INTERDEPARTMENTAL MEMORANDUM

TO: Butte County Water Commission Technical Advisory Committee

FROM: Christina Buck, Water Resources Scientist
Water and Resource Conservation

SUBJECT: 2012 Cumulative Groundwater Quality Trend Monitoring Update

DATE: August 17, 2012

INTRODUCTION and BACKGROUND

The Butte County Department of Water and Resource Conservation (DW&RC) conducted its eleventh year of groundwater quality trend monitoring within the county during the week of July 23 - 26, 2012. As required by Chapter 33A, the parameters monitored were temperature, pH, and Electrical Conductivity (EC). These parameters are the basic water quality characteristics needed to evaluate a basin for evidence of saline intrusion. The groundwater quality trend monitoring serves to establish baseline levels for these parameters throughout the county so that any future changes can be identified and further investigation and/or monitoring can subsequently be developed. This year, all samples fell within the acceptable range of water quality values set forth by State and Federal agencies and alert stages defined in Chapter 33A.

METHODOLOGY and RESULTS

The DW&RC owns a Hach sensION multi-parameter meter, which is used to do the groundwater quality testing. Glenn County has the same meter and conducts similar water quality monitoring during July or August. Collaboration with Glenn County helps to ensure we are collecting, analyzing, and reporting data in a similar manner, which will allow for greater confidence in comparing data across county lines.

The sites visited in Butte County were on private land and many of the wells are used for agricultural purposes (irrigating orchards, rice, or pasture). However, the two Thermalito wells, Chico Urban Area well, Vina well, and the Llano Seco well provide for domestic use. The sampling grid spans from north of the Chico Urban Area (Vina sub-inventory unit), west towards the Sacramento River (M & T sub-inventory unit), east towards the foothills (Pentz sub-inventory unit), and south towards Gridley (Biggs-West Gridley sub-inventory unit). Figure 1 shows the approximate locations (township, range, and section) of the water quality wells in relation to wells monitored four times per year for groundwater level.

As in previous years, we are fortunate to have support and permission from local property owners who allow access to their wells. We have provided them with the preliminary results from this year's monitoring for their general knowledge. Due to extenuating circumstances, water quality sampling was not completed at one of the Thermalito wells (domestic), the Durham Dayton well, or at the Western Canal (east) well. Future water quality reports will incorporate these wells once again.

This summer's measurements are well within acceptable ranges defined in Chapter 33A and established by State and Federal agencies (Table 1). Meter readings are recorded when the temperature, pH and EC from the well stabilizes. Temperature is a standard parameter measured when assessing water quality, mostly to indicate that water being sampled is representative of aquifer water and not water standing in the well itself.

The US Environmental Protection Agency (US EPA) establishes drinking water quality standards using two categories, Primary Standards and Secondary Standards[1]. Primary Standards are based on health considerations and Secondary Standards are based on taste, odor, color, corrosivity, foaming, and staining properties of water. Secondary water quality thresholds for pH and EC compared to the range of 2012 values are presented in Table 1.

Table 1. US EPA Secondary Standards for measured parameters

Parameter	Secondary Standard or Secondary WQ Threshold	Range of 2012 Values	Notes re: Butte County Study
pH	6.5 to 8.5	7.17-8.00	Within range of secondary water quality thresholds.
Electrical Conductivity (EC)	< 900 µS – drinking water < 700 µS – ag water	174-630	Within range of secondary water quality thresholds

Water quality data for specific wells is presented in tables on the attached pages.

Temperature is an important parameter because it affects chemical reactions that may occur in groundwater. Also, considerable changes in temperature could be an indication of other source waters migrating into the aquifer system such as stream seepage or flow from a different aquifer system. To date, temperature has been relatively consistent in all wells. Chapter 33A states that "the BMO Alert Stage for temperature will be reached when the measurement is more than five (5) degrees outside of the historic range of measurements." The 2012 measurements were all within 2.5 ^{o}C of the average temperature for each well. The 11 year temperature range for all wells is less than 5 ^{o}C (Table 3). The lowest temperature reading was in the Thermalito well (17.8 ^{o}C) and the high was, like last year, in the Pentz well (21.9 ^{o}C).

