Appendix A
Subwatershed Overview

Summary of Subwatershed Descriptions (from Attachment A of the WDR)

Subwatershed	Total area (acres)	Counties	Major Population Centers	Major Streams	Major Crops	Hydrogeologic Area
Butte/Yuba/Sutter	1,795,400	All of Butte and Yuba Counties, most of Sutter Co.	Oroville, Chico, Marysville, and Yuba City	Yuba, Lower Feather, Bear, and Sacramento Rivers	Orchards (almonds, walnuts, peaches, prunes, olives), Row crops (beans, tomatoes), rice, alfalfa and pasture	Valley Floor
Colusa Glenn	1,541,600	Colusa and Glenn Counties	Williams, Colusa, Willows, and Orland	Colusa Basin Drain, Walker Creek, Stony Creek, and Sacramento River	Rice, almonds, prunes, walnuts, wheat, pasture alfalfa/hay, corn, and row crops (tomatoes, melons, squash, beets and cucumbers)	Valley Floor
El Dorado	1,005,700	El Dorado Co.	Placerville and Camino	South Fork American River, and North & Middle Forks of Cosumnes River	Wine grapes, apples, pears, walnuts, cherries, peaches and plums	Upland Bedrock
Lake	649,900	Most of Lake Co.	Clearlake, Lower Lake, Kelseyville, Lakeport, Nice, Lucerne, Clearlake Oaks, and Middletown	Upper Cache, Middle, Scotts, and Kelsey Creeks	Wine grapes, walnuts and pears	Mountain Valley
Napa	230,900	Eastern Napa Co.	No significant population centers	Upper Putah Creek	Wine grapes and olives	Mountain Valley
Pit River	3,213,800	Mostly Modoc Co., portions of Lassen and Shasta Counties	Burney, Fall River Mills, and Alturas	Fall River, and North & South Forks of the Pit River	Variety of hay, oats, barley, wheat, potatoes, pasture, strawberries, nursery plants, wild rice, peppermint, garlic, onions and various vegetable seeds	Mountain Valley
Placer/Nevada/S. Sutter /N. Sacramento	1,516,100	All or portions of Placer, Nevada, Sutter and Sacramento Counties	Sacramento, Roseville, Lincoln, Auburn, and Grass Valley	American, Sacramento, and Bear Rivers, and Coon and Pleasant Grove Creeks	No Sac Co: Wine grapes, orchard crops (apples, oranges, peaches, plums, pears, walnuts), field corn, silage corn, rice, and processing tomatoes Sutter Co: Prunes, rice, walnuts, peaches Nevada Co: Wine grapes, pasture and rangeland	Valley Floor and Upland Bedrock
Sacramento/Amador	750,300	Portions of Sacramento (South of American River) and Amador (North of Mokelumne Watershed)	Elk Grove	Sacramento and Cosumnes Rivers; Deer and Laguna Creeks; and northern portions of the Sacramento-San Joaquin Delta	Wine grapes, citrus, mixed pasture, corn, grain and hay, alfalfa, walnuts, rice, tomatoes, safflower	Valley Floor and Upland Bedrock
Shasta/Tehama	2,965,200	Tehama Co. and Shasta Co. below Shasta dam	Corning, Red Bluff, and Redding	Thomas, Elder, Cottonwood, Red Bank, Burch, and Cow Creeks	Pasture, orchards, field and forage crops, wine grapes, alfalfa/grass and small grains, walnuts, prunes/plums, almonds, olives, corn, dry beans, wheat, rice	Valley Floor
Dixon/Solano	324,400	Eastern Solano Co.	Vacaville and Dixon	Ulatis and Pleasants Creeks, Cache and Shag Slough, and portion of NW Sacramento-San Joaquin Delta	Alfalfa hay, wheat, field corn, walnuts, prunes, almonds, vegetables (predominately processing tomatoes), seeds (dry beans and sunflowers), wine grapes	Valley Floor
Upper Feather River	2,148,000	All or portions of Plumas, Sierra and Lassen Counties	Quincy, Portola, Loyalton, Greenville, Graegal, Chester, and Sierraville	Feather River, north and middle forks	Alfalfa, hay, and pasture or range for livestock	Mountain Valley
Yolo	653,300	All of Yolo Co. and a small portion of Colusa Co.	Davis, Woodland, and West Sacramento	Willow Slough, Cache and Putah Creeks and the Yolo Bypass	Field crops (alfalfa hay, wheat, field corn), wine grapes, rice, walnuts, prunes, almonds, vegetables (predominately processing tomatoes), seed crops (dry beans, sunflowers and vegetables)	Valley Floor
Goose Lake	233,500	Modoc Co.	Davis Creek and Willow Ranch	Lassen and Willow Creeks	Alfalfa hay, orchardgrass hay, native meadow hay, and irrigated pasture	Mountain Valley

Area was computed from GIS (rounded to nearest 100 acres)
Hydrogeologic area assignments based on groundwater basins and agriculture areas (defined in Section 2)

Appendix B
Land Use Data Description

APPENDIX B

Land Use Data Description

Land use information to support the GAR was compiled from two sources: the Department of Water Resources (DWR) land use surveys and Department of Pesticide Regulation (DPR) Pesticide Use Reporting (PUR) system field boundaries land use data. Details on both these data sources and how they were used together for this assessment are provided below.

DWR Land Use Surveys

DWR land use surveys are conducted separately for each county and are recorded in various years. The most recent available survey for each county was used, ranging from 1994 to 2008 (Table B-1). This table gives a general initial overview of agriculture distribution by County, from a broad planning-level perspective.

TABLE B-1
DWR Land Use Data in Acres by County

County	Total Area	Surveyed Agriculture Area	DWR Survey Year
Amador	387,825	10,050	1997
Butte	1,073,262	129,341	2004
Colusa	740,382	129,875	2003
El Dorado	1,144,947	8	2008*
Glenn	849,132	143,332	2003
Lake	557,718	27,456	2001
Lassen	3,021,450	45,235	1997
Modoc	2,923,192	85,092	1997
Napa	331,585	4,306	1999
Nevada	623,851	6,001	2005
Placer	960,038	32,561	1994
Plumas	1,672,707	42,197	1997
Sacramento	636,077	158,683	2000
Shasta	2,465,231	65,372	2005
Sierra	615,316	32,823	2002
Solano	422,195	102,683	2003
Sutter	389,351	125,947	2004
Tehama	1,892,924	110,241	1999
Yolo	460,728	220,057	2008
Yuba	412,018	50,870	2005
Total Acres	**21,579,929**	**1,522,130**	**Surveys range 1994–2008**

* NRCS Web Soil Survey Land Cover dataset used because no DWR Land Use Survey was available.

Note:
County areas are clipped to the SVWQC watershed boundary.

It should be noted that actual irrigated acres generally fluctuate year to year in comparison to planning level estimates from DWR.

These land use surveys are collected using aerial photos and satellite imagery. Data are entered directly into a digital map using geographic information system (GIS) software. A DWR staff visit visually confirmed identified land uses on over 95 percent of the developed agricultural areas in each surveyed county (DWR, 2013a). A digital composite map of the survey area is then created from the individual surveys and the data is made publically available in the form of shapefiles and metadata.

There are some limitations to the applicability of these DWR land use data; specifically, DWR land use surveys are limited in showing land use change on an annual basis.

DPR Pesticide Use Reporting Land Use Information

Following feedback received during stakeholder outreach calls, the land use, crop distribution, and categories were refined and updated for a more robust groundwater quality vulnerability analysis. DWR land use data by county is, in some cases, not representative of the changes in agriculture that have occurred in the Sacramento River Watershed in the last five to ten years, and is not originally intended for an agriculture-specific study such as this. The application of DWR land use surveys by county required the compilation of data over the study area from a span of fourteen years (1994-2008) (DWR 2013a). DWR land use surveys are limited in showing land use change or expanse on an annual basis since those years. In an effort to update this data gap, it was determined that the 2013 California DPR's Pesticide Use Reporting system's Field Boundaries land use data, available also by county, was more recent, representative, comprehensive, and agriculture-specific, and therefore more appropriate for the analytical needs of the GAR.

Under the U.S. EPA's Federal Insecticide, Fungicide, and Rodenticide Act, the use of pesticides requires regulation on a state-level basis. In California, DPR regulates pesticide use by funding and requiring each county's County Agriculture Commissioner (CAC) office to enforce the annual Pesticide Use Reporting (PUR) system. The PUR system, in effect since the late 1970s, requires that farmers register their use of restricted materials on a monthly basis in association with the crop for which it is used, and that they obtain annual permits for such use (DPR, 2013). With recent upgrades to the PUR system in which spatial data is incorporated, most counties' CAC offices provide spatial land use data on a parcel-to-parcel basis, specifying specific crop growth, on an annual basis for 2008 through 2013 (DWR, 2013b). Although the limitation of this dataset is that it exclusively represents agriculture for which pesticides are used and registered, it was determined to be appropriate for the GAR development since a large majority of the irrigated agriculture operations in the SVWQC use and register pesticides.

The PUR data represents a robust dataset in that it undergoes several validation checks as it is reported and published in the PUR system. For example, pesticide product registration numbers are cross-checked against the commodity reported, parcel acreages are cross-checked against reported acreages, and historical reporting on that parcel is cross-checked against each subsequent year's report. Various statistical assessments have been conducted by DPR to verify the quality of this data, and the error rate is assumed to be small (DPR, 2000).

Additional land use data sources were reviewed, including the general plans developed by counties, the county crop reports, the USDA's cultivated land data, and the Department of Conservation's Farmland Mapping and Monitoring (FMMP) Program resources. However, the PUR and DWR data sources were determined of higher analysis value for the GAR technical approach. In addition, although county crop reports have accurate acreage estimates of various crops grown in each county, they only provide a tabulated crop summary, and not a detailed geospatial dataset, which is needed for the technical analysis of the GAR. For the purposes of the GAR, a more thorough and geospatial groundwater vulnerability analysis is possible using the agricultural-, spatial- and temporal-specific detail provided in the PUR data. Additionally,

PUR data allow for more a more valley-wide consistent assessment due to the existing wide-spread use and familiarity with PUR data.

Some of the PUR dataset limitations are that it:

- Does not distinguish enrolled acres in the SVWQC; therefore, some acres represented in this dataset might not be enrolled in the Coalition, and the enrolled acres do not exactly match the PUR acreages mapped for the analysis. However, this approach represents a more conservative approach to the analysis by potentially slightly over-estimating enrolled acreage, rather than underestimating it. Also, some acres might become enrolled after the Order is adopted and would already be included in the GAR analysis. Finally, this dataset provides a robust initial spatial depiction and understanding of the crop distribution, and will be updated per Order requirements; therefore, the 5-year GAR update will incorporating more accurate spatial data.
- Does not distinguish between irrigated and non-irrigated land use; therefore, some acres might not fall under the irrigated lands designation and would not need to be regulated under the Order. During stakeholder outreach, some areas were identified that are traditionally not irrigated for a variety of reasons (such as areas with winter crop, shallow water tables, or rangeland). Those areas were removed from the PUR dataset for the vulnerability analysis. In cases where the exact location of non-irrigated lands was not identified, it was included in the overall acreage for analysis. As mentioned in the previous bullet, this approach represents a more conservative approach to the analysis by potentially slightly over-estimating irrigated acreage, rather than underestimating it. Again, as part of the Order requirements, a detailed mapping of enrolled irrigated acreages will be provided and used for the next GAR update.
- Provides one snapshot in time for each plot of farmland; therefore, it doesn't take into account crop rotations for annual crops, or multiple cropping for a plot during the same year. This level of detail is beyond the scope of the current analysis and might be refined at a later date. For this first version of the GAR, the most recent crop information available will be used for the analysis.

To ensure the representativeness and accuracy of the land use data used for the GAR vulnerability assessment, each subwatershed was consulted to review the acreages and distribution of the crops grown in their areas, according to the 2013 PUR data. In counties that had not yet associated spatial data with the PUR data, the DWR land use survey, along with other sources of readily available land use data, were reviewed. For each subwatershed and county, the most appropriate dataset will be used for the GAR's vulnerability assessment. The following table shows the land use data sources that will be used for the GAR analysis on a Subwatershed and county basis. Furthermore, general irrigation practices for major crops in the each Subwatershed are listed.

TABLE B-2
Sacramento Valley Watershed's Land Use Data Source by County for GAR Vulnerability Assessment

Subwatershed	County	Land Use Data Source[a]	Year	Irrigation Practices[b]
Butte-Yuba-Sutter	Butte	Cal Ag PUR	2013	Orchards: north of Durham: sprinkler, south of Gridley: furrow, east of Feather River: flood; Vineyards: drip; Others: DWR 2010 default
	Sutter	Cal Ag PUR	2013	
	Yuba	DWR	2005	
Colusa-Glenn	Colusa	Modified Cal Ag PUR	2013	Deciduous: drip; Vineyards: drip; Others: DWR 2010 default
	Glenn	Modified Cal Ag PUR	2012/2013	Deciduous: microsprinkler; Vineyards: drip; Others: DWR 2010 default
El Dorado	El Dorado	Modified Cal Ag PUR	2013	All pasture: not irrigated; Others: sprinklers

TABLE B-2
Sacramento Valley Watershed's Land Use Data Source by County for GAR Vulnerability Assessment

Subwatershed	County	Land Use Data Source[a]	Year	Irrigation Practices[b]
Goose Lake	Modoc	DWR	1997	Weighted average based on feedback (NHI of 3.7)
Lake	Lake	Modified DWR	2001	Oats & wild rice: not irrigated; grapes: micro; Others: sprinkler
Napa	Napa	Cal Ag PUR	2013	Vineyards: micro; Others: DWR 2010 default
Pit River	Lassen	DWR	1997	DWR 2010 default
	Modoc	DWR	1997	
	Shasta	Modified Cal Ag PUR	2013	
Placer-Nevada-South Sutter-North Sacramento	Nevada	Modified DWR	2005	DWR 2010 default
	Placer	Modified Cal Ag PUR	2013	
	Sacramento	Modified Cal Ag PUR	2013	
	Sutter	Modified Cal Ag PUR	2013	
Sacramento-Amador	Amador	Cal Ag PUR	2013	Pasture, grain, hay, field & tomatoes: flood; grape: micro; Others: DWR 2010 default
	Sacramento	Cal Ag PUR	2013	
Shasta-Tehama	Shasta	Cal Ag PUR	2013	Deciduous: microsprinkler; Vineyards: drip; Others: DWR 2010 default
	Tehama	DWR	1999	Deciduous: microsprinkler; Vineyards: drip; Others: DWR 2010 default
Solano	Solano	Cal Ag PUR underlain with DWR	2013/2003	Deciduous: micro; Vineyards: micro; Others: furrow/flood
Upper Feather River	Plumas	DWR	1997	Pasture: flood; Others: no irrigation
	Sierra	DWR	2002	
Yolo	Yolo	Cal Ag PUR	2013	Tomato, watermelon, melon, cucumber, onion: drip; Orange, walnut, almond, prune, pear, peach, pistachio, apple: micro sprinklers; Sunflower, safflower: furrow; Wheat, oat, barley, hay, alfalfa, pasture: flood; Others: DWR 2010 default

[a] Modified land use: changes based on stakeholder feedback (generally, non-irrigated crops removed from data set)

[b] Default irrigation trends identified on weighted-average basis by crop per DWR's 2010 California Irrigation Method Survey for Sacramento Valley. Other specific irrigation methods as identified during stakeholder outreach.

Crop Categories in the Sacramento Valley

Following further research of the Sacramento Valley Watershed's agriculture and feedback received by Farm Advisors, crop categories specific to the Sacramento Valley were developed.

These categories, presented in the following table, are based on the original categories used by DWR in their land use surveys, and are more inclusive of the crops grown in the region (see Table B-3); they are modified under the advisement of Alan Fulton, UCCE Water Resources Advisor, to better represent agricultural practices and management in the Sacramento Valley Watershed. Wetland easements managed by the

Wetland Reserves Program and delineated by the NRCS are hereafter also included as a separate land use category as they are enrolled under the SVWQC.

TABLE B-3
Crops by Crop Category within Sacramento Valley Watershed

Annual Fruit, Vegetables, & Seed Crops	Citrus, Olive, & Ornamental Crops	Deciduous Fruit & Nut Crops	Field Crops	Grain & Hay Crops	Pasture Crops	Vineyard Crops
Anise	Aloe Vera	Almond	Bean, Dry	Alfalfa	Clover	Grape, Table
Arugula	Artichoke	Apple	Bean, Fava	Barley	Grass Seed	Grape, Wine
Asparagus	Avocado	Apricot	Bean, Garbanzo (Chickpea)	Forage Hay	Orchardgrass	
Bamboo Shoot	Eucalyptus	Banana	Bean, Succulent	Oat	Pastureland	
Beet	Grapefruit	Blackberry	Corn	Sudangrass	Ryegrass	
Broccoli	Jujube	Blueberry	Cotton	Triticale		
Cabbage	Lemon	Cherry	Flax	Vetch		
Canola/Rape Seed	Olive, Oil	Chestnut	Hops	Wheat		
Cantaloupe	Olive, Table	Fig	Mustard	Wild Rice		
Carrot	Orange	Kiwi	Potato			
Cauliflower	Outdoor Plants	Mulberry	Safflower			
Cilantro	Pineapple	Nectarine	Sorghum			
Cole Crop	Tangerine	Peach	Soybean			
Collard		Pear	Sunflower			
Cucumber		Pecan				
Dandelion Green		Persimmon				
Eggplant		Pistachio				
Fruiting Vegetable		Plum				
Garlic		Pluot				
Gourd		Pomegranate				
Herbs		Prune				
Honeydew Melon		Raspberry				
Horseradish		Stone Fruit				
Kale		Walnut				
Kohlrabi						
Leaf Lettuce						
Leek						
Loquat						
Melon						
Mint						
Mushroom						
Okra						
Onion						
Outdoor flowers						
Peas						
Pepper						
Pepper, Spice						

TABLE B-3
Crops by Crop Category within Sacramento Valley Watershed

Annual Fruit, Vegetables, & Seed Crops	Citrus, Olive, & Ornamental Crops	Deciduous Fruit & Nut Crops	Field Crops	Grain & Hay Crops	Pasture Crops	Vineyard Crops
Pumpkin						
Radicchio						
Radish						
Spinach						
Squash						
Strawberry						
Sweet Basil						
Swiss Chard						
Tomato						
Turnip						
Watermelon						
Zucchini						

References

California Department of Pesticide Regulation (DPR). 2000. California's Pesticide Use Report: An Assessment of Spatial Data Quality. http://www.cdpr.ca.gov/docs/pur/appendix_c_dataq_ldr.pdf. Accessed January 2014.

California Department of Pesticide Regulation (DPR). 2013. Pesticide Use Reporting (PUR). http://www.cdpr.ca.gov/docs/pur/purmain.htm. Accessed January 2014.

California Department of Water Resources (DWR). 2013a. Land Use Surveys by County. http://www.water.ca.gov/landwateruse/lusrvymain.cfm. Accessed September 2013.

California Department of Water Resources (DWR). 2013b. Pesticide Use Reporting (PUR) Field Boundaries Land Use Data. GIS file. http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm. Accessed November 2013 by county from County Agriculture Commissioner

Appendix C
NRCS Soil Drainage Classes

APPENDIX C

NRCS Soil Drainage Classes

The definitions of NRCS drainage classes are provided in Table C-1

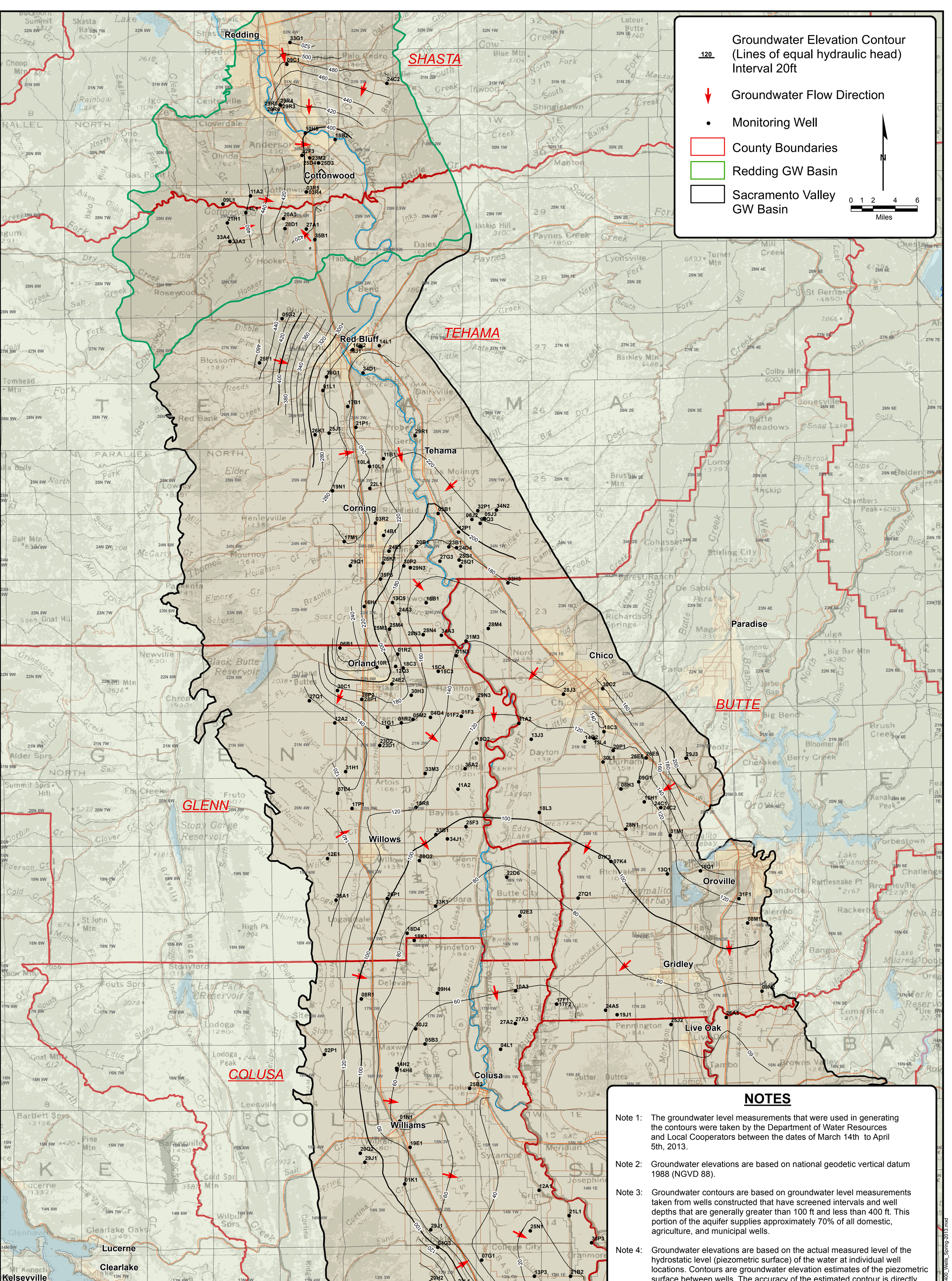
TABLE C-1
NRCS SSURGO Natural Soil Drainage Classes

Natural Soil Drainage Class	Water Removal Rate	Internal Free Water Occurrence	Effect on Mesophytic Crop[a] Growth	Soils[b]
Excessively drained	Rapidly	Very rare or very deep	None	Coarse texture, high HC, very shallow
Somewhat excessively drained	Rapidly	Very rare or very deep	None	Coarse texture, high saturated HC, very shallow
Well drained	Readily	Deep or very deep	None	Free of features related to wetness
Moderately well drained	Slowly during some parts of year	Moderately deep and transitory, permanent	Inhibited growth occasional	Wet for short time within rooting depth during growing season, low saturated HC within upper 1 m, high occasional rainfall
Somewhat poorly drained	Slowly so soil is wet at shallow depth during growing season	Shallow to moderately deep and transitory, permanent	Inhibited growth common	Low or very low saturated HC, high water table, additional water from seepage, continuous rainfall
Poorly drained	Slowly so soil remains wet at shallow depth throughout year	Shallow to very shallow, persistent, at or near surface during growing season	Growth inhibited during growing season	Not continuously wet directly below plow-depth, water table result of low or very low saturated HC, continuous rainfall, free water at shallow depth common
Very poorly drained	Slowly so free water remains at or near surface during growing season	Very shallow, persistent	Growth inhibited always	Level or depressed; Frequently ponded

[a] Mesophytic crops: terrestrial plants which are adapted to neither particularly dry nor particularly wet environments; prefer moist, well-drained soils.

[b] Saturated HC (hydraulic conductivity): Quantitative measure of a soil's ability to transmit water when subjected to a hydraulic gradient; ease with which pores of a saturated soil permit water movement.

Appendix D
DWR Groundwater Contour Maps



NOTES

Note 1: The groundwater level measurements that were used in generating the contours were taken by the Department of Water Resources and Local Cooperators between the dates of March 14th to April 5th, 2013.

Note 2: Groundwater elevations are based on national geodetic vertical datum 1988 (NGVD 88).

Note 3: Groundwater contours are based on groundwater level measurements taken from wells constructed that have screened intervals and well depths that are generally greater than 100 ft and less than 400 ft. This portion of the aquifer supplies approximately 70% of all domestic, agriculture, and municipal wells.

Note 4: Groundwater elevations are based on the actual measured level of the hydrostatic level (piezometric surface) of the water at individual well locations. Contours are groundwater elevation estimates of the piezometric surface between wells. The accuracy of the estimated contour is directly related to the spacing and the distribution of nearby monitoring wells, the similarity of nearby monitoring well construction, and the local changes or similarities in aquifer characteristics.

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NORTHERN SACRAMENTO VALLEY GROUNDWATER ELEVATION MAP
Spring 2013

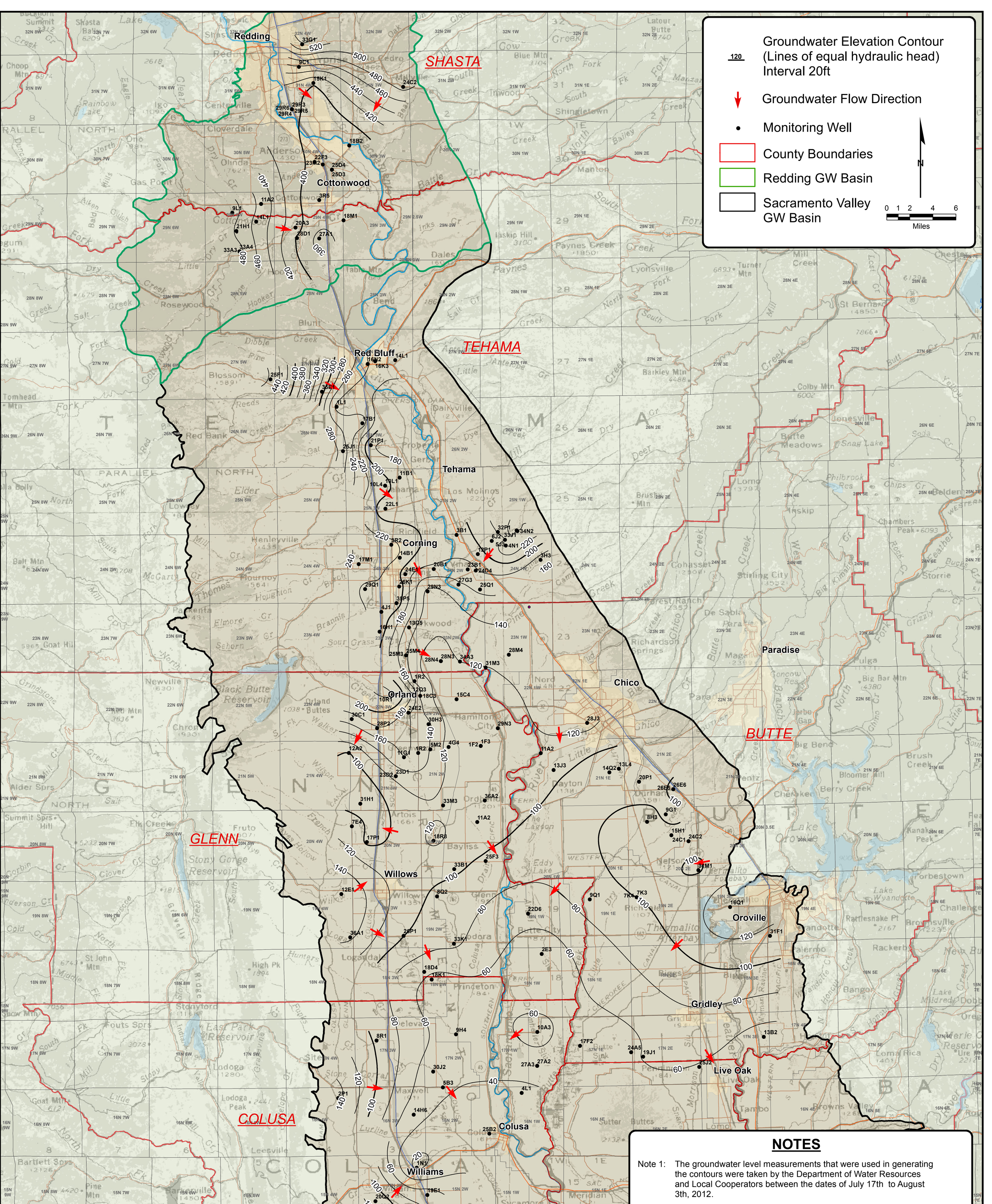
PLATE 1

Date: July 2013

BY: G. Gordon

Path: R:\Sections\DCM\CONTOUR_MAP\2013\SpringArcMap\100400_Wells_Spring-2013.mxd

http://www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/gw_level_monitoring.cfm



NOTES

Note 1: The groundwater level measurements that were used in generating the contours were taken by the Department of Water Resources and Local Cooperators between the dates of July 17th to August 3th, 2012.

Note 2: Groundwater elevations are based on national geodetic vertical datum 1988 (NGVD 88).

Note 3: Groundwater contours are based on groundwater level measurements taken from wells constructed that have screened intervals and well depths that are generally greater than 100 ft and less than 400 ft. This portion of the aquifer supplies approximately 70% of all domestic, agriculture, and municipal wells.

Note 4: Groundwater elevations are based on the actual measured level of the hydrostatic level (piezometric surface) of the water at individual well locations. Contours are groundwater elevation estimates of the piezometric surface between wells. The accuracy of the estimated contour is directly related to the spacing and the distribution of nearby monitoring wells, the similarity of nearby monitoring well construction, and the local changes or similarities in aquifer characteristics.

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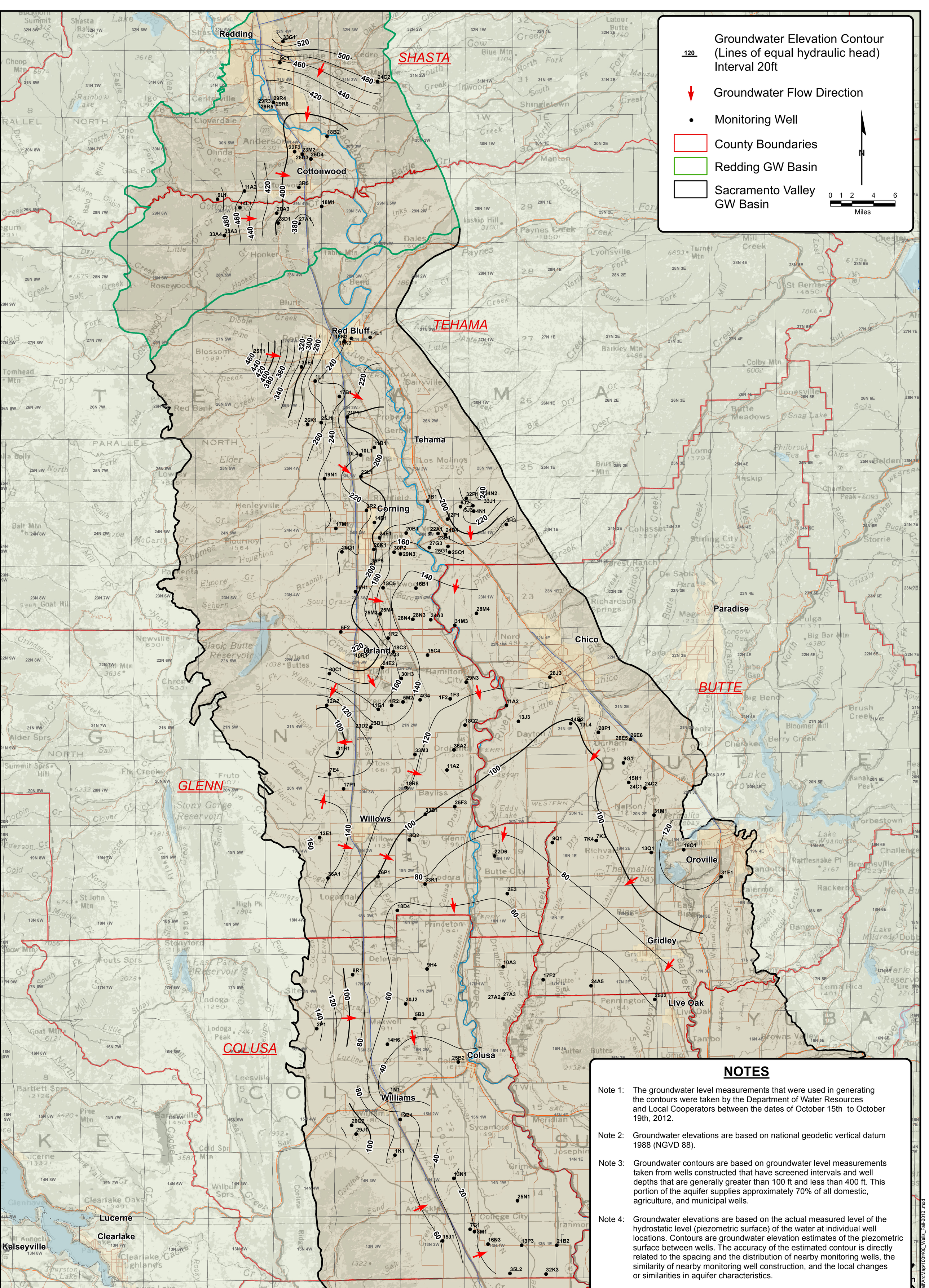
NORTHERN SACRAMENTO VALLEY GROUNDWATER ELEVATION MAP
Summer 2012

PLATE 2

Date: April 2013

BY: G. Gordon

Path: R:\Sections\DCM\CONTOUR_MAP\2012\100f400_Wells_Summer-2012.mxd



NOTES

Note 1: The groundwater level measurements that were used in generating the contours were taken by the Department of Water Resources and Local Cooperators between the dates of October 15th to October 19th, 2012.

Note 2: Groundwater elevations are based on national geodetic vertical datum 1988 (NGVD 88).

Note 3: Groundwater contours are based on groundwater level measurements taken from wells constructed that have screened intervals and well depths that are generally greater than 100 ft and less than 400 ft. This portion of the aquifer supplies approximately 70% of all domestic, agriculture, and municipal wells.

Note 4: Groundwater elevations are based on the actual measured level of the hydrostatic level (piezometric surface) of the water at individual well locations. Contours are groundwater elevation estimates of the piezometric surface between wells. The accuracy of the estimated contour is directly related to the spacing and the distribution of nearby monitoring wells, the similarity of nearby monitoring well construction, and the local changes or similarities in aquifer characteristics.

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NORTHERN SACRAMENTO VALLEY GROUNDWATER ELEVATION MAP
Fall 2012

PLATE 3

Date: May 2013

BY: G. Gordon

http://www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/gw_level_monitoring.cfm

Path: R:\Sections\DCM\CONTOUR_MAP\2012\Fall\ArcMap\100400_Wells_Fall-2012.mxd

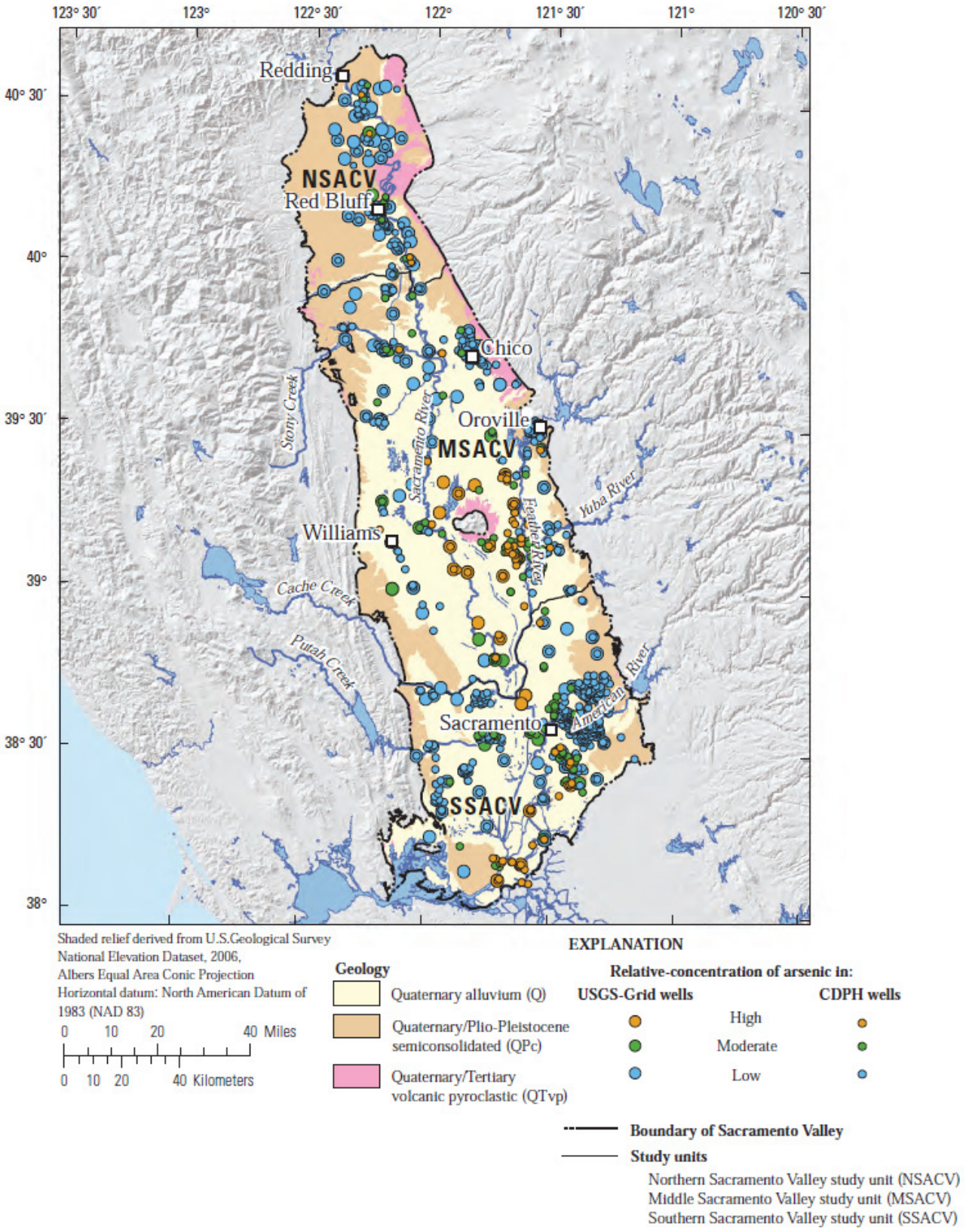
Appendix E
USGS Water Quality Maps

APPENDIX E

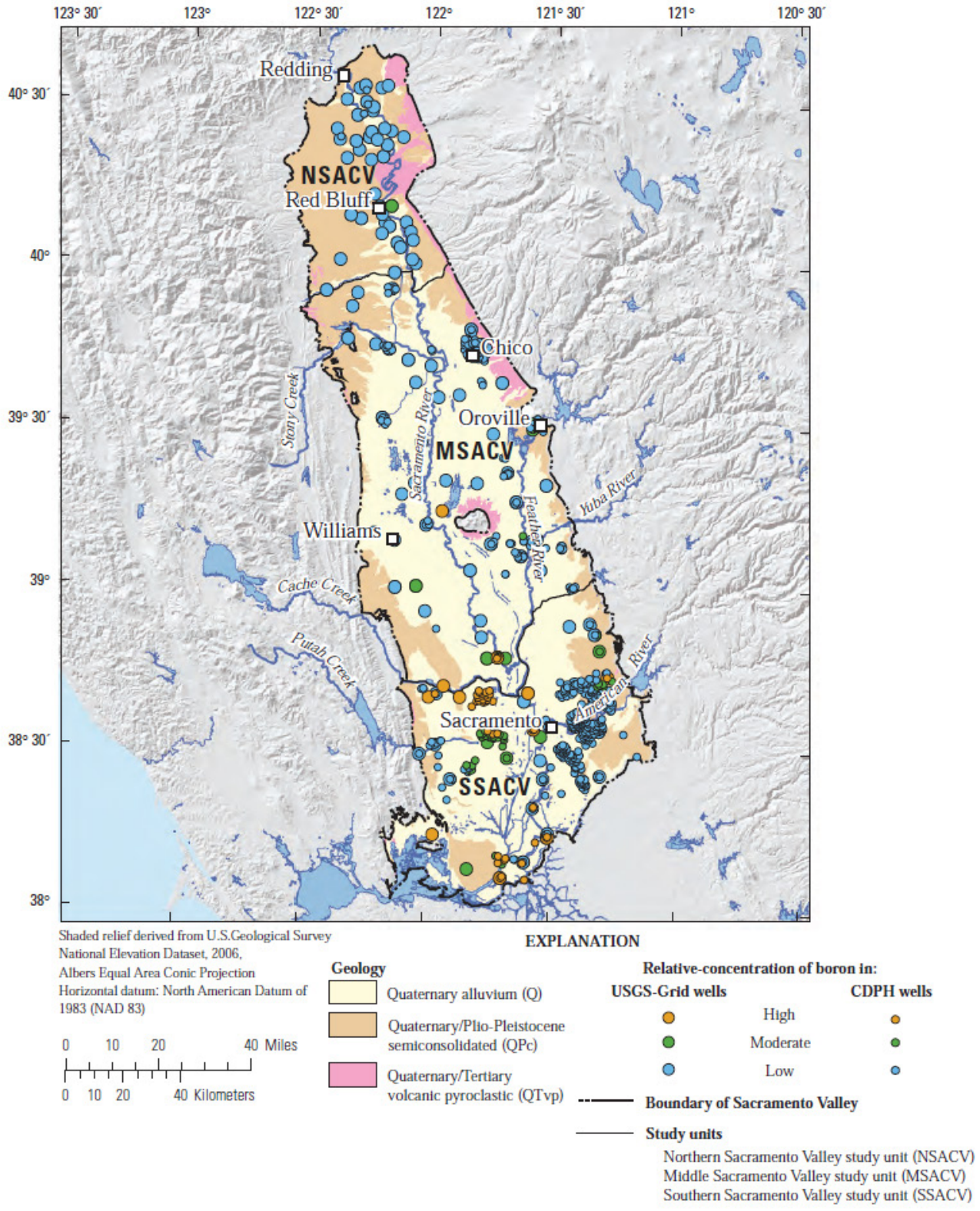
USGS Water Quality Maps

The maps provided in this Appendix show the relative concentrations of arsenic, boron, nitrate, manganese, and TDS in the Sacramento Valley Groundwater Basin. The maps were developed by the USGS as part of the California GAMA Priority Basin Project for a review of groundwater quality in the Sacramento Valley Groundwater Basin.

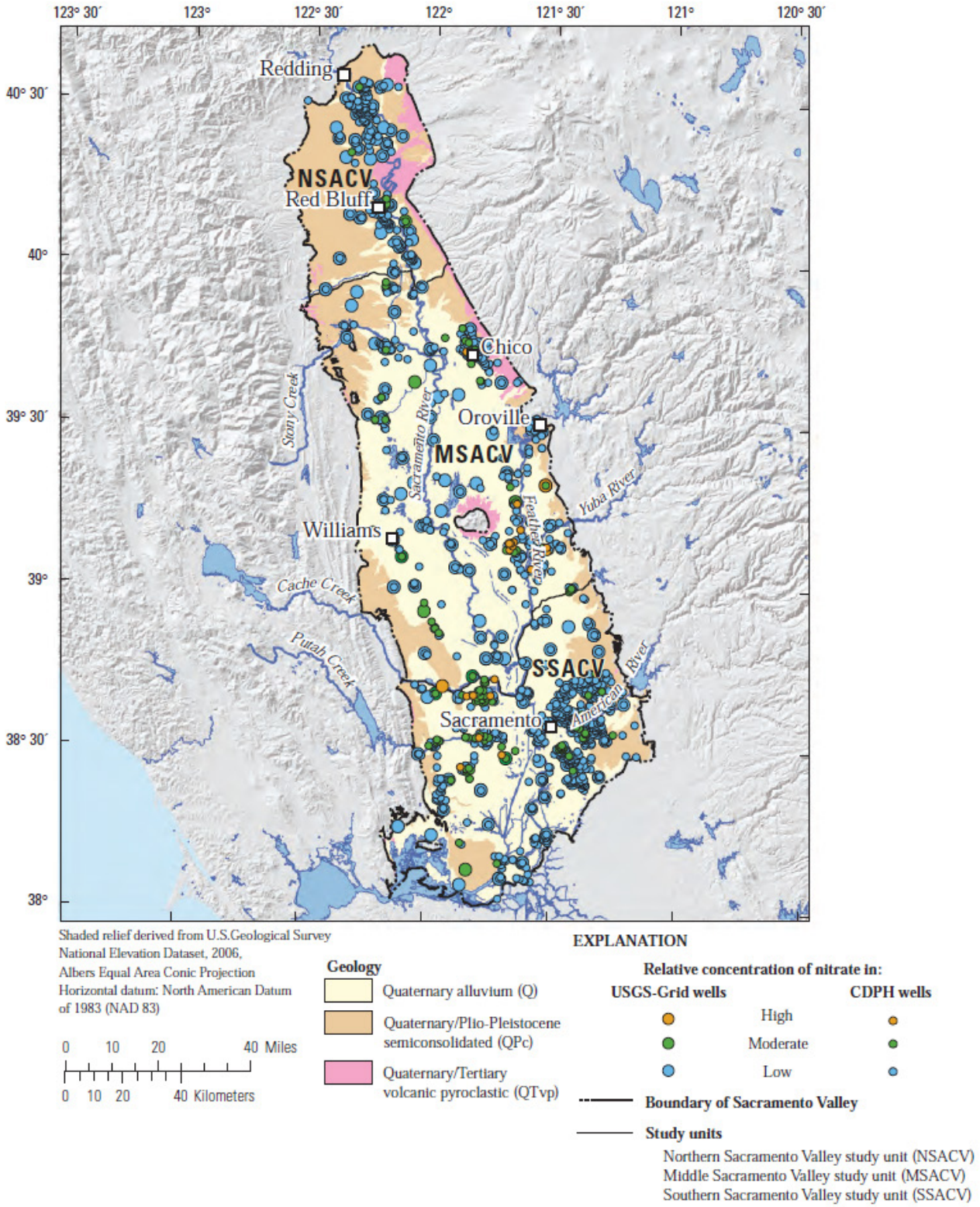
USGS. 2011. *Status of Groundwater Quality in the Southern, Middle, and Northern Sacramento Valley Study Units, 2005-08: California GAMA Priority Basin Project*. United States Geological Survey Scientific Investigations Report 2011-5002. 120 p.



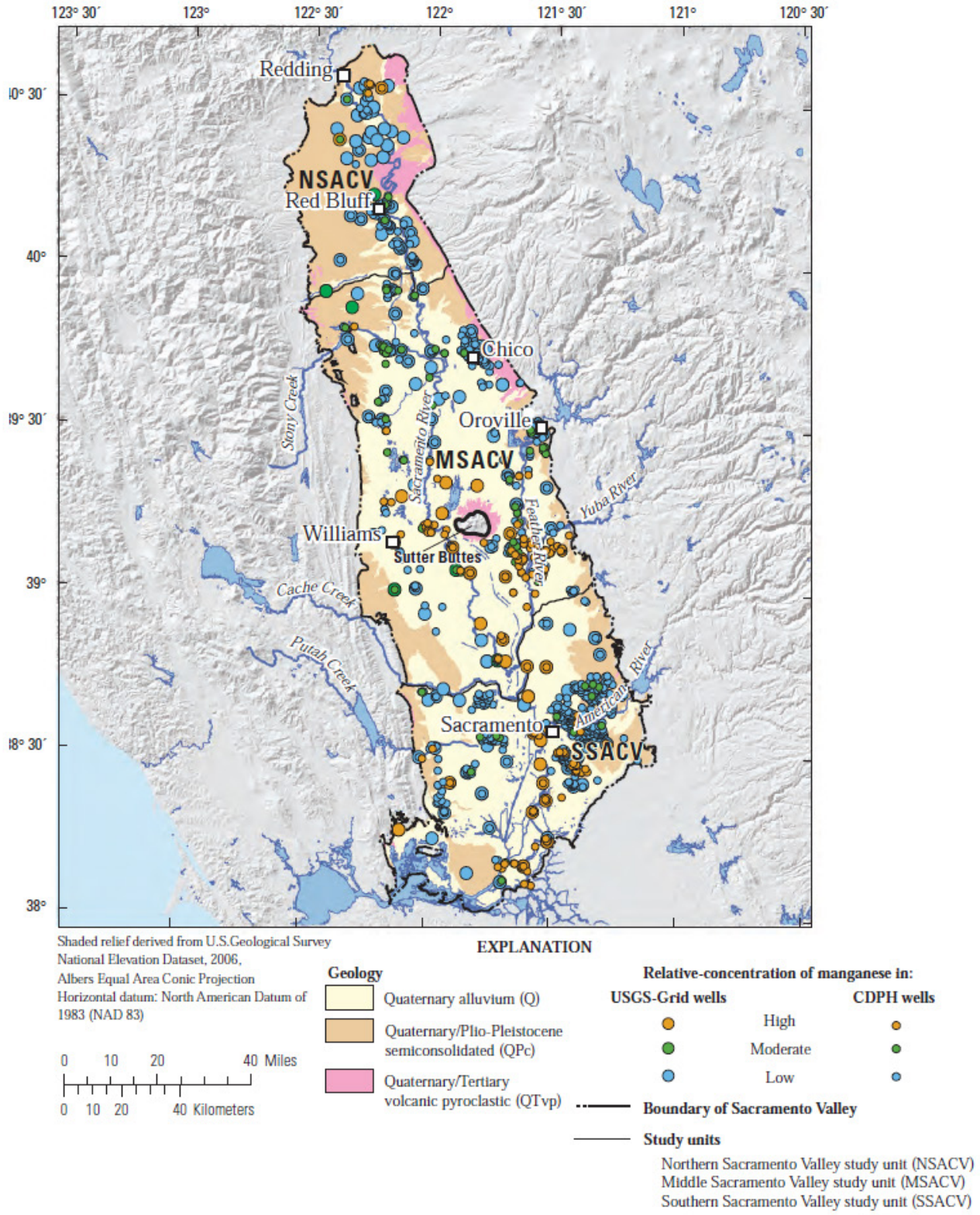
Relative Concentrations of Arsenic in USGS -grid wells and D.PH. wells, Southern, Middle, and Northern Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study units, California (USGS 2011)



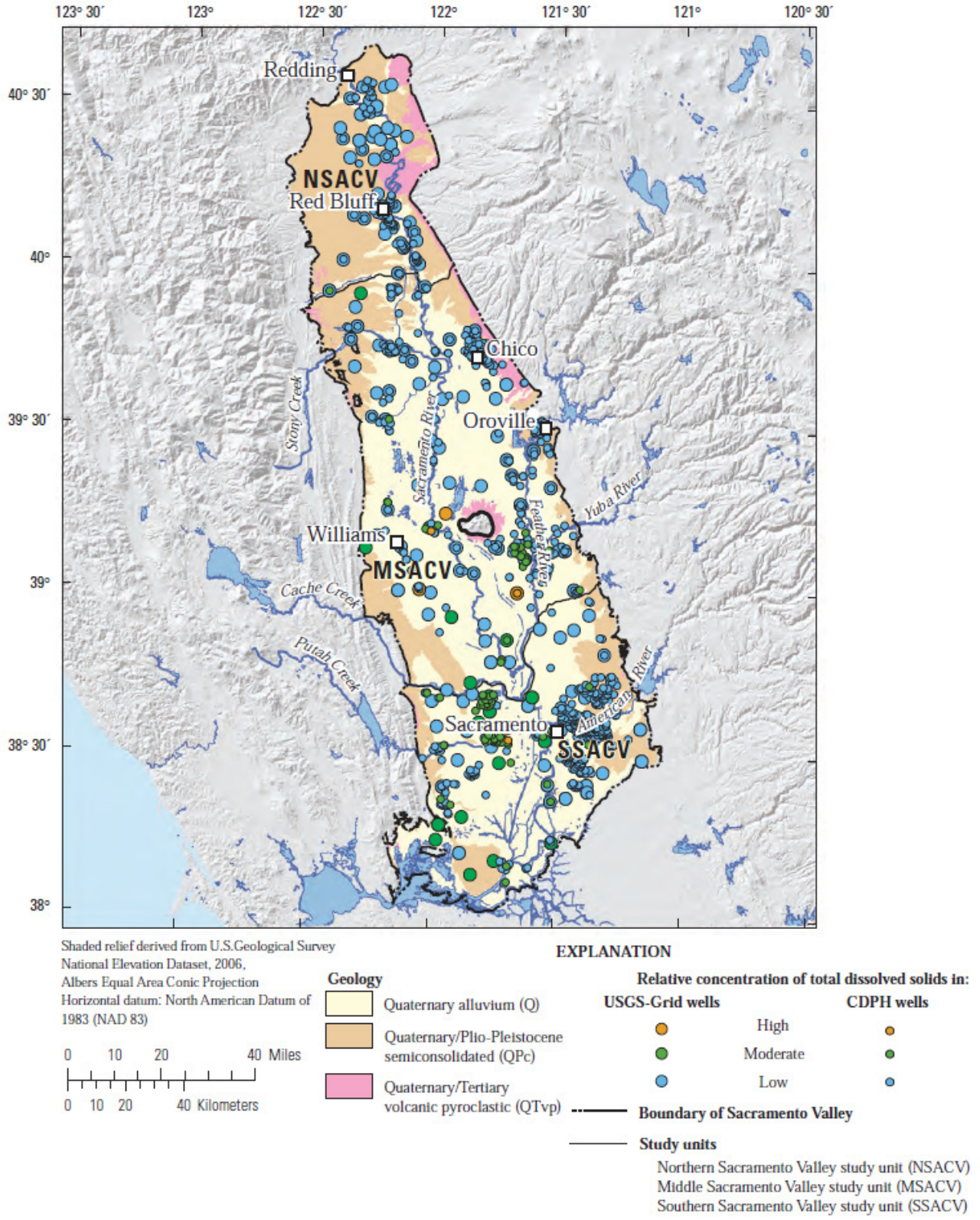
Relative Concentrations of Boron in USGS -grid wells and D.PH. wells, Southern, Middle, and Northern Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study units, California (USGS 2011)



Relative Concentrations of Nitrate in USGS -grid wells and D.PH. wells, Southern, Middle, and Northern Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study units, California (USGS 2011)



Relative Concentrations of Manganese in USGS -grid wells and D.PH. wells, Southern, Middle, and Northern Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study units, California (USGS 2011)



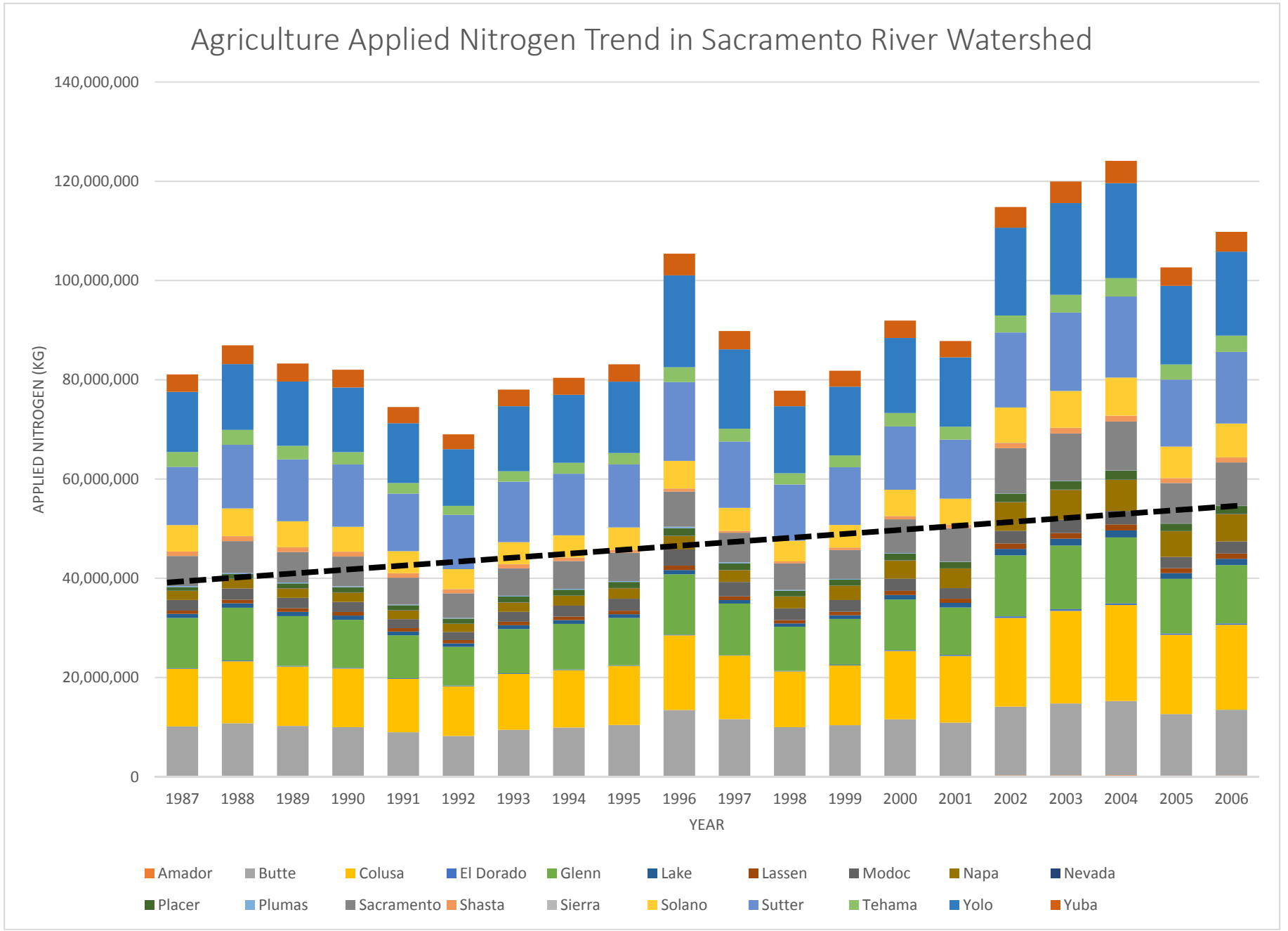
Relative Concentrations of Total Dissolved Solids in USGS -grid wells and D.PH. wells, Southern, Middle, and Northern Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study units, California (USGS 2011)

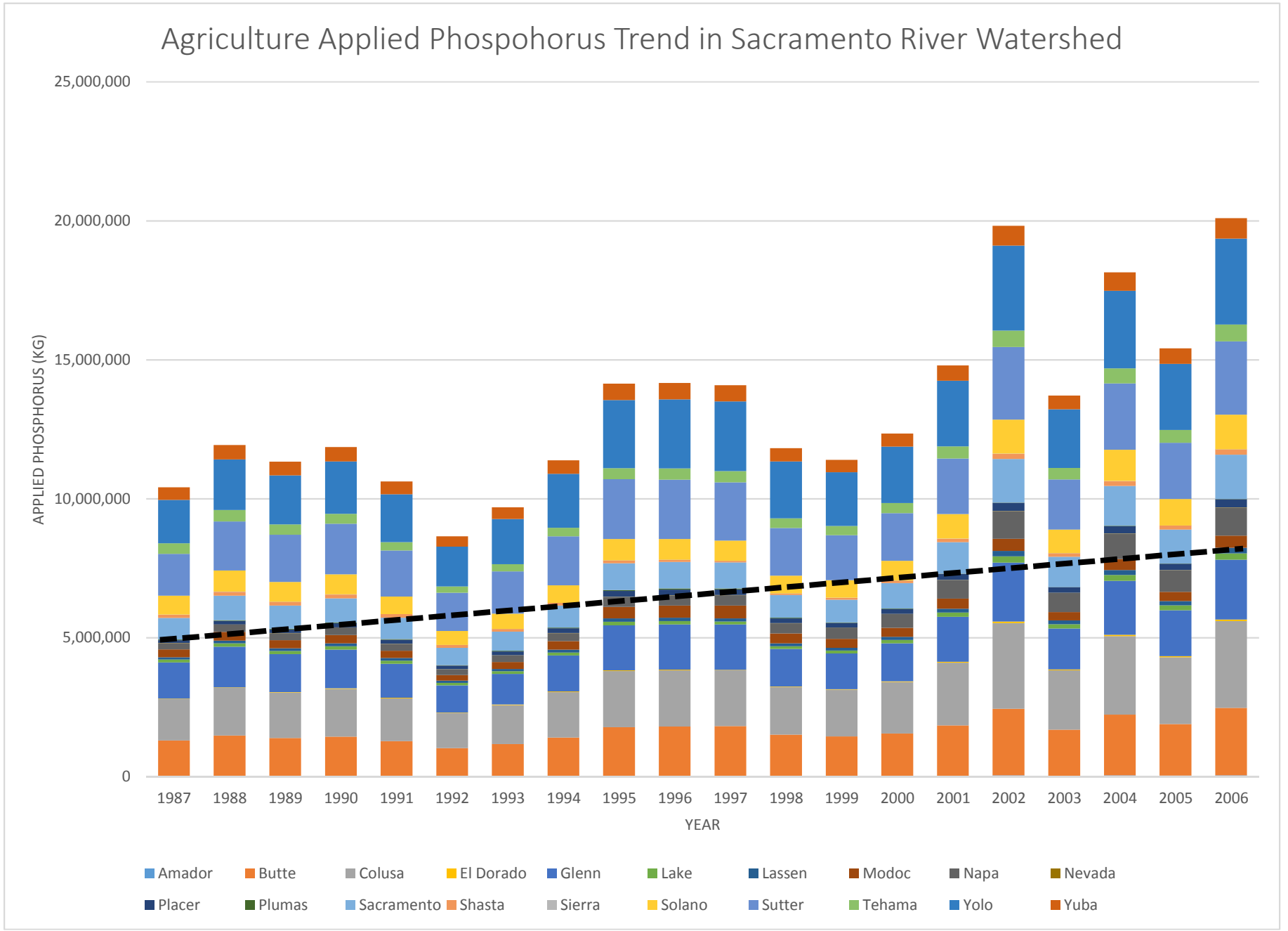
Appendix F
Estimated Fertilizer Use in the Sacramento River Watershed

APPENDIX F

Estimated Fertilizer Use in the Sacramento River Watershed

The graphs provided in this Appendix show the estimated applied nitrate and phosphorus fertilizer inputs over the period 1987 to 2006 for each county in the Sacramento River Watershed. The data were compiled and analyzed by the USGS from fertilizer sales in each county (USGS 2012b).


