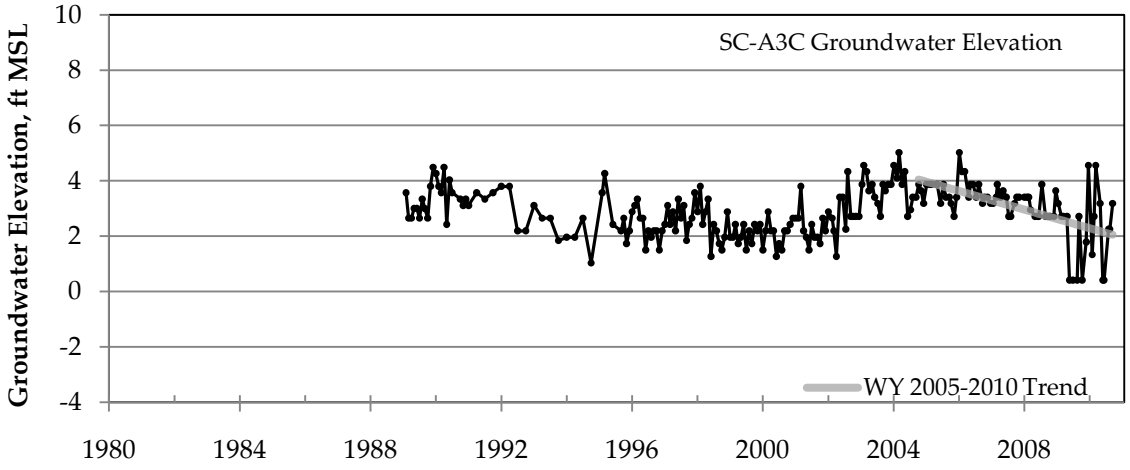

SC-A3B Chloride
Chloride, mg/L
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1980
1984
1988
1992
1996
2000
2004
2008

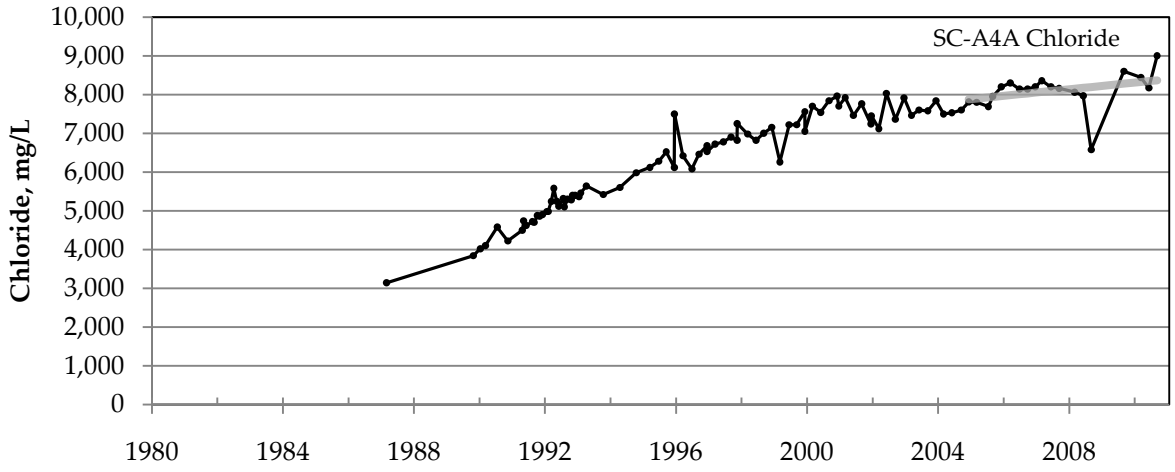

SC-A3B Total Dissolved Solids
TDS, mg/L
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1980
1984
1988
1992
1996
2000
2004
2008

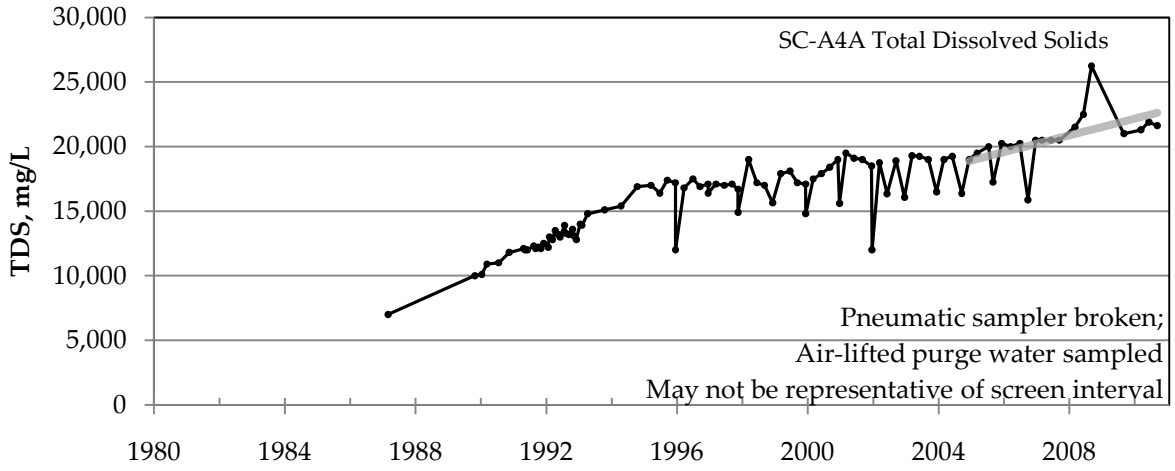

SC-A3B Groundwater Elevation
Groundwater Elevation, ft MSL
10
8
6
4
2
0
-2
-4
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

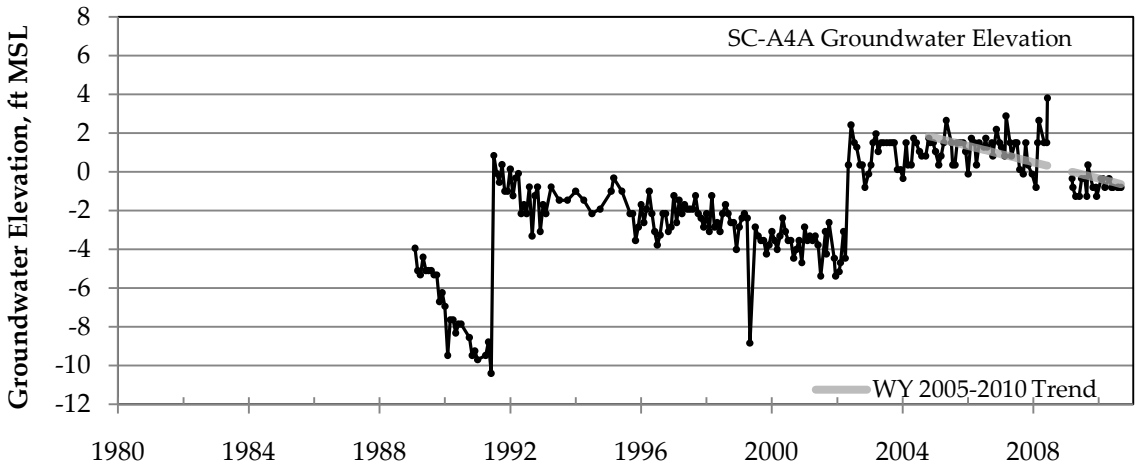

SC-A3C Chloride
Chloride, mg/L
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

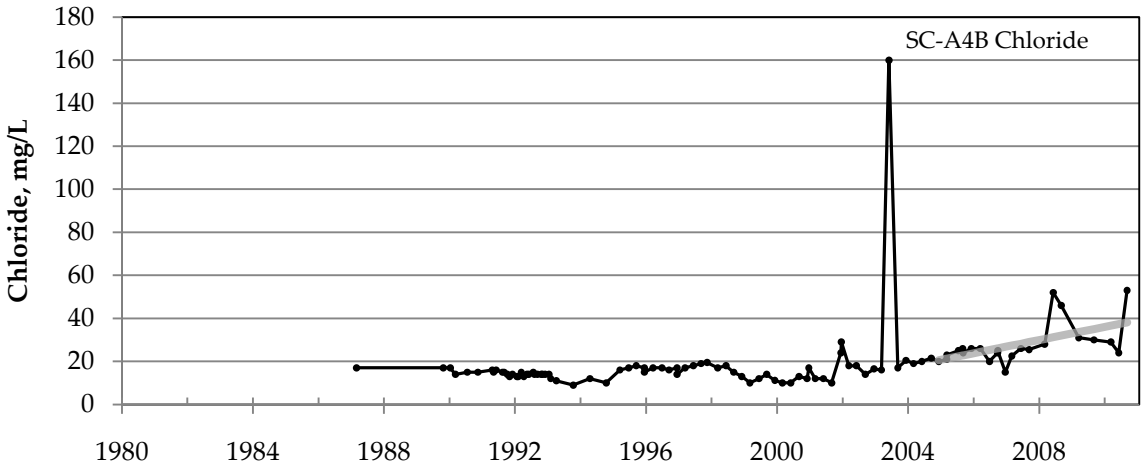

SC-A3C Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
Purge pump broken but sampler within
screen so samples considered representative
1980
1984
1988
1992
1996
2000
2004
2008

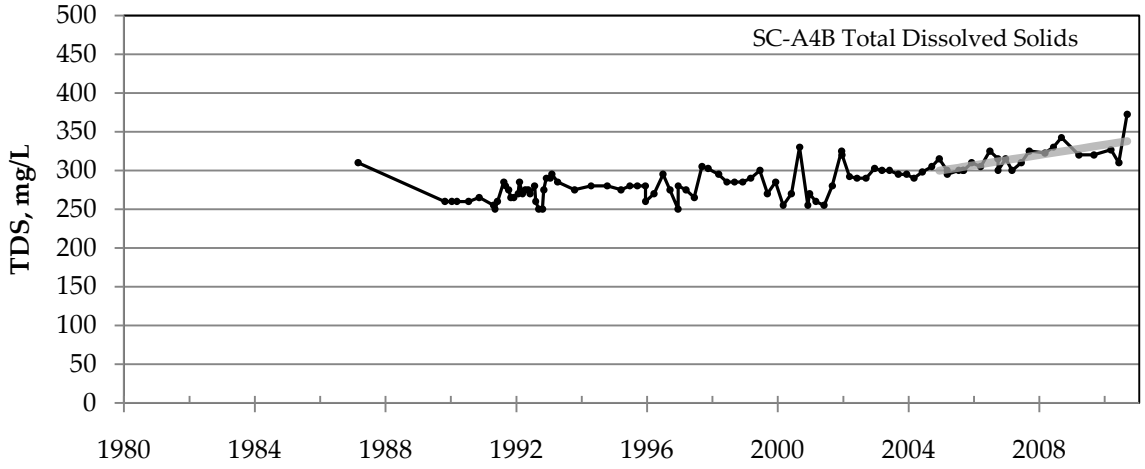

SC-A3C Groundwater Elevation
Groundwater Elevation, ft MSL
10
8
6
4
2
0
-2
-4
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

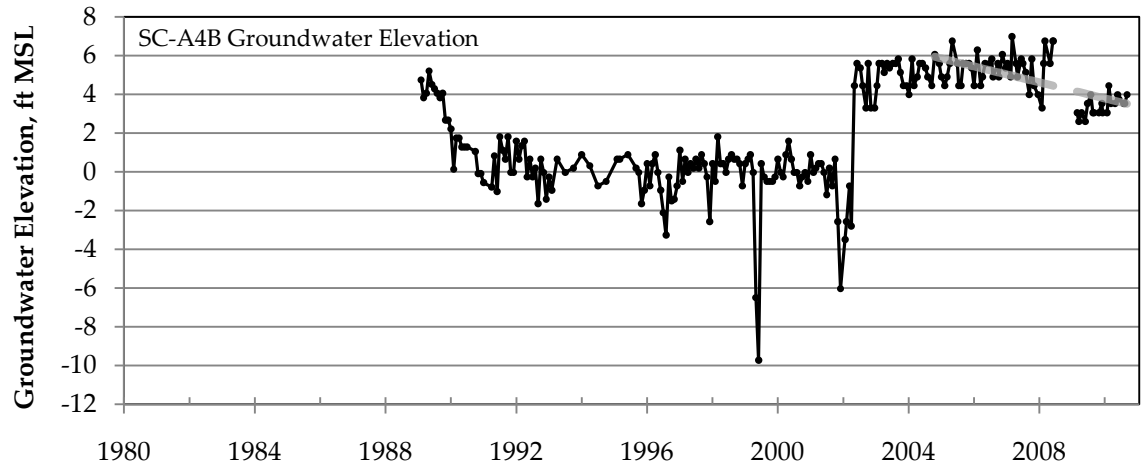

SC-A4A Chloride
Chloride, mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1984
1988
1992
1996
2000
2004
2008

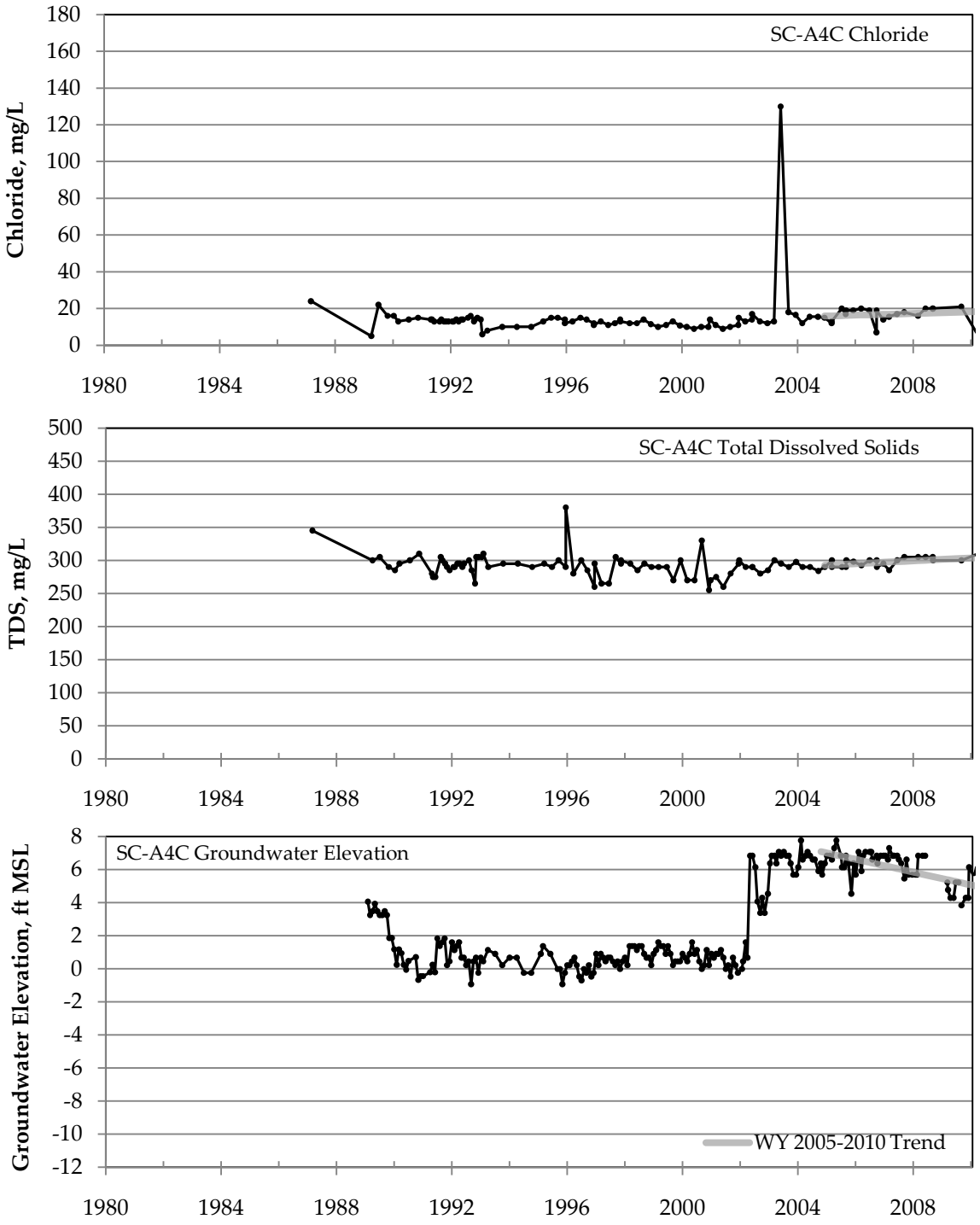

SC-A4A Total Dissolved Solids
TDS, mg/L
30,000
25,000
20,000
15,000
10,000
5,000
0
Pneumatic sampler broken;
Air-lifted purge water sampled
May not be representative of screen interval
1980
1984
1988
1992
1996
2000
2004
2008

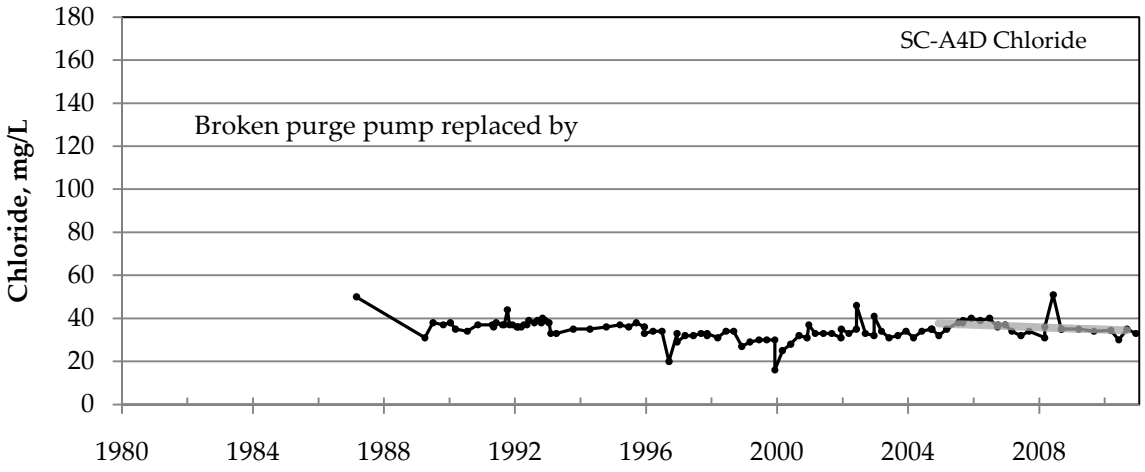

SC-A4A Groundwater Elevation
Groundwater Elevation, ft MSL
8
6
4
2
0
-2
-4
-6
-8
-10
-12
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

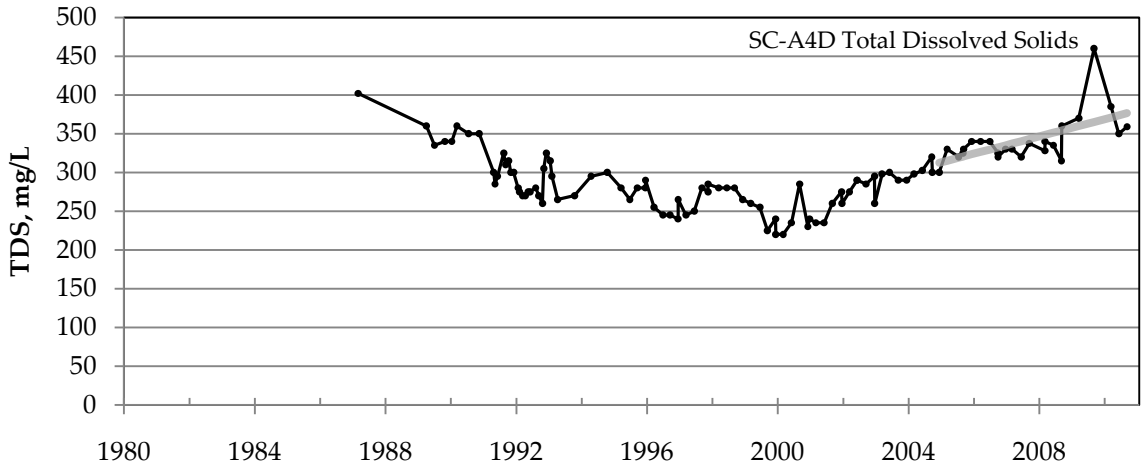

SC-A4B Chloride
Chloride, mg/L
180
160
140
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

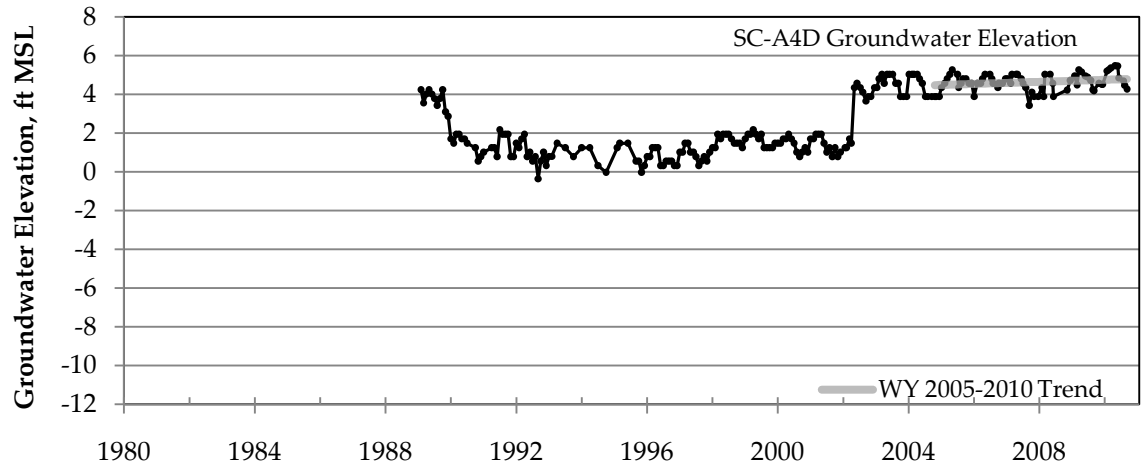

SC-A4B Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

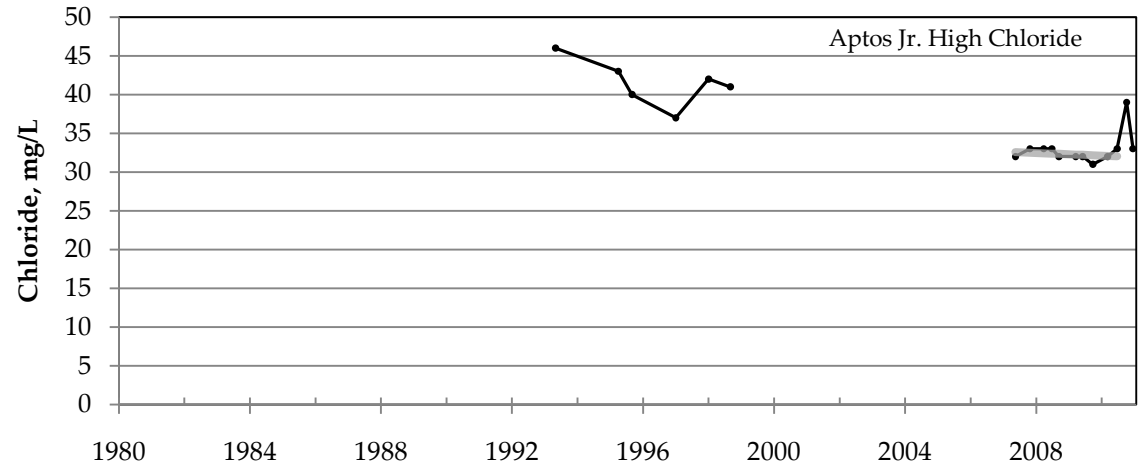

SC-A4B Groundwater Elevation
Groundwater Elevation, ft MSL
8
6
4
2
0
-2
-4
-6
-8
-10
-12
1980
1984
1988
1992
1996
2000
2004
2008

