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Ms. Kim Adamson
General Manager
Soquel Creek Water District
PO Box 1550
Capitola, CA 95010-1550

March 13, 2014

Subject: Quarterly Report for Coastal Monitoring Data through January 2014

Ms. Adamson:

Attached is the second quarterly report with updates on groundwater level and salt concentration data at coastal monitoring wells where protective elevations have been defined. These wells, SC-1A, SC-3A, SC-5A, SC-9C, SC-8D, SC-A1A and B, SC-A8A and B, SC-A2A and B, SC-A3A and B, and SC-A4A and B are the key wells for assessing risk of seawater intrusion and the status of basin recovery in the Soquel-Aptos basin. Protective elevations estimated to protect productive aquifer units from seawater intrusion and secondary drinking water standards (MCLs) for chlorides and total dissolved solids (TDS) are shown on the plots. Data through January 2014 are included, although the Purisima wells SC-3A, SC-5A, SC-9C, and SC-8D are sampled semi-annually so no new salt concentrations were measured at these wells from November 2013-January 2014.

GROUNDWATER LEVEL TRENDS

It was noted in the last quarterly report that there was a partial reversal of the multi-year recovery trend in groundwater levels in the Western Purisima A unit (SC-1A, 3A, and 5A), groundwater levels in Water Year 2013 are lower than the previous year, which is a partial reversal of the multi-year recovery trend in these wells. A declining trend since 2012 is observed for groundwater level data through January 2014 in these wells despite a seasonal recovery of groundwater levels at SC-3A and SC-5A. In the Central Purisima (BC and DEF units),

groundwater levels show a multi-year recovery trend although seasonal recovery did not occur in January at SC-9C and SC-8D. In the Aromas area (Purisima F unit and Aromas Red Sands), groundwater levels generally continue to recover.

SALT CONCENTRATION TRENDS AND SC-1A EVALUATION

There are no notable changes in salt concentration trends except at SC-1A. In my January 9 letter responding to questions related to the first quarterly report, I stated the opinion that the recent increasing trend for chloride and TDS does not indicate seawater intrusion. We have further evaluated these trends based on the general minerals content from this well.

We plotted the sodium/chloride molar ratio for data since 2009 coincident with the increasing trend in chloride and TDS (Figure 1). Chloride concentrations had previously peaked above 50 mg/L in January 1996 and sodium/chloride molar ratio was plotted in Johnson et al. (2004) for 1996-2003 (Figure 2). In both time periods, peak chloride concentrations coincided with sodium/chloride molar ratios as low as approximately 0.8 which can be an early indicator of seawater intrusion. However, similar to the post-1996 period, the ratios have recently shown an increasing trend with decreasing chloride concentrations. This lack of a continuing trend makes it unlikely to be an early indicator of seawater intrusion, but these ratios are worth continuing to follow.

We also evaluated the cation/anion composition of water quality at SC-1A using a trilinear (Piper) diagram (Figure 3). Similar to the prior discussion in Johnson et al. (2004), the samples appeared to be trending toward seawater intrusion in the middle diamond, chloride concentrations are not trending toward seawater (lower-right corner) in the lower-right triangle. Therefore, there is not a consistent indication for seawater intrusion, but the general mineral composition is worth continuing to follow.

The observed short-term trends in chloride and TDS concentrations also do not indicate appropriateness of the protective groundwater level of 4 feet mean sea level established at SC-1A. Rising concentrations have coincided with rising groundwater levels and a declining concentrations have coincided with declining groundwater levels.

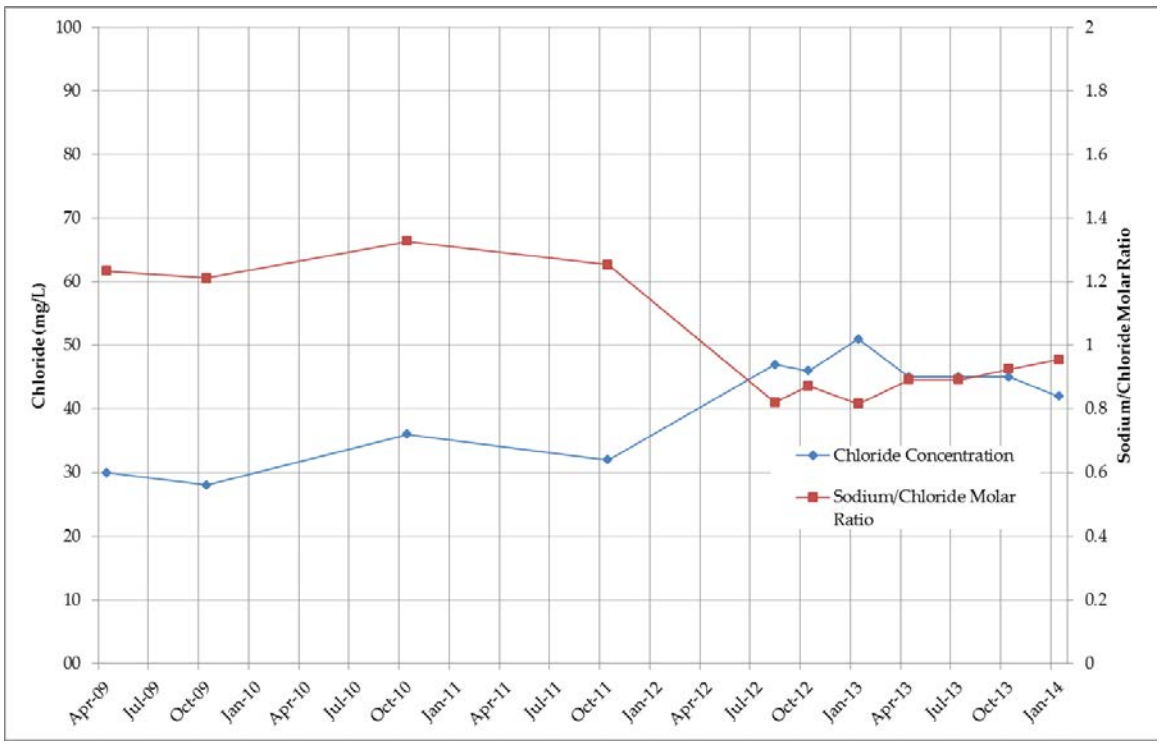


Figure 1. Chloride Concentrations and Sodium/Chloride Molar Ratio 2009-2014

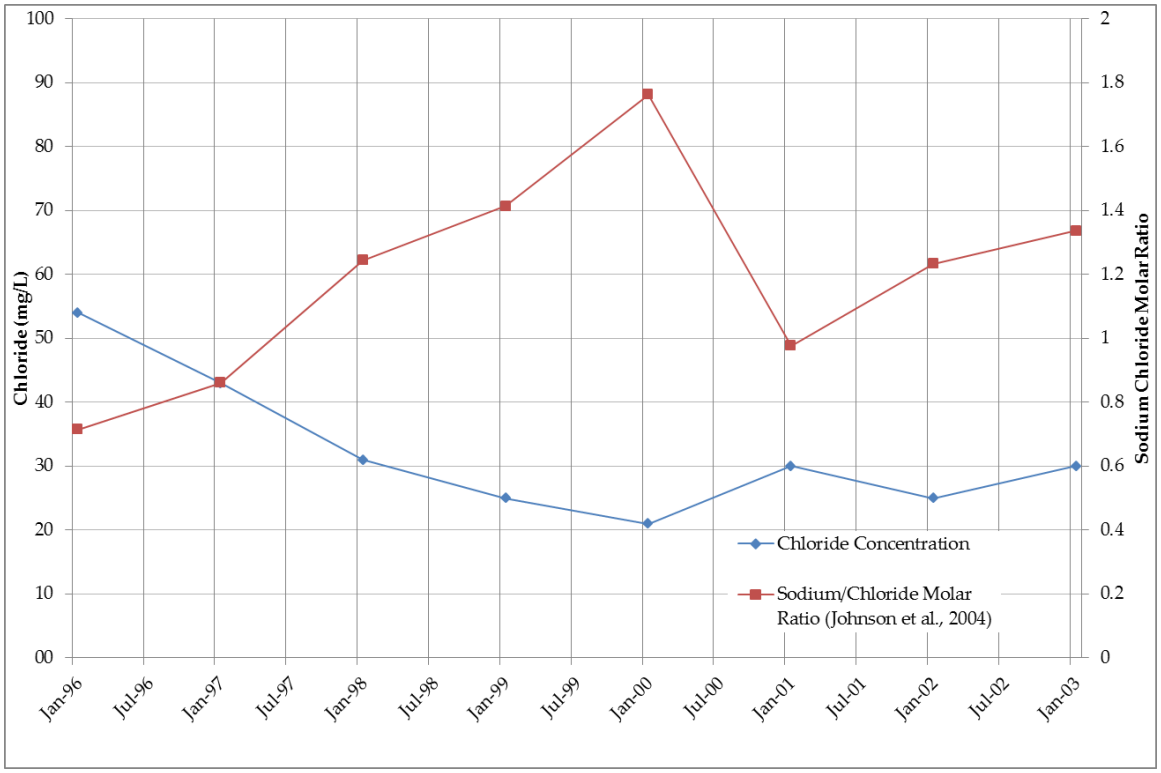


Figure 2. Chloride Concentrations and Sodium/Chloride Molar Ratio 1996-2003

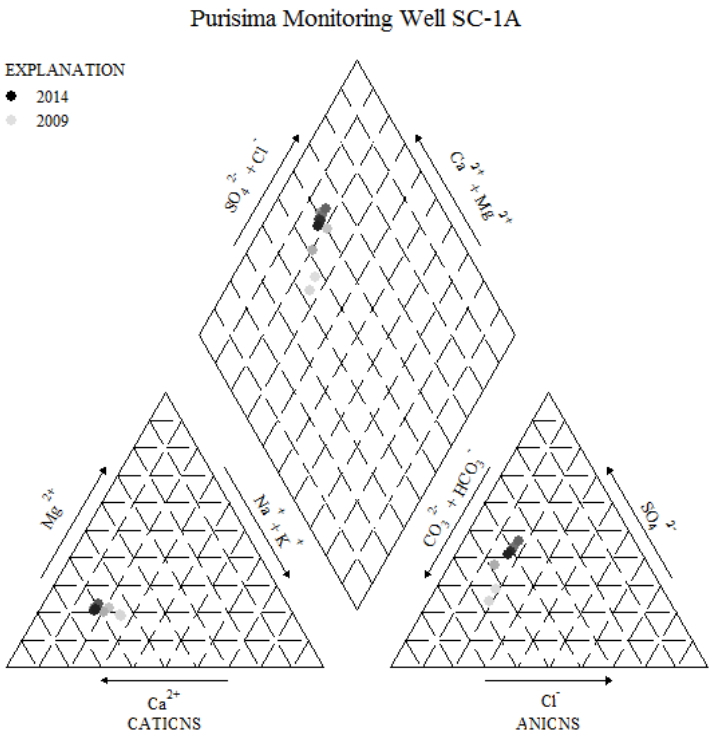


Figure 3. Trilinear (Piper) Diagram for SC-1A 2009-2014

ADDITIONAL NOTES

In a change from the first quarterly report, we have retrieved information indicating whether all chloride and TDS data were measured in the field or in lab. Christine Mead has noted that field tests for chlorides result in lower concentrations than laboratory tests. We have excluded field data for both chloride and TDS data.

The final issue that was raised by the Board in its review of the last quarterly report was the sudden drop in concentrations at SC-A3B. We recommended ordering a new drop tube to sample the bottom screen of the well, but that recommendation was given after the December sample was taken. The District has recently received the new equipment.