Agriculture Applied Nitrogen Trend in Sacramento River Watershed
140,000,000
120,000,000
100,000,000
80,000,000
60,000,000
40,000,000
20,000,000
0
APPLIED NITROGEN (KG)
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
YEAR
Amador
Butte
Colusa
El Dorado
Glenn
Lake
Lassen
Modoc
Napa
Nevada
Placer
Plumas
Sacramento
Shasta
Sierra
Solano
Sutter
Tehama
Yolo
Yuba


Agriculture Applied Phospohorus Trend in Sacramento River Watershed
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
APPLIED PHOSPHORUS (KG)
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
YEAR
Amador
Butte
Colusa
El Dorado
Glenn
Lake
Lassen
Modoc
Napa
Nevada
Placer
Plumas
Sacramento
Shasta
Sierra
Solano
Sutter
Tehama
Yolo
Yuba

Appendix G
NHI Scores and Descriptions

APPENDIX G

NHI Scores and Descriptions

This appendix shows the crop and soils index ratings for the NHI tool, based on literature.

TABLE G-1
NHI Crop Hazard Rating and Justification*

Crop Category	Crop	NHI Crop Hazard Index	Risk Rating	Justification	Amount N-fertilizer concentrated in plant tissue	Proportion N-fertilizer left on soil available for leaching
Annual Fruit, Vegetable & Seed Crops	Anise	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Arugula	4	High	Quick nitrate removal beneath shallow roots	Moderate	
	Asparagus	3	Moderately High	N on soil available for leaching after harvest		High
	Bamboo shoot	4	High	Quick nitrate removal beneath shallow roots	Moderate	Moderate
	Beet	4	High	Quick nitrate removal beneath shallow roots		
	Broccoli	4	High	Quick nitrate removal beneath shallow roots		
	Cabbage	4	High	Moderately deep roots may slow nitrate removal	Moderate	Moderate
	Canola	2	Moderate	Slow nitrate removal due to deep roots	Moderate	Moderate
	Carrot	2	Moderate	Quick nitrate removal beneath shallow roots	High	High
	Cauliflower	4	High	Quick nitrate removal beneath shallow roots	Low	
	Cilantro*	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Cole Crop	4	High	Quick nitrate removal beneath shallow roots	Moderate	Moderate
	Collard	4	High	Quick nitrate removal beneath shallow roots	Moderate	Moderate
	Cucumber*	3	Moderately High	Quick nitrate removal beneath shallow roots	Low	
	Dandelion Green	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Eggplant	3	Moderately High	Moderately deep roots may slow nitrate removal		Moderate
	Garlic	3	Moderately High	Moderately deep roots may slow nitrate removal		Moderate
	Horseradish	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Kale	4	High	Quick nitrate removal beneath shallow roots	Moderate	Moderate

TABLE G-1
NHI Crop Hazard Rating and Justification*

Crop Category	Crop	NHI Crop Hazard Index	Risk Rating	Justification	Amount N-fertilizer concentrated in plant tissue	Proportion N-fertilizer left on soil available for leaching
Annual Fruit, Vegetable & Seed Crops	Kohlrabi	3	Moderately High	Quick nitrate removal beneath shallow roots		Moderate
	Lettuce	4	High	Quick nitrate removal beneath shallow roots	Moderate	Low
	Loquat	2	Moderate	Slow nitrate removal due to deep roots	High	
	Melon*	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Mint	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Mushroom	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Okra	3	Moderately High	Moderately deep roots may slow nitrate removal	Moderate	Moderate
	Onion*	4	High	Quick nitrate removal beneath shallow roots	Moderate	Moderate
	Ornamental Flowers	4	High	Quick nitrate removal beneath shallow roots	Moderate	Moderate
	Peas	3	Moderately High	Quick nitrate removal beneath shallow roots	Low	
	Pepper	4	High	Quick nitrate removal beneath shallow roots	Moderate	Low
	Pumpkin	3	Moderately High	Quick nitrate removal beneath shallow roots	Moderate	
	Radish	3	Moderately High	Quick nitrate removal beneath shallow roots	Moderate	
	Spinach	4	High	Quick nitrate removal beneath shallow roots	Moderate	
	Squash	3	Moderately High	Quick nitrate removal beneath shallow roots	Moderate	
	Strawberry	4	High	Quick nitrate removal beneath shallow roots	Moderate	
	Sweet Basil	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Swiss Chard	4	High	Quick nitrate removal beneath shallow roots	Moderate	
	Tomato*	3	Moderately High	Moderately deep roots may slow nitrate removal		Moderate
	Turnip	3	Moderately High	Moderately deep roots may slow nitrate removal	Moderate	Moderate
	Watermelon*	3	Moderately High	Moderately deep roots may slow nitrate removal		Moderate

TABLE G-1
NHI Crop Hazard Rating and Justification*

Crop Category	Crop	NHI Crop Hazard Index	Risk Rating	Justification	Amount N-fertilizer concentrated in plant tissue	Proportion N-fertilizer left on soil available for leaching
Citrus, Olive & Ornamental Crops	Aloe vera	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Artichoke	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Avocado	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Eucalyptus*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Grapefruit	3	Moderately High	N on soil available for leaching after harvest		High
	Jujube	1	Low	Slow nitrate removal due to deep roots	High	High
	Lemon	2	Moderate	Slow nitrate removal due to deep roots	Low	
	Olive*	1	Low	Slow nitrate removal due to deep roots	Moderate	High
	Orange*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Ornamental outdoor plants*	4	High	Quick nitrate removal beneath shallow roots	Moderate	Moderate
	Pineapple	4	High	Moderately deep roots may slow nitrate removal		
	Tangerine	2	Moderate	Slow nitrate removal due to deep roots	Low	
Deciduous Fruit & Tree Crops	Almond*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Apple*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Apricot	1	Low	Slow nitrate removal due to deep roots	Moderate	High
	Banana	3	Moderately High	N on soil available for leaching after harvest		High
	Blackberry	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Blueberry	2	Moderate	Slow nitrate removal due to deep roots	Low	
	Cherry	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Chestnut	2	Moderate	Slow nitrate removal due to deep roots	High	
	Fig	1	Low	Slow nitrate removal due to deep roots	Moderate	High
	Kiwi	3	Moderately High	N on soil available for leaching after harvest		High
	Mulberry	2	Moderate	Slow nitrate removal due to deep roots	Low	
	Nectarine	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Peach*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Pear*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Pecan	2	Moderate	Slow nitrate removal due to deep roots		Moderate
	Persimmon	2	Moderate	Slow nitrate removal due to deep roots	High	
	Pistachio*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Plum	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Pluot	2	Moderate	Slow nitrate removal due to deep roots	High	Low

TABLE G-1
NHI Crop Hazard Rating and Justification*

Crop Category	Crop	NHI Crop Hazard Index	Risk Rating	Justification	Amount N-fertilizer concentrated in plant tissue	Proportion N-fertilizer left on soil available for leaching
Deciduous Fruit & Tree Crops	Pomegranate	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Prune*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Raspberry	2	Moderate	Slow nitrate removal due to deep roots	High	Low
	Walnut*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
Field Crop	Bean, dry*	1	Low	Quick nitrate removal beneath shallow roots	High	High
	Corn*	3	Moderately High	Moderately deep roots may slow nitrate removal		Moderate
	Cotton*	2	Moderate	Slow nitrate removal due to deep roots	Moderate	Low
	Flax	2	Moderate	Slow nitrate removal due to deep roots	Moderate	Low
	Hops	2	Moderate	Slow nitrate removal due to deep roots	Moderate	Low
	Mustard	4	High	Quick nitrate removal beneath shallow roots	Moderate	Moderate
	Potato	3	Moderately High	Moderately deep roots may slow nitrate removal	Low	
	Safflower*	2	Moderate	Slow nitrate removal due to deep roots	Low	Low
	Sorghum*	2	Moderate	Slow nitrate removal due to deep roots	Moderate	Low
	Soybean	2	Moderate	Slow nitrate removal due to deep roots	Moderate	Low
	Sunflower*	2	Moderate	Slow nitrate removal due to deep roots	High	Low
Grain & Hay Crops	Barley*	2	Moderate	Slow nitrate removal due to deep roots	Moderate	High
	Forage hay/silage*	2	Moderate	Moderately deep roots may slow nitrate removal	High	High
	Oat*	2	Moderate	Slow nitrate removal due to deep roots	Low	Low
	Sudangrass*	1	Low	Slow nitrate removal due to deep roots	High	High
	Triticale	1	Low	Slow nitrate removal due to deep roots	High	High
	Vetch	1	Low	Slow nitrate removal due to deep roots	High	High
	Wheat*	2	Moderate	Slow nitrate removal due to deep roots	Moderate	High
	Wild rice*	1	Low	Quick nitrate removal beneath shallow roots	Moderate	Low
Pasture Crops	Alfalfa*	1	Low	Slow nitrate removal due to deep roots	High	High
	Clover	1	Low	Slow nitrate removal due to deep roots	High	High
	Grass seed	2	Moderate	Moderately deep roots may slow nitrate removal	High	High
	Orchardgrass	2	Moderate	Slow nitrate removal due to deep roots	Moderate	Moderate
	Pastureland*	2	Moderate	Moderately deep roots may slow nitrate removal	Moderate	Moderate
	Rangeland*	1	Low	Slow nitrate removal due to deep roots	High	High
	Ryegrass*	3	Moderately High	Moderately deep roots may slow nitrate removal	Moderate	Low
	Turf/sod	3	Moderately High	Relatively shallow root system		

TABLE G-1
NHI Crop Hazard Rating and Justification*

Crop Category	Crop	NHI Crop Hazard Index	Risk Rating	Justification	Amount N-fertilizer concentrated in plant tissue	Proportion N-fertilizer left on soil available for leaching
Vineyard Crops	Table grapes	1	Low	Slow nitrate removal due to deep roots	Moderate	High
	Wine grapes*	1	Low	Slow nitrate removal due to deep roots	Moderate	High

Notes:
UC-ANR IWR (University of California Agriculture & Natural Resources and California Institute for Water Resources). 2013. Nitrate Groundwater Pollution Hazard Index. http://ciwr.ucanr.edu/Tools/Nitrogen_Hazard_Index/. Accessed October 2013.
*Major crop (>1% land use within crop category)

TABLE G-2
NHI Soil Hazard Rating and Justification

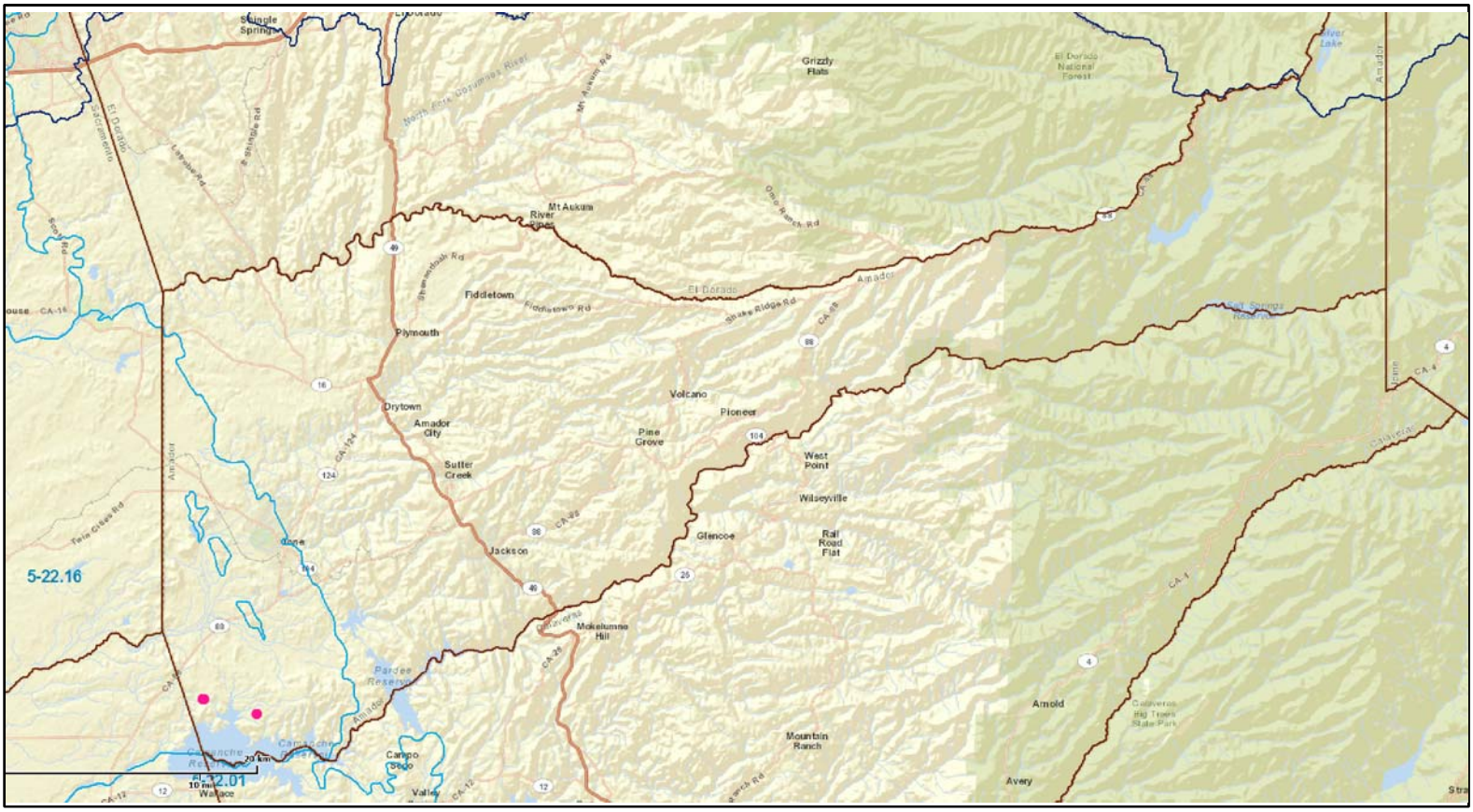
NHI Soil Hazard Index	Risk Rating	Justification	Effect of Irrigation Method
5	Very High	Due to very low water-holding capacities and very low denitrification, irrigation water will percolate through it rapidly, leaching nitrate	No physical restrictions to water movement to depth. Control of amount and timing of added water may focus soil moisture and fertilizer nutrients on root zone of crop.
4	High	Due to loamy or permeable textures, low denitrification and moderately low water-holding capacities, irrigation water will percolate fairly rapidly, leaching nitrate	Few physical restrictions to water movement to depth. Control of amount and timing of added water focuses soil moisture and fertilizer nutrients on root zone of crop.
3	Moderately High	Due to moderate infiltration rates, denitrification and water-holding capacities, excessive water application will leach nitrate	Some physical characteristics which slow permeability. Irrigation water should be judiciously applied using well-maintained irrigation systems in concert with fertilizer-nitrogen application plan tailored to crop.
2	Moderately Low	Due to clay and silt or shallow restrictive layer (hardpan, duripan, bedrock) layer presence and probable denitrification, soils slow or reduce risk of nitrate leaching	Slow permeability due to their fine textures. Additions of irrigation water and fertilizer nitrogen tend to remain near the land surface and move to depth slowly. Generally, any carefully managed and well-maintained irrigation system can be used on these soils with relatively low risk of polluting groundwater.
1	Low	Due to high clay content and likely denitrification, soils strongly retard or reduce risk of nitrate leaching	Slow permeability, with occasional ponding, due to clayey textures. Additions of irrigation water and fertilizer nitrogen tend to remain near land surface and move to depth only extremely slowly. Generally, any crop or irrigation method can be used on these soils with extremely limited risk of polluting groundwater with nitrate as long as they are not deep-ripped to excessive depths.

Note:
UC-ANR IWR (University of California Agriculture & Natural Resources and California Institute for Water Resources). 2013. Nitrate Groundwater Pollution Hazard Index. http://ciwr.ucanr.edu/Tools/Nitrogen_Hazard_Index/. Accessed October 2013.

Appendix H
CASGEM Maps

Amador County CASGEM Wells

Map from GIS Application



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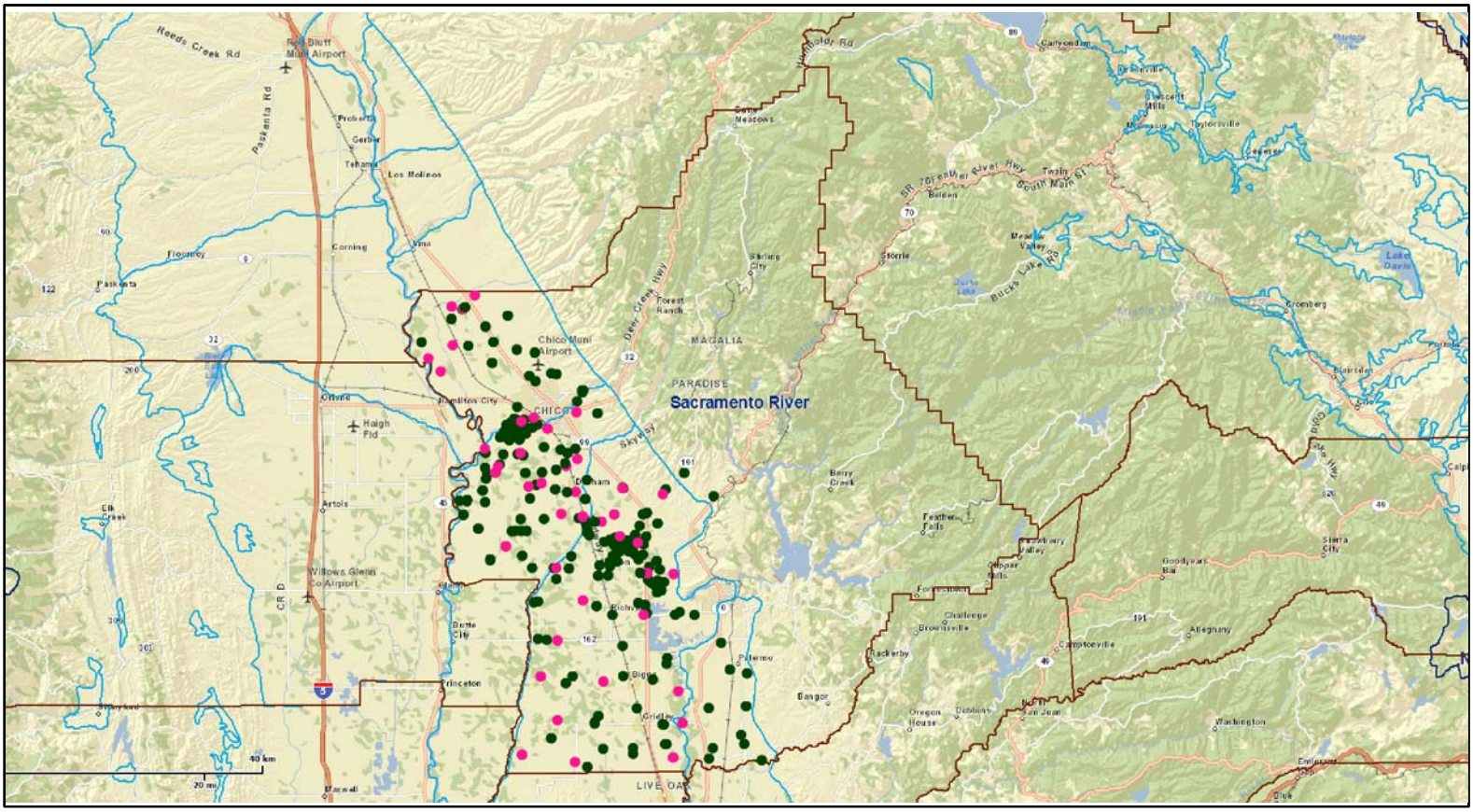
Butte County CASGEM Wells

Map from GIS Application



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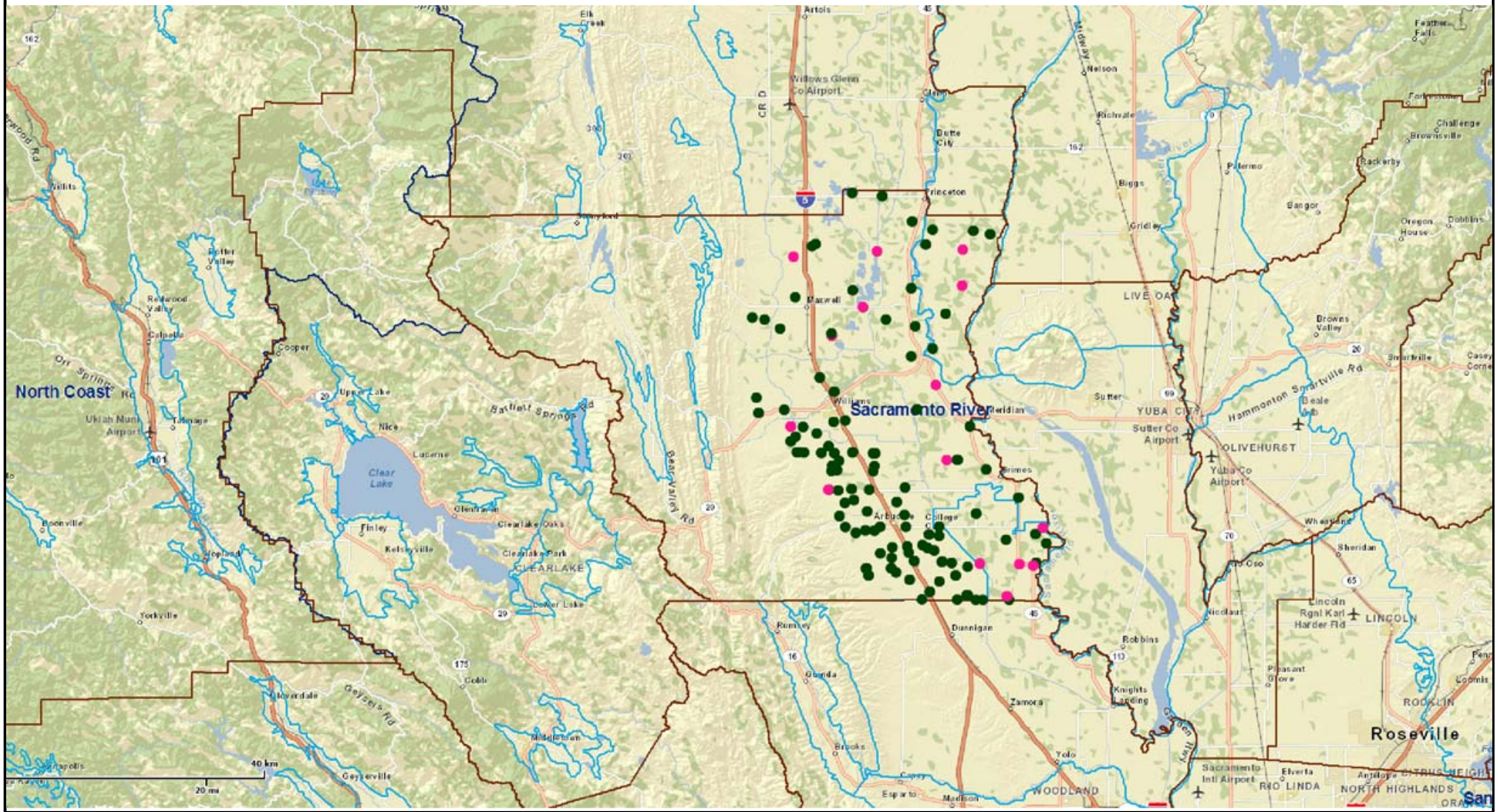
Colusa County CASGEM Wells

Map from GIS Application



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Well	County	Township	DWR Region Office	Basin Unmonitored
	Groundwater Basin	Section	Hydrologic Region	Designated

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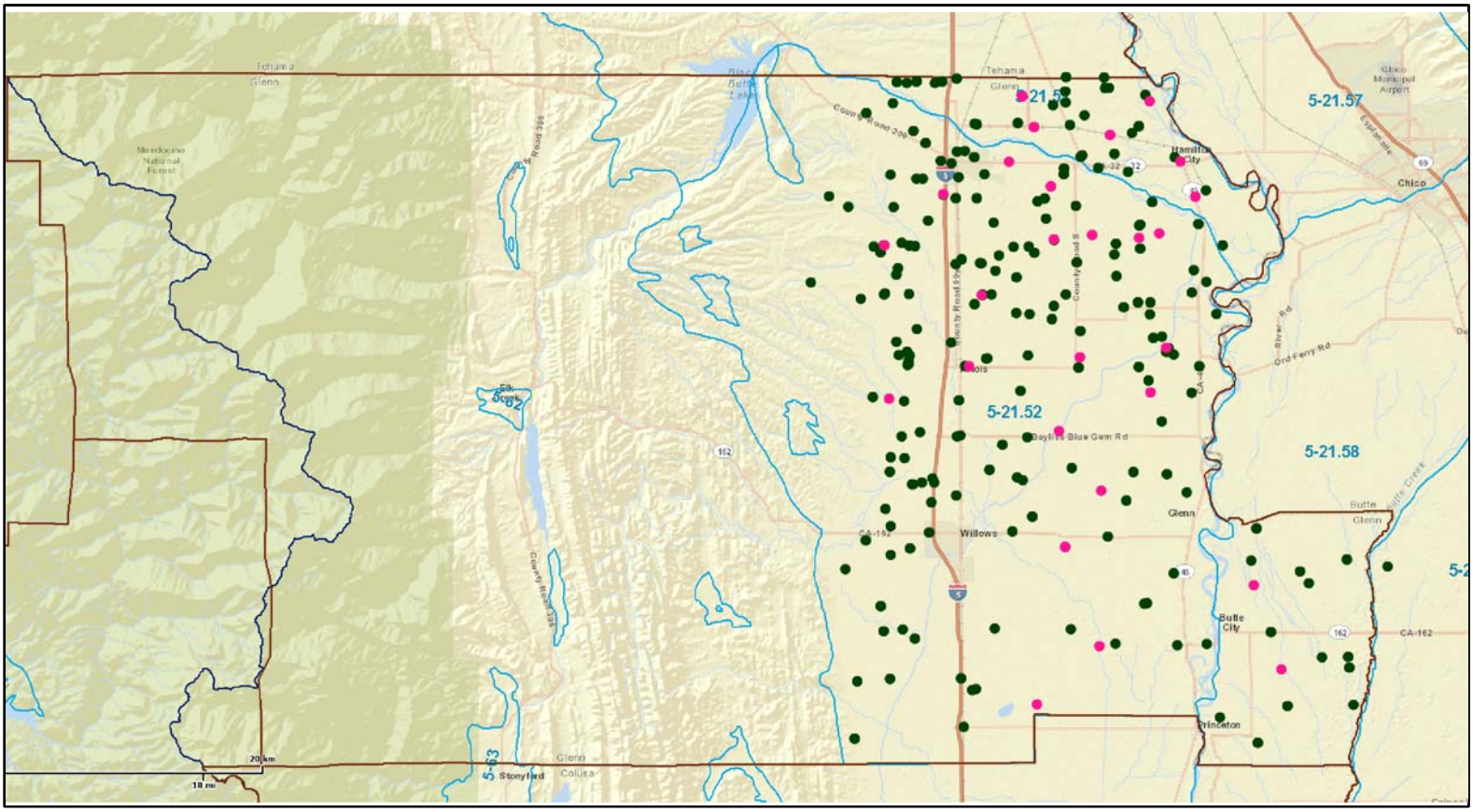
Glenn County CASGEM Wells

Map from GIS Application



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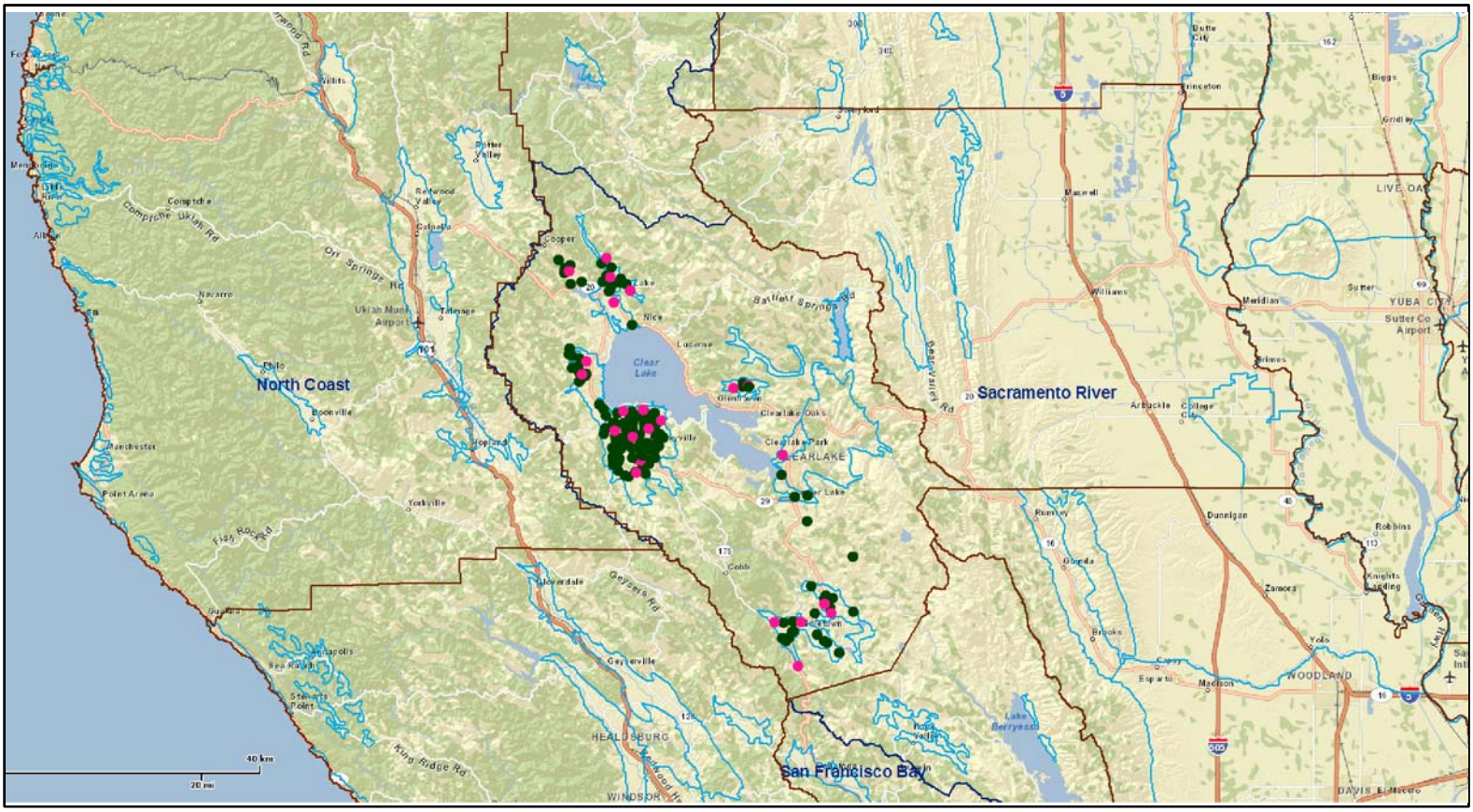
Lake County CASGEM Wells

Map from GIS Application



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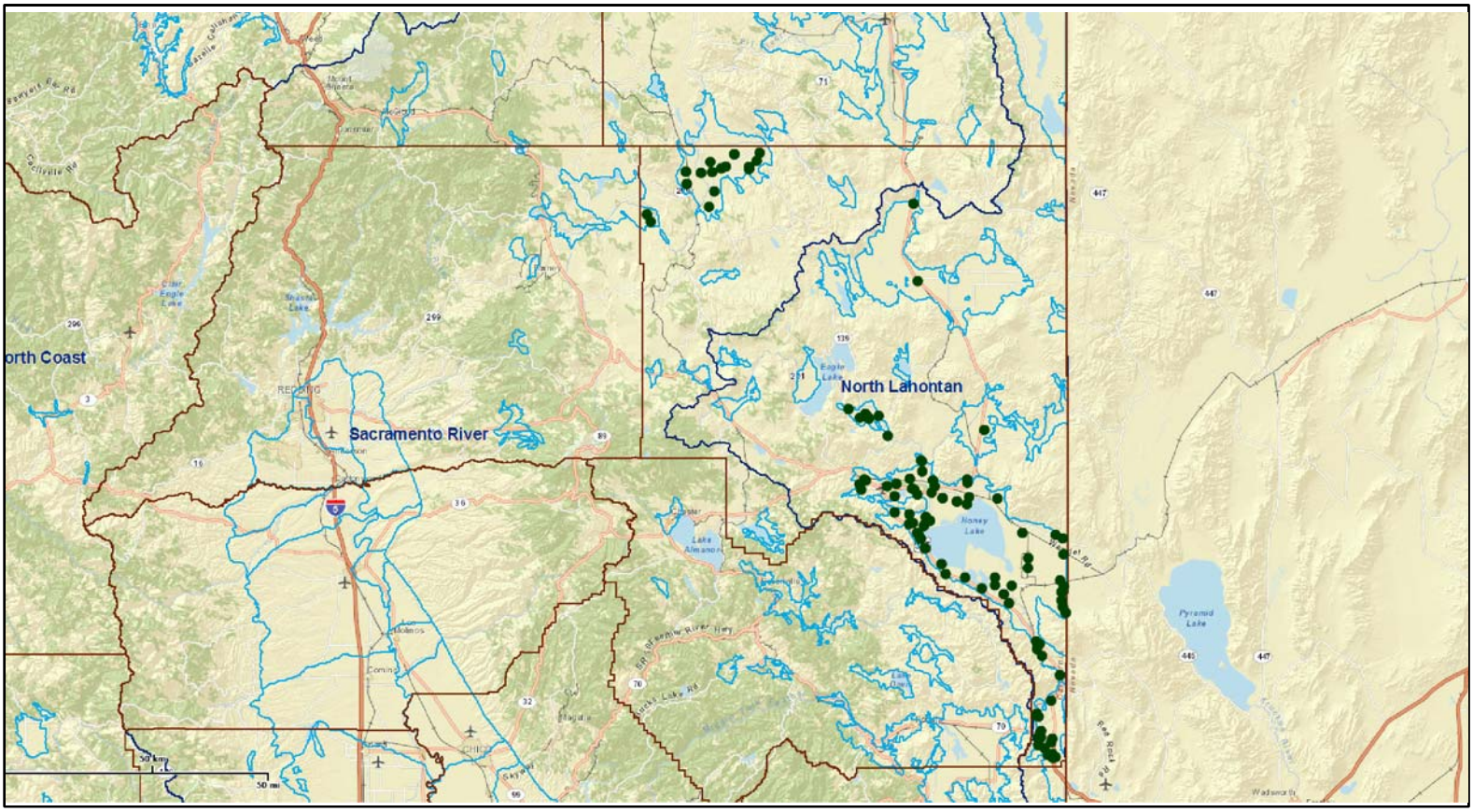
Lassen County CASGEM Wells

Map from GIS Application



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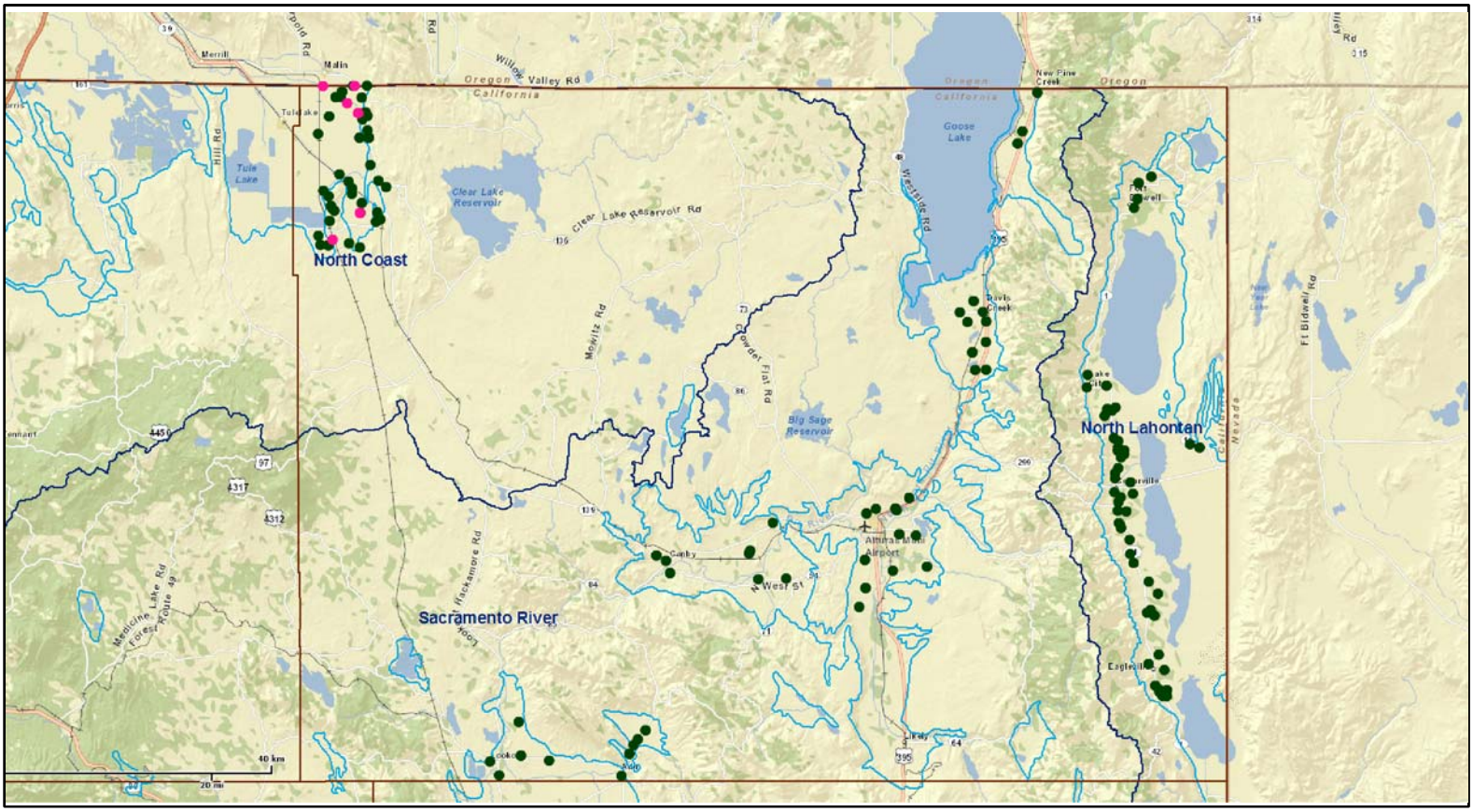
Modoc County CASGEM Wells

Map from GIS Application



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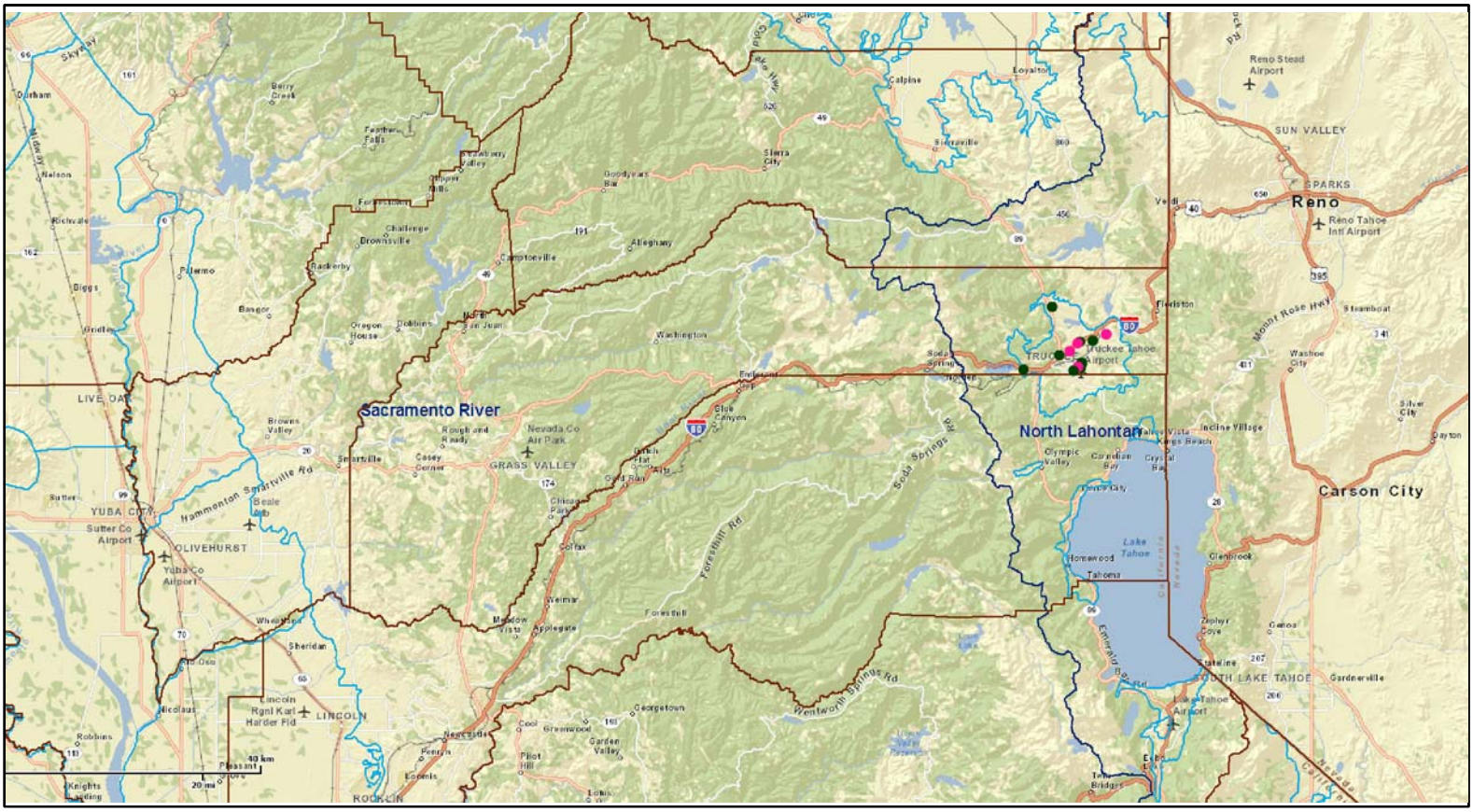
Nevada County CASGEM Wells

Map from GIS Application



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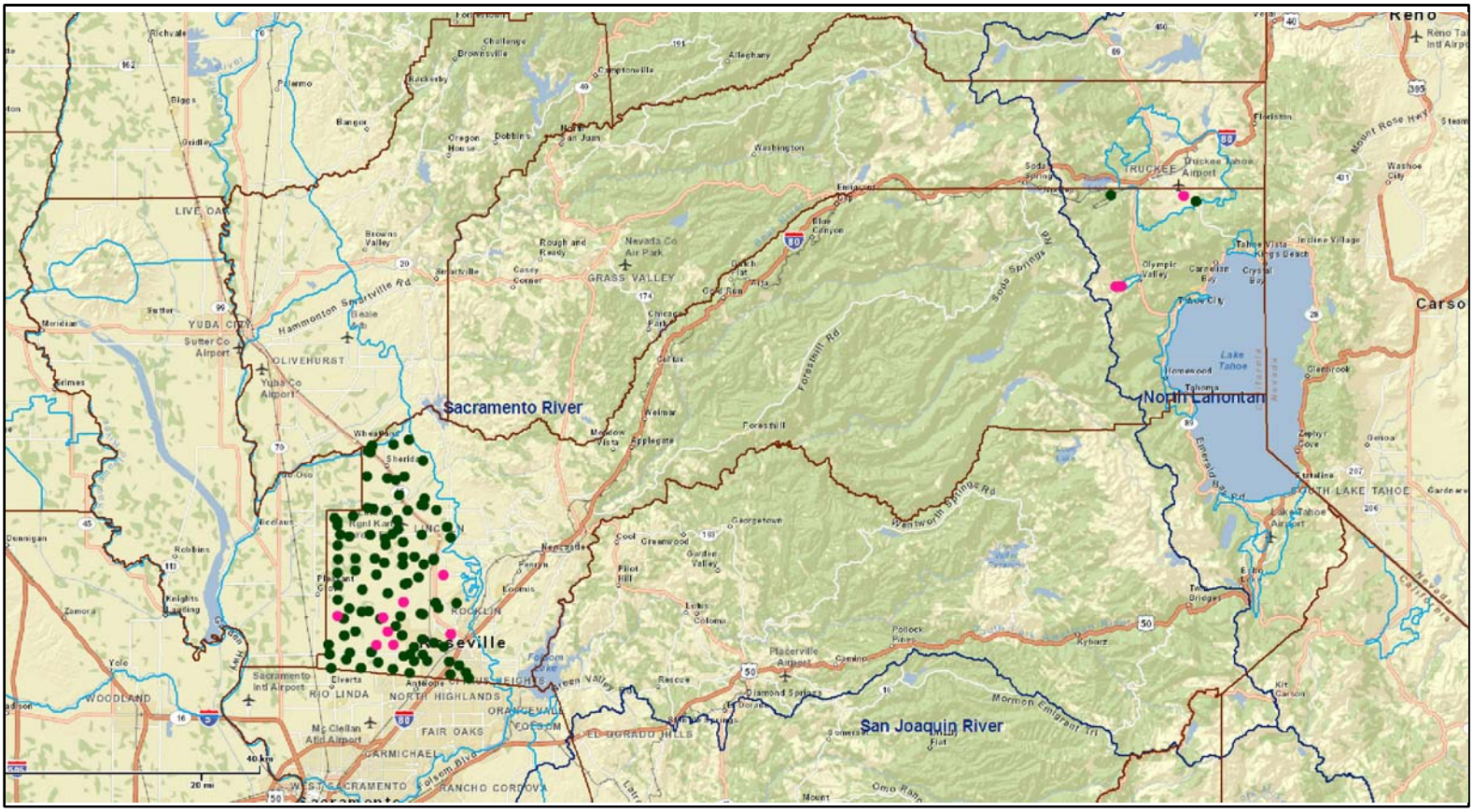
Placer County CASGEM Wells

Map from GIS Application



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Groundwater Basin

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Hydrologic Region

Basin Unmonitored

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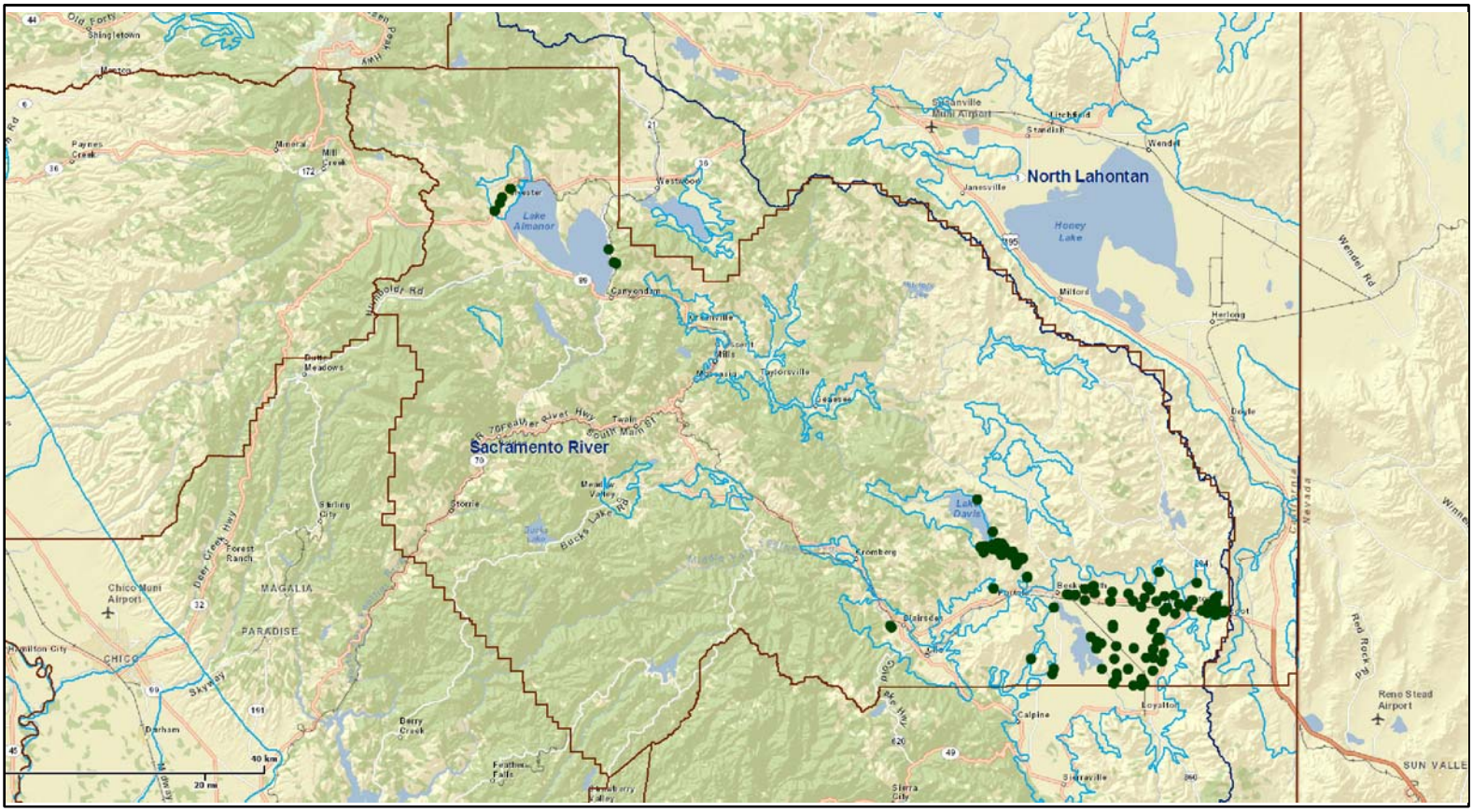
Plumas County CASGEM Wells

Map from GIS Application



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Groundwater Basin

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Hydrologic Region

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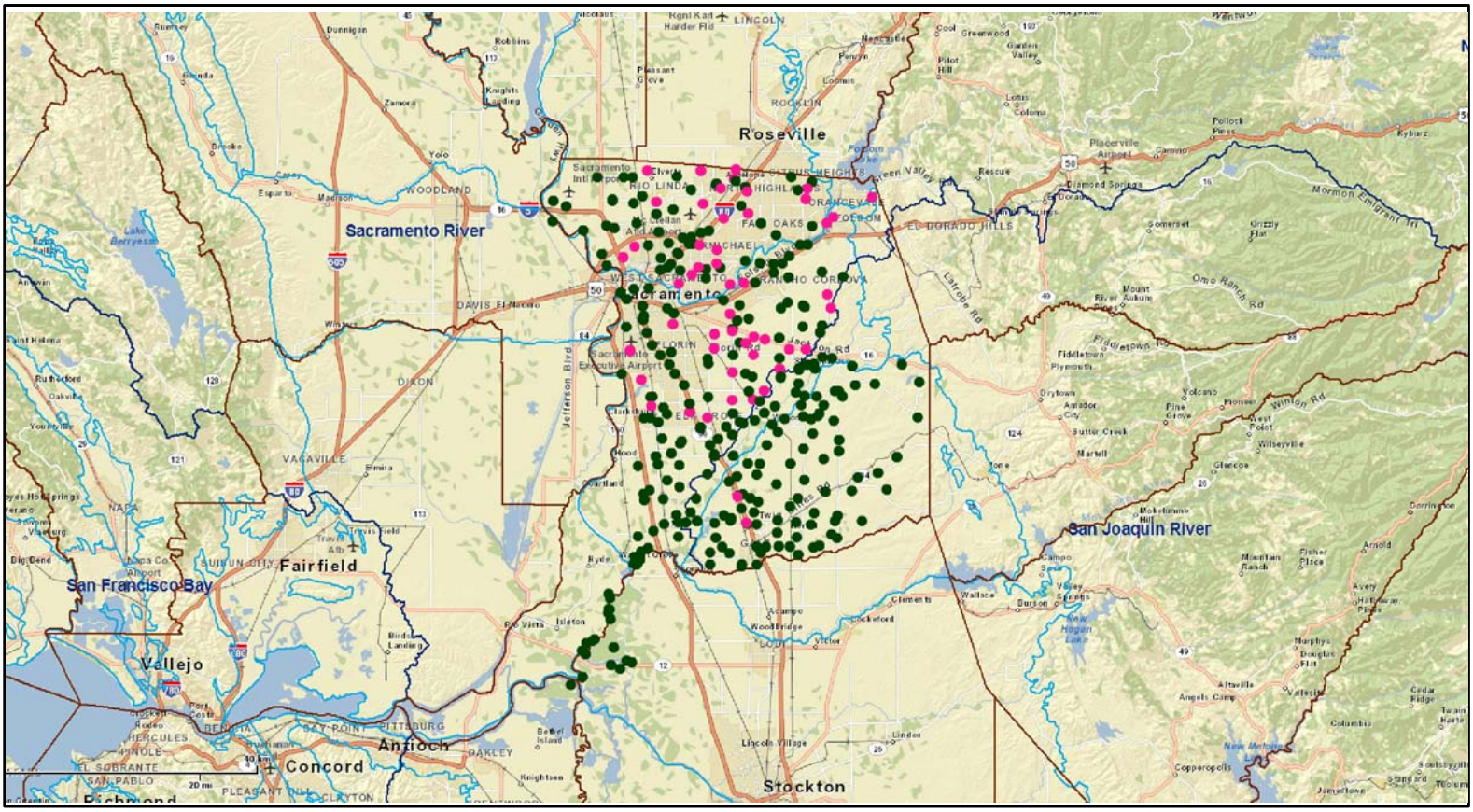
Sacramento County CASGEM Wells

Map from GIS Application



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Well

County

Groundwater Basin

Township

Section

DWR Region Office

Hydrologic Region

Basin Unmonitored

Designated

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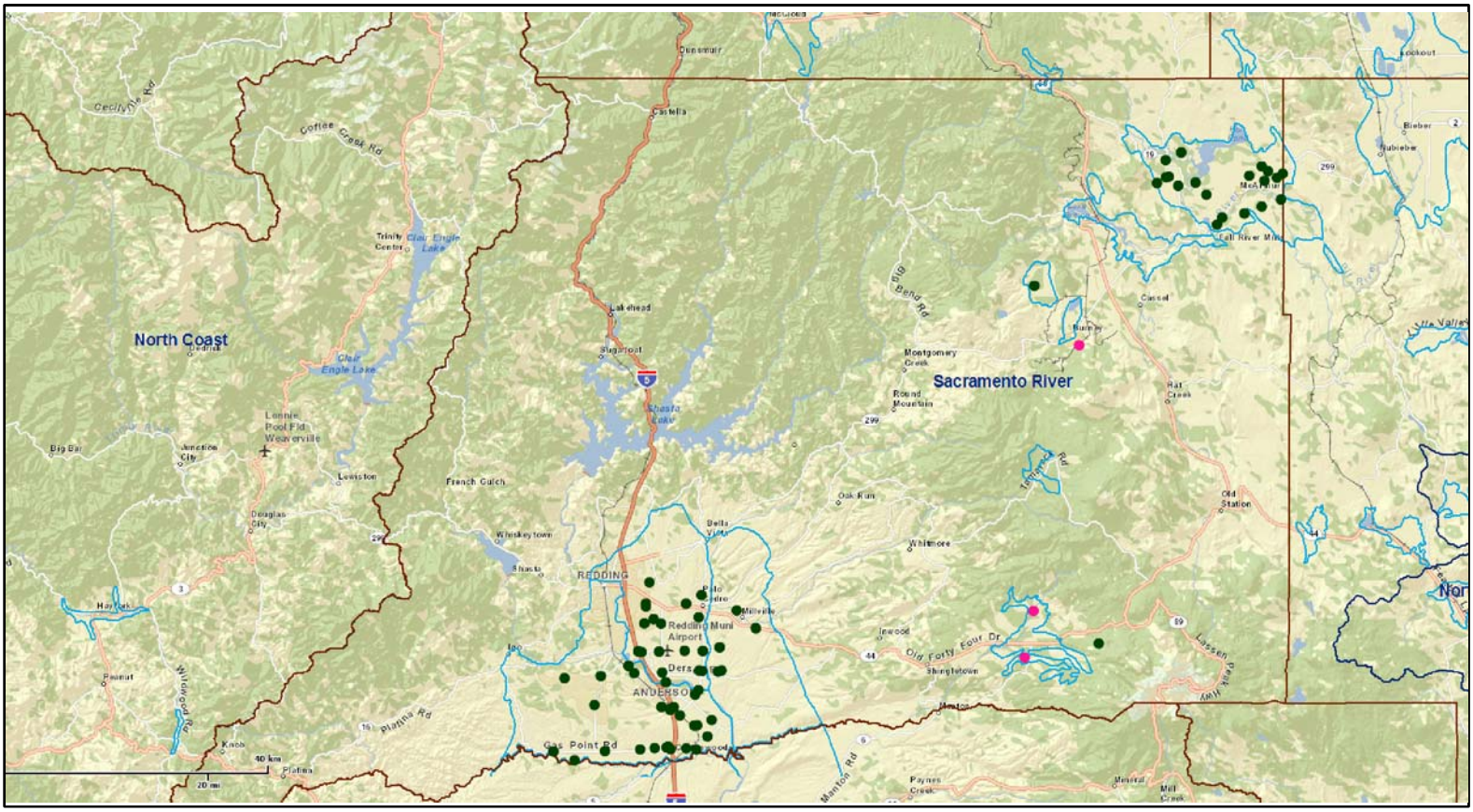
Shasta County CASGEM Wells