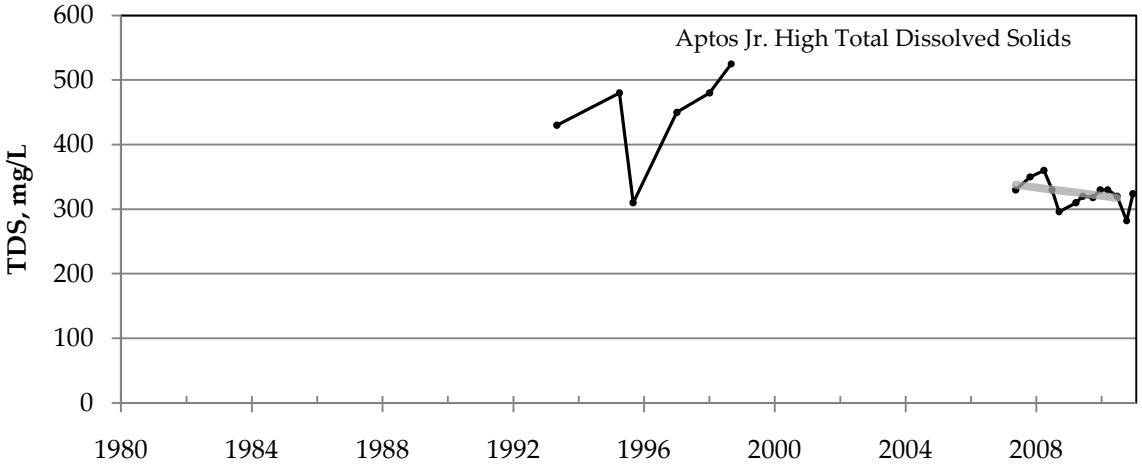

SC-A4C Chloride
Chloride, mg/L
180
160
140
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008
SC-A4C Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
SC-A4C Groundwater Elevation
Groundwater Elevation, ft MSL
8
6
4
2
0
-2
-4
-6
-8
-10
-12
WY 2005-2010 Trend

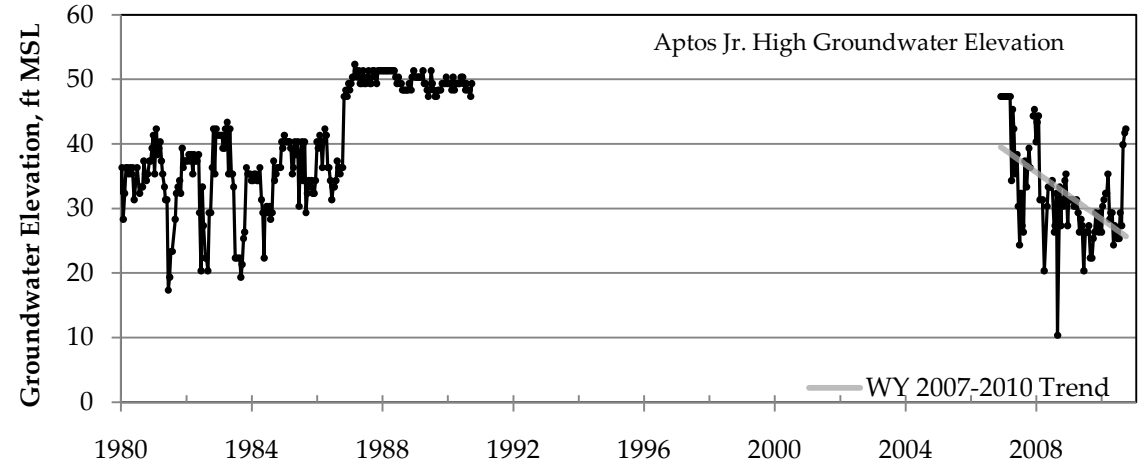

SC-A4D Chloride
Broken purge pump replaced by
Chloride, mg/L
180
160
140
120
100
80
60
40
20
0
1980
1984
1988
1992
1996
2000
2004
2008

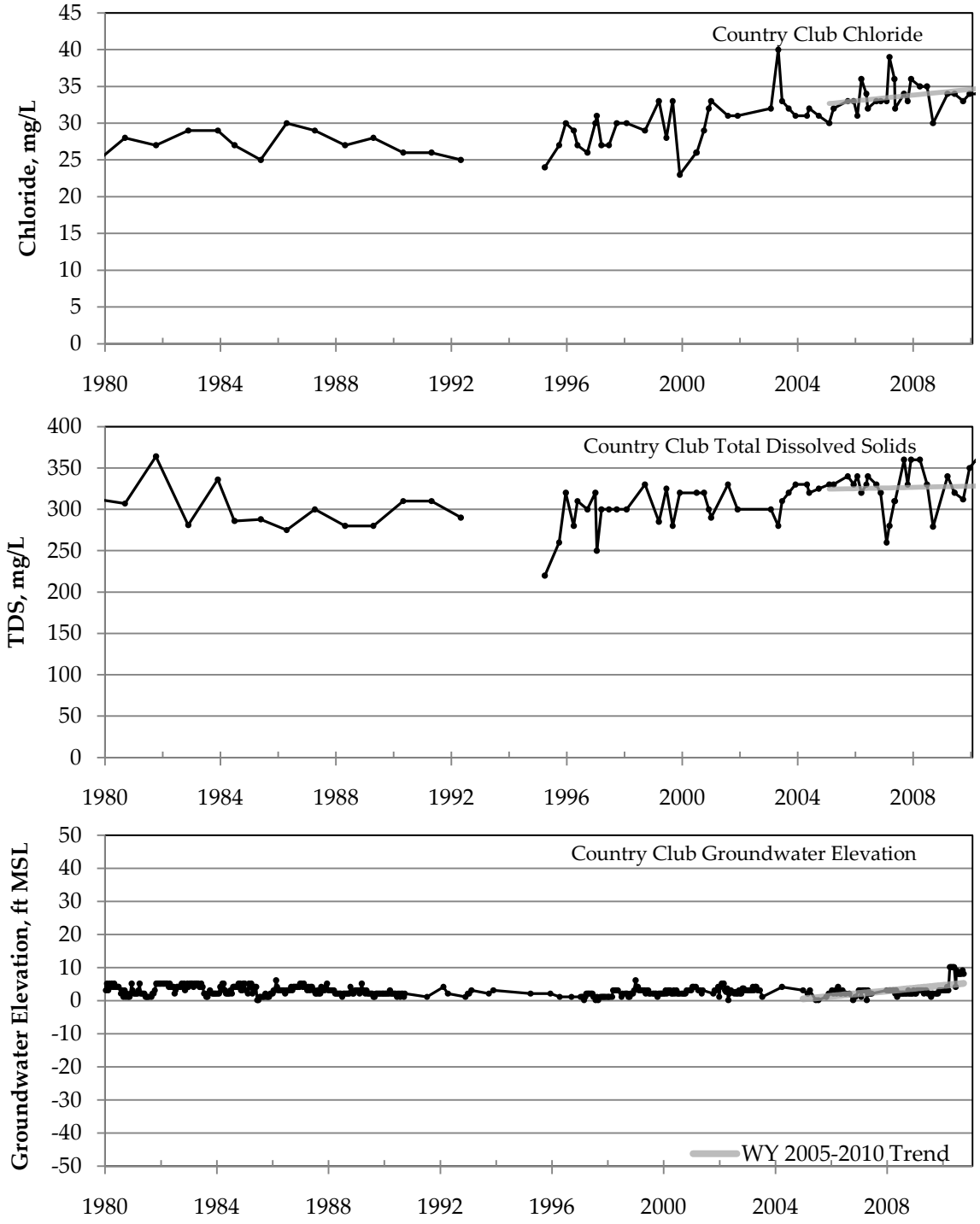

SC-A4D Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

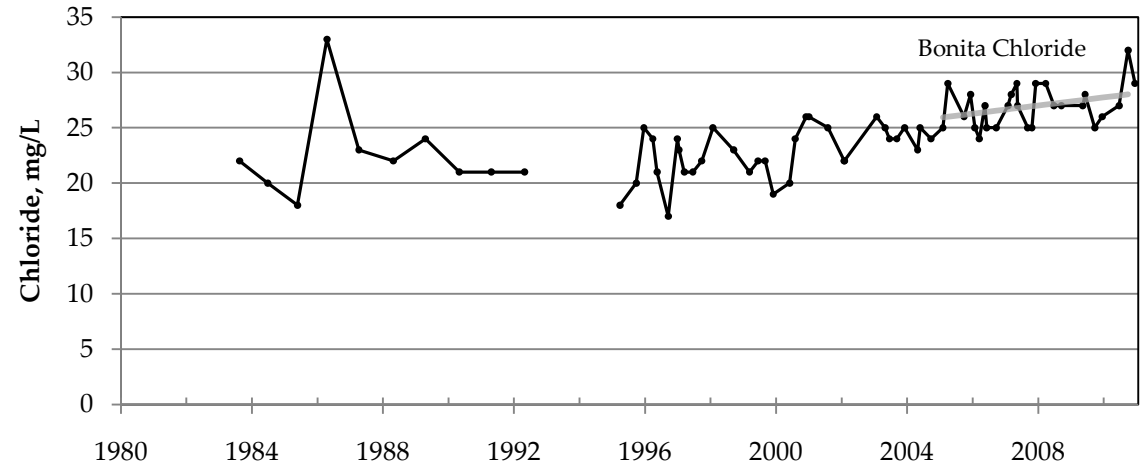

SC-A4D Groundwater Elevation
Groundwater Elevation, ft MSL
8
6
4
2
0
-2
-4
-6
-8
-10
-12
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

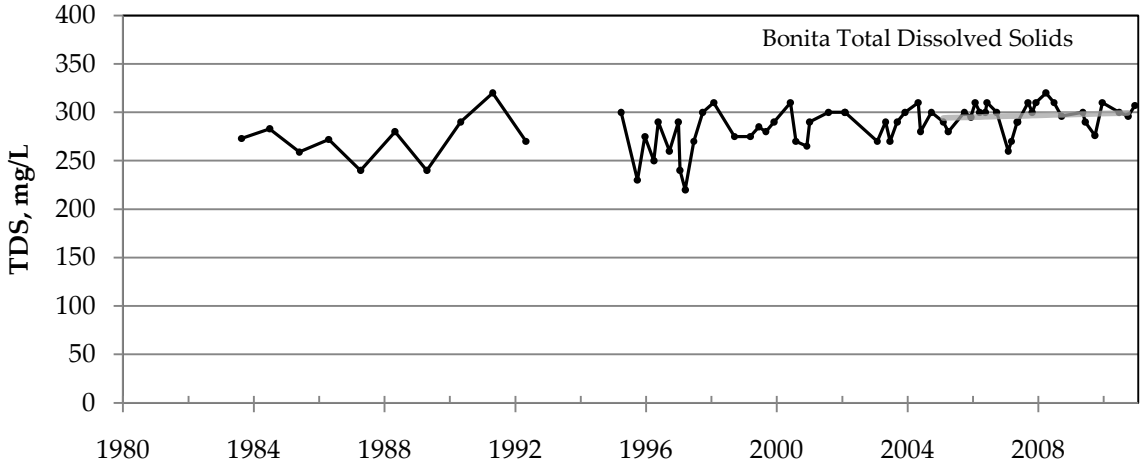

Aptos Jr. High Chloride
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

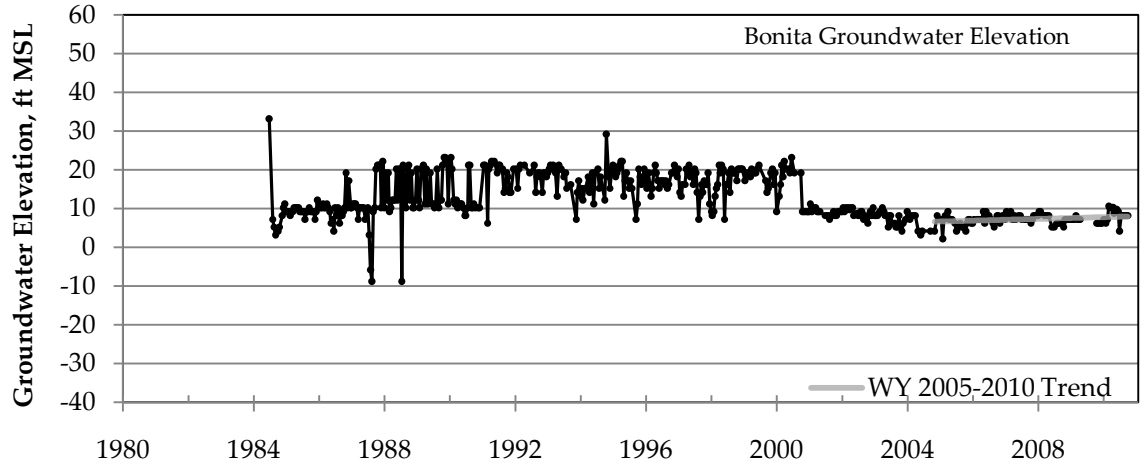

Aptos Jr. High Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

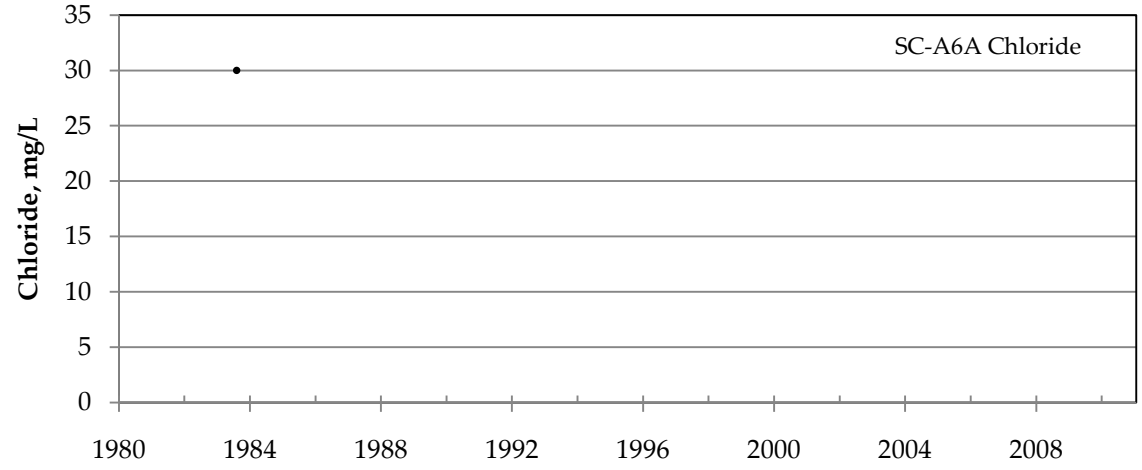

Aptos Jr. High Groundwater Elevation
Groundwater Elevation, ft MSL
60
50
40
30
20
10
0
WY 2007-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

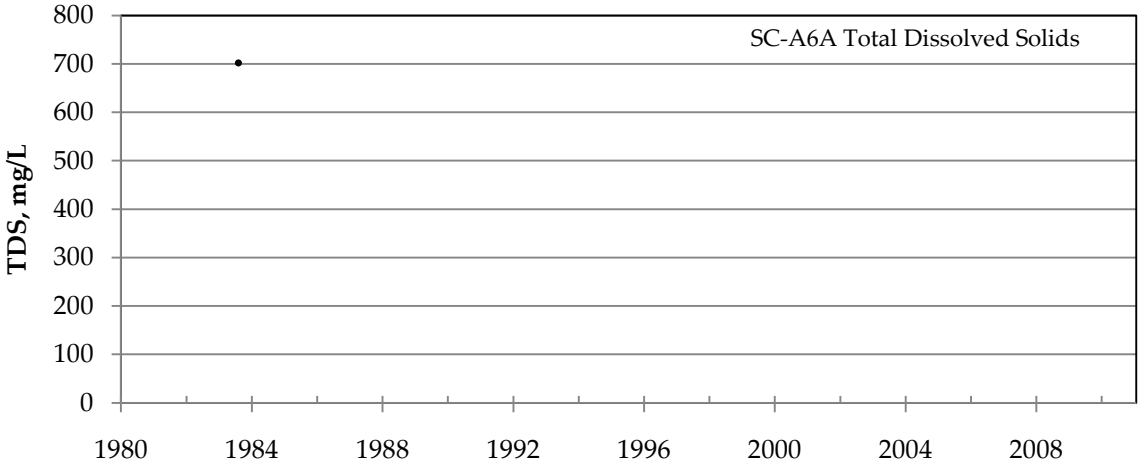

Country Club Chloride
Chloride, mg/L
45
40
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008
Country Club Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
Country Club Groundwater Elevation
Groundwater Elevation, ft MSL
50
40
30
20
10
0
-10
-20
-30
-40
-50
WY 2005-2010 Trend

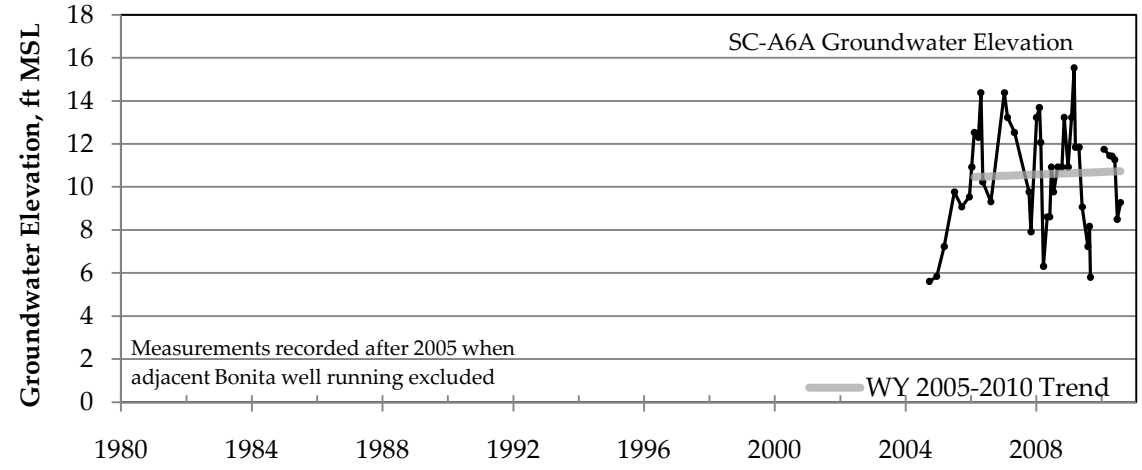

Bonita Chloride
Chloride, mg/L
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

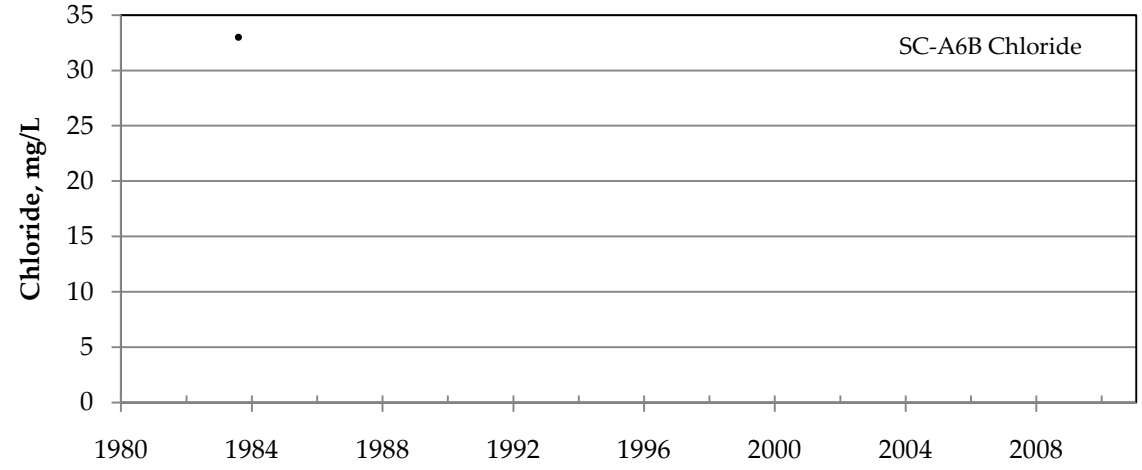

Bonita Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

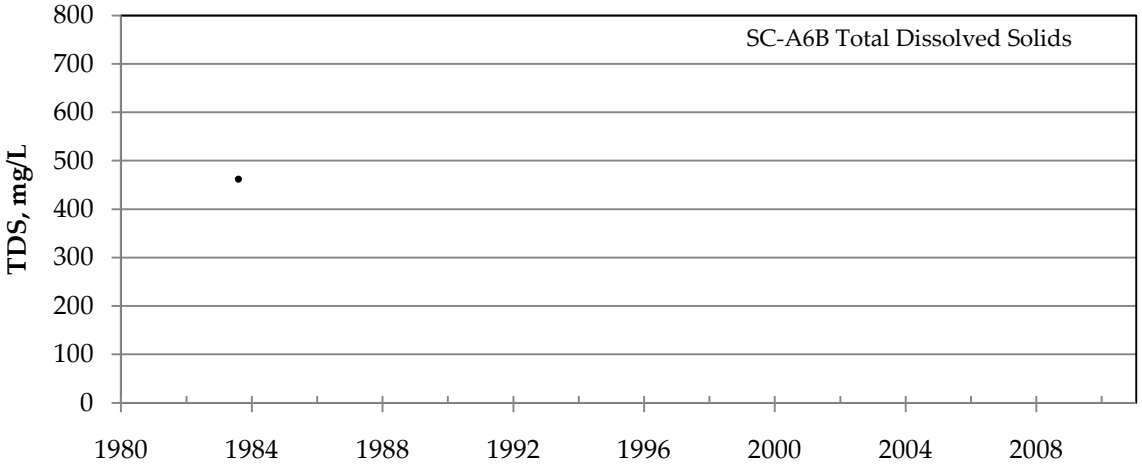

Bonita Groundwater Elevation
Groundwater Elevation, ft MSL
60
50
40
30
20
10
0
-10
-20
-30
-40
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

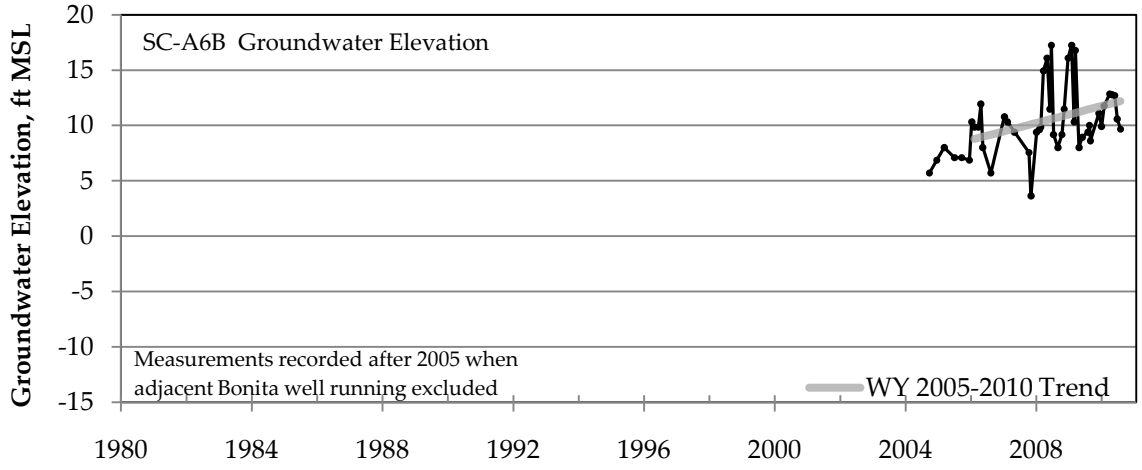

SC-A6A Chloride
Chloride, mg/L
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