Like the first report, this report does not include groundwater level logger data planned for these reports going forward. District staff is working on configuring new software that will expedite the transfer of this data for future quarterly reports and the annual report. Future quarterly reports will include the following based on the logger data:

- Plots of available groundwater elevation data recorded by groundwater level loggers. The current equipment was installed at most of these wells in 2012.
- Average groundwater elevations will be calculated based on the logger data for the quarter, water year to date, and preceding four quarters. Average equivalent freshwater heads will be estimated for the three time periods at wells where chloride concentrations are above the MCL of 250 mg/L.

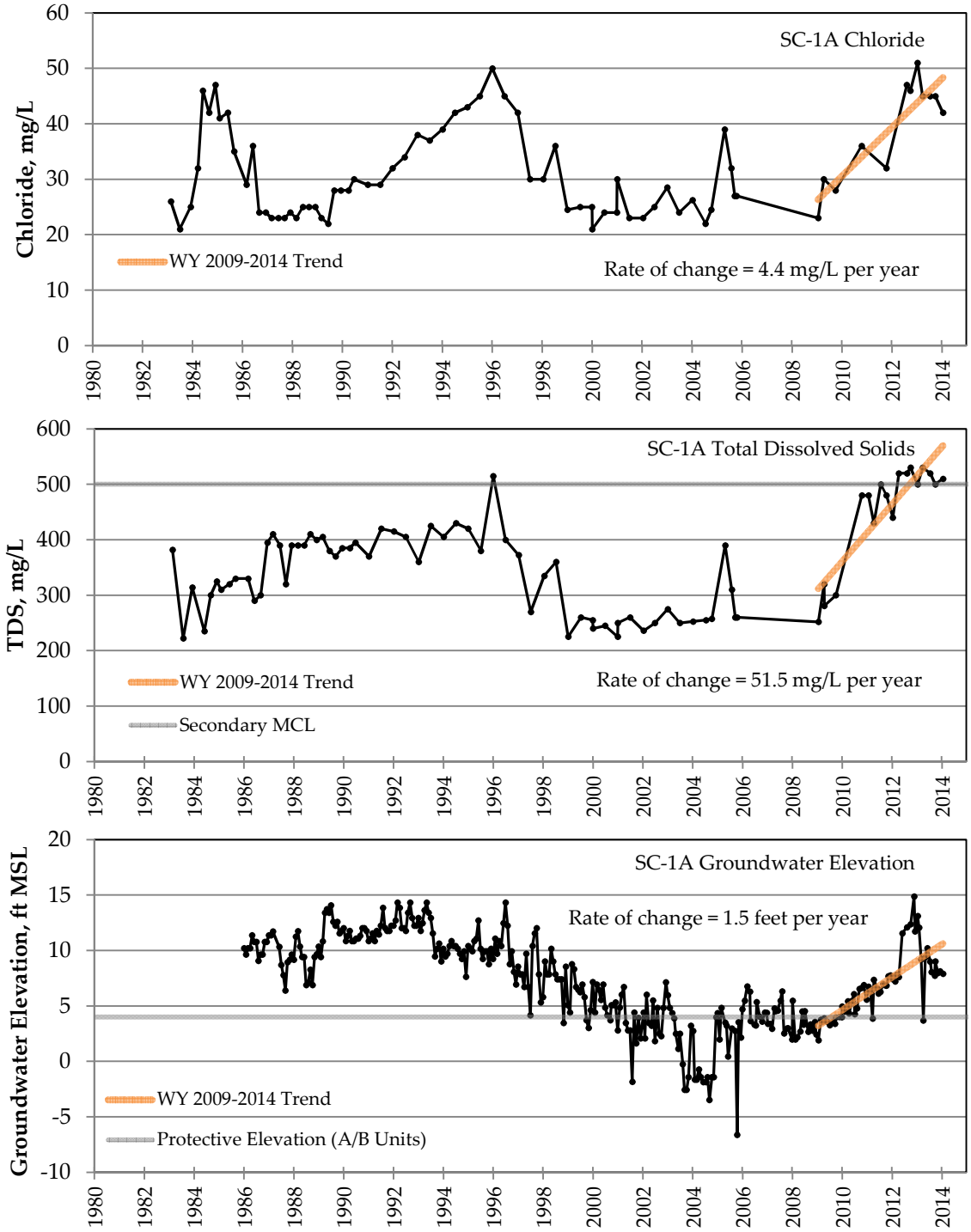
Page numbers are consistent with the Annual Report and Review figure sections 3B, 4B, and 5B, and therefore are not in consecutive order.

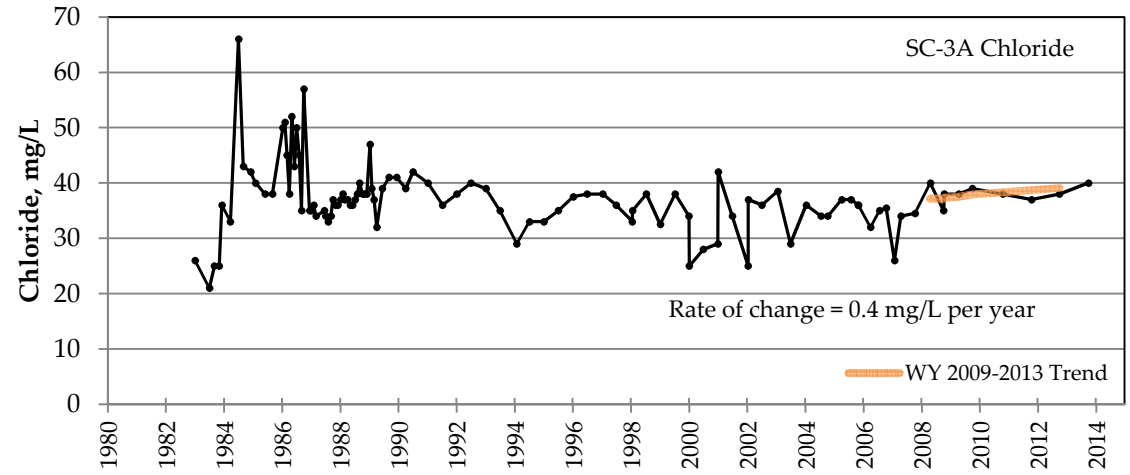
Thank you to District staff for making the data available expeditiously. Please let me know if you have any questions.

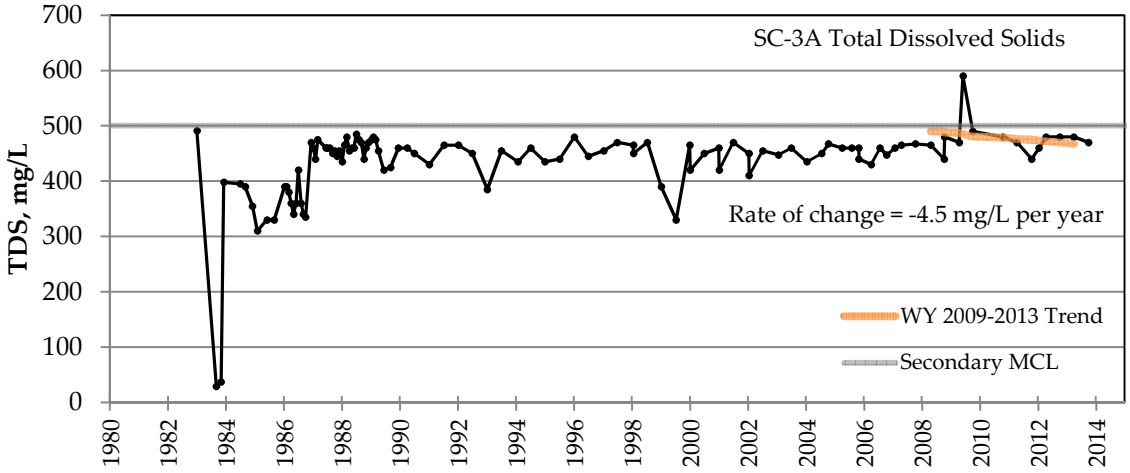
Sincerely,

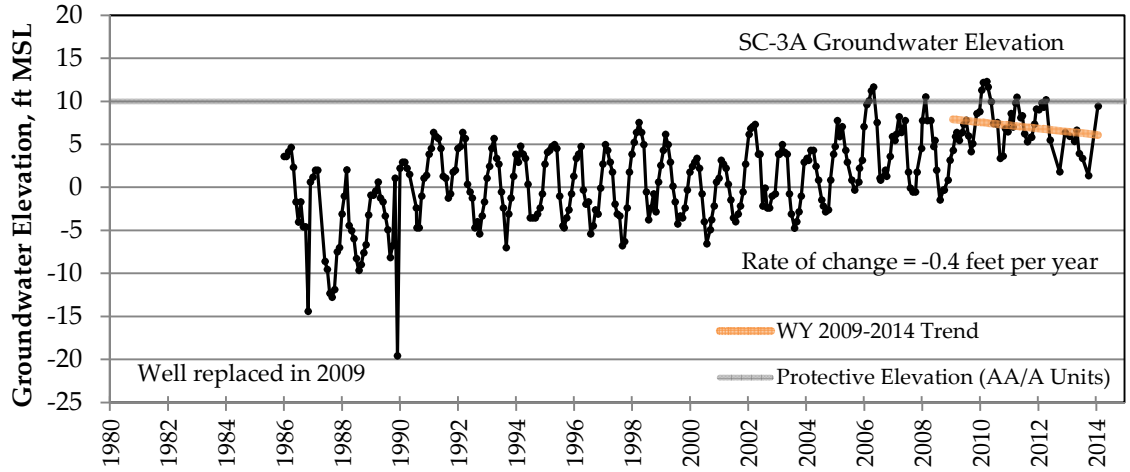
Cameron Tana, Vice President
HydroMetrics Water Resources Inc.

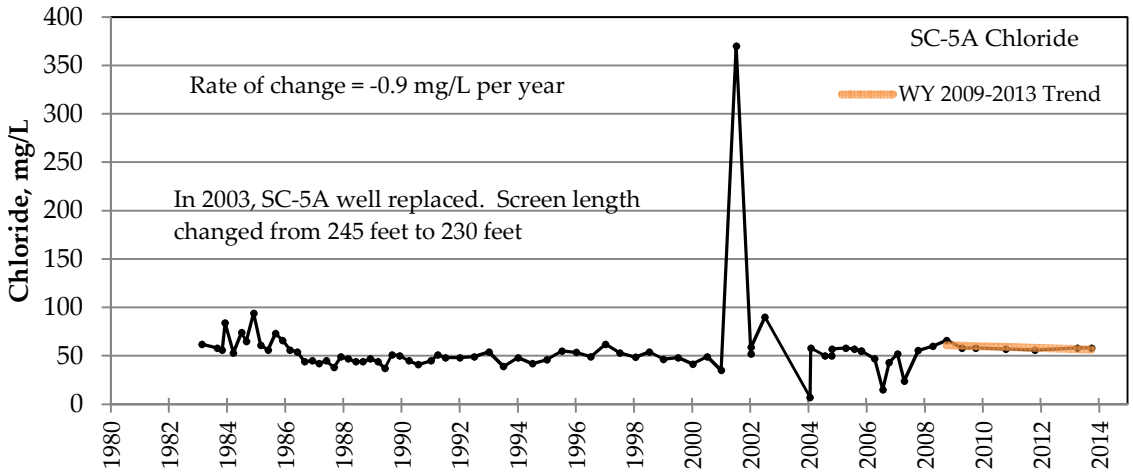
Attachment: Coastal monitoring well hydrographs and chemographs