Map from GIS Application



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Solano County CASGEM Wells

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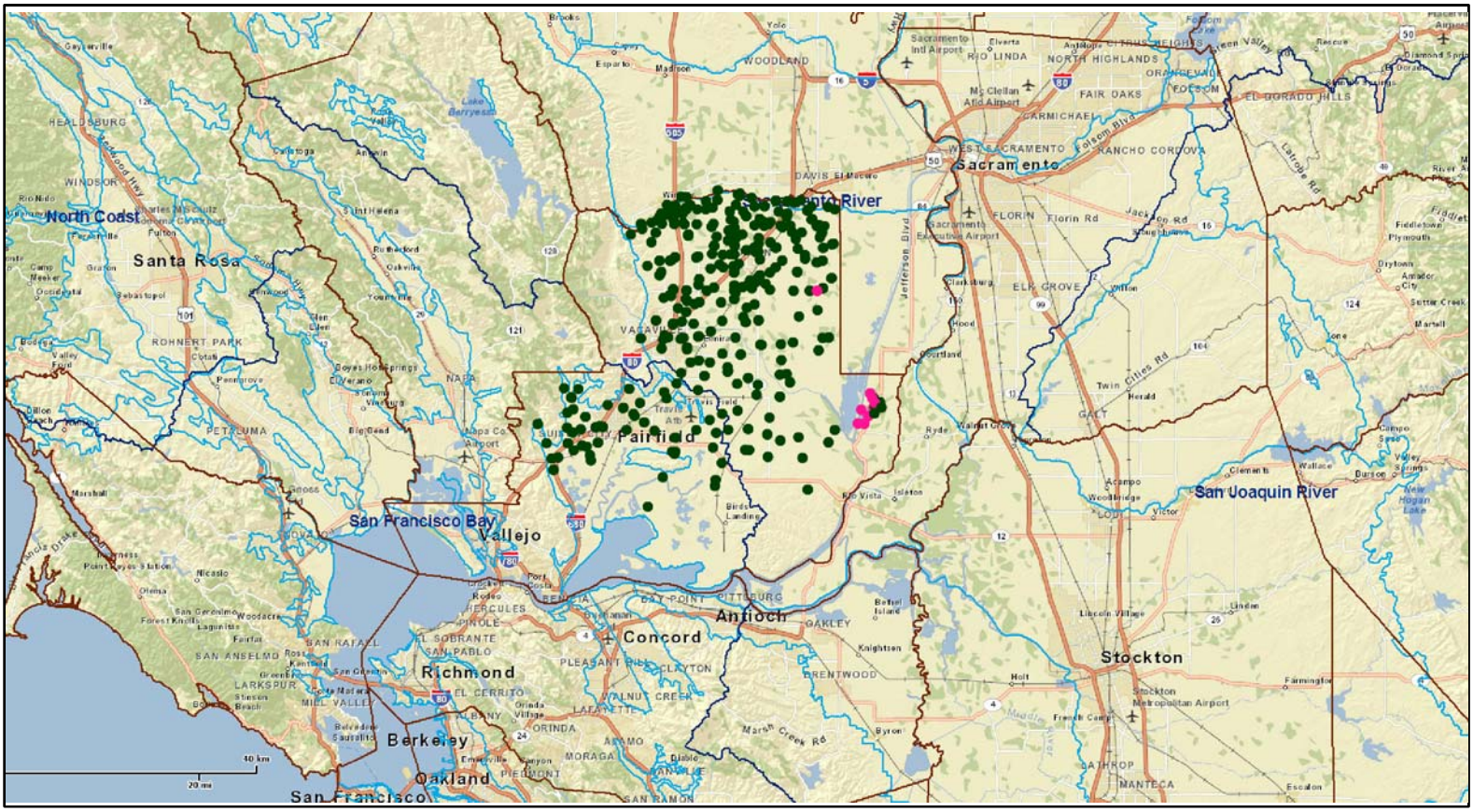

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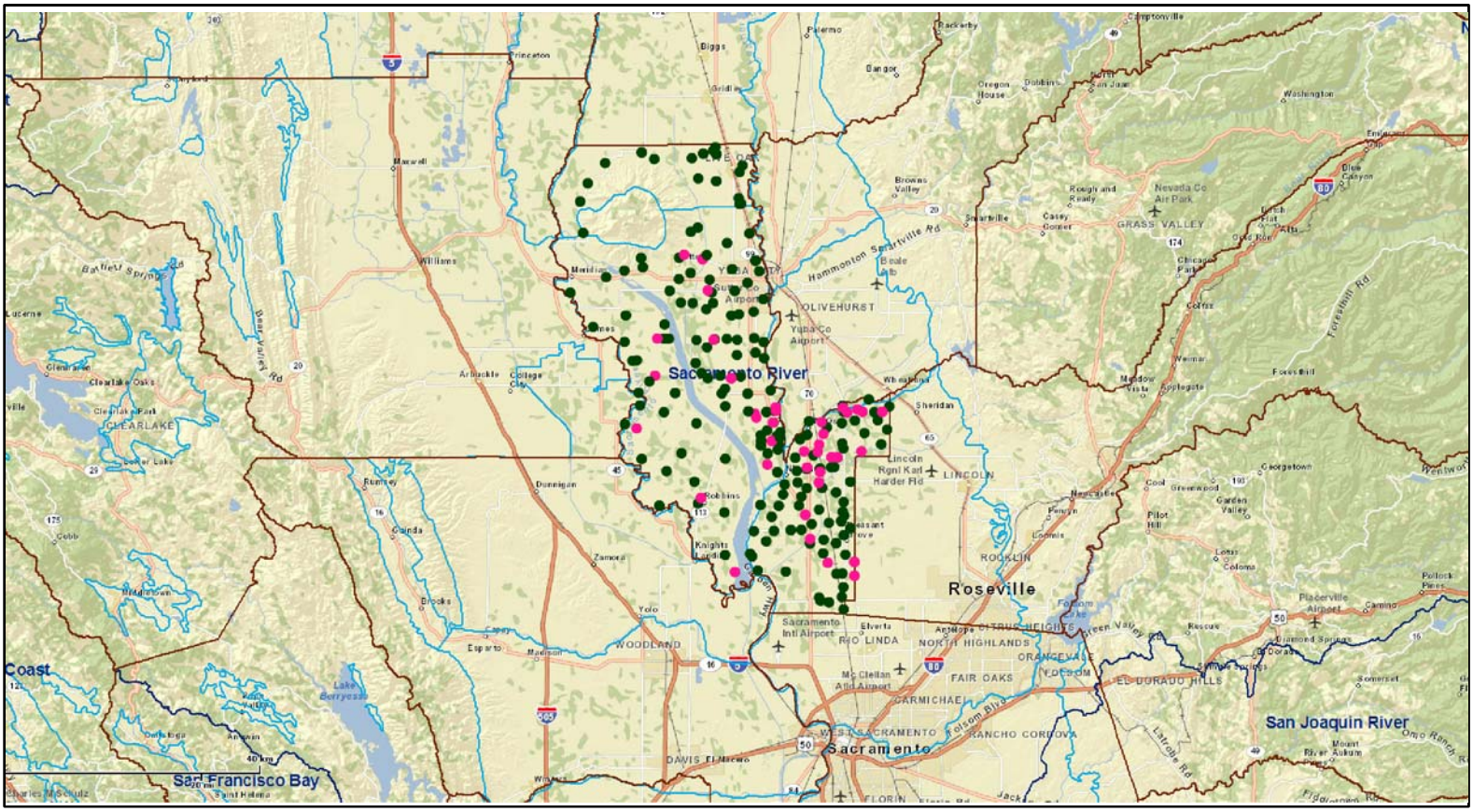
Sutter County CASGEM Wells

Map from GIS Application



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Well

County

Groundwater Basin

Township

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DWR Region Office

Hydrologic Region

Basin Unmonitored

Designated

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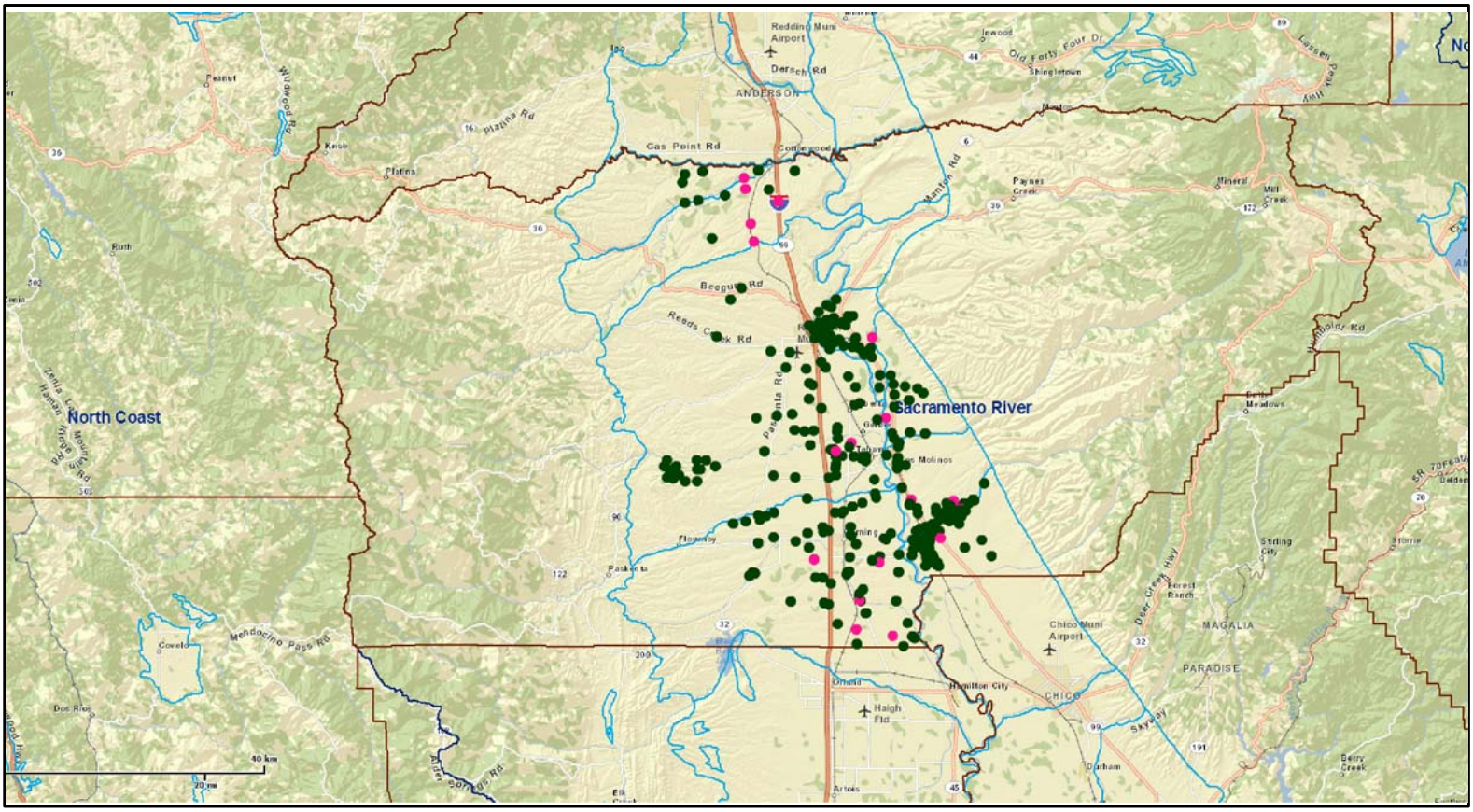
Tehama County CASGEM Wells

Map from GIS Application



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Well

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Groundwater Basin

Township

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Hydrologic Region

Basin Unmonitored

Designated

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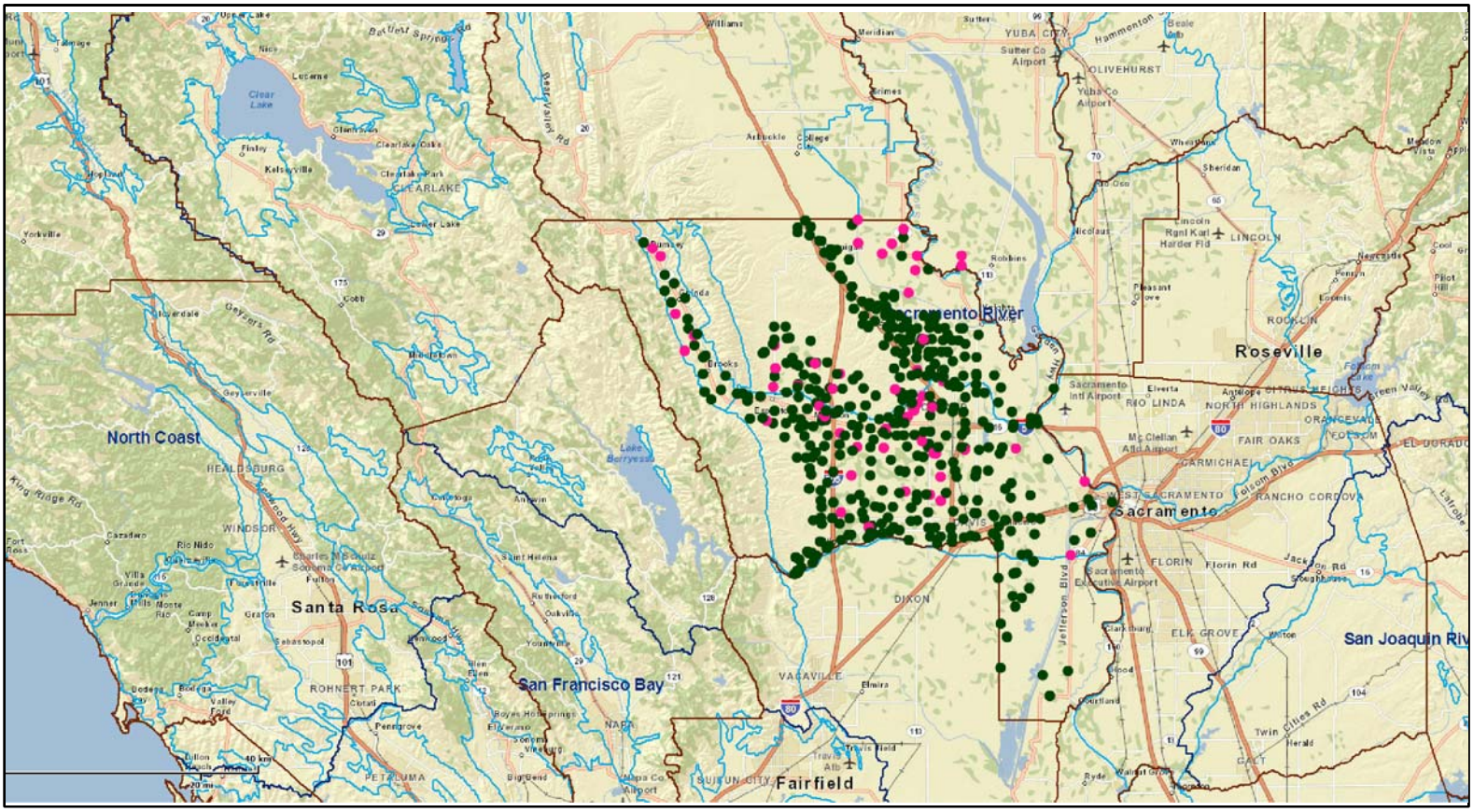
Yolo County CASGEM Wells

Map from GIS Application



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Well

County

Groundwater Basin

Township

Section

DWR Region Office

Hydrologic Region

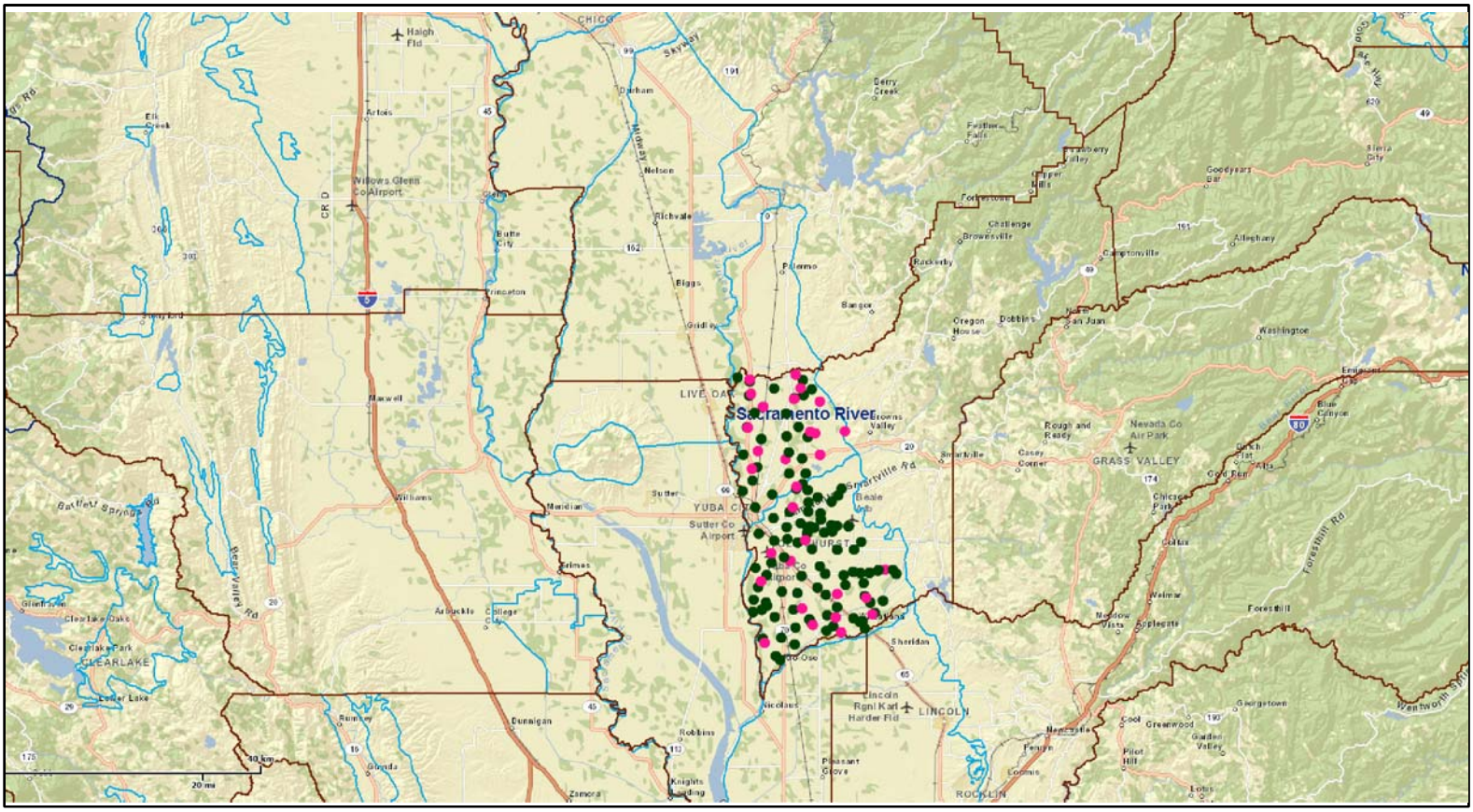
Basin Unmonitored

Designated

Print Date:Mon Aug 26 2013 02:05:00 PM

Yuba County CASGEM Wells

Map from GIS Application



N

Well

County

Groundwater Basin

Township

Section

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Hydrologic Region

Basin Unmonitored

Designated

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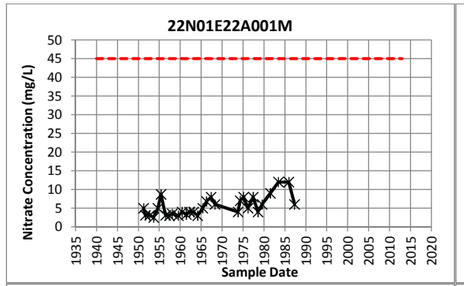
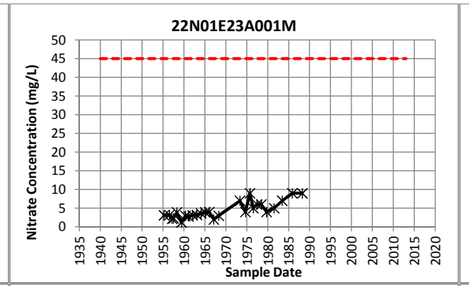
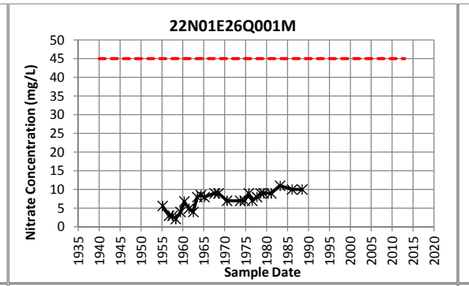
Appendix I
Nitrate and TDS Trend Graphs

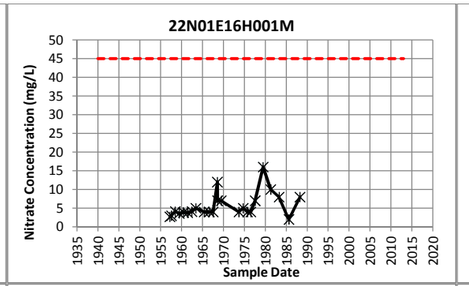
Nitrate as NO3 Concentration Trends

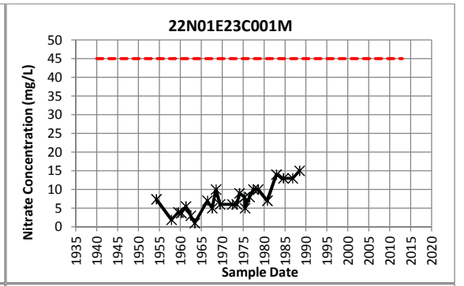
Butte-Yuba-Sutter Subwatershed

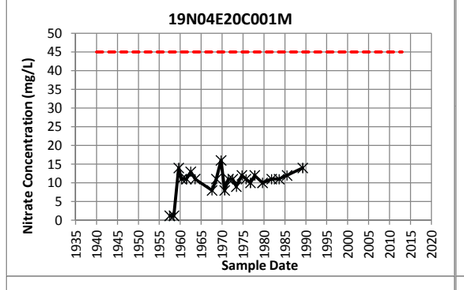


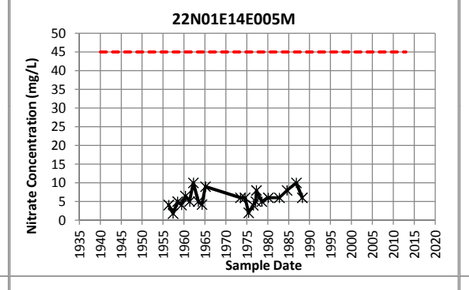


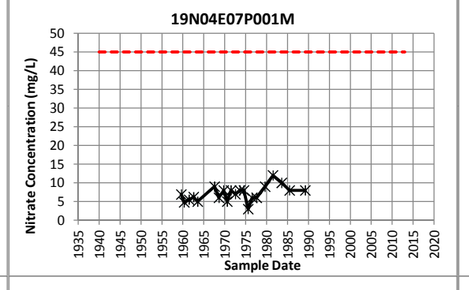


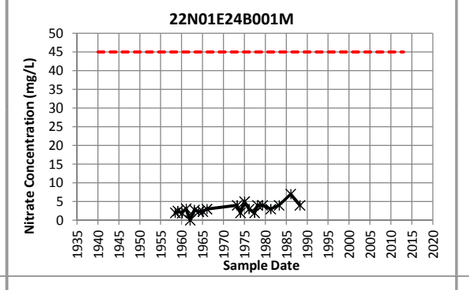


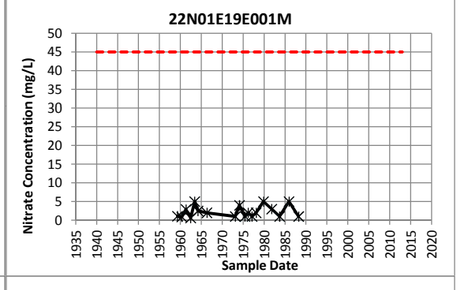


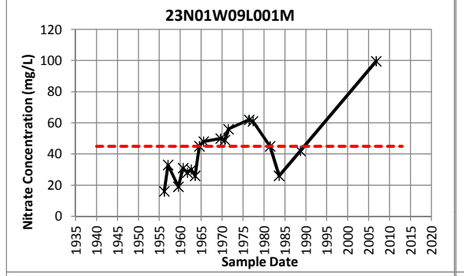


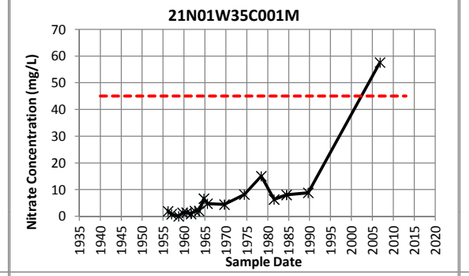


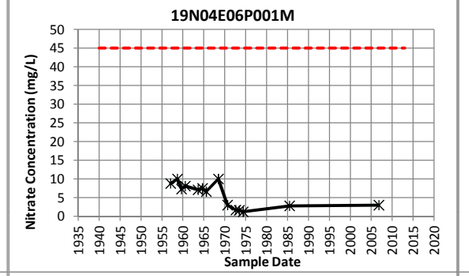


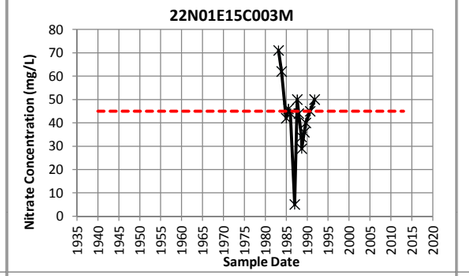


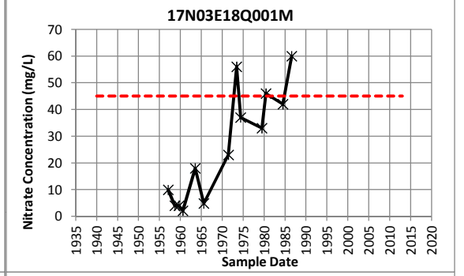


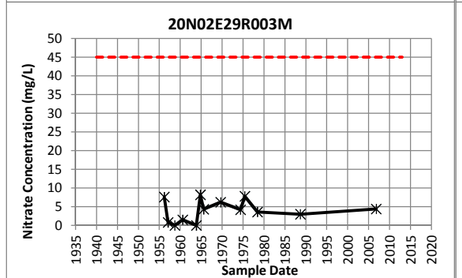


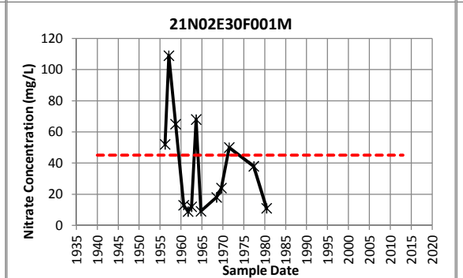


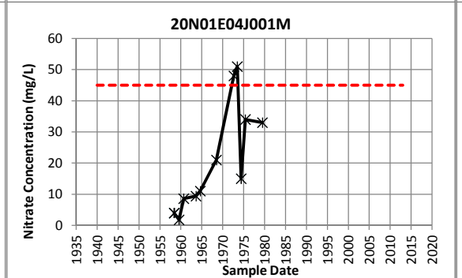


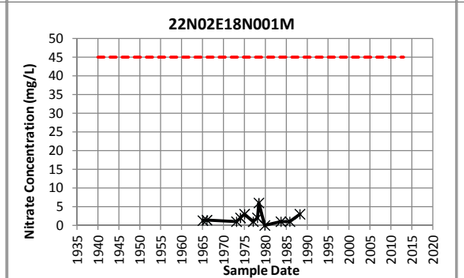


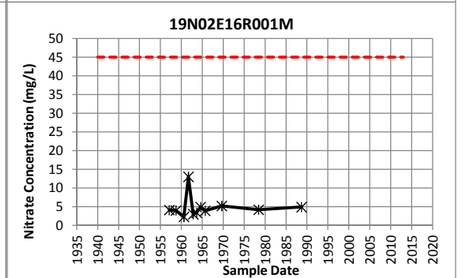


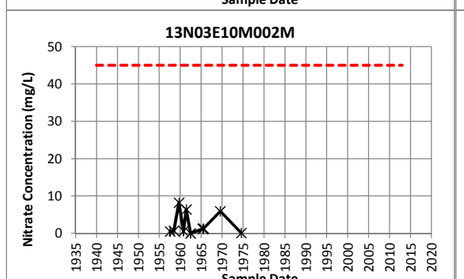


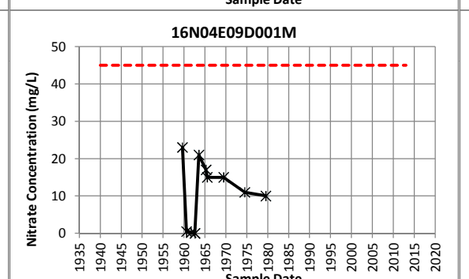


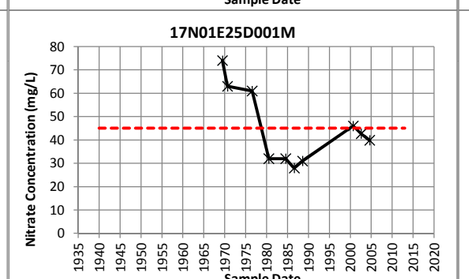


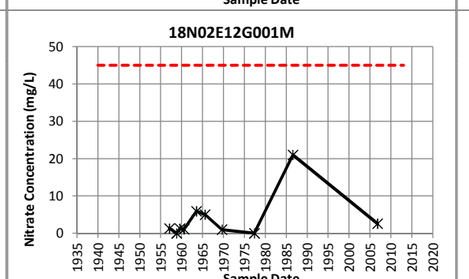


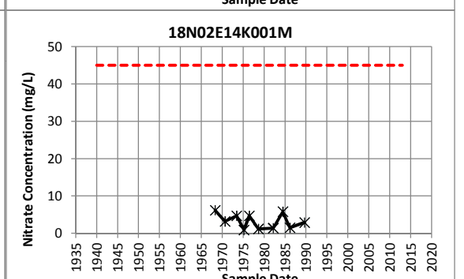






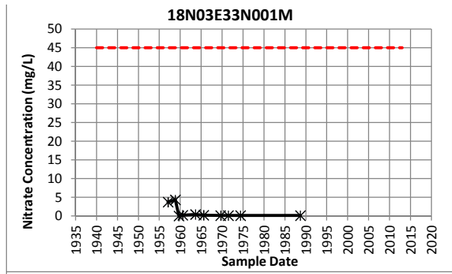


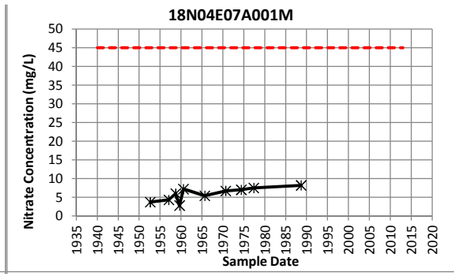


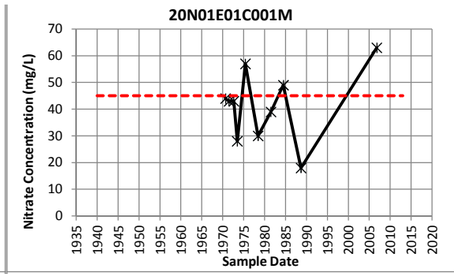


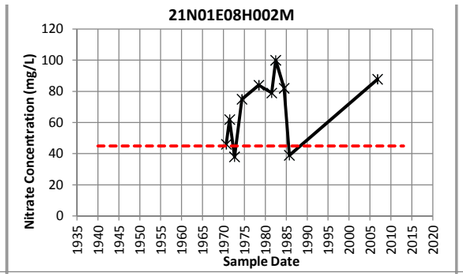
Nitrate as NO3 Concentration Trends

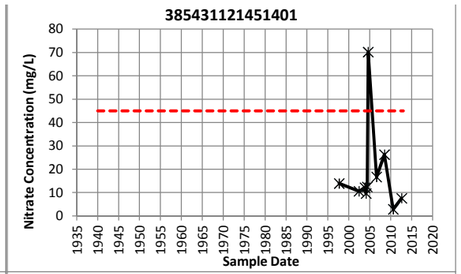
Butte-Yuba-Sutter Subwatershed

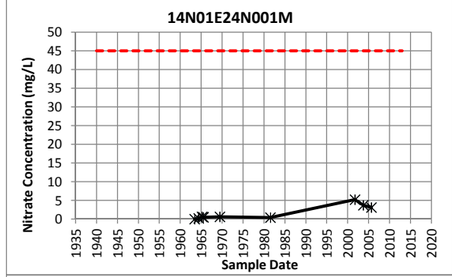


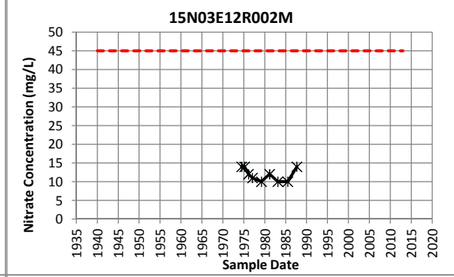


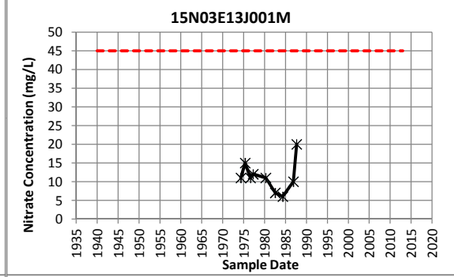


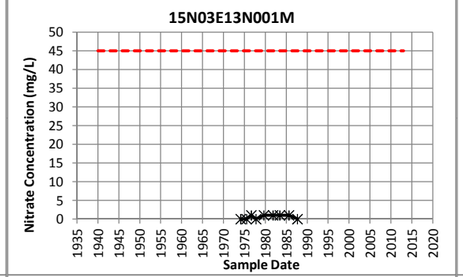


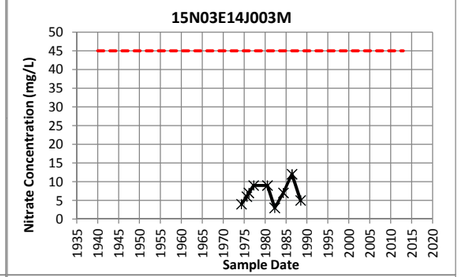


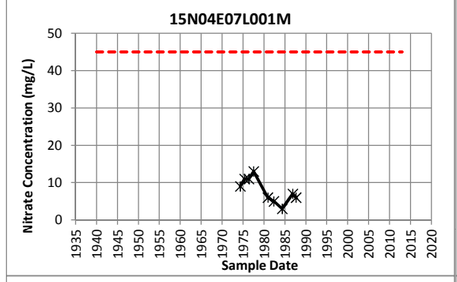


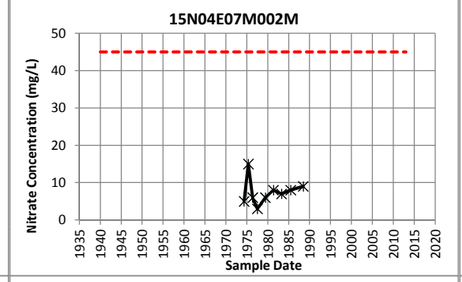


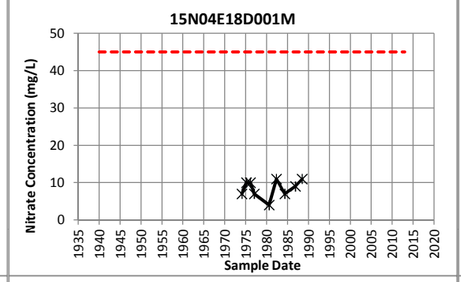


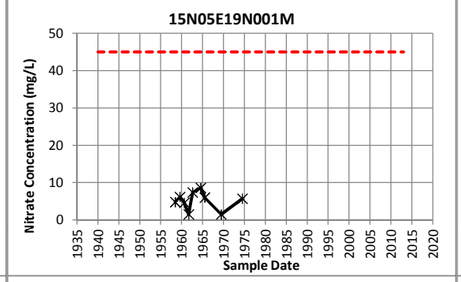


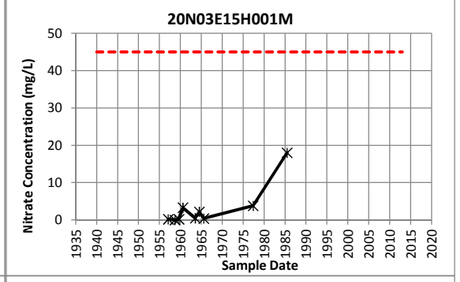


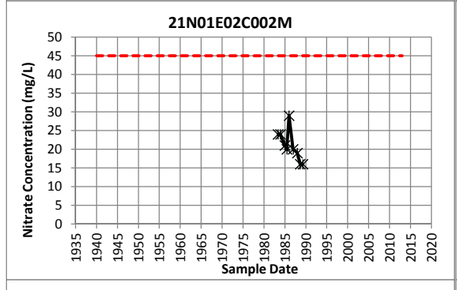


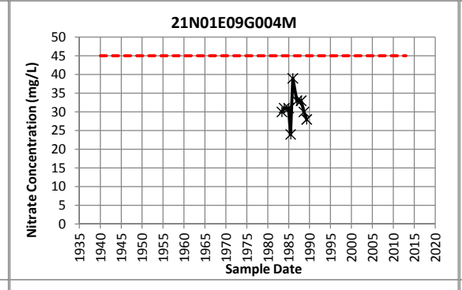


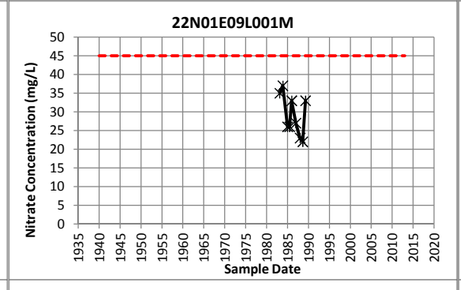


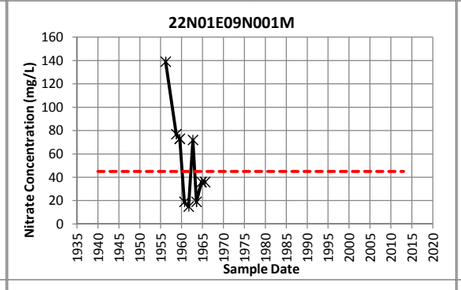


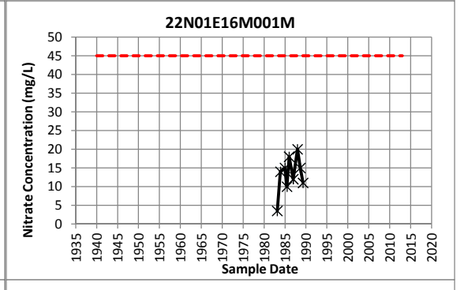


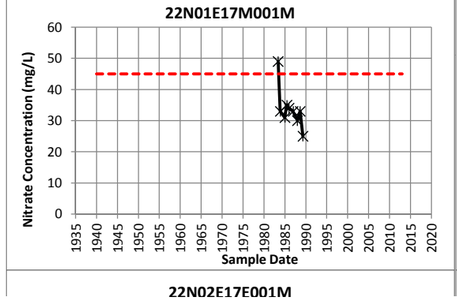


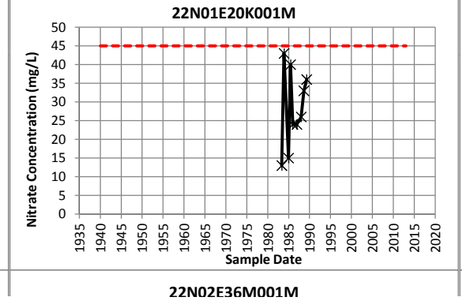


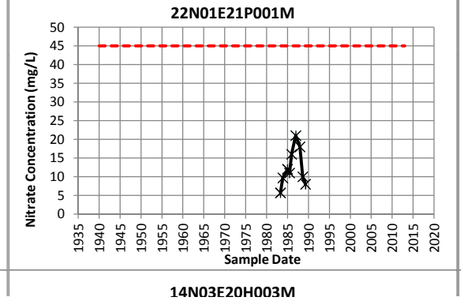


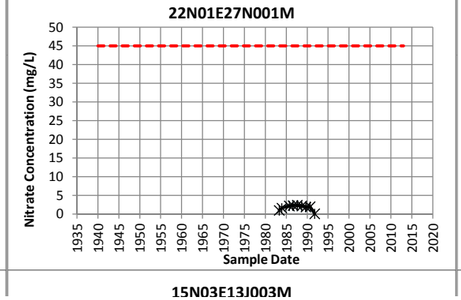


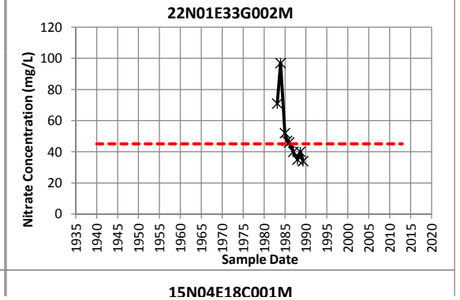












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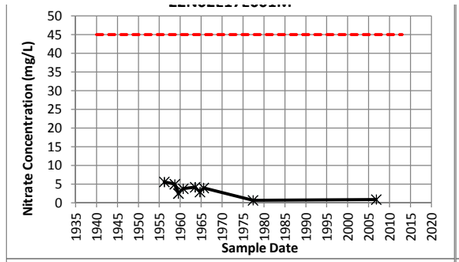
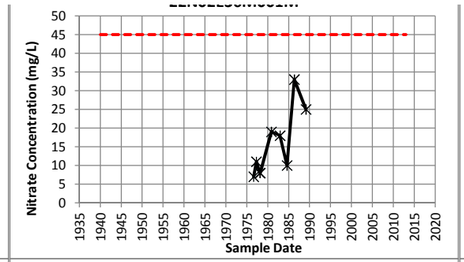
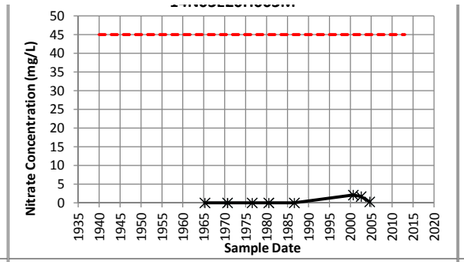
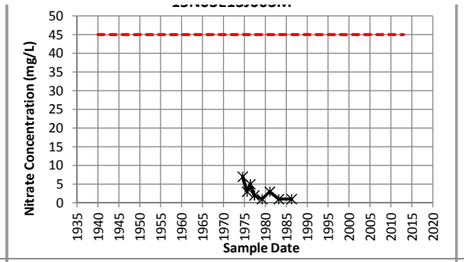
Nitrate as NO3 Concentration Trends