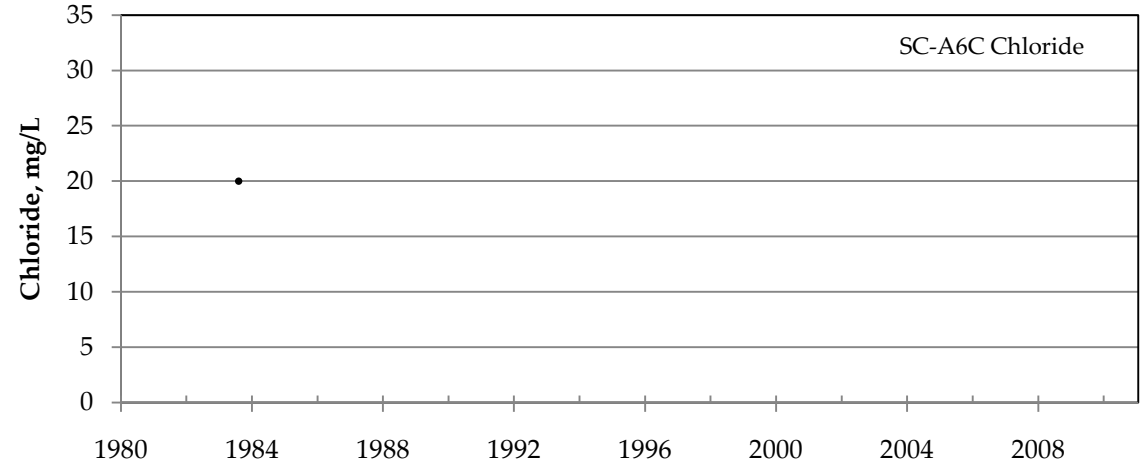

SC-A6A Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

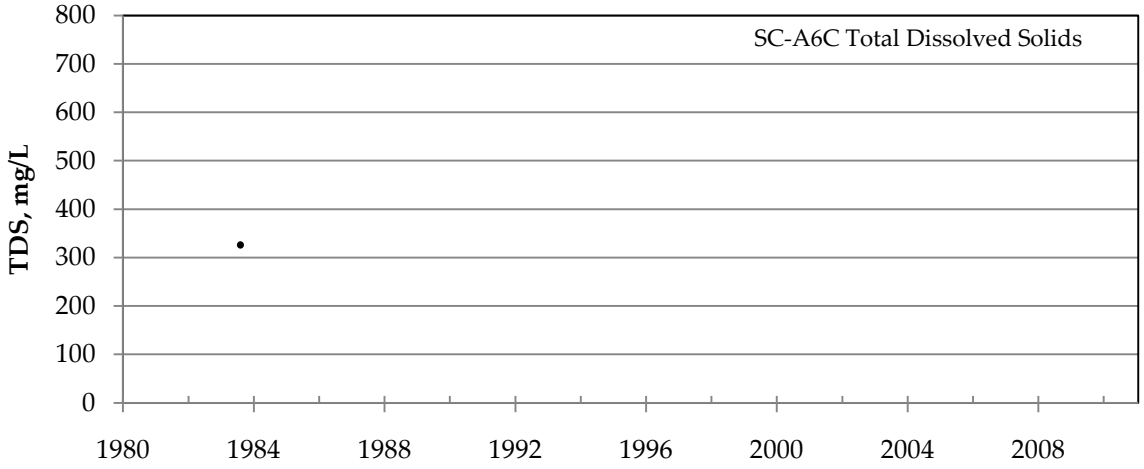

SC-A6A Groundwater Elevation
Groundwater Elevation, ft MSL
18
16
14
12
10
8
6
4
2
0
Measurements recorded after 2005 when adjacent Bonita well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

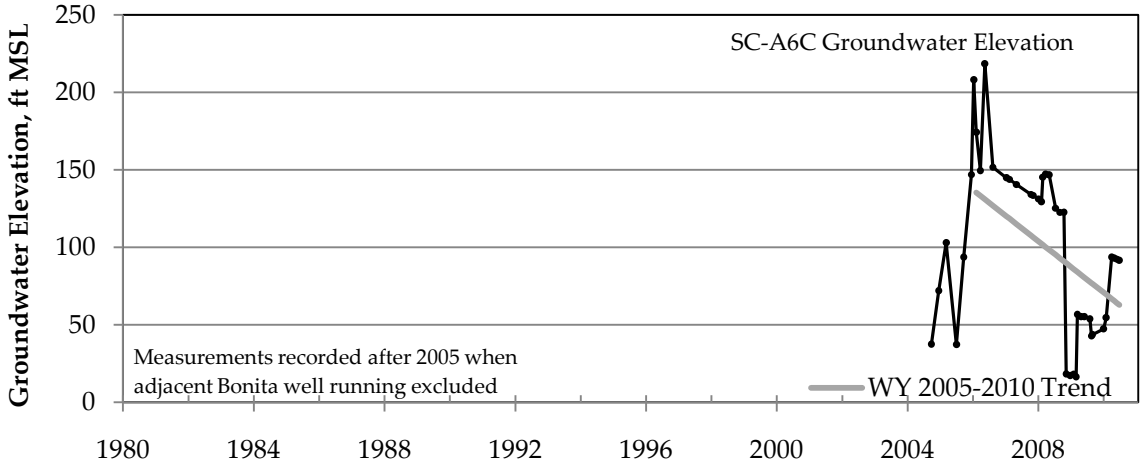

SC-A6B Chloride
Chloride, mg/L
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

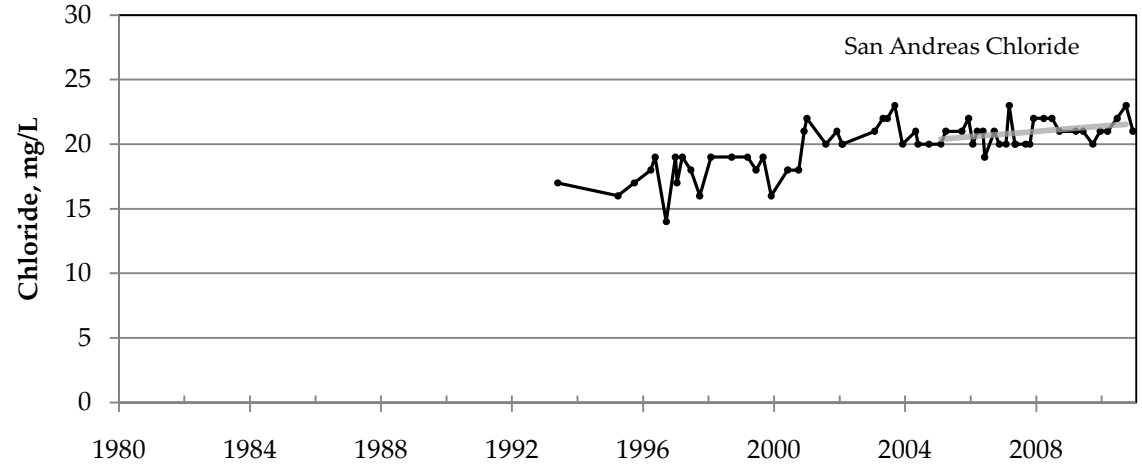

SC-A6B Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

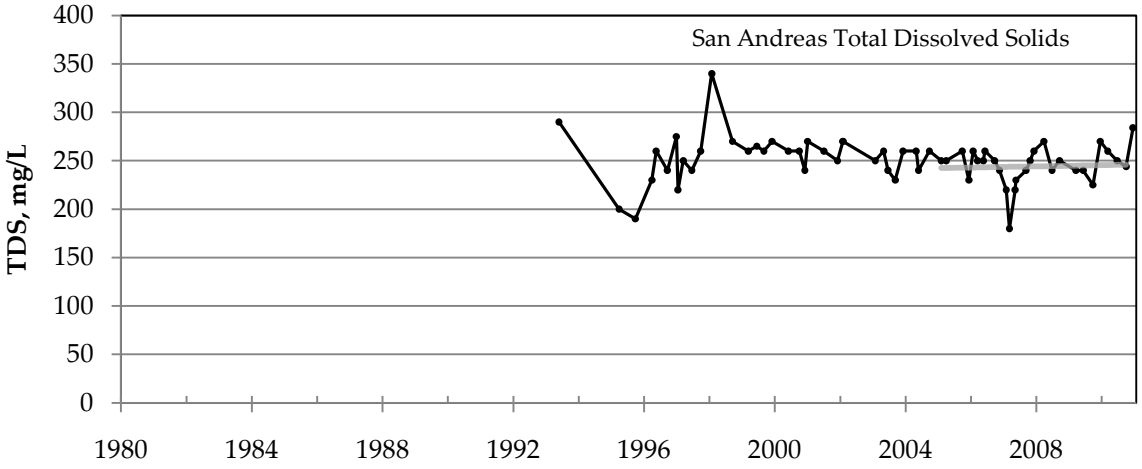

SC-A6B Groundwater Elevation
Groundwater Elevation, ft MSL
20
15
10
5
0
-5
-10
-15
Measurements recorded after 2005 when adjacent Bonita well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

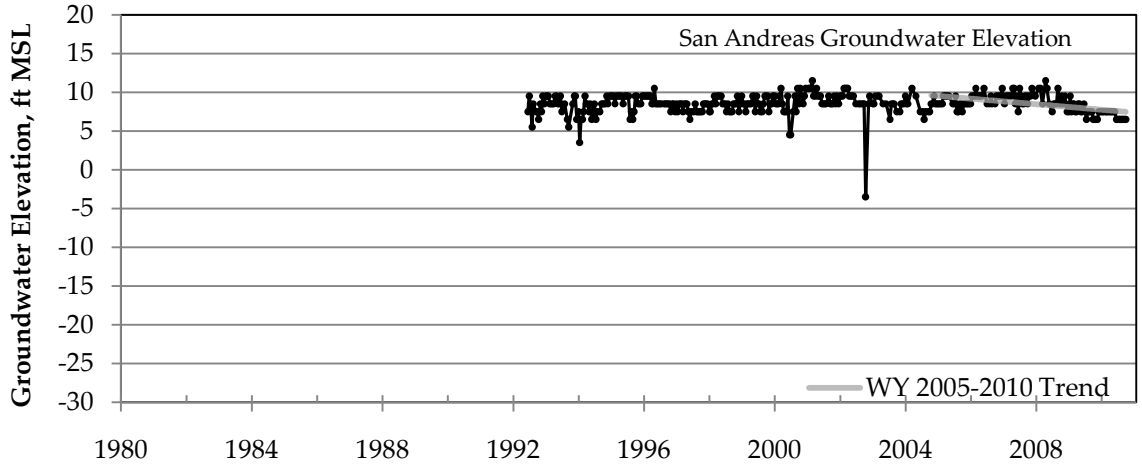

SC-A6C Chloride
Chloride, mg/L
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

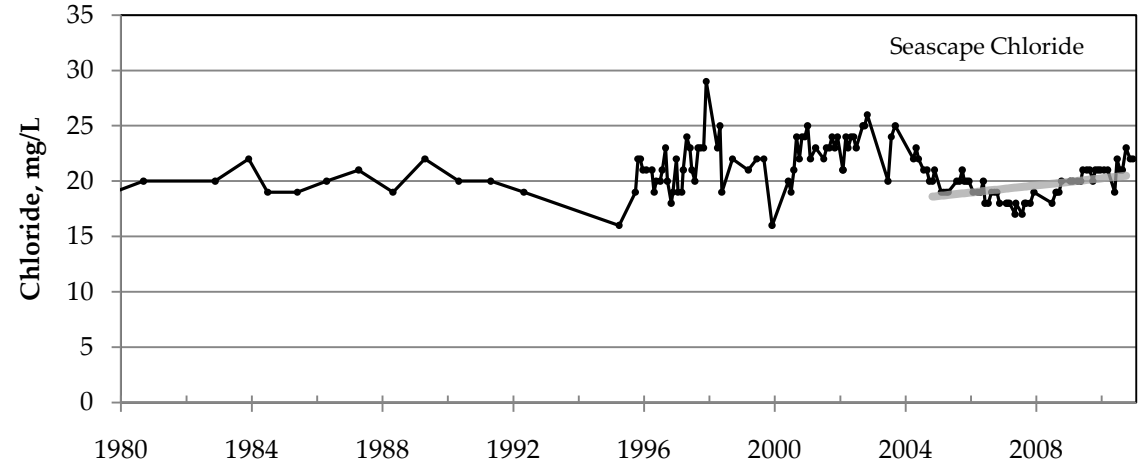

SC-A6C Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

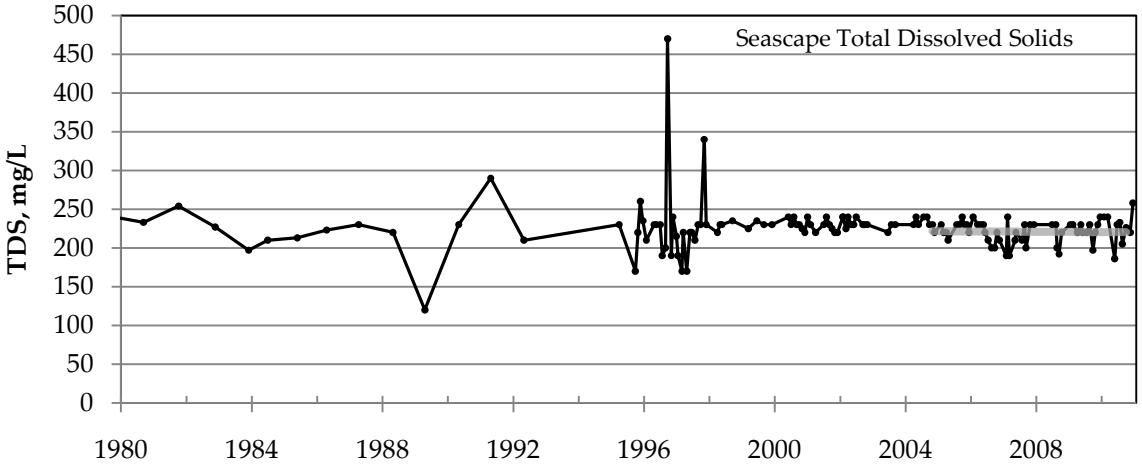

SC-A6C Groundwater Elevation
Groundwater Elevation, ft MSL
250
200
150
100
50
0
Measurements recorded after 2005 when adjacent Bonita well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

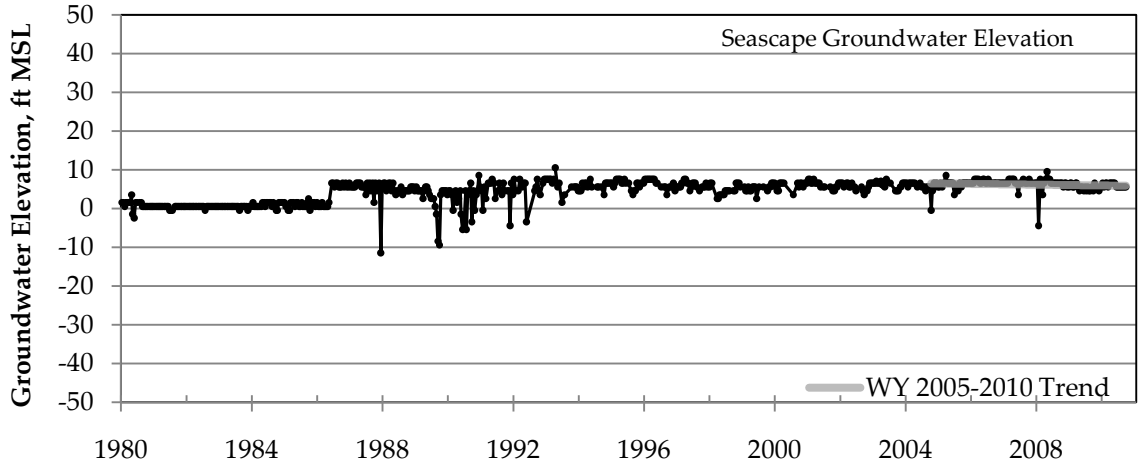

San Andreas Chloride
Chloride, mg/L
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

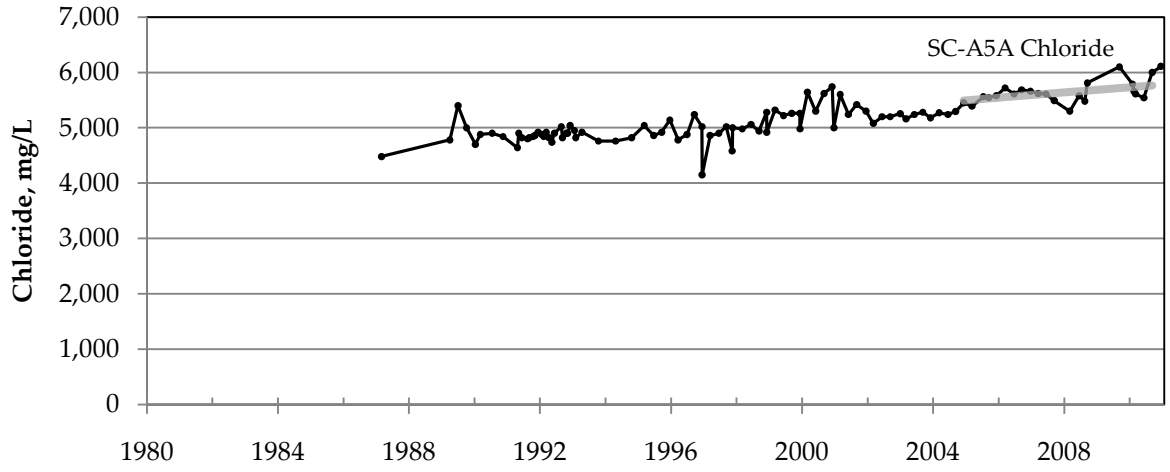

San Andreas Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

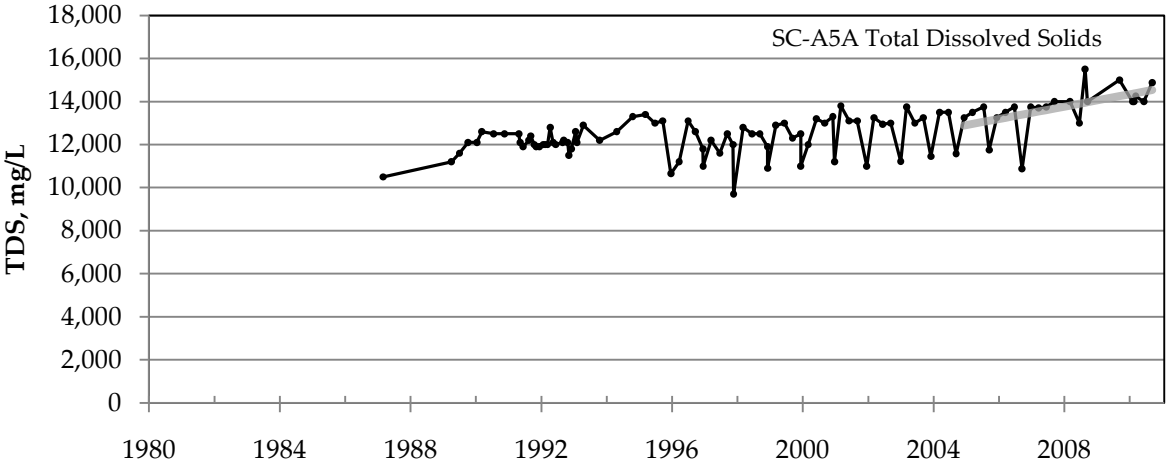

San Andreas Groundwater Elevation
Groundwater Elevation, ft MSL
20
15
10
5
0
-5
-10
-15
-20
-25
-30
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

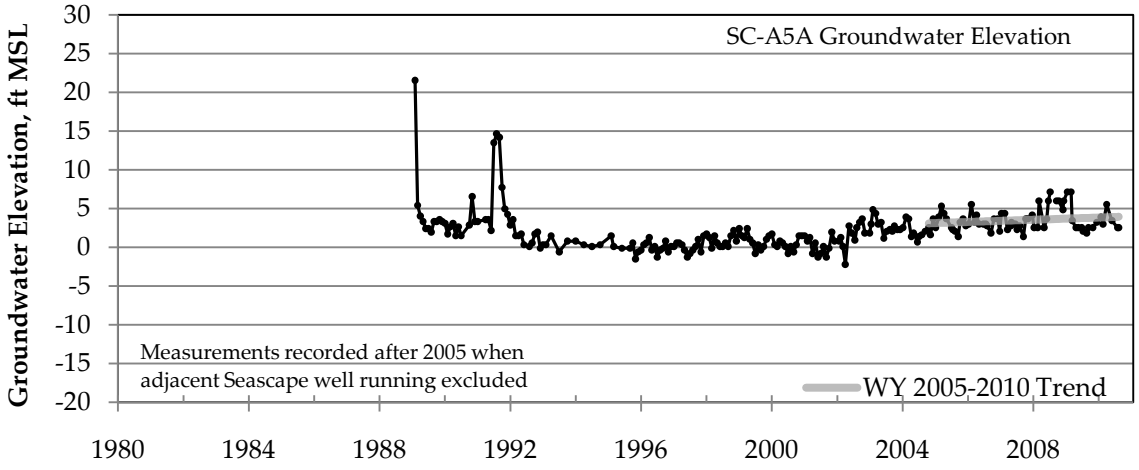

Seascape Chloride
Chloride, mg/L
35
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