Measurements for pH remained relatively stable compared to previous years (see attached graphs). The highest pH was found in the Thermalito well (8.00) and the lowest in Esquon (7.17). All measurements for pH were well within the secondary water quality thresholds of 6.5-8.5 (Table 1, Table 4, and included graphs).

Electrical conductivity (EC) measures the ability of a solution to conduct an electrical current due to the presence of ions. Observed readings for electrical conductivity can have a large range, up to 382 µS at a particular well (Western Canal-west), yet 2012 measurements were all well within the secondary water quality thresholds established by State and Federal regulatory agencies (Table 1, Table 6 and included graphs).

CONCLUSIONS

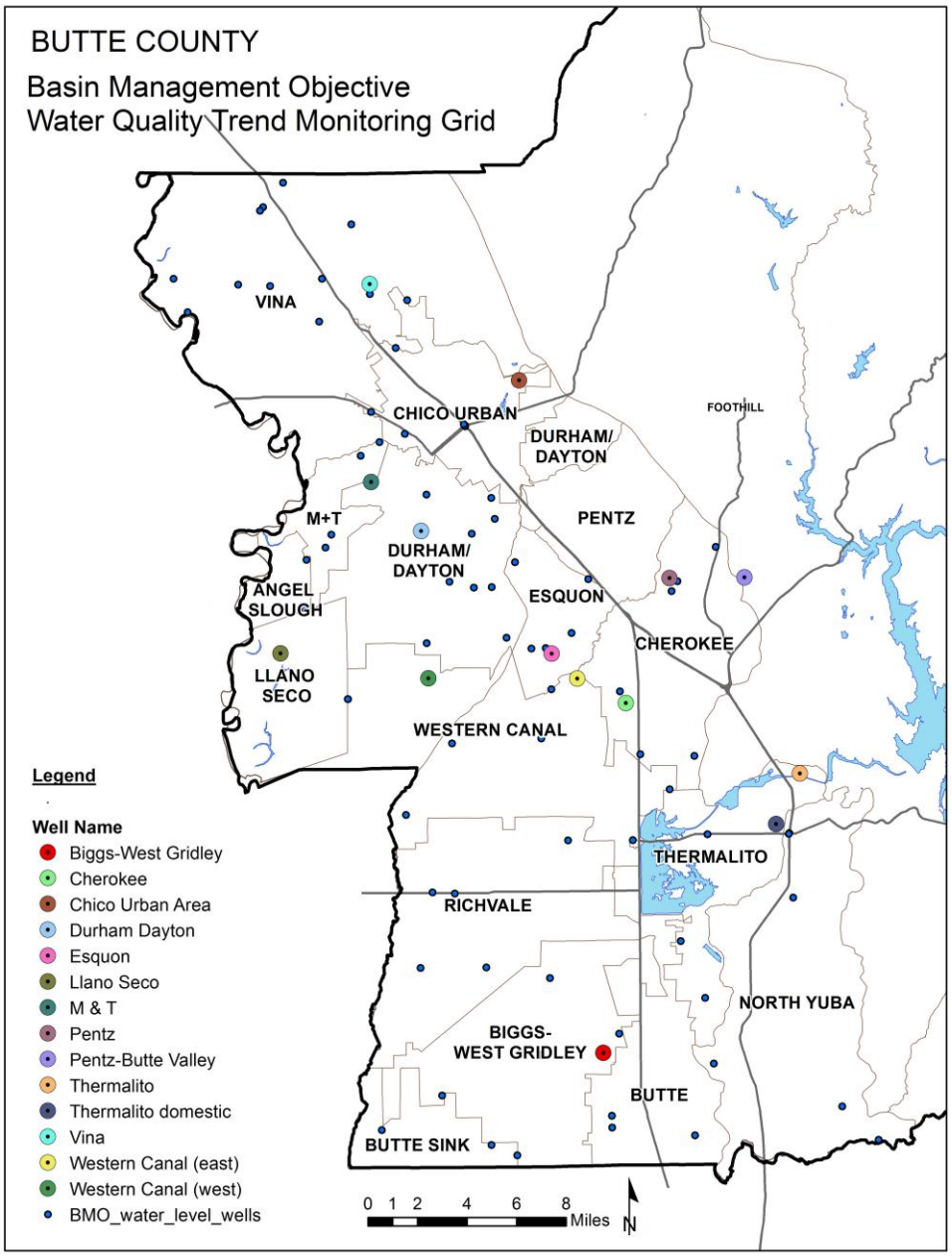
This was the eleventh season the DW&RC collected groundwater quality information. Overall, the results of the water quality sampling indicate no significant changes in groundwater quality with respect to temperature, pH, or electrical conductivity and the basin appears to be free of saline intrusion. Water quality parameters have naturally occurring variability, so year to year changes are expected and nothing in this year's measurements give cause for further investigation or analysis. Further investigation would be advisable if values were to fall outside of the acceptable range. This data will help the DW&RC continue to establish baseline levels for these parameters across

