INTERDEPARTMENTAL MEMORANDUM

TO: Butte County Water Commission

FROM: Kristen McKillop, Manager – Program Development
Water and Resource Conservation

SUBJECT: 2009 Cumulative Groundwater Quality Trend Monitoring update

DATE: September 2, 2009

INTRODUCTION and BACKGROUND

The Butte County Department of Water and Resource Conservation (DW&RC) conducted its eighth year of groundwater quality trend monitoring within the county during the week of July 15-17, 2009. As required by Chapter 33A, the parameters monitored were temperature, pH, Electrical Conductivity. Total Dissolved Solids were also recorded. These parameters encompass the basic characteristics to consider when evaluating water for evidence of saline intrusion.

METHODOLOGY and ANALYSIS

The Department owns a Hach sensION multi-parameter meter, which is used to do the groundwater quality testing with. This is the same meter being used by Glenn County for their monitoring efforts. Data collected by both Butte and Glenn County can be reviewed through the Four County BMOIC. This collaboration will ensure that we are collecting, analyzing and reporting data in the same manner, which will allow for greater confidence in comparing data across county lines. The sites visited were on private land and the wells are typically used for agricultural purposes (irrigating orchards, rice, or pasture), but the two Thermalito wells as well as the Llano Seco sample represent supply 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). Just to note, the well in the Durham/Dayton sub-inventory unit was not sampled this year, as the orchard was pulled for replanting and the well pump had been removed for repairs.

As in previous years, we are fortunate to have the support and permission from the local property owners who allowed access to their wells. We have provided them with the preliminary results from this year's monitoring for their general knowledge.

The data collected this summer is comparable to data collected in the seven preceding years. Every effort is made to sample each location within the same hourly window as in previous years. To date, temperature has been consistent in all wells. Temperature is a standard parameter measured when assessing water quality mostly to indicate the point at which water being sampled is representative of aquifer water and not water standing in the well casing. Data is recorded when the temperature, pH and EC from the well stabilizes, typically after purging a minimum of three well volumes. 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. The overall observed average water temperatures from our wells this summer was approximately 19.1 ^{o}C (66.4 ^{o}F), with the low temp being in the Thermalito area (17.6 ^{o}C) and the high being in the Pentz sub-inventory unit (21.3 ^{o}C). Temperature is an important parameter because it affects chemical reactions that may occur in groundwater. Other parameters such as pH remained stable and within the secondary water quality thresholds.

Total dissolved solids measures water quality suitability for public, industrial, and agricultural uses and electrical conductivity measures the ability of a solution to conduct an electrical current. Readings for total dissolved solids and electrical conductivity varied more than pH and temperature. However, the readings we observed were well within the secondary water quality thresholds established by State and Federal regulatory agencies.

The US Environmental Protection Agency (US EPA) establishes drinking water quality standards using two categories; Primary Standards and Secondary Standards. Primary Standards are based on health considerations and Secondary Standards are based on taste, odor, color, corrosivity, foaming, and staining properties of water. Examples of secondary water quality thresholds are summarized in Table 1 below:

Table 1. US EPA Secondary Standards for measured parameters

Parameter	Secondary Standard or Secondary WQ Threshold	Range of Observed 2009 Readings	Notes re: Butte County Study
pH	6.5 to 8.5	6.6 – 7.9	Within range of secondary water quality thresholds.
Total Dissolved Solids (TDS)	< 500 ppm – drinking water < 450 ppm – ag water	75.6 - 237	Within range of secondary water quality thresholds
Electrical Conductivity (EC)	< 900 uS – drinking water < 700 uS – ag water	151.8 - 488	Within range of secondary water quality thresholds

Water quality data collected from the specific wells are presented in tables on the attached pages.

CONCLUSION

This was the eighth season the DW&RC collected groundwater quality information. At this time we do not have sufficient information to make valid assumptions regarding any trends in water quality changes. Overall, the results of the water quality sampling indicate that groundwater in the basin is of high-quality, free of saline intrusion and is in good health. This data will help the DW&RC continue building a foundation that serves to establish baseline levels of these parameters across the county so that any future changes in water quality can be detected and further investigation and monitoring can subsequently 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. Otherwise, if you have questions please contact Kristen at 538-6265.

Table 2. Cumulative Temperature Measurements in degrees Celsius

° Celsius	° Fahrenheit
0	32
5	41
10	50
15	59
20	68
21	69.8
22	71.6
23	73.4
24	75.2

Groundwater Temperature - 2002 through 2009

Sub-area	State Well Number	2002 Temp °C	2003 Temp °C	2004 Temp °C	2005 Temp °C	2006 Temp °C	2007 Temp °C	2008 Temp °C	2009 Temp °C
Biggs-West Gridley	18NO2E35R01M	18.5	18.5	18.1	20.5	18.2	18.3	18.7	19.0
Cherokee	20N02E24QO1M	22.4	21.9	21.2	21.4	21.1	20.7	21.0	20.9
Chico Urban Area	22N02E17						18.4	20.1	18.2
Durham Dayton	21N01E15EO2M	18.8	19.9	21.8	20.4	17.4	n/a	19.3	n/a
Esquon	20N02E09M02M	19.7	18.9	19.6	20.1	20.7	19.0	19.6	19.0
Llano Seco								20.8	20.6
M & T	22N01E15DO2M	17.6	18.2	17.8	19.2	18.6	18.0	17.7	18.6
Pentz	21N03E29J003M						22.2	21.5	21.3
*Pentz-Butte Valley	21N03E26EO1M	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
Thermalito domestic								19.4	19.4
Vina	23N01E29LO3M	19.6	20.3	19.2	19.2	19.6	18.9	19.6	18.9
Western Canal (east)	20N02E15RO1M	18.4	18.2	19.9	20.5	18.8	18.6	19.1	19.0
Western Canal (west)	20N01E15D01M	19.0	18.1	19.8	20.8	18.5	20.6	21.8	18.5

*The distance between the Pentz-Butte Valley well no longer monitored and the new Pentz well is approximately 2.4 miles.

Table 3. Average and Range of Temperature – 2002 through 2009

Sub-area	Average	Range
Biggs-West Gridley	18.73	18.1-20.5
Cherokee	21.33	20.7-22.4
Chico Urban Area	18.90	18.2-20.1
Durham Dayton	19.60	17.4-21.8
Esquon	19.58	18.9-20.7
M & T	18.21	17.6-19.2
Pentz	21.67	21.3-22.2
*Pentz-Butte Valley	25.83	23.2-27.0
Thermalito	17.88	17.1-18.9
Vina	19.41	18.9-20.3
Western Canal (east)	19.06	18.2-20.5
Western Canal (west)	19.64	18.1-21.8

Table 4. Cumulative pH Measurements

Groundwater pH - 2002 through 2009

Sub-area	State Well Number	2002 pH	2003 pH	2004 pH	2005 pH	2006 pH	2007 pH	2008 pH	2009 pH
Biggs-West Gridley	18NO2E35R01M	7.6	7.5	7.5	7.0	7.6	7.6	7.7	7.9
Cherokee	20N02E24QO1M	7.5	7.5	7.1	7.4	7.4	7.3	7.3	7.3
Chico Urban Area	22N02E17						6.9	6.9	6.9
Durham Dayton	21N01E15EO2M	7.7	7.2	7.6	7.6	7.5	n/a	7.5	n/a
Esquon	20N02E09M02M	7.3	7.5	7.1	7.4	7.5	7.4	7.2	7.4
Llano Seco								7.9	8.1
M & T	22N01E15DO2M	7.2	7.5	6.9	7.8	7.9	7.6	7.7	7.6
Pentz	21N03E29J003						7.6	7.4	7.5
*Pentz-Butte Valley	21N03E26EO1M	7.1	6.9	7.3	6.2				
Thermalito	19NO4E06E02M	7.0	6.5	7.1	7.1	7.9	7.4	7.4	7.4
Thermalito domestic								7.7	7.8
Vina	23N01E29LO3M	7.5	7.6	6.9	6.2	7.7	7.5	7.5	7.4
Western Canal (east)	20N02E15RO1M	7.0	6.6	6.8	6.9	7.3	6.9	7.0	7.0
Western Canal (west)	20N01E15D01M	7.8	8.1	7.1	6.9	7.9	7.9	7.8	6.6

Table 5. Average and Range of pH – 2002 through 2009

Sub-area	Average	Range
Biggs-West Gridley	7.6	7.0-7.7
Cherokee	7.4	7.1-7.5
Chico Urban Area	6.9	6.9
Durham Dayton	7.5	7.2-7.7
Esquon	7.4	7.1-7.5
M & T	7.5	6.9-7.9
Pentz	7.5	7.4-7.6
*Pentz-Butte Valley	6.9	6.2-7.3
Thermalito	7.2	6.5-7.9
Vina	7.3	6.2-7.7
Western Canal (east)	6.9	6.6-7.3
Western Canal (west)	7.5	6.6-8.1

Table 6. Cumulative EC Measurements in microsiemens

Groundwater EC - 2002 through 2009

Sub-area	State Well Number	2002 EC	2003 EC	2004 EC	2005 EC	2006 EC	2007 EC	2008 EC	2009 EC
Biggs-West Gridley	18NO2E35R01M	346.0	370.0	323.0	361.0	351.0	382.0	354.0	331.0
Cherokee	20N02E24QO1M	222.0	232.0	215.0	266.0	242.0	267.0	268.0	243.0
Chico Urban Area	22N02E17						280.0	291.0	260.0
Durham Dayton	21N01E15EO2M	315.0	348.0	259.0	340.0	322.0	n/a	327.0	n/a
Esquon	20N02E09M02M	388.0	526.0	470.0	557.0	507.0	480.0	439.0	419.0
Llano Seco								204.0	194.6
M & T	22N01E15DO2M	418.0	551.0	678.0	504.0	465.0	451.0	667.0	445.0
Pentz	21N03E29J003						218.0	229.0	227.0
*Pentz-Butte Valley	21N03E26EO1M	195.0	186.0	211.0	240.0				
Thermalito	19NO4E06E02M	132.0	164.0	149.0	150.0	152.0	242.0	205.0	158.1
Thermalito domestic								374.0	350.0
Vina	23N01E29LO3M	197.0	225.0	180.0	216.0	192.0	224.0	203.0	199.6
West. Canal (east)	20N02E15RO1M	447.0	344.0	400.0	524.0	492.0	471.0	482.0	488.0
West. Canal (west)	20N01E15D01M	464.0	248.0	407.0	501.0	309.0	477.0	469.0	462.0