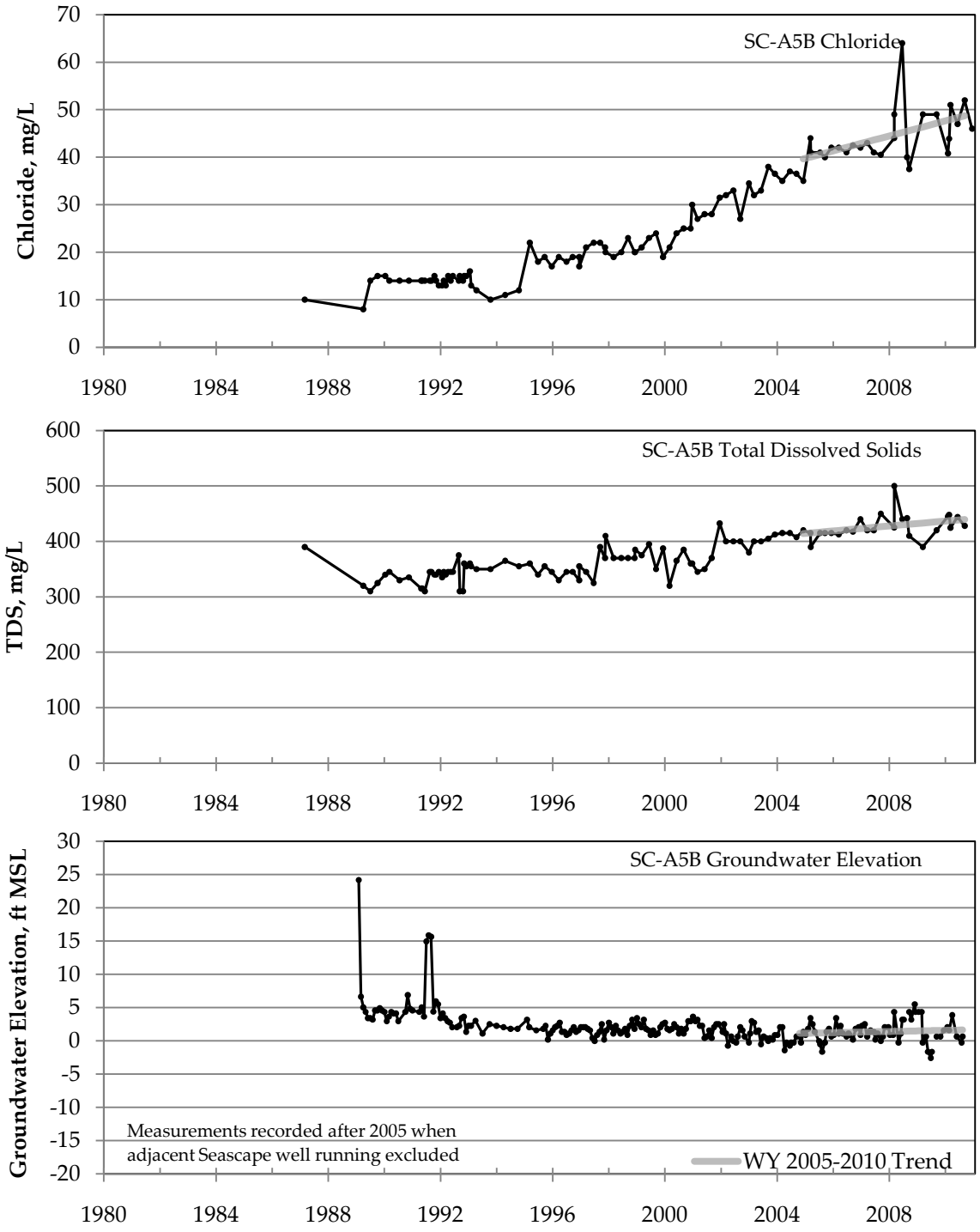

Seascape Total Dissolved Solids
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

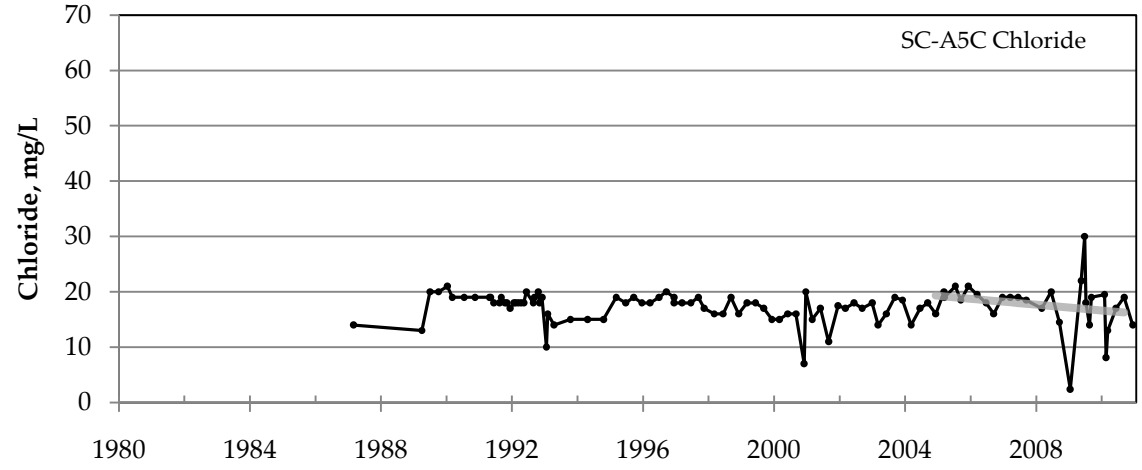

Seascape Groundwater Elevation
Groundwater Elevation, ft MSL
50
40
30
20
10
0
-10
-20
-30
-40
-50
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

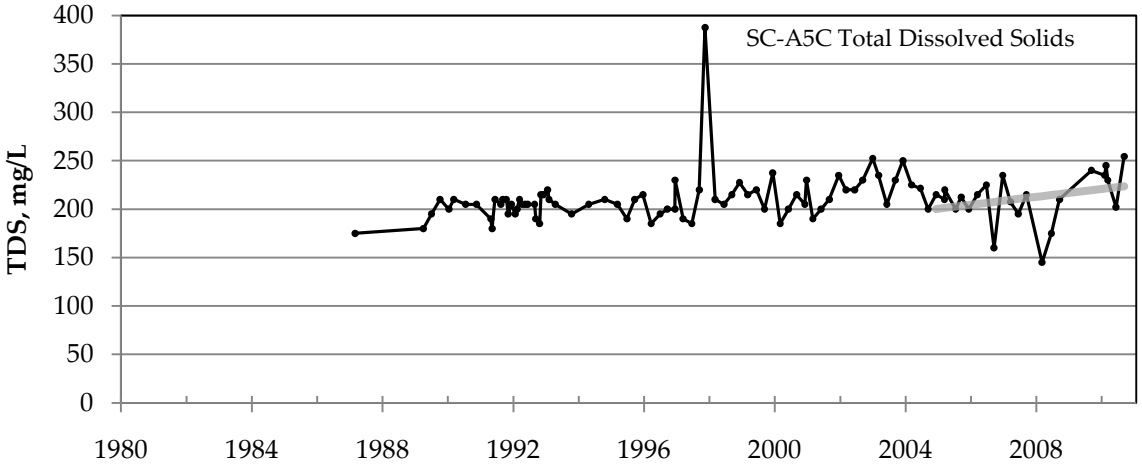

SC-A5A Chloride
Chloride, mg/L
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1984
1988
1992
1996
2000
2004
2008

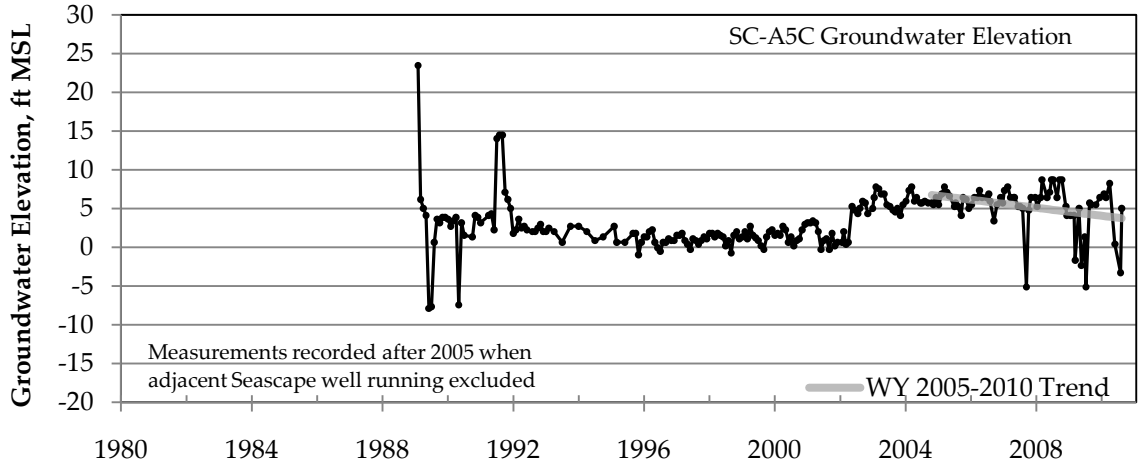

SC-A5A Total Dissolved Solids
TDS, mg/L
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1980
1984
1988
1992
1996
2000
2004
2008

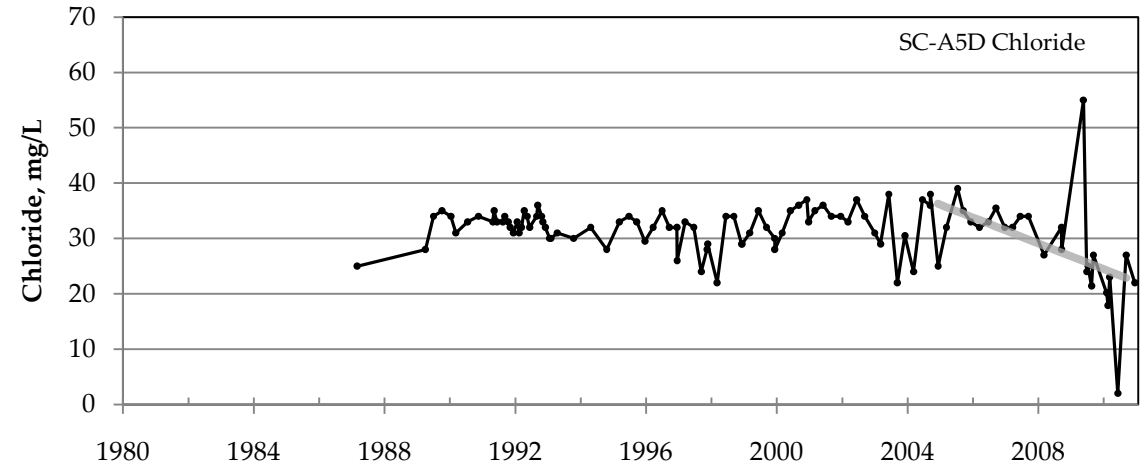

SC-A5A Groundwater Elevation
Groundwater Elevation, ft MSL
30
25
20
15
10
5
0
-5
-10
-15
-20
Measurements recorded after 2005 when adjacent Seascape well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

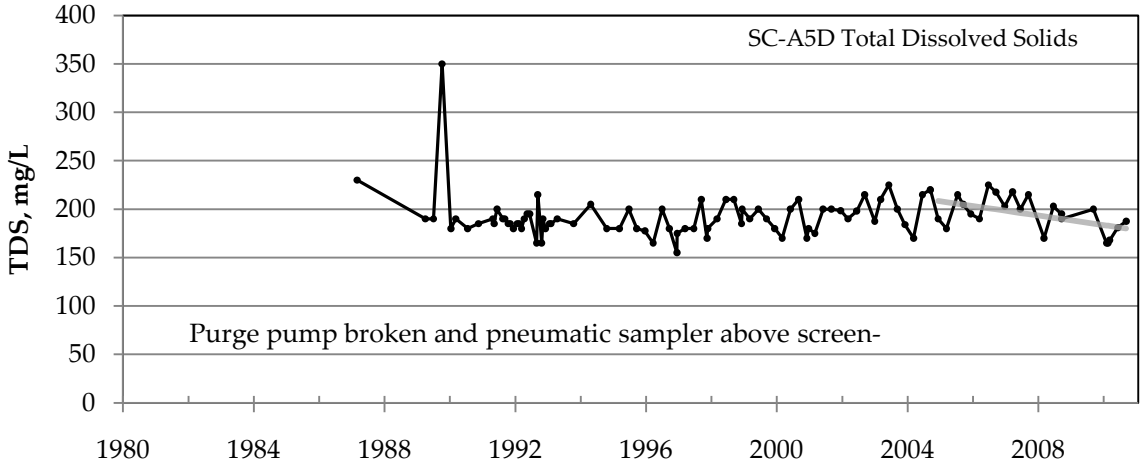

SC-A5B Chloride
Chloride, mg/L
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008
SC-A5B Total Dissolved Solids
TDS, mg/L
600
500
400
300
200
100
0
SC-A5B Groundwater Elevation
Groundwater Elevation, ft MSL
30
25
20
15
10
5
0
-5
-10
-15
-20
Measurements recorded after 2005 when adjacent Seascape well running excluded
WY 2005-2010 Trend

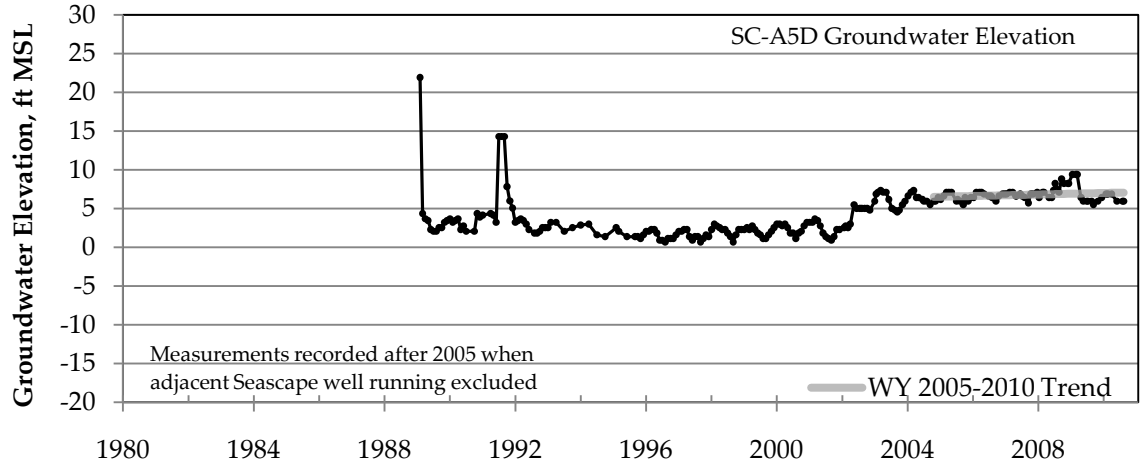

SC-A5C Chloride
Chloride, mg/L
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

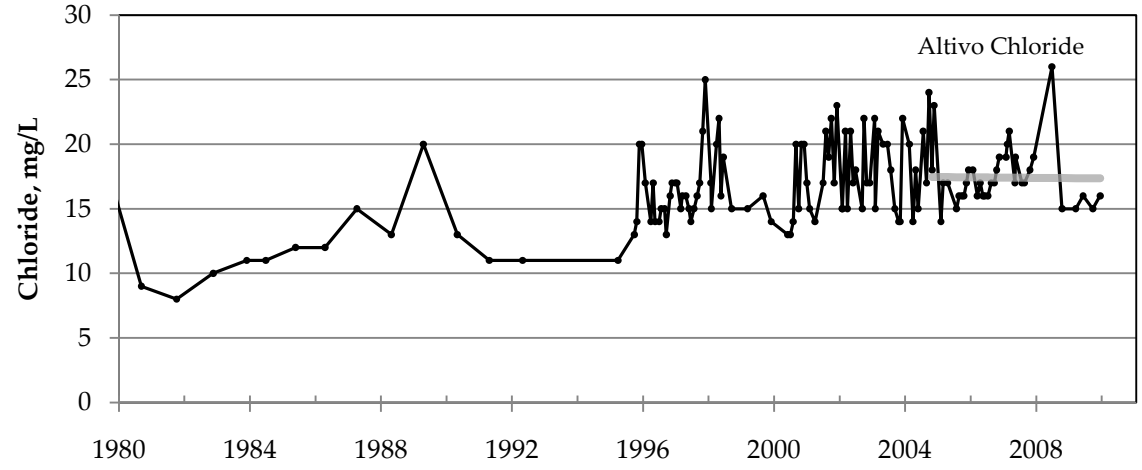

SC-A5C Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

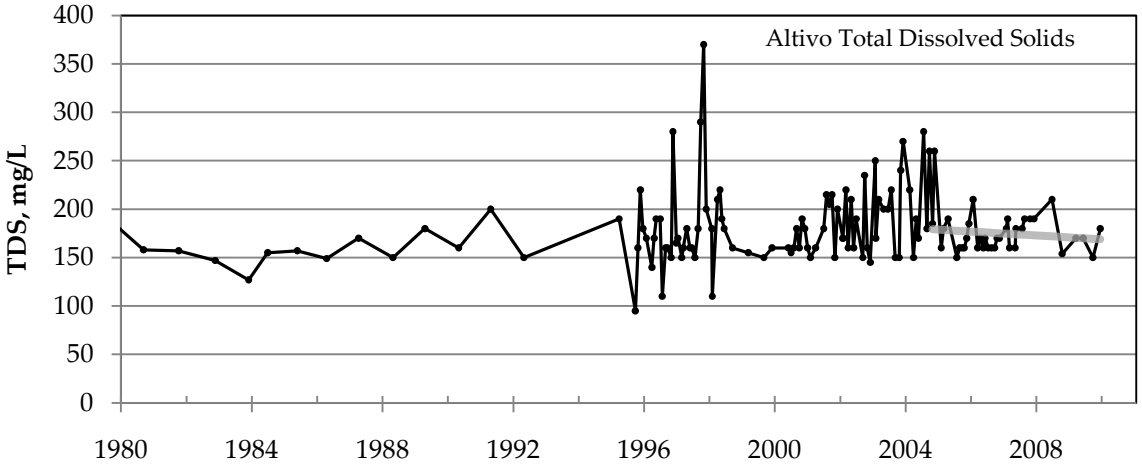

SC-A5C Groundwater Elevation
Groundwater Elevation, ft MSL
30
25
20
15
10
5
0
-5
-10
-15
-20
Measurements recorded after 2005 when adjacent Seascape well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

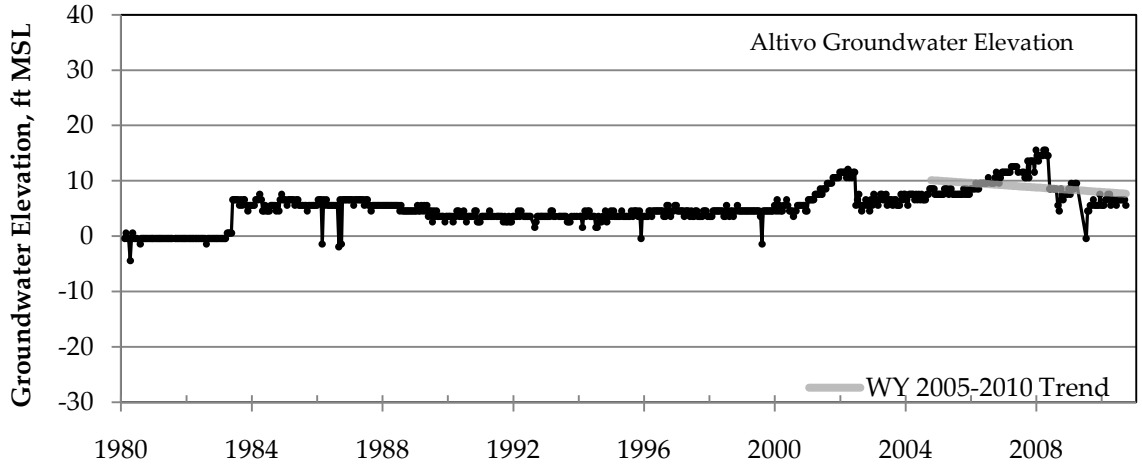

SC-A5D Chloride
Chloride, mg/L
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008

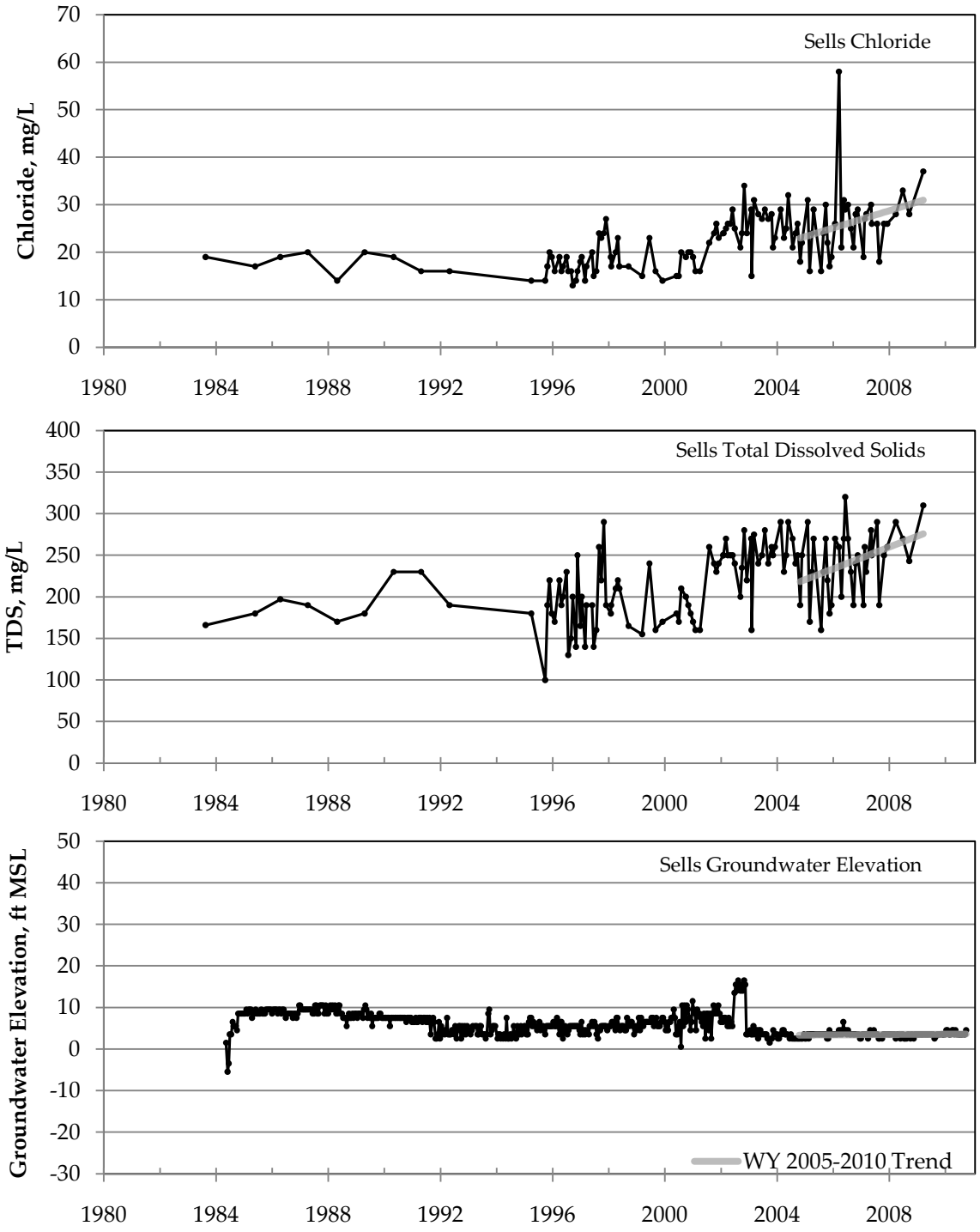

SC-A5D Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
Purge pump broken and pneumatic sampler above screen-
1980
1984
1988
1992
1996
2000
2004
2008