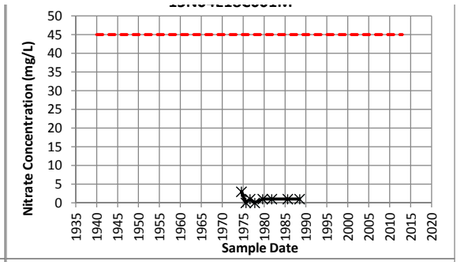
Butte-Yuba-Sutter Subwatershed

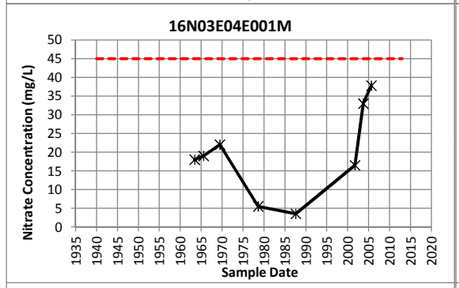


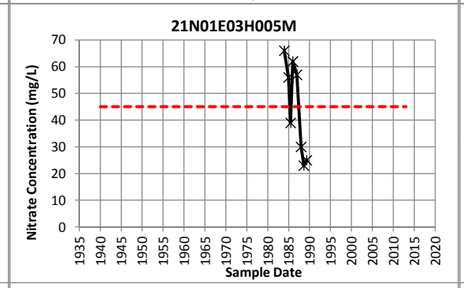


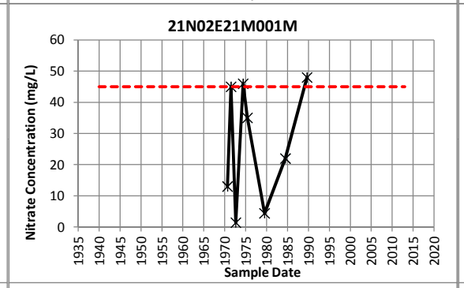


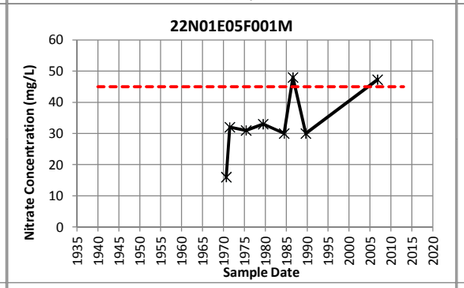


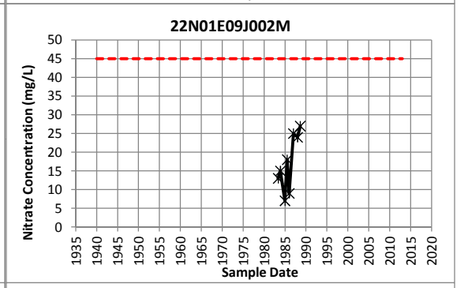


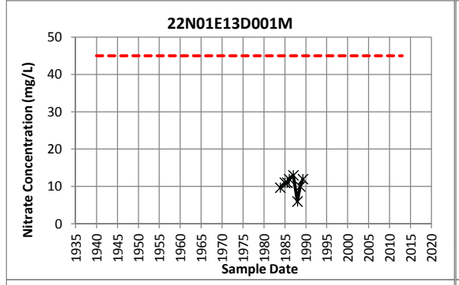


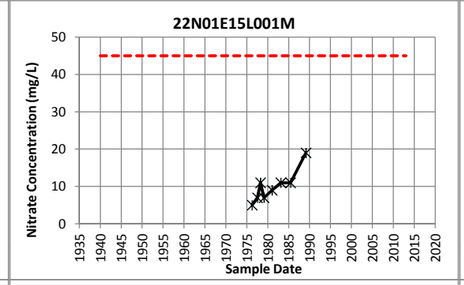


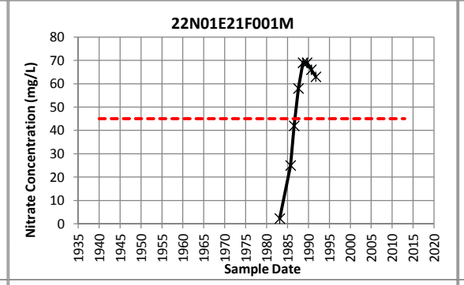


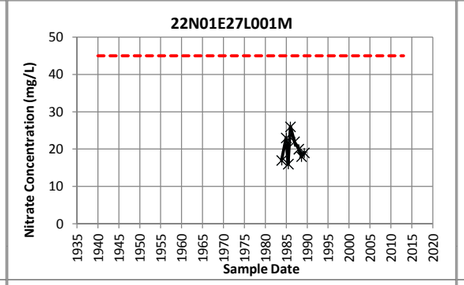


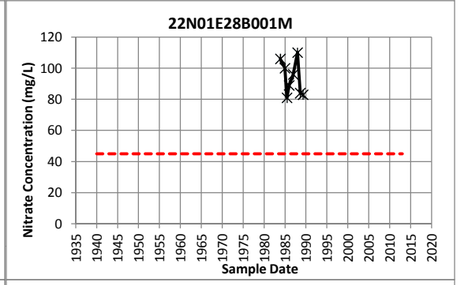


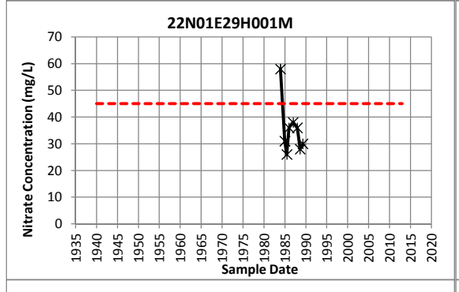


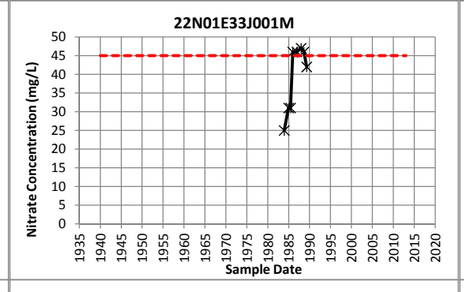


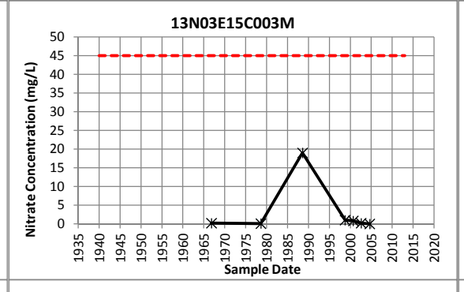


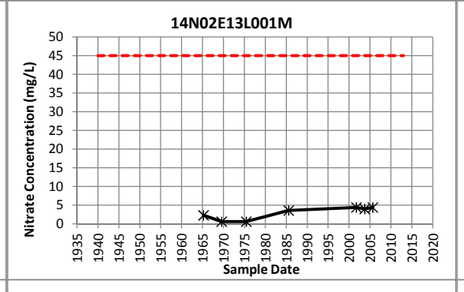


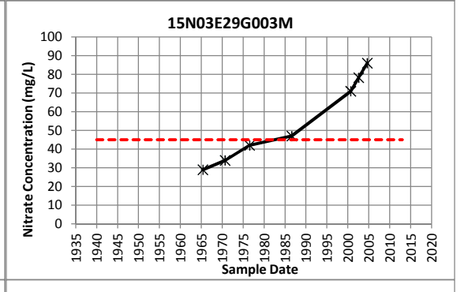


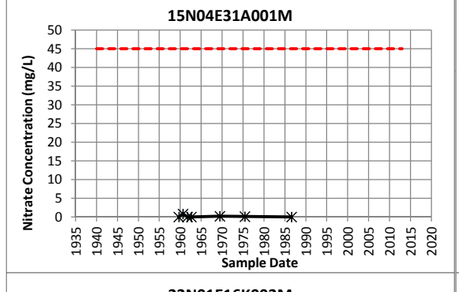


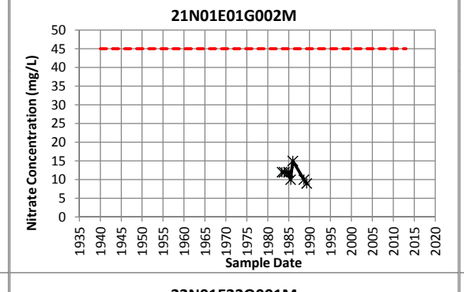


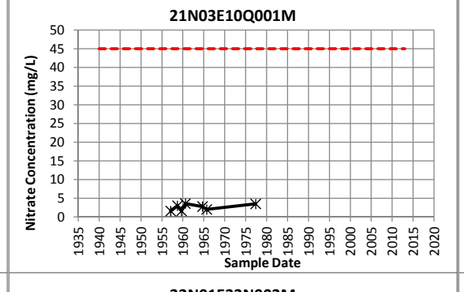


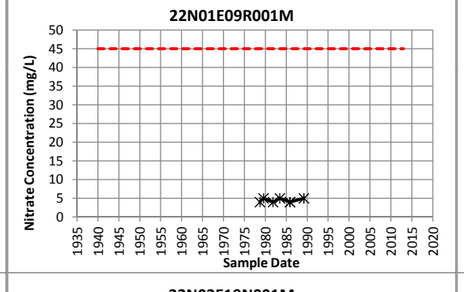


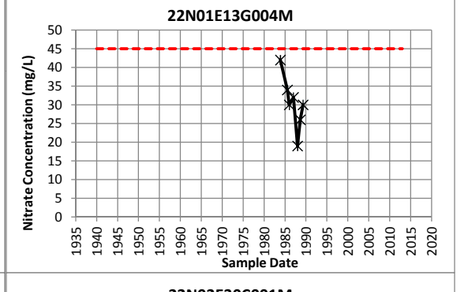


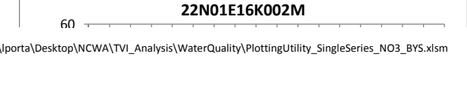


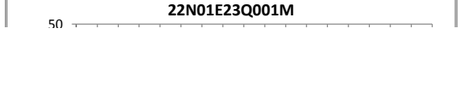


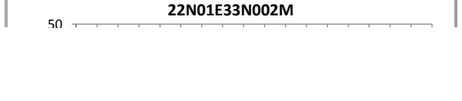


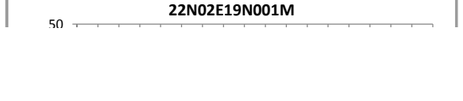


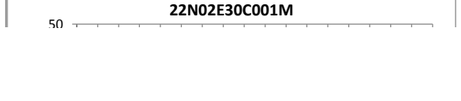






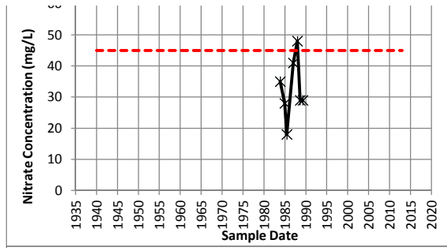


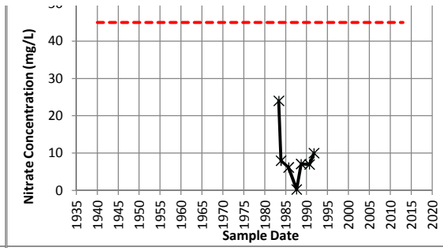


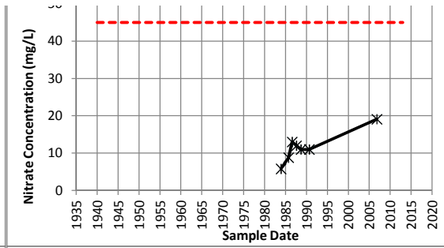


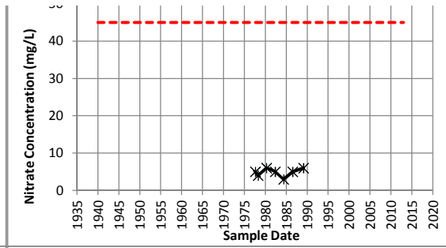
Nitrate as NO3 Concentration Trends

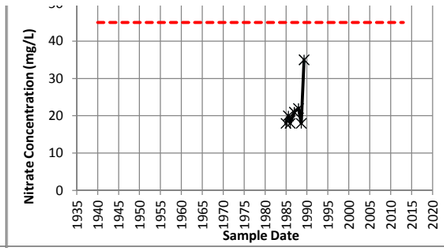
Butte-Yuba-Sutter Subwatershed

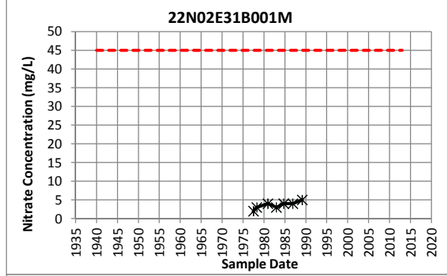


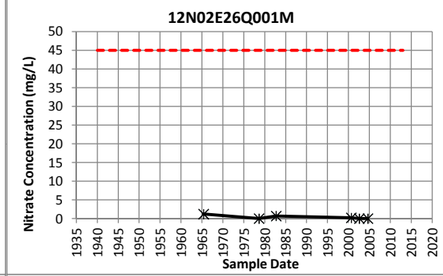


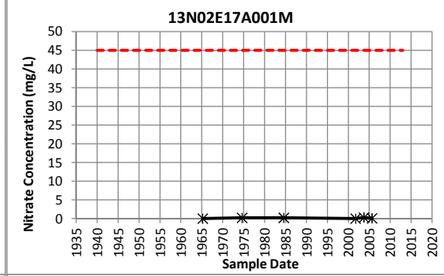


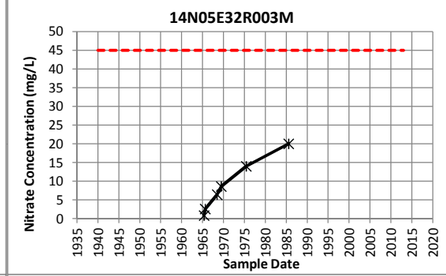


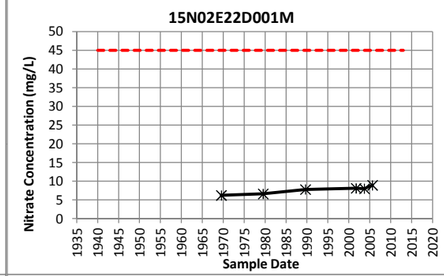


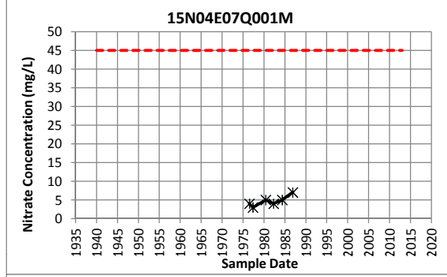


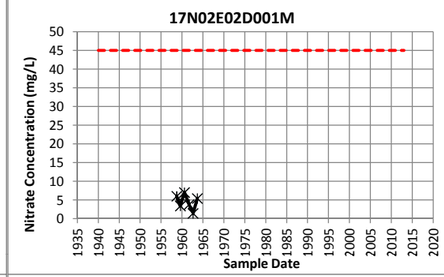


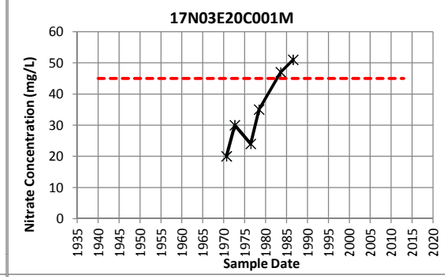


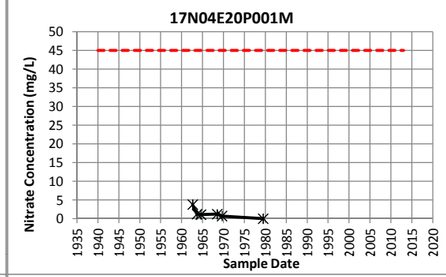


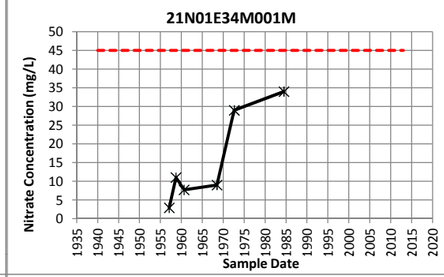


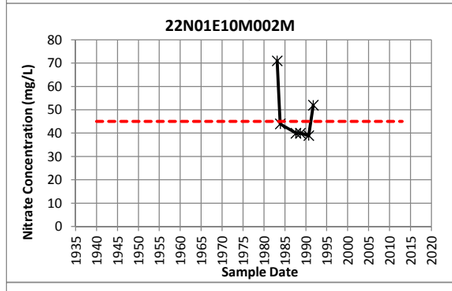


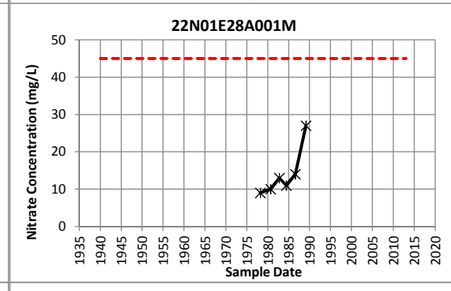


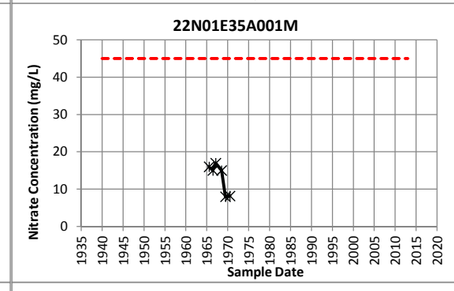


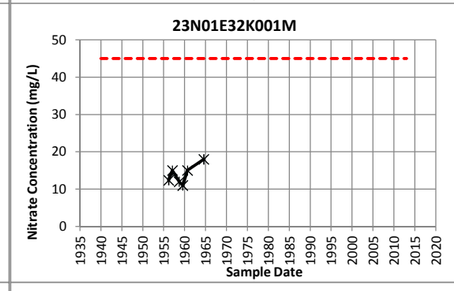


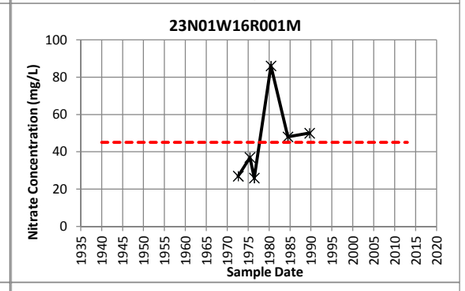


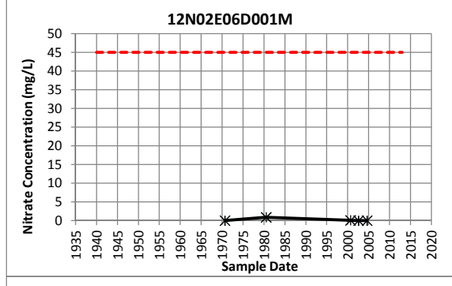


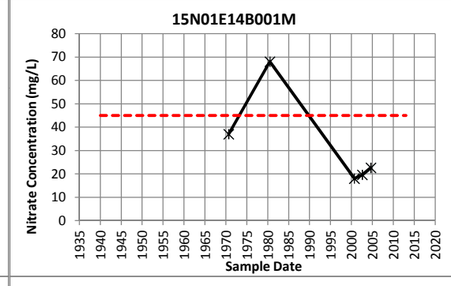


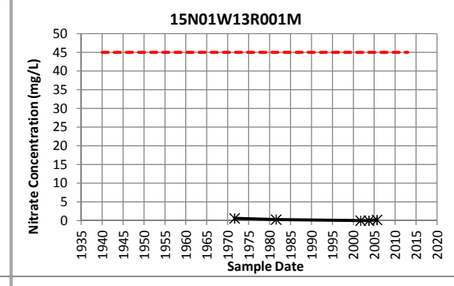


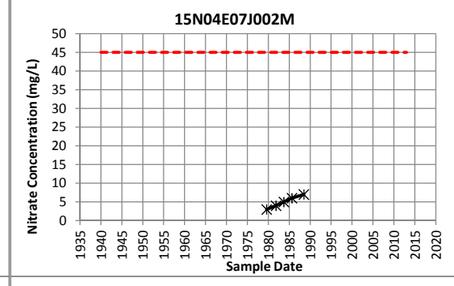


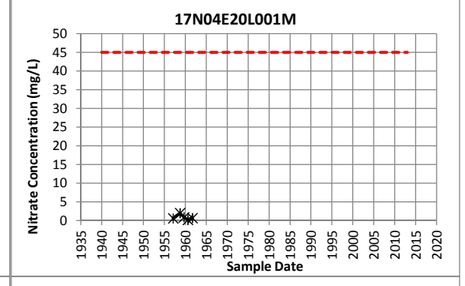


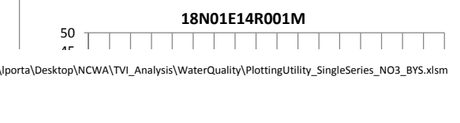


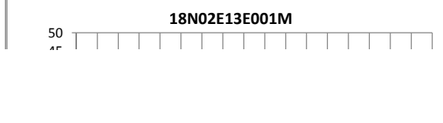






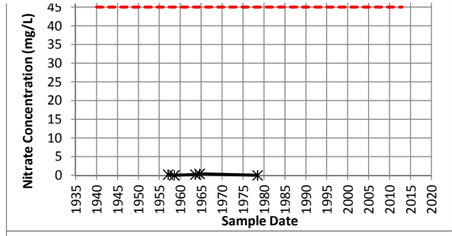


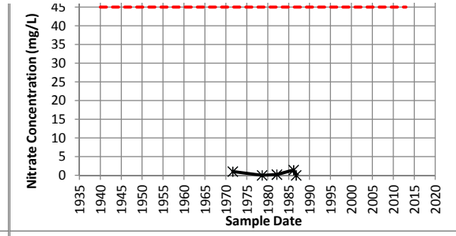


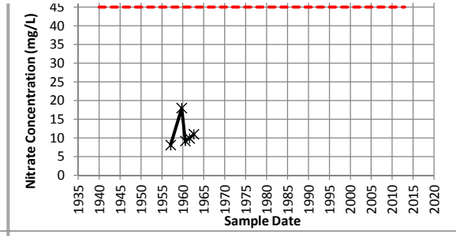


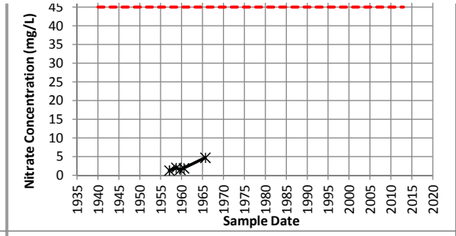
Nitrate as NO3 Concentration Trends

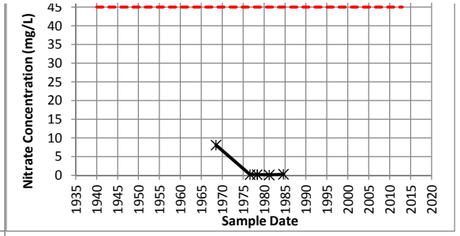
Butte-Yuba-Sutter Subwatershed

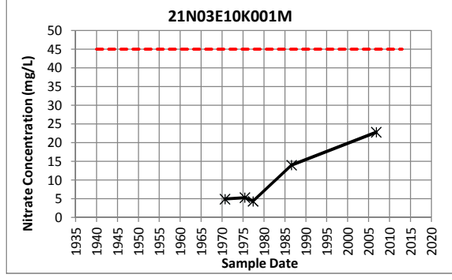


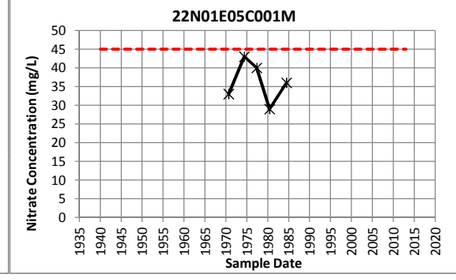


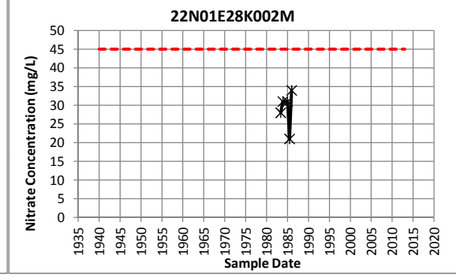


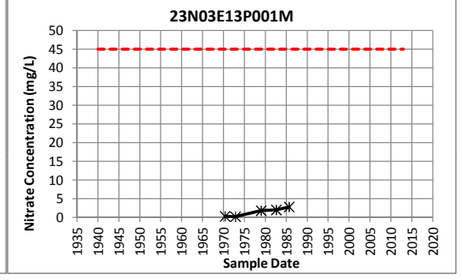






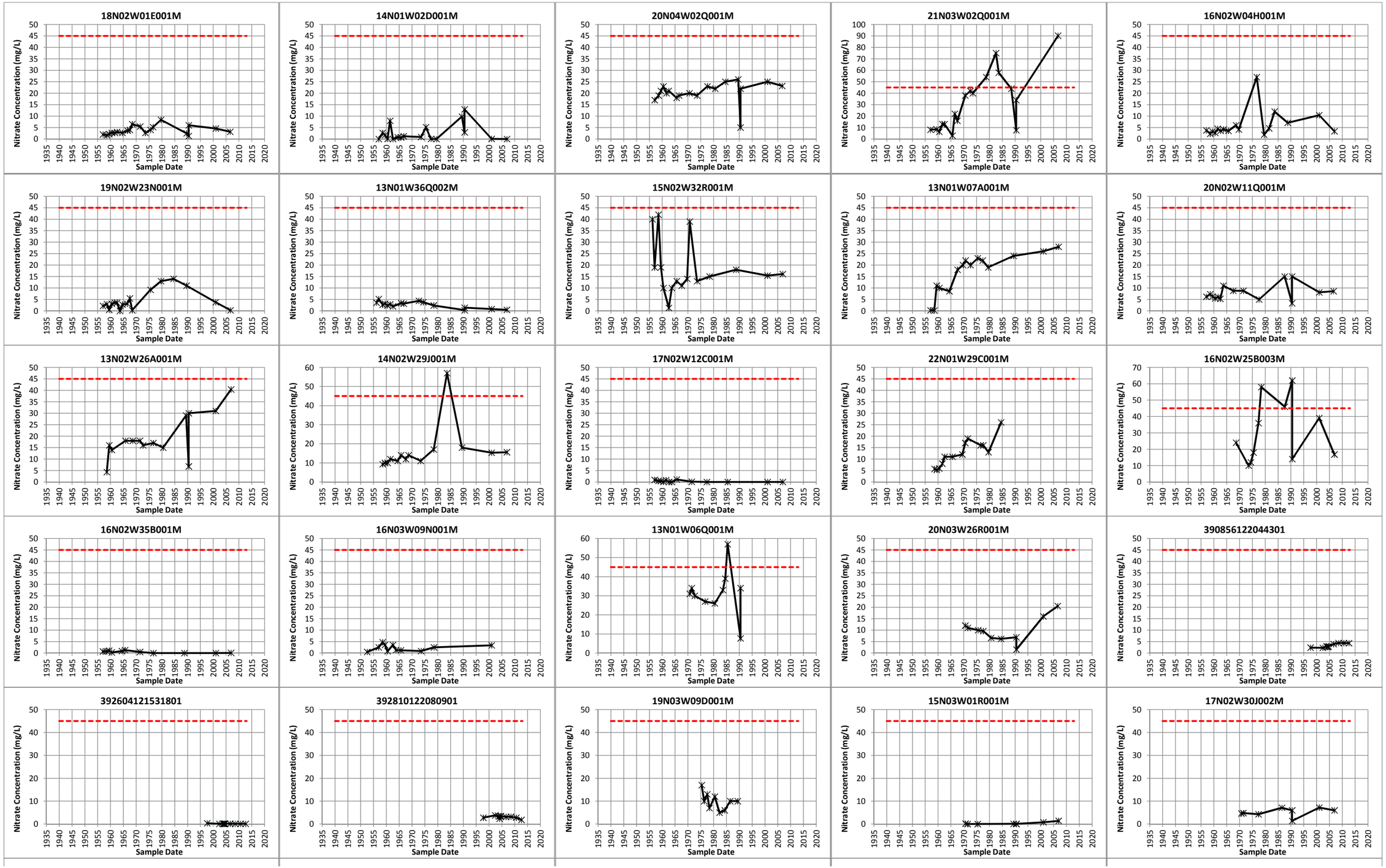






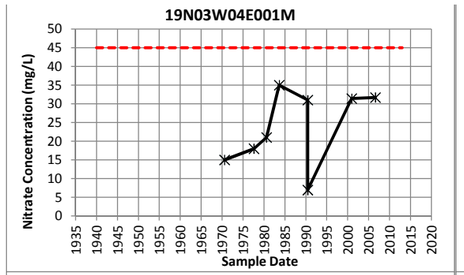
Nitrate as NO3 Concentration Trends

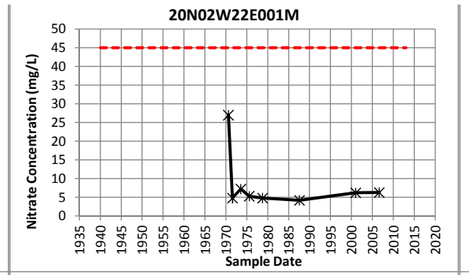
Colusa Glenn Subwatershed

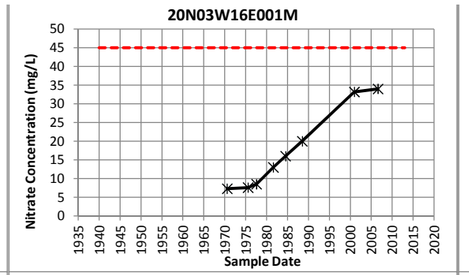


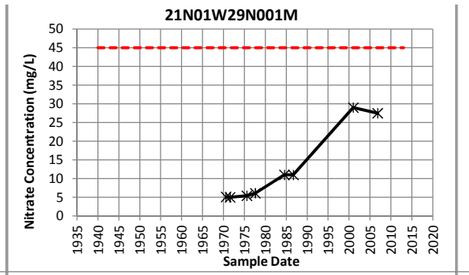
Nitrate as NO3 Concentration Trends

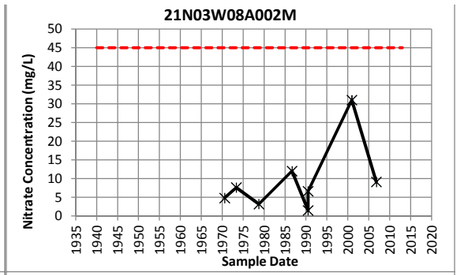
Colusa Glenn Subwatershed

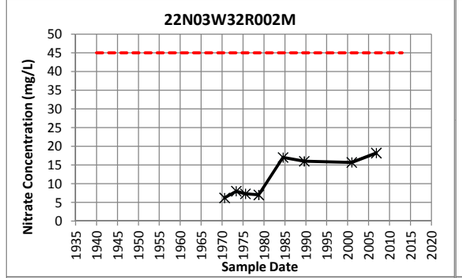


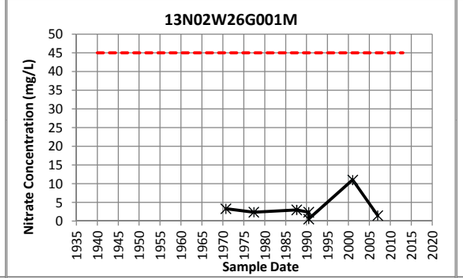


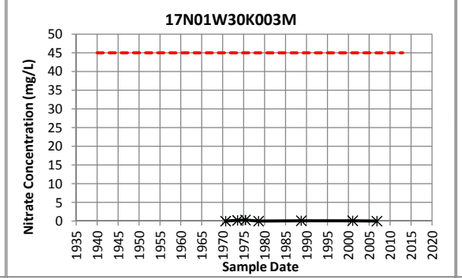


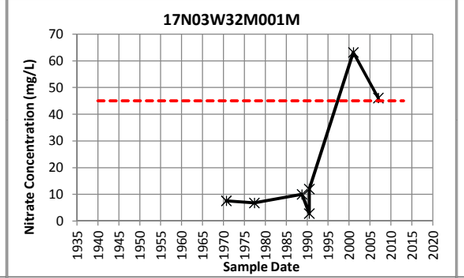


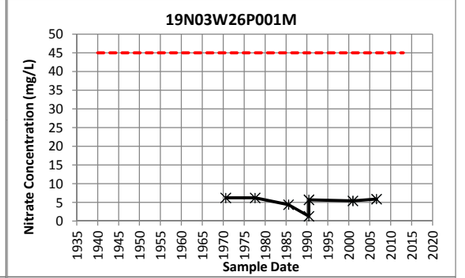


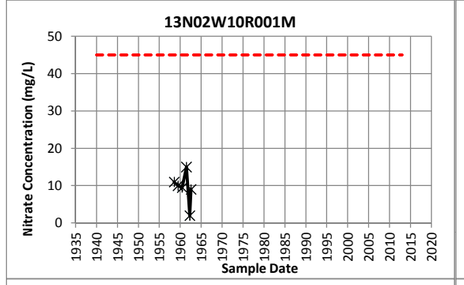


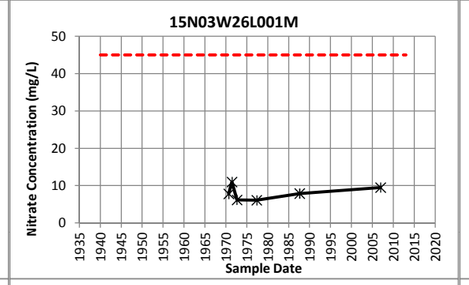


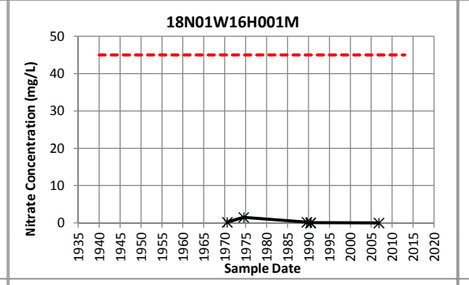


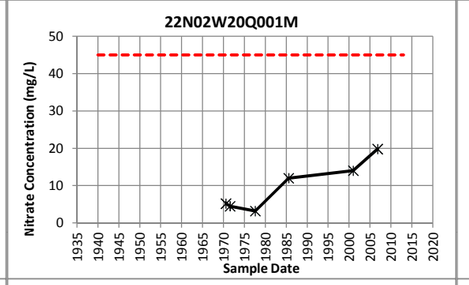


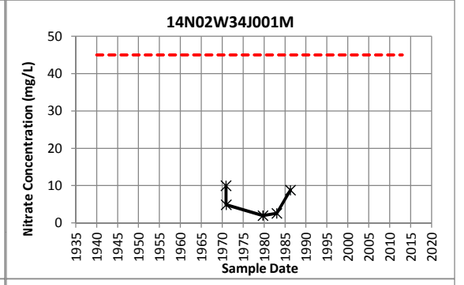


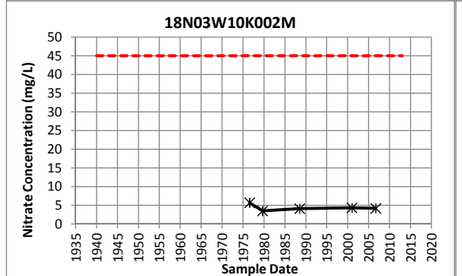


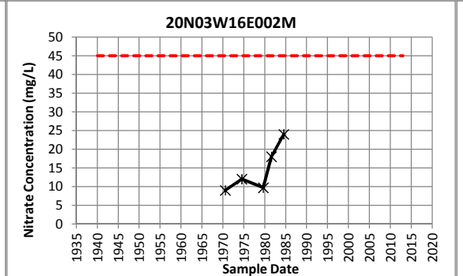


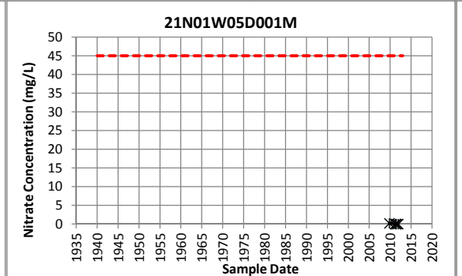


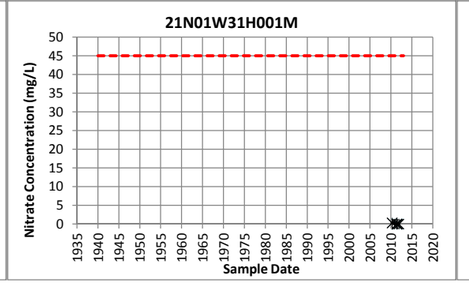


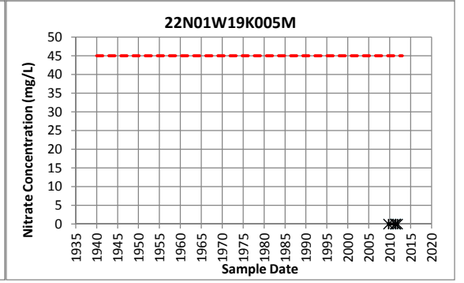


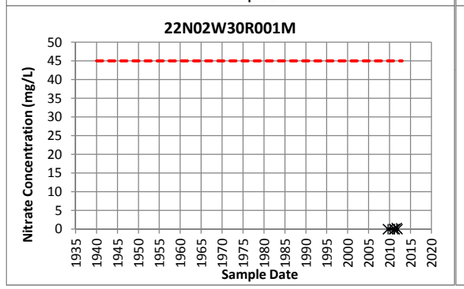


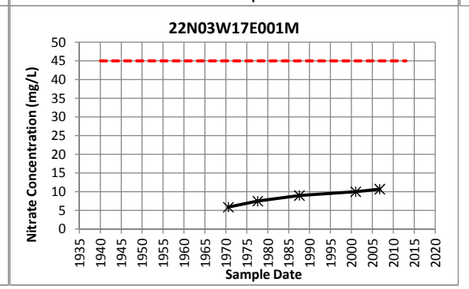






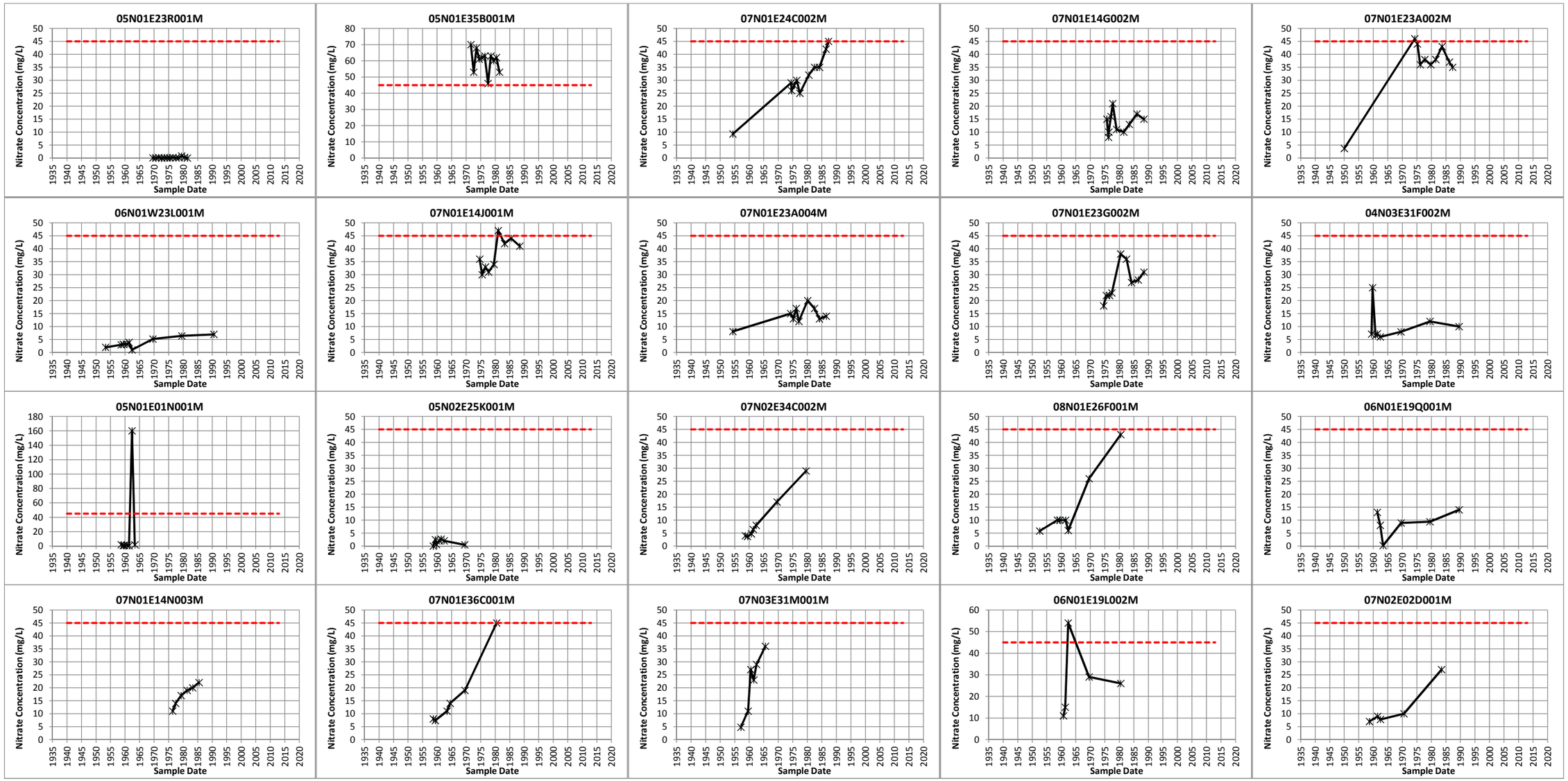






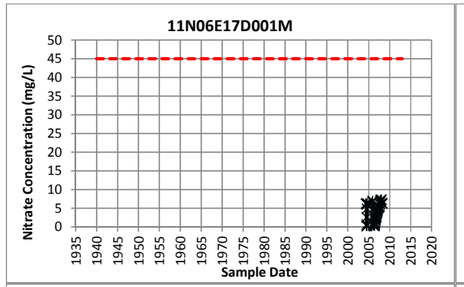
Nitrate as NO3 Concentration Trends

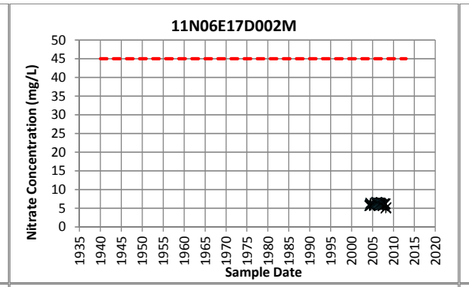
Dixon-Solano Subwatershed

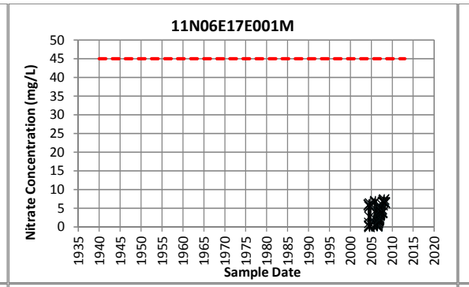


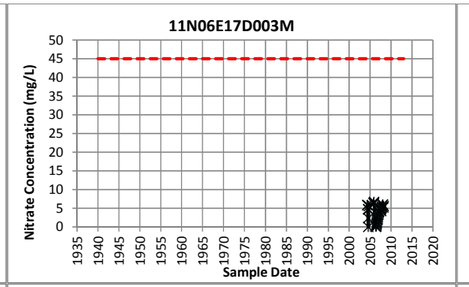
Nitrate as NO3 Concentration Trends

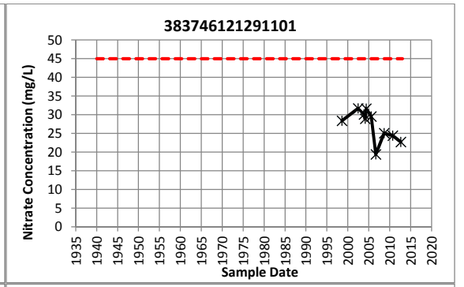
Placer Nevada South Sutter North Sacramento Subwatershed

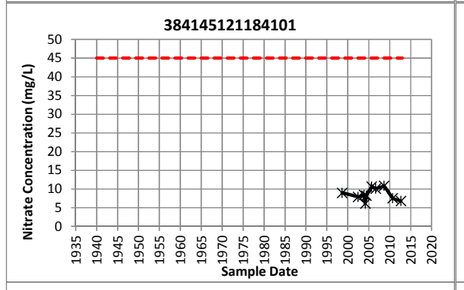


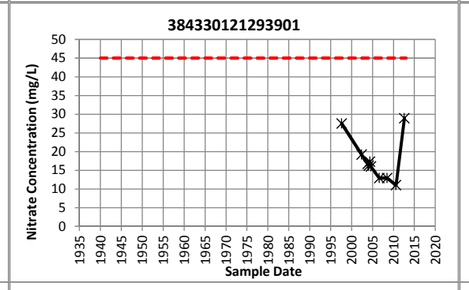


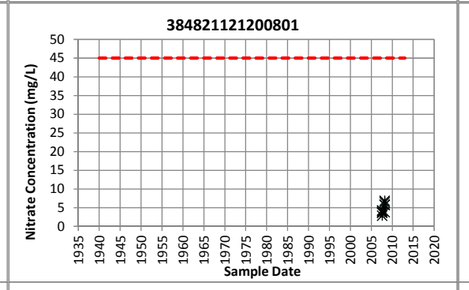


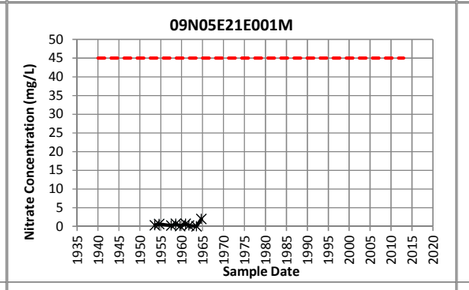


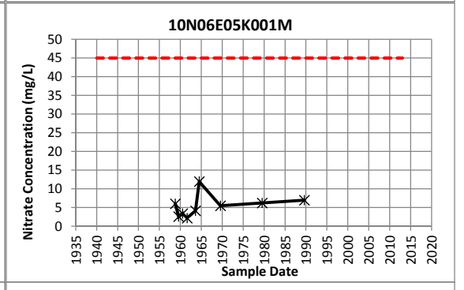


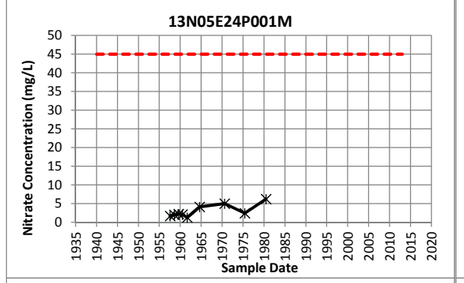


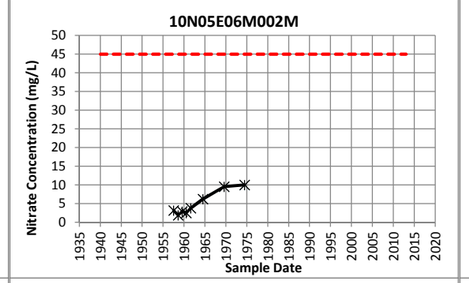


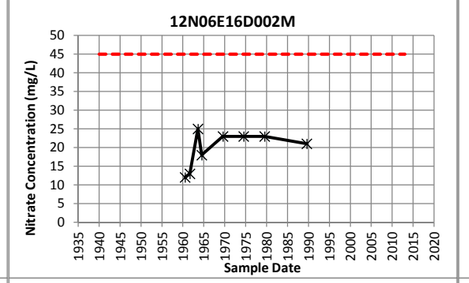


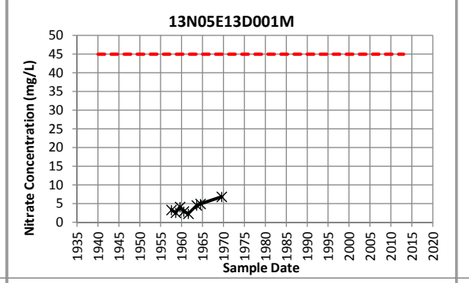


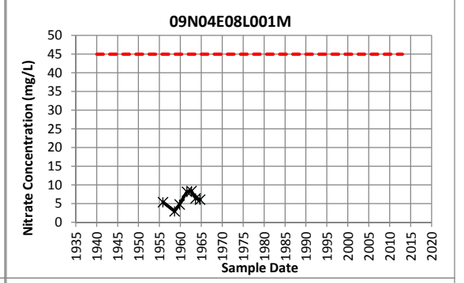


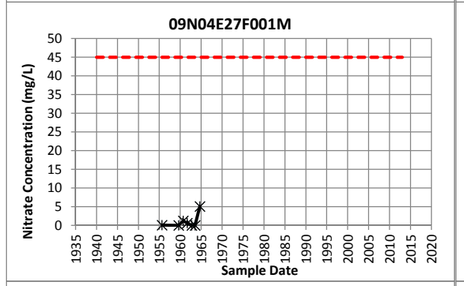


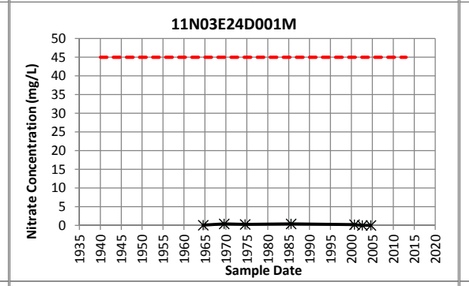


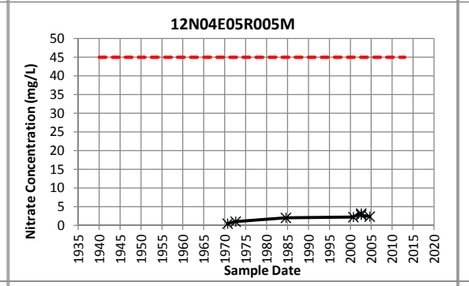


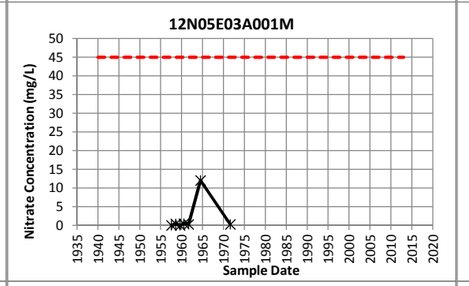


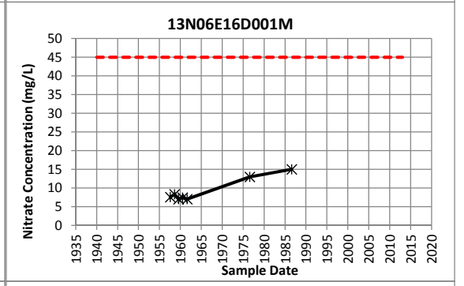


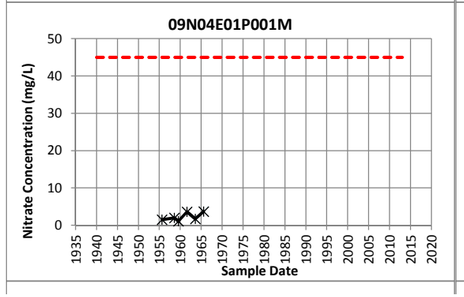


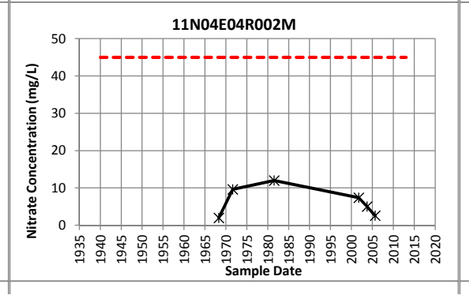


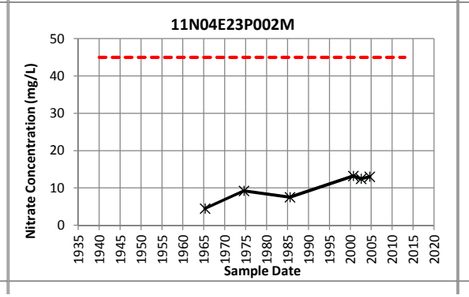


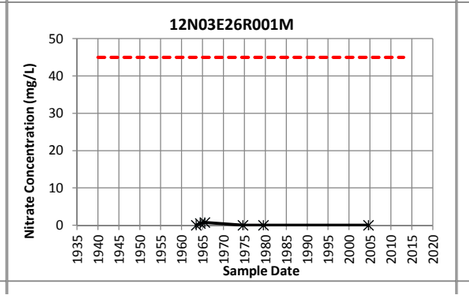


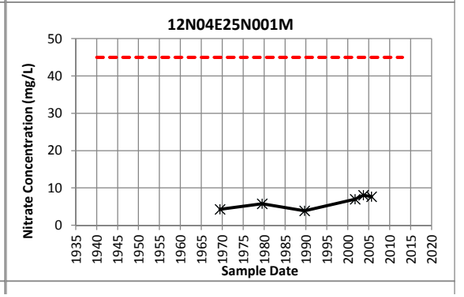






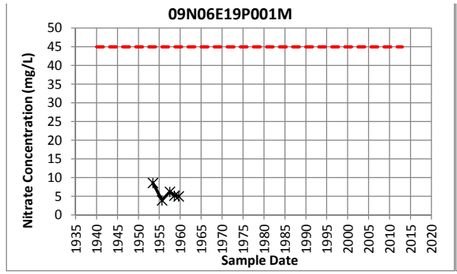


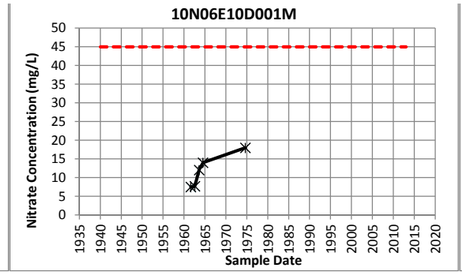


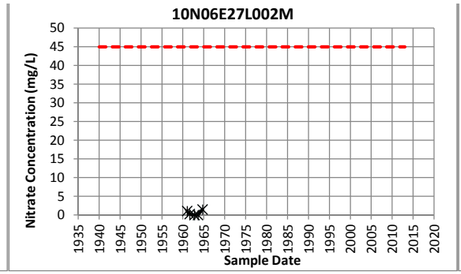


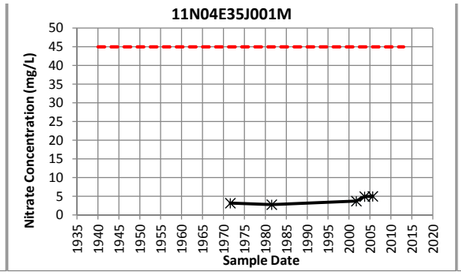
Nitrate as NO3 Concentration Trends

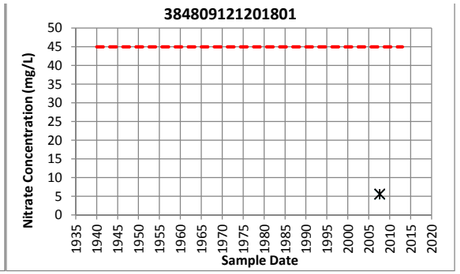
Placer Nevada South Sutter North Sacramento Subwatershed





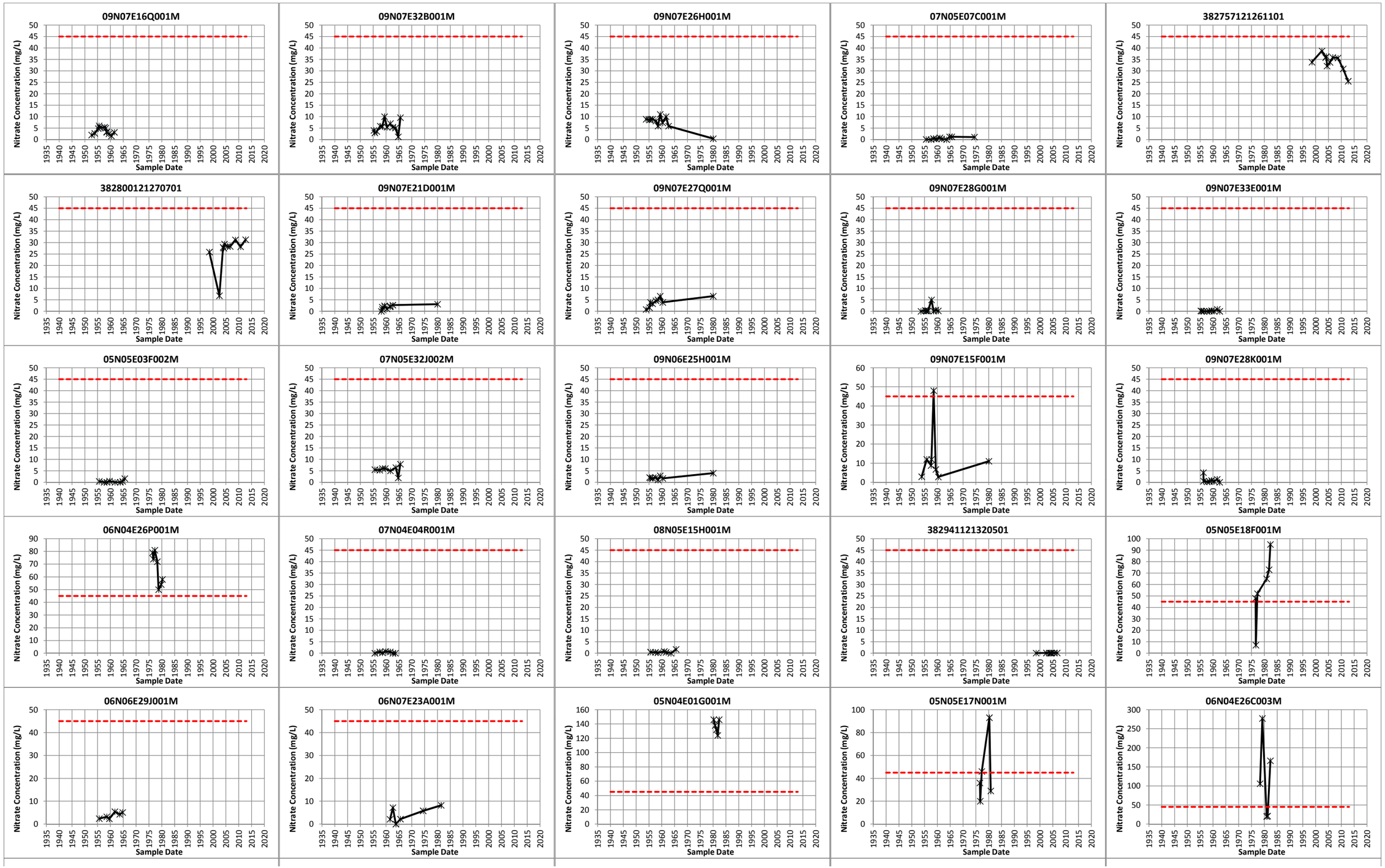






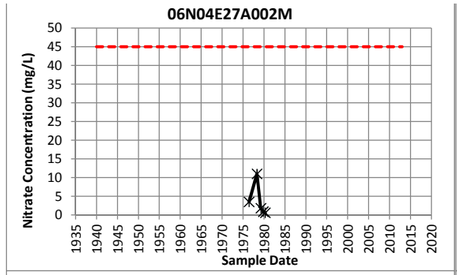
Nitrate as NO3 Concentration Trends

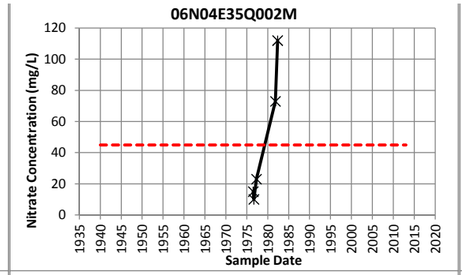
Sacramento Amador Subwatershed

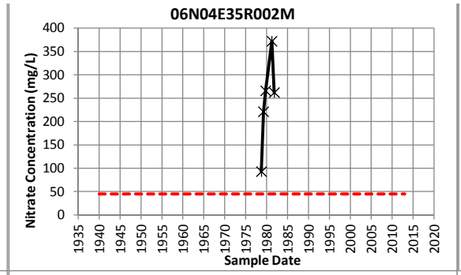


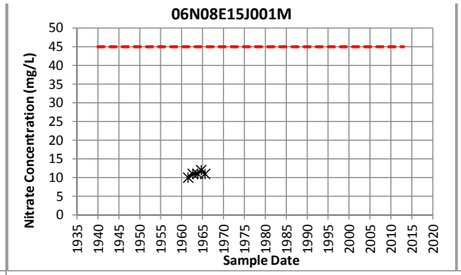
Nitrate as NO3 Concentration Trends

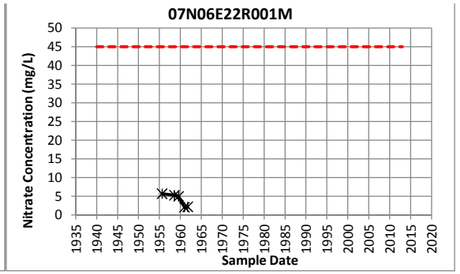
Sacramento Amador Subwatershed

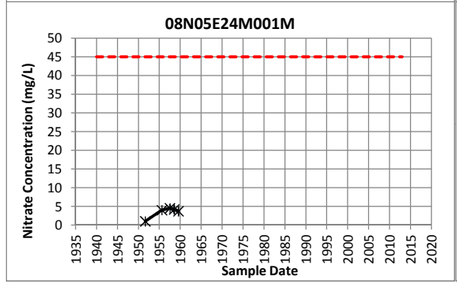


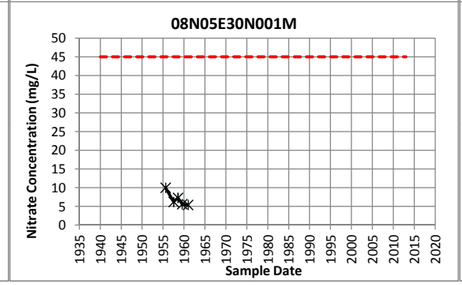


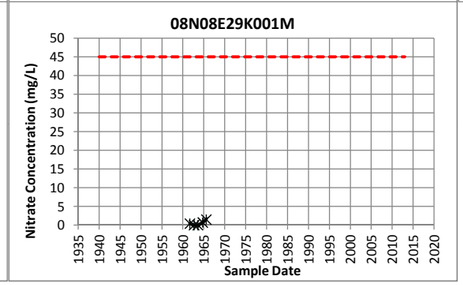






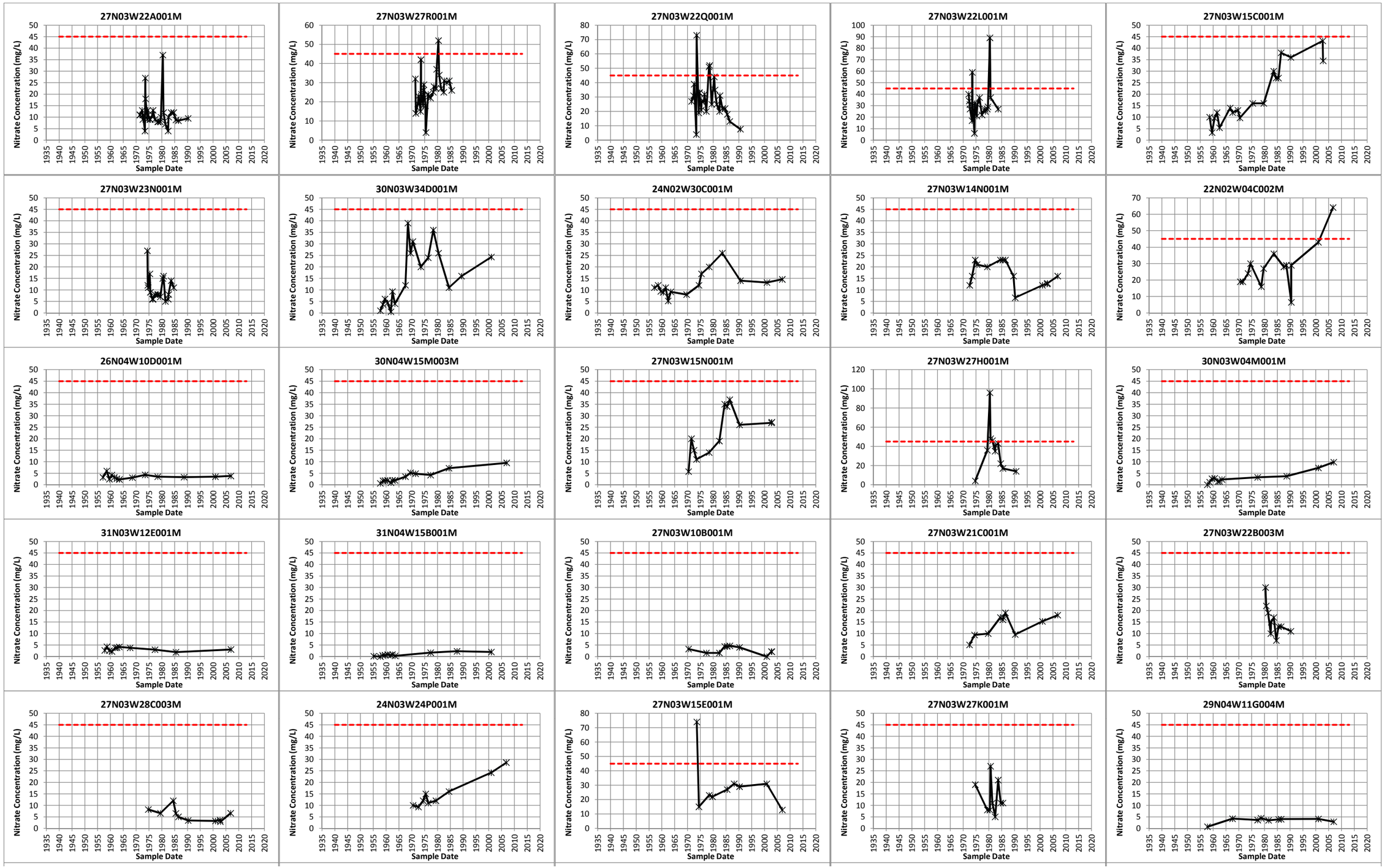






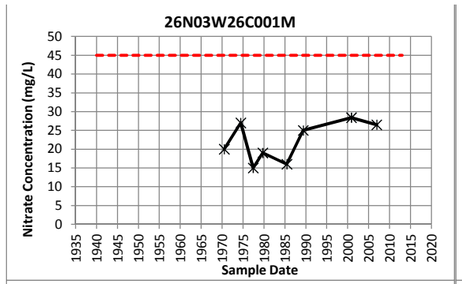
Nitrate as NO3 Concentration Trends

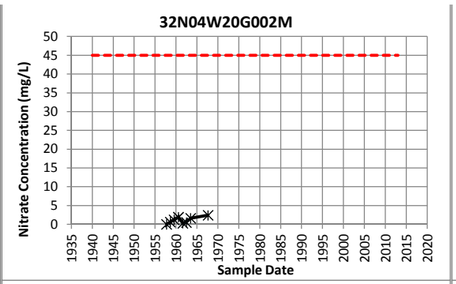
Shasta-Tehama Subwatershed

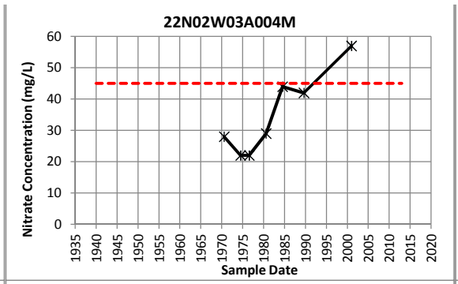


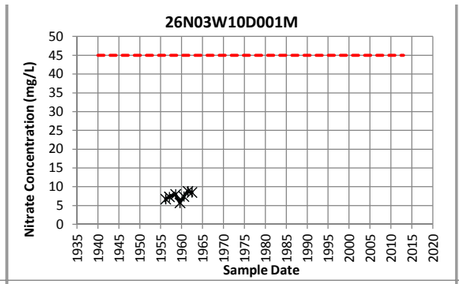
Nitrate as NO3 Concentration Trends

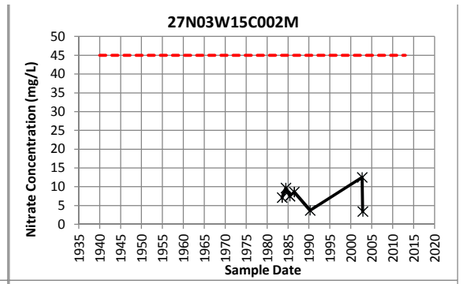
Shasta-Tehama Subwatershed

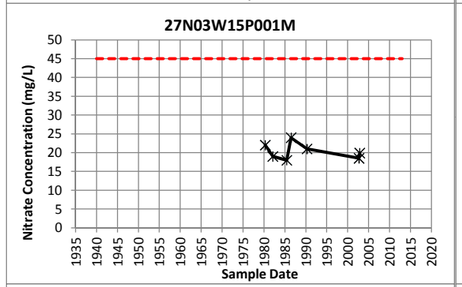


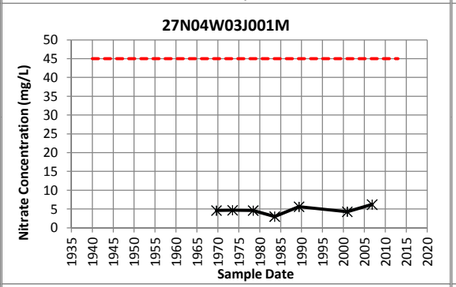


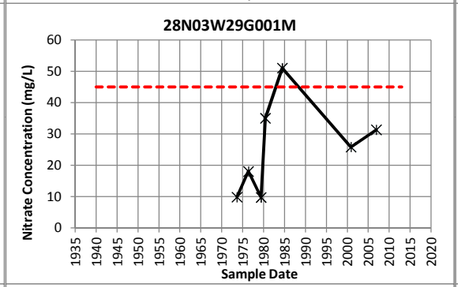


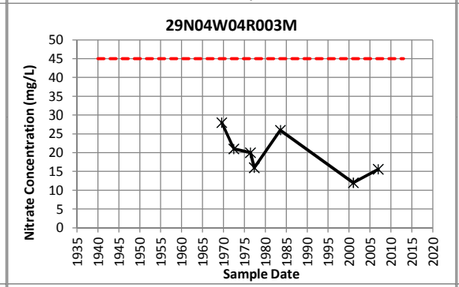


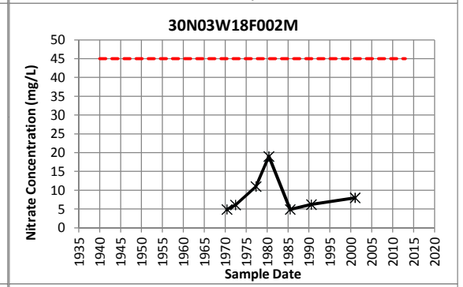


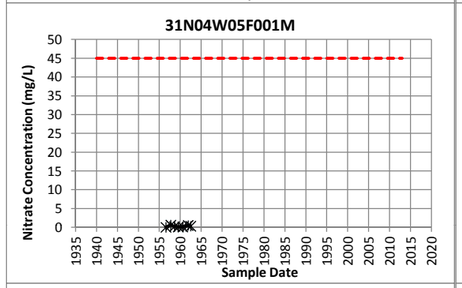


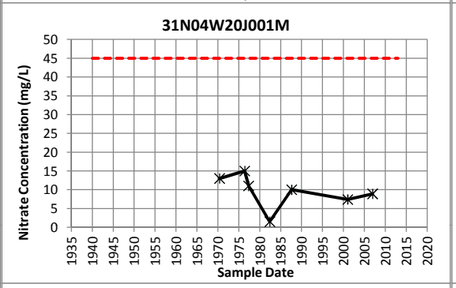


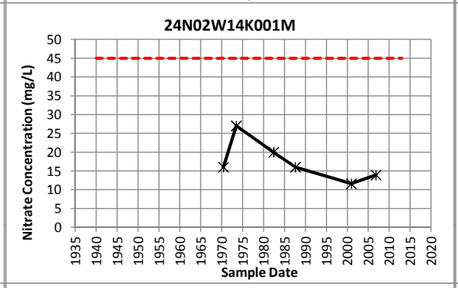


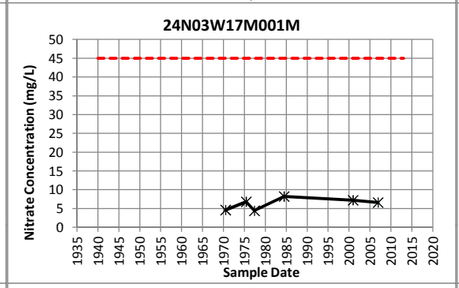


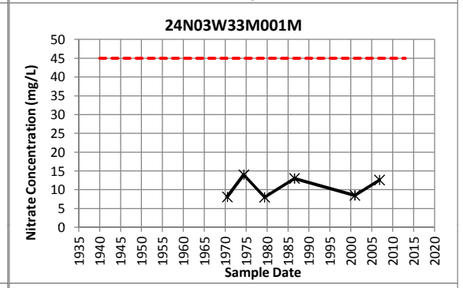


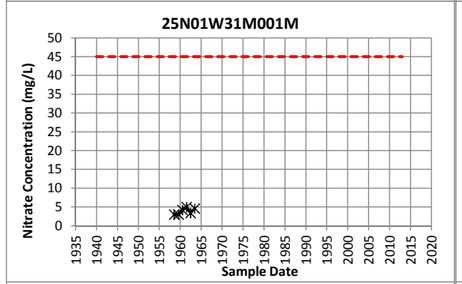


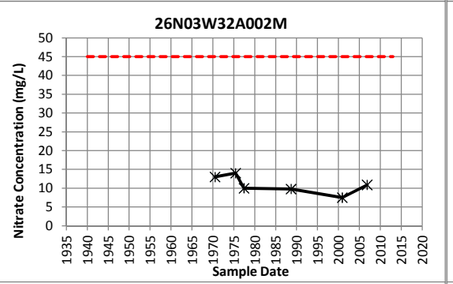


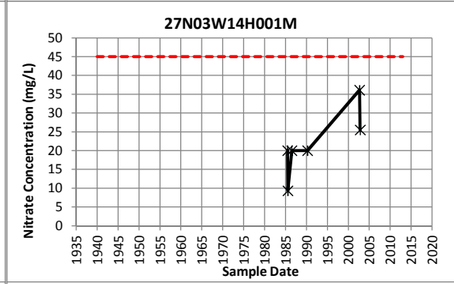


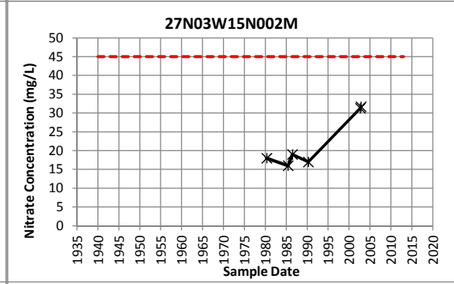


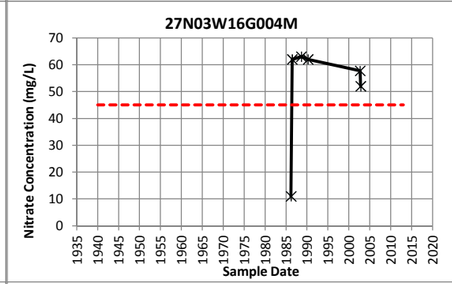


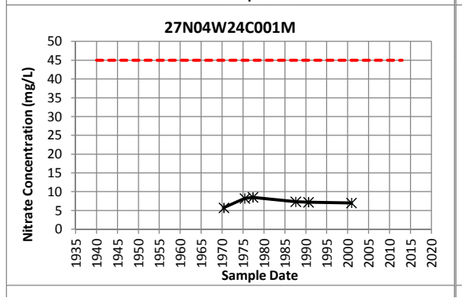


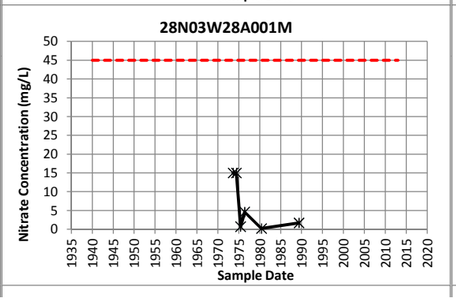


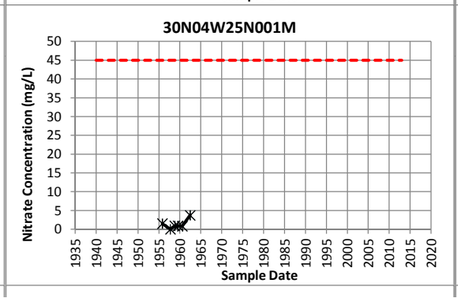


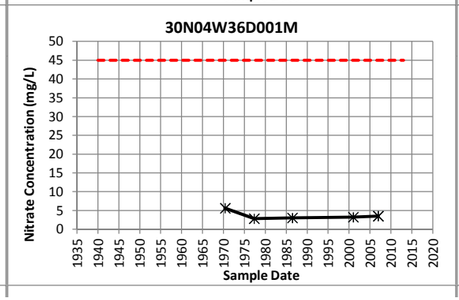


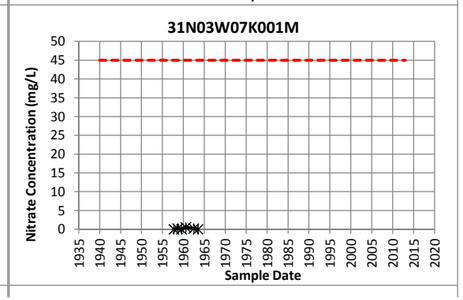












Nitrate as NO3 Concentration Trends

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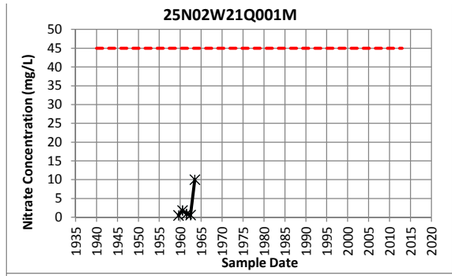