** The distance between the Pentz-Butte Valley well no longer monitored and the new Pentz well is approximately 2.4 miles.*

Table 7. Average and Range of EC – 2002 through 2009

Sub-area	Average	Range
Biggs-West Gridley	352.3	323-370
Cherokee	244.4	215-268
Chico Urban Area	277.0	260-291
Durham Dayton	318.5	259-348
Esquon	473.3	388-557
M & T	522.4	418-667
Pentz	224.7	218-229
*Pentz-Butte Valley	208.0	186-240
Thermalito	169.0	132-242
Vina	204.6	180-225
Western Canal (east)	456.0	344-524
Western Canal (west)	417.1	248-501

Table 8. Cumulative TDS Measurements in mg/L (1 mg/L = 1 ppm for dilute aqueous solutions)

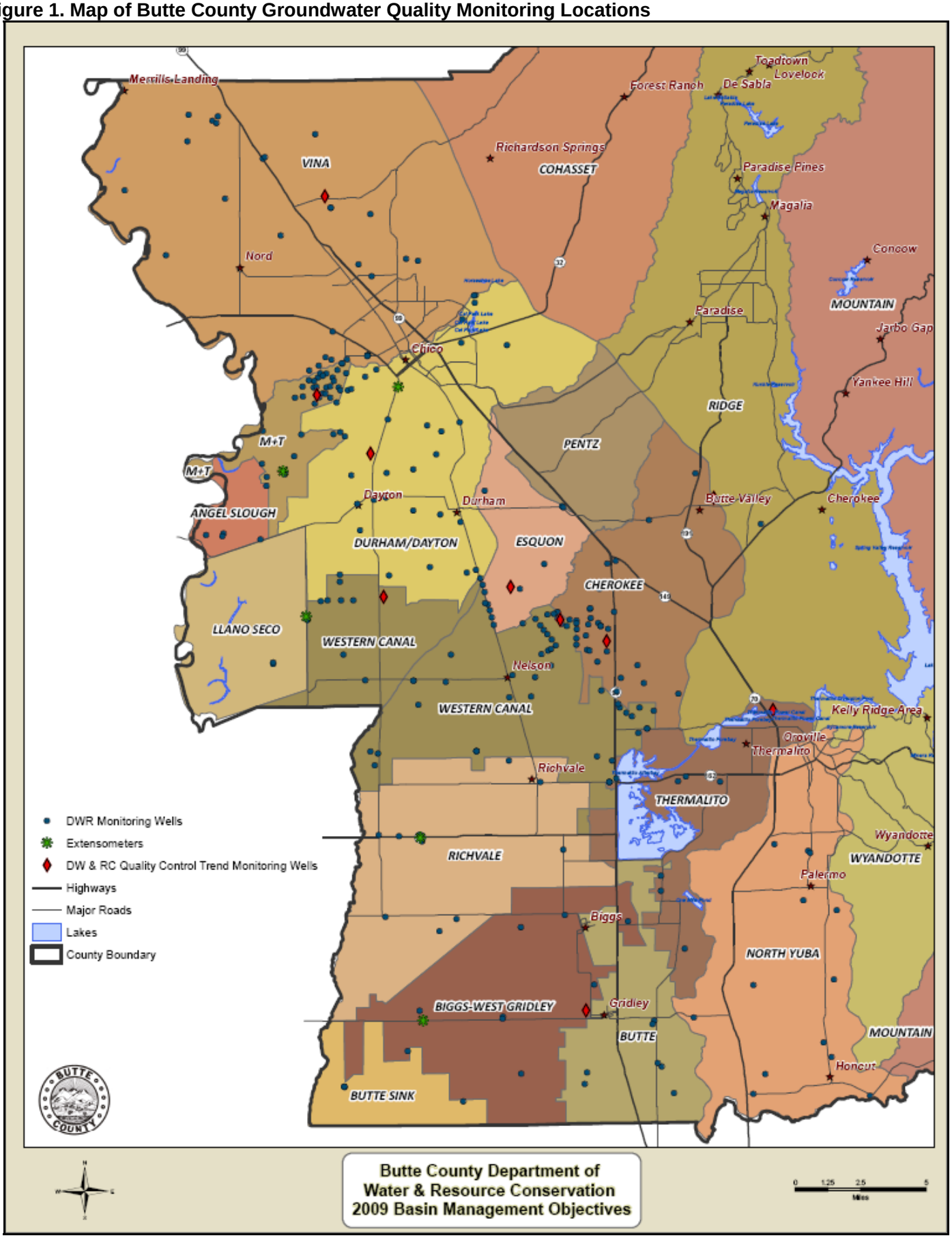
Groundwater TDS - 2002 through 2009

Sub-area	State Well Number	2002 TDS	2003 TDS	2004 TDS	2005 TDS	2006 TDS	2007 TDS	2008 TDS	2009 TDS
Biggs-West Gridley	18NO2E35R01M	172.0	184.0	163.0	180.0	169.0	184.0	171.0	162.1
Cherokee	20N02E24QO1M	111.0	115.0	109.0	132.0	116.0	128.0	128.4	116.6
Chico Urban Area	22N02E17						136.0	139.8	124.3
Durham Dayton	21N01E15EO2M	161.0	175.0	130.0	169.0	155.0	n/a	157.4	n/a
Esquon	20N02E09M02M	194.0	265.0	235.0	278.0	244.0	232.0	212.0	203.0
Llano Seco								97.1	93.2
M & T	22N01E15DO2M	209.0	279.0	340.0	251.0	225.0	218.0	324.0	215.0
Pentz	21N03E29J003						105.0	109.8	108.8
*Pentz-Butte Valley	21N03E26EO1M	100.0	93.0	105.0	120.0				
Thermalito	19NO4E06E02M	67.0	82.0	73.0	75.0	73.0	116.0	98.3	75.6
Thermalito domestic								179.0	168.7
Vina	23N01E29LO3M	96.0	109.0	90.0	107.0	90.0	108.0	97.5	95.5
Western Canal (east)	20N02E15RO1M	223.0	172.0	203.0	262.0	246.0	228.0	233.0	237.0
Western Canal (west)	20N01E15D01M	232.0	123.0	206.0	250.0	155.0	230.0	227.0	224.0

Table 9. Average and Range of TDS – 2002 through 2009

Sub-area	Average	Range
Biggs-West Gridley	173.1	162-184
Cherokee	119.5	109-132
Chico Urban Area	133.4	136-139.8
Durham Dayton	157.9	169-175
Esquon	232.9	194-278
M & T	257.6	209-340
Pentz	107.9	105-109.8
*Pentz-Butte Valley	104.5	93-120
Thermalito	82.5	67-116
Vina	99.1	90-109
Western Canal (east)	225.5	172-262
Western Canal (west)	205.9	123-250