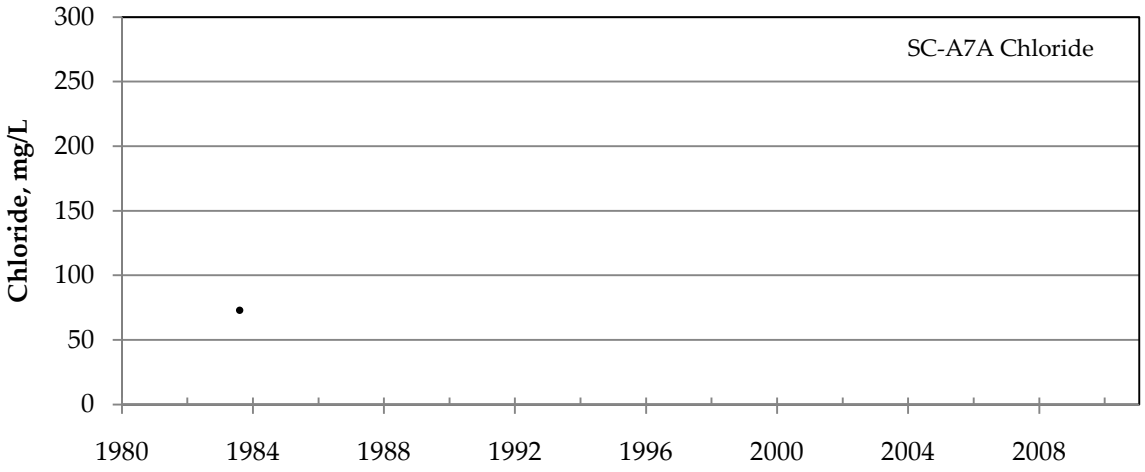

SC-A5D Groundwater Elevation
Groundwater Elevation, ft MSL
30
25
20
15
10
5
0
-5
-10
-15
-20
Measurements recorded after 2005 when
adjacent Seascape well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

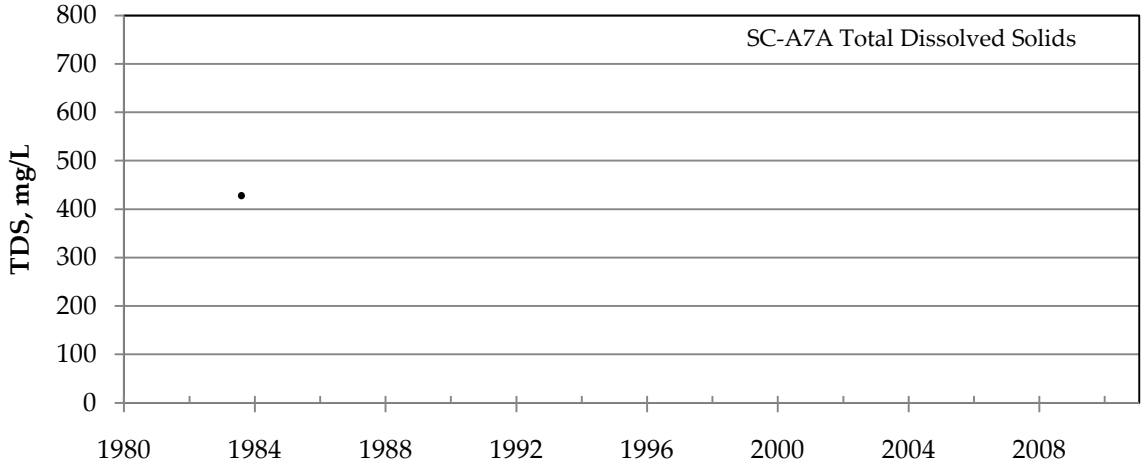

Altivo Chloride
Chloride, mg/L
30
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008

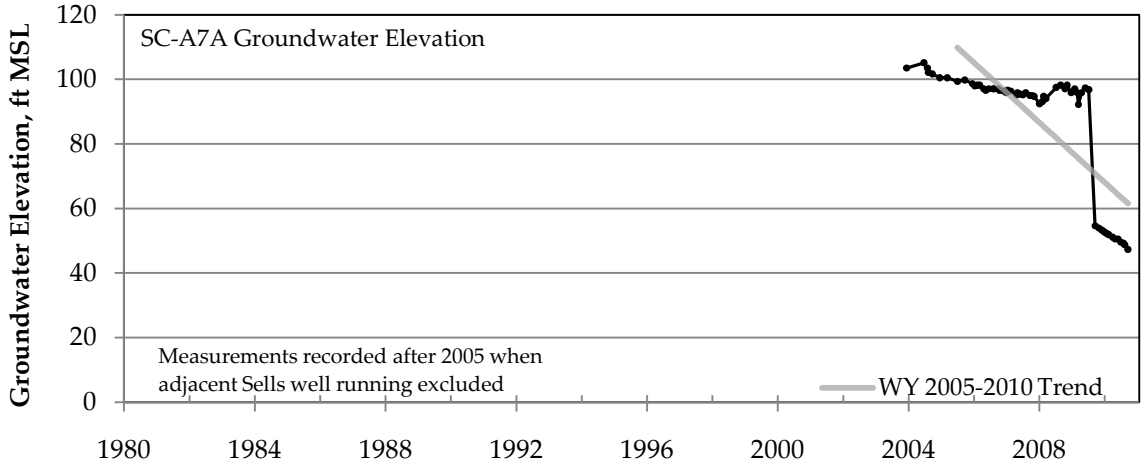

Altivo Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

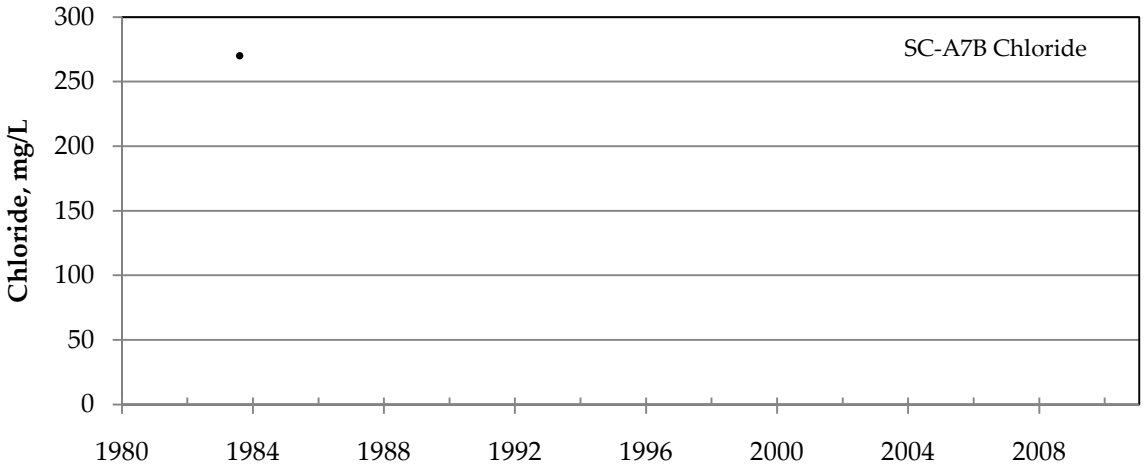

Altivo Groundwater Elevation
Groundwater Elevation, ft MSL
40
30
20
10
0
-10
-20
-30
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

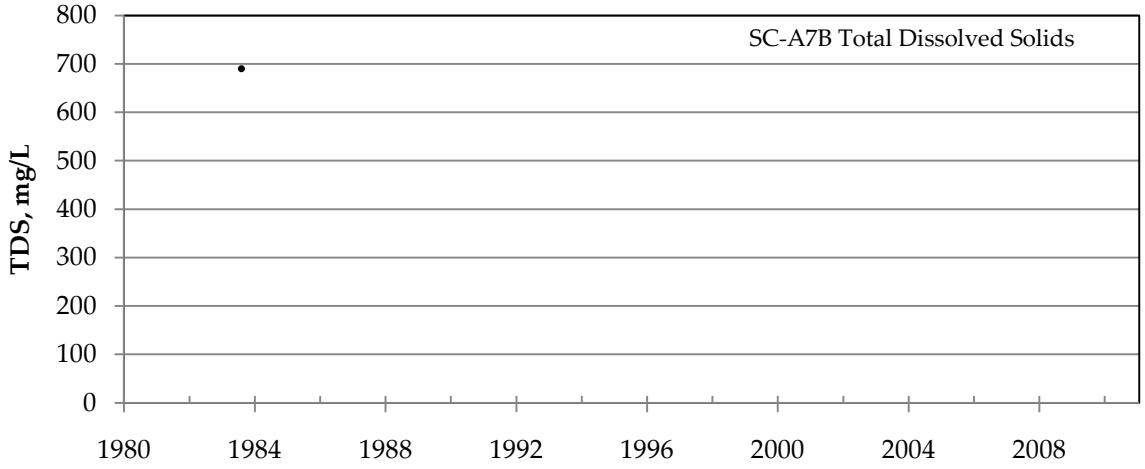

Sells Chloride
Chloride, mg/L
70
60
50
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008
Sells Total Dissolved Solids
TDS, mg/L
400
350
300
250
200
150
100
50
0
Sells Groundwater Elevation
Groundwater Elevation, ft MSL
50
40
30
20
10
0
-10
-20
-30
WY 2005-2010 Trend

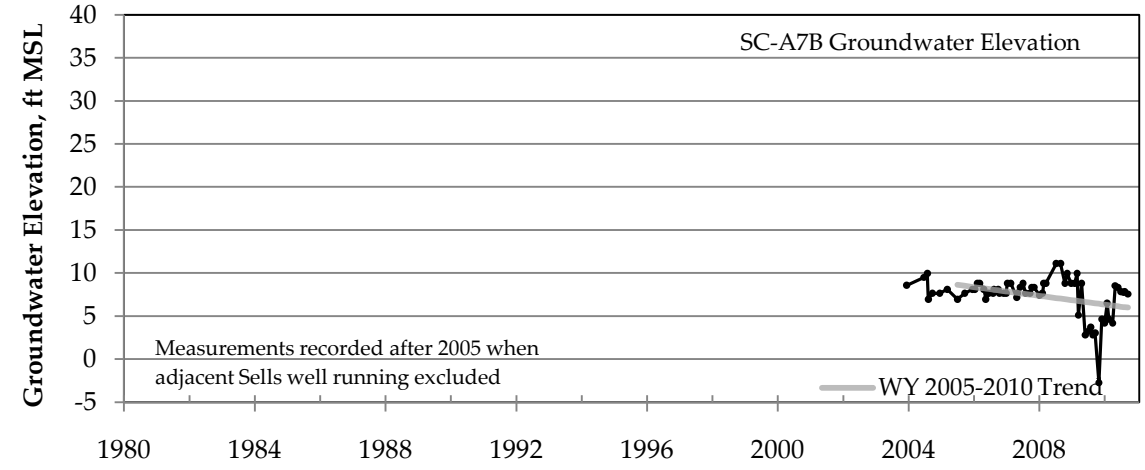

SC-A7A Chloride
Chloride, mg/L
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

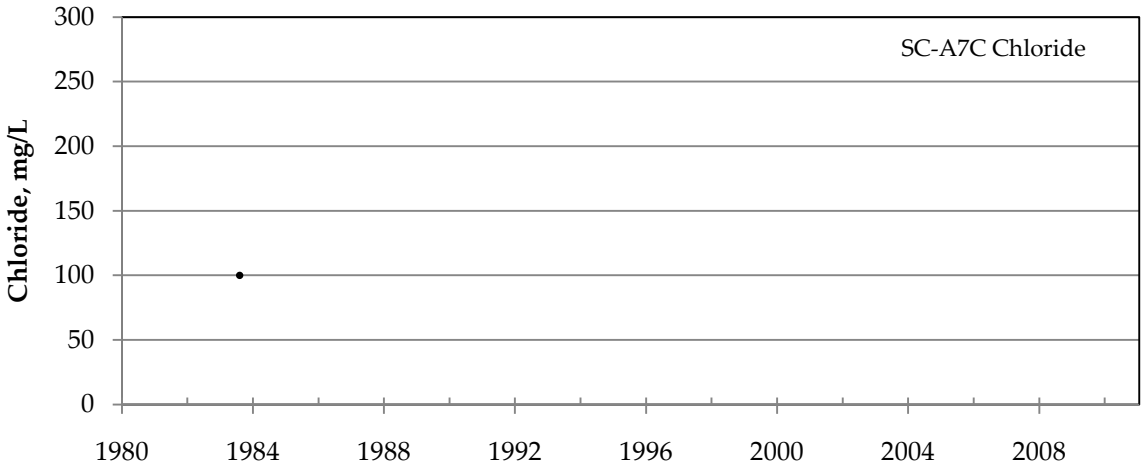

SC-A7A Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

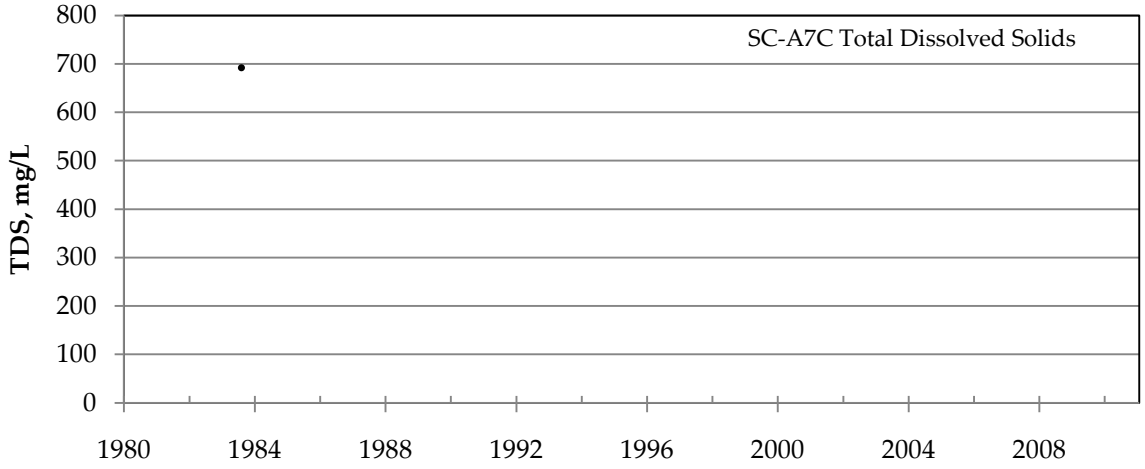

SC-A7A Groundwater Elevation
Groundwater Elevation, ft MSL
120
100
80
60
40
20
0
Measurements recorded after 2005 when adjacent Sells well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

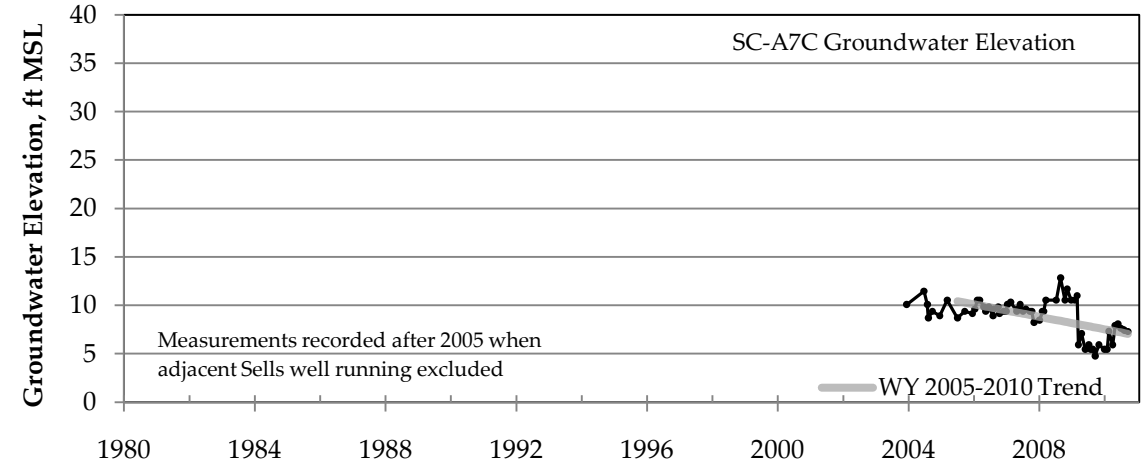

SC-A7B Chloride
Chloride, mg/L
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

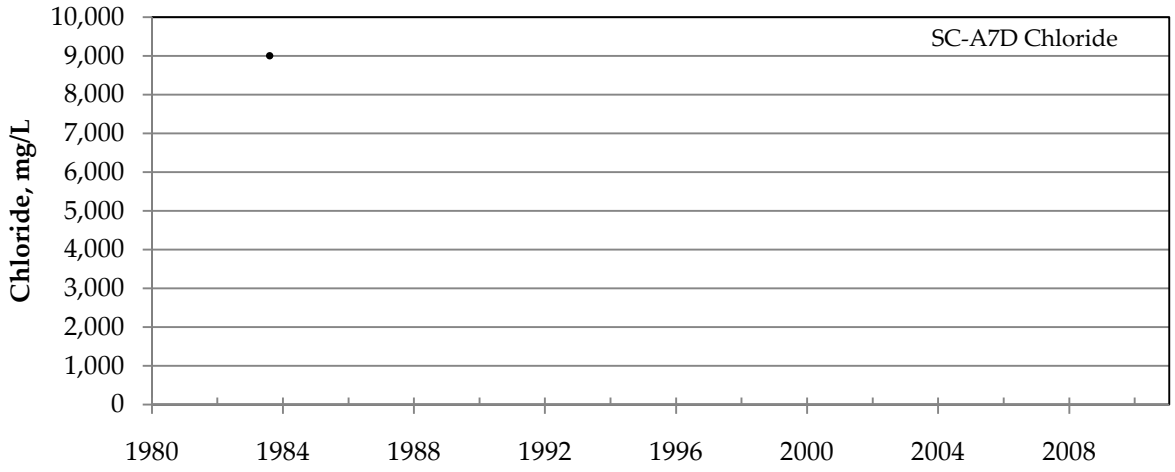

SC-A7B Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

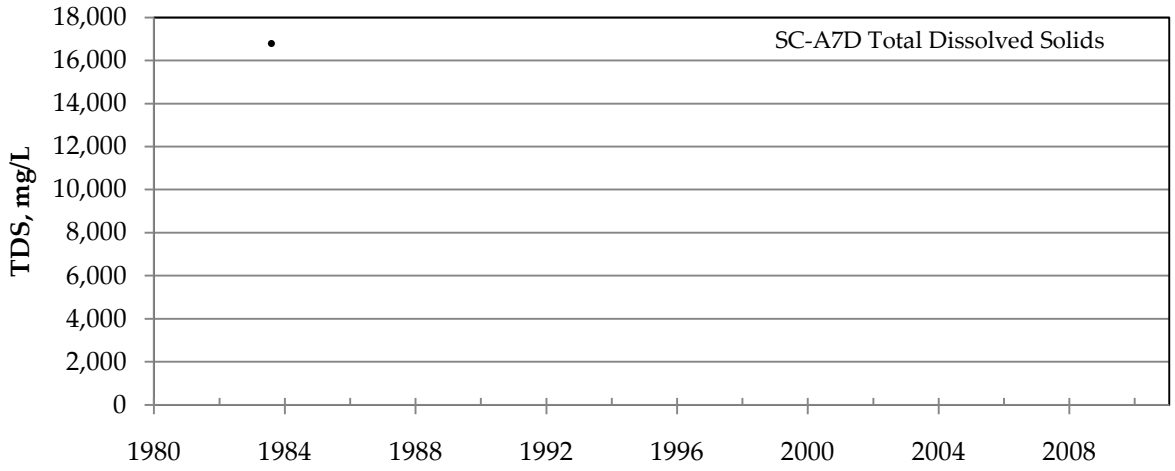

SC-A7B Groundwater Elevation
Groundwater Elevation, ft MSL
40
35
30
25
20
15
10
5
0
-5
Measurements recorded after 2005 when adjacent Sells well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

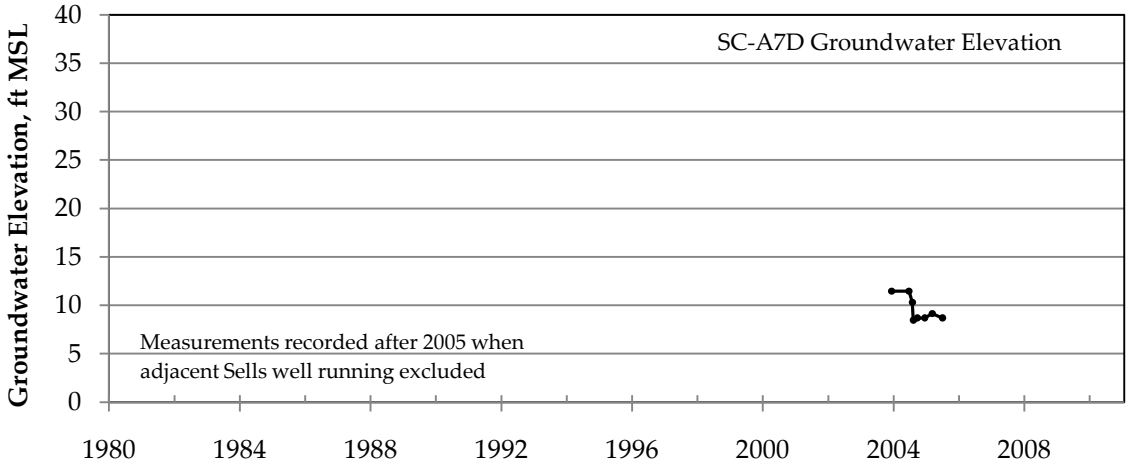

SC-A7C Chloride
Chloride, mg/L
300
250
200
150
100
50
0
1980
1984
1988
1992
1996
2000
2004
2008

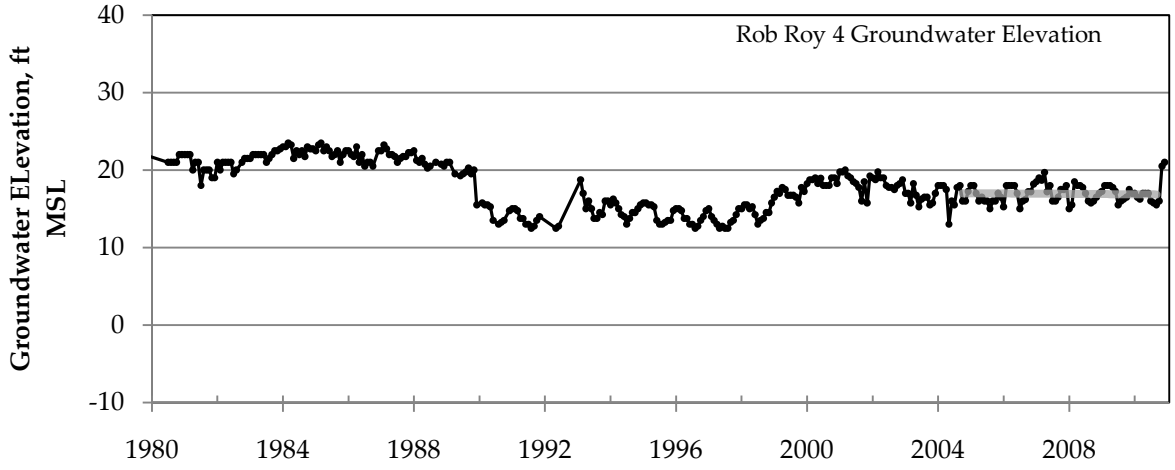

SC-A7C Total Dissolved Solids
TDS, mg/L
800
700
600
500
400
300
200
100
0
1980
1984
1988
1992
1996
2000
2004
2008