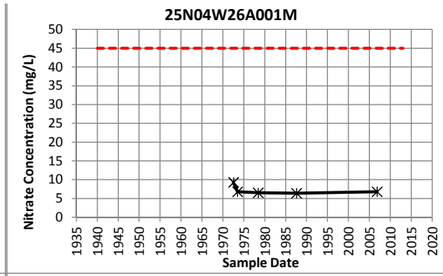

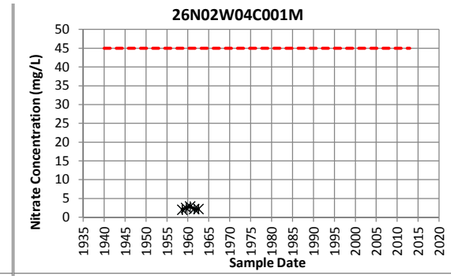

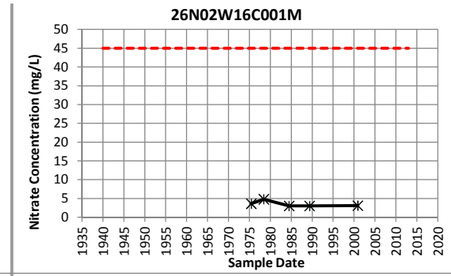

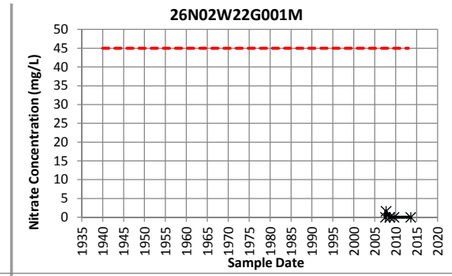

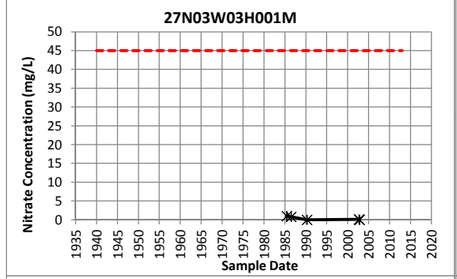

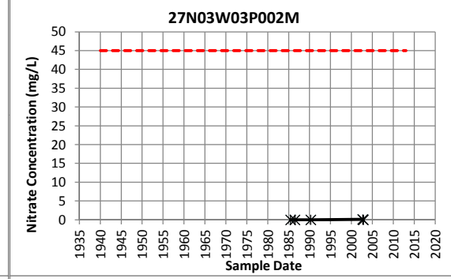

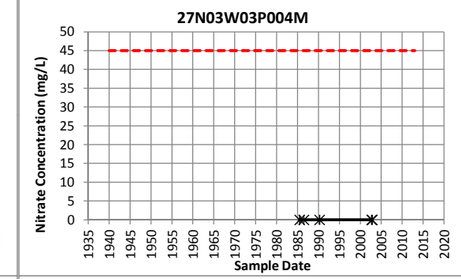

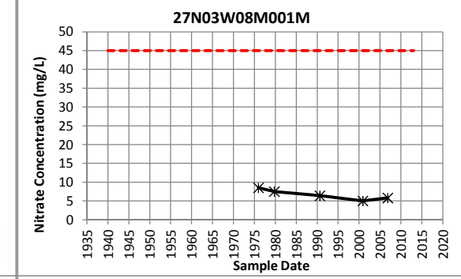

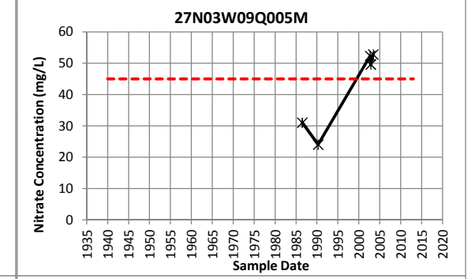

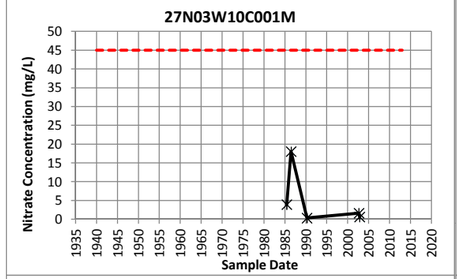

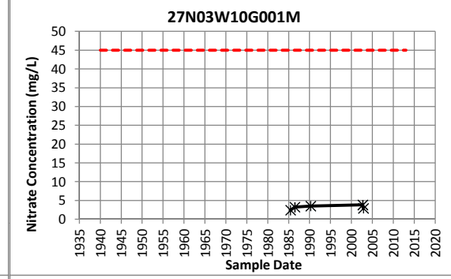

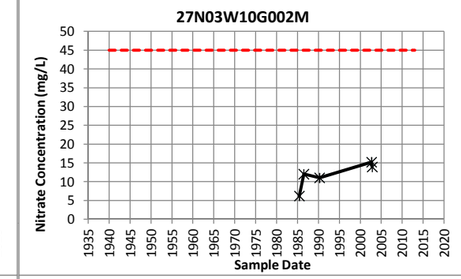

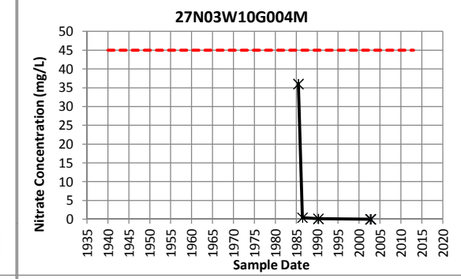

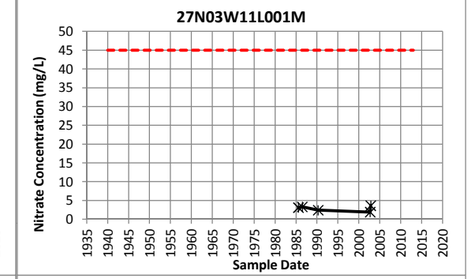

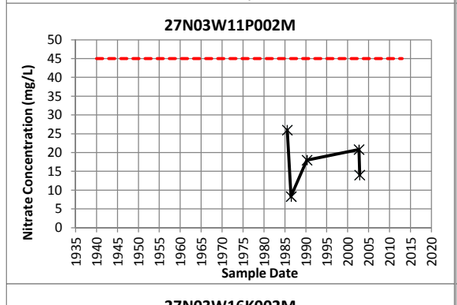

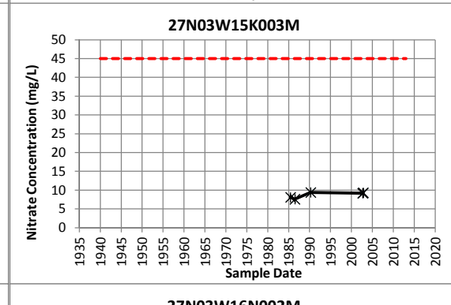

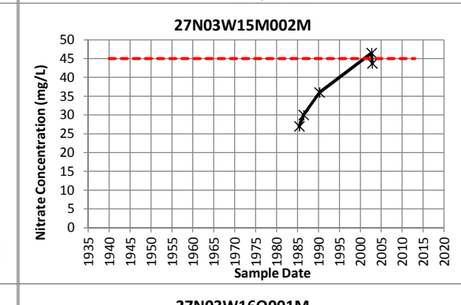

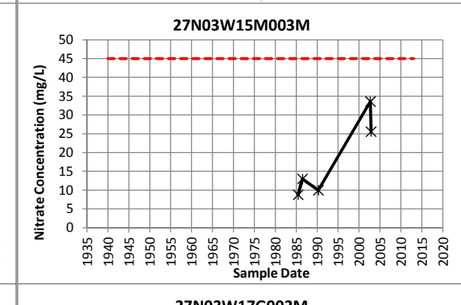

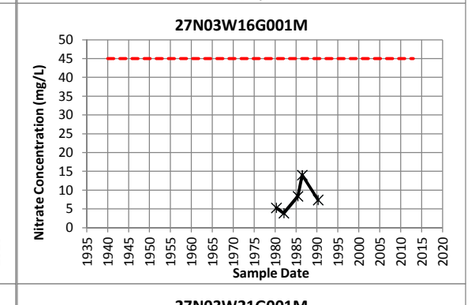

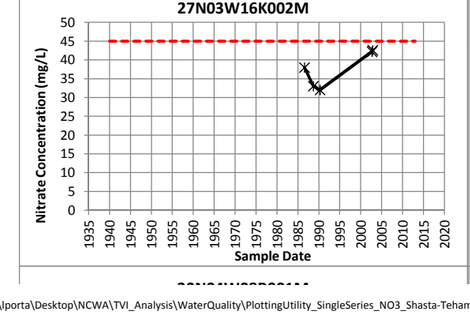

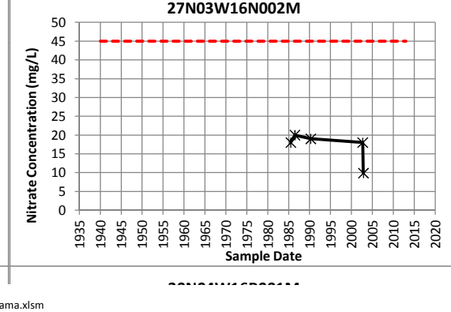

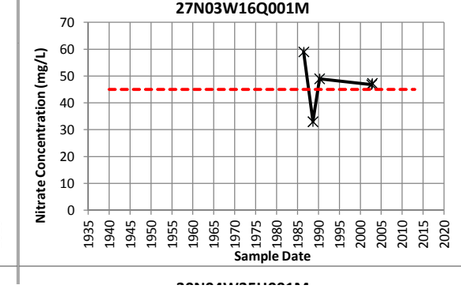

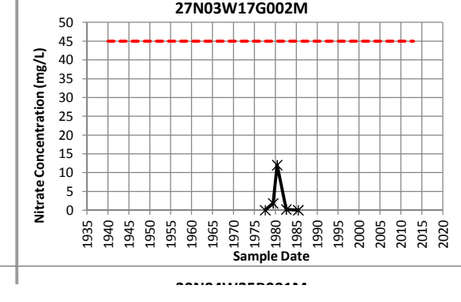

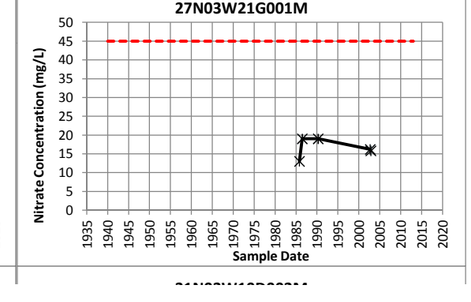

Nitrate as NO3 Concentration Trends

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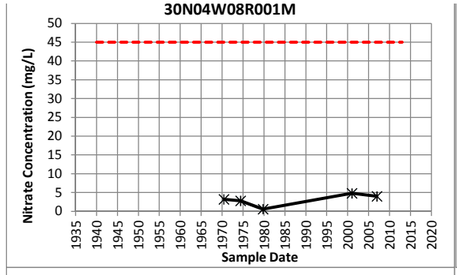
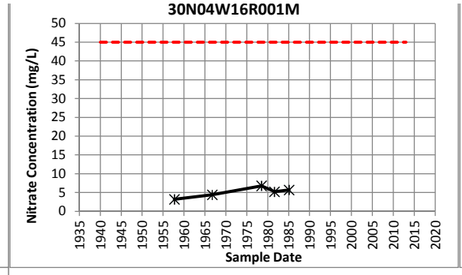
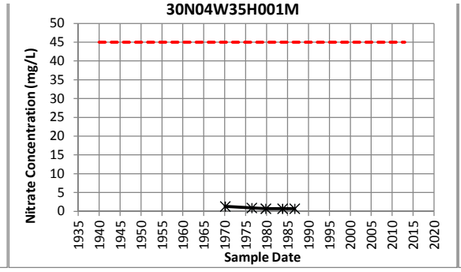
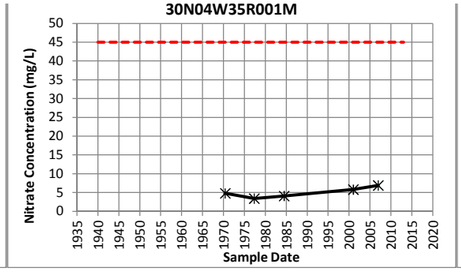
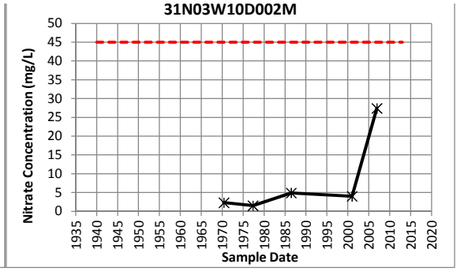
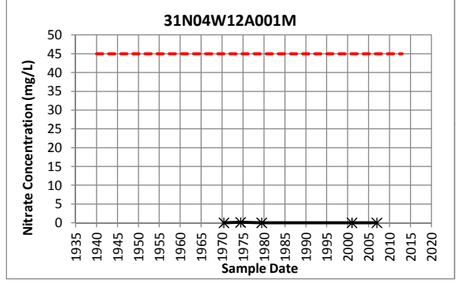




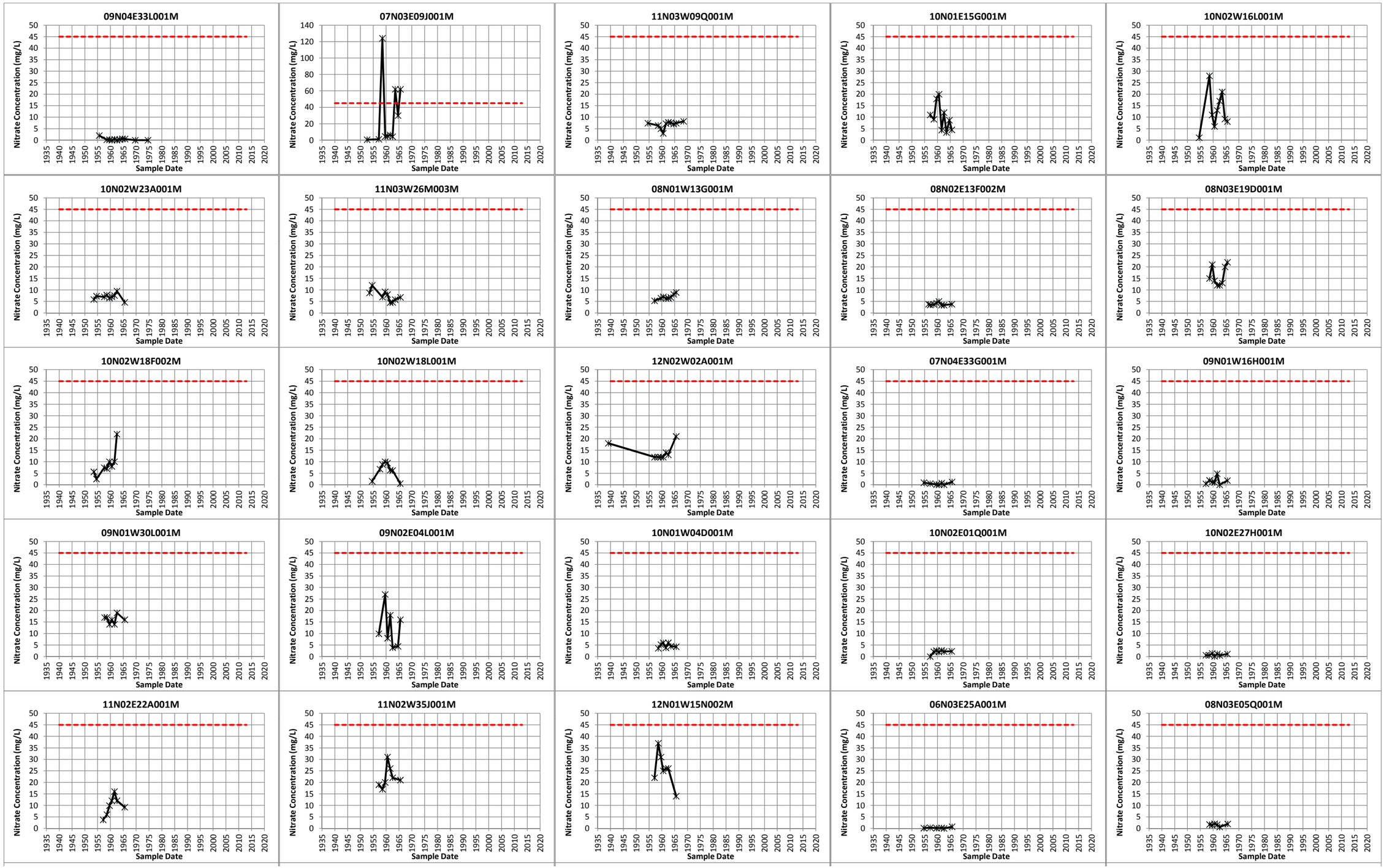






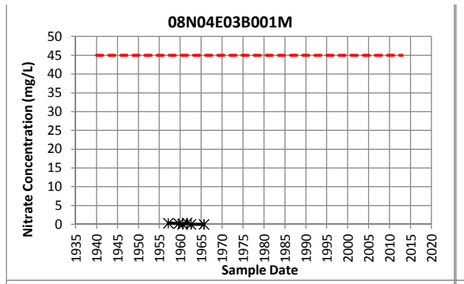


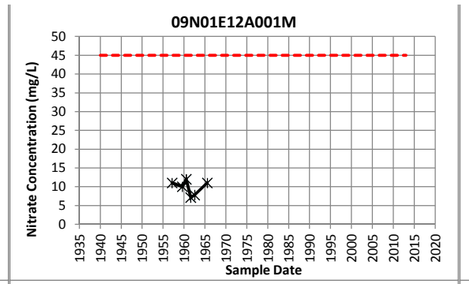
Yolo Subwatershed

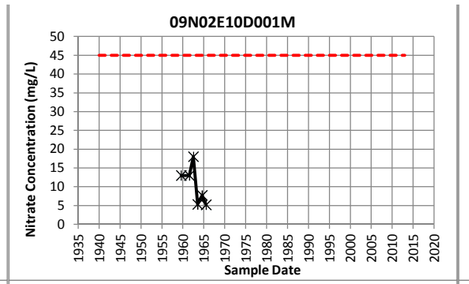


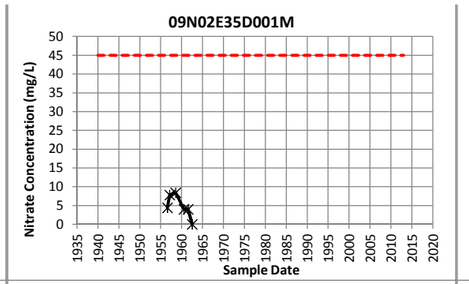
Nitrate as NO3 Concentration Trends

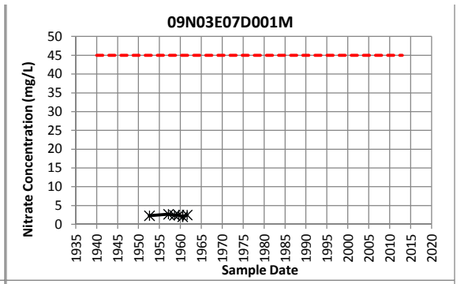
Yolo Subwatershed

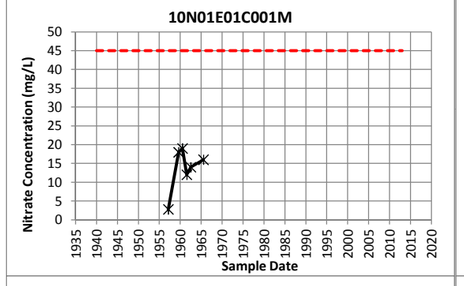


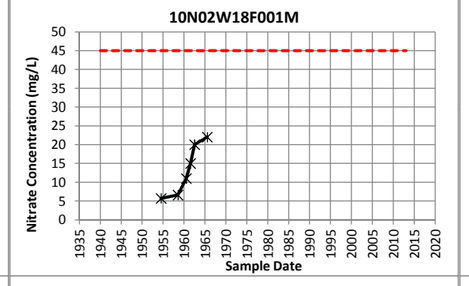


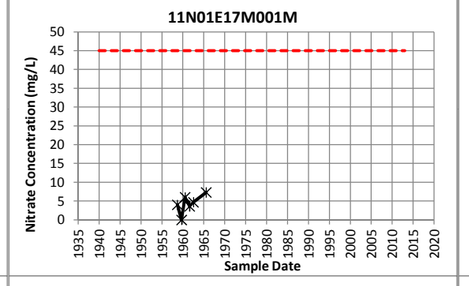


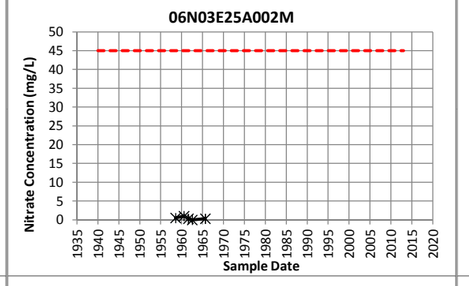


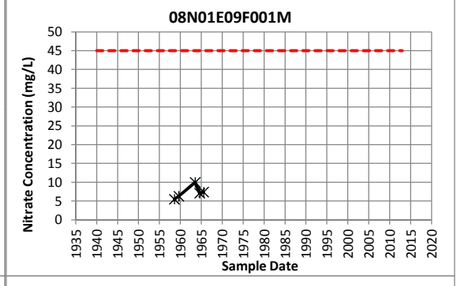


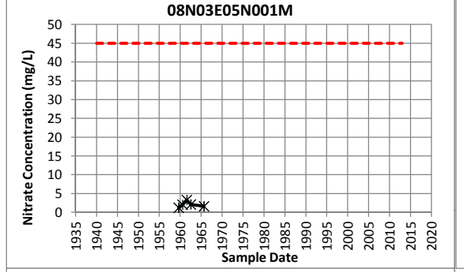


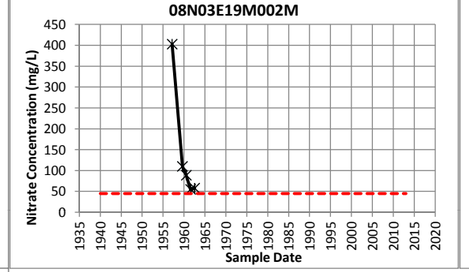


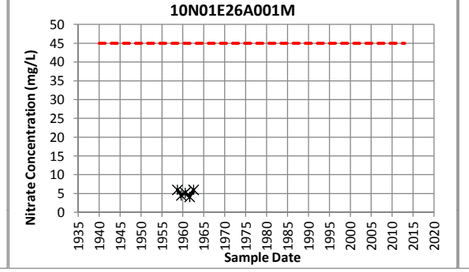


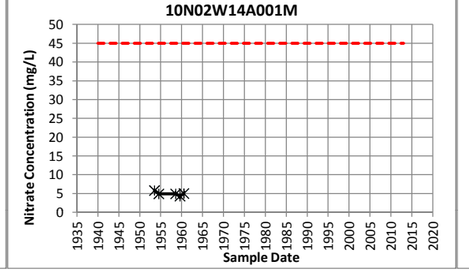


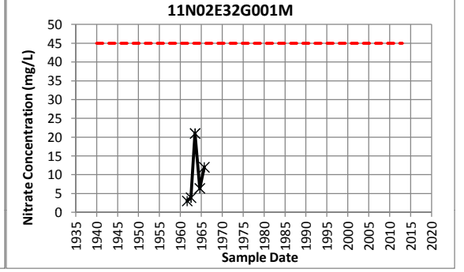


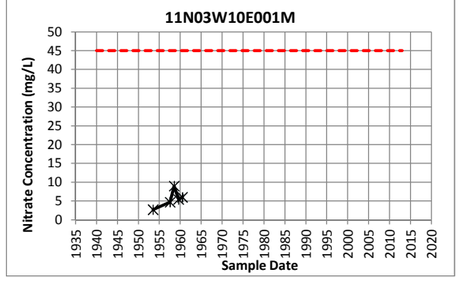


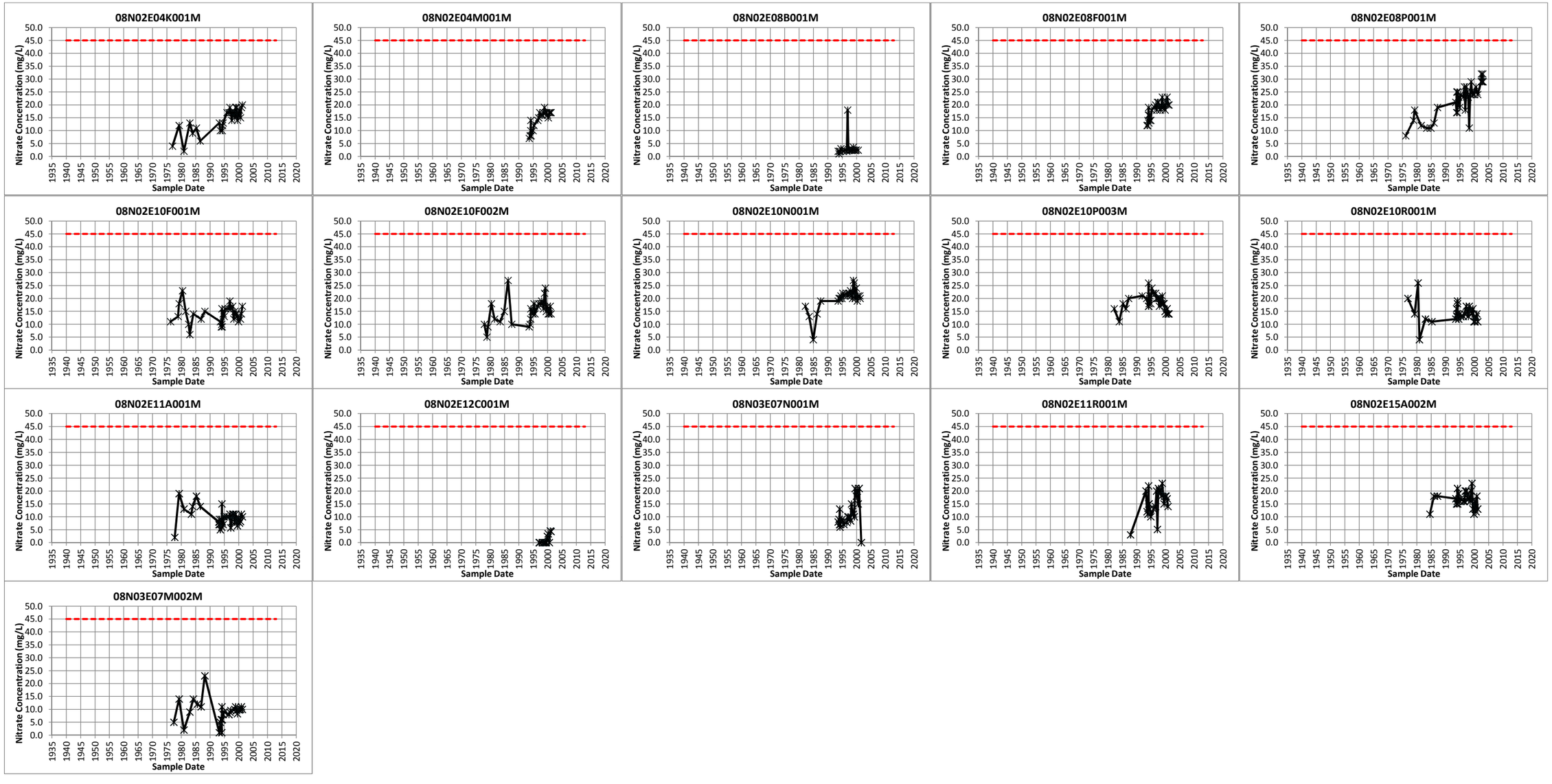








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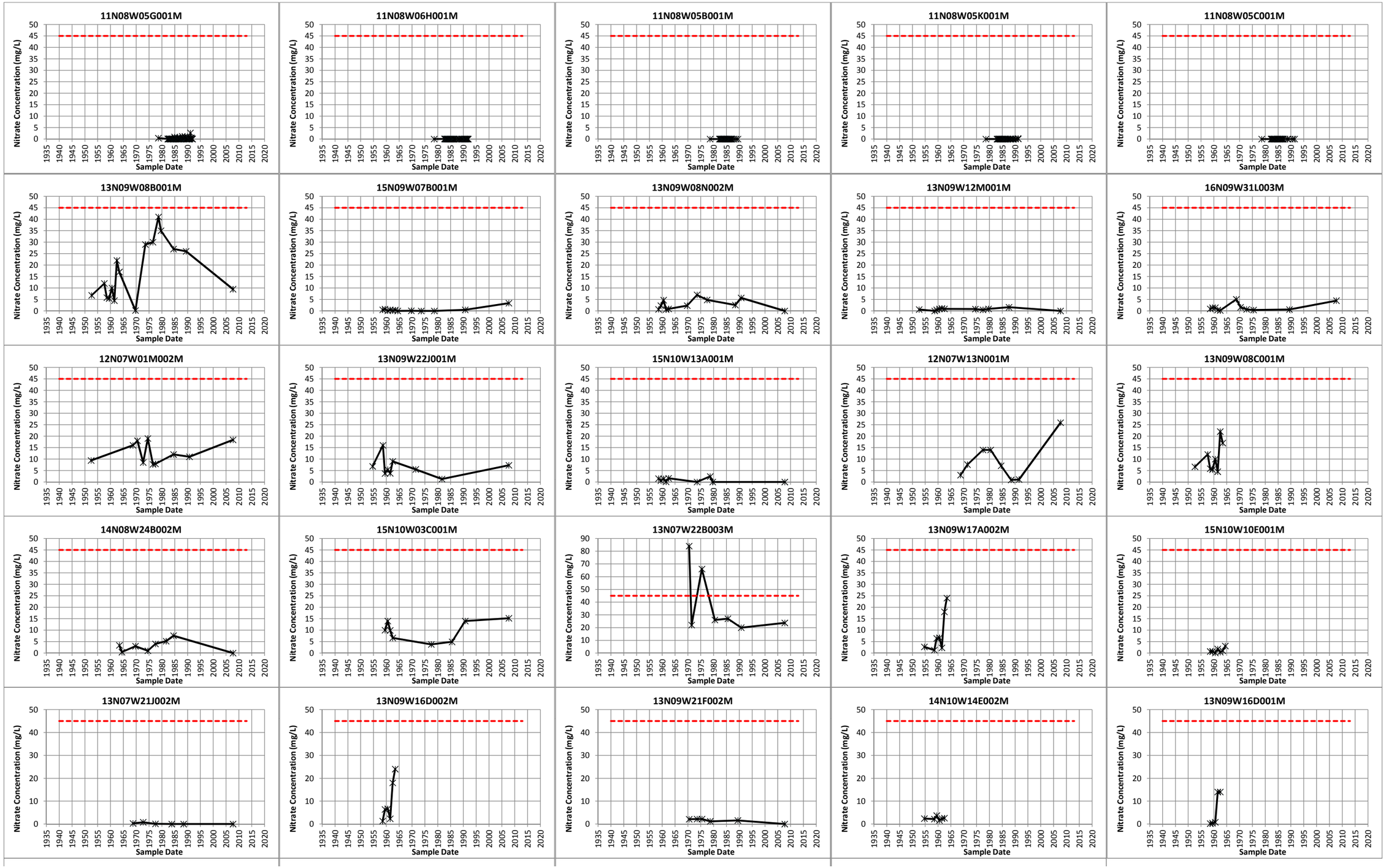
08N02E11A001M
08N02E12C001M
08N03E07N001M
08N02E11R001M
08N02E15A002M
08N03E07M002M
Nitrate Concentration (mg/L)
Sample Date
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020

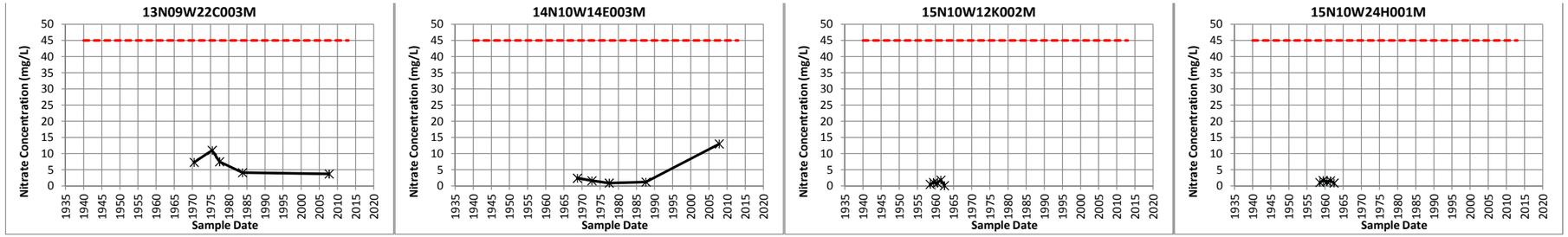
Nitrate as NO3 Concentration Trends

Lake Subwatershed



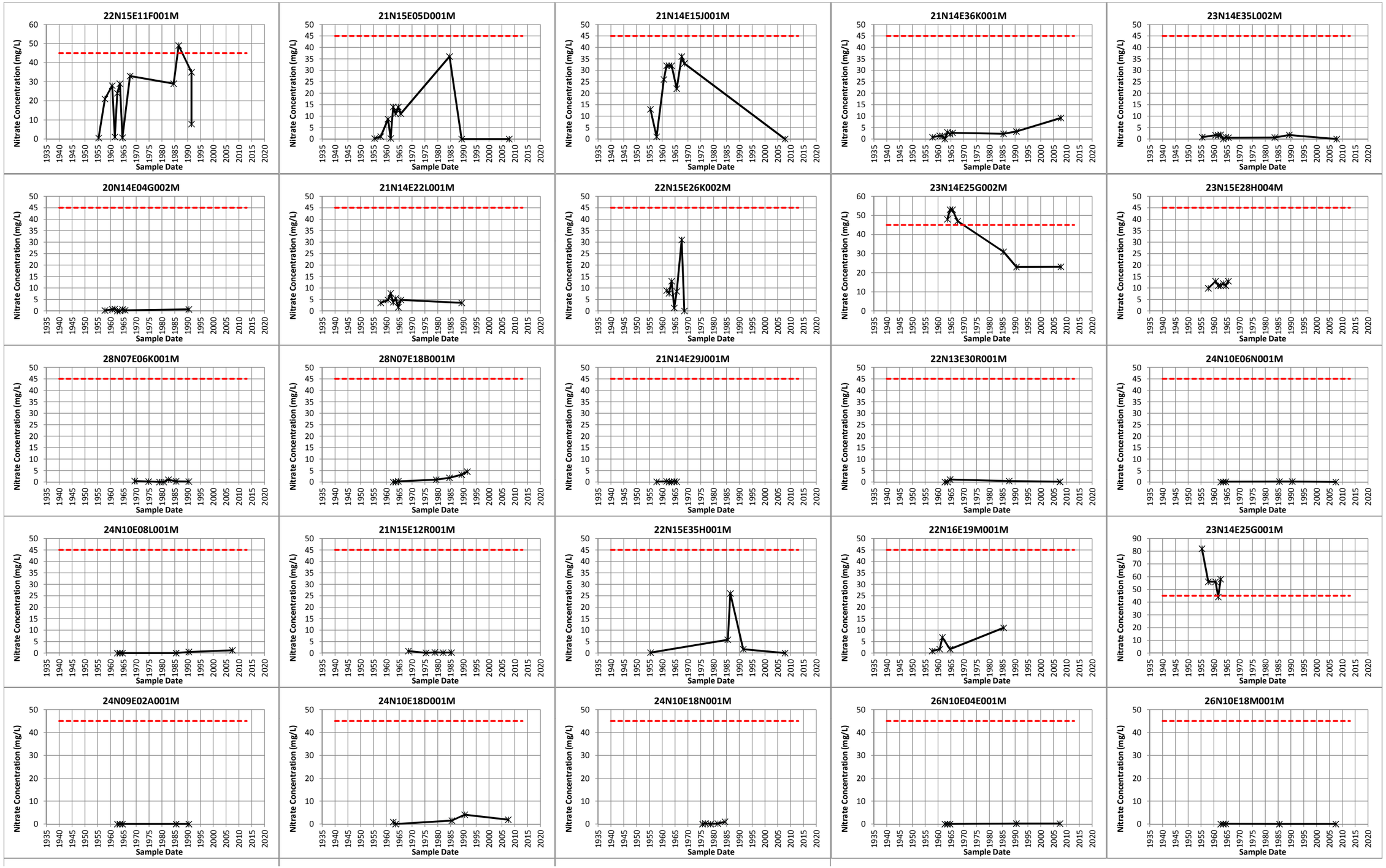
Nitrate as NO3 Concentration Trends

Lake Subwatershed



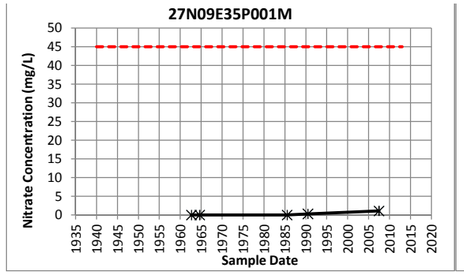
Nitrate as NO3 Concentration Trends

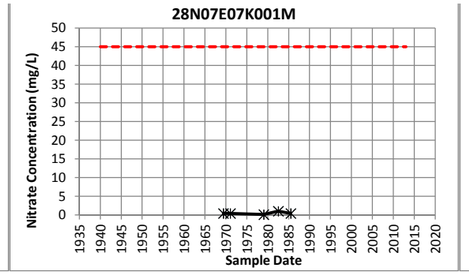
Upper Feather River Subwatershed

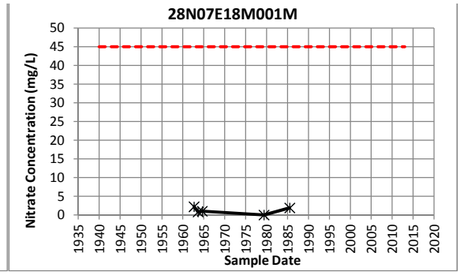


Nitrate as NO3 Concentration Trends

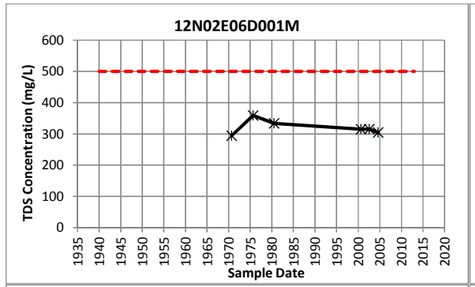
Upper Feather River Subwatershed

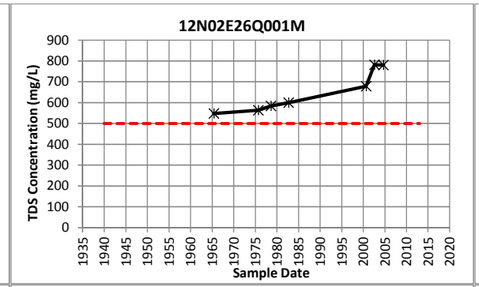


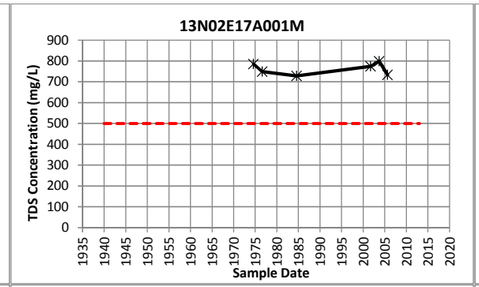


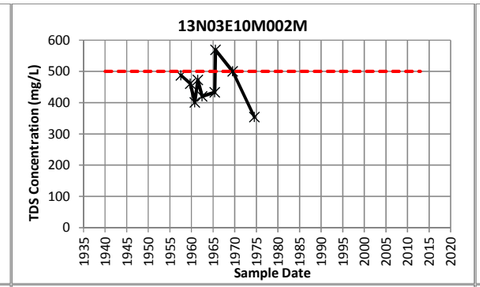


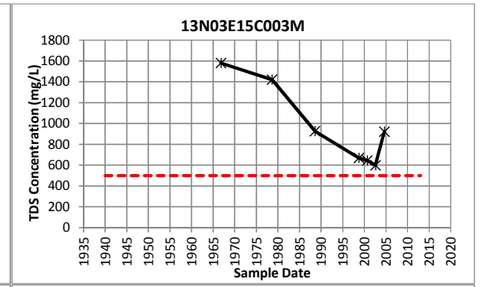
Butte-Yuba-Sutter Subwatershed

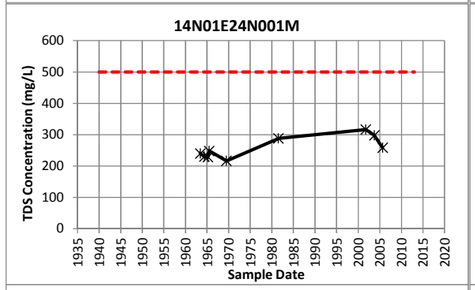


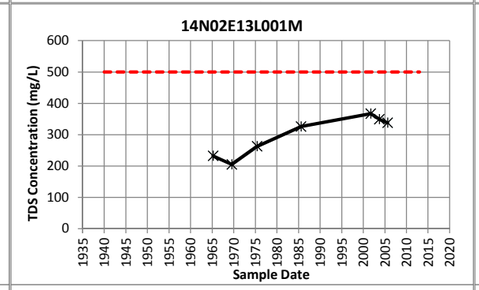


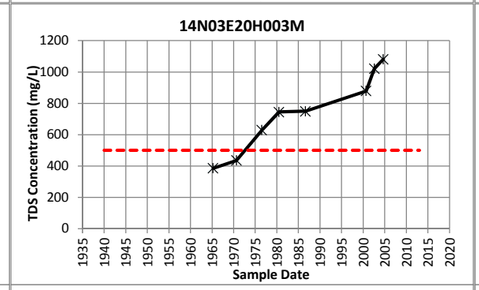


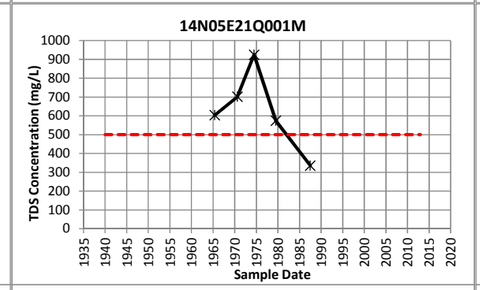


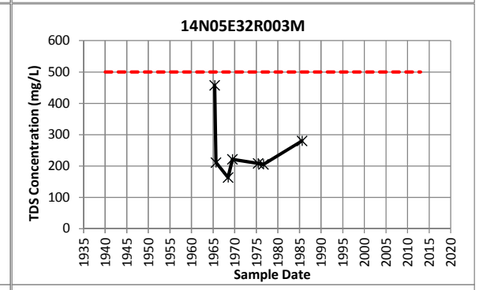


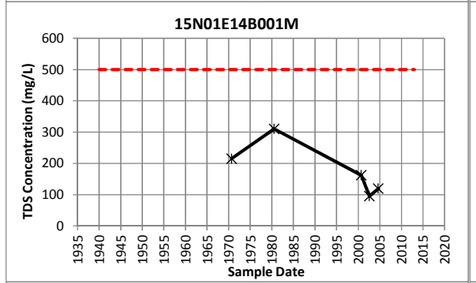


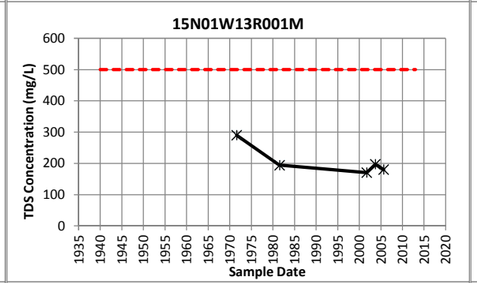


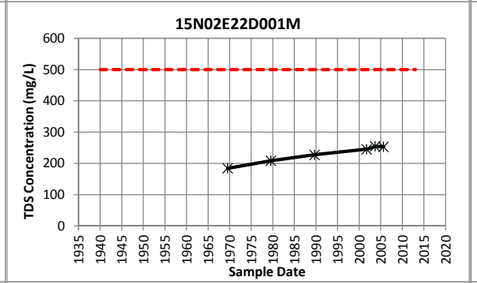


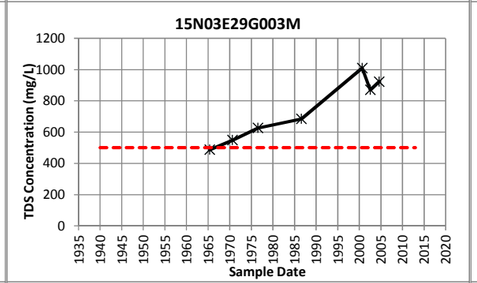


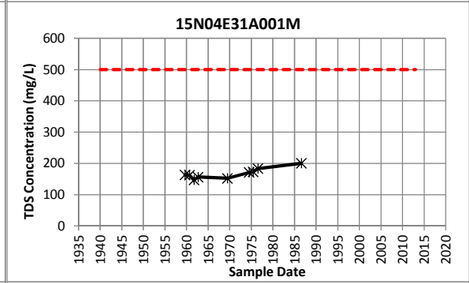


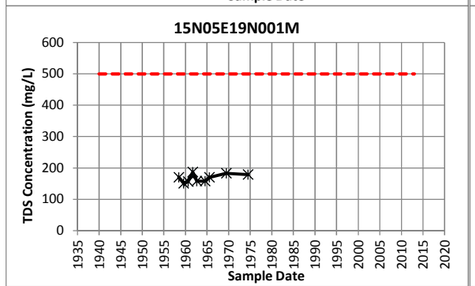


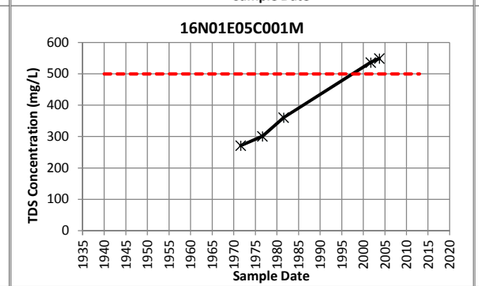


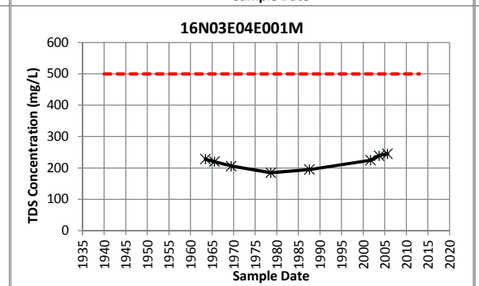


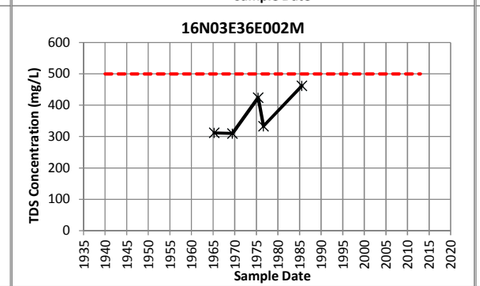


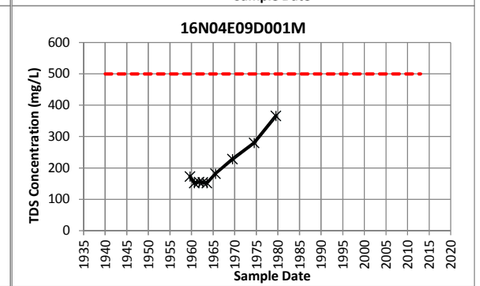


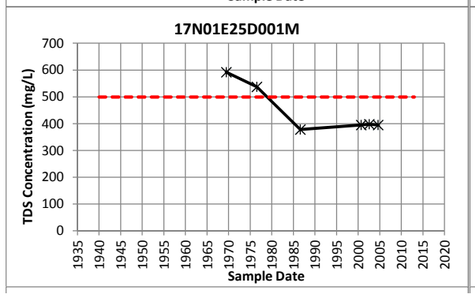


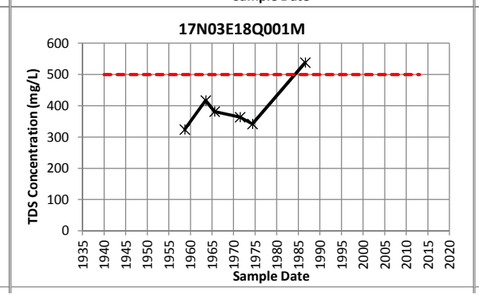


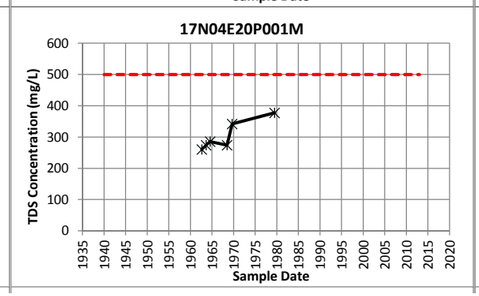


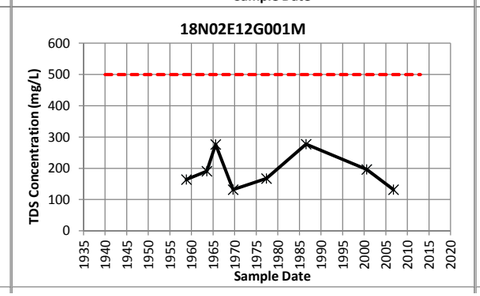


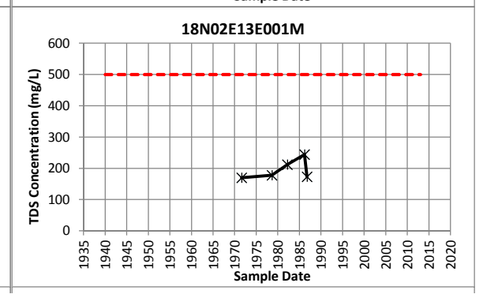




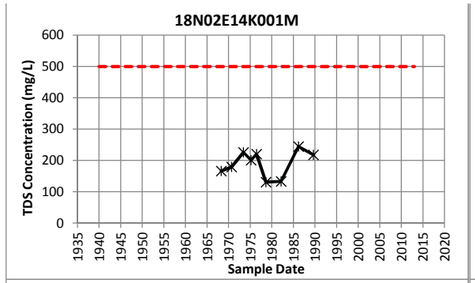


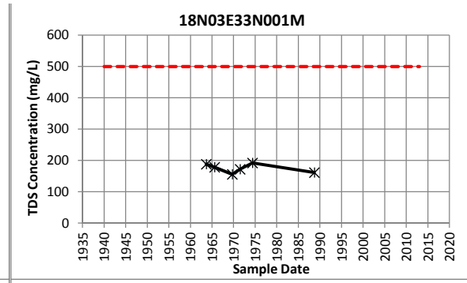


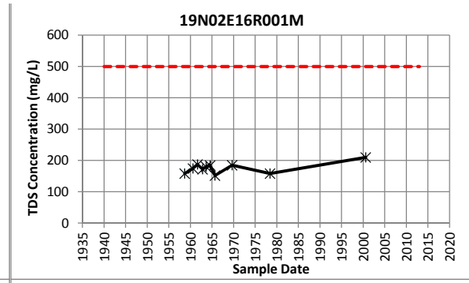


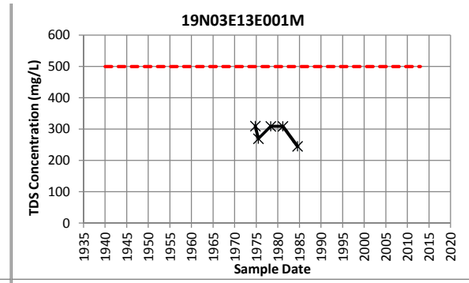


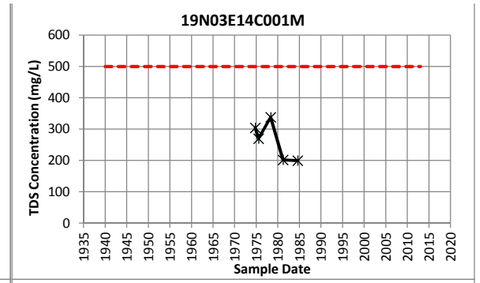
Butte-Yuba-Sutter Subwatershed

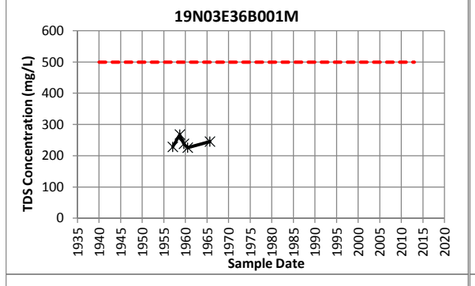


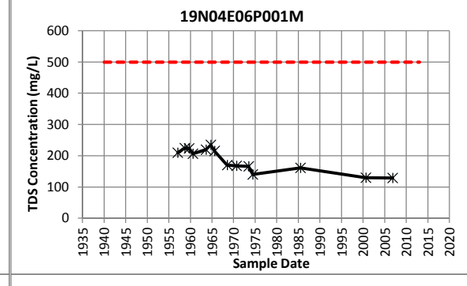


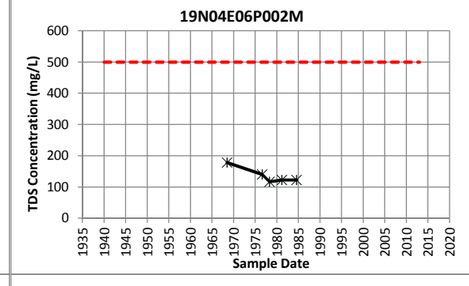


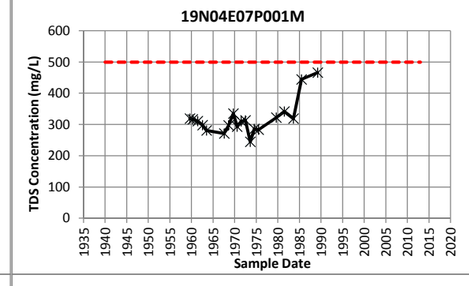


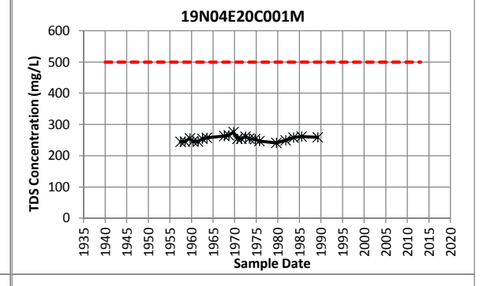


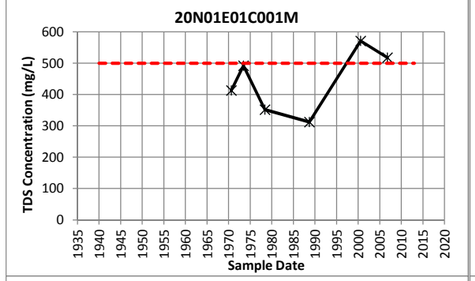


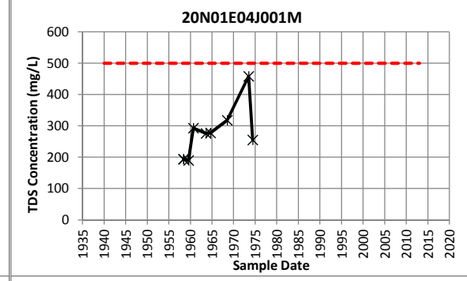


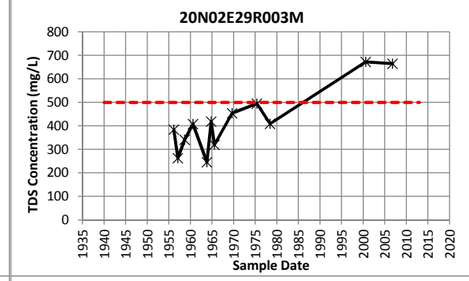


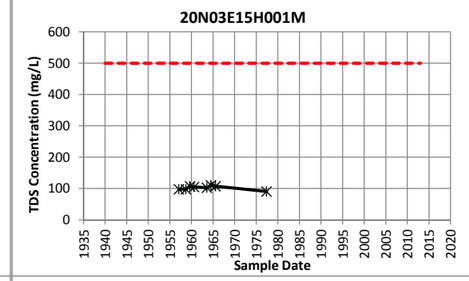


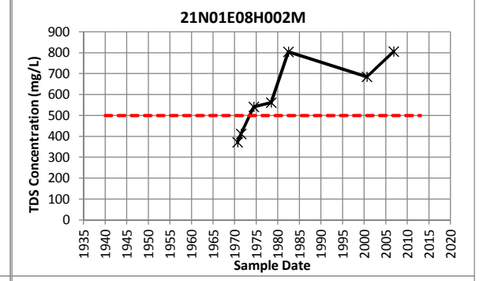


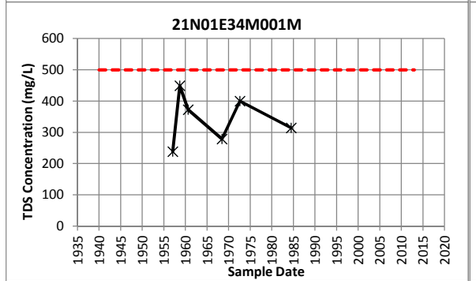


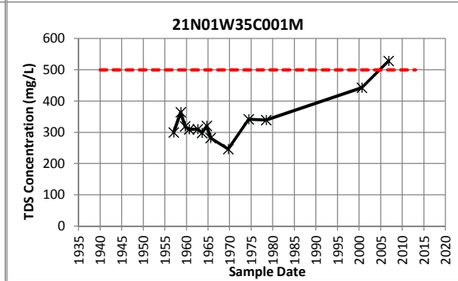


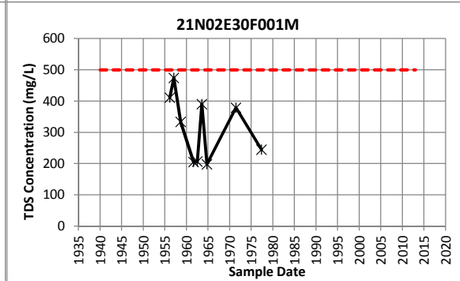


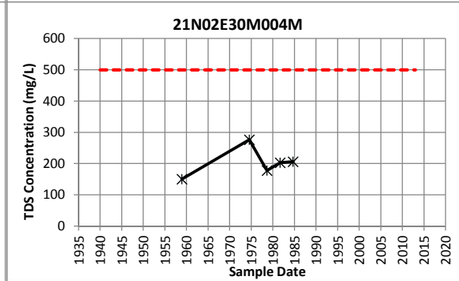


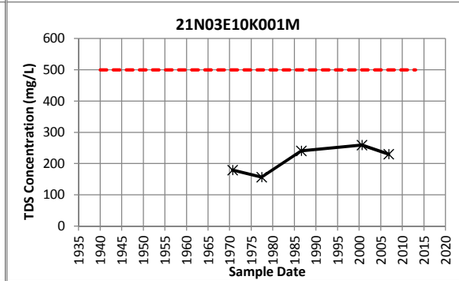


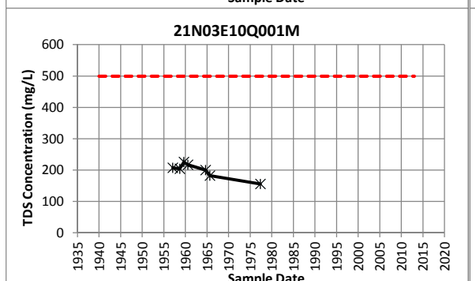


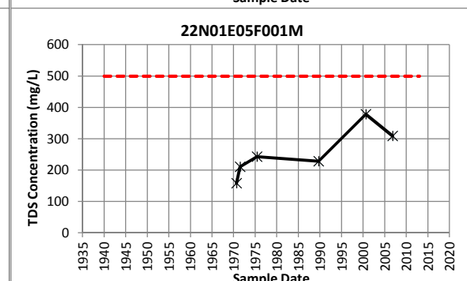


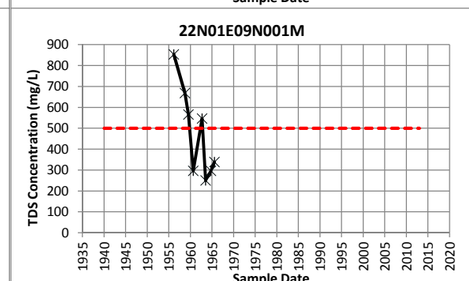


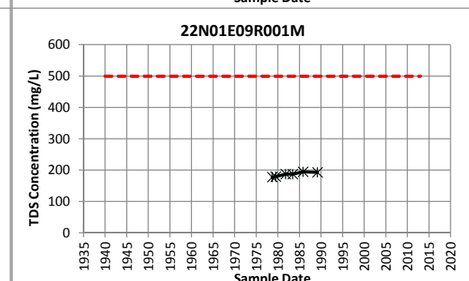


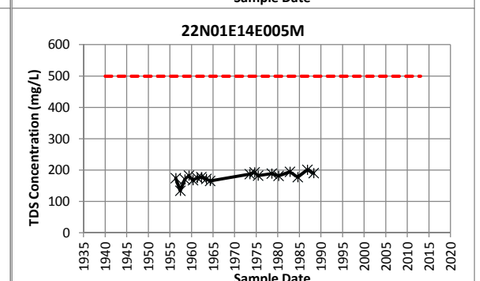












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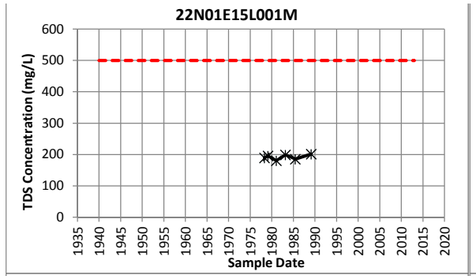