[1] http://www.epa.gov/safewater/consumer/2ndstandards.html

the county so that any future changes in water quality can be detected and further investigation and/or monitoring can be developed.

Further information on water quality standards for different constituents can be found at www.swrcb.ca.gov or in the *Compilation of Water Quality Goals*, published by the State Water Resources Control Board. Additionally, in 2010 the State Water Resources Control Board published the *Groundwater Quality Protection Strategy for the Central Valley Region, a Roadmap*[2]. Work plans for high priority actions identified in the Roadmap document have subsequently been developed.

Figure 1. Approximate well locations for water quality wells in relation to wells monitored annually (four times) for water level.



[2] http://www.swrcb.ca.gov/rwqcb5/water_issues/groundwater_quality/index.shtml

DATA TABLES and GRAPHS

Table 2. Annual groundwater temperature (°C)

Sub-Inventory Unit	State Well Number	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Biggs-West Gridley	18NO2E35R01M	18.5	18.5	18.1	20.5	18.2	18.3	18.7	19.0	19.2	20.1	18.0
Cherokee	20N02E24Q01M	22.4	21.9	21.2	21.4	21.1	20.7	21.0	20.9	21.9	21.8	21.8
Chico Urban Area	22N02E17						18.4	20.1	18.2	18.8	19.5	21.6
Durham Dayton	21N01E15E02M	18.8	19.9	21.8	20.4	17.4	NM	19.3	NM	18.9	18.0	NM
Esquon	20N02E09M02M	19.7	18.9	19.6	20.1	20.7	19.0	19.6	19.0	19.1	20.0	21.4
Llano Seco								20.8	20.6	20.7	20.6	21.7
M & T	22N01E15D02M	17.6	18.2	17.8	19.2	18.6	18.0	17.7	18.6	17.8	NM	18.3
Pentz	21N03E29J03M						22.2	21.5	21.3	21.5	23.9	21.9
*Pentz-Butte Valley	21N03E26E01M	27.0	26.4	26.7	23.2							
Thermalito	19NO4E06E02M	18.3	17.9	17.1	17.1	18.4	17.7	18.9	17.6	NM	NM	17.8
Thermalito domestic								19.4	19.4	19.4	NM	NM
Vina	23N01E29L03M	19.6	20.3	19.2	19.2	19.6	18.9	19.6	18.9	18.8	22.8	18.8
Western Canal (east)	20N02E15R01M	18.4	18.2	19.9	20.5	18.8	18.6	19.1	19.0	18.8	19.0	NM
Western Canal (west)	20N01E15D01M	19.0	18.1	19.8	20.8	18.5	20.6	21.8	18.5	19.1	20.5	20.1

***Pentz-Butte Valley discontinued

Table 3. Groundwater temperature average and range over 11 year sampling period (°C)

Sub-Inventory Unit	Average	Range
Biggs-West Gridley	18.8	2.5
Cherokee	21.5	1.7
Chico Urban Area	19.4	3.4
Durham Dayton	19.3	4.4
Esquon	19.7	2.5
Llano Seco	20.9	1.1
M & T	18.2	1.6
Pentz	22.1	2.6
*Pentz-Butte Valley	25.8	3.8
Thermalito	17.9	1.8
Thermalito domestic	19.4	0.0
Vina	19.6	4.0
Western Canal (east)	19.0	2.3
Western Canal (west)	19.7	3.7