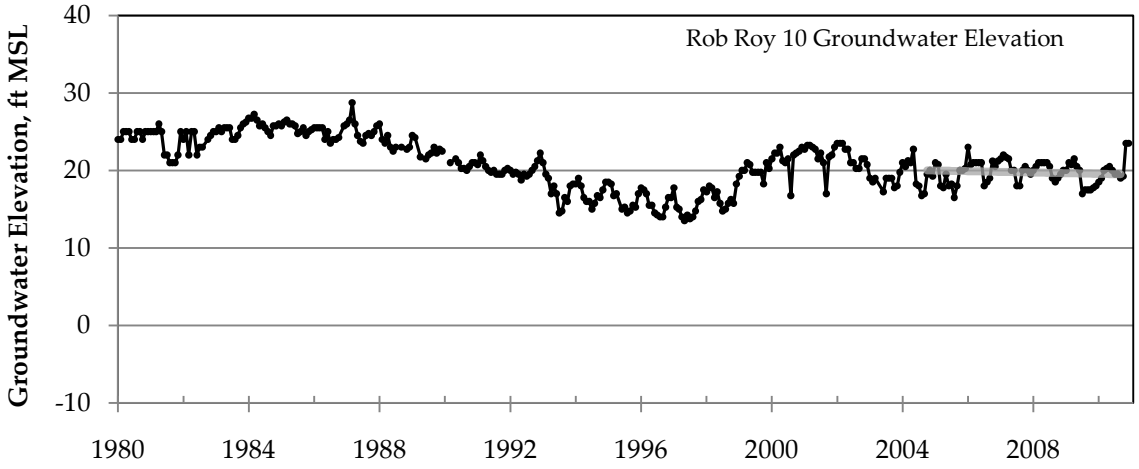

SC-A7C Groundwater Elevation
Groundwater Elevation, ft MSL
40
35
30
25
20
15
10
5
0
Measurements recorded after 2005 when adjacent Sells well running excluded
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

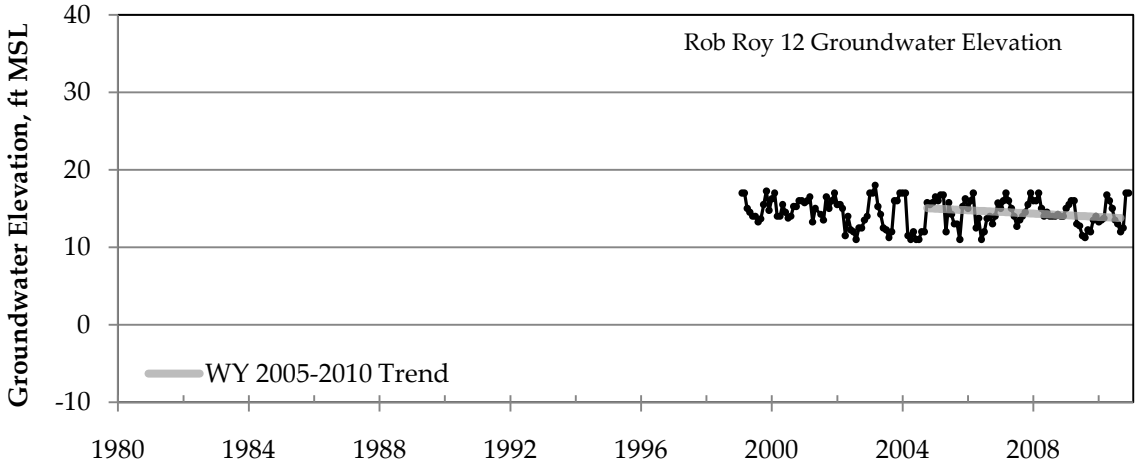

SC-A7D Chloride
Chloride, mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1984
1988
1992
1996
2000
2004
2008

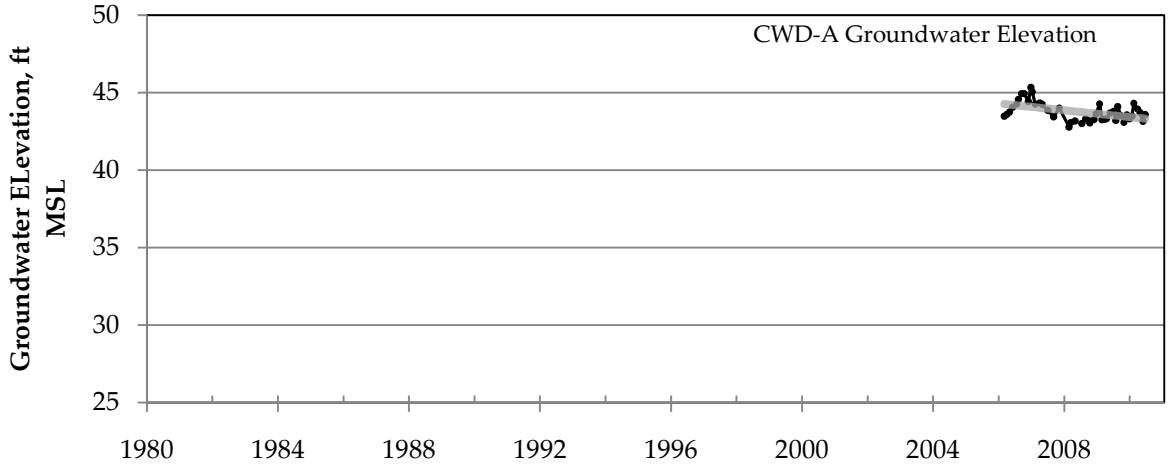

SC-A7D Total Dissolved Solids
TDS, mg/L
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1980
1984
1988
1992
1996
2000
2004
2008

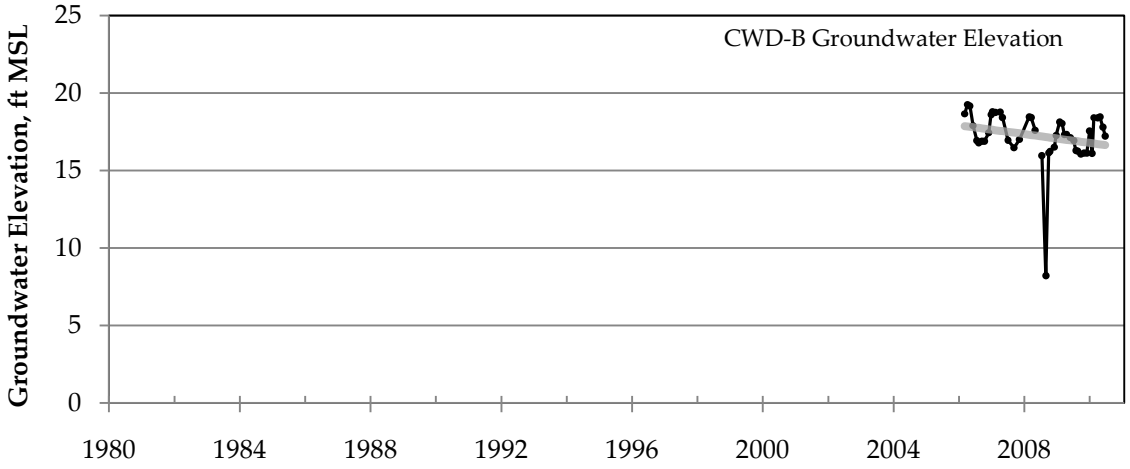

SC-A7D Groundwater Elevation
Groundwater Elevation, ft MSL
40
35
30
25
20
15
10
5
0
Measurements recorded after 2005 when
adjacent Sells well running excluded
1980
1984
1988
1992
1996
2000
2004
2008

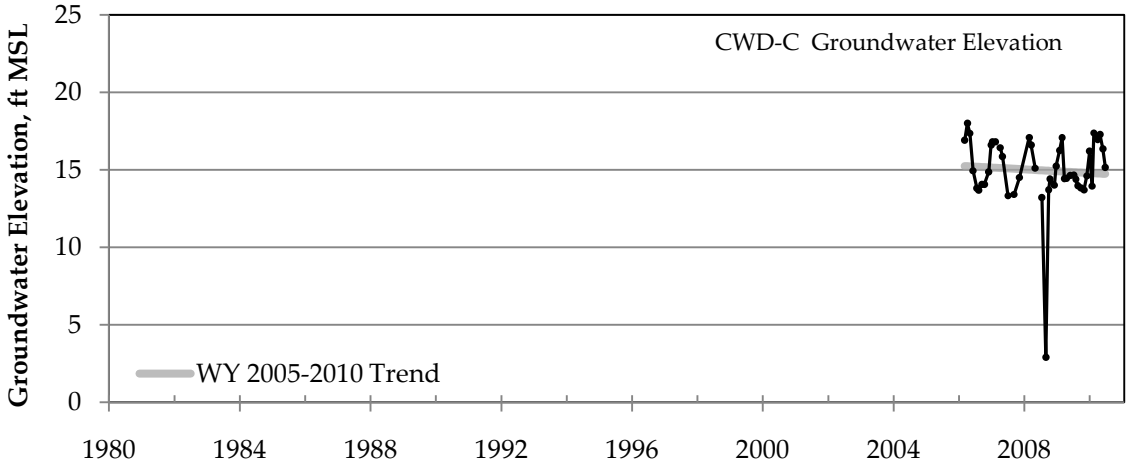

Rob Roy 4 Groundwater Elevation
Groundwater ELevation, ft MSL
40
30
20
10
0
-10
1980
1984
1988
1992
1996
2000
2004
2008

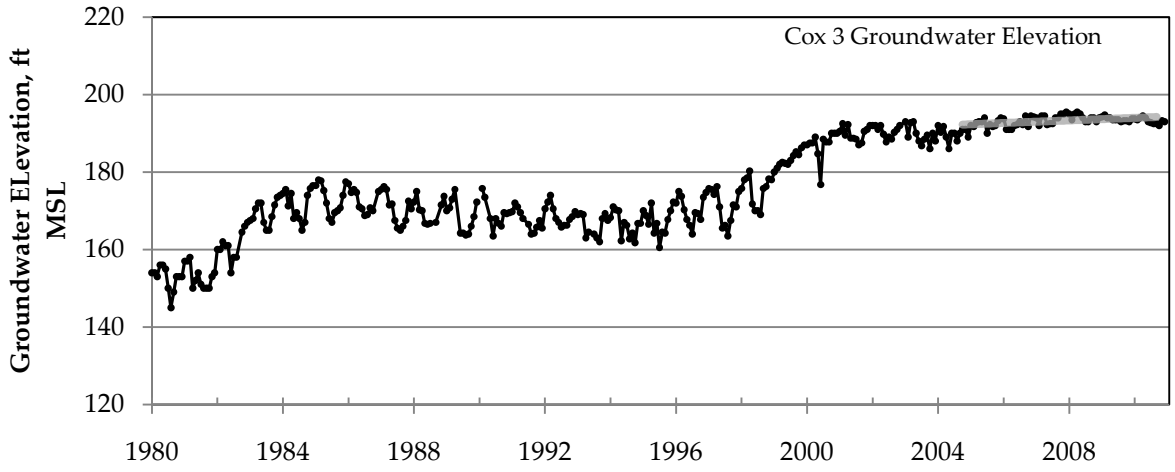

Rob Roy 10 Groundwater Elevation
Groundwater Elevation, ft MSL
40
30
20
10
0
-10
1980
1984
1988
1992
1996
2000
2004
2008

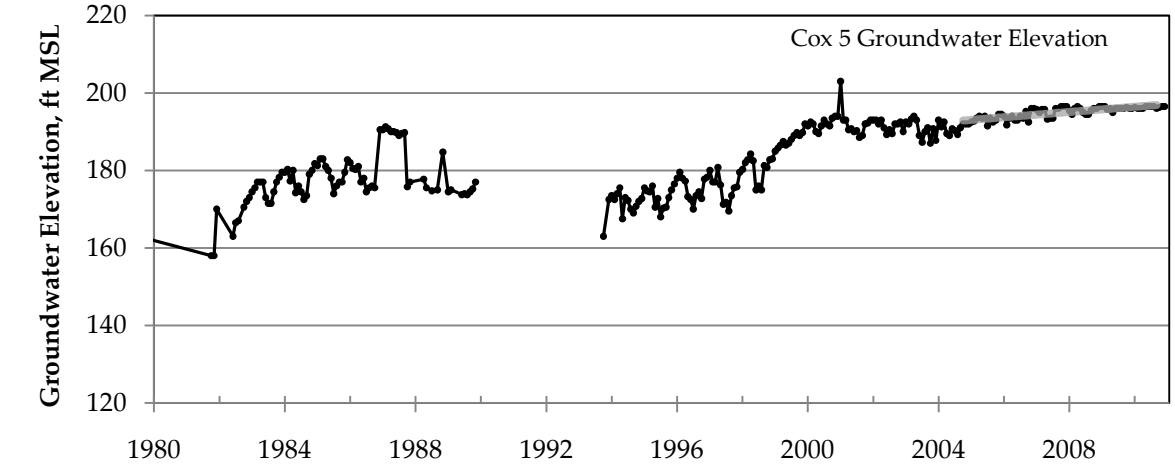

Rob Roy 12 Groundwater Elevation
Groundwater Elevation, ft MSL
40
30
20
10
0
-10
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

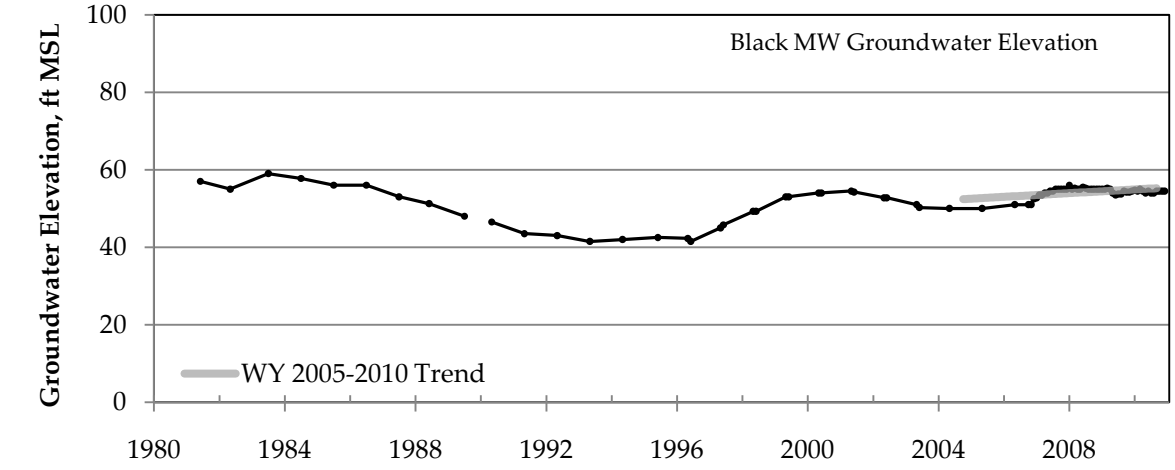

CWD-A Groundwater Elevation
Groundwater ELevation, ft MSL
50
45
40
35
30
25
1980
1984
1988
1992
1996
2000
2004
2008


CWD-B Groundwater Elevation
Groundwater Elevation, ft MSL
25
20
15
10
5
0
1980
1984
1988
1992
1996
2000
2004
2008


CWD-C Groundwater Elevation
Groundwater Elevation, ft MSL
25
20
15
10
5
0
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008


Cox 3 Groundwater Elevation
Groundwater ELevation, ft MSL
220
200
180
160
140
120
1980
1984
1988
1992
1996
2000
2004
2008


Cox 5 Groundwater Elevation
Groundwater Elevation, ft MSL
220
200
180
160
140
120
1980
1984
1988
1992
1996
2000
2004
2008


Black MW Groundwater Elevation
Groundwater Elevation, ft MSL
100
80
60
40
20
0
WY 2005-2010 Trend
1980
1984
1988
1992
1996
2000
2004
2008

SECTION 6
GROUNDWATER MANAGEMENT PLAN IMPLEMENTATION STATUS

6.1 STATUS OF BASIN MANAGEMENT OBJECTIVES

The 2007 Groundwater Management Plan (SqCWD and CWD, 2007) listed nine Basin Management Objectives (BMOs). The status of each of the BMOs during Water Year 2010 is summarized below. Each BMO in the Groundwater Management Plan (GMP) is listed, along with an assessment of how well the objective was met in Water Year 2010. Specific basin management activities, or elements, are discussed in Section 3.2.

BMO 1-1: PUMP WITHIN THE SUSTAINABLE YIELD

- Sustainable yield estimates were re-evaluated based on modeled offshore flows required to achieve groundwater elevations protective against seawater intrusion (HydroMetrics LLC, 2009c). Using prior assumptions for recharge and consumptive use (Johnson et al., 2004), the evaluation showed that pumping goals in the GMP may not be adequate to protect the basin against seawater intrusion after the basin recovers to protective elevations. The evaluation suggested that a reasonable estimate of SqCWD's share of sustainable yield in the Purisima is 2,500 acre-feet per year as opposed to the pumping goal of 3,000 acre-feet per year stated in the GMP. Although the evaluation concluded that the SqCWD pumping goal in the Aromas of 1,800 acre-feet per year for the Aromas is at least hundreds of acre-feet too high, a new reasonable estimate of sustainable yield in the Aromas has not been suggested. Due to uncertainty in the calculations for the Aromas, the USGS model of Pajaro Valley will be reviewed before re-evaluating the concept of sustainable yield for the Aromas. The USGS model of Pajaro Valley is due to be released in 2011.

- SqCWD's total groundwater pumping for Water Year 2010 was 4,100 acre-feet. SqCWD pumped 2,804 acre-feet from Service Areas I and II and the Aptos Jr. High well. This was greater than the revised sustainable yield estimate of 2,500 acre-feet per year for the Purisima. SqCWD pumped 1,295 acre-feet from Service Areas III and IV excluding Aptos Jr. High.

- In Water Year 2010, SqCWD pumped 700 acre-feet less than its pumping goals stated in the GMP and the lowest total amount going back to 1984. In Water Year 2009, SqCWD pumped over 415 acre-feet less than its pumping goal stated in the GMP. From Water Years 2005 to 2008, SqCWD had been within 2% of meeting the GMP overall pumping goal of 4,800 acre-feet per year, while from Water Years 1987-2004, SqCWD exceeded the GMP overall annual pumping goal by an average of 12%.

- Rainfall was above average amounts in Water Year 2010, and SqCWD did not declare a drought curtailment. The decline in SqCWD production is mostly attributed to economic conditions, lack of corresponding development for completed water demand offsets, and weather conditions reducing outdoor irrigation demand and does not reflect a permanent change in overall water use.

- CWD's groundwater pumping for Water Year 2010 was 23 acre-feet in the Purisima Formation and 559 acre-feet in the Aromas Red Sands, which meets CWD's target objectives for pumping within the sustainable yield.

- CWD has been within its pumping targets consistently over the last 25 years.

- SqCWD and CWD's target pumping are within the context of a total estimated pumping in the basin. Other pumpers in the Soquel-Aptos Area include the City of Santa Cruz, small water systems, and private domestic and agricultural wells.

- The City of Santa Cruz pumped 451 acre-feet from the Purisima area in Water Year 2010. This amount is under the 575 acre-feet per year estimate (Johnson et al., 2004) that was assumed for establishing SqCWD's share of the sustainable yield in the Purisima area.

- The City of Santa Cruz has been within 3% or under the estimate of 575 acre-feet per year since 1994.

- Except for an update from Polo Grounds Park in 2007 and Cabrillo College in 2009, there have been no updates on pumping estimates for other pumpers, such as private wells and small water systems, since the GMP was enacted.

- Measured pumping amounts meet numerical targets set under this BMO in the GMP; however, a recent evaluation of the sustainable yield indicates that pumping continues to exceed the sustainable yield. In addition, the sustainable yield estimates are based on the amount of pumping required to maintain protective groundwater levels after they are achieved (BMO 2-2). Recovery of the groundwater basin to protective coastal groundwater levels still needs to be achieved before applying these sustainable yield estimates as pumping goals. The basin remains in overdraft and pumping will need to be reduced below the sustainable yield to recover groundwater levels in the basin.

BMO 1-2: DEVELOP ALTERNATIVE WATER SUPPLIES TO ACHIEVE A LONG-TERM BALANCE BETWEEN RECHARGE AND WITHDRAWALS TO MEET CURRENT AND FUTURE DEMAND

- The pilot plant for the Santa Cruz Water Department/Soquel Creek Water District (SCWD^2) Regional Seawater Desalination Project completed testing in April 2009. The pilot study report was issued in 2010.

- Environmental review and design were initiated for the Regional Seawater Desalination Project. The Notice of Preparation and Initial Study for the Regional Seawater Desalination Project was issued in November 2010.

- Final reports of studies for the desalination plant including a watershed sanitary survey, open ocean intake study, offshore geophysical survey, dilution study of brine disposal were issued in 2010. The report on the energy minimization and greenhouse gas reduction study is due to be finalized in 2011.

- A tentative priority system for distributing water produced by the desalination plant has been developed. The plan provides for at least 1,148 acre-feet per year in all years to SqCWD for in-lieu recharge of the groundwater basin.

- Other alternative water supplies listed in SqCWD's Integrated Resources Plan (ESA, 2006) continue to be evaluated. SqCWD's water recycling planning study concluded that construction of satellite reclamation plants (SRP) to provide recycled water is not cost-effective (Black and Veatch,

2009). SqCWD could pursue grants to fund the SRP construction, although the yield from this source would be much less than required to recover and balance the basin based on projected demand.

- The County is evaluating the feasibility and benefits of interties and water transfers among water agencies in northern Santa Cruz County. A report on this evaluation is scheduled to be issued in 2011 (Khalsa, 2010).

- SqCWD, CWD, and the City of Santa Cruz continue to maintain and update their conservation programs to reduce current and future demand.

BMO 1-3: MANAGE GROUNDWATER STORAGE FOR FUTURE BENEFICIAL USES AND DROUGHT RESERVE

- Groundwater pumping in Water Year 2010 was not below the most recent estimates of the sustainable yield therefore water was not stored for future beneficial uses and drought reserve.

- The GMP states that "achieving this objective is likely to depend on first achieving BMO 1-1 and BMO 1-2 since storing surplus water will not be possible without first eliminating overdraft conditions and developing alternative supplies." BMO 1-1 has not been met because the GMP pumping goal exceeds the sustainable yield as recently evaluated. The potential desalination plant identified under BMO 1-2 is not scheduled for completion until at least 2015.

BMO 2-1: MEET EXISTING WATER QUALITY STANDARDS FOR BENEFICIAL USES, SUCH AS DRINKING WATER STANDARDS

- Drinking water from SqCWD and CWD municipal wells was tested according to Title 22 requirements. In Water Year 2010, raw groundwater pumped by SqCWD from the Purisima Formation met all water quality standards except for iron, manganese, color and turbidity. Raw groundwater from the Purisima Formation was treated to meet water quality standards for these constituents; all delivered water met drinking water standards. In Water Year 2010, groundwater pumped by SqCWD from the Aromas Red Sands met all drinking water standards, thereby meeting the basin management objective for the Aromas Red Sands

aquifer. Water delivered by CWD from its Purisima Formation and Aromas Red Sands sources met all drinking water standards.

- Groundwater from SqCWD monitoring wells was tested regularly for indications of seawater intrusion. TDS and chloride concentrations in Aromas monitoring wells show long term seawater intrusion. No new intrusion was detected in monitoring wells that were previously un-impacted.

- Groundwater at two City of Santa Cruz monitoring wells have TDS and chloride concentrations that suggest seawater intrusion.

- Testing at SqCWD's Sells well showed concentrations at or just under the maximum contaminant limit for nitrates. The Sells well was taken out of service in April 2009. Concentrations from the offline well continued to be above the maximum contaminant limit in 2010.