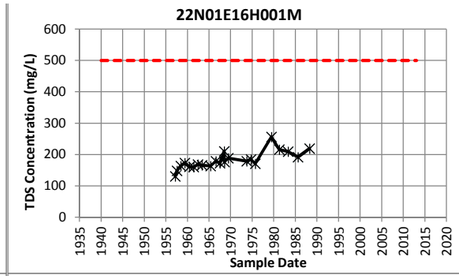

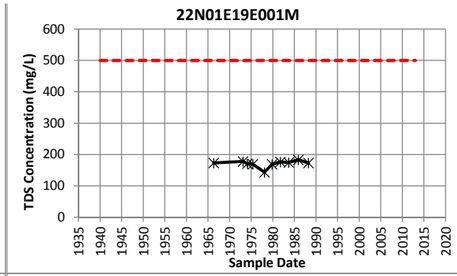

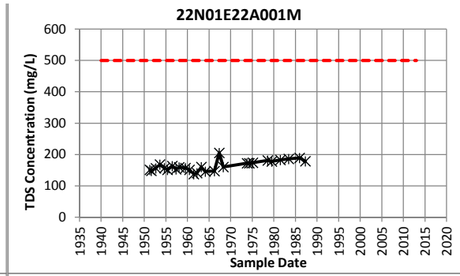

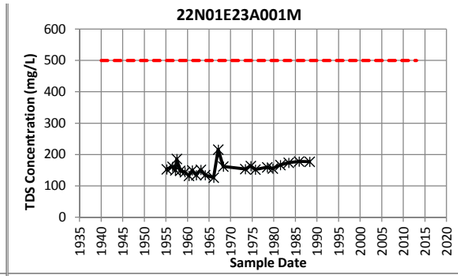

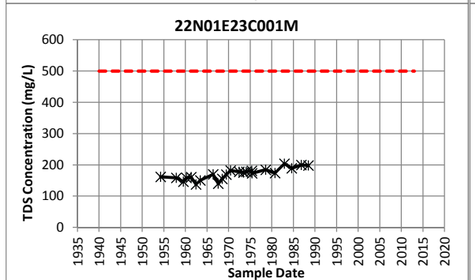

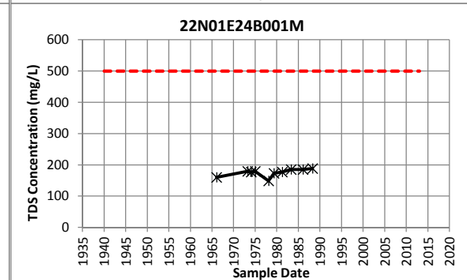

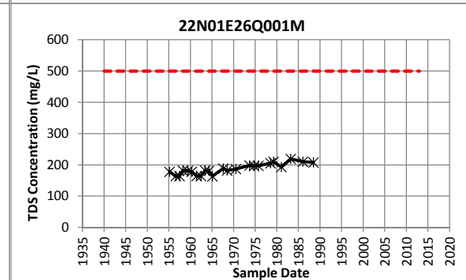

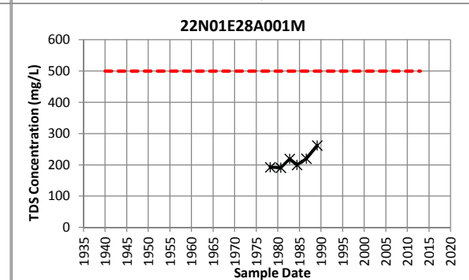

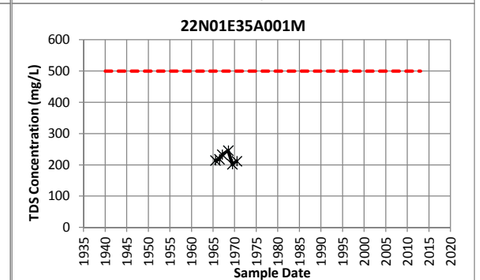

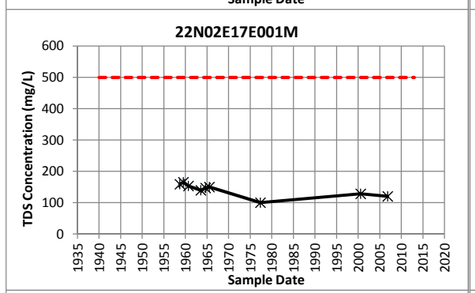

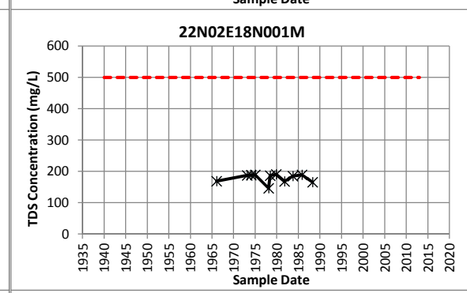

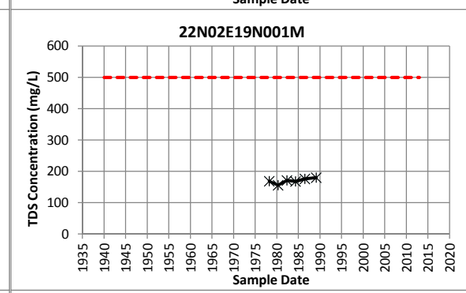

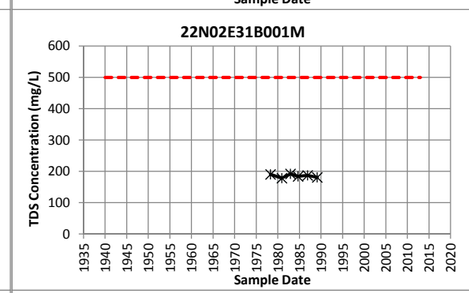

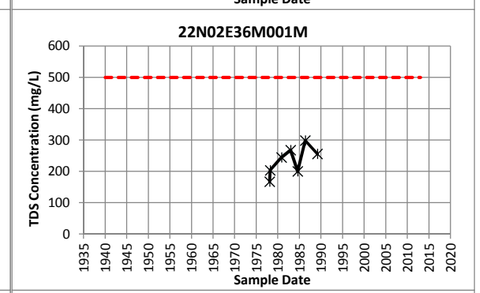

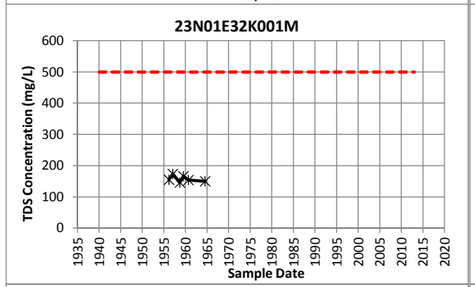

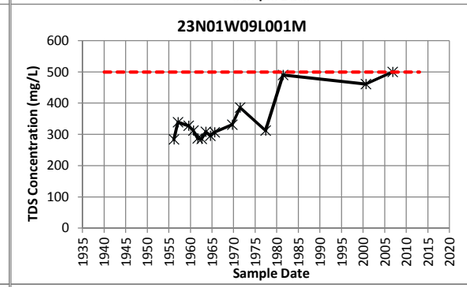

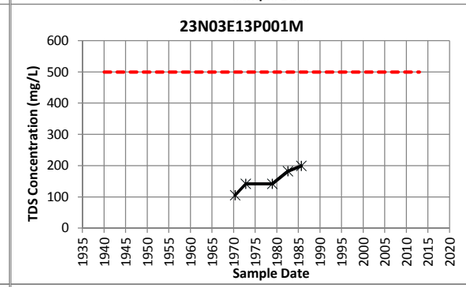

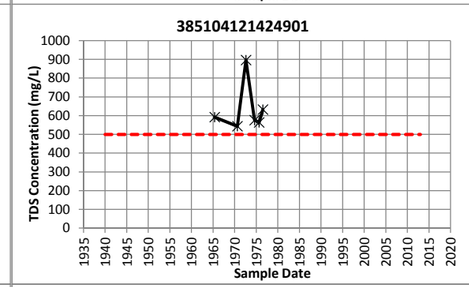

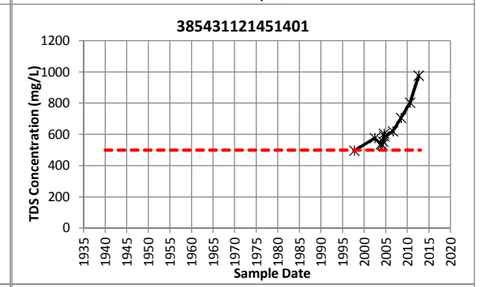

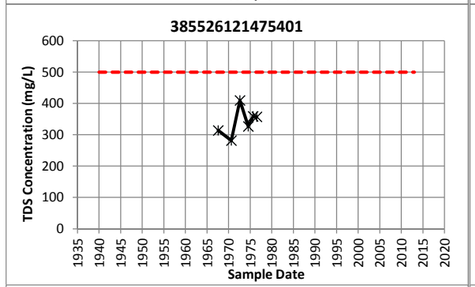

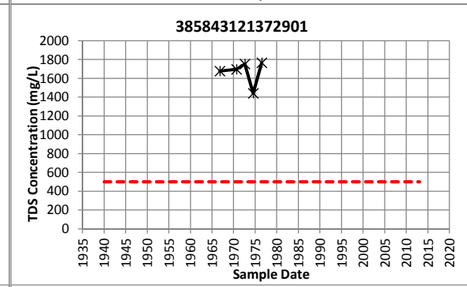

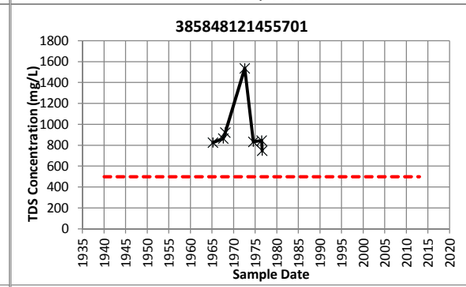

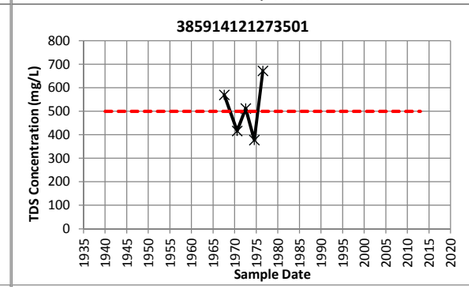

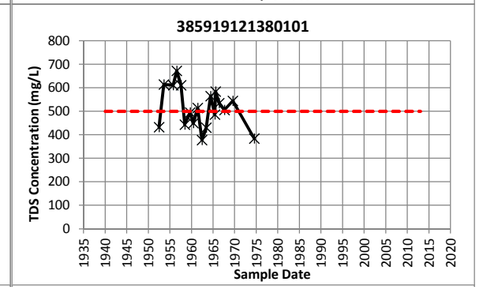

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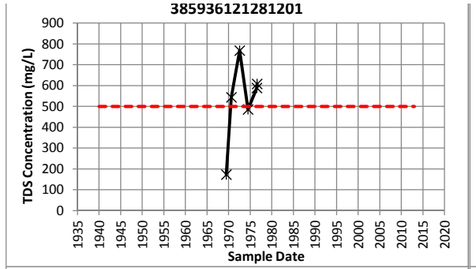
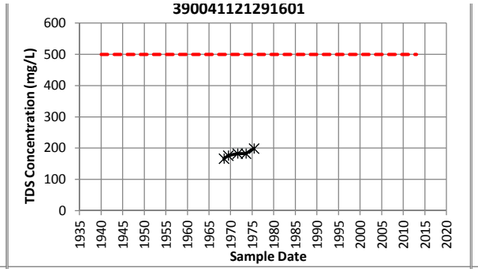
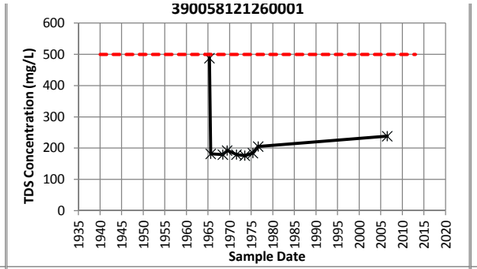
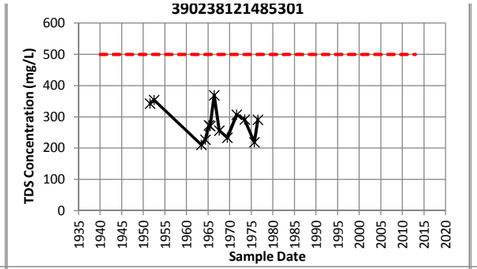
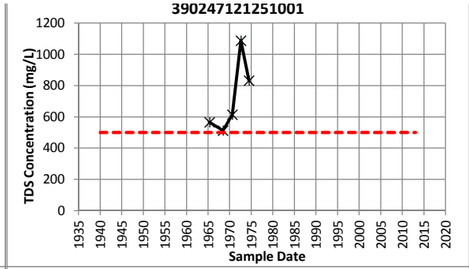
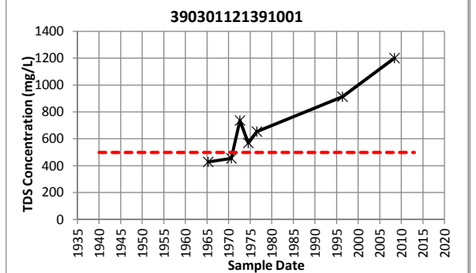


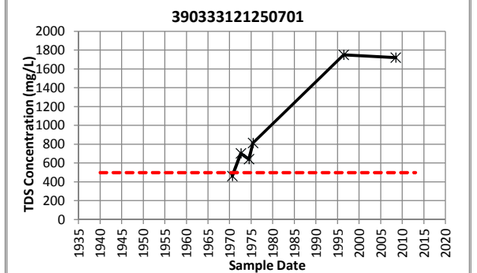


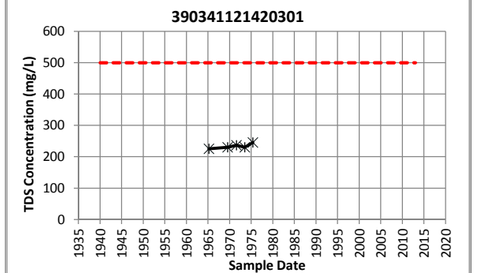


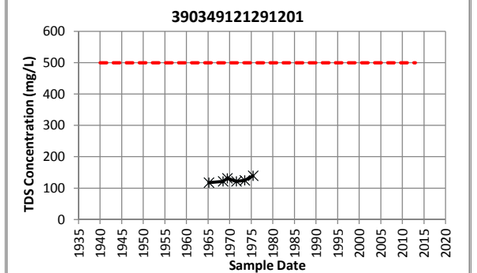


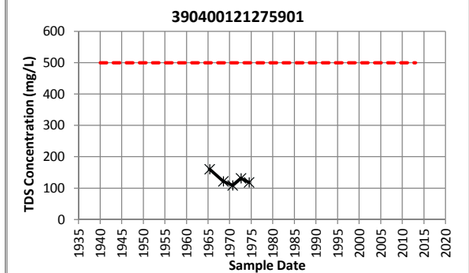


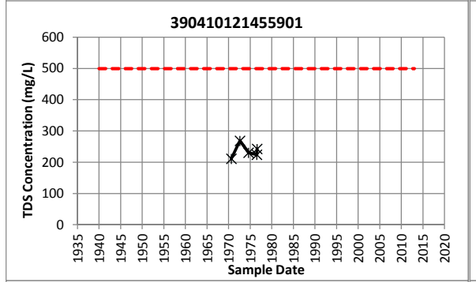


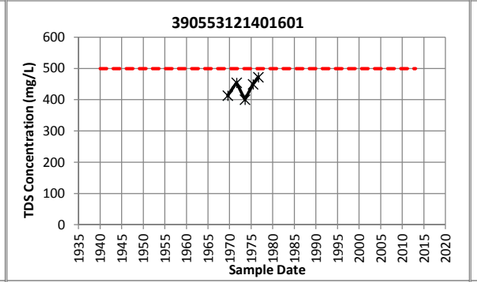


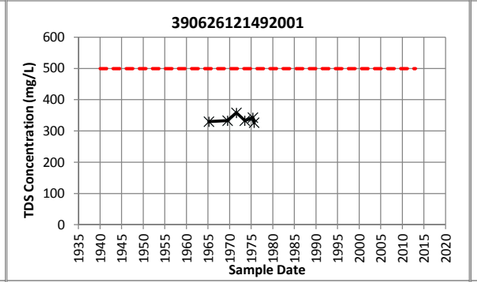


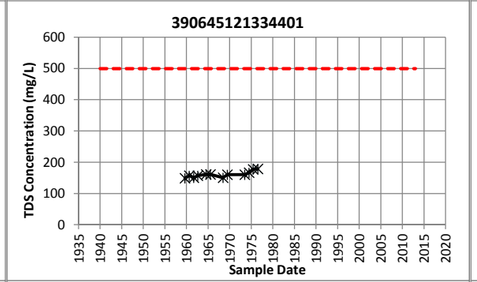


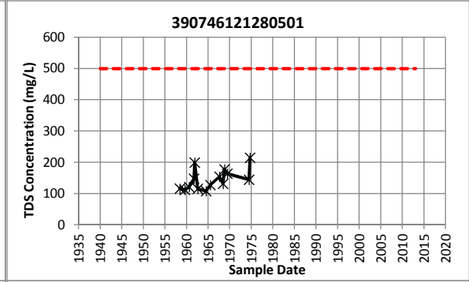


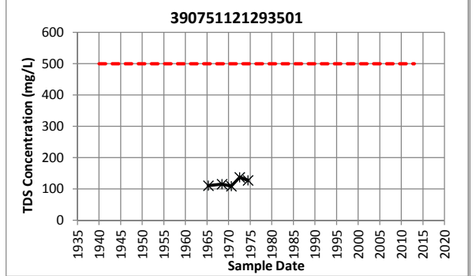


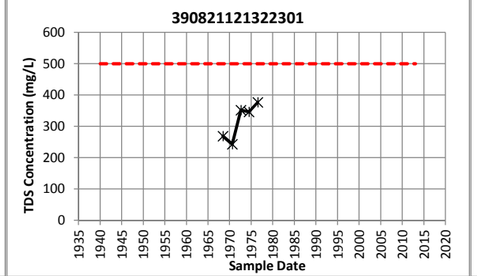


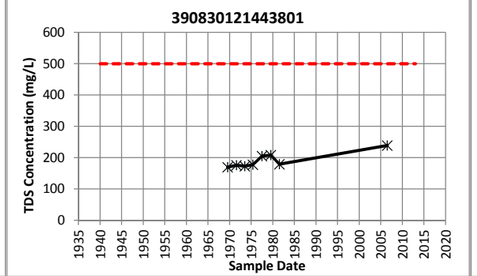


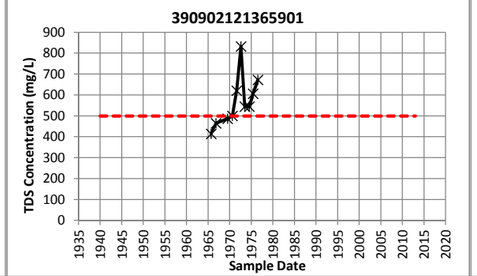


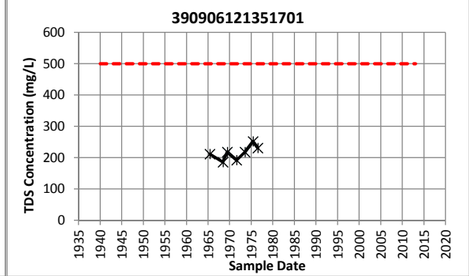


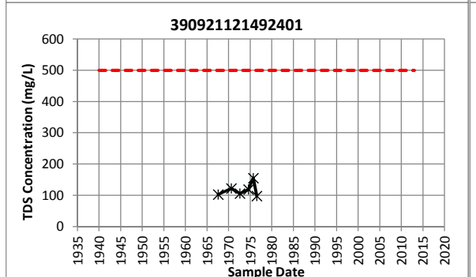


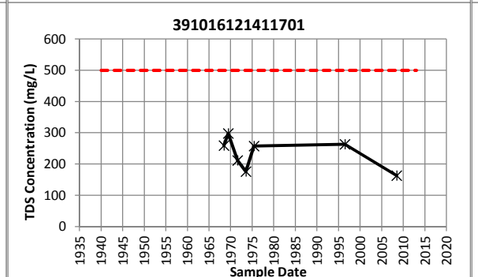


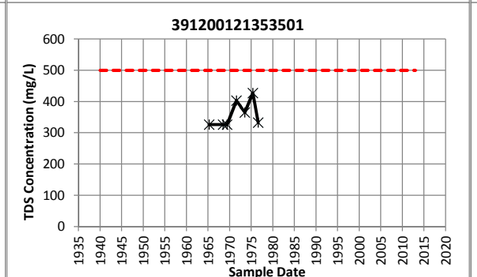


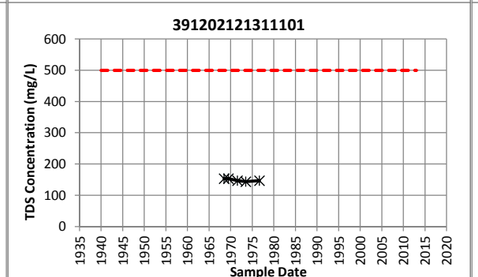


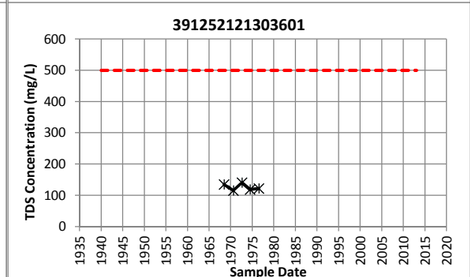


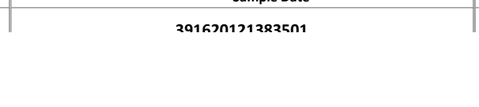


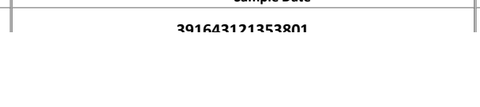


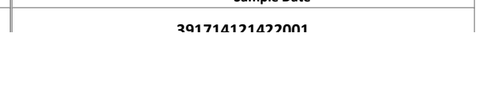




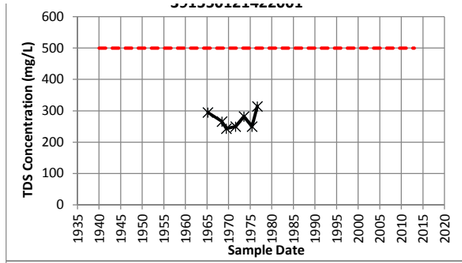


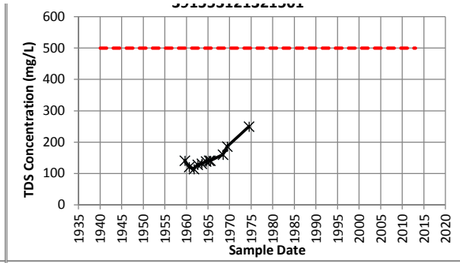


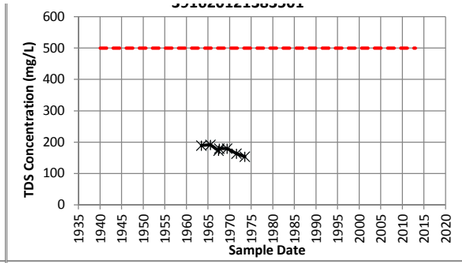


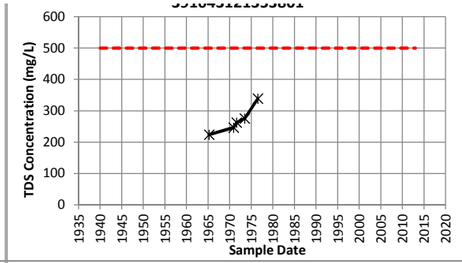


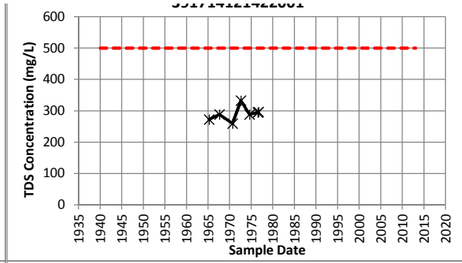
Butte-Yuba-Sutter Subwatershed

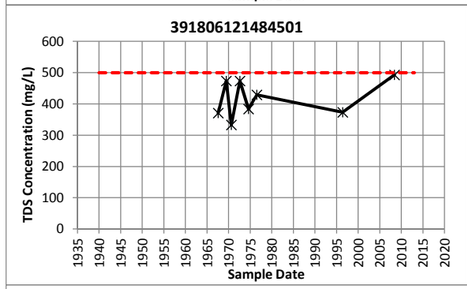


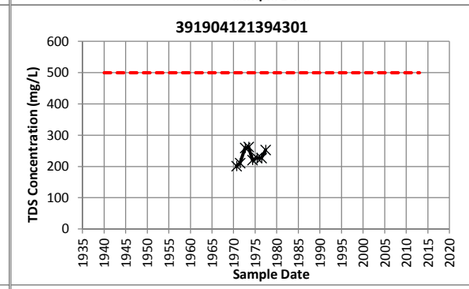


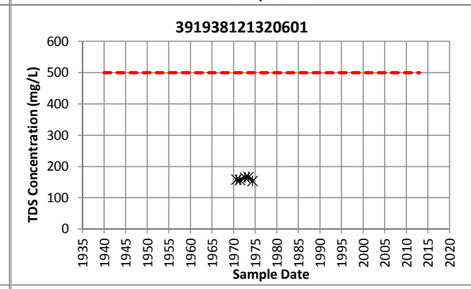


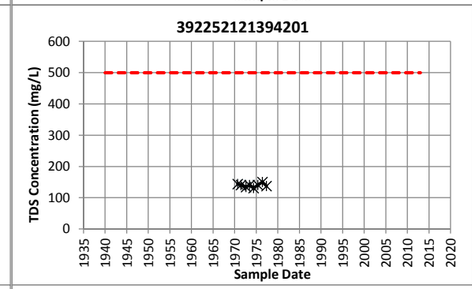


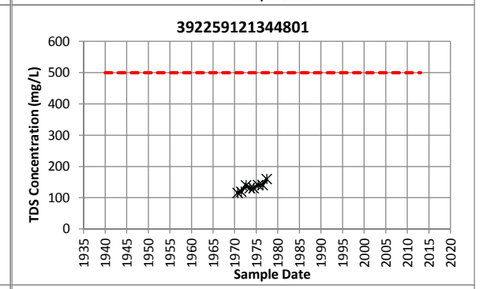


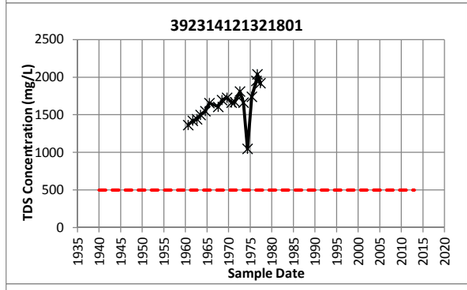


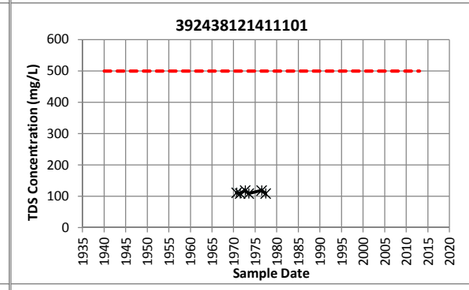


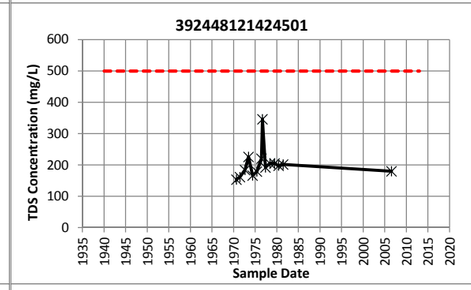


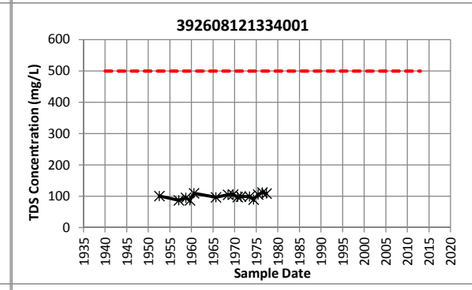


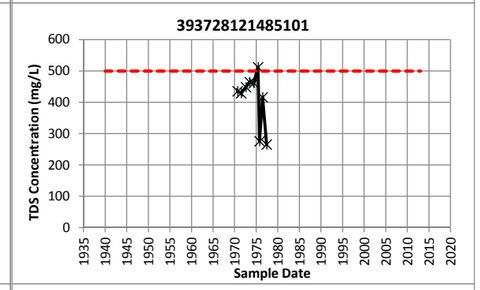


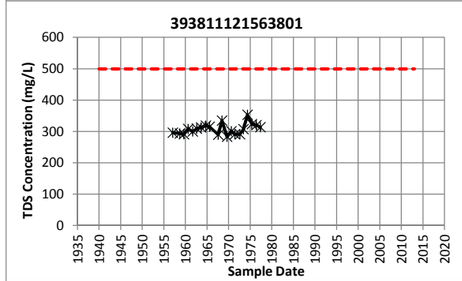


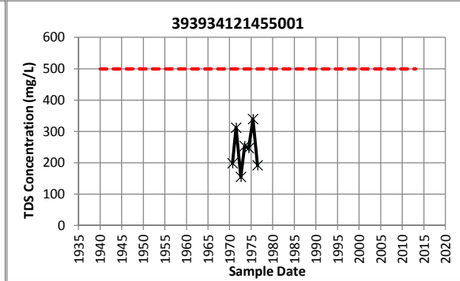


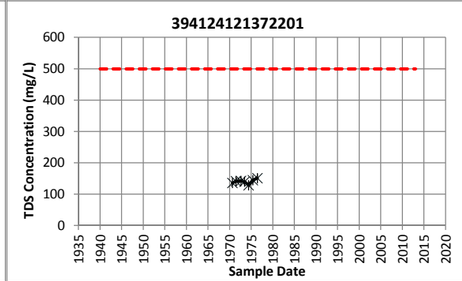


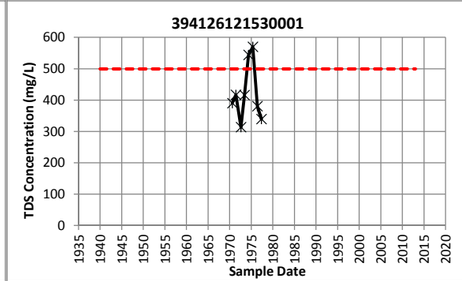


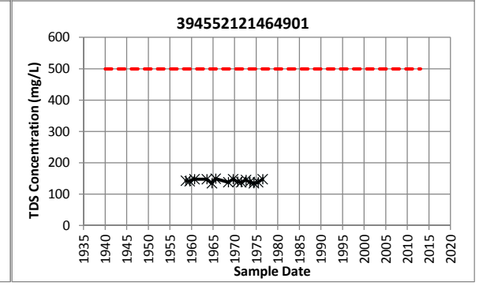


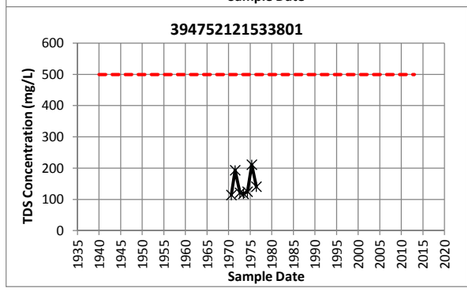


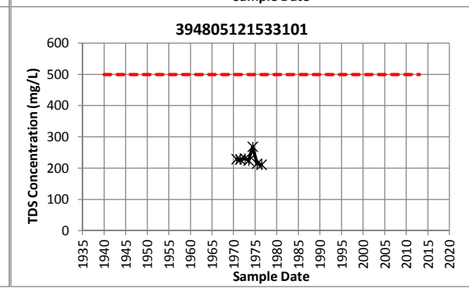


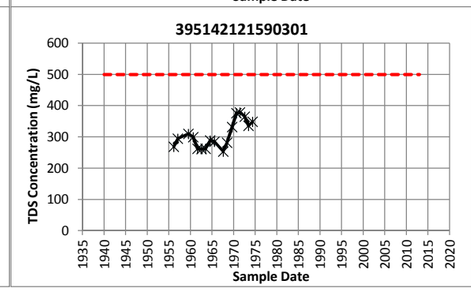






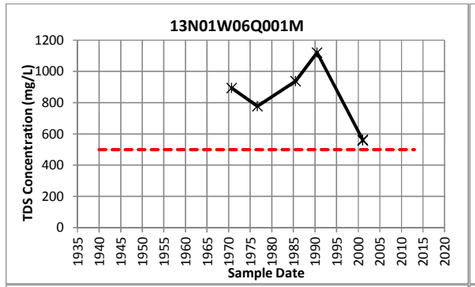


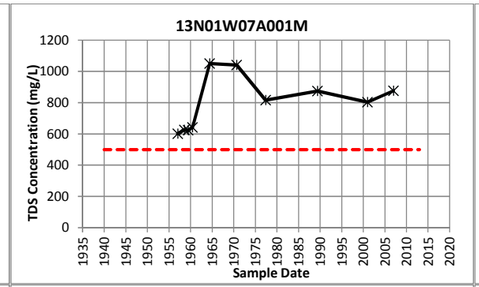


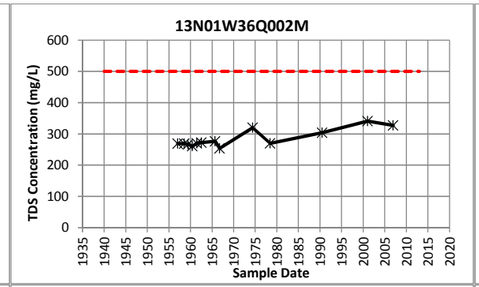


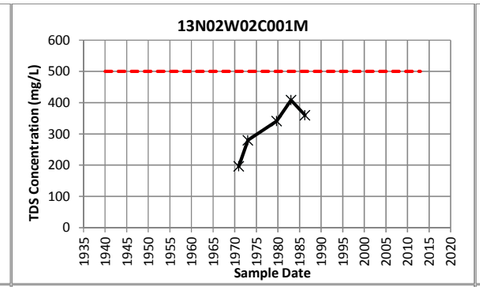
TDS Concentration Trends

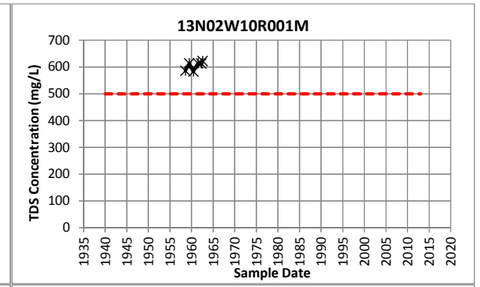
Colusa Glenn Subwatershed

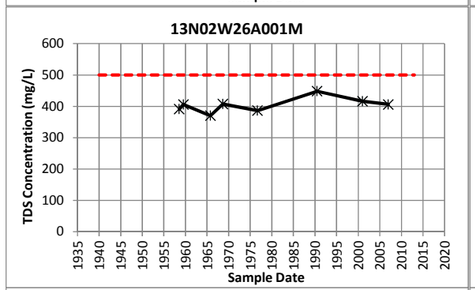


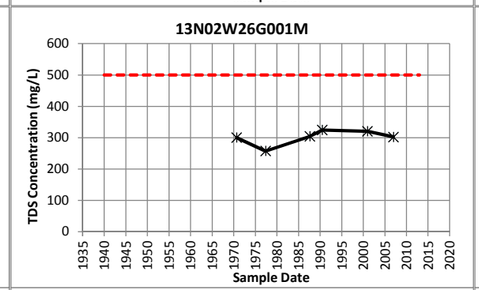


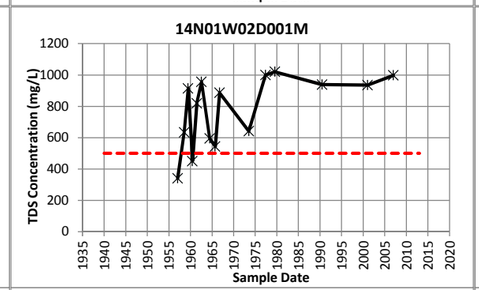


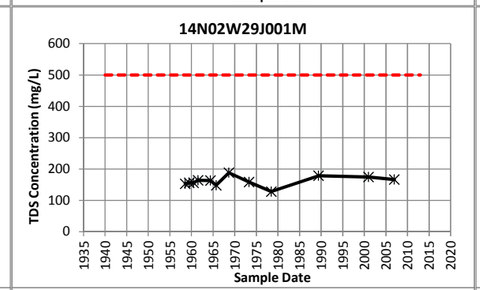


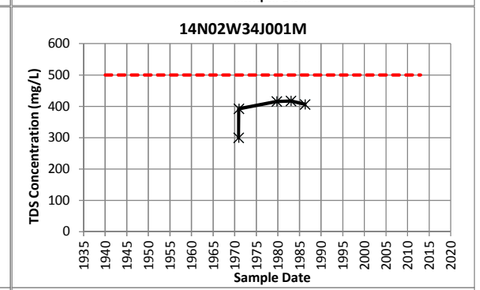


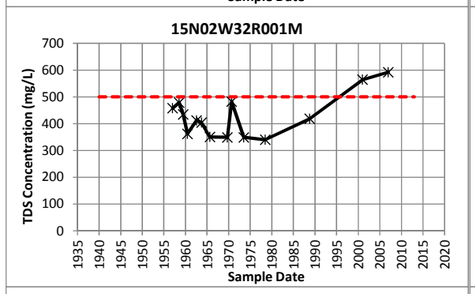


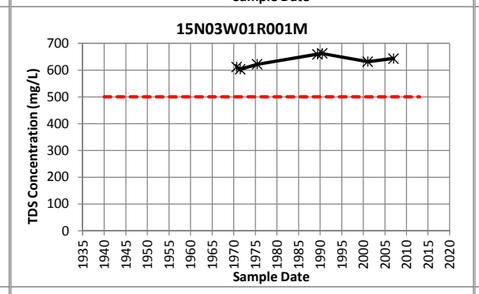


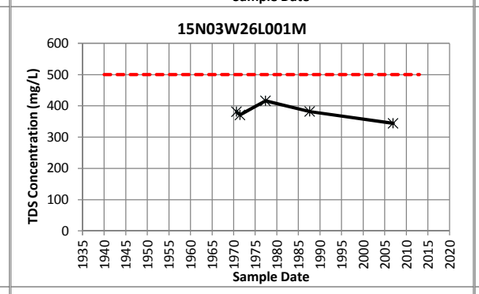


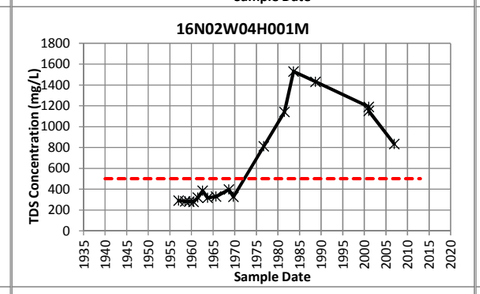


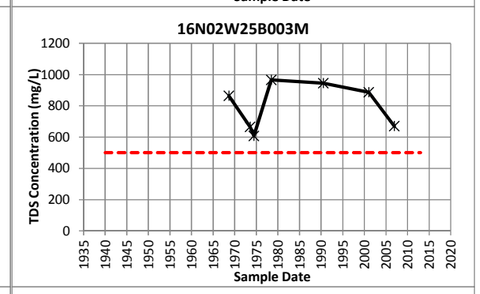


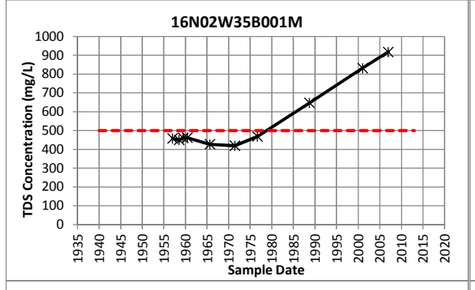


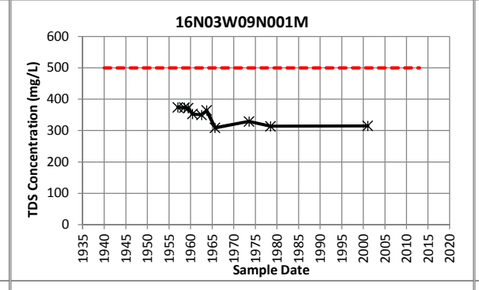


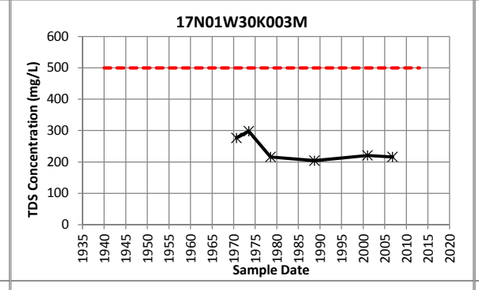


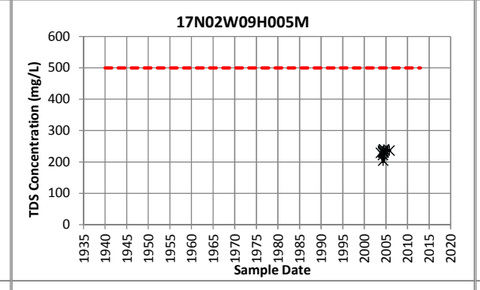


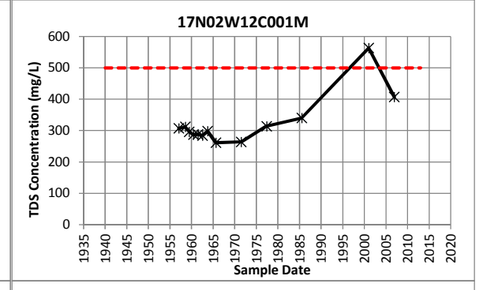


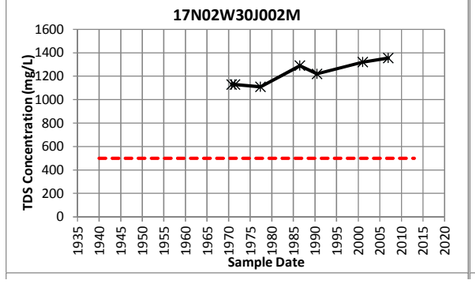


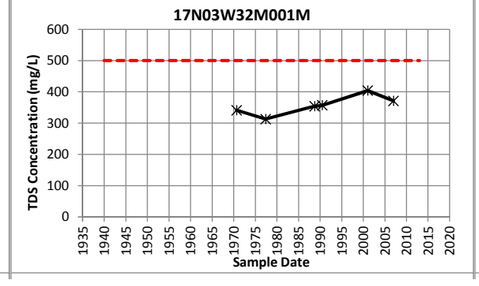


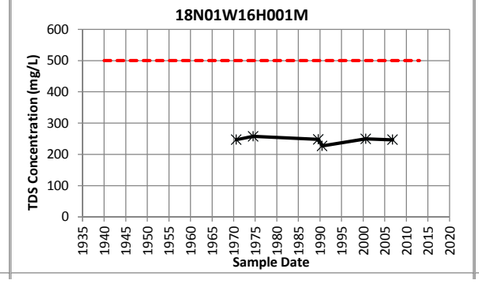


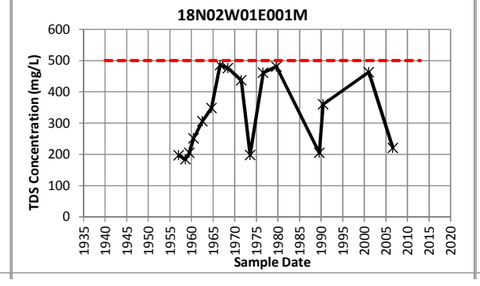


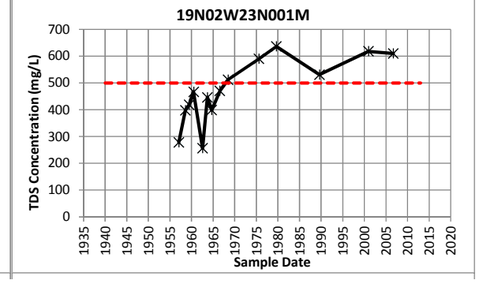




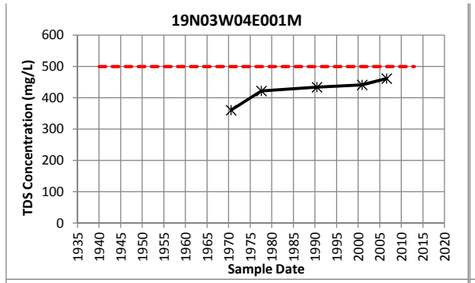


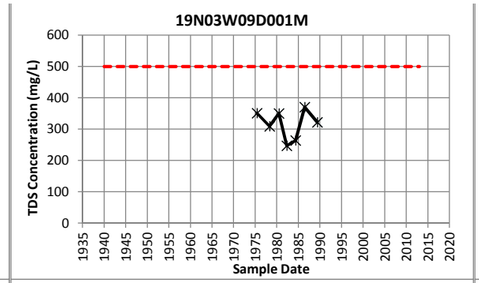


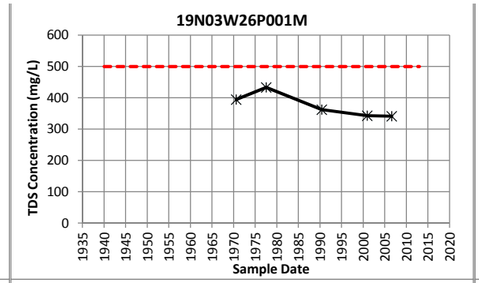


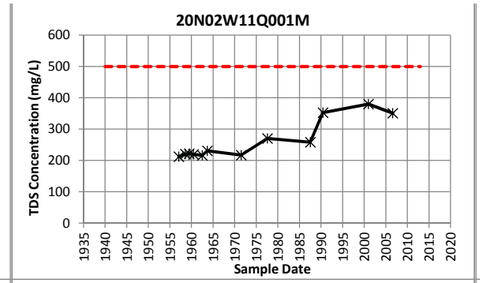


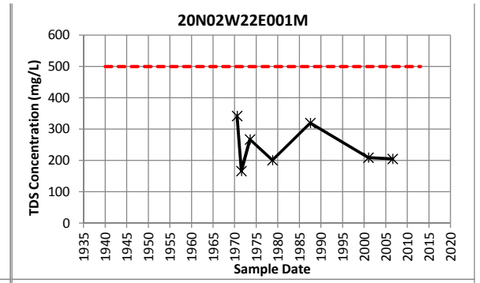
Colusa Glenn Subwatershed

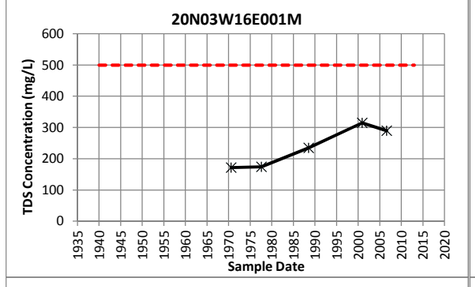


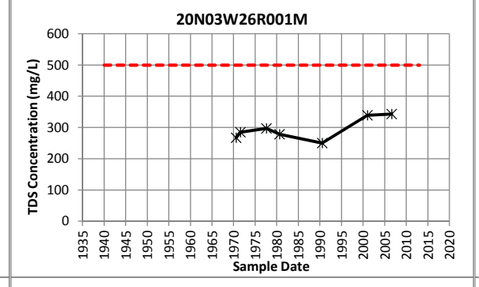


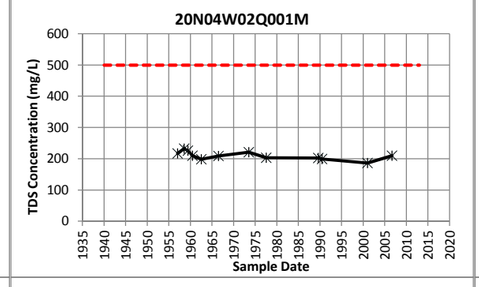


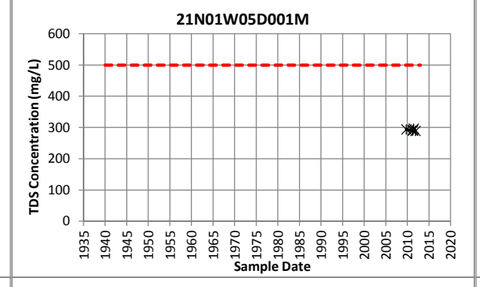


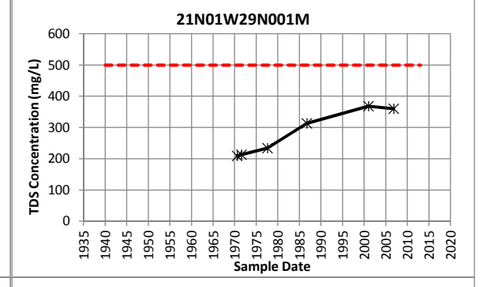


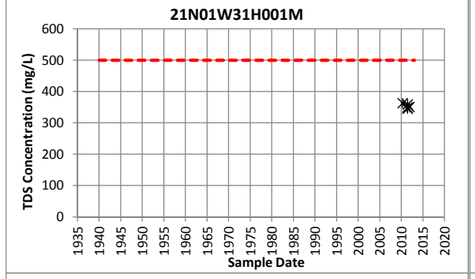


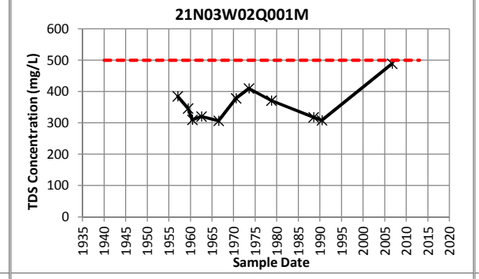


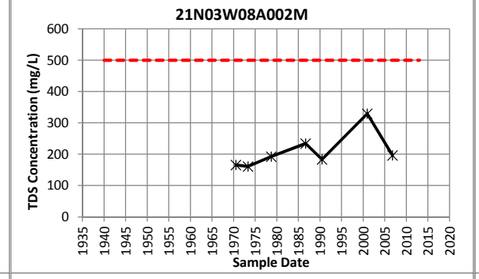


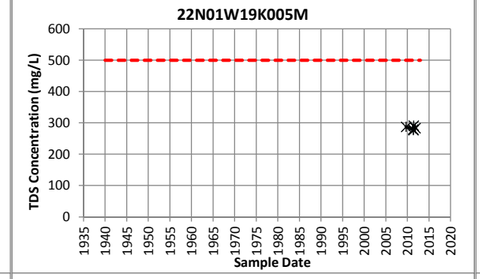


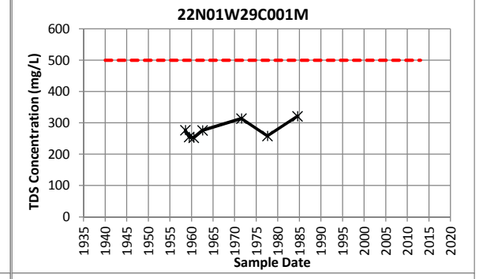


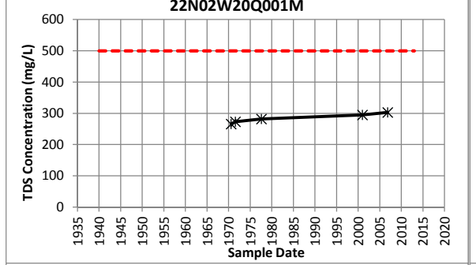


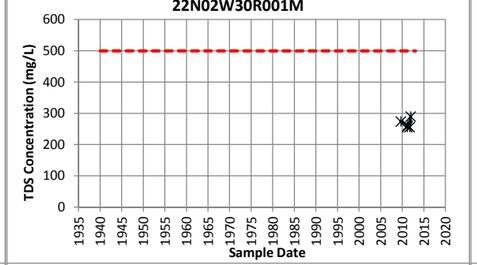


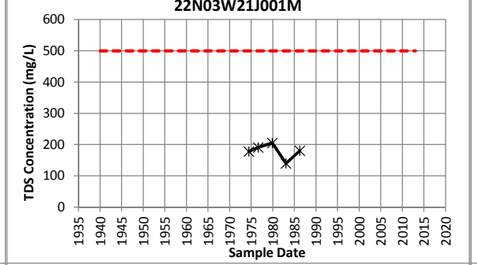


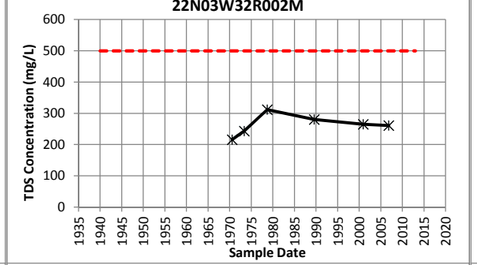


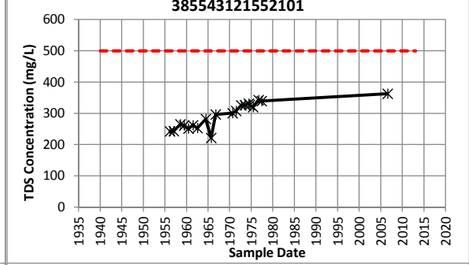


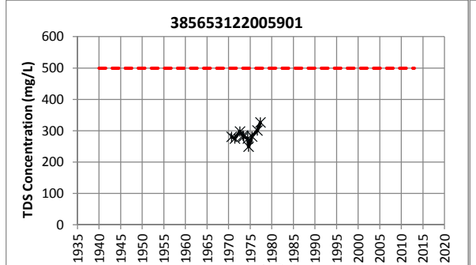


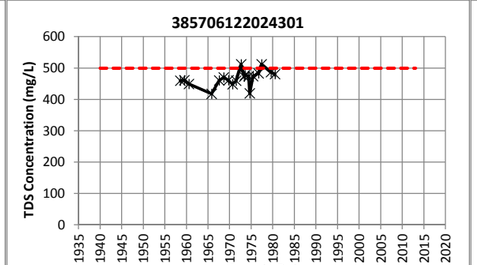


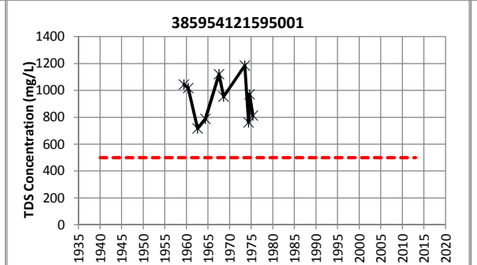


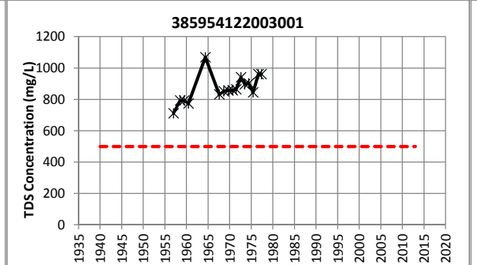


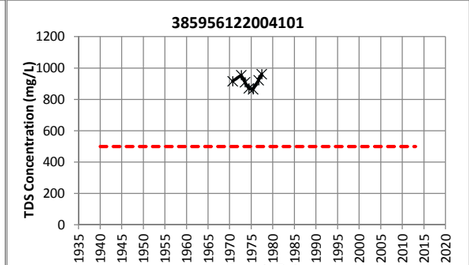












TDS Concentration Trends

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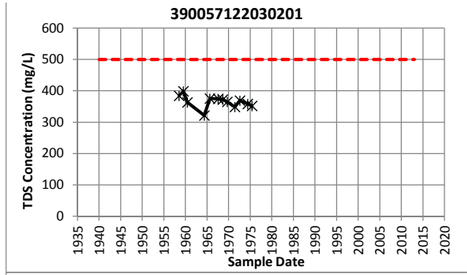