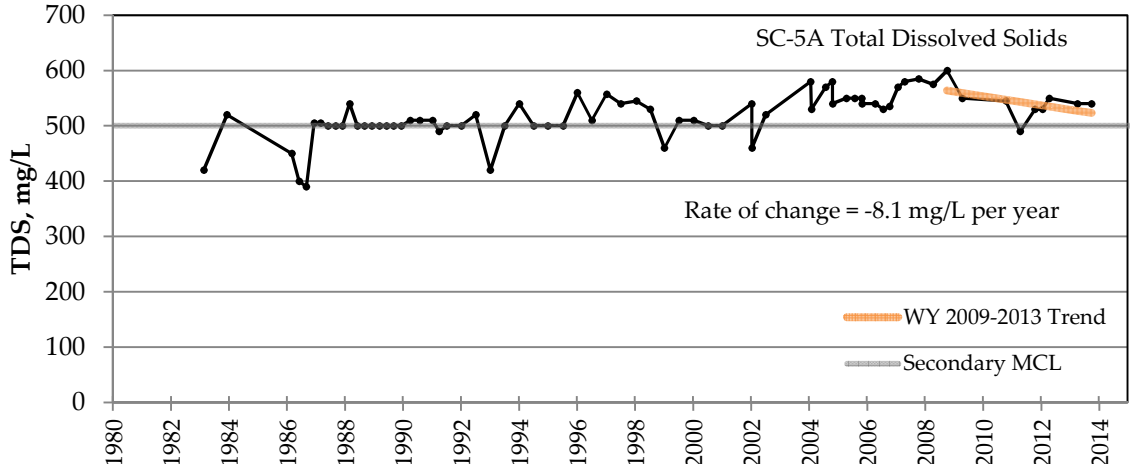

SC-1A Chloride
Chloride, mg/L
WY 2009-2014 Trend
Rate of change = 4.4 mg/L per year
SC-1A Total Dissolved Solids
TDS, mg/L
WY 2009-2014 Trend
Rate of change = 51.5 mg/L per year
Secondary MCL
SC-1A Groundwater Elevation
Groundwater Elevation, ft MSL
Rate of change = 1.5 feet per year
WY 2009-2014 Trend
Protective Elevation (A/B Units)

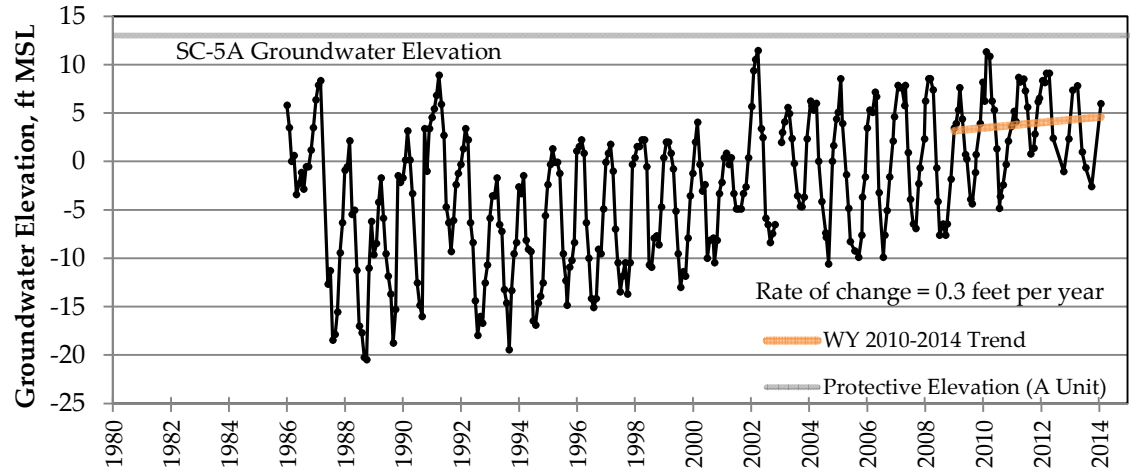

SC-3A Chloride
Chloride, mg/L
Rate of change = 0.4 mg/L per year
WY 2009-2013 Trend

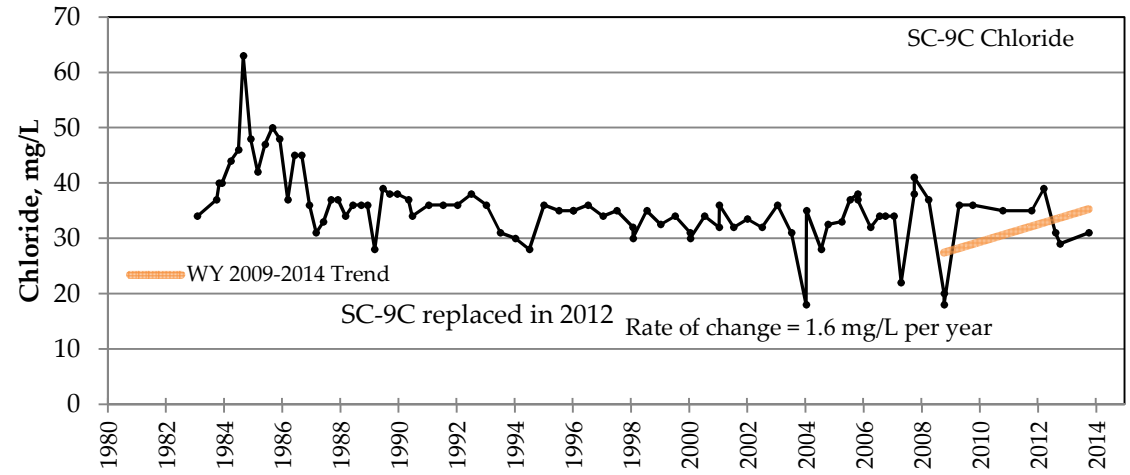

SC-3A Total Dissolved Solids
TDS, mg/L
Rate of change = -4.5 mg/L per year
WY 2009-2013 Trend
Secondary MCL

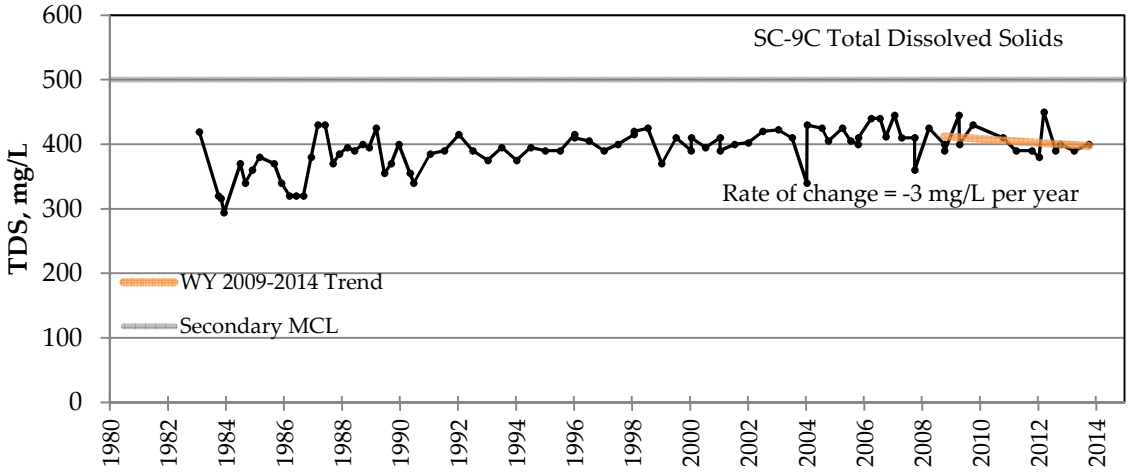

SC-3A Groundwater Elevation
Groundwater Elevation, ft MSL
Rate of change = -0.4 feet per year
WY 2009-2014 Trend
Protective Elevation (AA/A Units)
Well replaced in 2009

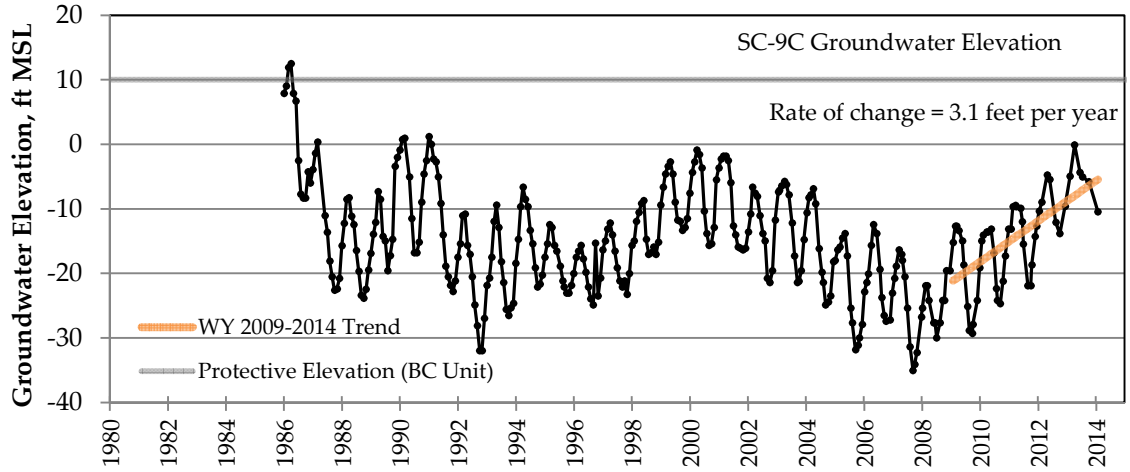

SC-5A Chloride
Rate of change = -0.9 mg/L per year
WY 2009-2013 Trend
In 2003, SC-5A well replaced. Screen length changed from 245 feet to 230 feet
Chloride, mg/L
400
350
300
250
200
150
100
50
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