BMO 2-2: MAINTAIN GROUNDWATER LEVELS TO PREVENT SEAWATER INTRUSION

- Groundwater levels at SqCWD coastal monitoring wells did not meet protective elevations as outlined in *Groundwater Levels to Protect against Seawater Intrusion and Store Freshwater Offshore* (HydroMetrics LLC, 2009b).

- Groundwater levels at City of Santa Cruz coastal monitoring wells met protective elevations as proposed by the City (Almond, 2010) at one of three well clusters.

- Groundwater levels will not meet protective elevations until BMO 1-2 is achieved together with pumping in the basin being maintained below the sustainable yield.

BMO 2-3: PREVENT AND MONITOR CONTAMINANT PATHWAYS

- SqCWD and CWD continue to implement the well abandonment requirements in Santa Cruz County's well ordinance.

- SqCWD has not updated its Drinking Water Source Assessment and Protection (DWSAP) reports (Todd Engineers, 2002 and LSCE, 2002) since the GMP has been enacted.

- SqCWD submitted a DWSAP report for the Aptos Jr. High well to State Department of Public Health in 2011 (HydroMetrics WRI, 2011).

- CWD submitted updated DWSAP reports (Johnson, 2009) to State Department of Public Health in Water Year 2009.

- Santa Cruz County is scheduled to use Proposition 50 bond funding to implement a well destruction program in 2011 and 2012.

BMO 3-1: MAINTAIN OR ENHANCE THE QUANTITY AND QUALITY OF GROUNDWATER RECHARGE BY PARTICIPATING IN LAND USE PLANNING PROCESSES

- SqCWD and CWD continue to support Santa Cruz County efforts to review land use proposals in Primary Recharge Areas and identify projects to enhance groundwater recharge. SqCWD has a representative on the Technical Advisory Committee for these efforts.

- CWD continued to maintain much of its area as a primary recharge area.

BMO 3-2: AVOID ALTERATION OF STREAMFLOWS THAT WOULD ADVERSELY IMPACT THE SURVIVAL OF POPULATIONS OF AQUATIC AND RIPARIAN ORGANISMS

- SqCWD continued to monitor streamflow and shallow groundwater levels near Soquel Creek.

- Analyses of these data are not included in this report, but it is recommended that the data are analyzed regularly in a separate report, particularly as new production wells are installed.

- No minimum streamflows have been established for the survival of aquatic and riparian populations.

- SqCWD's Well Master Plan EIR includes measures for monitoring streamflow at Soquel Creek and Aptos Creek and pumping modifications if baseflow depletion related to future pumping in the vicinities of the proposed O'Neill Ranch Well and Austrian Way Well, respectively, are detected (ESA, 2011).

BMO 3-3: PROTECT THE STRUCTURE AND HYDRAULIC CHARACTERISTICS OF THE GROUNDWATER BASIN BY AVOIDING WITHDRAWALS THAT CAUSE SUBSIDENCE

- No subsidence was reported in Water Year 2010.

6.2 STATUS OF BASIN MANAGEMENT ELEMENTS

The Soquel-Aptos Basin Groundwater Management Plan Update includes 14 elements. Elements are the specific projects, programs, and policies that are planned for management of the Basin. Action items were identified for each element. This section provides a summary and status of the action items included in each element. Status descriptions were provided by SqCWD, CWD, City of Santa Cruz, Santa Cruz County, and Pajaro Valley Water Management Agency.

ELEMENT 1: GROUNDWATER MONITORING

1. ***Continue and expand existing regional groundwater monitoring programs***
   SqCWD and CWD continued measuring groundwater levels and sampling groundwater quality at its network of monitoring and production wells as described in the GMP.

   SqCWD has expanded its network by adding monitoring wells:

   - In Water Year 2008, quarterly groundwater level measurements were initiated at the SC-19 well at Austrian Way and monthly groundwater level measurements and quarterly water quality measurements were initiated at the three SC-A8 wells located at Dolphin Drive and Sumner Avenue.
   - In Water Year 2009, SqCWD installed three SC-20 monitoring wells at Polo Grounds Park using Proposition 50 bond funding. Data loggers

were installed in these new wells to continuously record groundwater levels.

The City of Santa Cruz continued measuring groundwater levels and sampling groundwater quality at its network of monitoring wells. In early 2010, the City of Santa Cruz expanded its network when it installed monitoring wells at three new locations: Coffee Lane Park, Cory Street, and Auto Plaza Drive. Groundwater levels are measured monthly and groundwater quality is sampled semi-annually at all City of Santa Cruz's monitoring wells.

Santa Cruz County Environmental Health Services monitors groundwater levels in approximately 35 private and small water system wells constructed in the Purisima and Aromas aquifers. Most wells are measured semi-annually (spring and fall), but a smaller group of wells in the Valencia Creek area are measured monthly.

2. ***Continue shallow Groundwater Monitoring Program***
   SqCWD continued to monitor groundwater levels in shallow wells along Soquel Creek.

3. ***Share and consolidate monitoring data among all agencies overlying the Soquel-Aptos Area Basin***
   SqCWD, CWD, Pajaro Valley Water Management Agency, the City of Santa Cruz, and Santa Cruz County continue to share data in an ad-hoc manner. SqCWD's file transfer protocol (FTP) site is used for the agencies to upload and download data.

   In 2009, the state enacted legislation (SBX7 6) implementing California Statewide Groundwater Elevation Monitoring (CASGEM) requiring submittal of groundwater level data for all groundwater basins in the state. With the support of the Basin Advisory Group, Santa Cruz County will be the reporting entity for groundwater basins in the County. PVWMA staff has developed a framework for the database that will be used to submit the data to the state. The first submission of data is due January 1, 2012.

   The County will also integrate groundwater level data with other water resources data in the coordinated database being developed through the Integrated Regional Water Management Program.

4. ***Analyze data and assess the adequacy of the monitoring well network annually***

   Analyses of groundwater data are discussed in Sections 3-5.

   In Water Year 2008, SqCWD began implementing recommendations in the *Evaluation of Water Quality Monitoring Network and Recommendations for Improvement* (HydroMetrics LLC, 2007) by installing new sampling equipment and identifying monitoring wells that need to be replaced.

   Starting in 2007, SqCWD has installed bladder pumps in wells SC-1A, SC-8A, SC-8B, SC-A2C, SC-A4D, SC-A8A, SC-A8B, and SC-A8C.

   In Water Year 2009, SqCWD replaced the three SC-3 monitoring wells at Escalona Drive because they were providing unreliable data. The new wells were outfitted with groundwater level data loggers and bladder pumps. Water quality measurements will continue to be measured quarterly at this location.

   The monitoring wells SC-8F and well SC-9A have also been identified as needing replacement.

   Based on an Assessment and Informational Update of the Groundwater Management Program, SqCWD's board approved a plan in 2009 for retrofitting existing monitoring wells with groundwater level data loggers and bladder pumps. In addition to the SC-3 monitoring wells, groundwater level loggers are currently installed in SC-1A, SC-8D, SC-16A, SC-20A, SC-20B, SC-20C, SC-A1B, SC-A6A ,and SC-A6C.

5. ***Coordinate with other groundwater resource agencies to develop uniform data collection procedures and data sharing protocols***

   Minimum standards for monitoring protocols have not yet been set for all agencies in the Soquel-Aptos Area Basin.

   SqCWD continued to support Santa Cruz County efforts to create a GIS well layer for information about private wells in Santa Cruz County. The database has information about 6,000 private wells throughout the County. The County provided a GIS layer of monitored private wells for use in this annual report.

The County has begun development of a coordinated database for water resources data through the Integrated Regional Water Management Plan using Proposition 50 funds.

6. ***Develop an outreach program to obtain groundwater level data from private pumpers within the Soquel-Aptos area***
   In 2008, Santa Cruz County established a voluntary groundwater monitoring program with private well owners in the Soquel-Aptos basin and provided the data for use in this annual report.

   As part of the Well Master Plan EIR, SqCWD is including a voluntary monitoring and mitigation program for private wells within 1,000 meters of new SqCWD production wells (ESA, 2010). The program includes collection of production and groundwater level data at private wells to monitor for restrictive effects related to pumping of a new SqCWD well.

ELEMENT 2: SURFACE WATER MONITORING

1. ***Monitor stream gauges on Soquel Creek to identify and track changes in baseflow conditions***
   SqCWD continued to monitor streamflow and temperature at the Upper Soquel Creek and West Branch stream gauges. Data loggers record values every 15 minutes, and the data are downloaded and converted to daily values once a month. SqCWD continued to contribute toward the cost to operate and maintain the Soquel Creek Stream Gauging Station at Bridge Street along with Santa Cruz County and the U.S. Geological Survey.

   The County also continued a sediment monitoring program on Soquel Creek and the West Branch. This effort will continue for at least one more year.

   SqCWD's Well Master Plan EIR contains measures for monitoring streamflow on Soquel Creek, including installation of a new streamflow gauge downstream of the proposed O'Neill Ranch well (ESA, 2011).

2. ***Monitor rainfall in the Soquel-Aptos Area Basin to establish rainfall-runoff relationship***
   SqCWD continued to collect rainfall data at the Mancarti and Kraeger/Longridge Rain Gauges within the Soquel Creek Watershed. Data loggers record values every 15 minutes, and the data are downloaded and converted to daily values once a month.

SqCWD, CWD, and the City of Santa Cruz are cooperatively funding a study to estimate the spatial and temporal variation in deep groundwater recharge. The study uses daily rainfall data at four coop climate stations in and around the Soquel-Aptos Basin in addition to the Mancarti and Kraeger/Longridge gauges.

3. ***Monitor selected shallow wells adjacent to creeks to identify and quantify stream aquifer interactions. Coordinate a meeting with SqCWD and the County of Santa Cruz to discuss future analysis of the shallow well monitoring data from 2003 – 2006***

   SqCWD continued to measure shallow groundwater levels at the four monitoring sites along the eastern side of Soquel Creek: Simons, Balogh, Main Street, and Nob Hill.

   Analysis of these shallow groundwater levels was provided in the *Water Year 2007 Annual Review and Report* (HydroMetrics LLC, 2009a). Santa Cruz County is on the Basin Advisory Group that reviewed the analysis.

4. ***Analyze stream gauge data, rainfall data, and shallow monitoring data annually***

   Data from the above three monitoring programs were analyzed in the *Water Year 2007 Annual Review and Report* (HydroMetrics LLC, 2009a). Additional analysis is not included in this report, but it is recommended that further analysis be included in a separate report before the proposed O'Neill Ranch becomes operational. A separate report may be necessary in the future as the surface water monitoring program is expanded to other creeks such as Aptos Creek and streamflow is monitored for changes to baseflow due to pumping from new production wells.

5. ***Support stream monitoring and management activities along Aptos Creek and Valencia Creek***

   SqCWD and CWD have not participated in any interagency meetings regarding implementation of total maximum daily load (TMDL) projects and programs in the Aptos Creek and Valencia Creek watersheds. The Aptos Creek pathogen TMDL has been adopted by the Regional Water Quality Control Board. The sediment TMDL for the Aptos watershed is on hold because management measures are implemented through the Santa Cruz County Stormwater Management Program (Briggs, 2007). Stormwater management plans for the County were approved by the State Regional

Water Quality Control Board in 2009 and implementation activities are ongoing.

The County has maintained a program of streamflow and sediment monitoring on Valencia Creek since September 2008.

SqCWD's Well Master Plan EIR contains measures for monitoring streamflow on Aptos Creek, including installation of a new streamflow gauge downstream of the proposed Austrian Way well (ESA, 2011).

SqCWD continued its ongoing funding and review of stream habitat and juvenile salmonid (steelhead and coho salmon) monitoring in the Soquel and Aptos Creek watersheds as part of the Santa Cruz County Stream Habitat and Juvenile Salmonid Sampling Program.

ELEMENT 3: SUBSIDENCE MONITORING

1. ***Develop and implement a GPS based subsidence monitoring program***
   SqCWD and CWD have not initiated work to develop and implement a subsidence monitoring program.

2. ***Analyze data and assess the frequency of the subsidence monitoring***
   This action item cannot be performed until a subsidence monitoring program is implemented.

3. ***Review other means of subsidence measuring and monitoring***
   SqCWD and CWD have not reviewed alternate means of measuring and monitoring subsidence.

ELEMENT 4: INTERAGENCY COORDINATION

1. ***Develop and secure a supplemental source of supply with the City of Santa Cruz***
   The pilot plant for the Santa Cruz Water Department/Soquel Creek Water District (SCWD²) Regional Seawater Desalination Project completed testing in 2009. Environmental review and design were initiated for the Regional Seawater Desalination Project in 2010. A Notice of Preparation and Initial Study for Environmental Impact Report of the Regional Seawater Desalination Project was issued in November 2010.

2. ***Continue to cooperatively manage groundwater under the provisions of the Soquel Aptos Groundwater Management Alliance (SAGMA)***
   SAGMA continues to meet annually to discuss management of the groundwater basin. SAGMA makes up most of the Basin Advisory Group that reviews this annual report.

3. ***Expand the Soquel-Aptos Groundwater Management Authority to include other water resource agencies that have jurisdiction within the Soquel-Aptos area***
   The Soquel-Aptos Groundwater Management Authority has not been expanded and the area subject to the GMP remains the areas of SqCWD and CWD. However, the City of Santa Cruz indicated in 2009 an interest in joining the GMP.

4. ***Continue to support the USGS GAMA project and work cooperatively with USGS, State, and regional agencies to improve statewide monitoring***
   The Groundwater Ambient Monitoring and Assessment Program (GAMA) last tested private and public wells in the Soquel-Aptos area in 2005 (Kulongoski and Belitz, 2007). The GAMA program intends to sample a subset of these wells every three years to establish groundwater quality trends. SqCWD and CWD will support the USGS as it conducts new sampling at wells in the Soquel-Aptos area.

5. ***Continue to support the USGS Soquel Creek Stream Gauging Station***
   SqCWD continues to contribute toward the cost to operate and maintain the Soquel Creek Stream Gauging Station at Bridge Street in Soquel.

6. ***Continue to participate and support the Northern Santa Cruz County Integrated Regional Water Management Plan (IRWMP)***
   Proposition 50 funding for projects identified in the IRWMP has reimbursed the 2009 construction of monitoring wells at the Polo Grounds Park. SqCWD is working with the County Parks department to use Proposition 50 funding to convert the Polo Grounds irrigation well to a municipal well. SqCWD and CWD support Santa Cruz County in its plans to use funding for abandoned well destruction and projects to enhance groundwater recharge. Funding has also been awarded for intake study costs of the regional desalination plant.

   A Proposition 84 planning grant for IRWMP studies was approved by the state in 2011. Included in the approved studies was the Aromas and Purisima

Groundwater Basin Management Study submitted by CWD to evaluate maximizing the developable yield in CWD's Cox Well Field to address concerns about Chromium VI in the CWD service area and SqCWD's Aromas water quality and overdraft concerns.

The general manager of SqCWD serves on the Board of the Regional Water Management Foundation which oversees the implementation of the Santa Cruz Integrated Regional Water Management Plan (IRWMP). The SqCWD general manager is a member of the IRWMP steering committee. An update of the IRWMP will also be completed using Proposition 50 funding.

7. ***Support implementation of Pajaro Valley Water Management Agency's (PVWMA) Basin Management Plan and PVWMA/City of Watsonville efforts to develop the Watsonville Area Water Recycling Project***
   SqCWD and CWD continue to support implementation of PVWMA's Basin Management Plan (BMP) and the Watsonville Area Water Recycling Project, which began operation in April 2009. From 2009-2010, approximately 2,900 acre-feet of recycled water was produced and 5,000 acre-feet of blended water was delivered by the Coastal Distribution System. The BMP is scheduled to commence being updated in 2011 and the Conservation and Customer Service Field Manager of SqCWD serves on the ad-hoc BMP Advisory Committee.

8. ***Support PVWMA efforts to develop a numerical model of the Pajaro Valley groundwater basin***
   PVWMA has developed the Pajaro Valley Hydrologic Model, a numerical model of the Pajaro Valley basin. SqCWD has a representative on the model's Technical Advisory Committee, which approved the final model in 2010. SqCWD and CWD also provided data for the model. The report documenting the model is scheduled to be released in 2011.

9. ***Support the Central Coast Regional Water Quality Control Board's (RWQCB) Implementation Strategy for the Aptos Watershed Sediment Total Maximum Daily Load (TMDL) Report***
   RWQCB decided in 2007 to implement management measurements for sediment impairment of the Aptos watershed through the Santa Cruz County Stormwater Management Program (Briggs, 2007). The State Water Resources Control Board approved the County's Storm Water Management Plan in Water Year 2009. The County is also working to develop a draft county

stormwater ordinance for introduction in 2011. SqCWD and CWD continue to support the County's implementation of stormwater management.

10. Action Items not Included in Groundwater Management Plan

SqCWD and CWD staff participated with County staff in a 2009 joint meeting of the County Water Advisory Commission and the Commission on the Environment to discuss local issues related to water supply and climate change. The County is sponsoring a U.S. Geological Survey study of climate change effects on County hydrology and water agency staff and consultantsfrom SqCWD and the City of Santa Cruz have reviewed premliminary results.

SqCWD, CWD, and the City of Santa Cruz are cooperatively funding a study to estimate the spatial and temporal variation in deep groundwater recharge.

SqCWD, CWD, the City of Santa Cruz, and PVWMA are working with the County to provide groundwater level data for submission to the state under the new California Statewide Groundwater Elevation Program (CASGEM).

The County, City of Santa Cruz, SqCWD, and CWD also are coordinating water conservation efforts.

ELEMENT 5: DEVELOP A SUPPLEMENTAL SOURCE OF SUPPLY

1. Develop and secure a supplemental water supply suitable for implementing a conjunctive use program

The pilot plant for the Santa Cruz Water Department/Soquel Creek Water District (SCWD^2) Regional Seawater Desalination Project completed testing in April 2009. A Notice of Preparation and Initial Study for Environmental Impact Report of the Regional Seawater Desalination Project was issued in November 2010. A tentative priority schedule for water produced at the plant will provide at least 1,148 acre-feet per year to SqCWD for implementing a conjunctive use program.

2. Explore and pursue funding opportunities for supplemental supply projects

SqCWD and CWD supported the IRWMP that was awarded Proposition 50 funding for intake study costs related to the desalination plant. SqCWD also received grant funding in 2008 to study the feasibility and cost-effectiveness of constructing satellite reclamation plants to provide recycled water. The recommendation from this study concluded that construction of satellite

reclamation plants to provide recycled water is not cost-effective and SqCWD would need to obtain additional funding to pursue the project (Black and Veatch, 2009).

ELEMENT 6: PROTECT EXISTING RECHARGE ZONES

1. ***Support existing Santa Cruz County efforts to update Groundwater Recharge Maps that identify primary groundwater recharge zones***
   SqCWD and CWD continue to support Santa Cruz County efforts to update these maps. The County has updated primary groundwater recharge maps using electronic GIS data on soils and geology. The County also has soil information to assist with identifying secondary recharge areas as needed.

2. ***Support PVWMA's efforts to optimize recharge and recovery, and develop an ASR (Aquifer Storage and Retrieval) Project in the Aromas Red Sands***
   PVWMA has developed and is operating its Harkins Slough Aquifer Storage and Recovery (ASR) Project. This ASR project involves seasonal percolation of diverted Harkins Slough water into the Harkins Slough recharge basin for storage until the irrigation season, when it is extracted and delivered to the Coastal Distribution System (CDS) for distribution. The construction of the Harkins Slough diversion structure and recharge basin was completed in Fall 2001. The project has operated every year since 2002. Between 2002 and 2010, 5,940 acre feet of water have been diverted from Harkins Slough and pumped to the percolation pond. Recovery wells have extracted nearly 1,300 acre feet of diverted water for distribution in the CDS. The remaining water is left to recharge the Alluvial and Aromas Red Sands aquifers. Ongoing studies being performed by the University of California, Santa Cruz (hydrogeology), and Stanford University (geophysics) are meant to provide data to help understand the hydrologic structure that controls recharge and recovery. SqCWD and CWD wrote letters of support for PVWMA's successful Local Grant Assistance (AB303) grant application to study the recharge processes beneath the pond with the goal of gaining better understanding of the fate of percolated water. The study, called the Harkins Slough Project Re-Operation Feasibility Study began in 2010 with the installation of three new monitoring wells and is expected to continue through at least 2012.

3. ***Support future efforts to characterize recharge areas within the Soquel-Aptos area***

The data from the GAMA project (Kulongoski and Belitz, 2007) are expected to include chemical analyses that will help characterize recharge areas. A full review of these data to perform this characterization has not taken place.

4. ***Coordinate and expand efforts between groundwater management agencies and the County of Santa Cruz to establish regulations for land use within Primary Recharge Areas***
   SqCWD and CWD continue to support County efforts to review land use proposals within Primary Recharge Areas.

ELEMENT 7: ENHANCE GROUNDWATER RECHARGE

1. ***Enhance groundwater recharge with stormwater runoff***
   SqCWD and CWD continue to support Santa Cruz County efforts to identify projects to enhance groundwater recharge. The County is leading a Proposition 50 funded effort to implement demonstration projects to restore groundwater infiltration from developed areas at Polo Grounds Park and Brommer Street Park within the Groundwater Management Area. Installation of these recharge facilities is to take place in 2011. The Resource Conservation District of Santa Cruz County is also implementing a separate grant funded project to promote recharge through home drainage improvements, including outreach and technical assistance.

   CWD supported Aptos High School with its recharge pond project in 2008.

2. ***Develop and implement standards that require discretionary projects in primary recharge zones to maintain or increase a site's pre-development absorption of runoff***
   SqCWD and CWD continue to support County efforts to develop a program that will include standards regulating impervious surfaces and provide measures to increase groundwater recharge. The County is working with RWQCB to develop hydromodification criteria as required in the County's stormwater plan. A draft stormwater ordinance will be released in 2011.

3. ***Support County of Santa Cruz efforts to prioritize potential sites for drainage facilities, and implement construction***
   SqCWD and CWD continue to support County efforts to identify drainage facilities with potential for groundwater recharge.

4. ***Participate in public outreach and awareness for groundwater recharge***

SqCWD and CWD supported the County and Resource Conservation District (RCD)'s implementation of the grant funded projects to promote recharge.

5. ***Investigate the water storage potential of the Aromas Red Sands***
   SqCWD and CWD continue to explore potential projects for enhanced recharge in the Pleasant Valley/Freedom Blvd. area.

ELEMENT 8: MANAGE PUMPING

1. ***Locate, design, and install additional and replacement production wells to improve pumping distribution, disperse the basin's overall drawdown and improve operational flexibility***
   SqCWD published its draft EIR for the Well Master Plan in 2010. After responding to comments, SqCWD certified the EIR in 2011 and approved the Polo Grounds well, Cunnison Lane well, and Austrian Way well projects. The first of the new municipal wells to be brought online is the Polo Grounds well. SqCWD is working with the County's Parks Department to convert the Polo Grounds irrigation well to a municipal well by 2012.

2. ***Continue to encourage private well users located within critical groundwater areas of the Soquel-Aptos basin to discontinue pumping and connect to the local municipal water supply systems***
   SqCWD continued to use its Private Well Incentive Policy to encourage private well users located in critical groundwater areas to properly abandon their wells and connect to the District's distribution system.

   SqCWD has coordinated with the Potbelly Beach Club to remove 19 residences from coastal wells and connect to the District's distribution system. Construction is planned for the fall of 2011.