Figure 1. Map of Butte County Groundwater Quality Monitoring Locations



Biggs-West Gridley

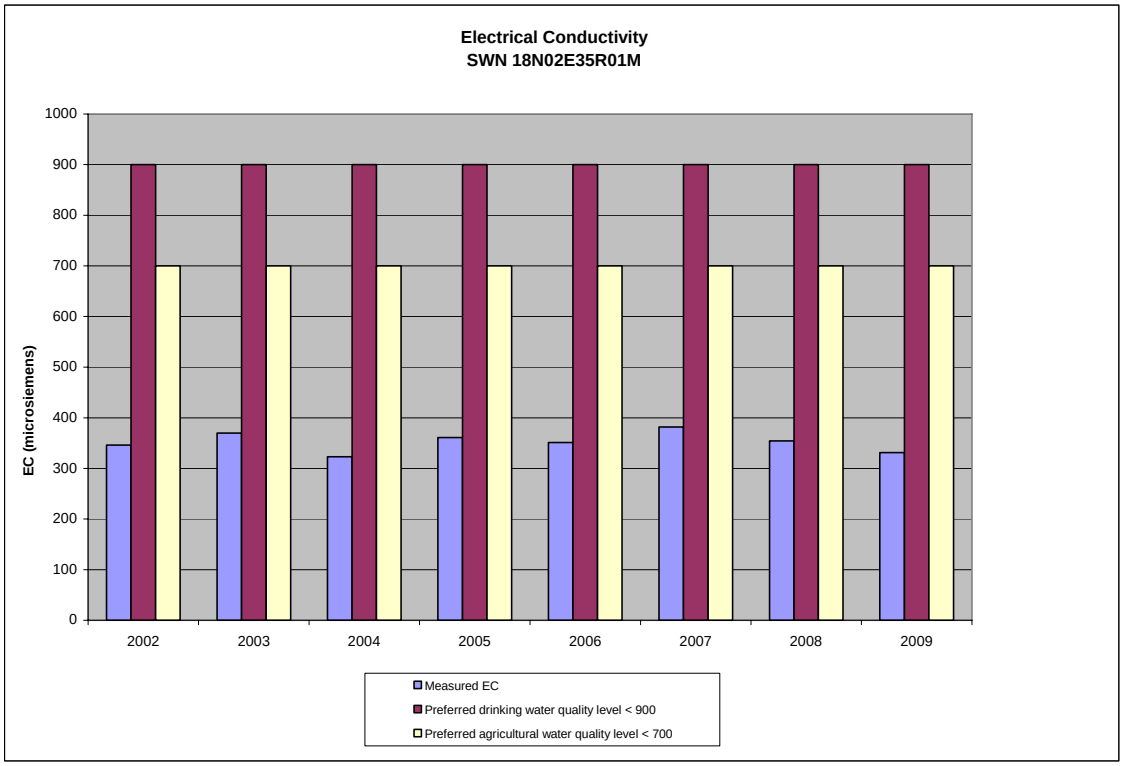


Figure 2. Biggs-West Gridley well monitored for EC

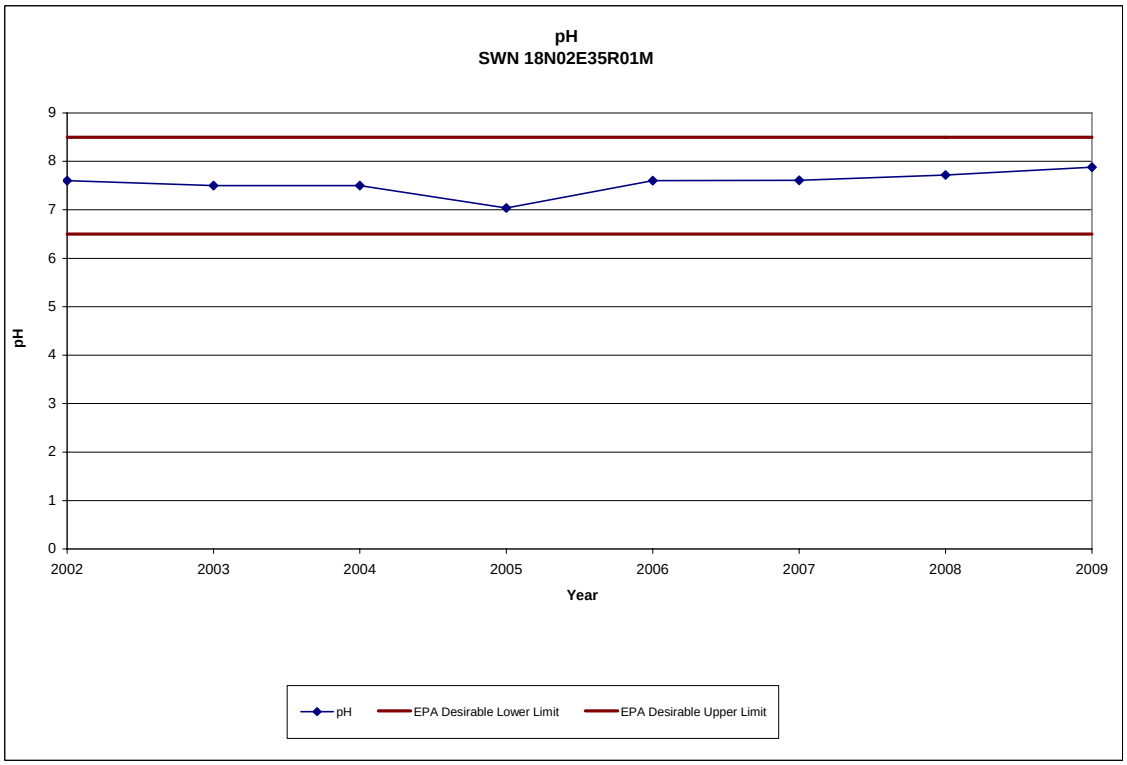


Figure 3. Biggs-West Gridley well monitored for pH

Cherokee

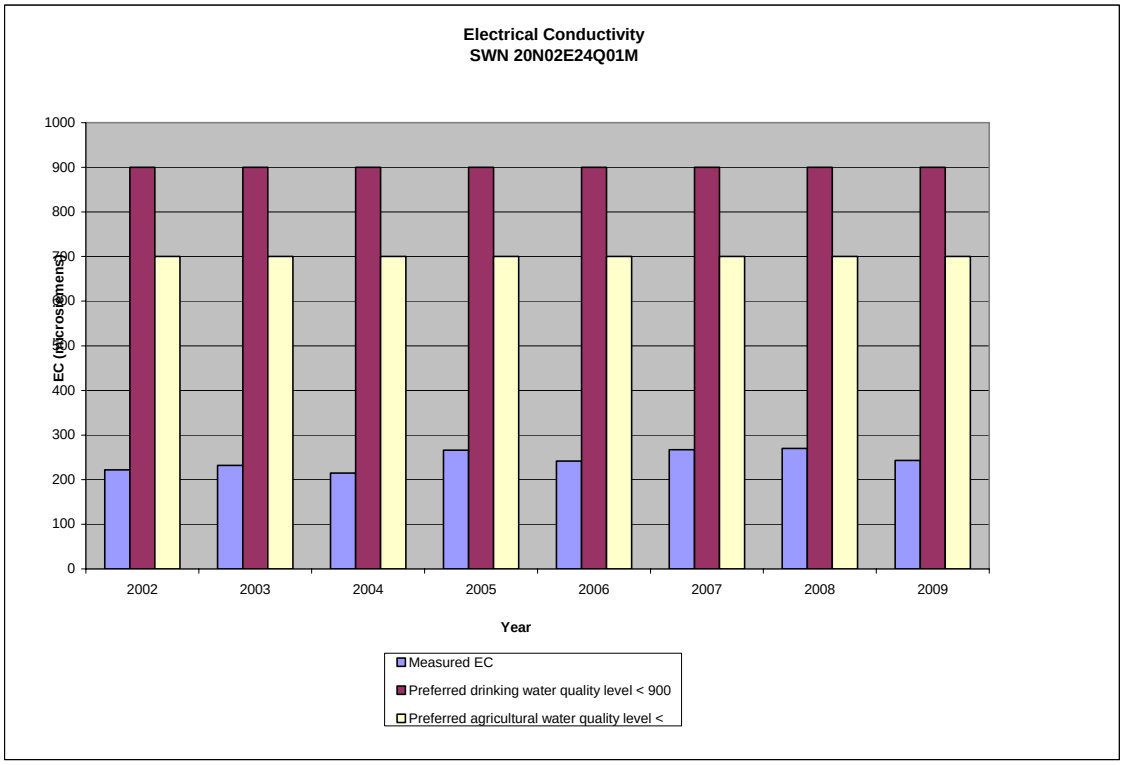