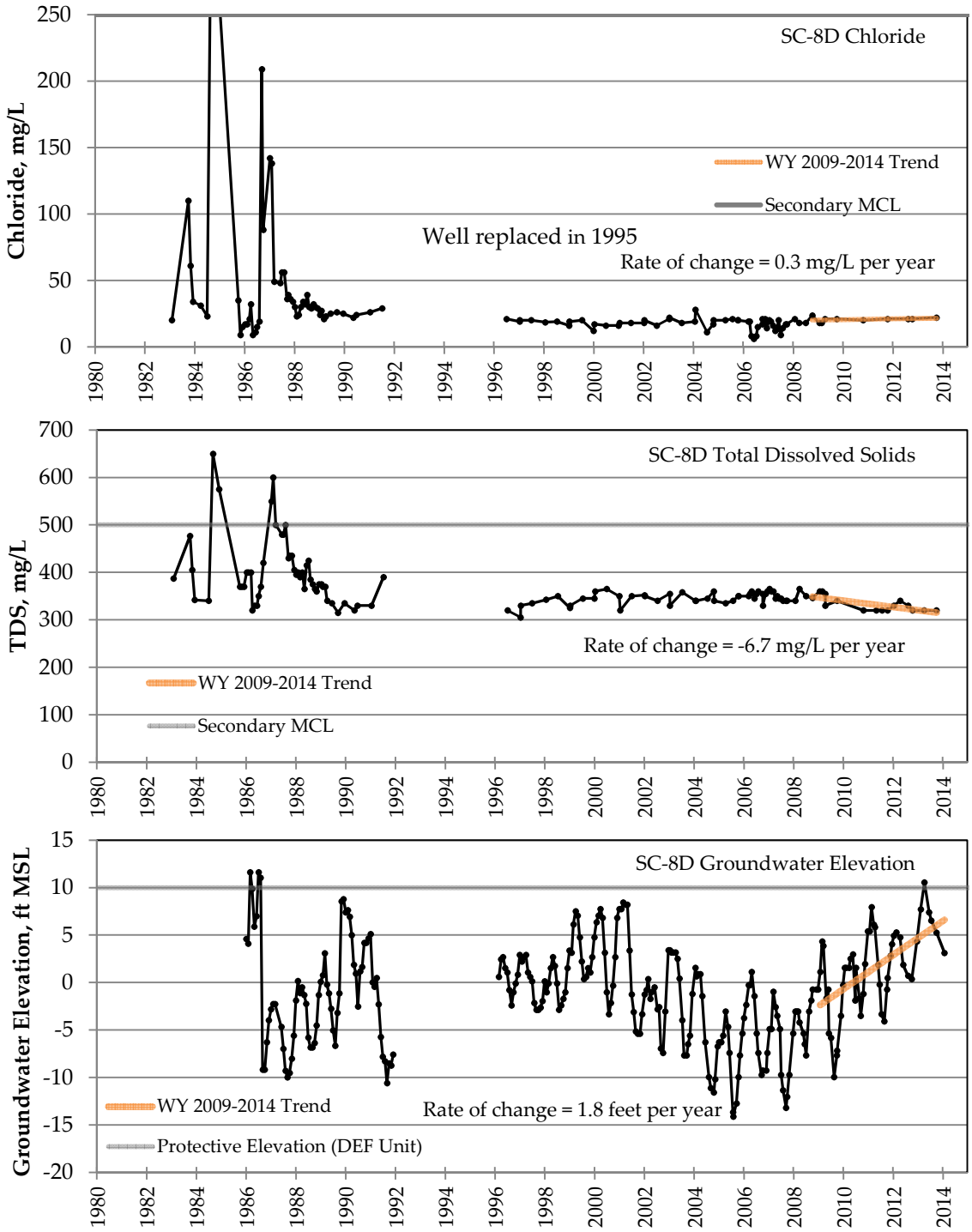

SC-5A Total Dissolved Solids
Rate of change = -8.1 mg/L per year
WY 2009-2013 Trend
Secondary MCL
TDS, mg/L
700
600
500
400
300
200
100
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

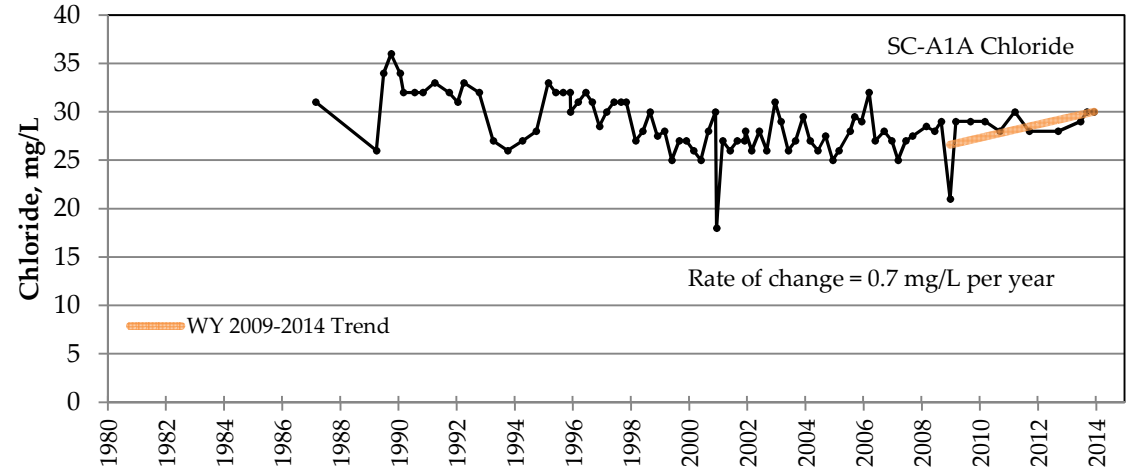

SC-5A Groundwater Elevation
Rate of change = 0.3 feet per year
WY 2010-2014 Trend
Protective Elevation (A Unit)
Groundwater Elevation, ft MSL
15
10
5
0
-5
-10
-15
-20
-25
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

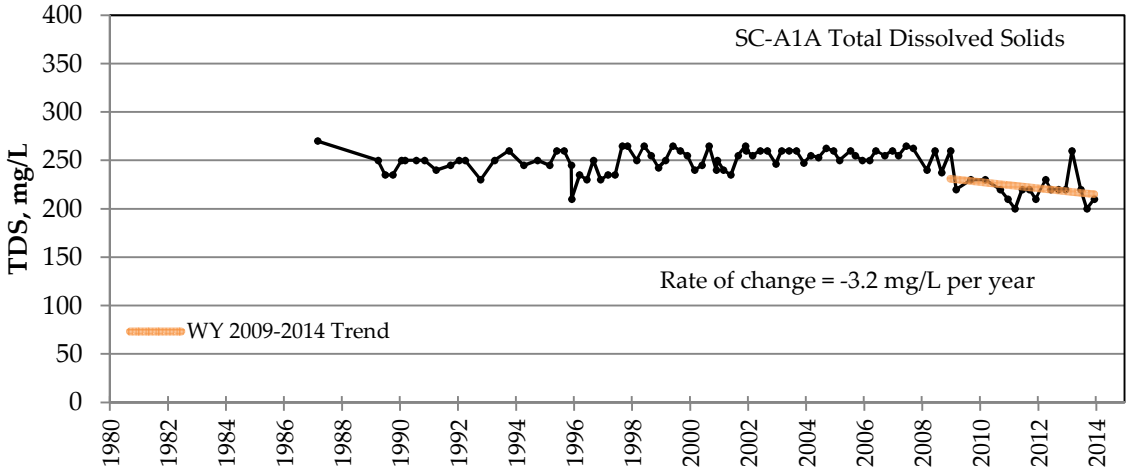

SC-9C Chloride
Chloride, mg/L
WY 2009-2014 Trend
SC-9C replaced in 2012
Rate of change = 1.6 mg/L per year

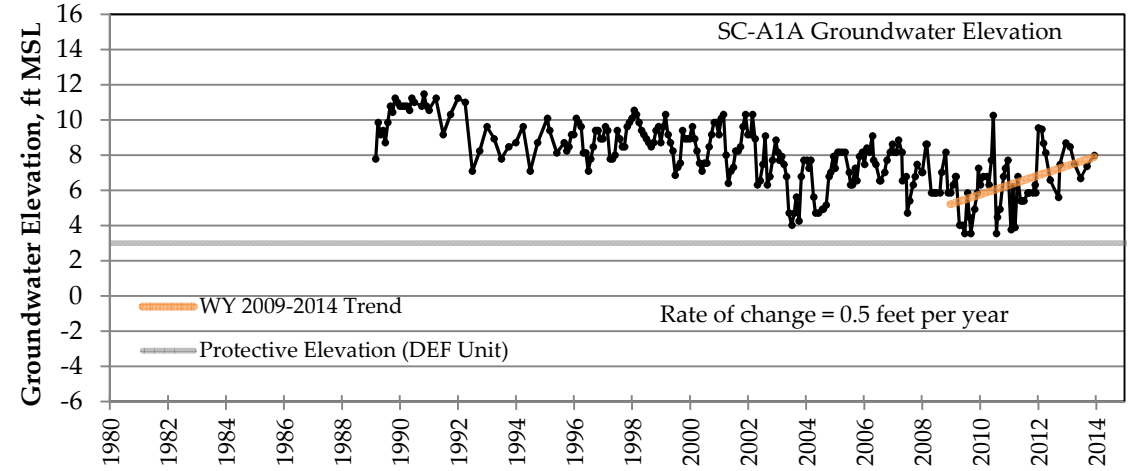

SC-9C Total Dissolved Solids
TDS, mg/L
Rate of change = -3 mg/L per year
WY 2009-2014 Trend
Secondary MCL

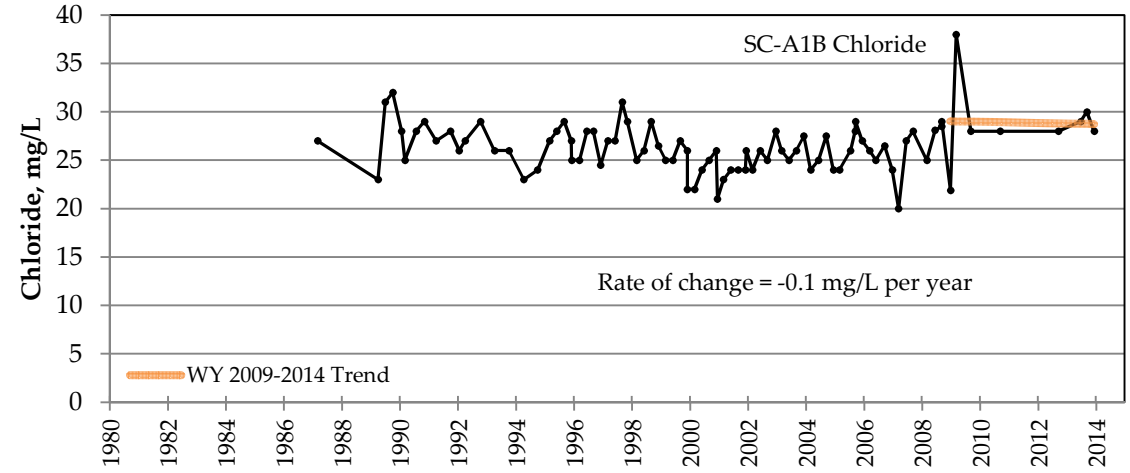

SC-9C Groundwater Elevation
Groundwater Elevation, ft MSL
Rate of change = 3.1 feet per year
WY 2009-2014 Trend
Protective Elevation (BC Unit)

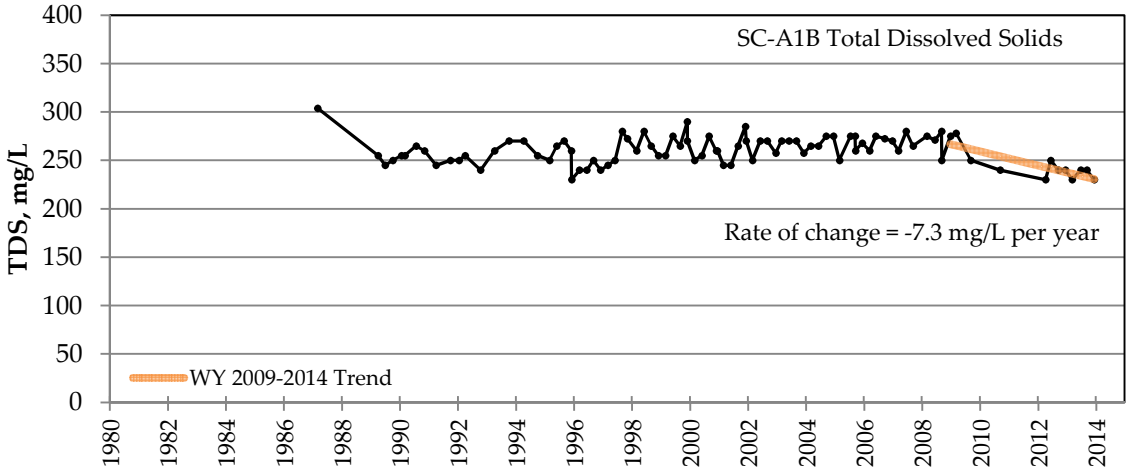

SC-8D Chloride
Chloride, mg/L
WY 2009-2014 Trend
Secondary MCL
Well replaced in 1995
Rate of change = 0.3 mg/L per year
SC-8D Total Dissolved Solids
TDS, mg/L
Rate of change = -6.7 mg/L per year
WY 2009-2014 Trend
Secondary MCL
SC-8D Groundwater Elevation
Groundwater Elevation, ft MSL
WY 2009-2014 Trend
Rate of change = 1.8 feet per year
Protective Elevation (DEF Unit)