Table 4. Annual groundwater pH

Sub-Inventory Unit	State Well Number	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Biggs-West Gridley	18NO2E35R01M	7.60	7.50	7.50	7.04	7.60	7.64	7.72	7.88	7.86	7.22	7.91
Cherokee	20N02E24Q01M	7.50	7.50	7.10	7.40	7.40	7.30	7.30	7.30	7.23	7.58	7.30
Chico Urban Area	22N02E17						6.88	6.94	6.90	6.99	7.53	7.29
Durham Dayton	21N01E15E02M	7.70	7.20	7.60	7.60	7.50	NM	7.54	NM	7.41	7.70	NM
Esquon	20N02E09M02M	7.30	7.50	7.10	7.40	7.50	7.43	7.24	7.42	7.38	7.55	7.17
Llano Seco								7.90	8.07	8.15	8.05	7.92
M & T	22N01E15D02M	7.20	7.50	6.90	7.80	7.90	7.62	7.68	7.62	7.62	NM	7.24
Pentz	21N03E29J03M						7.58	7.40	7.53	7.44	7.27	7.75
*Pentz-Butte Valley	21N03E26E01M	7.10	6.90	7.29	6.24							
Thermalito	19NO4E06E02M	7.00	6.50	7.10	7.10	7.90	7.40	7.42	7.44	NM	NM	8.00
Thermalito domestic								7.73	7.84	7.71	NM	NM
Vina	23N01E29L03M	7.50	7.60	6.90	6.20	7.70	7.54	7.51	7.39	7.57	7.95	7.33
Western Canal (east)	20N02E15R01M	7.00	6.60	6.80	6.90	7.30	6.92	6.96	7.00	7.10	6.95	NM
Western Canal (west)	20N01E15D01M	7.80	8.10	7.10	6.90	7.90	7.88	7.81	6.59	7.75	7.50	7.70

Table 5. Groundwater pH average and range over 11 year sampling period

Sub-Inventory Unit	Average	Range
Biggs-West Gridley	7.59	0.87
Cherokee	7.36	0.48
Chico Urban Area	7.09	0.65
Durham Dayton	7.53	0.50
Esquon	7.36	0.45
Llano Seco	8.02	0.25
M & T	7.51	1.00
Pentz	7.50	0.48
*Pentz-Butte Valley	6.88	1.05
Thermalito	7.32	1.50
Thermalito domestic	7.76	0.13
Vina	7.38	1.75
Western Canal (east)	6.95	0.70
Western Canal (west)	7.55	1.51

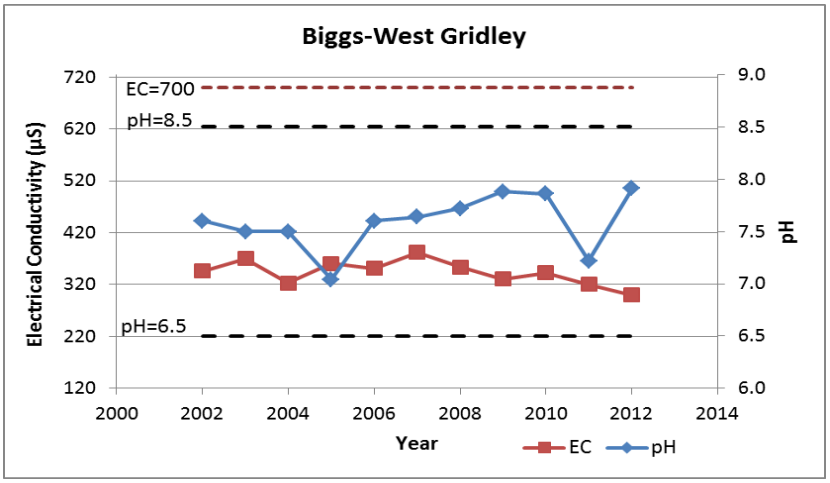
Table 6. Annual groundwater electrical conductivity (µS)