Figure 4. Cherokee well monitored for EC

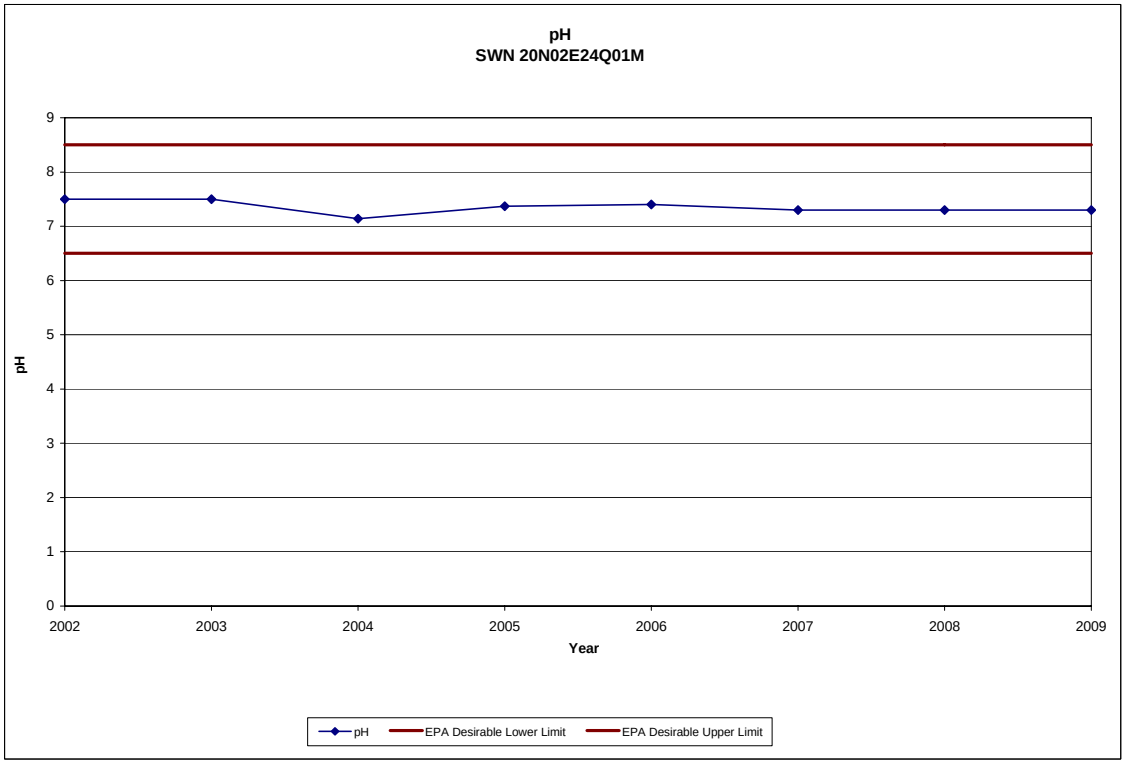


Figure 5. Cherokee well monitored for pH

Chico Urban Area

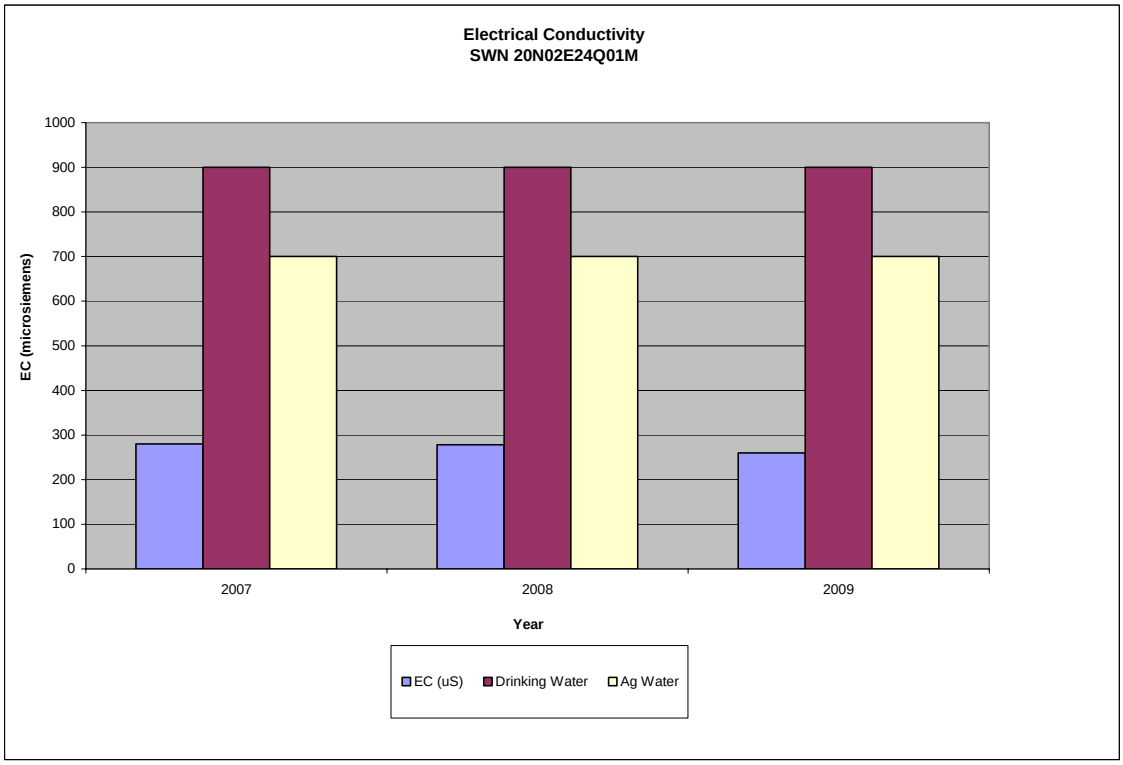


Figure 6. Chico Urban Area well monitored for EC

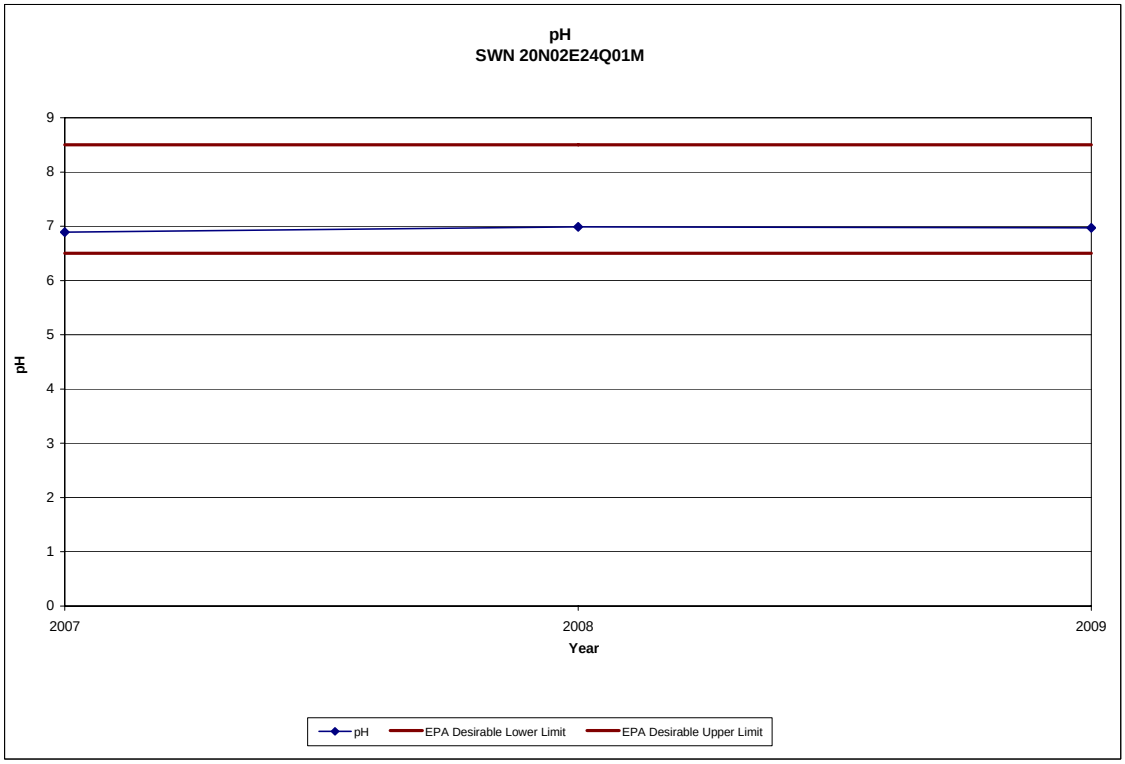


Figure 7. Chico Urban Area well monitored for pH

Durham-Dayton