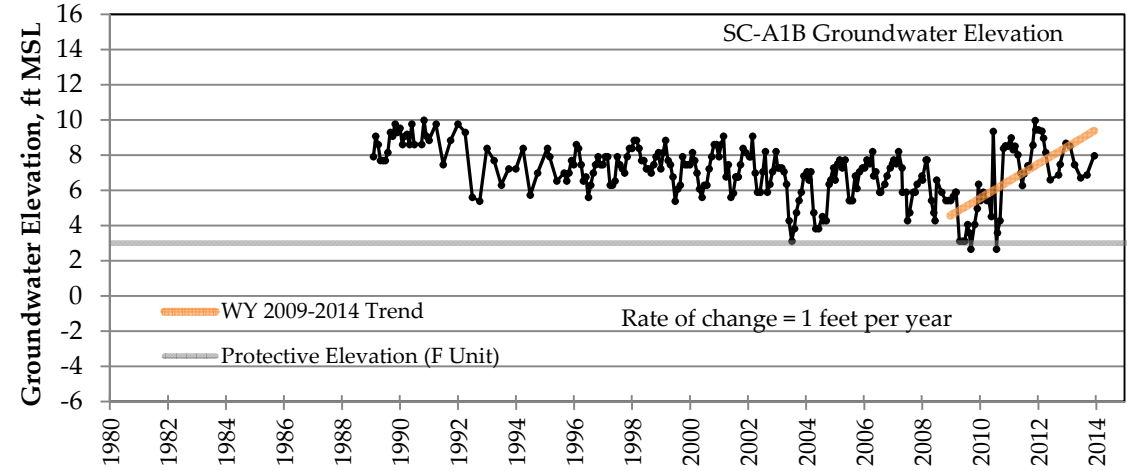

SC-A1A Chloride
Chloride, mg/L
Rate of change = 0.7 mg/L per year
WY 2009-2014 Trend
40
35
30
25
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


SC-A1A Total Dissolved Solids
TDS, mg/L
Rate of change = -3.2 mg/L per year
WY 2009-2014 Trend
400
350
300
250
200
150
100
50
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


SC-A1A Groundwater Elevation
Groundwater Elevation, ft MSL
Rate of change = 0.5 feet per year
WY 2009-2014 Trend
Protective Elevation (DEF Unit)
16
14
12
10
8
6
4
2
0
-2
-4
-6
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


SC-A1B Chloride
Chloride, mg/L
Rate of change = -0.1 mg/L per year
WY 2009-2014 Trend
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
2012
2014


SC-A1B Total Dissolved Solids
TDS, mg/L
Rate of change = -7.3 mg/L per year
WY 2009-2014 Trend
400
350
300
250
200
150
100
50
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


SC-A1B Groundwater Elevation
Groundwater Elevation, ft MSL
Rate of change = 1 feet per year
WY 2009-2014 Trend
Protective Elevation (F Unit)
16
14
12
10
8
6
4
2
0
-2
-4
-6
1980
1982
1984
1986
1988
1990
1992
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1996
1998
2000
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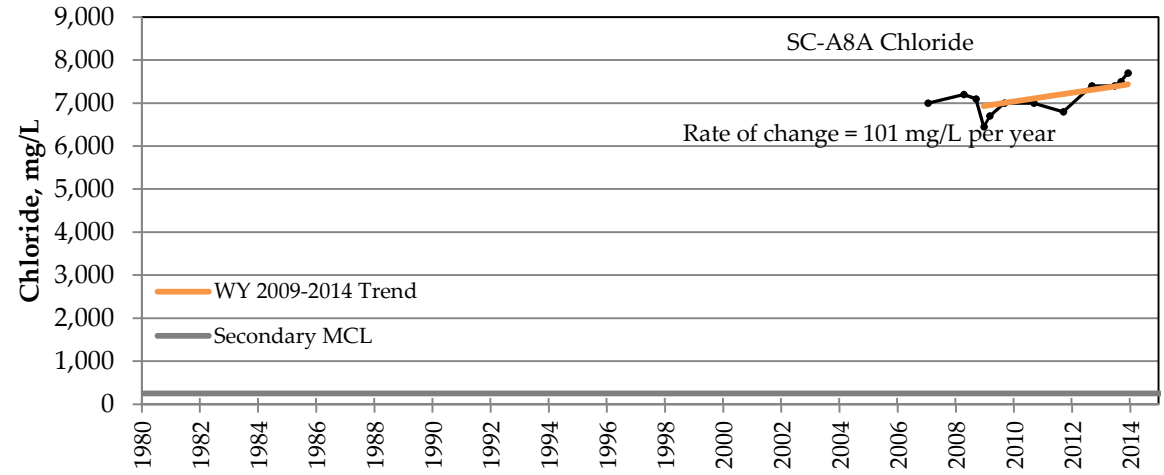
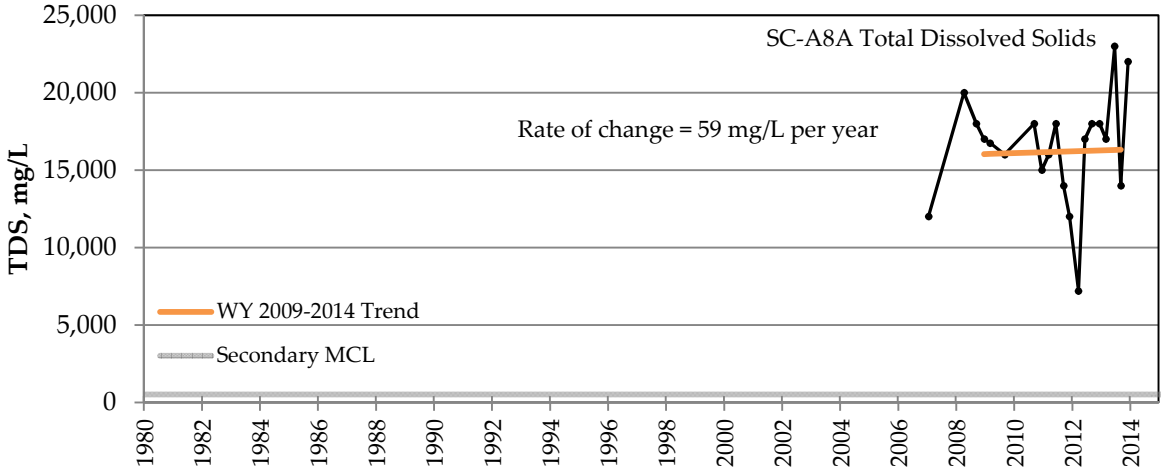
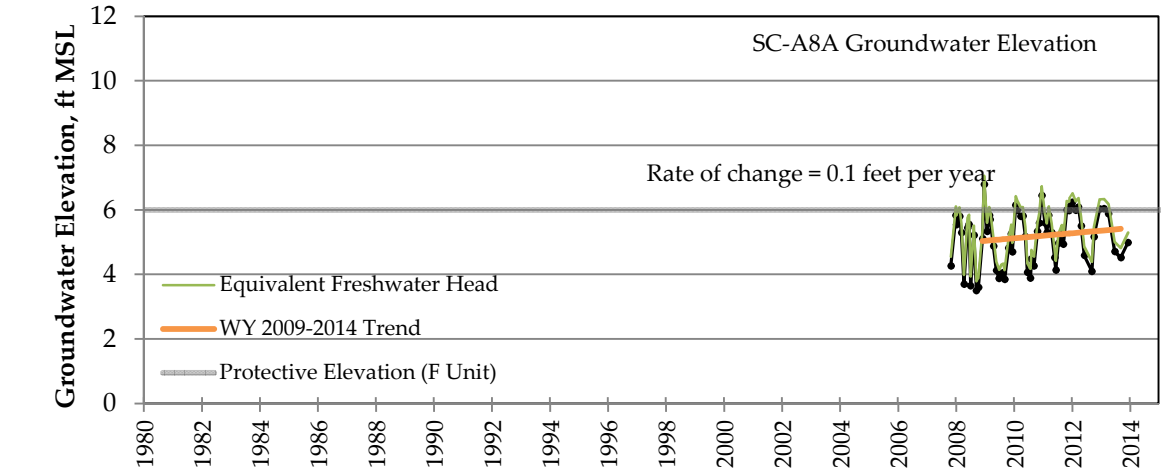
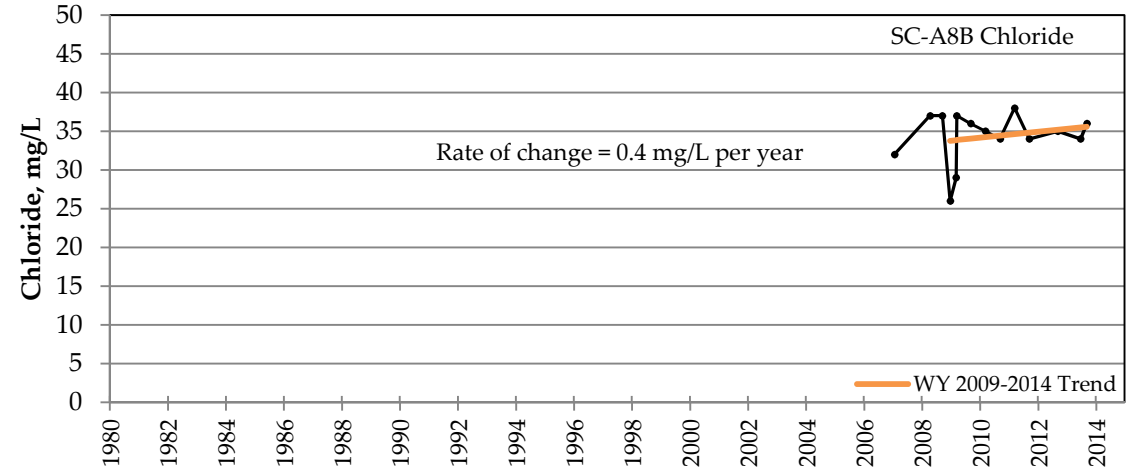
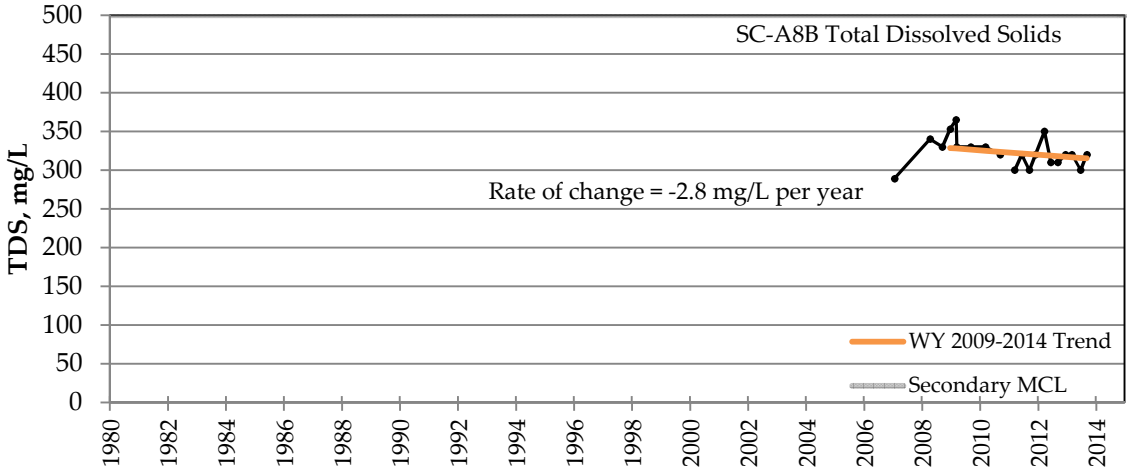
2004
2006
2008
2010
2012
2014