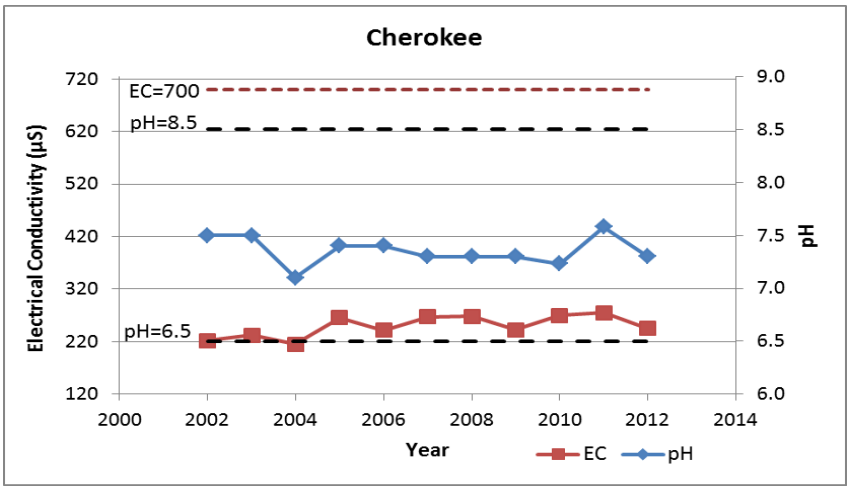
Sub-Inventory Unit	State Well Number	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Biggs-West Gridley	18NO2E35R01M	346	370	323	361	351	382	354	331	343	320	300
Cherokee	20N02E24Q01M	222	232	215	266	242	267	268	243	270	275	245
Chico Urban Area	22N02E17						280	291	260	249	250	248
Durham Dayton	21N01E15E02M	315	348	259	340	322	NM	327	NM	307	315	NM
Esquon	20N02E09M02M	388	526	470	557	507	480	439	419	427	415	408
Llano Seco								204	195	196	198	192
M & T	22N01E15D02M	418	551	678	504	465	451	667	445	592	NM	427
Pentz	21N03E29J03M						218	229	227	225	224	204
*Pentz-Butte Valley	21N03E26E01M	195	186	211	240							
Thermalito	19NO4E06E02M	132	164	149	150	152	242	205	158	NM	NM	292
Thermalito domestic								374	350	354	NM	NM
Vina	23N01E29L03M	197	225	180	216	192	224	203	200	199	194	174
Western Canal (east)	20N02E15R01M	447	344	400	524	492	471	482	488	465	459	NM
Western Canal (west)	20N01E15D01M	464	248	407	501	309	477	469	462	455	460	630

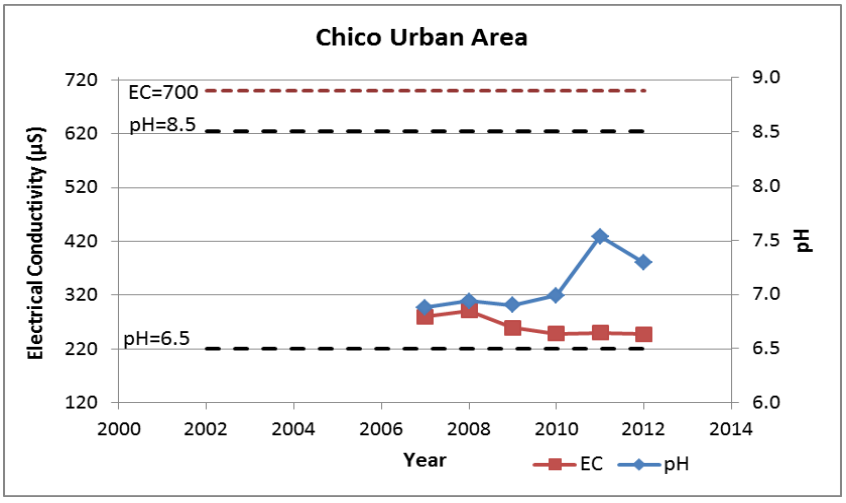
Table 7. Groundwater EC (µS) average and range over 11 year sampling period