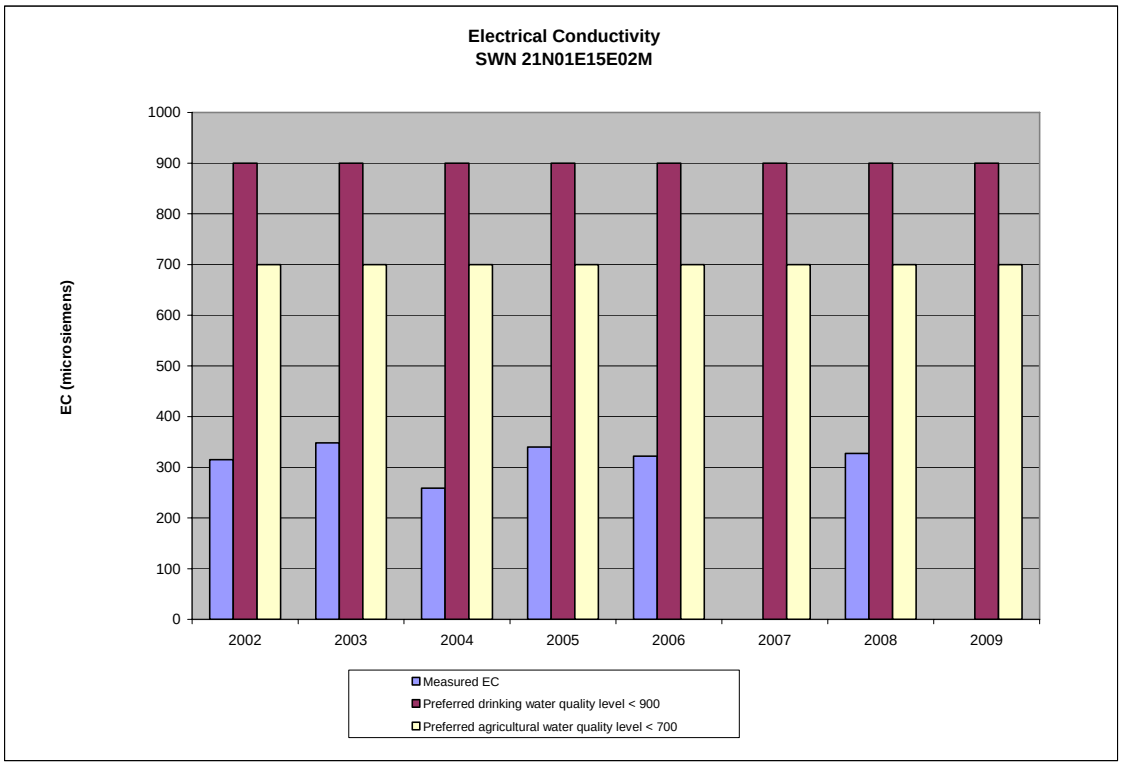


Figure 8. Durham Dayton well monitored for EC

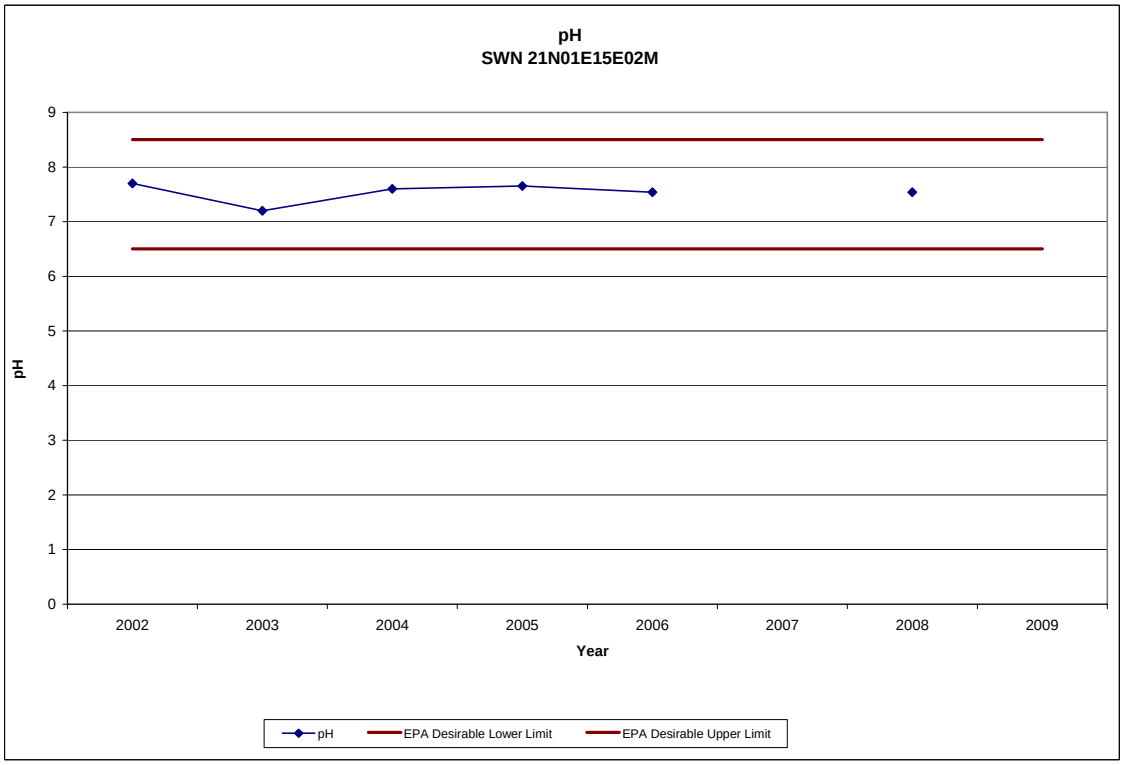


Figure 9. Durham Dayton well monitored for pH

Esquon

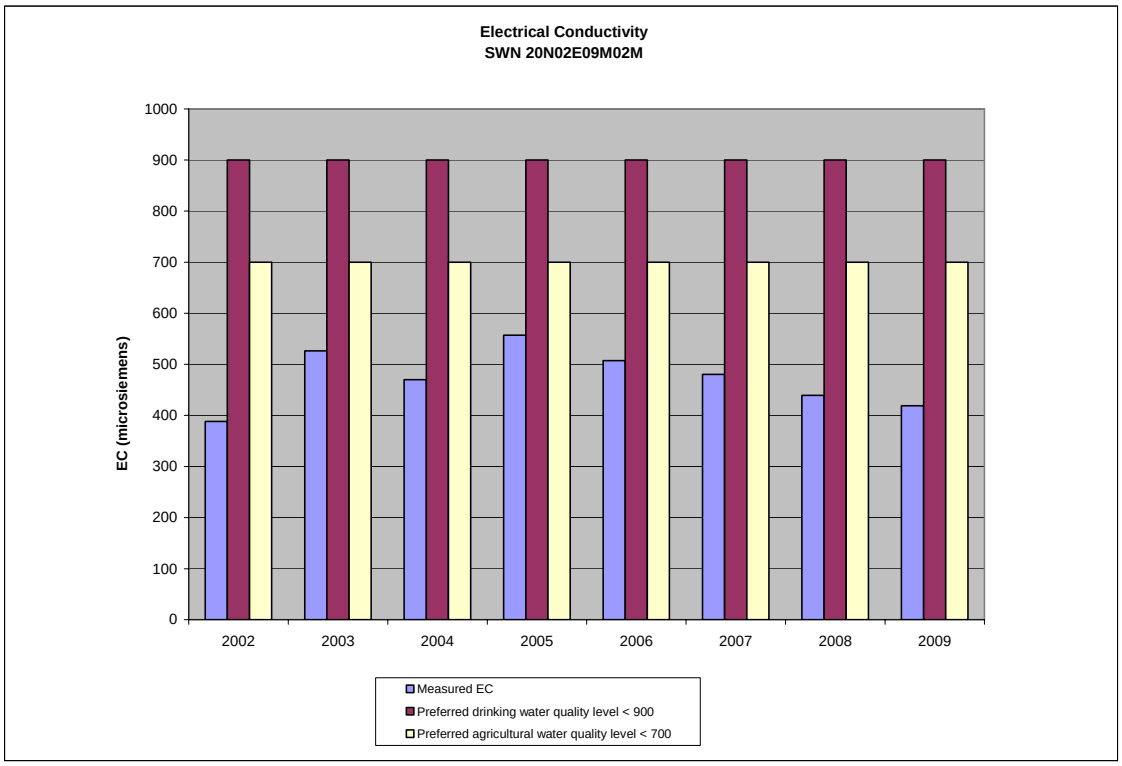


Figure 10. Esquon well monitored for EC

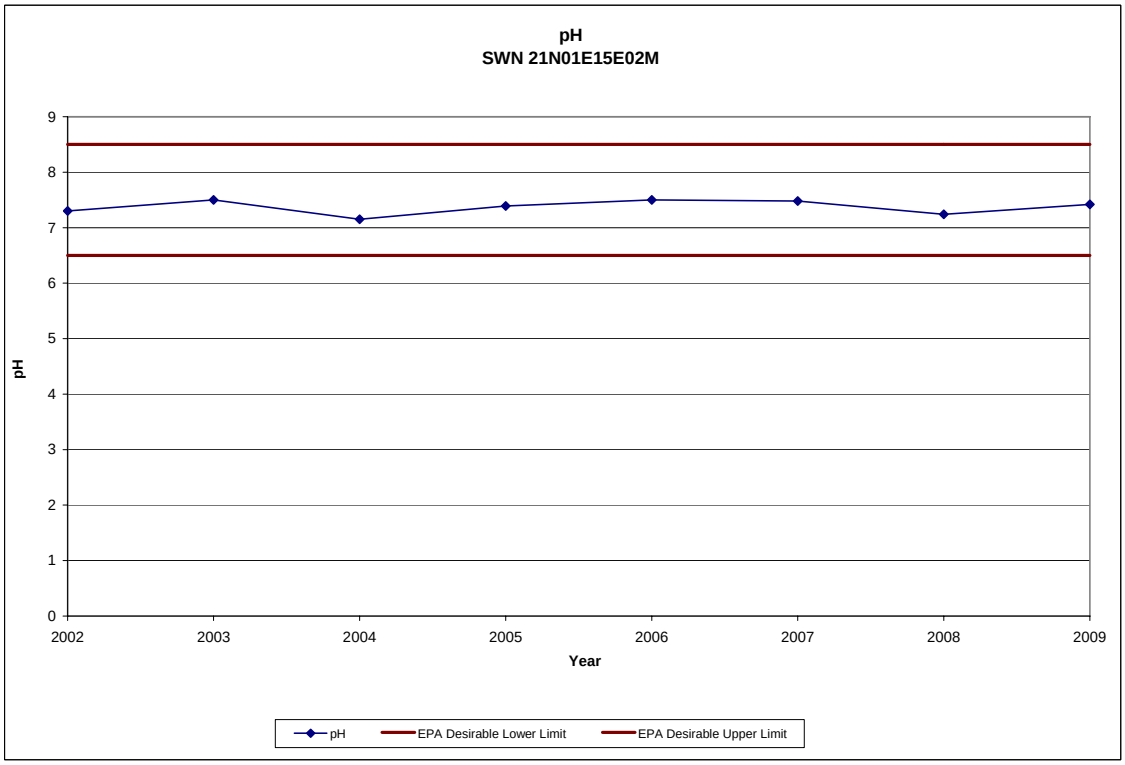


Figure 11. Esquon well monitored for pH

M&T