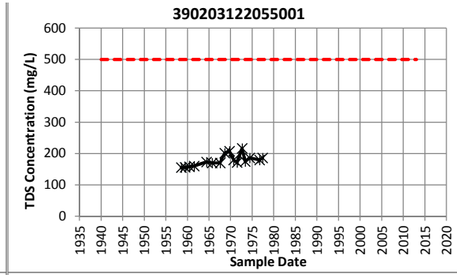

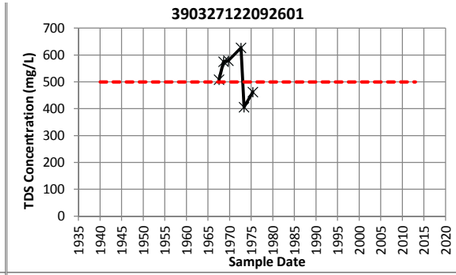

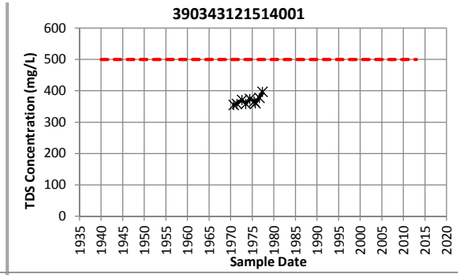

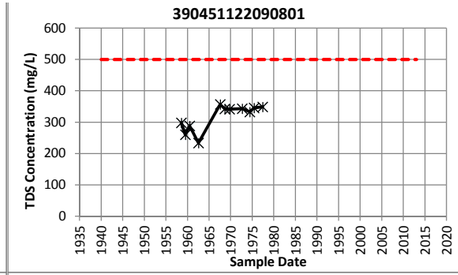

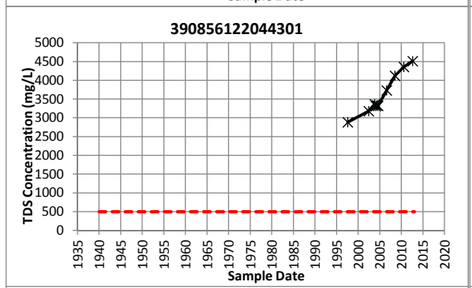

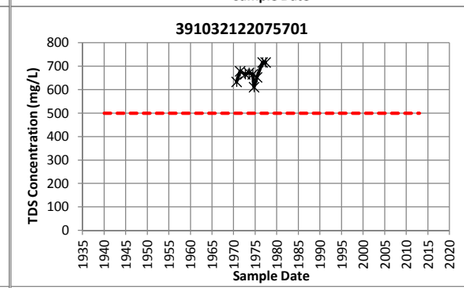

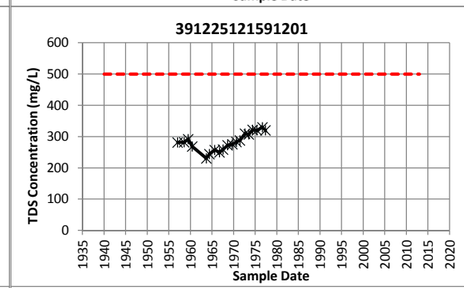

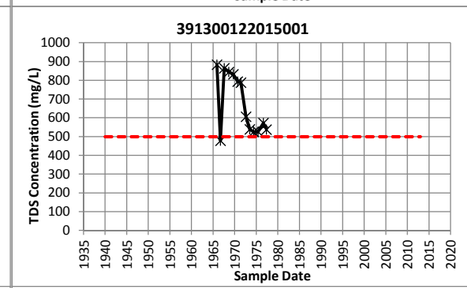

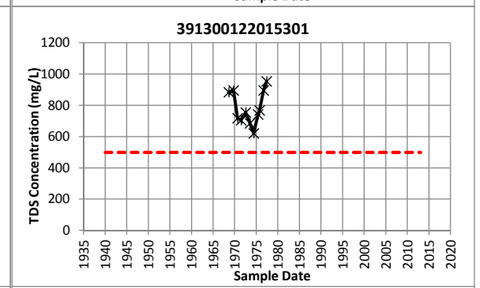

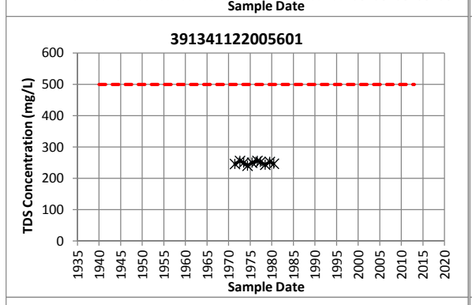

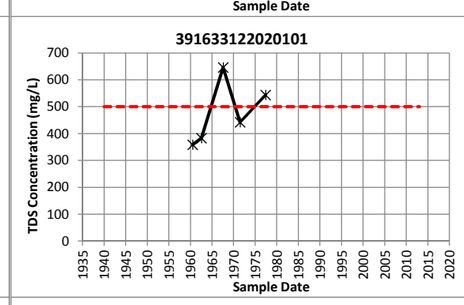

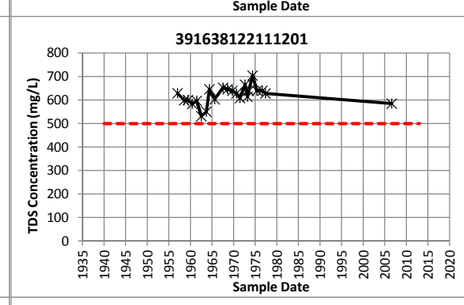

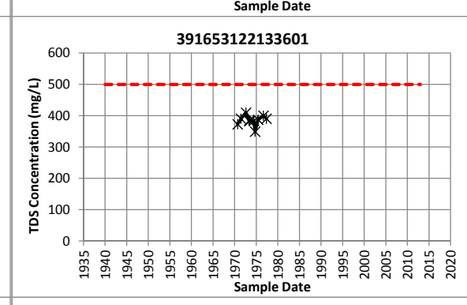

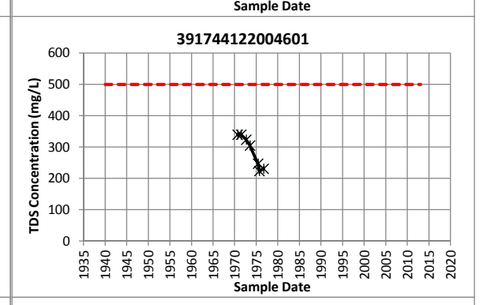

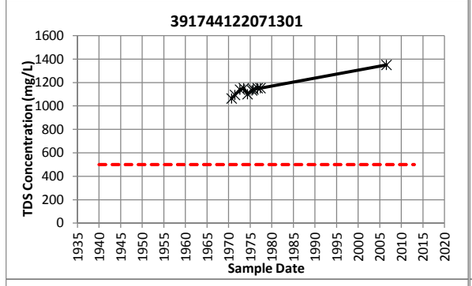

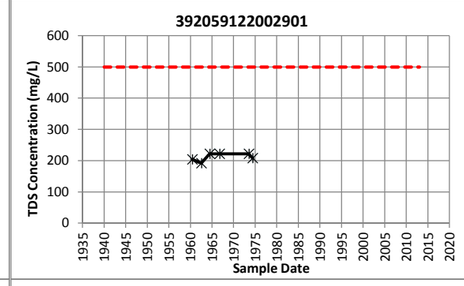

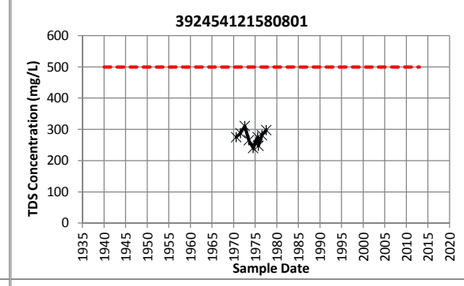

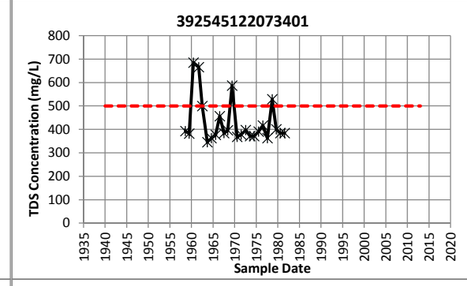

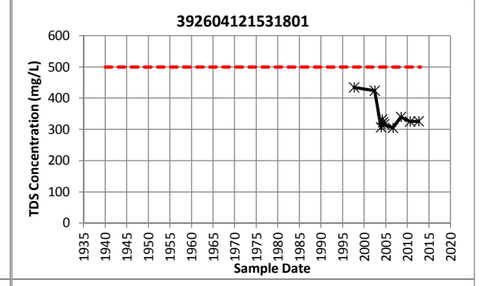

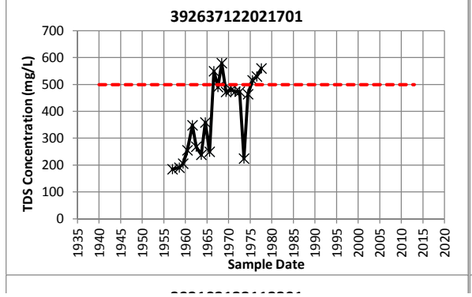

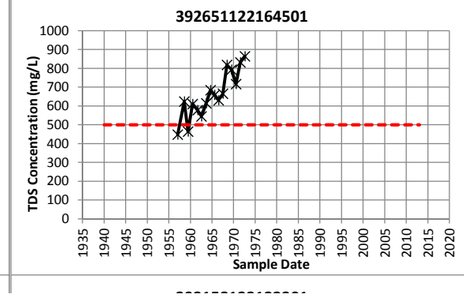

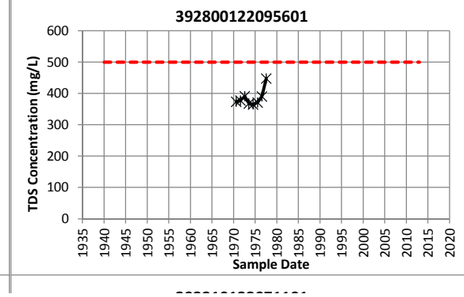

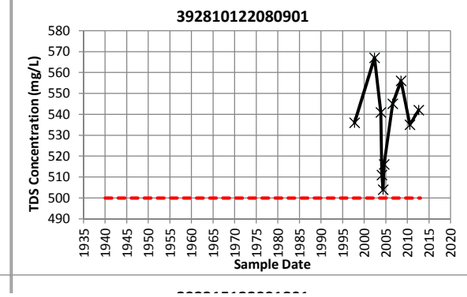

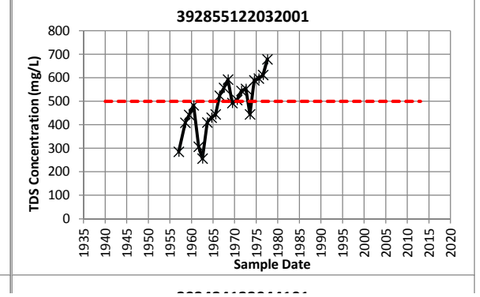

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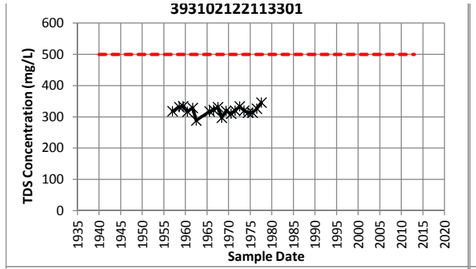
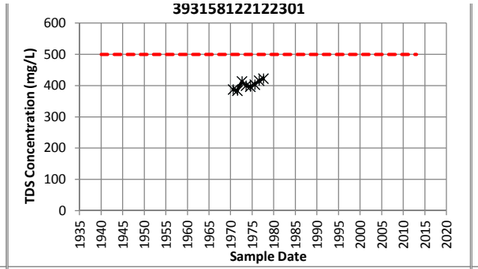
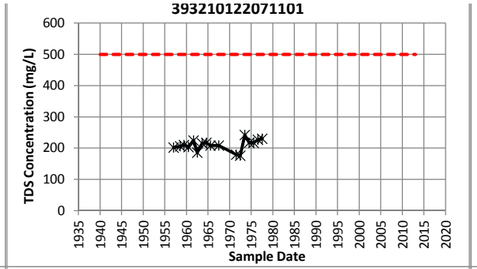
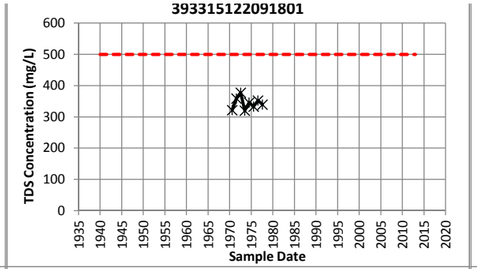
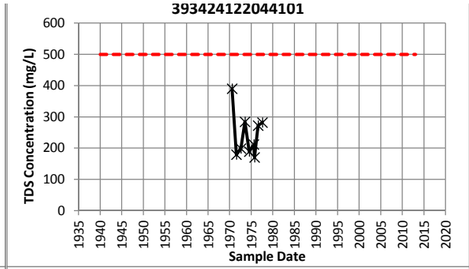
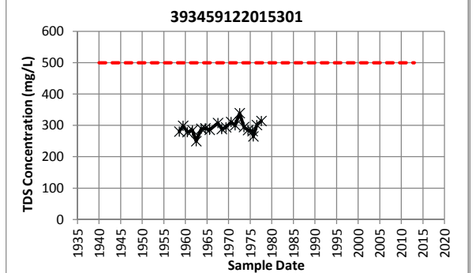


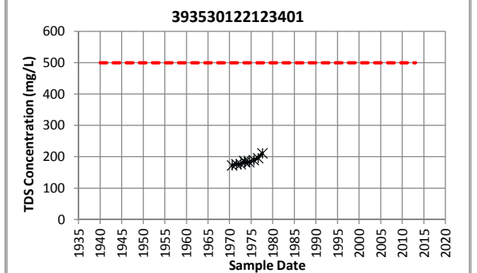


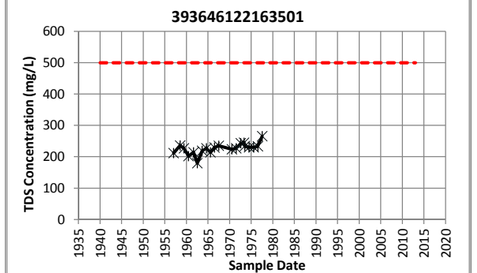


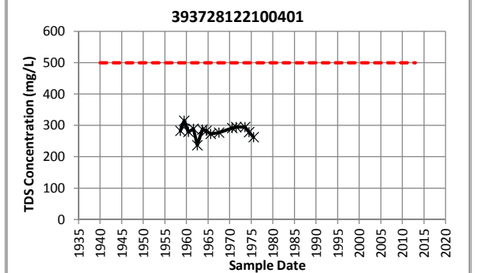


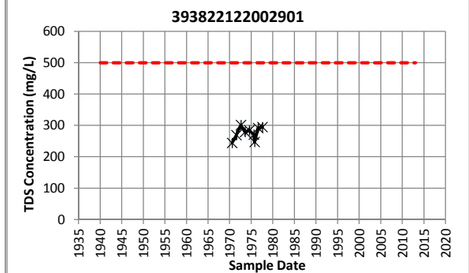


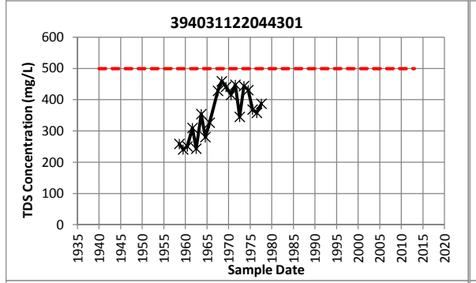


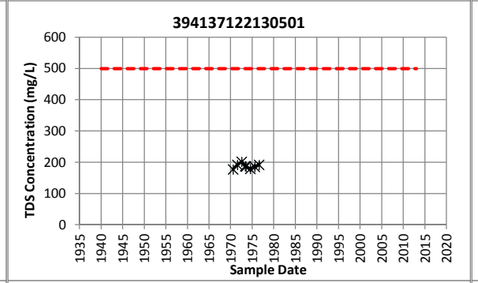


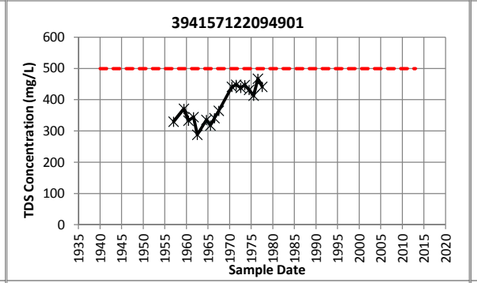


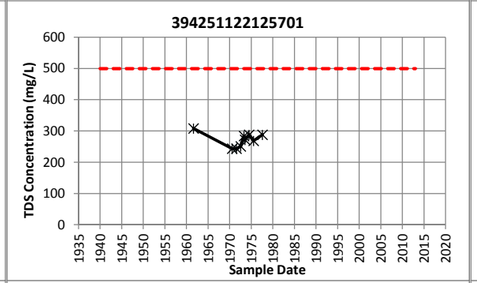


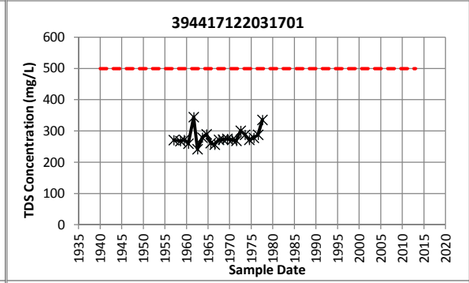


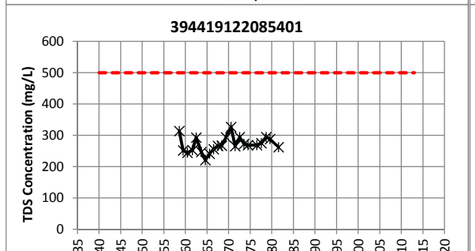


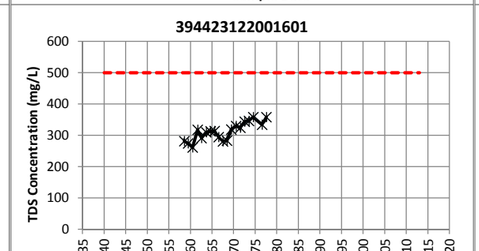


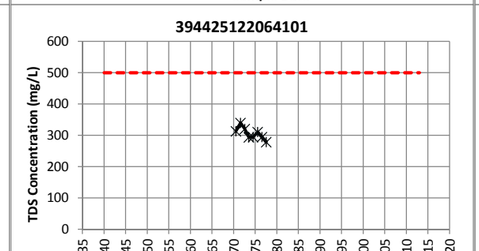


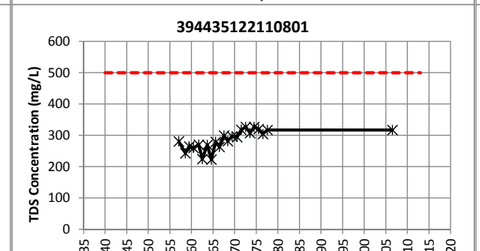


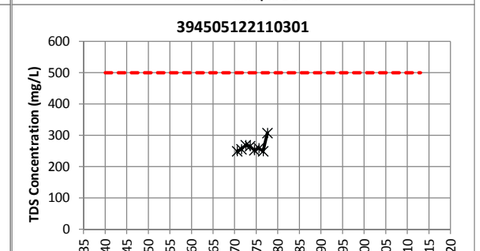


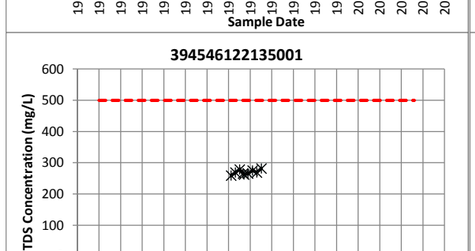


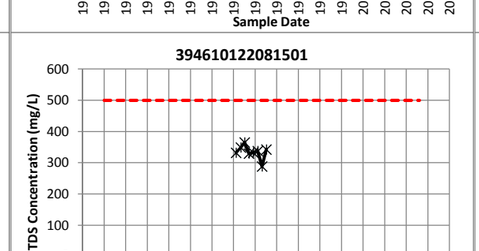


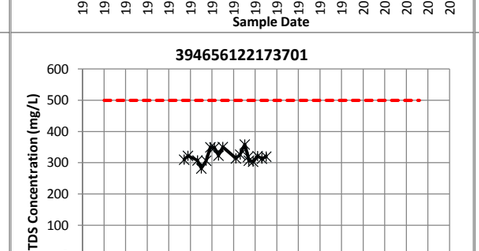


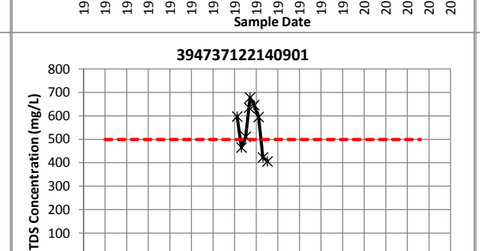


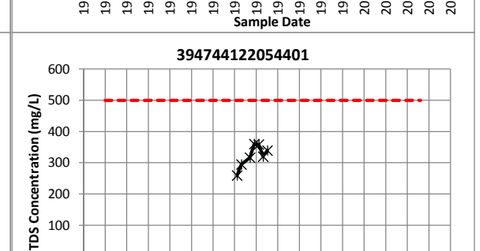


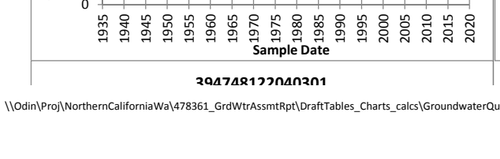






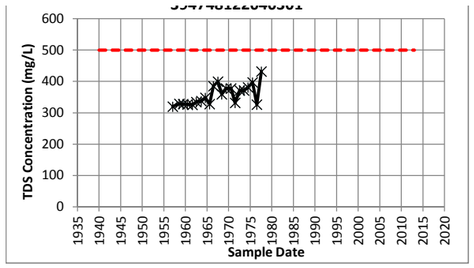




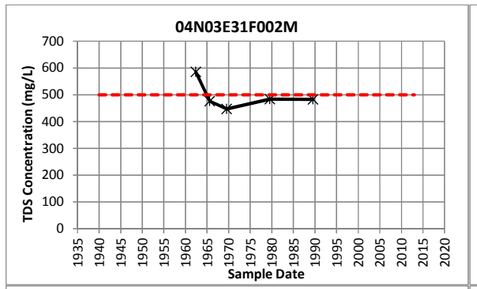


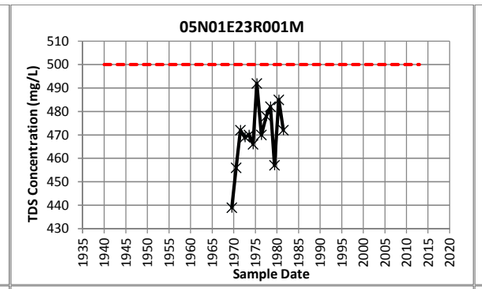
TDS Concentration Trends

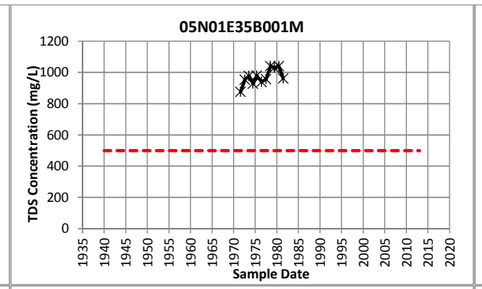
Colusa Glenn Subwatershed

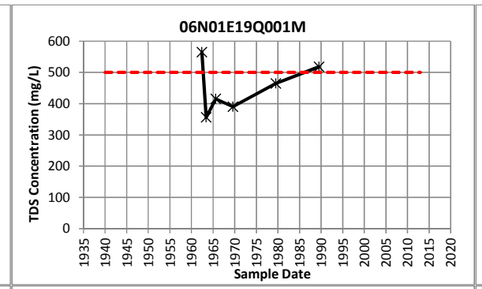


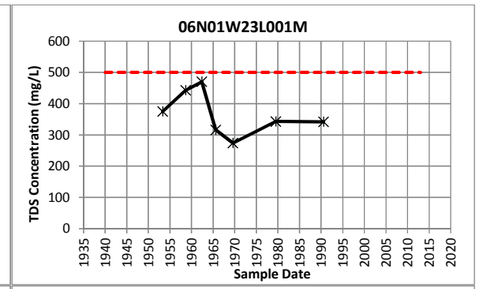
Dixon-Solano Subwatershed

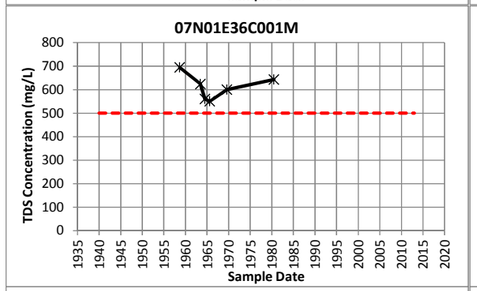


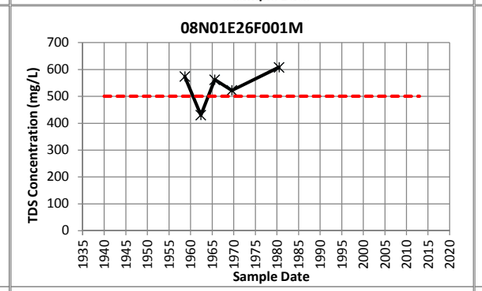


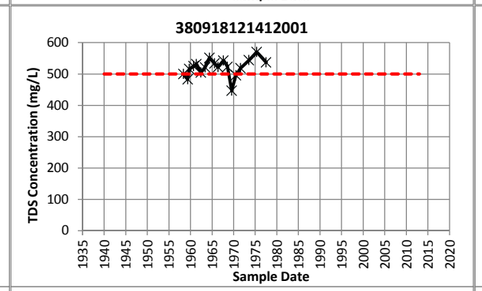


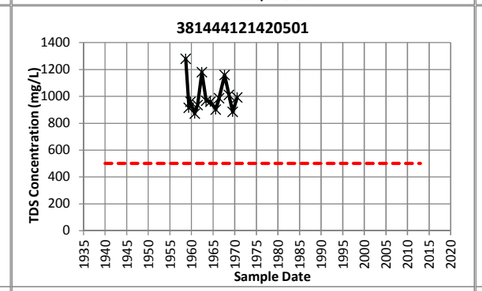


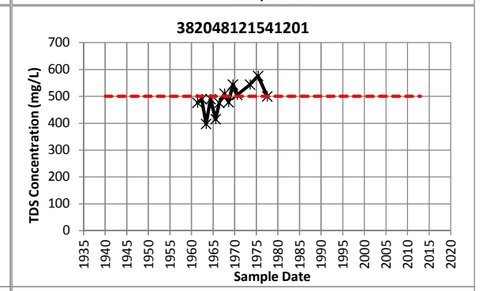


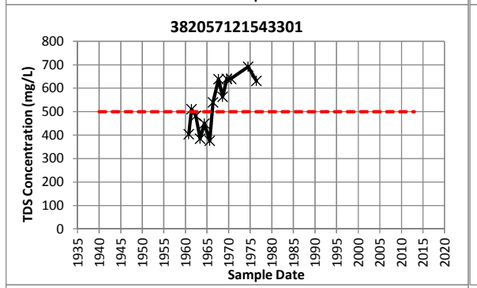


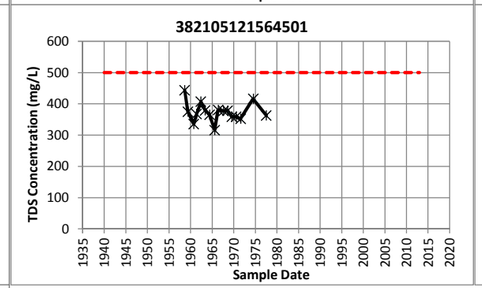


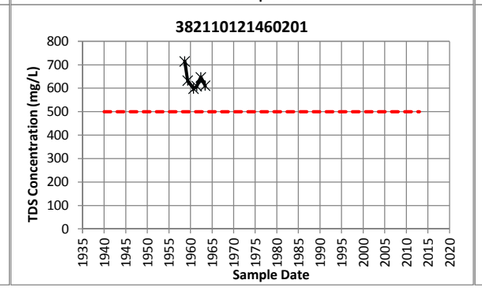


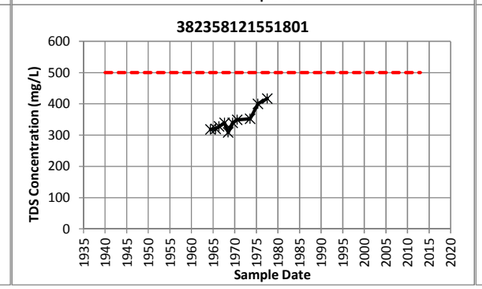


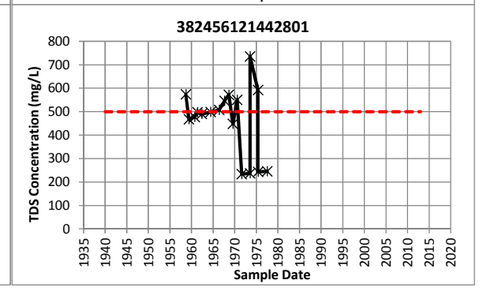


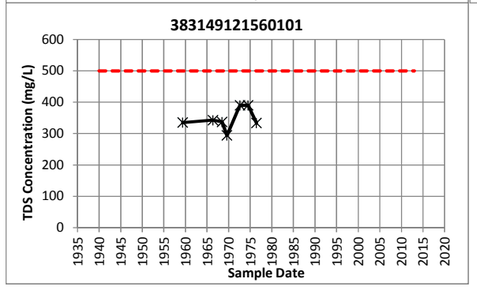






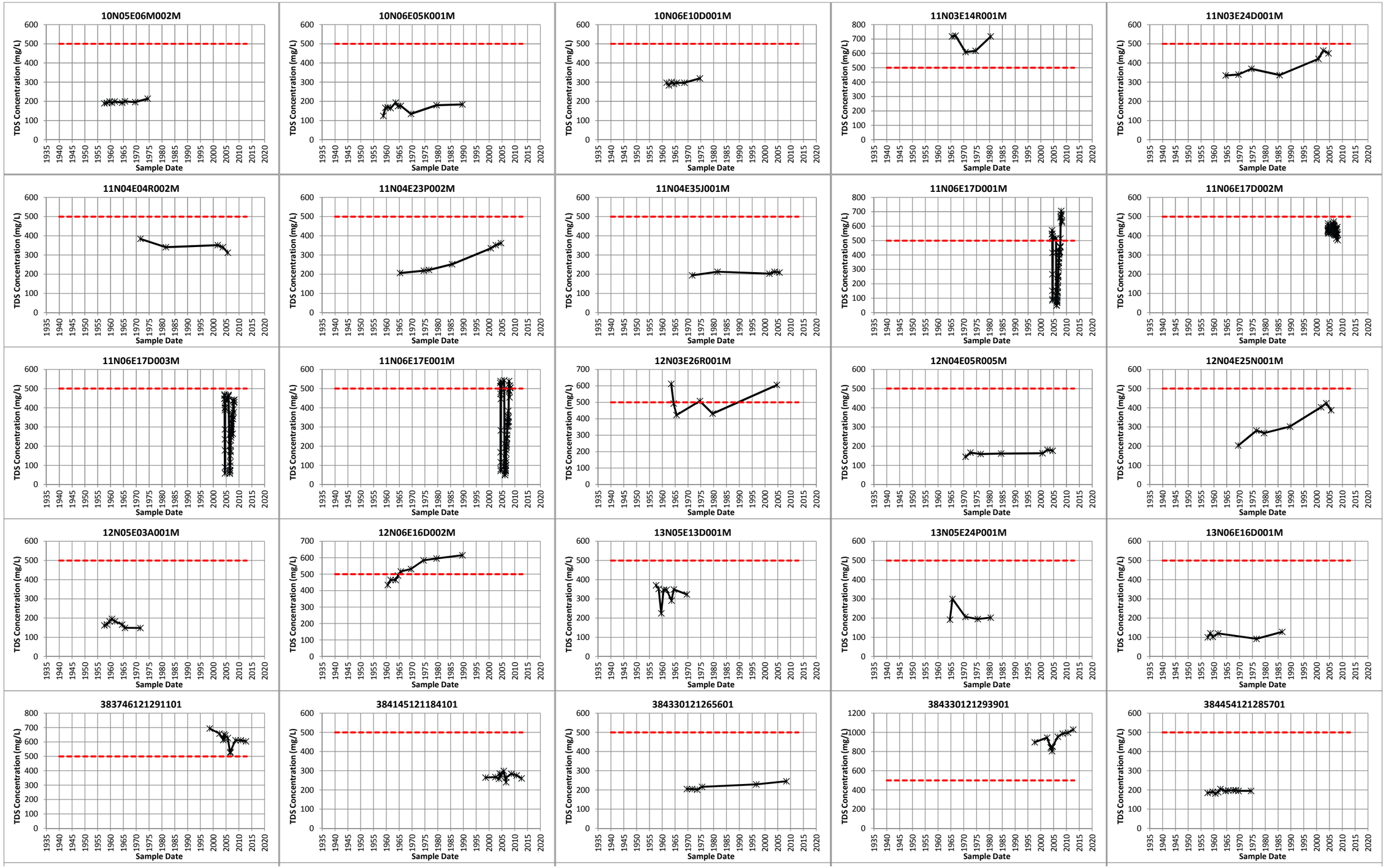




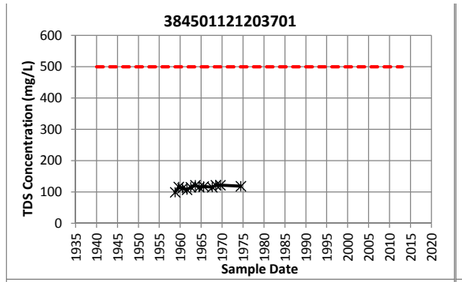


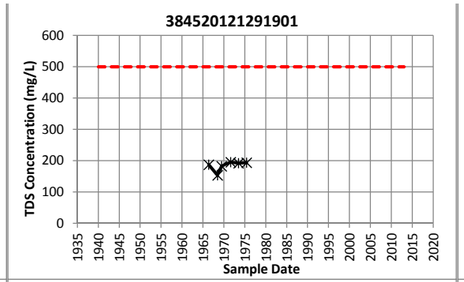
TDS Concentration Trends

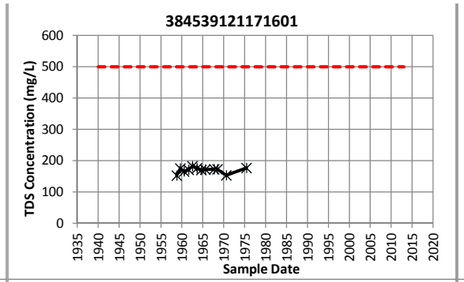
PNSSNS Subwatershed

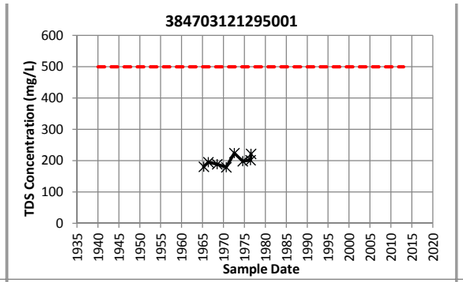


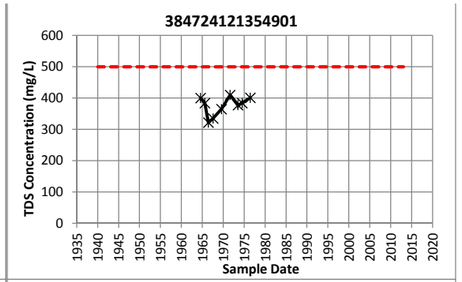
PNSSNS Subwatershed

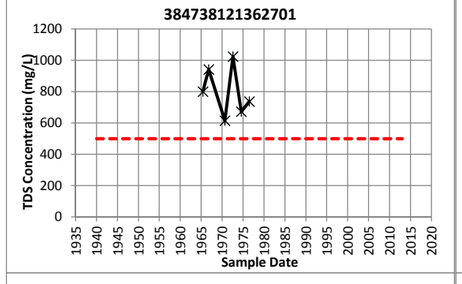


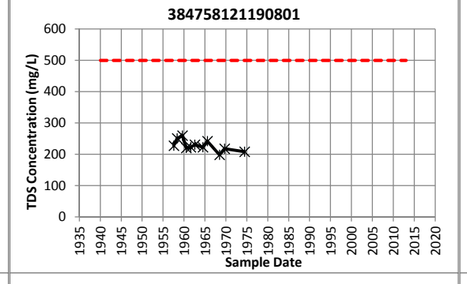


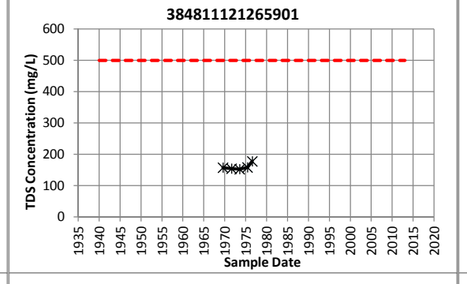


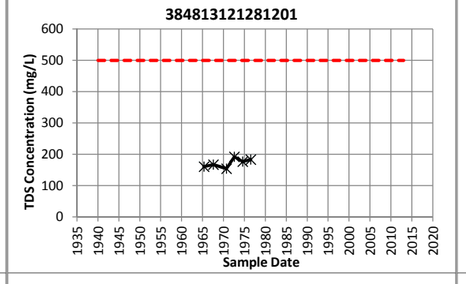


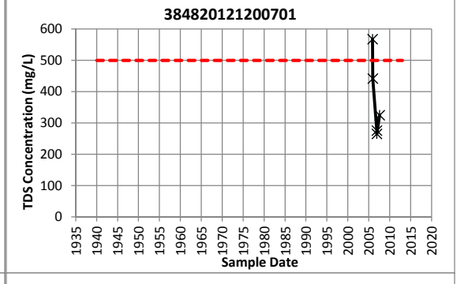


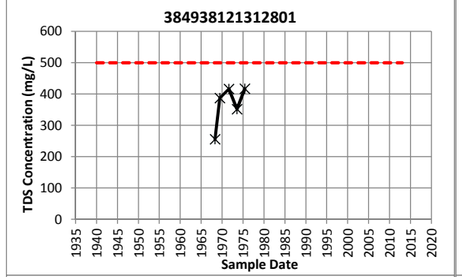


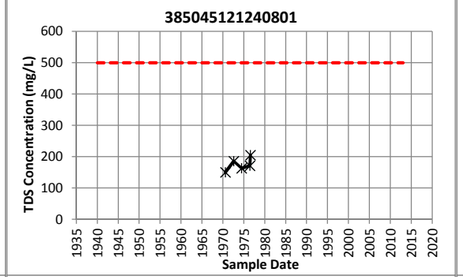


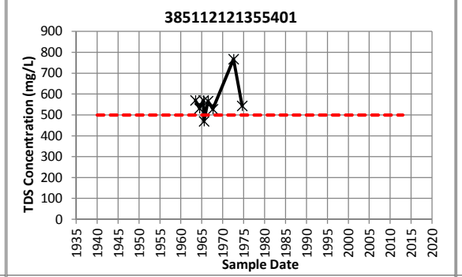


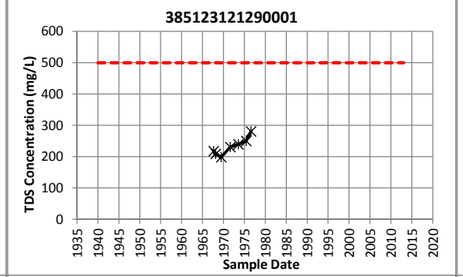


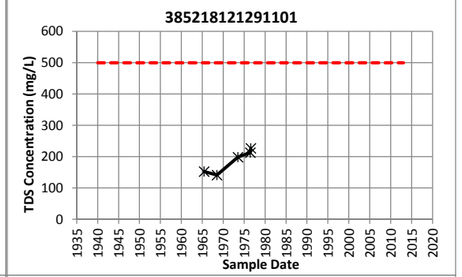


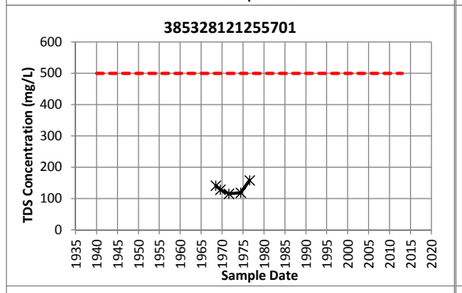


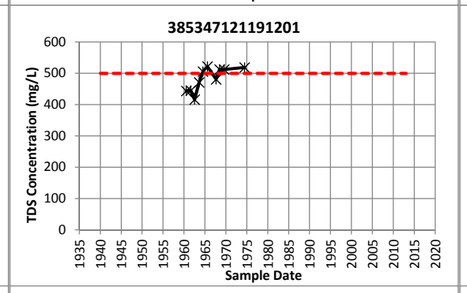


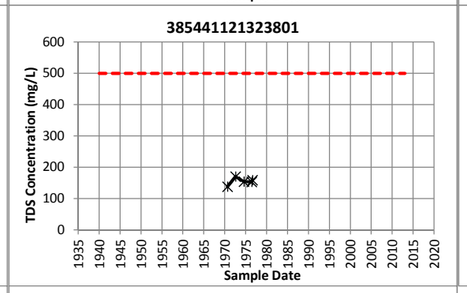


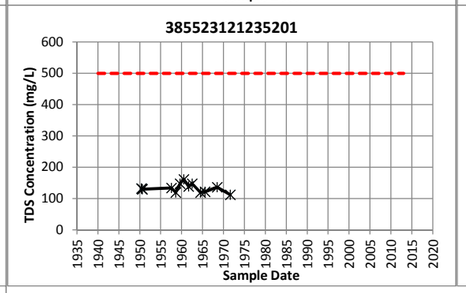


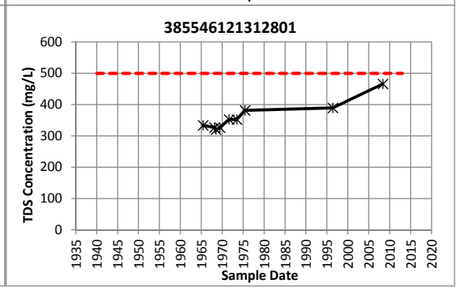


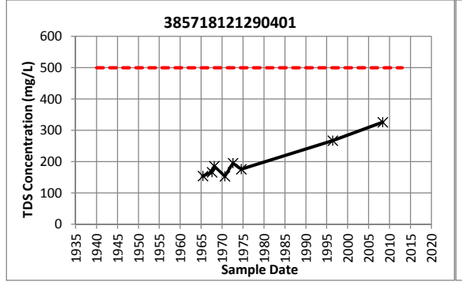


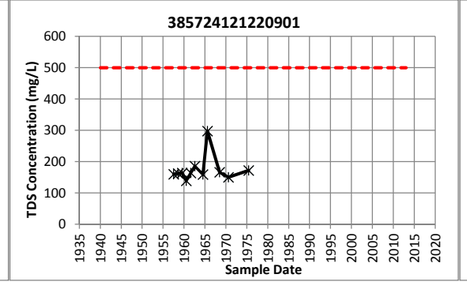


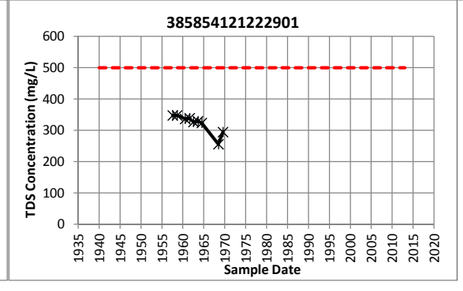






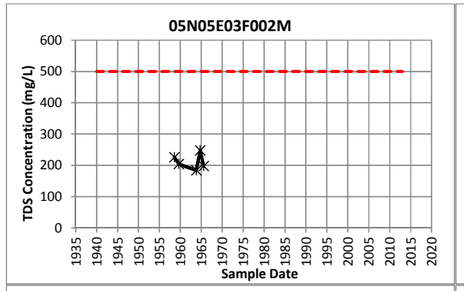


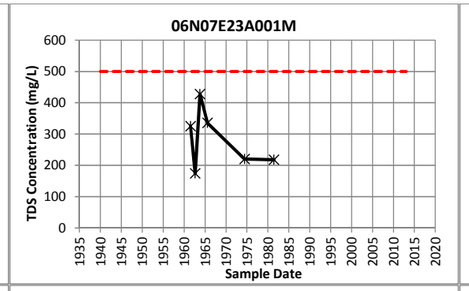


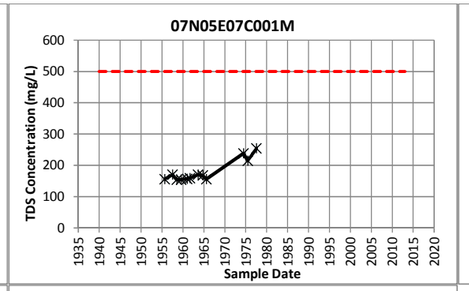


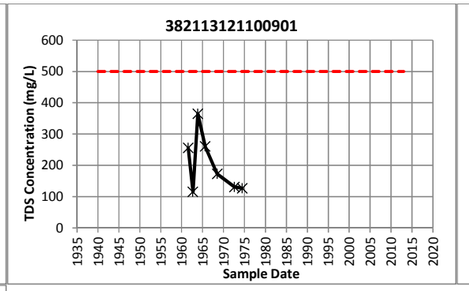
TDS Concentration Trends

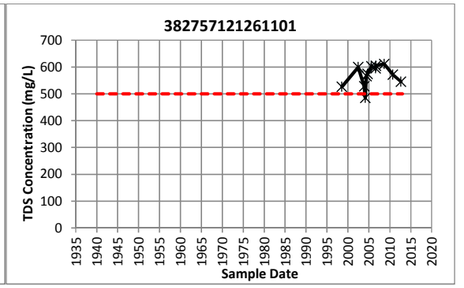
Sacramento Amador Subwatershed

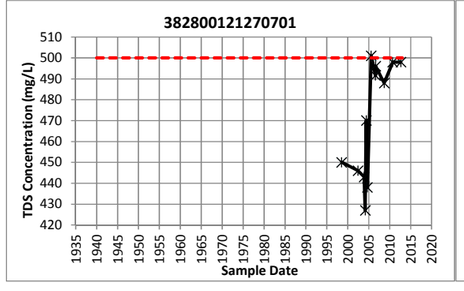


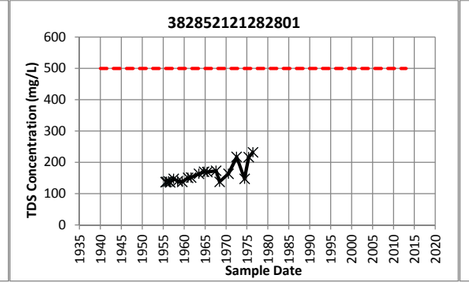


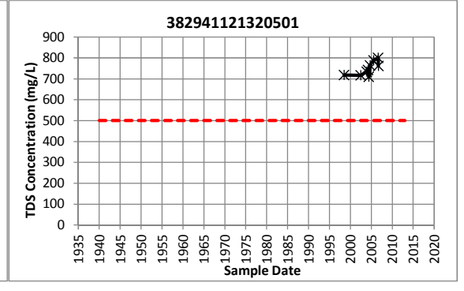






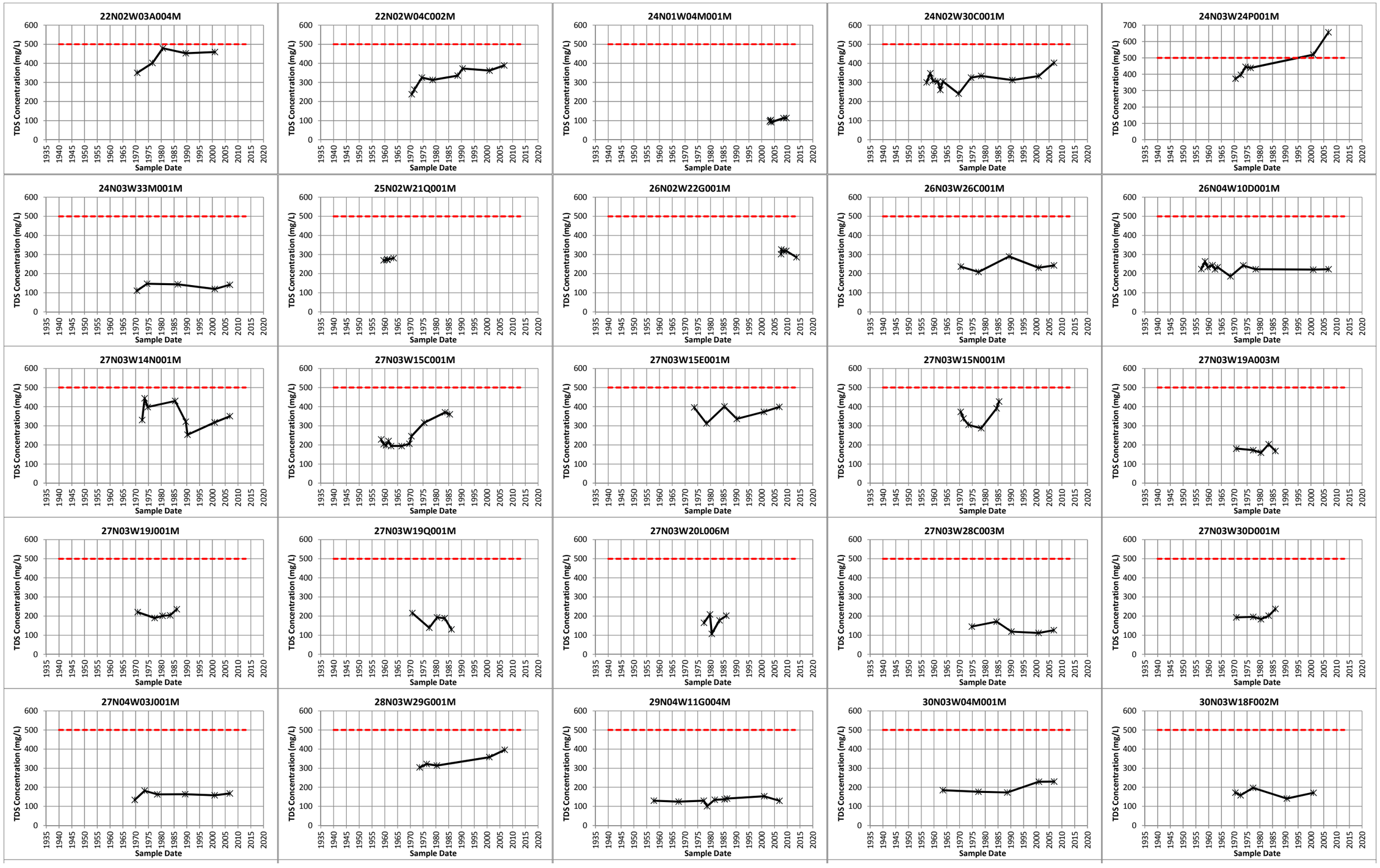




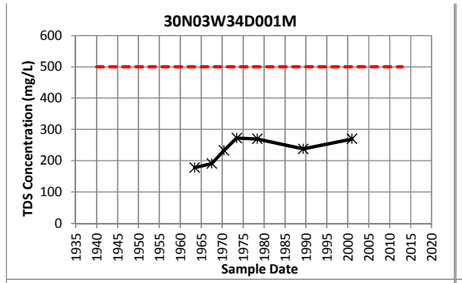


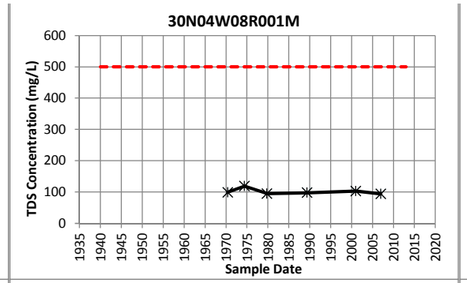
TDS Concentration Trends

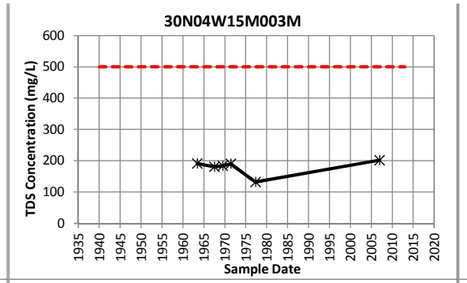
Shasta Tehama Subwatershed

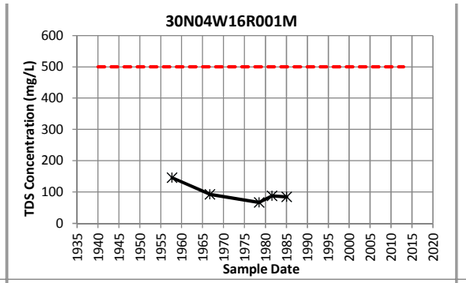


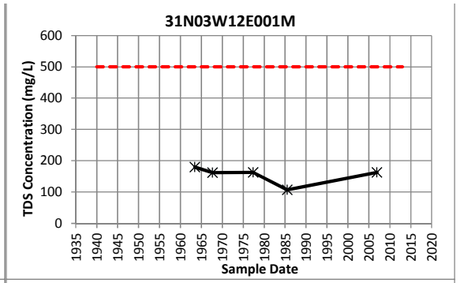
Shasta Tehama Subwatershed

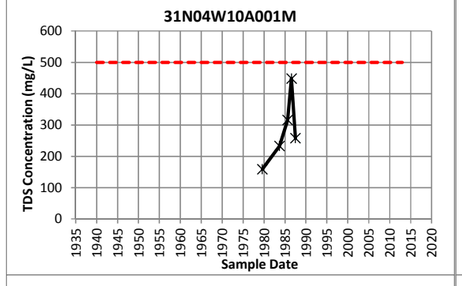


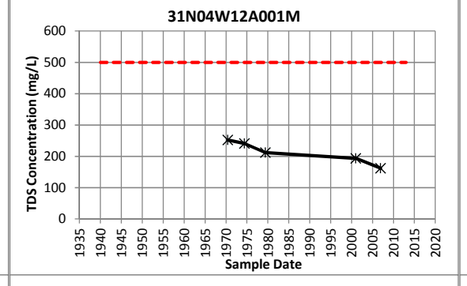


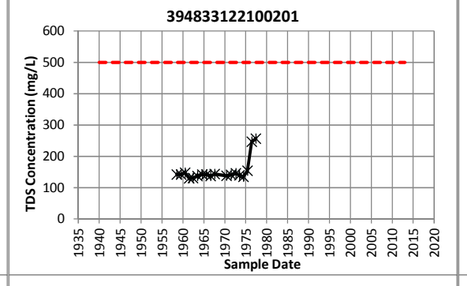


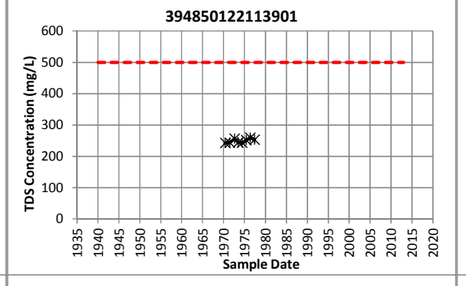


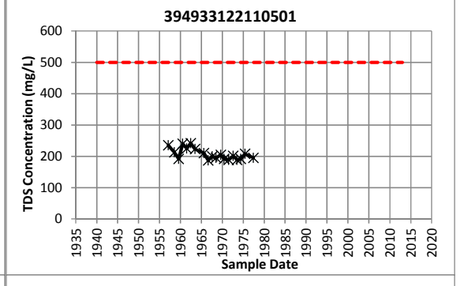


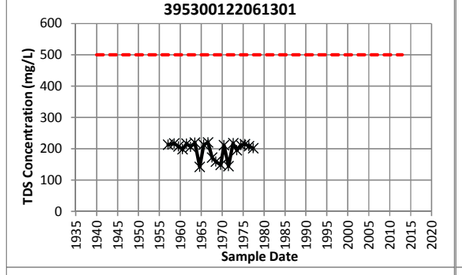


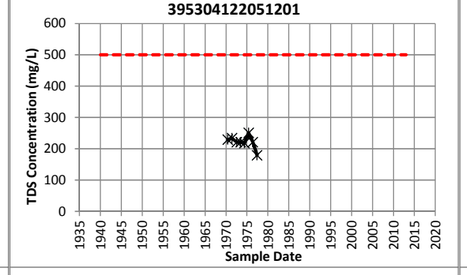


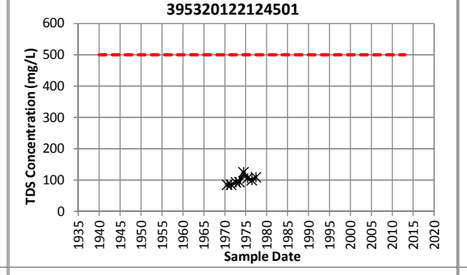


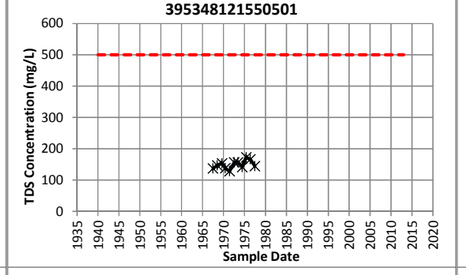


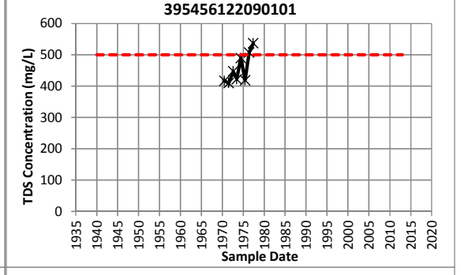


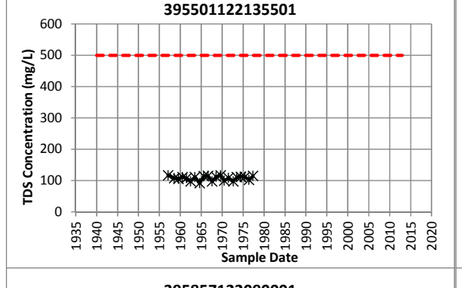


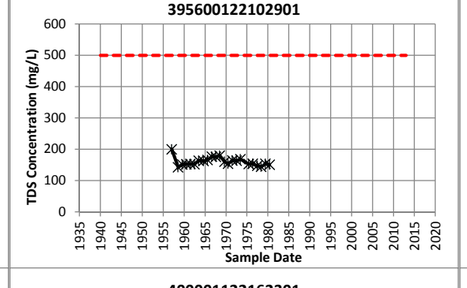


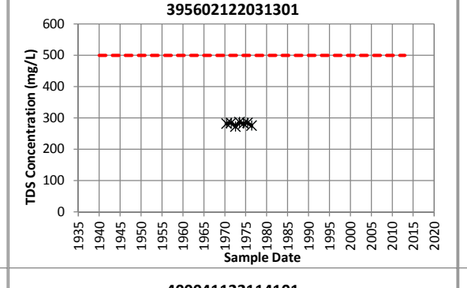


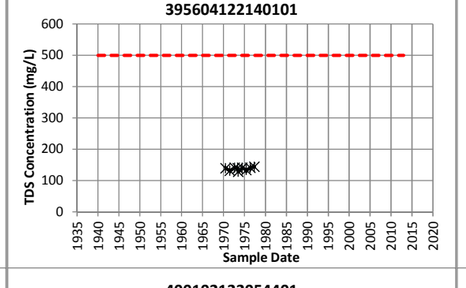


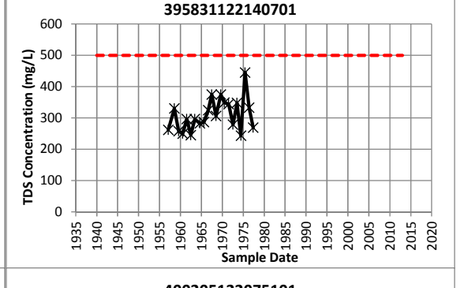


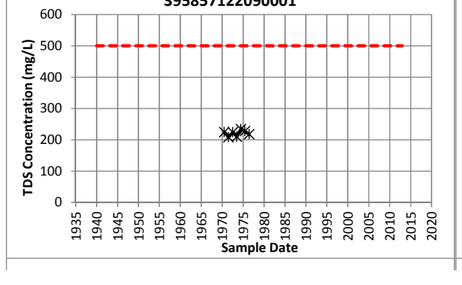


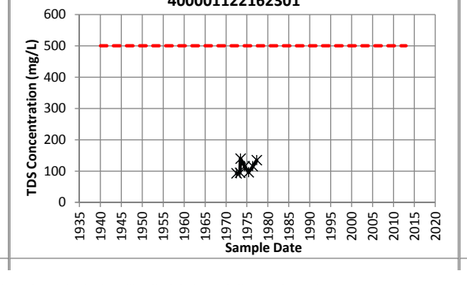


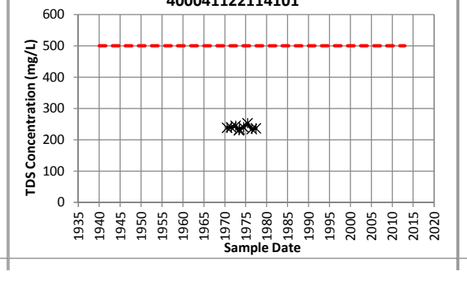


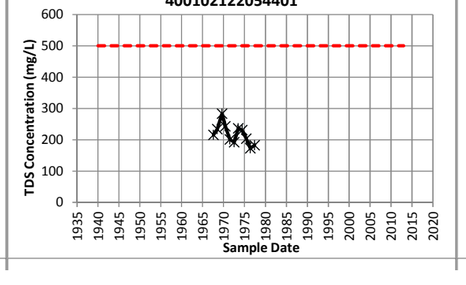


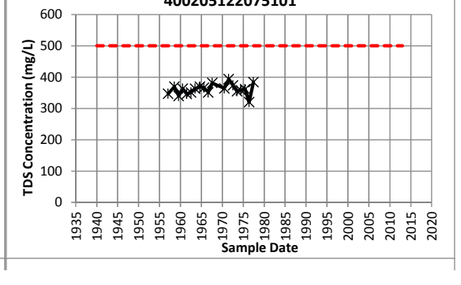












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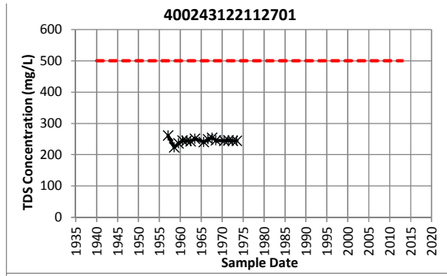