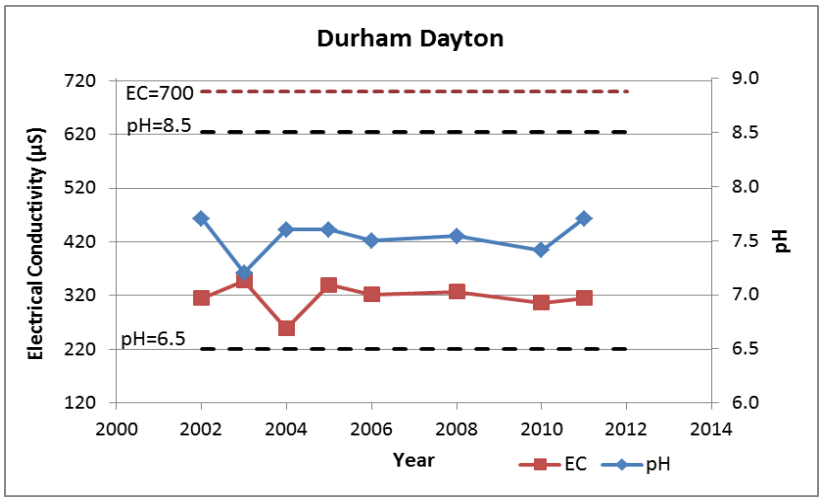
Sub-Inventory Unit	Average	Range
Biggs-West Gridley	344	82
Cherokee	250	60
Chico Urban Area	263	43
Durham Dayton	317	89
Esquon	458	169
Llano Seco	197	13
M & T	520	260
Pentz	221	25
*Pentz-Butte Valley	208	54
Thermalito	183	160
Thermalito domestic	359	24
Vina	200	51
Western Canal (east)	457	180
Western Canal (west)	444	382

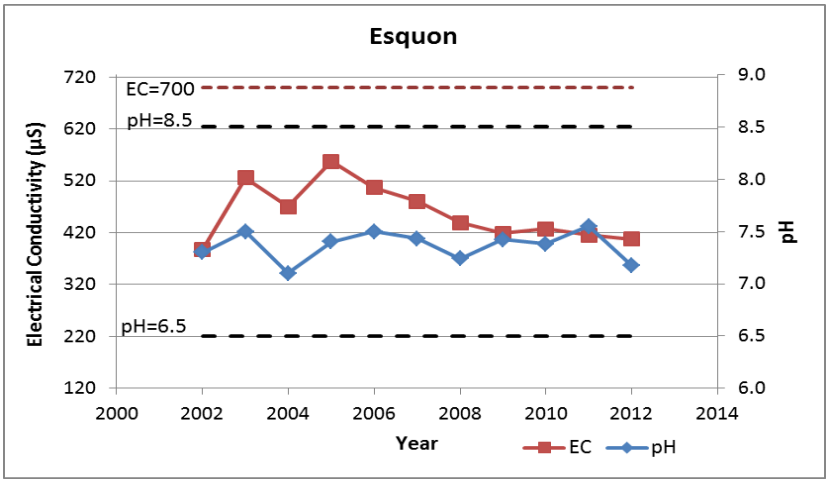
Annual electrical conductivity (µS) and pH for each water quality sampling well. The red dashed line indicates the preferred maximum level for EC and the black dashed lines bound the acceptable pH range, 6.5-8.5. Therefore, when the red plot of EC values is below the red dashed line (as it always is), then measured EC is within the secondary standard for agricultural water (<700), which is more restrictive than for drinking water (<900). To be within the acceptable pH range, the blue line should be within the black dashed lines.