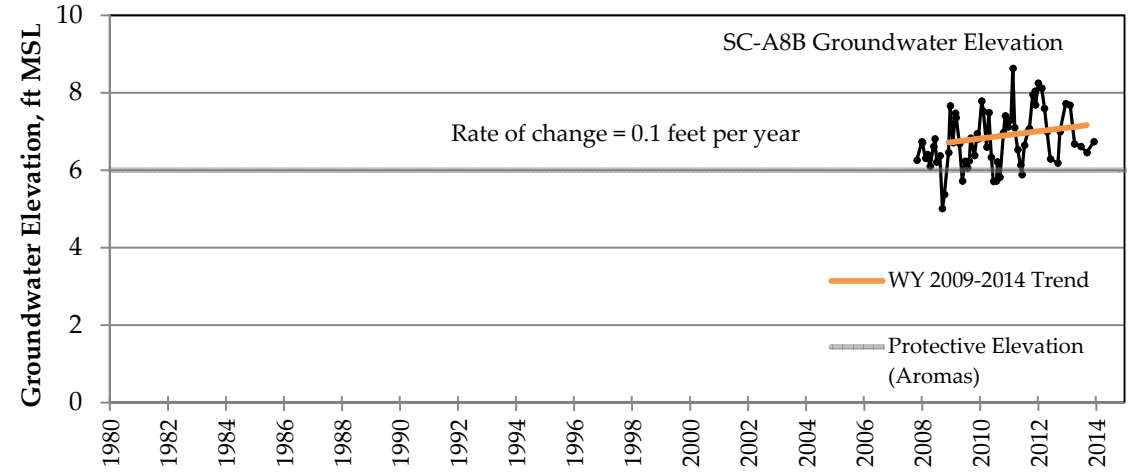

SC-A8A Chloride
Rate of change = 101 mg/L per year
Chloride, mg/L
WY 2009-2014 Trend
Secondary MCL
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

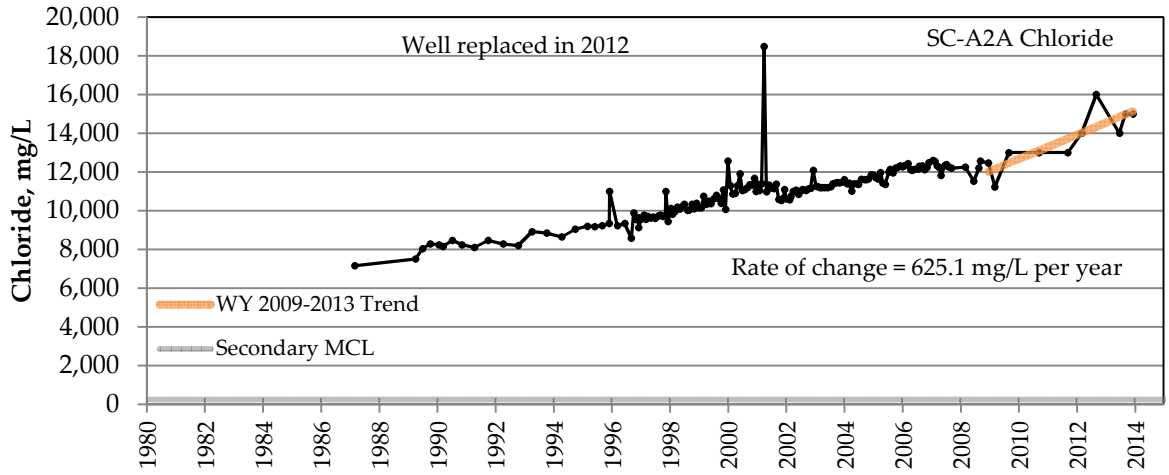

SC-A8A Total Dissolved Solids
Rate of change = 59 mg/L per year
TDS, mg/L
WY 2009-2014 Trend
Secondary MCL
25,000
20,000
15,000
10,000
5,000
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

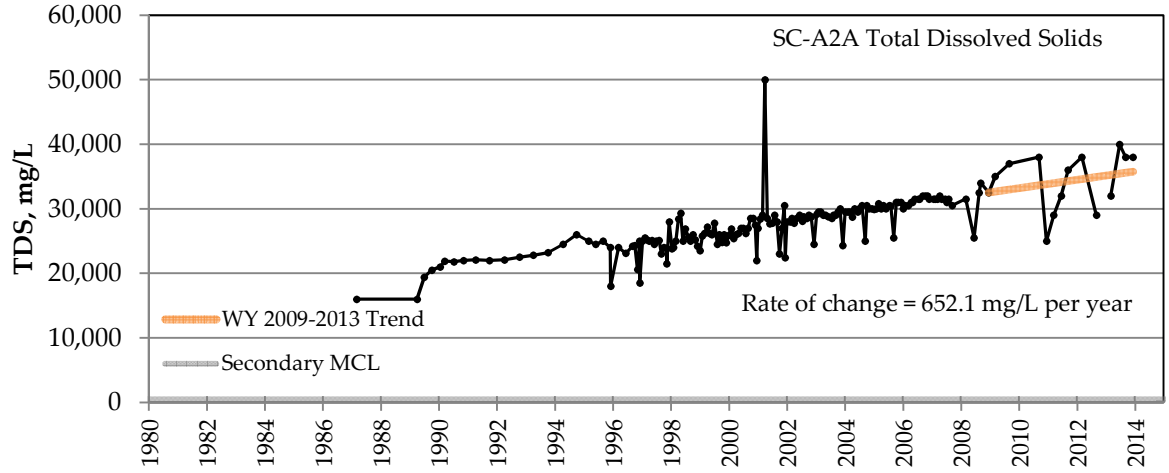

SC-A8A Groundwater Elevation
Rate of change = 0.1 feet per year
Groundwater Elevation, ft MSL
Equivalent Freshwater Head
WY 2009-2014 Trend
Protective Elevation (F Unit)
12
10
8
6
4
2
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

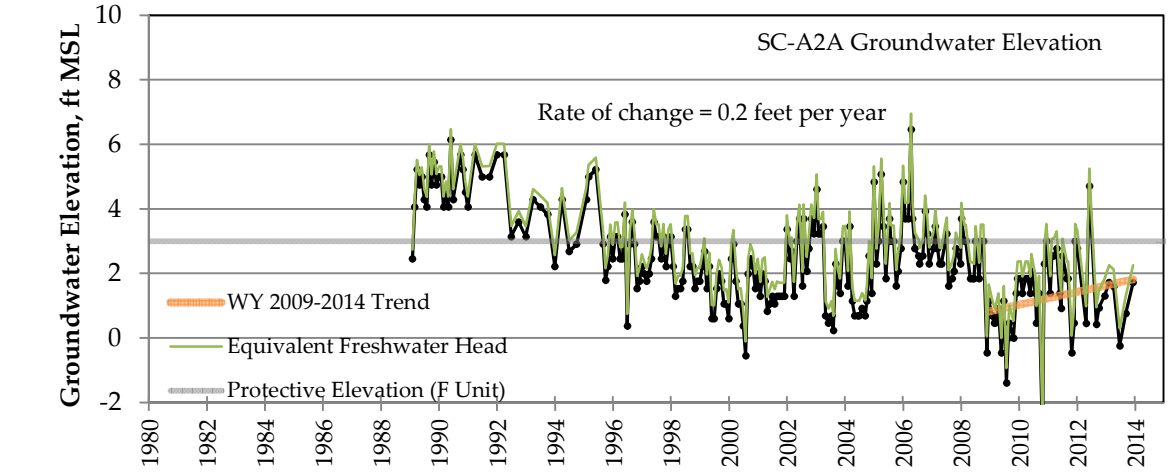

SC-A8B Chloride
Rate of change = 0.4 mg/L per year
WY 2009-2014 Trend
Chloride, mg/L
50
45
40
35
30
25
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

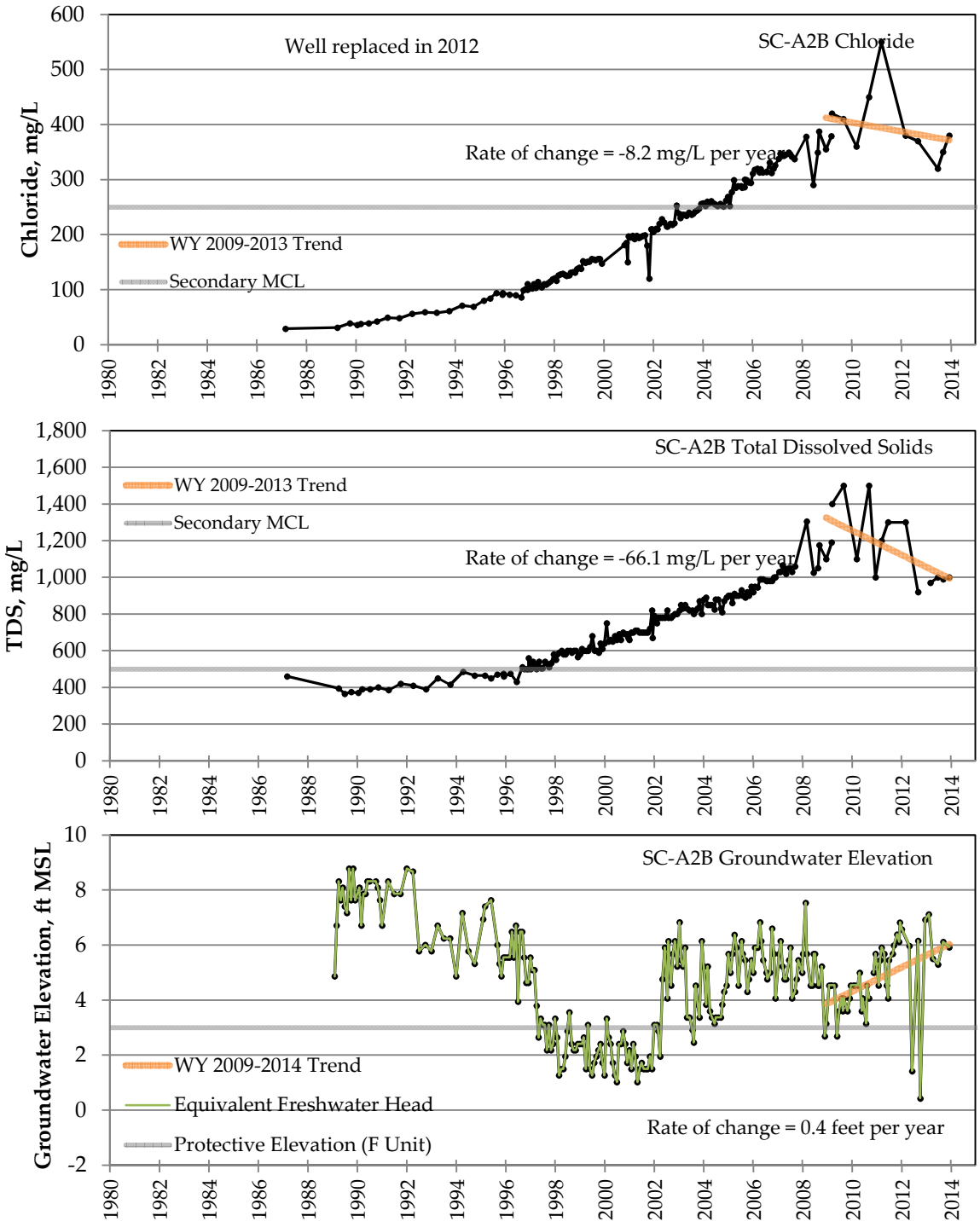

SC-A8B Total Dissolved Solids
Rate of change = -2.8 mg/L per year
WY 2009-2014 Trend
Secondary MCL
TDS, mg/L
500
450
400
350
300
250
200
150
100
50
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