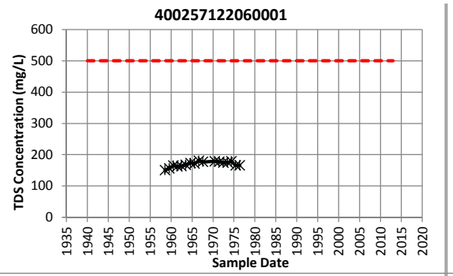

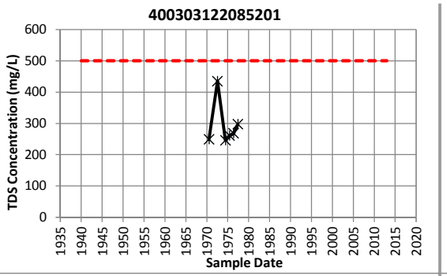

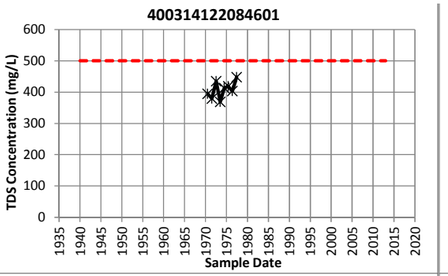

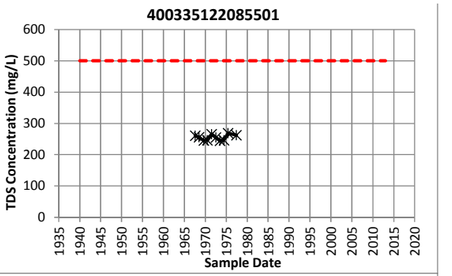

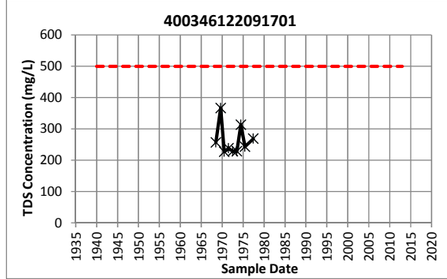

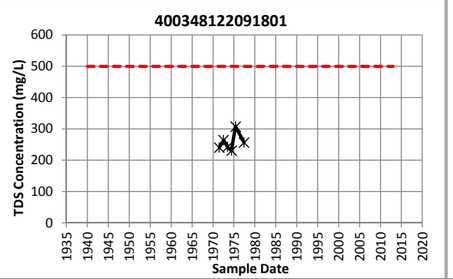

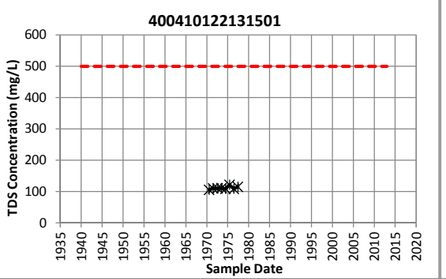

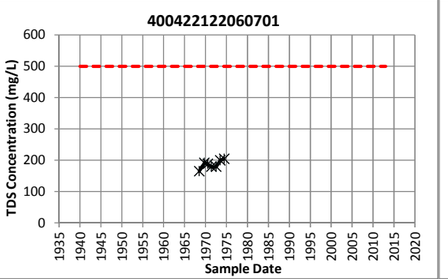

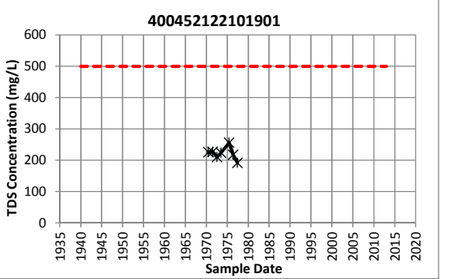

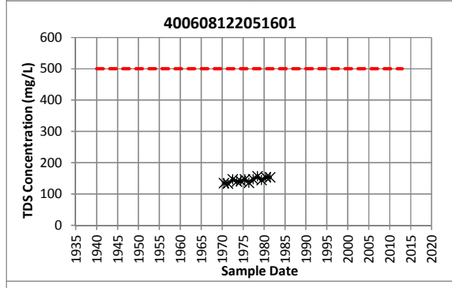

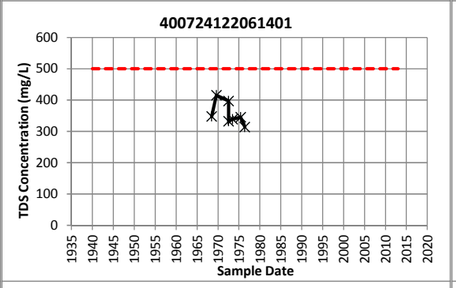

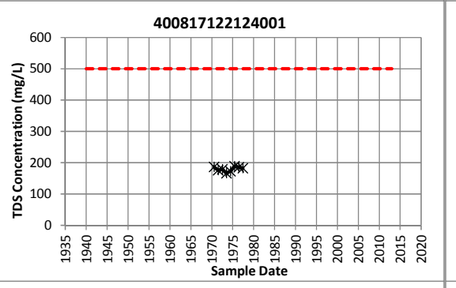

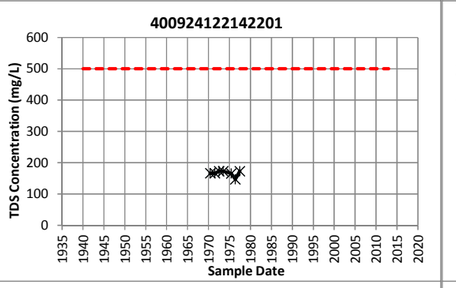

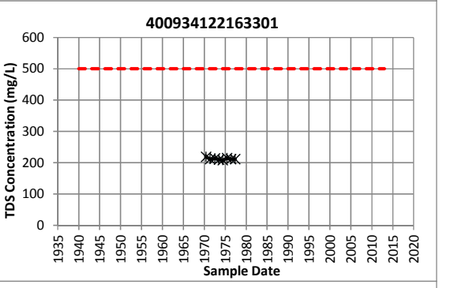

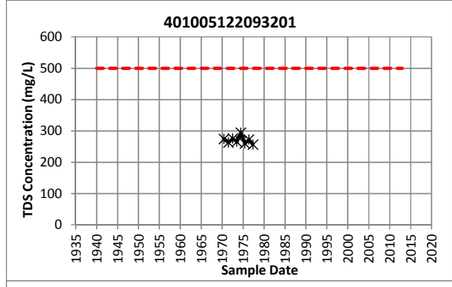

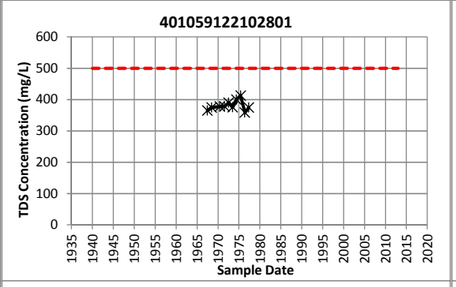

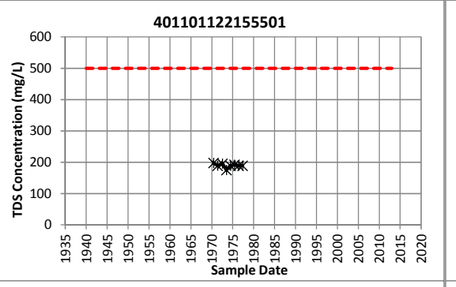

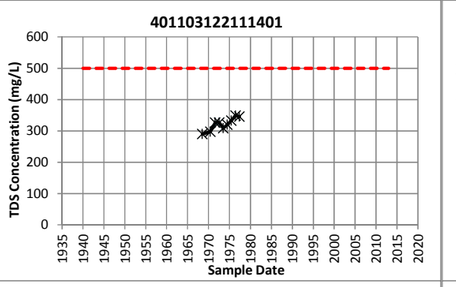

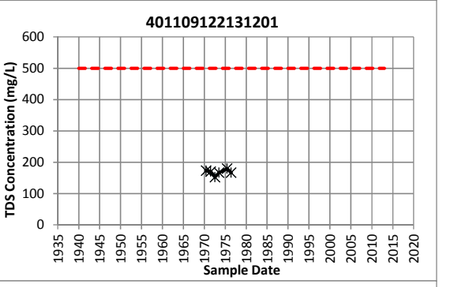

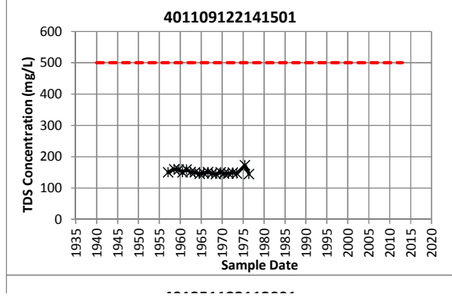

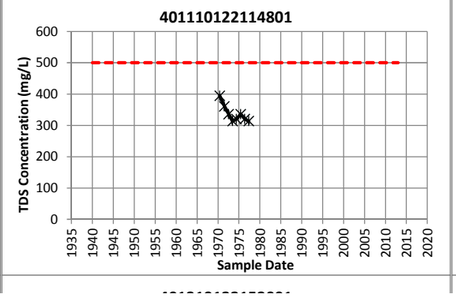

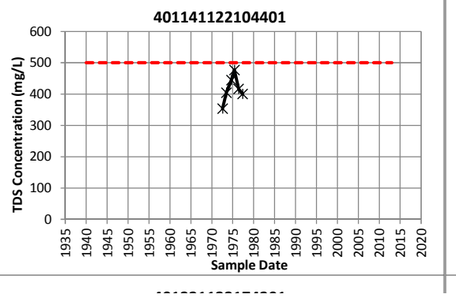

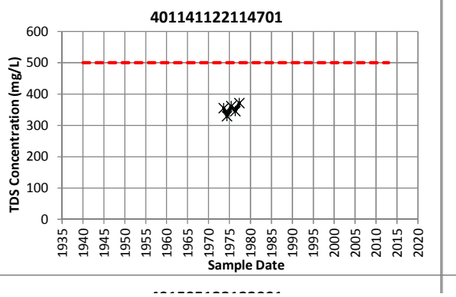

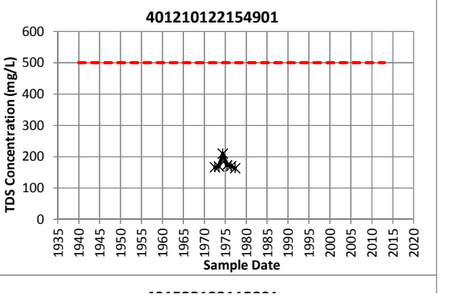

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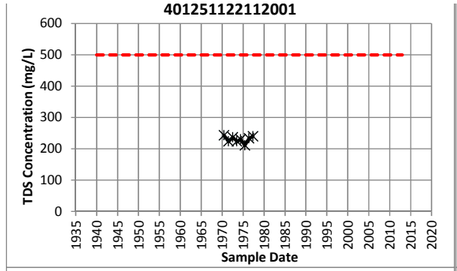
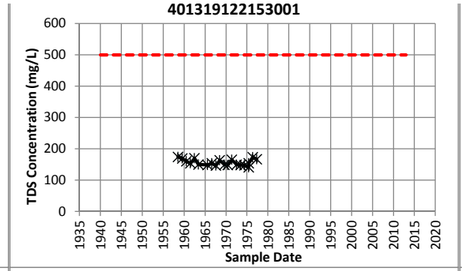
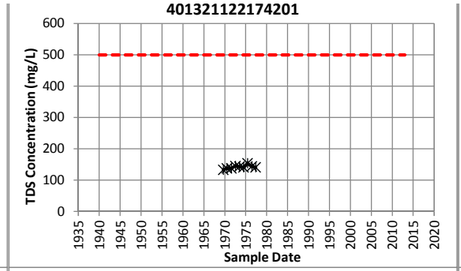
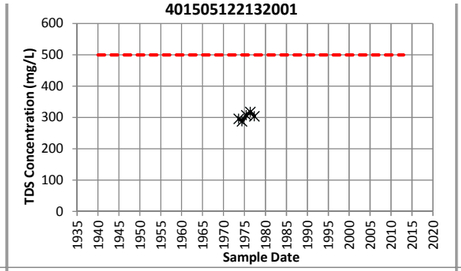
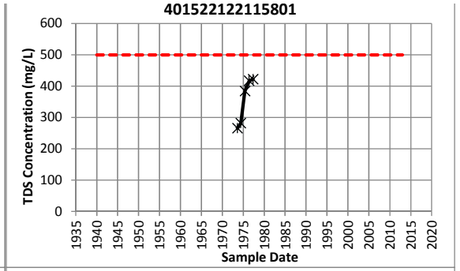
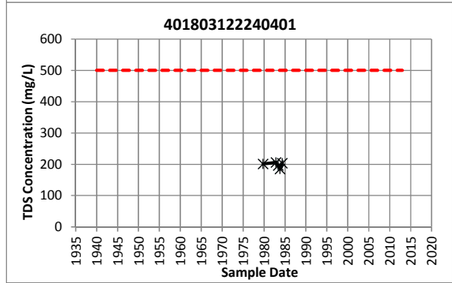


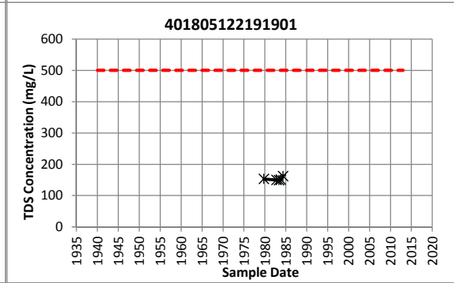


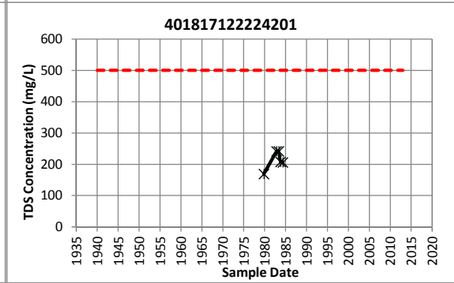


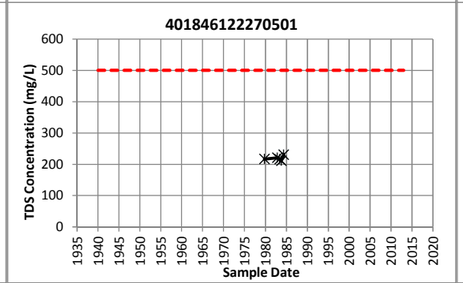


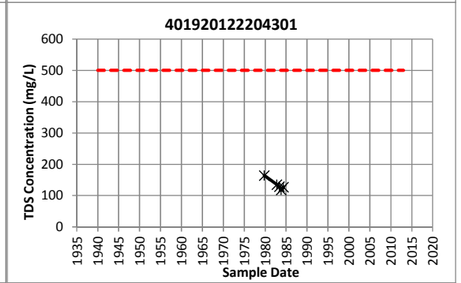


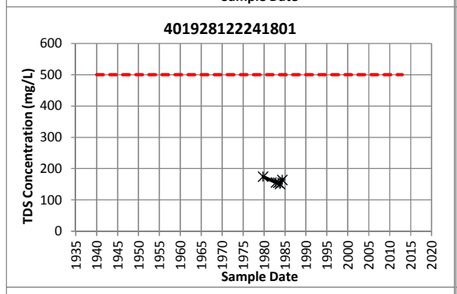


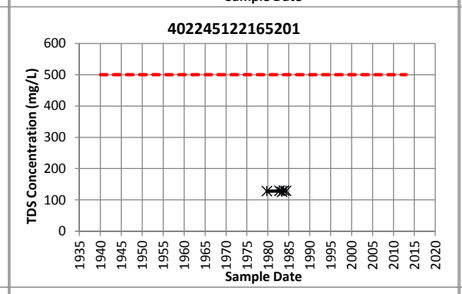


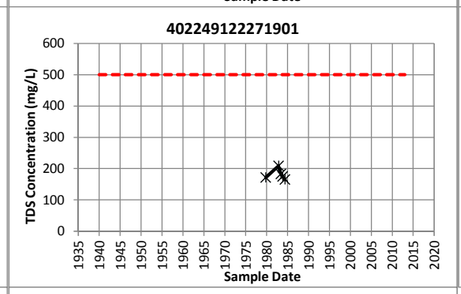


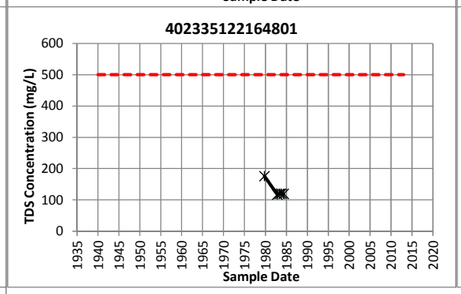


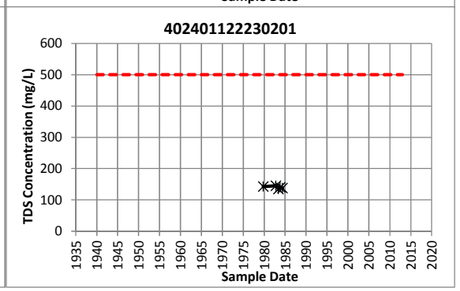


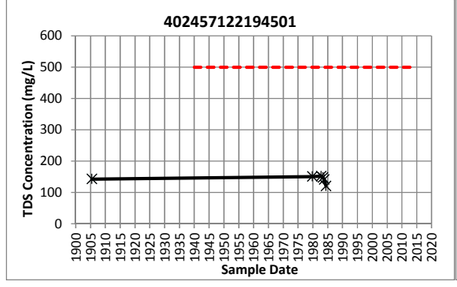


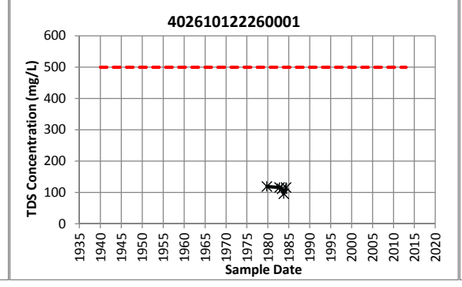


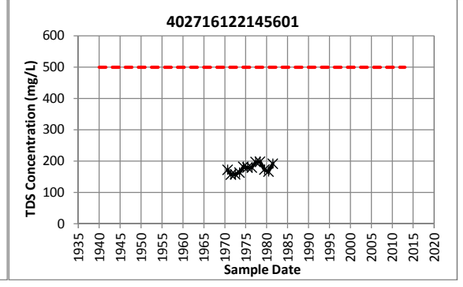




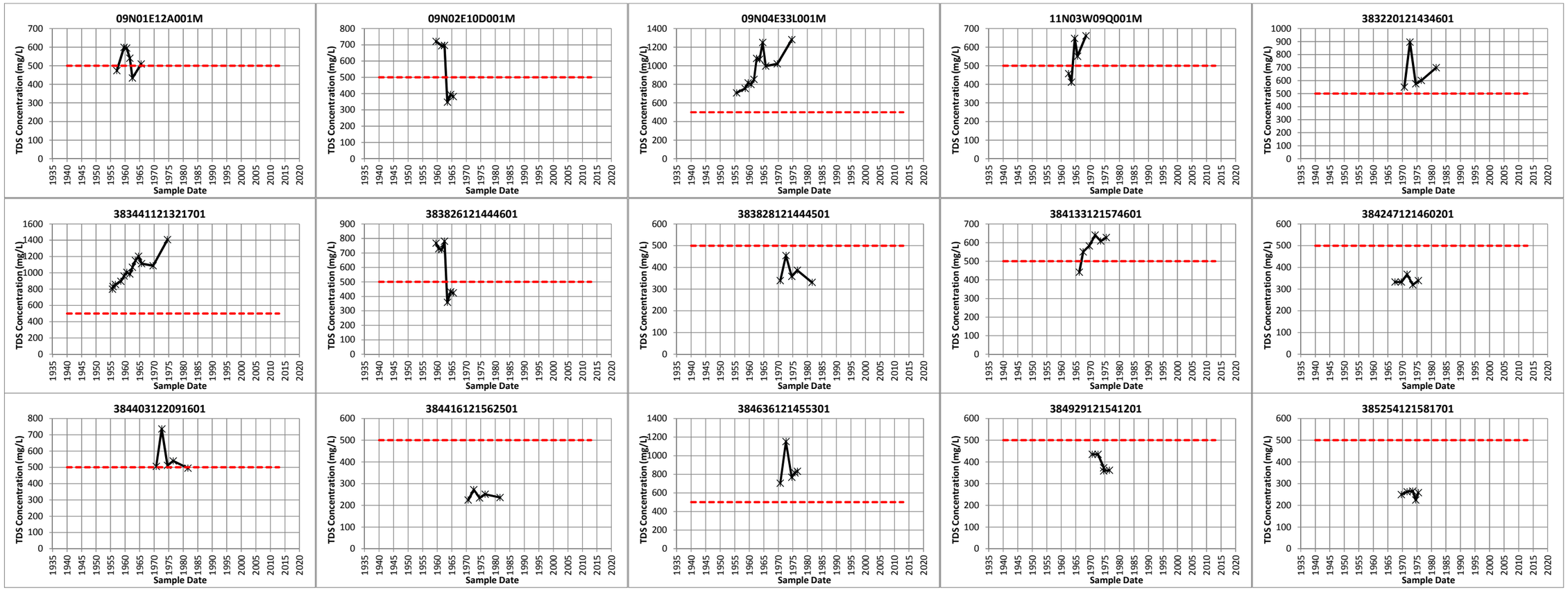






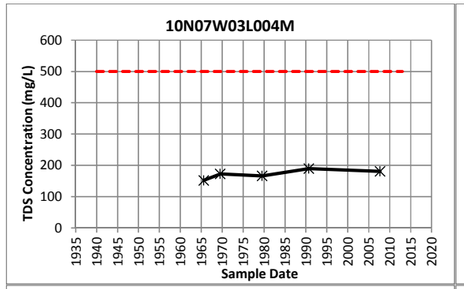


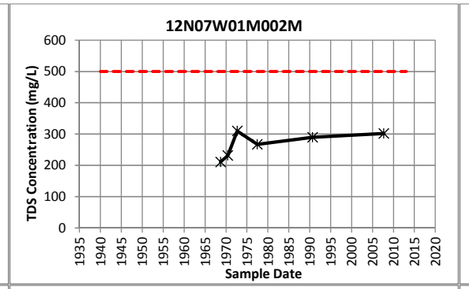
Yolo Subwatershed

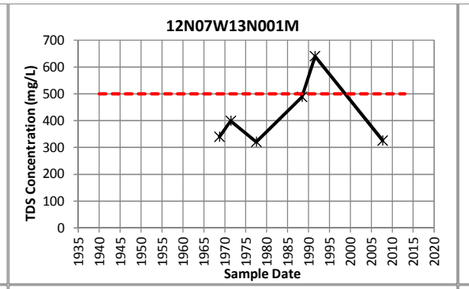


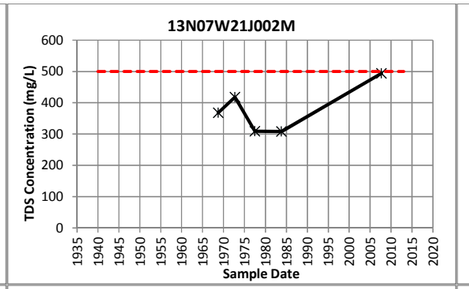
TDS Concentration Trends

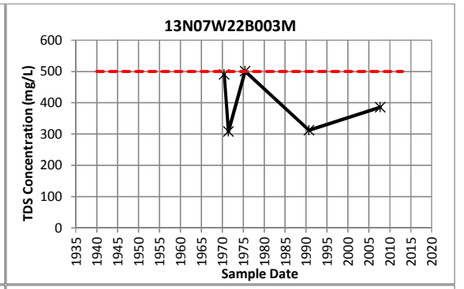
Lake Subwatershed

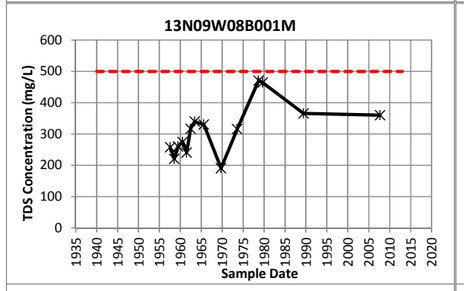


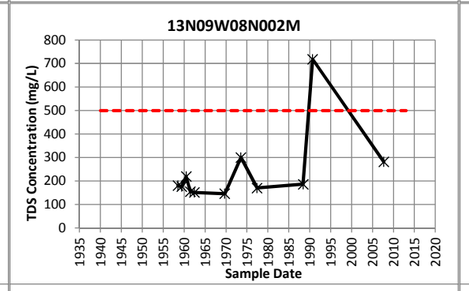


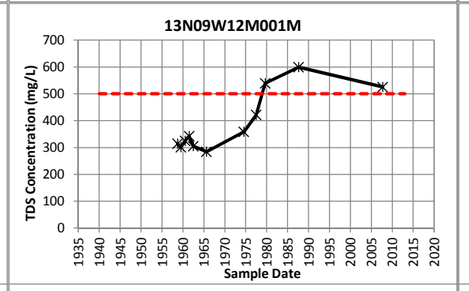


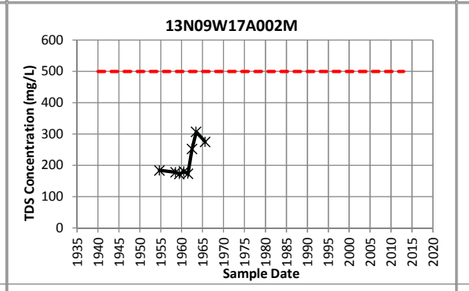


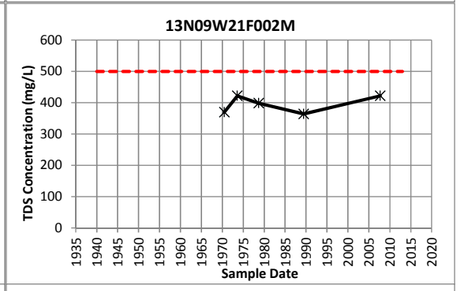


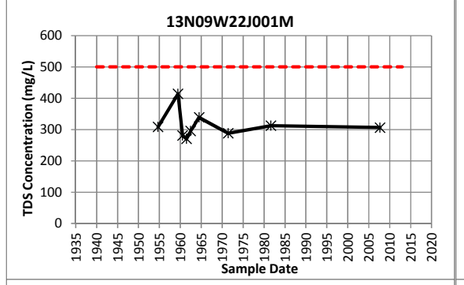


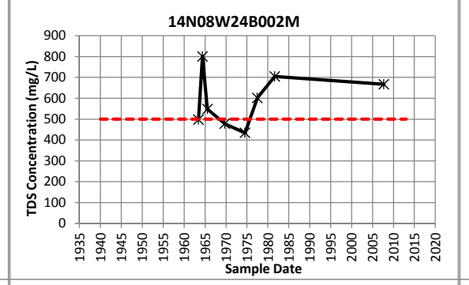


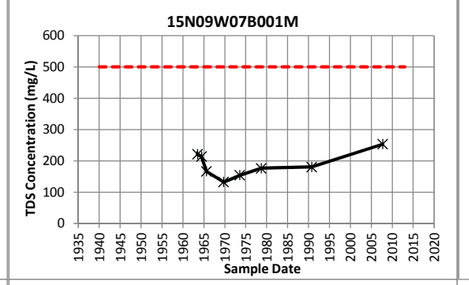


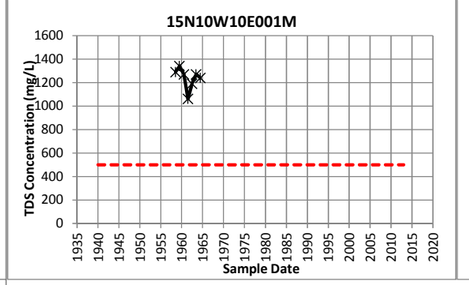


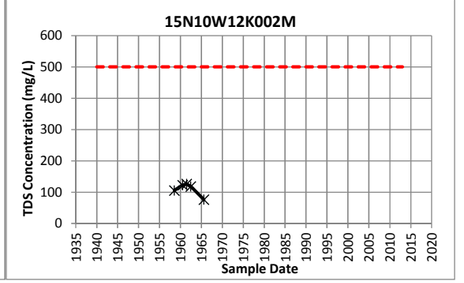


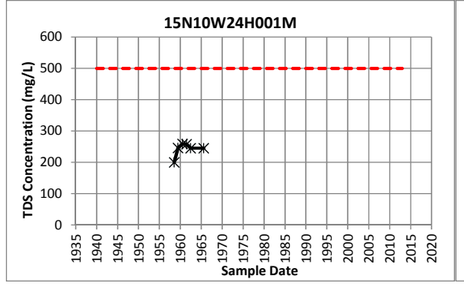


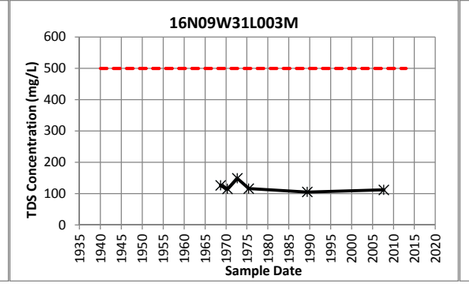


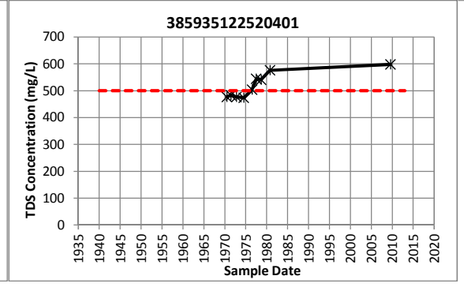




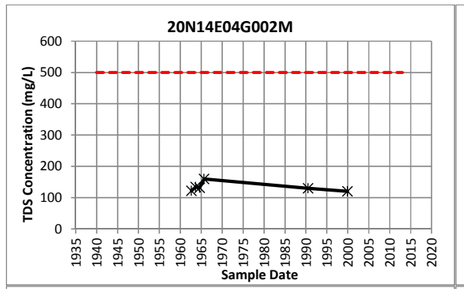


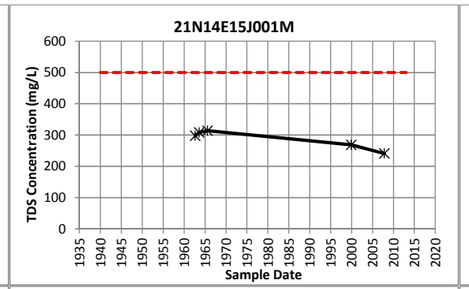


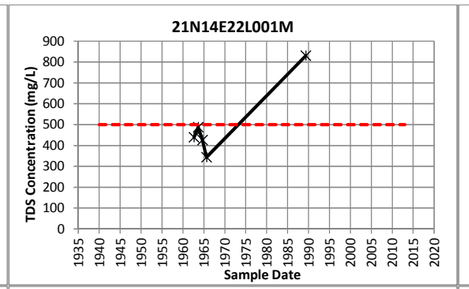


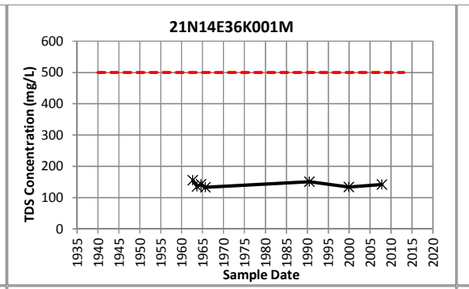


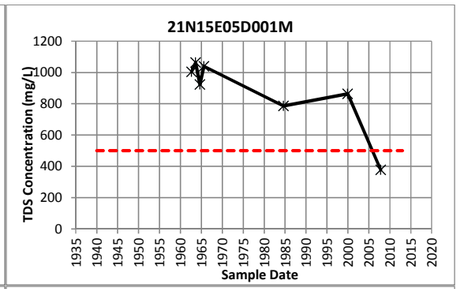
Upper Feather River Subwatershed

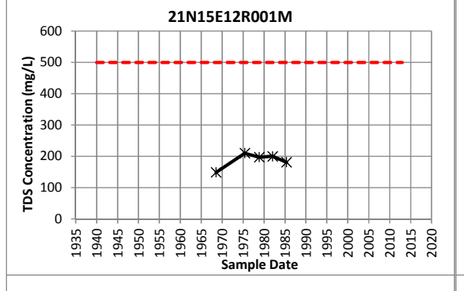


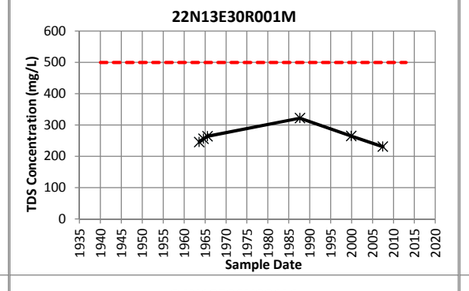


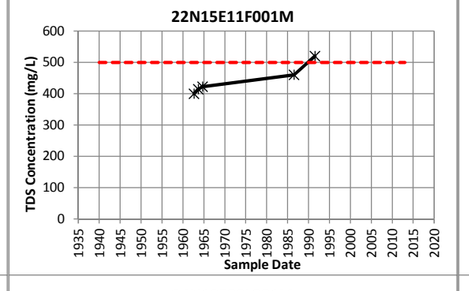


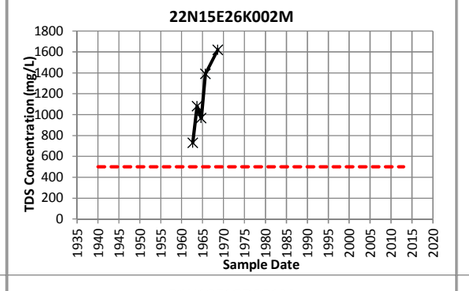


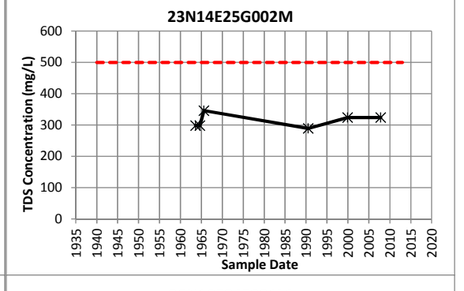


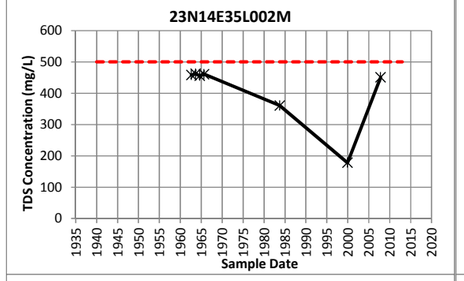


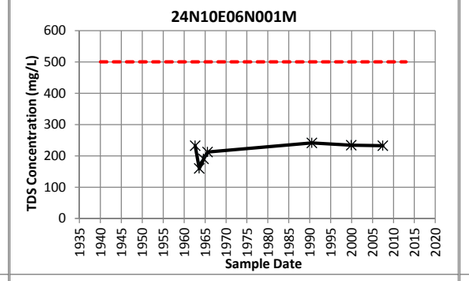


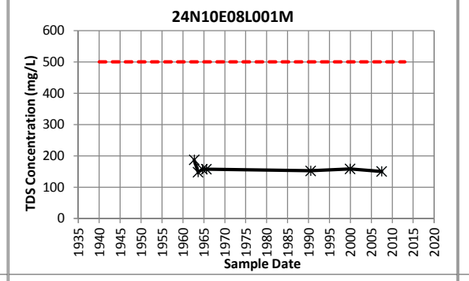


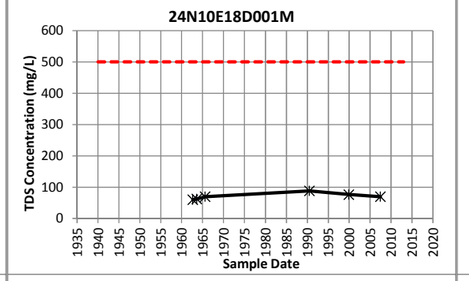


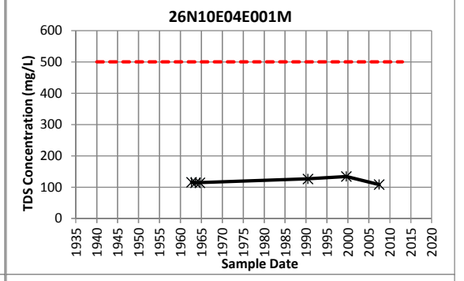


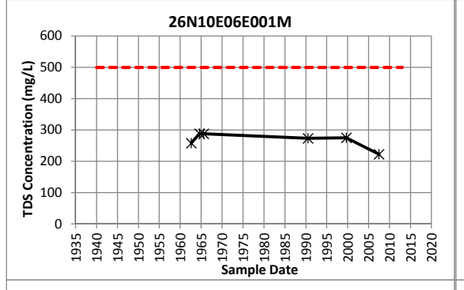


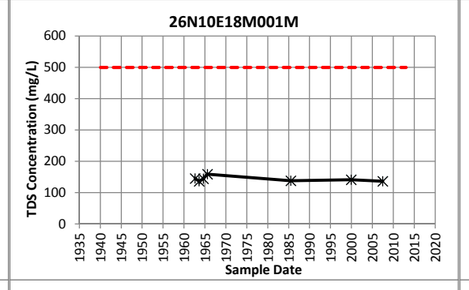


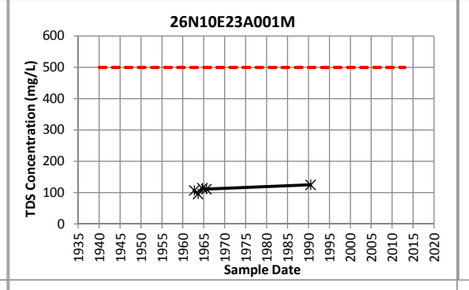


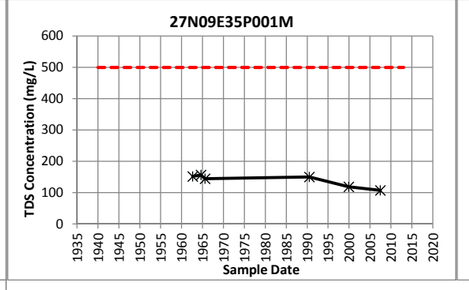


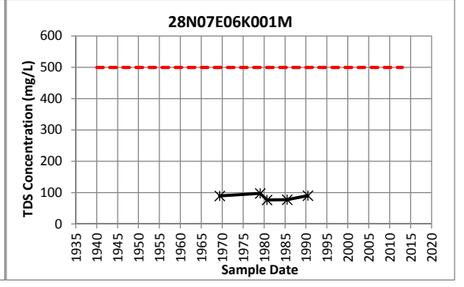


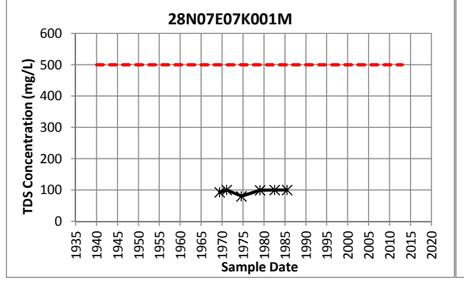


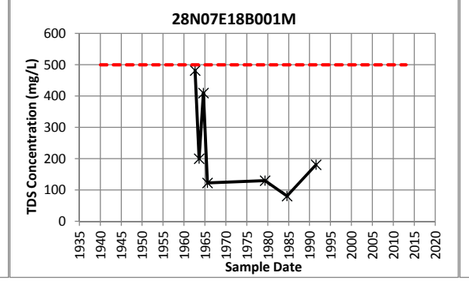


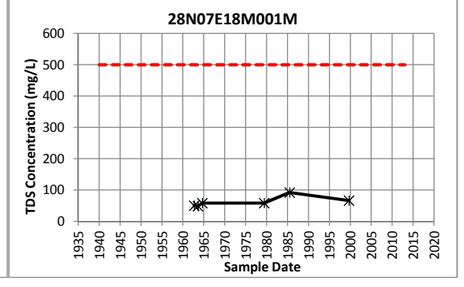












Appendix J
Pesticides Data Summary

APPENDIX J

Pesticides Data Summary

The Department of Pesticide Regulation (DPR) provided an export of its Groundwater Quality Database for currently registered pesticides and their degradates, for samples taken within the SVWQC counties. The resulting dataset includes over 130,000 individual records of pesticide sampling of groundwater. The data were reviewed and pesticide detections were summarized, including a review of the pertinent DPR Well Inventory Database reports. The list of pesticides included in past sampling was compared to the DPR Groundwater Protection List (GPL), and a summary of DPR's prioritization of monitoring of GPL pesticides is included. Finally, the DPR Groundwater Protection Program is summarized in an overall evaluation to provide an understanding of the comprehensive technical approach used by DPR. Pesticides that registered exclusively for use on rice have been excluded from this summary.

Summary of Pesticide Sampling Detections

TABLE J-1
Summary of Detections of Currently Registered Pesticides

Chemical	GPL	# of Detections	Report Years	Max Detection (ppb)
2,4-D	No	7	1989, 1991, 1992, 1999, 2007	6.3
3,4-DICHLORO ANILINE	No	24	2012	0.541
ACET (DEETHYL-SIMAZINE OR DEISOPROPYL-ATRAZINE)	No	24	1993, 1999, 2000, 2001, 2012	0.15
ALACHLOR	Yes[a]	5	1986, 1987, 1993	1.5
ALACHLOR ESA	degradate	6	2002	0.08
ALDICARB	Yes[a]	4	1993, 1998, 2010	87
ALDICARB SULFOXIDE	breakdown product of Aldicarb	2	2001	5.5
ATRAZINE	Yes[b]	199	1986, 1988, 1989, 1990, 1991, 1993, 1994, 1995, 1996, 1997, 2000, 2003, 2012	3.5
AZOXYSTROBIN ACID	Yes[a]	6	2011	0.268
BENTAZON, SODIUM SALT	Yes[b]	233	1989, 1992, 1993, 1994, 1996, 1997, 1998, 2003, 2012	13.7
BROMACIL	Yes[b]	19	1986, 1990, 1991, 1992, 1995, 1997, 2003, 2012	2.6
CAPTAN	No	3	1990	0.11
CARBARYL	Yes[a]	2	1990, 2012	2.3
CHLORPYRIFOS	No	2	1988, 2012	0.06
CHLORTHAL-DIMETHYL (DACTHAL / DCPA / DIMETHYL TETRACHLOROTER	No	2	1994	1.6

TABLE J-1
Summary of Detections of Currently Registered Pesticides

Chemical	GPL	# of Detections	Report Years	Max Detection (ppb)
CHLORTHAL-DIMETHYL ACID METABOLITES (DCPA ACID METABOLITES)	Degradate of DCPA	26	2003, 2004, 2005, 2007, 2010	8
DEETHYL-ATRAZINE (DEA)	No	166	1993, 1998, 1999, 2000, 2003, 2012	0.56
DESULFINYL FIPRONIL	No	2	2012	0.008
DIAMINOCHLOROTRIAZINE (DACT)	No	2	2001	0.058
DIAZINON	Yes[a]	3	1988, 2012	3.2
DICAMBA	Yes[a]	1	2000	0.5
DIMETHOATE	Yes[a]	1	1986	0.38
DIQUAT DIBROMIDE	Proposed removal 2014	4	1996, 2003, 2009, 2013	549.1
DIURON	Yes[b]	12	1989, 1990, 1994, 2000, 2003, 2012	1.57
ENDOSULFAN	No	5	1993	34.7
ENDOSULFAN SULFATE	No	4	1993	0.48
FIPRONIL	No	1	2012	0.017
FIPRONIL SULFIDE	No	2	2012	0.006
FIPRONIL SULFONE	No	2	2012	0.008
HEXAZINONE	Yes[a]	7	1999, 2012	0.056
MALATHION	Yes[a]	1	1986	0.32
MCPA	No	1	2012	0.02
METALAXYL	Yes[a]	2	2012	0.006
METHYL BROMIDE (BROMOMETHANE)	No	14	1997, 2002, 2008	4.6
METOLACHLOR	Yes[a]	4	2012	0.028
METOLACHLOR ESA	No	8	2002, 2010	0.76
METOLACHLOR OXA	No	4	2002	0.16
METRIBUZIN	Yes[a]	1	2012	0.113
NORFLURAZON	No	2	2000	0.21
OIET	No	8	2012	0.042
OXAMYL	No	8	2012	0.08
PARAQUAT DICHLORIDE	No	5	1994, 1998	16

TABLE J-1
Summary of Detections of Currently Registered Pesticides

Chemical	GPL	# of Detections	Report Years	Max Detection (ppb)
PROMETON	Yes[b]	30	1986, 1989, 1990, 1991, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2003, 2012	5.9
PROPANIL	Yes[a]	2	2012	0.097
SIMAZINE	Yes[b]	135	1986, 1989, 1990, 1991, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2003, 2012	3.3
SULFOMETURON METHYL	Yes[a]	1	2012	0.052
TEBUTHIURON	Yes[a]	5	2003, 2012	0.032
TRICLOPYR, TRIETHYLAMINE SALT	Yes[a]	1	2012	0.12
TRIFLURALIN	No	3	1988, 2012	0.2

[a] indicates that pesticides is on GWPL pursuant to section 13145(d) of the Food and Agricultural Code
[b] indicates that pesticides is on GWPL pursuant to pursuant to section 13149 of the Food and Agricultural (detected in groundwater)
Note that duplicate samples may be included in detection count.

A detailed review of the DPR Well Inventory Reports was undertaken to understand DPR's monitoring and enforcement program. The majority of pesticides initially detected have not been confirmed in follow-up testing. Where pesticides detections are confirmed, DPR seeks to determine if the detections are result of legal nonpoint source agriculture use, or point source use. In cases where the confirmed detections are a result of legal nonpoint source agricultural use, additional regulatory action is taken, including the designation and enforcement of Groundwater Protection Zones.

Evaluation of Pesticides Sampled

The 2014 proposed GPL was used as the basis for the summary below. As shown, the following pesticides that are included on the GPL have been included in sampling:

- 2,4-D, DIMETHYLAMINE SALT
- ACEPHATE
- ACET (DEETHYL-SIMAZINE OR DEISOPROPYL-ATRAZINE) (DEGRATE)
- ALACHLOR
- ALDICARB
- ATRAZINE
- AZOXYSTROBIN
- BENTAZON (BASAGRAN®)
- BROMACIL
- CARBARYL
- CHLOROPICRIN
- CHLOROTHALONIL
- CYCLOATE
- DIAZINON
- DICAMBA, DIGLYCOLAMINE SALT
- DICAMBA, DIMETHYLAMINE SALT
- DICAMBA, SODIUM SALT
- DICHLOBENIL
- DICHLORAN
- DIMETHOATE
- DIURON, EXCEPT FOR PRODUCTS WITH LESS THAN 7% DIURON THAT ARE APPLIED TO FOLIAGE
- EPTC
- ETHOPROP
- HEXAZINONE
- IMIDACLOPRID
- IPRODIONE
- LINURON
- MALATHION
- METALAXYL
- METHIOCARB
- METHOMYL
- METHYL BROMIDE (BROMOMETHANE)
- METRIBUZIN

- MYCLOBUTANIL
- NAPROPAMIDE
- NORFLURAZON
- ORYZALIN
- PHORATE
- PROMETON
- PROMETRYN
- PROPANIL
- PROPYZAMIDE
- SIMAZINE
- SULFOMETURON METHYL
- TEBUTHIURON
- TEBUTHIURON
- TRIADIMEFON
- TRIALLATE
- TRICLOPYR, BUTOXYETHYL ESTER
- TRICLOPYR, TRIETHYLAMINE SALT

The following GPL pesticides have not been included in the groundwater sampling. DPR has performed a technical analysis to prioritize additional sampling, relative to pesticide fate and transport characteristics and usage. The prioritization table is included in the Section below.

- (S)-METOLACHLOR
- 2,4-D, 2-ETHYLHEXYL ESTER (DEGRADATE)
- 2,4-D, DIETHANOLAMINE SALT (DEGRADATE)
- 2,4-D, ISOOCTYL ESTER (DEGRADATE)
- AMINOCYCLOPYRACHLOR
- AMINOCYCLOPYRACHLOR, POTASSIUM SALT
- AMINOPYRALID, TRIISOPROPANOLAMINE SALT
- BENSULIDE
- BISPYRIBAC-SODIUM
- BOSCALID
- CHLORANTRANILIPROLE
- CHLORSULFURON
- CLOTHIANIDIN
- CYPRODINIL
- DAZOMET
- DIFLUFENZOPYR, SODIUM SALT
- DIMETHENAMID-P
- DIMETHOMORPH
- DINOTEFURAN
- DITHIOPYR
- ETHOFUMESATE
- FENAMIDONE
- FLAZASULFURON
- FLUDIOXONIL
- FLUOPICOLIDE
- FLUTOLANIL
- FOSETYL-AL (ALUMINUM TRIS)
- FOSTHIAZATE
- HALOSULFURON-METHYL
- IMAZAMOX, AMMONIUM SALT
- IMAZAPYR, ISOPROPYLAMINE SALT
- IMAZETHAPYR, AMMONIUM SALT
- INDAZIFLAM
- ISOXABEN
- MEFENOXAM
- MESOTRIONE
- METALDEHYDE
- METCONAZOLE
- NITRAPYRIN
- ORTHOSULFAMURON
- PENOXSULAM
- PROPAMOCARB HYDROCHLORIDE
- PROPICONAZOLE
- PROTHIOCONAZOLE
- PYRACLOSTROBIN
- PYRAZON
- RIMSULFURON
- SIDURON
- SULFENTRAZONE
- TEBUCONAZOLE
- THIAMETHOXAM
- THIENCARBAZONE-METHYL
- THIOPHANATE METHYL
- TRIFLUMIZOLE
- TRITICONAZOLE

In addition, the following pesticides that are not on the GWPL have been included in sampling that is reported in DPR's Groundwater Database. A review of these pesticides relative to usage in the SVWQC area was not performed, and such as assessment is recommended should any further assessment of these pesticides be considered. It is noted that these pesticides are not on DPR's recommended priority list.

- 1,3-DICHLOROPROPENE (1,3-D TELONE)
- 1,4-DICHLOROBENZENE (P-DCB)
- 2,4-D
- 2,4-DB ACID
- 2,6-DIETHYLANILINE (DEGRADATE)
- 2-Dimethylethyl-5-amino-1,3,4-thiadiazole

- 2-Dimethylethyl-5-methylamino-1,3,4-thiadiazol
- 2-HYDROXYCYCLOHEXYL HEXAZINONE
- 3,4-DICHLORO ANILINE
- 3,5-DICHLORO ANILINE
- 3,5-DICHLOROANILINE
- 4(2,4-DB), DIMETHYLAMINE SALT
- 4-CLOC
- ACROLEIN
- AMITRAZ
- BENEFIN (BENFLURALIN)
- BROMOXYNIL OCTANOATE
- CAPTAN
- CARBENDAZIM (METHYL 2-BENZIMIDAZOLECARBAMATE)
- CHLORPROPHAM
- CHLORPYRIFOS
- CHLORPYRIFOS OXON
- CHLORTHAL-DIMETHYL (DACTHAL / DCPA / DIMETHYL TETRACHLOROTER
- CHLORTHAL-DIMETHYL ACID METABOLITES (DCPA ACID METABOLITES)
- CLOPYRALID
- COUMAPHOS
- CYFLUTHRIN
- CYPERMETHRIN
- DDVP (DICHLORVOS)
- DECYCLOHEXYL-4-HYDROXY HEXAZINONE
- DEETHYL-ATRAZINE (DEA)
- DESMETHYLNORFLURAZON
- DESULFINYL FIPRONIL
- DESULFINYL FIPRONIL AMIDE
- DIAMINOCHLOROTRIAZINE (DACT)
- DICOFOL
- DIQUAT DIBROMIDE
- ENDOSULFAN
- ENDOSULFAN SULFATE
- ESFENVALERATE
- ETHALFLURALIN
- ETHYLENE THIOUREA
- FENBUTATIN-OXIDE (VENDEX)
- FIPRONIL
- FIPRONIL SULFIDE
- FIPRONIL SULFONE
- FORMALDEHYDE
- FORMETANATE HYDROCHLORIDE
- GLYPHOSATE, ISOPROPYLAMINE SALT
- LAMBDA-CYHALOTHRIN
- MALAOXON
- MCPA
- MCPA, DIMETHYLAMINE SALT
- MCPP (2-(4-CHLORO-2-METHYLPHENOXY)PROPIONIC ACID)
- METHIDATHION
- METHYL ISOTHIOCYANATE
- METOLACHLOR
- METOLACHLOR ESA
- METOLACHLOR OXA
- MONOMETHYL HEXAZINONE
- MTP (MONOMETHYL 2,3,5,6-TETRACHLOROTEREPHTHALATE) DEGRADATE
- N-(5-(1,1-Dimethylethyl)-1,3,4-thiadiazol-2-yl)-N-methylurea
- N-(5-(1,1-Dimethylethyl)-1,3,4-thiadiazol-2-yl)-urea
- NALED
- NICOSULFURON
- OIET
- OXADIAZON
- OXAMYL
- OXYFLUORFEN
- PARAQUAT DICHLORIDE
- PENDIMETHALIN
- PENTACHLORONITROBENZENE (PCNB)
- PERMETHRIN
- PERMETHRIN, OTHER RELATED
- PHORATOXON
- PHOSMET (IMIDAN)
- PHOSMET-OA
- PROPARGITE
- PROPOXUR
- SIDURON
- SODIUM HYPOCHLORITE
- TERBUTHYLAZINE
- TETRACHLORVINPHOS (STIROFOS)
- THIOBENCARB
- THIOBENCARB SULFOXIDE
- THIRAM
- TPA (2,3,5,6-TETRACHLOROTEREPHTHALIC ACID) DEGRADATE OF CHLO
- TRIBUFOS
- TRIFLURALIN
- ZIRAM

DPR Prioritization

DPR conducted a technical analysis in 2011 that prioritized pesticides for sampling (DPR, 2011). The prioritization table is replicated below.

Table 1. Prioritization of pesticides for future analytical method development and ground water monitoring.

Pesticide rank	Pesticide type	Main sites/crops of application	Estimated proportion of soil applications	Annual state-wide use (lbs)	Average annual rate of change in use 1994 – 2007
		High priority monitoring			
1 Isoxaben	Herbicide	Rights of Way (55%), Landscape Maintenance (28%), N-Outdr Container/Fld Grwn Plants (9.8%), Structural Pest Control (1.1%), Almond (1.1%)	95%	26,761 (2006) 22,818 (2007)	9% increase
2 Linuron	Herbicide	Carrots, General (81%), Asparagus (Spears, Ferns, etc.) (13%), Celery, General (4.9%), Rights of Way (1.0%)	Probably >50% [z]	59,164 (2006) 58,592 (2007)	3% decrease
3 Propyzamide	Herbicide	Lettuce head (60%) Lettuce leaf (33%) Artichoke (2%) Landscape Maintenance (1%)	75%	121,711 (2006) 114,860 (2007)	No change
4 Thiobencarb	Herbicide	Rice (99.9%)	100%	310,352 (2006) 289,046 (2007)	No change
5 Mefenoxam	Fungicide	Carrots, General (28%), Spinach (12%), Onion (Dry, Spanish, White, Yellow, Red, etc.) (8.7%), Tomatoes, For Processing/Canning (7.6%), Strawberry (All or Unspec) (5.1%)	90%	72,958 (2006) 57,444 (2007)	8% increase
		Medium priority monitoring			
6 Ethofumesate	Herbicide	Sugarbeet (60%) Landscape maintenance (30%) Ornamental Turf (3.5%) Structual Pest Control (1%)	60% [z]	17,127 (2006) 18,495 (2007)	No change [y]
7 Flutolanil	Fungicide	Landscape Maintenance (97%), Structural Pest Control (1.2%), Ornamental Turf (All or Unspec) (0.4%)	75%	11,372 (2006) 10,843 (2007)	14% increase
8 Thiamethoxam	Insecticide	Cotton (64%) Commodity Fumigation (11%) Tomatoes (8%) Cataloupe (4%) Peppers (2%)	8%	13,964 (2006) 9,428 (2007)	No change
9 Ethoprop [x]	Insecticide, nematicide	Potato (71%) Sweet Potato (10%) Cabbage (6%) Beans Dried Type (4%) Beans Succulent (3%)	70%	24,485 (2006) 24,241 (2007)	6% increase
10 Pyrazon	Herbicide	Sugarbeet (95%) Beets (1%) Wheat (1%) Soil app. Preplant-outdoor seedbeds (1%)	99%	4,196 (2006) 2,712 (2007)	No change [y]
		Low priority monitoring			
11 Vinclozolin [w]	Fungicide	Lettuce head (52%) Strawberry (18%) Lettuce leaf (8%) N-Out Grwn Cut Flwrs or Greens (4%) Peach (4%)	<5%	402 (2006) 390 (2007)	14% decrease
12 2,4-D	Herbicide	Wheat (26%) Almond (10%) ROW (7%) Barley (7%) Landscape Mantenance (5%)	<1%	439,049 (2006) 397,154 (2007)	No change
13 Methomyl	Insecticide	Lettuce, Head (All or Unspec) (16%), Alfalfa (Forage - Fodder) (Alfalfa Hay) (15%), Corn, Human Consumption (6.2%), Grapes (5.8%), Tomatoes, For Processing/Canning (5.8%)	<1%	318,089 (2006) 307,154 (2007)	9% decrease
14 Metalaxyl	Fungicide	Cotton, General (15%), Carrots, General (11%), Onion (Dry, Spanish, White, Yellow, Red, etc.) (9.3%), Tomatoes, For Processing/Canning (8.1%), Tomato (7.1%)	~50%	1,654 (2006) 492 (2008) [v]	27% decrease

Evaluation of DPR Technical Approach

The DPR Groundwater Protection Program is a comprehensive regulatory program that evaluates risk to groundwater posed by the range of registered agricultural pesticides. The following characteristics demonstrate the robustness of the DPR Groundwater Protection Program:

- DPR's Well Inventory Database includes pesticide and degradate sampling of groundwater performed by DPR, municipal water suppliers and other entities. The database is publically available and includes sufficient information for independent review and follow-up.
- DPR has, as required, identified and implemented Groundwater Protection Zones with specific limitations for areas determined to be vulnerable to certain pesticides.
- DPR performs its own sampling based on a prioritization that accounts for the physical-chemical properties and usage of pesticides. This approach prioritizes sampling of pesticides with characteristics that could contribute to pesticide leaching to groundwater, and it defers sampling of pesticides with properties that would prevent migration into groundwater.
- The derivation of the Special Numeric Values used to assign leaching or non-leaching designations to pesticides is published.
- The program includes documented follow-up of detections, confirmatory sampling, and annual reporting of detections and activities.
- DPR's technical approach to evaluate pesticide risk to groundwater is documented in publically available technical reports.
- DPR has demonstrated use of its regulatory authority to address pesticides posing a risk to groundwater.
- DPR actively coordinates with other agencies evaluating groundwater, including USGS and SWRCB.