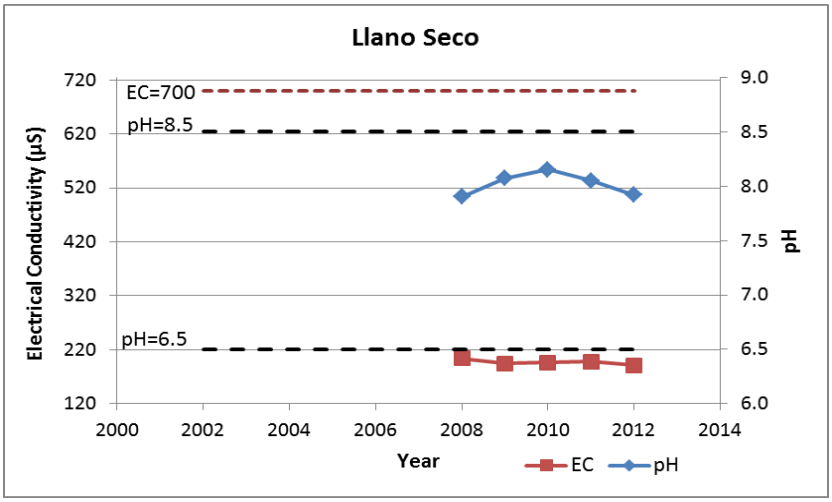












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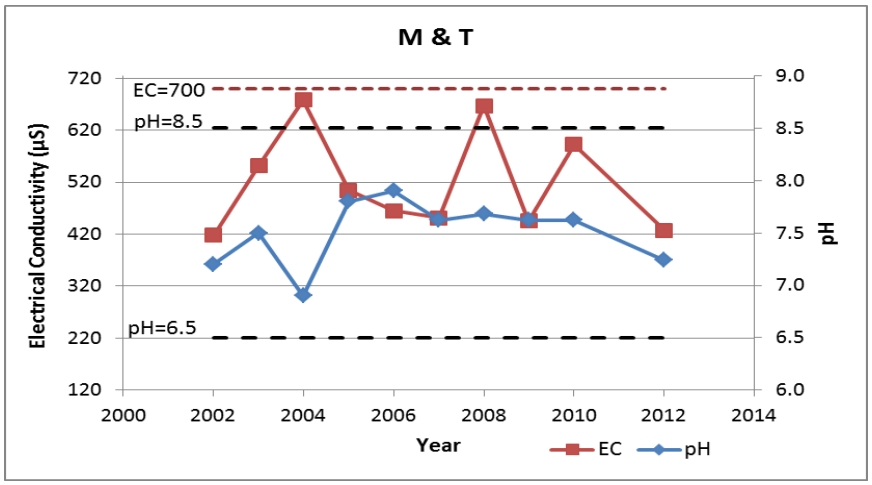