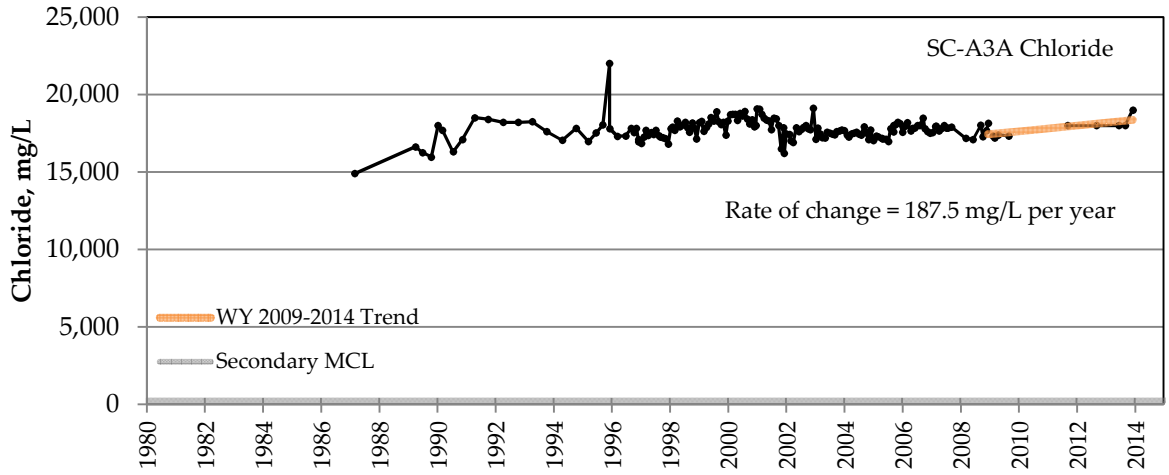

SC-A8B Groundwater Elevation
Rate of change = 0.1 feet per year
WY 2009-2014 Trend
Protective Elevation (Aromas)
Groundwater Elevation, ft MSL
10
8
6
4
2
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

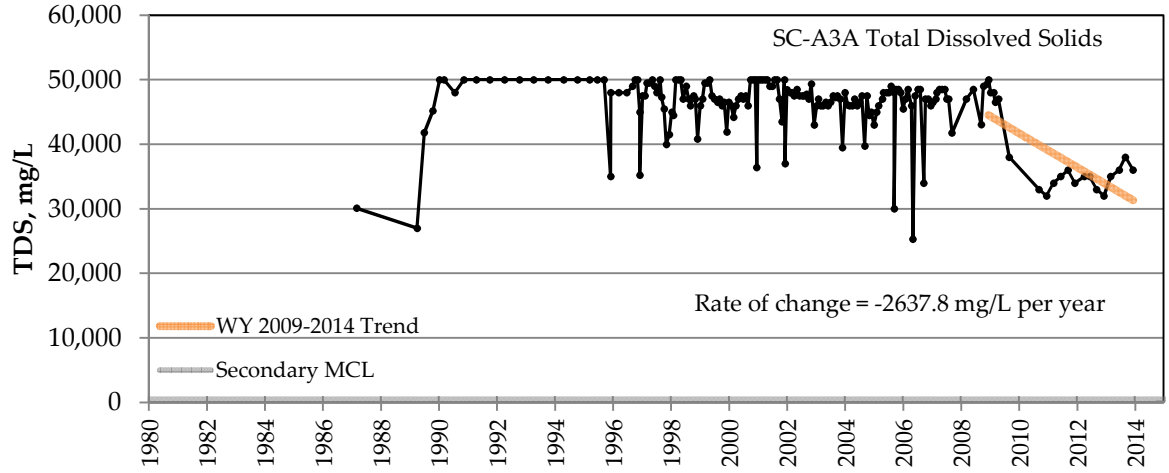

Well replaced in 2012
SC-A2A Chloride
Chloride, mg/L
Rate of change = 625.1 mg/L per year
WY 2009-2013 Trend
Secondary MCL

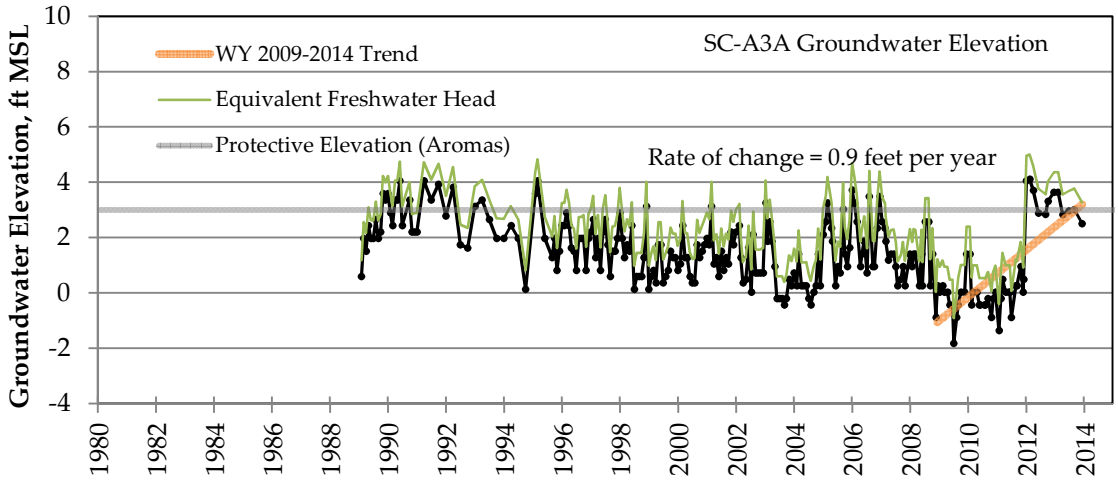

SC-A2A Total Dissolved Solids
TDS, mg/L
Rate of change = 652.1 mg/L per year
WY 2009-2013 Trend
Secondary MCL

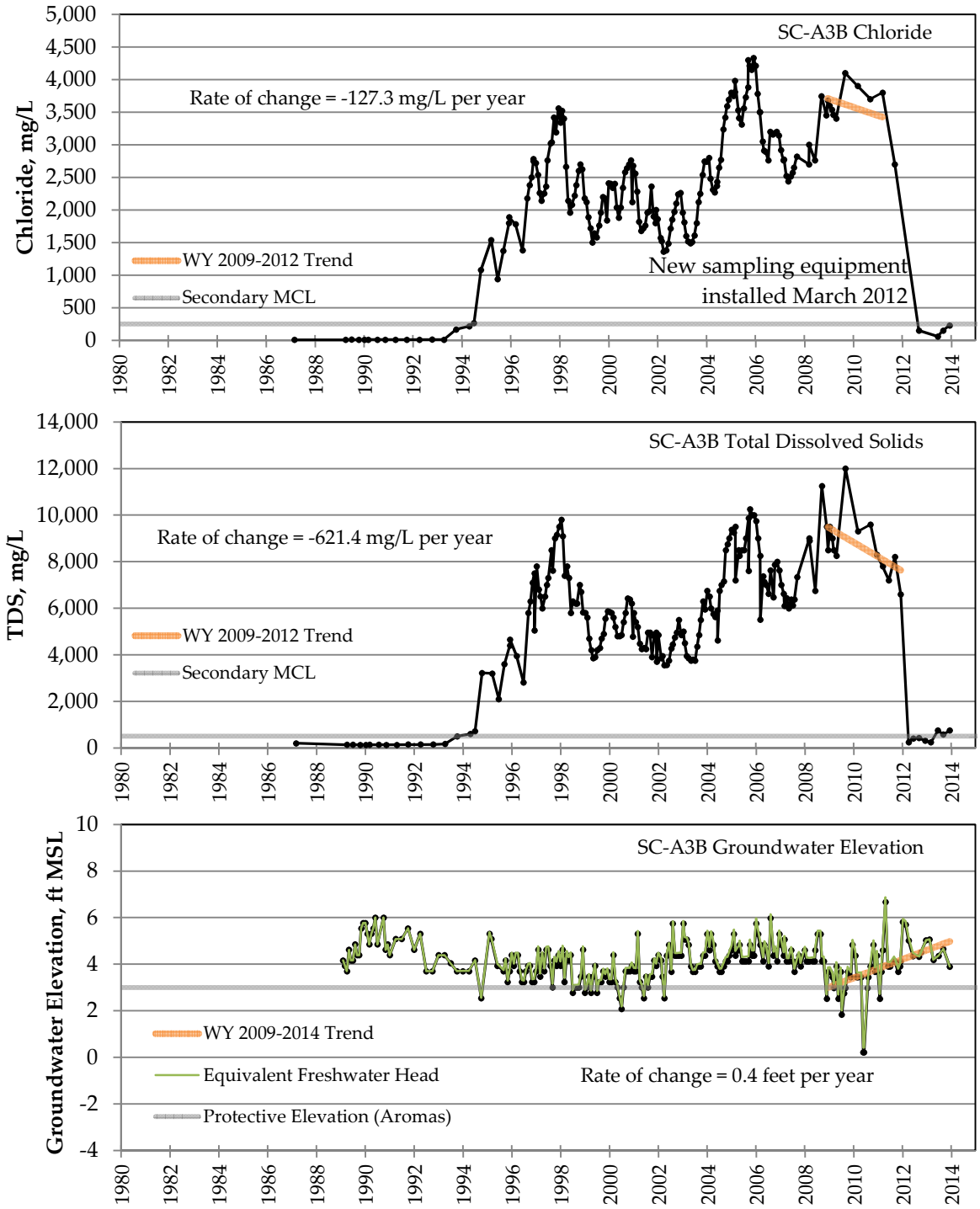

SC-A2A Groundwater Elevation
Groundwater Elevation, ft MSL
Rate of change = 0.2 feet per year
WY 2009-2014 Trend
Equivalent Freshwater Head
Protective Elevation (F Unit)

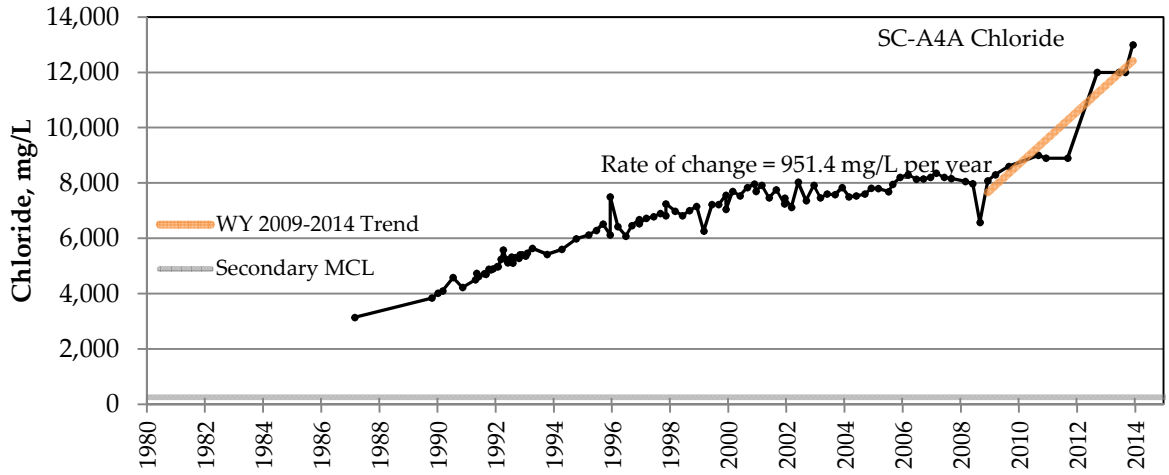

Well replaced in 2012
SC-A2B Chloride
Rate of change = -8.2 mg/L per year
WY 2009-2013 Trend
Secondary MCL
Chloride, mg/L
600
500
400
300
200
100
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
SC-A2B Total Dissolved Solids
WY 2009-2013 Trend
Secondary MCL
Rate of change = -66.1 mg/L per year
TDS, mg/L
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
SC-A2B Groundwater Elevation
WY 2009-2014 Trend
Equivalent Freshwater Head
Protective Elevation (F Unit)
Rate of change = 0.4 feet per year
Groundwater Elevation, ft MSL
10
8
6
4
2
0
-2