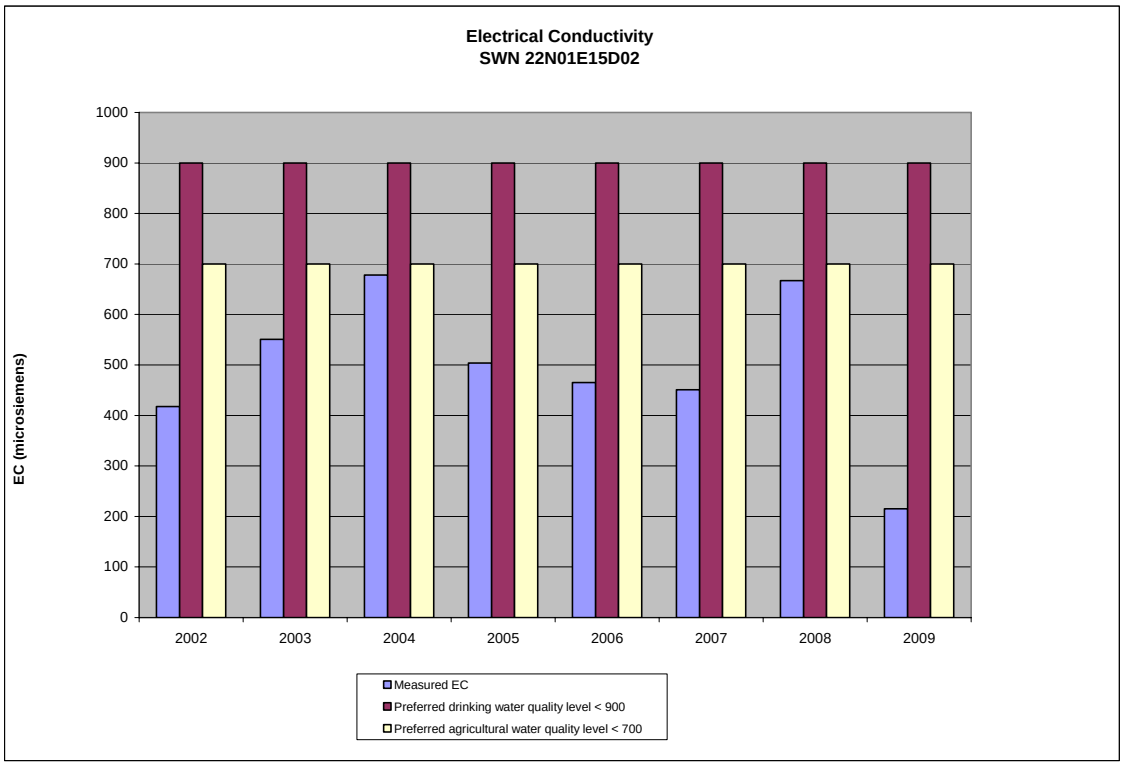


Figure 12. M&T well monitored for EC

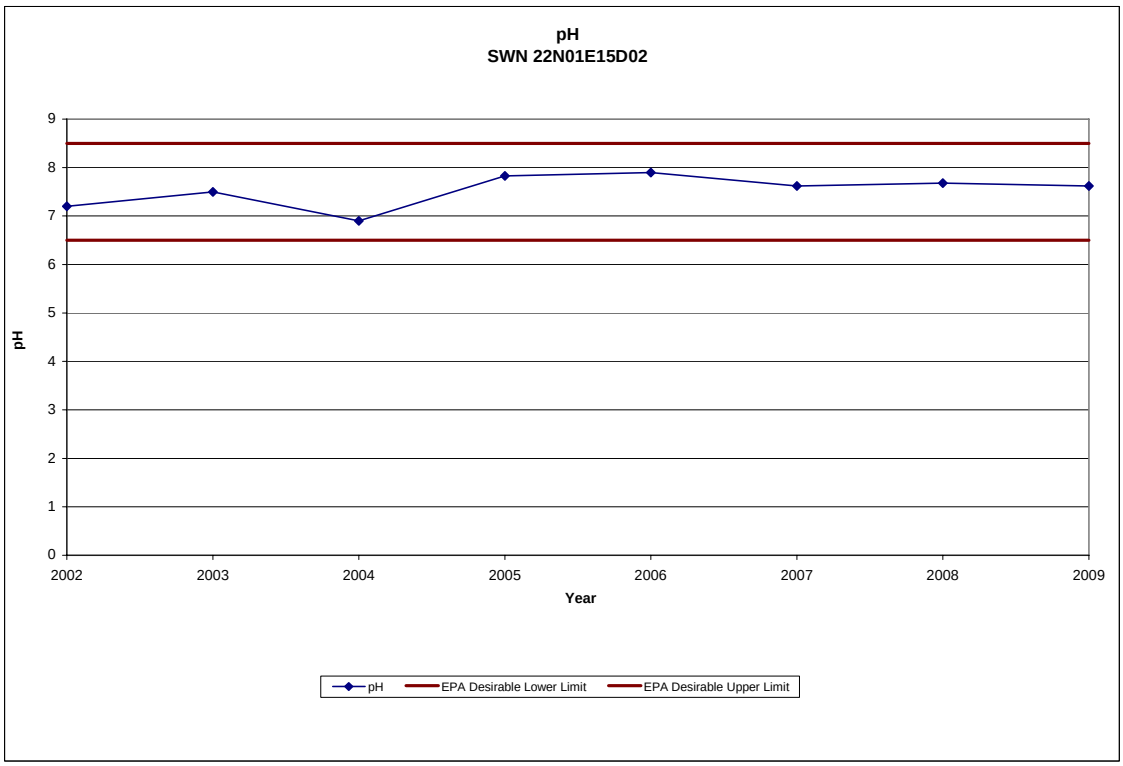


Figure 13. M&T well monitored for pH

Pentz

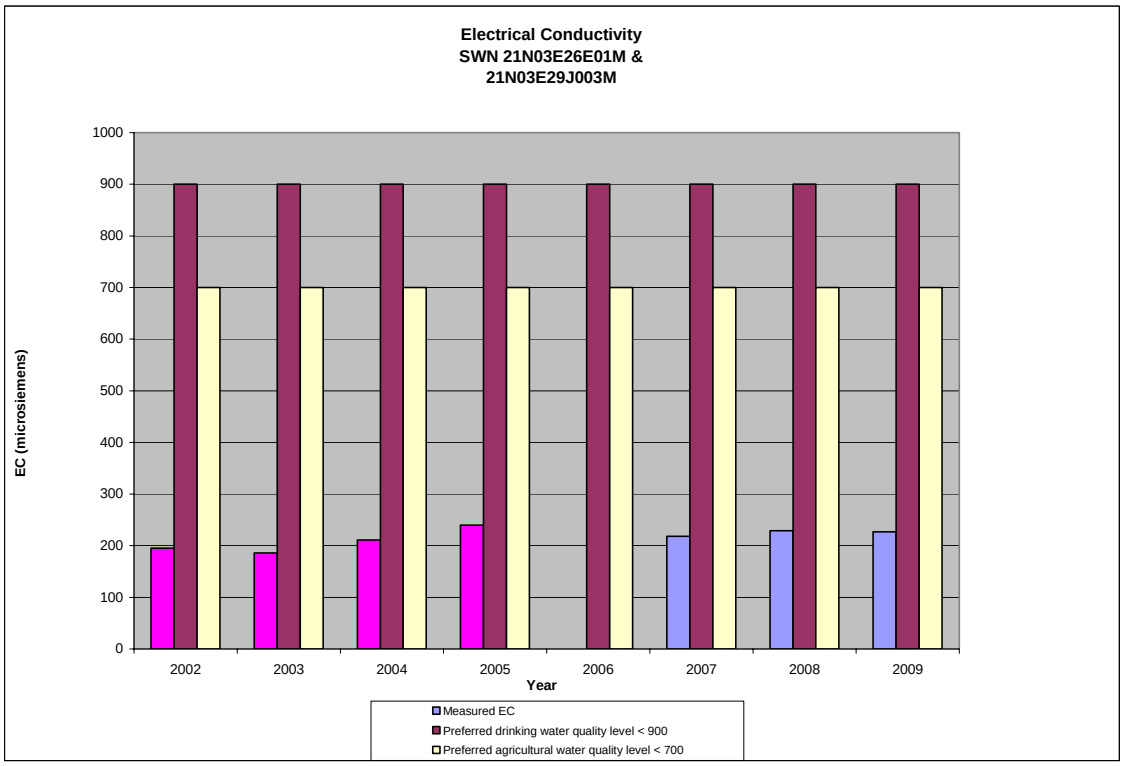


Figure 14. Pentz well monitored for EC

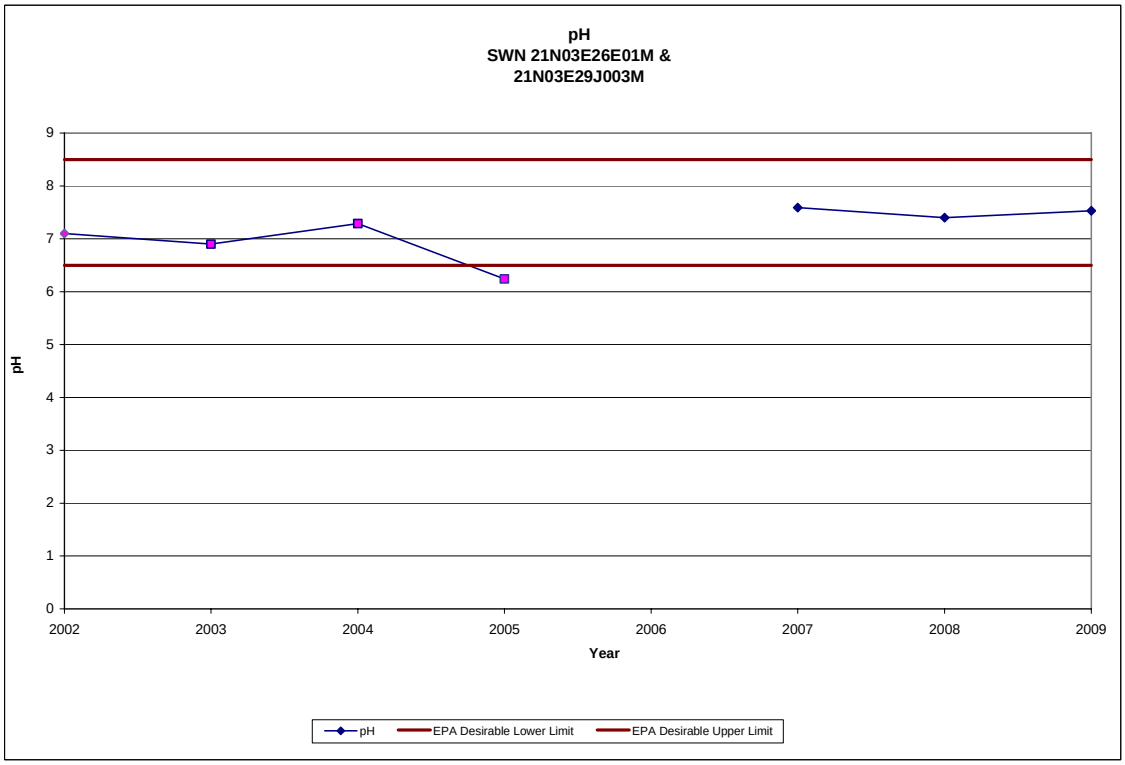


Figure 15. Pentz well monitored for pH

Thermalito