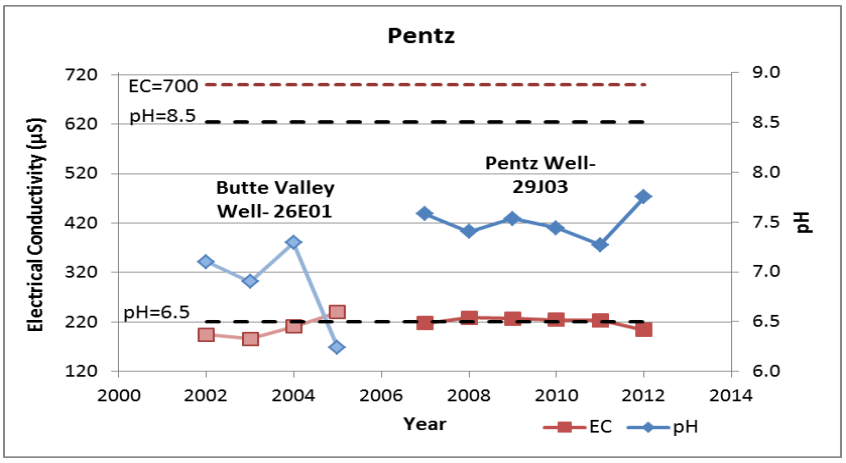

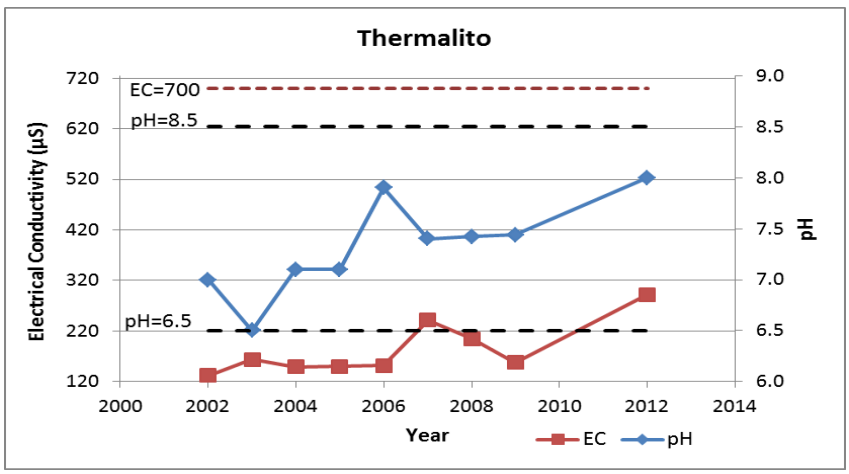

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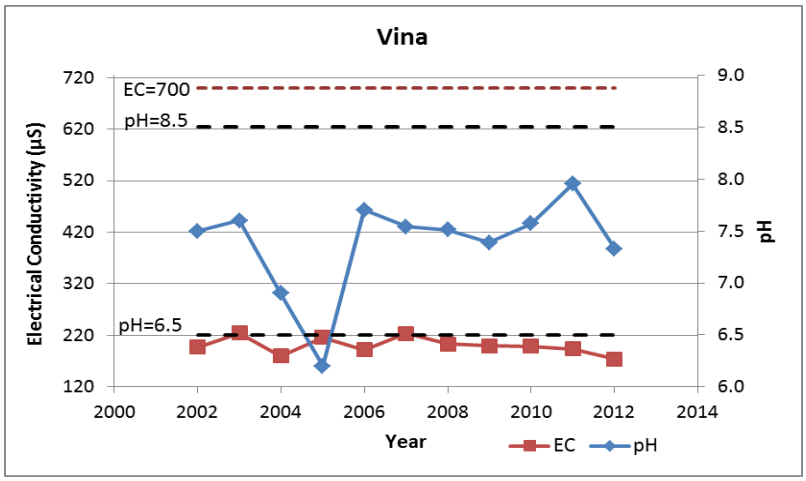

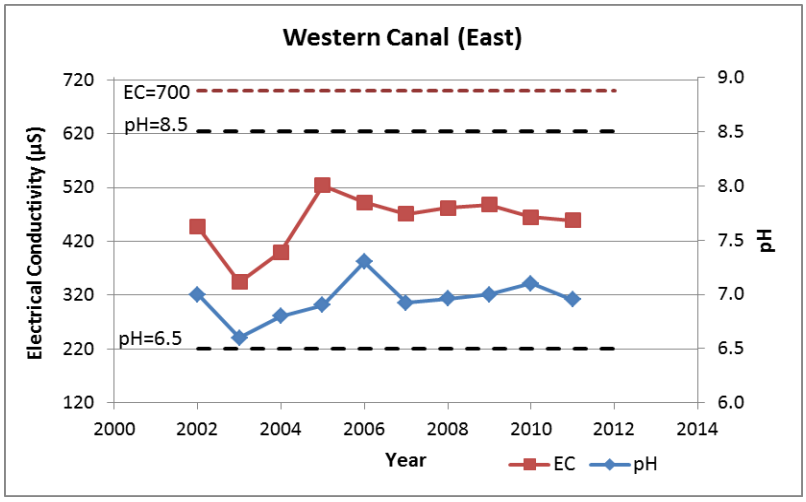

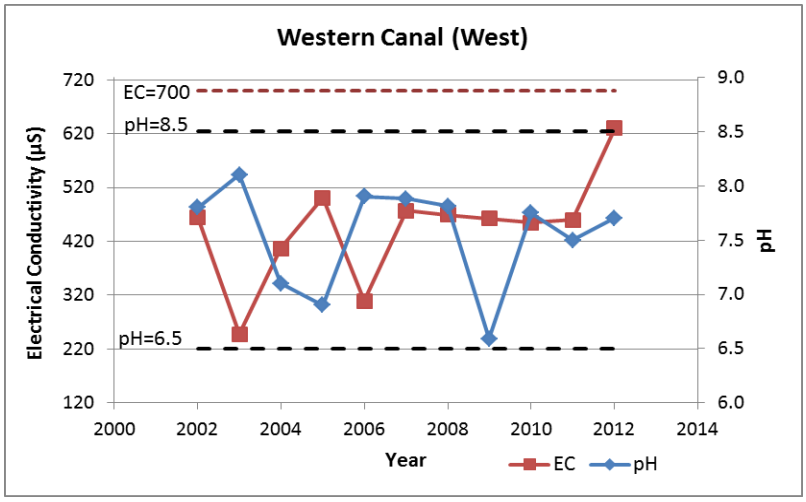

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