3. ***Cooperatively work with City of Santa Cruz to develop a coordinated pumping plan for the City's Live Oak wells and SqCWD's Purisima wells***
   SqCWD and the City of Santa Cruz met in 2010 to develop an approach to a cooperative groundwater management agreement. SqCWD revised its monitoring and mitigation plan in the Well Master Plan EIR (ESA, 2011) in response to comments from the City. The City sought and received feedback from SqCWD on its CEQA documentation for its proposed new inland well, Beltz #12. The two agencies have tentatively agreed that the City's maximum groundwater reliance during critically dry years will be limited to

approximately 645 acre-feet to be distributed between the City's existing coastal production wells and Beltz #12.

4. ***Analyze groundwater level/quality data and groundwater pumping data at least annually, and recommend changes to the groundwater pumping distribution as necessary***
   This analysis is completed in Sections 2-5. SqCWD's consulting hydrologist has made informal recommendations to SqCWD for changes to groundwater pumping distribution, but significant changes to the pumping distribution cannot be made until the Well Master Plan is implemented.

   SqCWD completed installing groundwater level transducers in all of its production wells in Water Year 2010. The transducers are connected to SqCWD's SCADA system, allowing SqCWD to adjust pumping based on current pumping groundwater levels.

ELEMENT 9: IDENTIFY AND MANAGE CUMULATIVE IMPACTS

1. ***Encourage sustainable pumping from non-agency groundwater users***
   SqCWD worked with Cabrillo College, Trout Gulch Mutual, PureSource Mutual, Seascape Greens and Seascape Golf Course to improve water use efficiency and implement conservation opportunities.

2. ***Identify and manage well interference and manage groundwater storage for beneficial uses and drought reserve***
   Groundwater levels in production wells are monitored to assess whether cones of depression from other wells have caused lowered groundwater levels that result in an appreciable diminution in the quantity or quality of water pumped by that well. Based on monitoring data, well interference between the three agencies that operate municipal production wells in the Soquel-Aptos Area Basin has not been identified as an issue at this time. Well interference has been identified as an issue within the SqCWD system. Well production has been affected at the Estates and T. Hopkins wells due to cumulative drawdown.

   The Well Master Plan EIR includes monitoring and mitigation plans to address restrictive effects on nearby production wells after implementation of the Well Master Plan. The plans address private wells, the City of Santa Cruz's Live Oak well field, and CWD's Cox and Rob Roy well fields.

3. ***Install new wells in locations that reduce cumulative impacts***

   Cumulative effects of pumping the new wells in the Well Master Plan have been analyzed. Based on planned redistribution of pumping, the net cumulative effects of the Well Master Plan should be beneficial.

   Two of the new wells in the Well Master Plan, the Austrian Way and Granite Way wells, are intended to alleviate the identified cumulative impacts that affect the production of the Estates and T. Hopkins wells.

   The City of Santa Cruz has issued a Notice of Preparation of a Draft Environmental Impact Report for the Beltz # 12 well at Research Park Drive and Cory Street to redistribute a portion of the City's projected drought year pumping to an inland location.

4. ***Continue to improve and quantify projected future demands from all groundwater users***

   SqCWD updated projections of future demands in Water Year 2009 to support analyses for the Well Master Plan EIR. Future projected demand was reduced 410 acre-feet per year from projections in SqCWD's *Integrated Resources Plan* (ESA, 2006) based on recent demand reductions.

ELEMENT 10: WATER CONSERVATION

1. ***Continue and update the existing water conservation programs for SqCWD.***

   SqCWD continued a broad and multi-faceted water conservation program and added rebates for greywater, turf replacement and hot water recirculation devices. SqCWD adopted water use efficiency ordinances for indoor and outdoor use by new development and remodels, updated the water waste ordinance and began enforcement to prevent haulers from taking water from SqCWD bulk water stations outside the District. SqCWD also installed the first phase of a grant funded landscape demonstration project at its headquarters in 2010.

2. ***Continue and update the existing water conservation programs for CWD.***

   CWD continued its existing water conservation programs and opened a drought tolerant demonstration garden in Water Year 2009.

3. ***Annually report estimated savings from the ongoing water conservation program.***

Water production by SqCWD in Water Year 2010 was the sixth straight year when production was at least 500 acre-feet less than the previous ten-year period average (1995-2004). Much of this continuing reduction is attributed to SqCWD's on-going conservation programs.

4. Action Items Not Included in Groundwater Management Plan.

The County is developing a water efficient landscape ordinance while implementing the state's water efficient landscape ordinance. The County is developing a package of measures to update and expand the County's water conservation measures that may include the creation of a water use impact fee. In 2009, amendments to the County well ordinance went into effect that resulted in increased water conservation by agricultural users and small water systems. New water use efficiency ordinances have been adopted for the SqCWD and City of Santa Cruz service areas. The County, SqCWD, the City of Santa Cruz, and the City of Capitola also worked with the local Greywater Alliance to establish procedures for use of greywater irrigation systems. SqCWD and CWD support these County efforts.

ELEMENT 11: SUPPORT THE DEVELOPMENT AND UPDATE OF POLICIES AND ORDINANCES FOR WELL CONSTRUCTION, ABANDONMENT, AND DESTRUCTION

1. Support existing well construction and well destruction standards, including the recent revisions to the County of Santa Cruz Well Ordinance

SqCWD and CWD worked closely with Santa Cruz County to implement revisions to the water well ordinance that went into effect March 23, 2009. SqCWD followed the revised ordinance when replacing monitoring wells SC-3 at Escalona Drive and constructing the new monitoring well cluster at Polo Grounds.

2. Support County of Santa Cruz's well destruction program

SqCWD and CWD support Santa Cruz County's abandoned well destruction program. With the support of the agencies through the IRWMP, the County was awarded Proposition 50 water bond funding to destroy abandoned wells, an effort that is scheduled to take place in 2011 and 2012.

SqCWD has identified one well at the County's Polo Grounds park for abandonment and destruction. Monitoring wells SC-5D and SC-5E have also been identified as needing proper destruction. Monitoring wells such as the

SC-9 cluster and SC-8F will need to be properly destroyed when they are replaced. The former production well at Madeline has also been identified for destruction.

3. ***Continue to implement SqCWD well destruction policy***
   SqCWD continues to require property owners to properly destroy abandoned private wells before connecting to the SqCWD system.

4. ***Request Santa Cruz County Environmental Health Services establish a voluntary monitoring program of private wells, particularly in inland areas of the Soquel-Aptos groundwater management area***
   The County has implemented this voluntary monitoring program of groundwater levels. Groundwater levels are being monitored semi-annually at wells in the inland areas of the groundwater management area and monthly at wells along Valencia Creek.

ELEMENT 12: WELLHEAD PROTECTION MEASURES

1. ***Periodically update and review the SqCWD and CWD Drinking Water Source Assessment and Protection (DWSAP) analysis and submittals.***
   SqCWD has not updated DWSAP analysis and submittals (LSCE, 2002 and Todd Engineers, 2002) since the GMP has been enacted. SqCWD submitted a DWSAP for the Aptos Jr. High well (HydroMetrics WRI, 2011) and is preparing a DWSAP for the planned conversion of the Polo Grounds well to municipal supply. CWD submitted updated DWSAP reports (Johnson, 2009) to State Department of Public Health in Water Year 2009.

2. ***Continue to assist with and endorse Santa Cruz County's expanded wellhead protection programs.***
   SqCWD and CWD continue to support Santa Cruz County's programs for wellhead protection. Related programs not listed in the Groundwater Management Plan are the County's septic system management program and the RCD and Ecology Action's Livestock and Land program.

3. ***Support groundwater remediation activities.***
   SqCWD and CWD continue to support the State and Santa Cruz County's programs such as regulation of the cleanup and monitoring of sites with known or potential contamination by the Central Coast Regional Water Quality Control Board (RWQCB) and Santa Cruz County Department of

Environmental Health, submittal of the MTBE Report to Public Water System Operators, and use of the State's Underground Storage Tank Cleanup Fund.

ELEMENT 13: PUBLIC EDUCATION

1. ***Maintain SqCWD's Public Information Program***

   In addition to its ongoing public information program, in 2010, SqCWD sponsored a demonstration garden on Wharf Rd. in Soquel, collaborated with other agencies and private non-profit organizations on the Green Gardner Program.

2. ***Maintain SqCWD School Education Program***

   SqCWD continued to conduct its robust school education program including assemblies, classroom teaching and teacher training.

3. ***Maintain CWD Public Education Programs***

   CWD continued to conduct its public education programs and completed development of a drought tolerant demonstration garden in Water Year 2009.

4. ***Support and participate in regional programs***

   SqCWD continued to support and participate in regional programs, such as outreach for the Integrated Regional Water Management Plan.

ELEMENT 14: IMPROVE GROUNDWATER BASIN MANAGEMENT TOOLS

1. ***Continue to improve and quantify sustainable yield estimates***

   Sustainable yield estimates were re-evaluated based on modeled offshore flows required to achieve groundwater elevations protective against seawater intrusion (HydroMetrics LLC, 2009c). Using prior assumptions for recharge and consumptive use (Johnson et al., 2004), the evaluation suggested that the GMP pumping goal for SqCWD from the Purisima of 3,000 acre-feet per year is 500 acre-feet too high to protect the basin against seawater intrusion after the basin recovers to protective elevations. The evaluation also concluded that the GMP pumping goal for SqCWD from the Aromas of 1,800 acre-feet per year is at least hundreds of acre-feet too high. The concept of sustainable yield for the Aromas will be evaluated after the USGS model of Pajaro Valley is published, scheduled for 2011

2. ***Establish water levels that protect the groundwater basin against seawater intrusion***

SqCWD has established protective groundwater elevations at its coastal monitoring wells as documented in *Groundwater Levels to Protect against Seawater Intrusion and Store Freshwater Offshore* (HydroMetrics LLC, 2009b).

3. ***Assist state, federal, or local wildlife and fisheries agencies as they develop water flow or water quality requirements for riparian and aquatic organisms***
   SqCWD continued its ongoing funding and review of stream habitat and juvenile salmonid (steelhead and coho salmon) monitoring in the Soquel and Aptos Creek watersheds as part of the Santa Cruz County Stream Habitat and Juvenile Salmonid Sampling Program. SqCWD and CWD also support the County's new policy for management of large woody material in county streams.

4. ***Maintain and enhance data collection and management.***
   Data collection has been enhanced by installing new sampling equipment in several of SqCWD's wells. SqCWD has also installed groundwater level transducers in production wells to facilitate real-time management of pumping.

   SqCWD and CWD continue to update the agencies' databases and Geographical Information Systems. Calendar year 2009 and future data for all water quality constituents analyzed by SqCWD are now stored in a new WaterTrax database.

5. ***Ensure data sharing among regional water agencies***
   A formal process for data sharing among regional water agencies has not been developed. Data were provided for this report by SqCWD, CWD, the City of Santa Cruz, and Santa Cruz County. SqCWD's file transfer protocol (FTP) site is used for the agencies to upload and download data. The California Statewide Groundwater Elevation Monitoring (CASGEM) program will result in compilation of groundwater level data collected by the agencies.

6. ***Explore methods to collect data from non-agency groundwater users***
   The County has implemented a voluntary monitoring program of groundwater levels at private wells. SqCWD's Well Master Plan EIR includes a voluntary monitoring and mitigation program for private wells within 1,000 meters. of new SqCWD production wells (ESA, 2010) that will collect production and groundwater level data at private wells to monitor for restrictive effects at the private wells related to pumping of the new SqCWD well.

7. ***Prepare a subregional groundwater model for CWD's Rob Roy Well Field***
   A subregional model for the Aromas area was prepared for CWD as a tool to delineate well capture zones in the updated DWSAP reports (Johnson, 2009).

8. ***Provide data and technical assistance to Pajaro Valley Water Management Agency (PVWMA) Groundwater Basin Model***
   PVWMA is finalizing the Pajaro Valley Hydrologic Model, a numerical model of the Pajaro Valley basin. SqCWD has a representative on the Technical Advisory Committee, which met in 2010 to approve the final model. The final report is scheduled to be issued in 2011.

9. ***Explore opportunities to expand existing groundwater models to cover the Soquel-Aptos area***
   Two models will be finalized in 2011 that may provide opportunities to develop a groundwater model that covers the Soquel-Aptos area: the Soquel-Aptos Area Recharge Model, a PRMS model that estimates the spatial and temporal variation in deep groundwater recharge, and the Pajaro Valley Hydrologic Model, a MODFLOW model of the Pajaro Valley basin.

10. ***Explore methods to measure and locate the seawater/freshwater interface***
    Methods to locate the seawater/freshwater interface have not been explored. SqCWD plans to develop an analysis of the rate and depth of seawater intrusion in the Aromas area. Other methods to explore include geophysics and infrared methods being used elsewhere on the Central Coast.

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SECTION 7
BASIN MANAGEMENT ACTION PRIORITIES AND RECOMMENDATIONS

7.1 BASIN MANAGEMENT ACTION PRIORITIES

This section lists the top priorities for projects and programs to achieve BMOs. BMO 2-2, maintain groundwater levels to prevent seawater intrusion, is the best indicator of the status of basin management. This objective has not been met, so the highest priorities are given to projects that will help raise coastal groundwater levels to prevent seawater intrusion.

1. Secure Supplemental Supply (Element 5, BMO 1-2). BMO 2-2 and other BMOs rely on successfully securing a supplemental supply and achieving BMO 1-2. The regional desalination plant is currently the most likely supplemental supply option. The Integrated Resources Plan (ESA, 2006) adopted by SqCWD emphasizes continued implementation of existing and new conservation and drought management programs regardless of developing a supplemental supply. It also identifies local supplemental supply alternatives for consideration instead of or in addition to, the regional desalination project: a Soquel Creek diversion project, local-only desalination, and/or site specific recycled water projects for nonpotable irrigation use.

2. Well Master Plan (Element 8). SqCWD should complete project approval for the Well Master Plan so that additional wells can be installed to effectively manage pumping in the basin.

3. Polo Grounds Well Monitoring and Mitigation Plan (Element 9). SqCWD should implement the monitoring and mitigation plan in the Well Master Plan EIR regarding potential restrictive effects on private wells and CWD's Cox and Rob Roy well fields from converting the Polo Grounds well to municipal use. Implementation of this plan begins before the Polo Grounds conversion in order to obtain baseline monitoring data. SqCWD and CWD should finalize a cooperative groundwater management agreement for this shared portion of the basin.

4. Cooperative Groundwater Management Agreement with City of Santa Cruz (Element 8). Plans by both agencies to install new wells in the shared portion of

the basin increase the importance of an agreement for groundwater management of the area.

5. Conduct Cox Well Field Aromas and Purisima Groundwater Basin Management Study. Using funds from a Proposition 84 planning grant, CWD should evaluate maximizing the developable yield in CWD's Cox Well Field to address concerns about Chromium VI in the CWD service area and SqCWD's Aromas water quality and overdraft concerns.

6. Replace identified monitoring wells (Element 1). To obtain useful groundwater data from all of the monitoring network, SqCWD should replace the monitoring wells SC-8F and SC-9A as they are sanded up to 100 feet. Since all SC-9 completions are in the same boring as SC-9A and are at risk of being sanded up, SqCWD should replace all SC-9 completions with the necessary completions for monitoring aquifer conditions.

7. Continue to upgrade groundwater monitoring equipment (Element 1). SqCWD should continue to follow recommendations in *Evaluation of Water Quality Monitoring Network and Recommendations for Improvement* for replacing groundwater sampling equipment to improve sampling efficiencies. Upgrades should also include installing groundwater level loggers in more monitoring wells.

8. Comply with statewide groundwater monitoring requirement (Element 1). SqCWD and CWD activities meet the requirements of 2009 state water package for groundwater monitoring (CASGEM). Santa Cruz County is responsible for reporting data to the state and SqCWD and CWD should work with the County to meet reporting requirements.

9. Reassess Sustainable Yield Estimates (Element 14). Data from this report, the groundwater recharge study and the PVWMA model can be used to reassess sustainable yield estimates last revised in 2009 (HydroMetrics LLC, 2009c). These estimates can be used for long-term water supply planning.

10. Evaluate results from time series analysis of groundwater level data (Element 1). Dr. Raquel Prado of UC Santa Cruz is expected to perform time series analysis of historical groundwater level data from SqCWD's monitoring wells. The results of the study should be evaluated to assess implications for groundwater management.

11. Manage well operation based on pumping water levels (Element 8). SqCWD should continue to manage pumping based on current groundwater level data measured by transducers installed in production wells to better manage pumping.

12. Formalize relationships with small water systems (Element 10). Cooperative relationships with small water systems to meter their wells and share data as well as implement conservation measures would help encourage those systems to pump sustainably. Additional relationships to monitor for impacts of SqCWD pumping on small water systems are being formalized through the Well Master Plan private well monitoring and mitigation program.

13. Survey elevations of monitoring wells that have not been surveyed (Element 1). Accurate groundwater level elevations depend on accurate survey information for well reference points. The SC-11, SC-A6, and SC-A7 monitoring wells do not have reference point elevations. The SC-11 wells at Porter Gulch are the highest priority for surveying because there is no nearby production well with survey information.

7.2 CURRENT DATA INADEQUACIES

The following is a list of current data inadequacies that could be addressed to enhance basin understanding and management. Some of these inadequacies are being addressed by recently implemented programs or will be addressed by basin management action priorities listed in Section 7.1. It is recommended that SqCWD and CWD develop additional programs and projects to address remaining data inadequacies as they gain more priority.

- Non-agency pumping. As shown in Table 2-1 and Table 2-2, estimates of non-agency pumpers are based on data from 1999 or earlier, more recent data is needed for a more complete analysis of basin pumping.
- Shallow groundwater levels. Basin-wide shallow groundwater level monitoring would help assess changes in basin storage. The County's recently implemented private well monitoring program is starting to provide data to assess this inadequacy. Multi-year data from wells completed in the shallowest unit could help quantify changes in basin storage.

- Continuous groundwater level measurements in monitoring wells. These measurements are being recorded in several SqCWD and CWD monitoring wells. The effects of tides, season, and pumping cycles could be evaluated by installing groundwater level transducers in more monitoring wells.
- Pumping requirements for basin recovery. It is unknown what the reduction in pumping and expected time-frame is for the basin to recover to elevations protective against seawater intrusion. Reducing pumping to gather data for this question may require a supplemental supply.
- New monitoring wells between pumping wells. The monitoring network includes coastal wells, wells adjacent to pumping wells, and wells upland of pumping areas. There are no monitoring wells placed to monitor potential well interference between pumping areas except for wells recently installed by the City of Santa Cruz. There are also no monitoring wells to assess inland advancement of seawater intrusion in the Aromas area.

SECTION 7
BASIN MANAGEMENT ACTION PRIORITIES AND RECOMMENDATIONS

7.1 BASIN MANAGEMENT ACTION PRIORITIES

This section lists the top priorities for projects and programs to achieve BMOs. BMO 2-2, maintain groundwater levels to prevent seawater intrusion, is the best indicator of the status of basin management. This objective has not been met so the highest priorities are given to projects that will help raise coastal groundwater levels to prevent seawater intrusion.

1. Secure Supplemental Supply (Element 5, BMO 1-2). BMO 2-2 and other BMOs rely on successfully securing a supplemental supply and achieving BMO 1-2. The regional desalination plant is currently the most likely supplemental supply option. The Integrated Resources Plan 2006 adopted by SqCWD emphasizes continued implementation of existing and new conservation and drought management programs regardless of developing a supplemental supply. It also identifies local supplemental supply alternatives for consideration instead of or in addition to, the regional desalination project: a Soquel Creek diversion project, local-only desalination, and/or site specific recycled water projects for nonpotable irrigation use.

2. Well Master Plan (Element 8). SqCWD should complete the Well Master Plan EIR so that additional wells can be installed to effectively manage pumping in the basin.

3. Conduct Groundwater Recharge Estimation Study (Element 14). Previous deep groundwater recharge estimates are fixed recharge estimates that cannot easily be divided into sub-regions or extrapolated to other areas, and do not provide information for estimating changes in recharge over time resulting from rainfall or land use variation. A study that estimates the spatial and temporal variation in deep groundwater recharge occurring in the source areas of the municipal production wells should be conducted.

4. Replace identified monitoring wells (Element 1). To obtain useful groundwater data from all of the monitoring network, SqCWD should replace the monitoring wells SC-8F and SC-9A as they are sanded up to 100 feet. All SC-

9 completions are in the same boring as SC-9A and are at risk of being sanded up so SqCWD should replace all SC-9 completions.

5. Manage well operation based on pumping water levels (Element 8). SqCWD should continue to install groundwater level transducers in production wells to better manage pumping based on current pumping and non-pumping groundwater levels. This project will be completed by June 2010.

6. Comply with statewide groundwater monitoring requirement (Element 1). SqCWD and CWD activities meet the requirements of 2009 state water package for groundwater monitoring. SqCWD and CWD should work together and with other local agencies to meet reporting requirements.

7. Continue to upgrade groundwater monitoring equipment (Element 1). SqCWD should continue to follow recommendations in *Evaluation of Water Quality Monitoring Network and Recommendations for Improvement* for replacing groundwater sampling equipment to improve sampling efficiencies. Upgrades should also include installing groundwater level loggers in more monitoring wells.

8. Formalize relationships with small water systems (Element 10). Small water systems and private wells may pump a significant portion of the sustainable yield, particularly in the Aromas area. Cooperative relationships with small water systems to meter their wells and share data as well as implement conservation measures would help encourage those systems to pump sustainably.

9. Survey elevations of monitoring wells that have not been surveyed (Element 1). Accurate groundwater level elevations depend on accurate survey information for well reference points. The SC-11, SC-A6, and SC-A7 monitoring wells do not have reference point elevations. The SC-11 wells at Porter Gulch are the highest priority for surveying because there is no nearby production well with survey information. SqCWD should survey these wells, probably when wells are replaced or monitoring wells are installed at Polo Grounds.

7.2 CURRENT DATA INADEQUACIES

The following is a list of current data inadequacies that could be addressed to enhance basin understanding and management. Some of these inadequacies are being addressed by recently implemented programs or will be addressed by basin management action priorities listed in Section 7.1. It is recommended that SqCWD and CWD develop additional programs and projects to address remaining data inadequacies as they gain more priority.

- Non-agency pumping. As shown in Table 2-1 and Table 2-2, estimates of non-agency pumpers are based on data from 1999 or earlier, more recent data is needed for a more complete analysis of basin pumping.
- Groundwater recharge estimates. Deep recharge estimates need to be refined to further evaluate the estimate of sustainable yield and to determine what impacts changing land use has on groundwater recharge.
- Shallow groundwater levels. Basin-wide shallow groundwater level monitoring would help assess changes in basin storage. The County's recently implemented private well monitoring program is starting to provide data to assess this inadequacy. Multi-year data from wells completed in the shallowest unit could help quantify changes in basin storage.
- Continuous groundwater level measurements in monitoring wells. These measurements are being recorded in several SqCWD and CWD monitoring wells. The effects of tides, season, and pumping cycles could be evaluated by installing groundwater level transducers in more monitoring wells.
- Pumping requirements for basin recovery. It is unknown what the reduction in pumping and expected time-frame is for the basin to recover to elevations protective against seawater intrusion. Reducing pumping to gather data for this question may require a supplemental supply.
- New monitoring wells between pumping wells. The monitoring network includes coastal wells, wells adjacent to pumping wells, and wells upland of pumping areas. There are no monitoring wells placed to monitor potential well interference between pumping areas except for wells recently installed by the City of Santa Cruz. However, future production wells are planned for the two well locations currently between pumping areas. There are also no monitoring wells to assess inland advancement of seawater intrusion in the Aromas area.

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SECTION 8
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