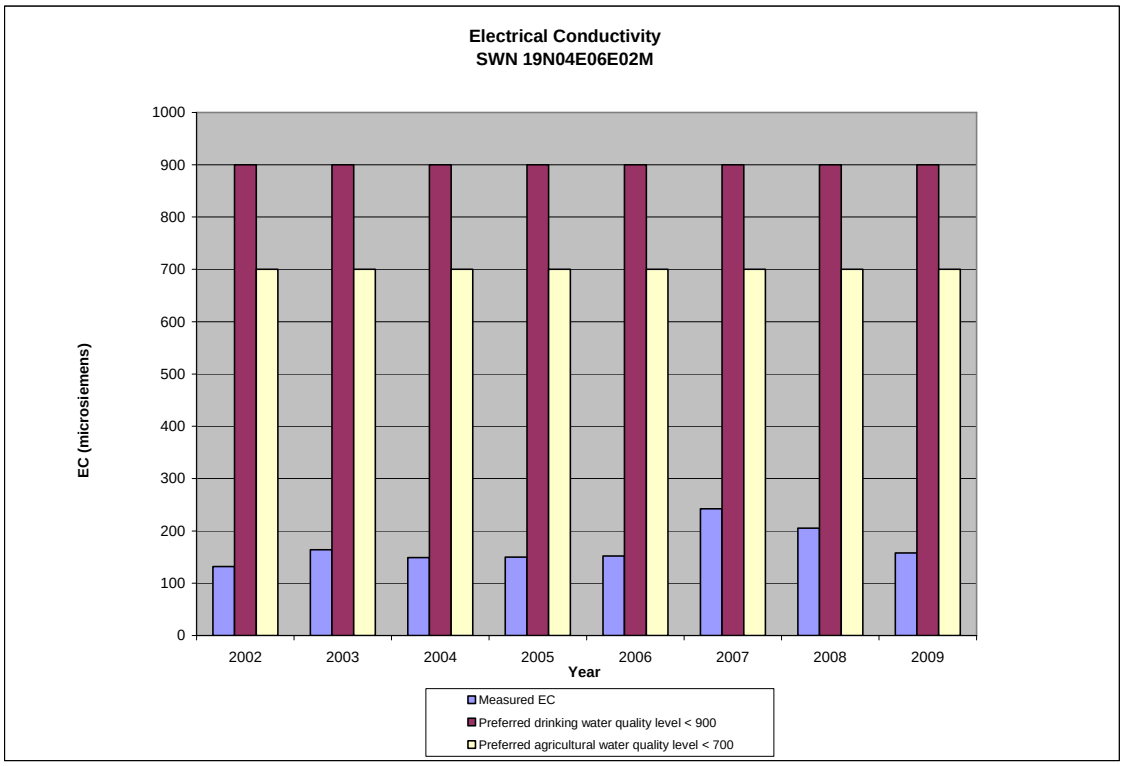


Figure 16. Thermalito well monitored for EC

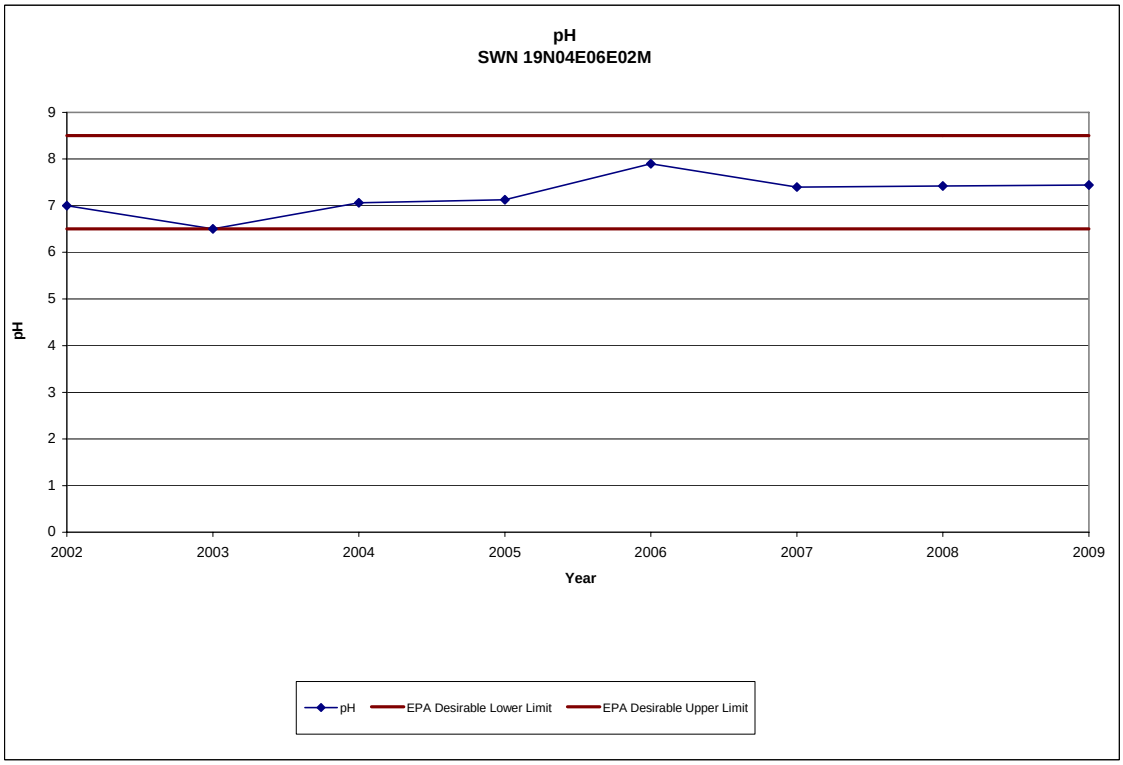


Figure 17. Thermalito well monitored for pH

Vina

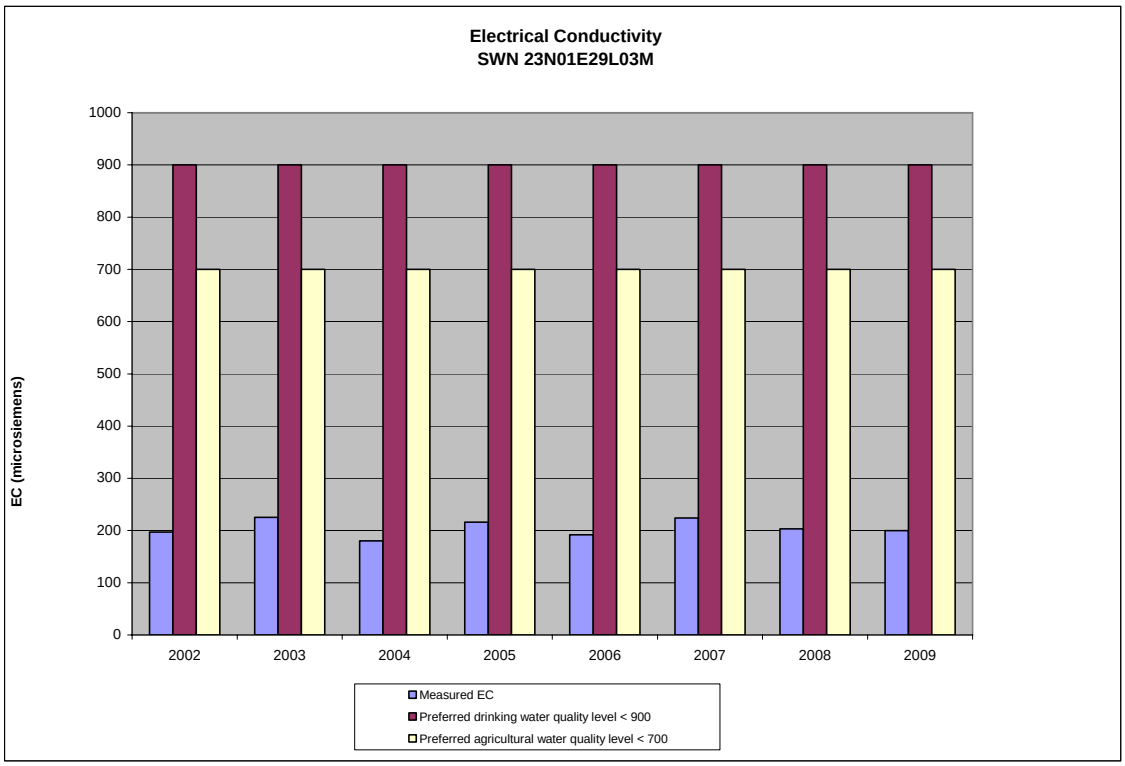


Figure 18. Vina well monitored for EC

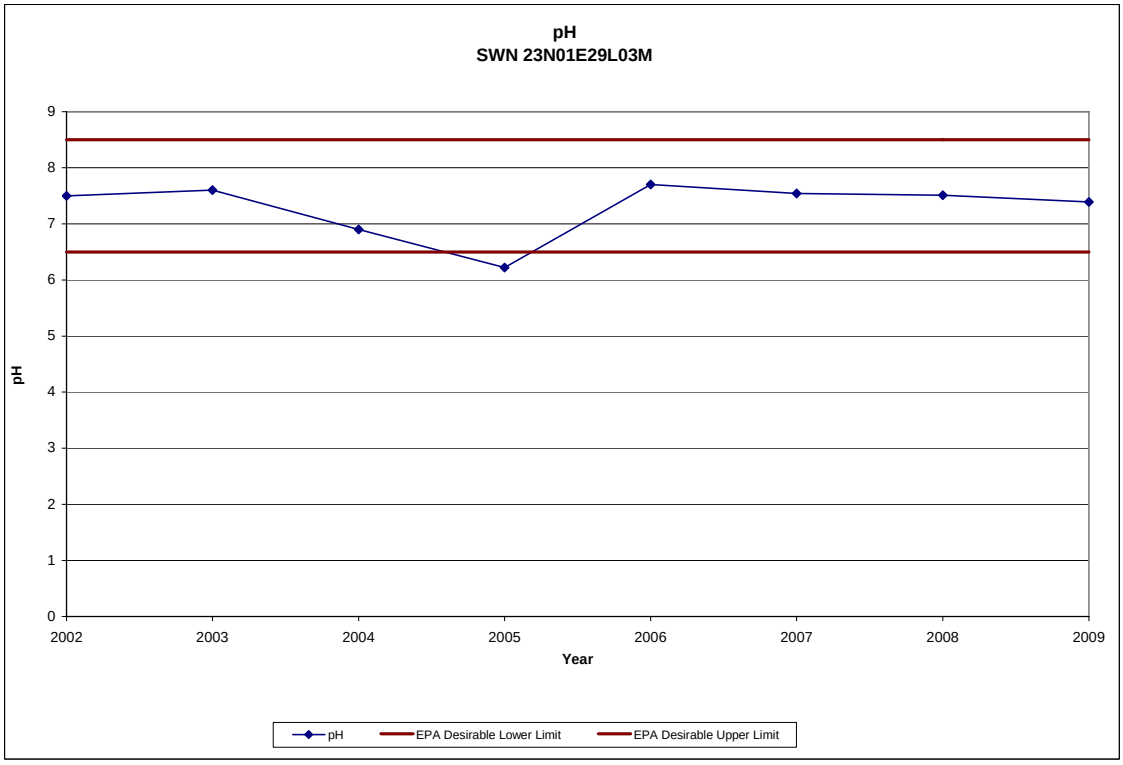


Figure 19. Vina well monitored for pH

Western Canal (east)