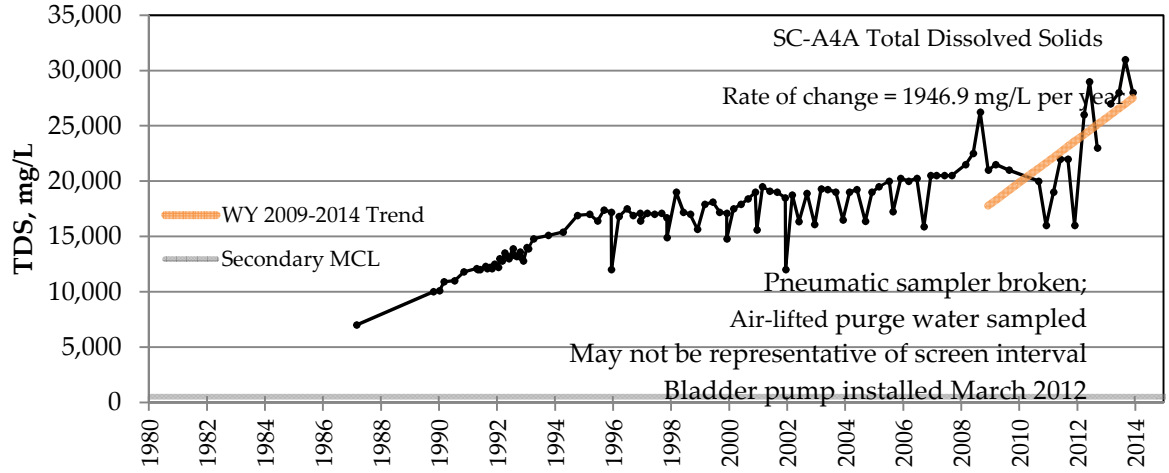

SC-A3A Chloride
Chloride, mg/L
25,000
20,000
15,000
10,000
5,000
0
Rate of change = 187.5 mg/L per year
WY 2009-2014 Trend
Secondary MCL
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

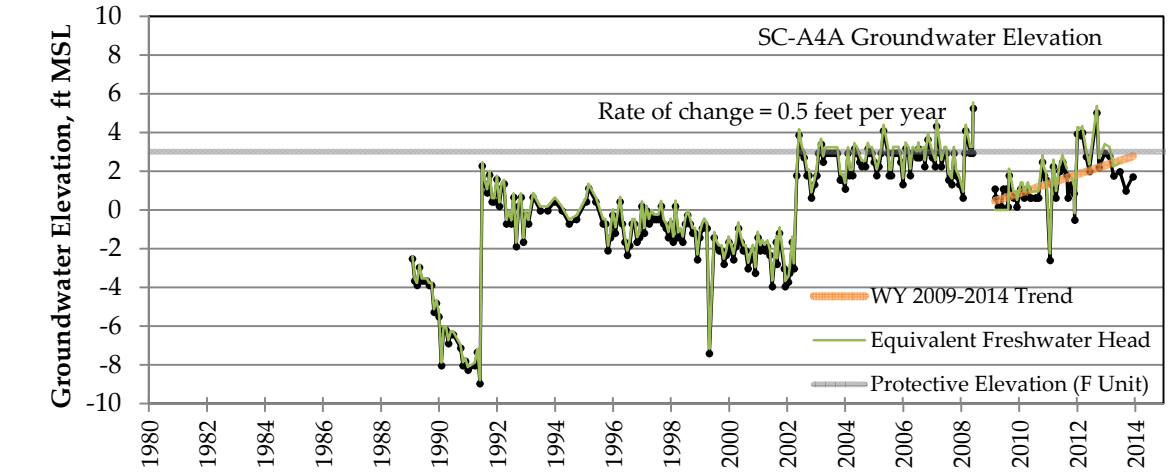

SC-A3A Total Dissolved Solids
TDS, mg/L
60,000
50,000
40,000
30,000
20,000
10,000
0
Rate of change = -2637.8 mg/L per year
WY 2009-2014 Trend
Secondary MCL
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

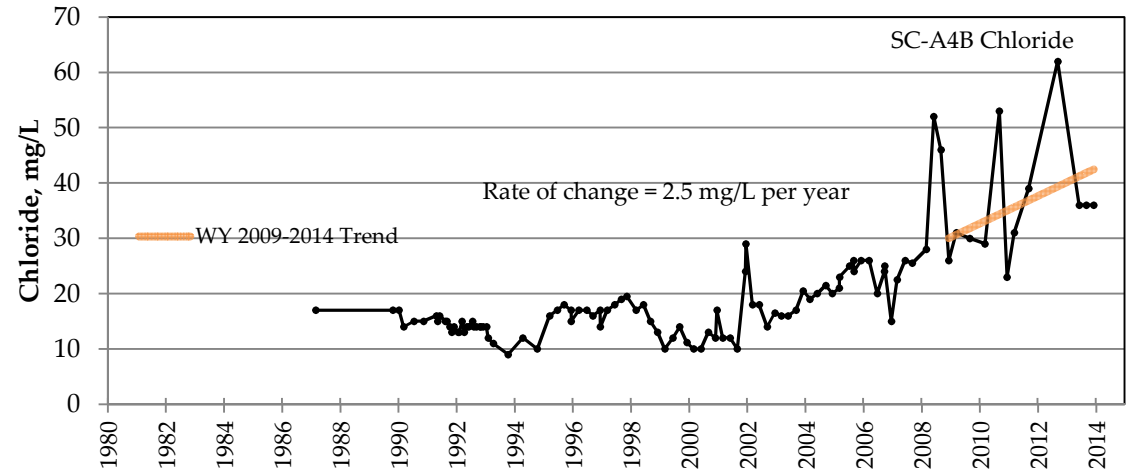

SC-A3A Groundwater Elevation
Groundwater Elevation, ft MSL
10
8
6
4
2
0
-2
-4
WY 2009-2014 Trend
Equivalent Freshwater Head
Protective Elevation (Aromas)
Rate of change = 0.9 feet per year
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014

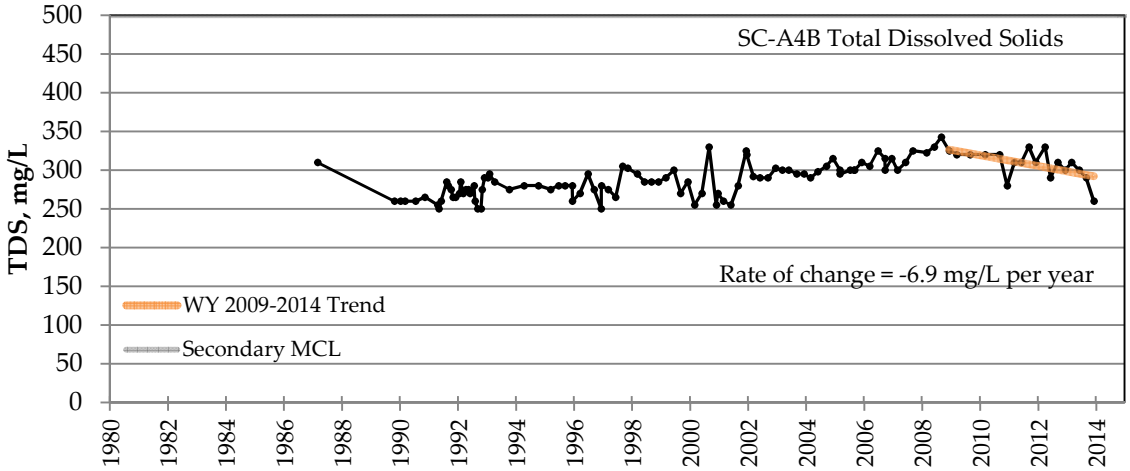

SC-A3B Chloride
Chloride, mg/L
Rate of change = -127.3 mg/L per year
WY 2009-2012 Trend
Secondary MCL
New sampling equipment installed March 2012
SC-A3B Total Dissolved Solids
TDS, mg/L
Rate of change = -621.4 mg/L per year
WY 2009-2012 Trend
Secondary MCL
SC-A3B Groundwater Elevation
Groundwater Elevation, ft MSL
WY 2009-2014 Trend
Equivalent Freshwater Head
Rate of change = 0.4 feet per year
Protective Elevation (Aromas)

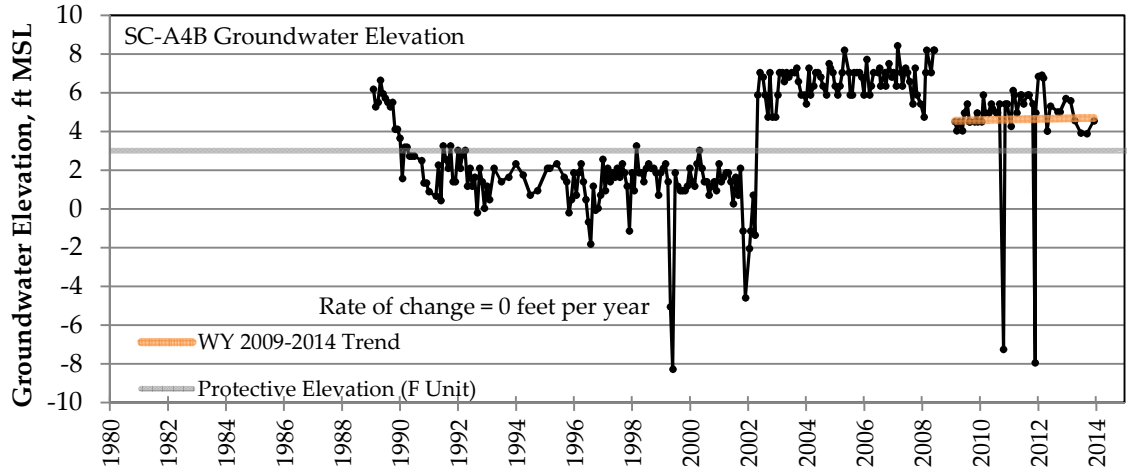

SC-A4A Chloride
Rate of change = 951.4 mg/L per year
WY 2009-2014 Trend
Secondary MCL
Chloride, mg/L
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


SC-A4A Total Dissolved Solids
Rate of change = 1946.9 mg/L per year
WY 2009-2014 Trend
Secondary MCL
Pneumatic sampler broken;
Air-lifted purge water sampled
May not be representative of screen interval
Bladder pump installed March 2012
TDS, mg/L
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


SC-A4A Groundwater Elevation
Rate of change = 0.5 feet per year
WY 2009-2014 Trend
Equivalent Freshwater Head
Protective Elevation (F Unit)
Groundwater Elevation, ft MSL
10
8
6
4
2
0
-2
-4
-6
-8
-10
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


SC-A4B Chloride
Chloride, mg/L
Rate of change = 2.5 mg/L per year
WY 2009-2014 Trend
70
60
50
40
30
20
10
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


SC-A4B Total Dissolved Solids
TDS, mg/L
Rate of change = -6.9 mg/L per year
WY 2009-2014 Trend
Secondary MCL
500
450
400
350
300
250
200
150
100
50
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014


SC-A4B Groundwater Elevation
Groundwater Elevation, ft MSL
Rate of change = 0 feet per year
WY 2009-2014 Trend
Protective Elevation (F Unit)
10
8
6
4
2
0
-2
-4
-6
-8
-10
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014