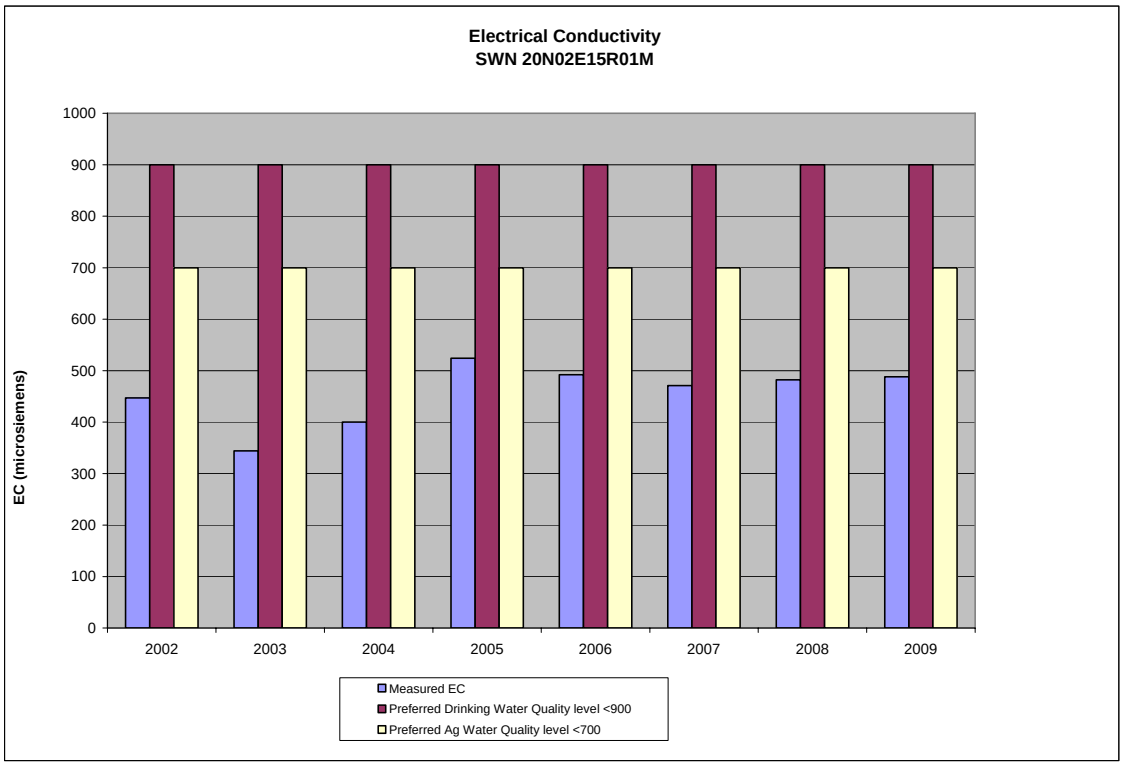


Figure 20. Western Canal (east) well monitored for EC

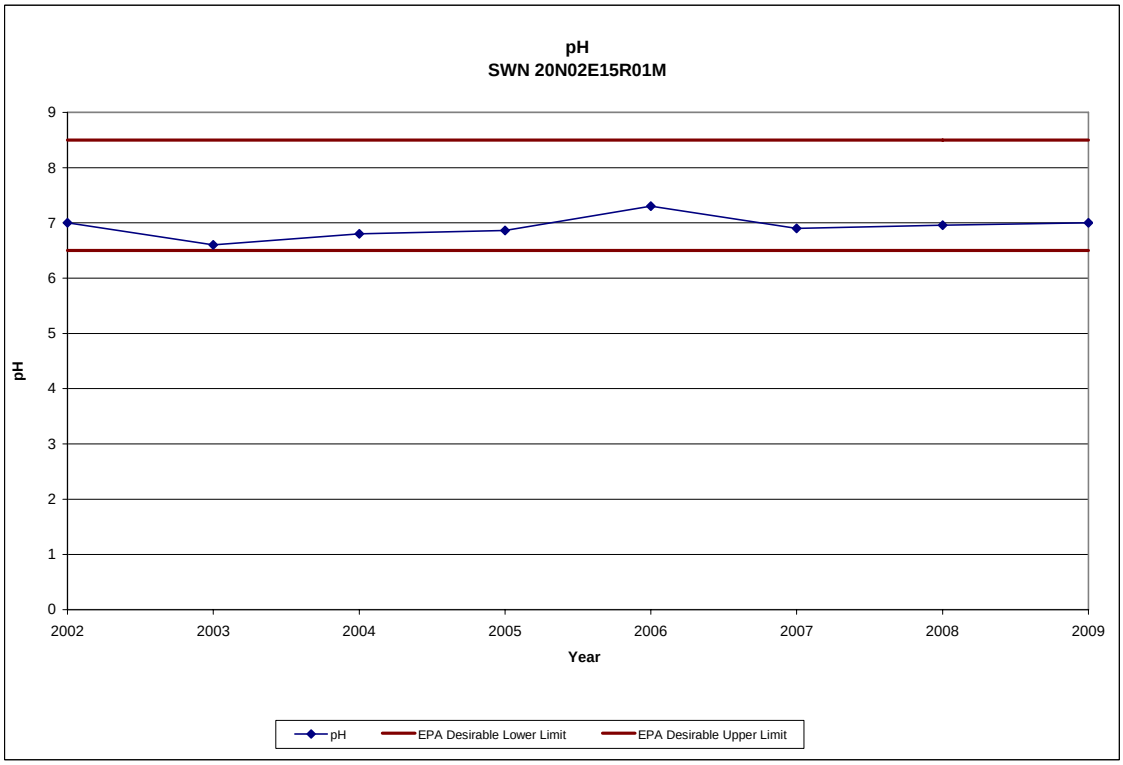


Figure 21. Western Canal (east) well monitored for pH

Western Canal (west)

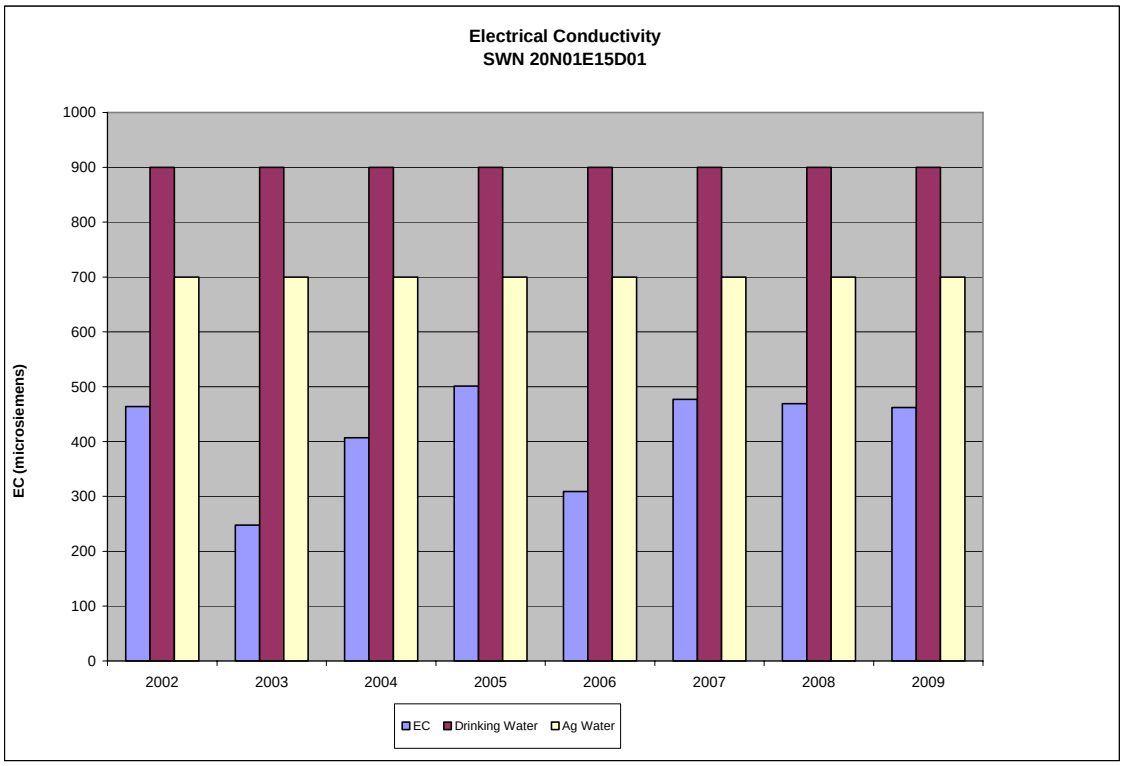


Figure 22. Western Canal (west) well monitored for EC

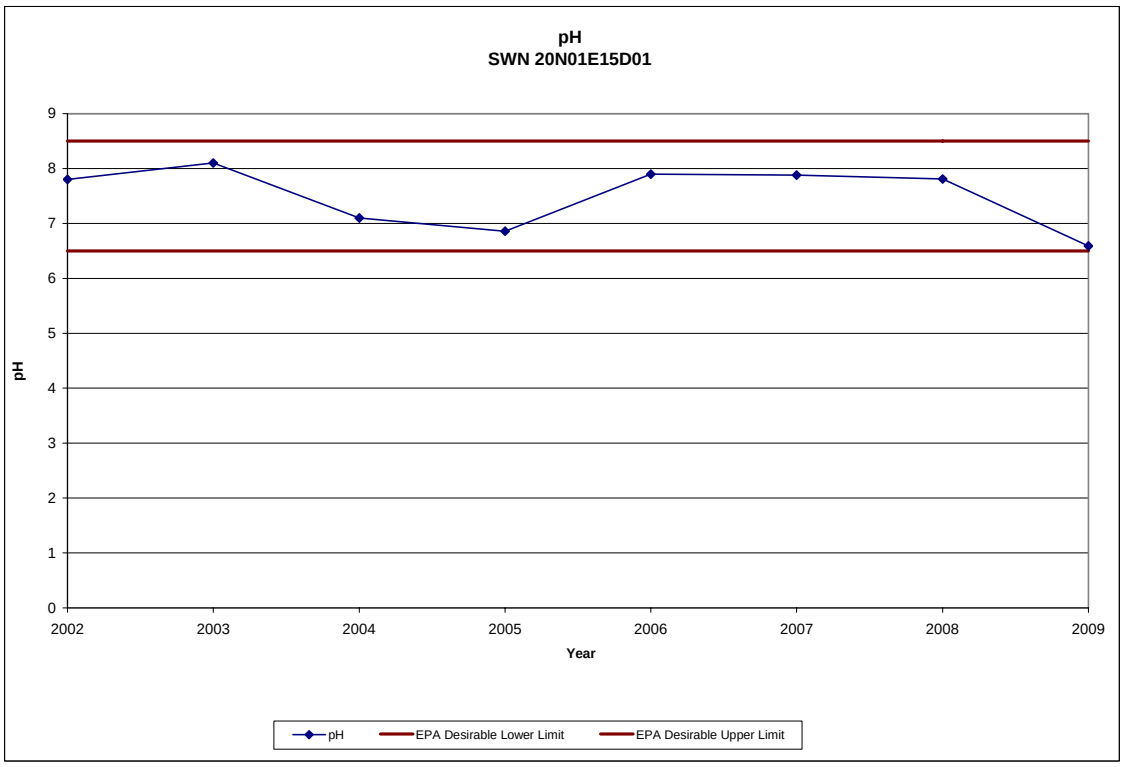


Figure 23. Western Canal (west) well monitored for pH