

SPARTA AQUIFER SUMMARY, 2010

AQUIFER SAMPLING AND ASSESSMENT PROGRAM



APPENDIX 1 TO THE 2012 TRIENNIAL SUMMARY REPORT
PARTIAL FUNDING PROVIDED BY THE CWA



Contents

BACKGROUND	4
GEOLOGY	4
HYDROGEOLOGY	4
PROGRAM PARAMETERS	5
INTERPRETATION OF DATA	6
Field and Conventional Parameters.....	6
Inorganic Parameters	7
Volatile Organic Compounds	7
Semi-Volatile Organic Compounds.....	7
Pesticides and PCBs	7
WATER QUALITY TRENDS AND COMPARISON TO HISTORICAL ASSET DATA.....	8
SUMMARY AND RECOMMENDATIONS	8
Table 1-1: List of Wells Sampled, Sparta Aquifer–FY 2010	9
Table 1-2: Summary of Field and Conventional Data, Sparta Aquifer–FY 2010	10
Table 1-3: Summary of Inorganic Data, Sparta Aquifer–FY 2010	11
Table 1-4: FY 2010 Field and Conventional Statistics, ASSET Wells	12
Table 1-5: FY 2010 Inorganic Statistics, ASSET Wells.....	12
Table 1-6: Triennial Field and Conventional Statistics, ASSET Wells.....	13
Table 1-7: Triennial Inorganic Statistics, ASSET Wells	13
Table 1-8: VOC Analytical Parameters.....	14
Table 1-9: SVOC Analytical Parameters	15
Table 1-10: Pesticides and PCBs.....	16
Figure 1-1: Location Plat, Sparta Aquifer	17
Figure 1-2: Map of pH Data.....	18
Figure 1-3: Map of TDS Lab Data	19
Figure 1-4: Map of Chloride Data	20
Figure 1-5: Map of Iron Data	21
Chart 1-1: Temperature Trend	22
Chart 1-2: pH Trend	22
Chart 1-3: Field Specific Conductance Trend.....	23
Chart 1-4: Lab Specific Conductance Trend.....	23

Chart 1-5: Field Salinity Trend.....24

Chart 1-6: Alkalinity Trend.....24

Chart 1-7: Chloride Trend25

Chart 1-8: Color Trend25

Chart 1-9: Sulfate (SO4) Trend26

Chart 1-10: Total Dissolved Solids (TDS) Trend.....26

Chart 1-11: Ammonia (NH3) Trend27

Chart 1-12: Hardness Trend.....27

Chart 1-13: Nitrite – Nitrate Trend28

Chart 1-14: TKN Trend.....28

Chart 1-15: Total Phosphorus Trend29

Chart 1-16: Iron Trend.....29



BACKGROUND

The Louisiana Department of Environmental Quality's (LDEQ) Aquifer Sampling and Assessment Program (ASSET) is an ambient monitoring program established to determine and monitor the quality of groundwater produced from Louisiana's major freshwater aquifers. The ASSET Program samples approximately 200 water wells located in 14 aquifers and aquifer systems across the state. The sampling process is designed so that all fourteen aquifers and aquifer systems are monitored on a rotating basis, within a three year period so that each well is monitored every three years.

In order to better assess the water quality of a particular aquifer, an attempt is made to sample all ASSET Program wells producing from it in a narrow time frame. To more conveniently and economically promulgate those data collected, a summary report on each aquifer is prepared separately. Collectively, these aquifer summaries will make up, in part, the ASSET Program's Triennial Summary Report for 2012.

Analytical and field data contained in this summary were collected from wells producing from the Sparta aquifer, during the 2010 state fiscal year (July 1, 2009 - June 30, 2010). This summary will become Appendix I of ASSET Program Triennial Summary Report for 2012.

Fourteen Sparta aquifer wells were sampled in July and August of 2009. Eleven of the fourteen are classified as public supply, while the remaining three wells are classified as industrial use. The wells are located in ten parishes in the north-central area of the state.

Figure 1-1 shows the geographic locations of the Sparta aquifer and the associated wells, whereas Table 1-1 lists the wells in the aquifer along with their total depths, use made of produced waters and date sampled.

Well data for registered water wells were obtained from the Louisiana Department of Natural Resources' water well registration data file.

GEOLOGY

The Sparta aquifer system is within the Eocene Sparta formation of the Claiborne group. The aquifer units consist of fine to medium sand with interbedded coarse sand, silty clay and lignite. Interconnected sands become more massive and coarsen slightly with depth and are laterally discontinuous. The Sparta aquifer is confined downdip by the clays of the overlying Cook Mountain formation and the clays and silty clays of the Cane River formation.

HYDROGEOLOGY

The Sparta aquifer is recharged through direct infiltration of rainfall, the movement of water through overlying terrace and alluvial deposits, and leakage from the Cockfield and Carrizo-Wilcox aquifers. The Sparta is pumped in a large area of north-central Louisiana and in a narrow band through Natchitoches and Sabine Parishes. The two areas are separated by a saltwater ridge below the Red River valley. Groundwater movement is eastward toward the

Mississippi River Valley and southward toward the Gulf of Mexico, except when altered by heavy pumping, and the hydraulic conductivity varies between 25 and 100 feet/day.

The maximum depths of occurrence of freshwater in the Sparta range from 200 feet above sea level to 1,700 feet below sea level. The range of thickness of the fresh water interval in the Sparta is 50 to 700 feet. The depths of the Sparta wells that were monitored in conjunction with the ASSET Program range from 153 to 773 feet below land surface.

PROGRAM PARAMETERS

The field parameters checked at each ASSET well sampling site and the list of conventional parameters analyzed in the laboratory are shown in Table 1-2. The inorganic (total metals) parameters analyzed in the laboratory are listed in Table 1-3. These tables also show the field and analytical results determined for each analyte. For quality control, duplicate samples were taken for each parameter at wells CA-105, L-31, SA-534, W-165, and WB-241.

In addition to the field, conventional and inorganic analytical parameters, the target analyte list includes three other categories of compounds: volatiles, semi-volatiles, and pesticides/PCBs. Due to the large number of analytes in these categories, tables were not prepared showing the analytical results for these compounds. A discussion of any detections from any of these three categories, if necessary, can be found in their respective sections. Tables 1-8, 1-9 and 1-10 list the target analytes for volatiles, semi-volatiles and pesticides/PCBs, respectively.

Tables 1-4 and 1-5 provide a statistical overview of field and conventional data, and inorganic data for the Sparta aquifer, listing the minimum, maximum, and average results for these parameters collected in the FY 2010 sampling. Tables 1-6 and 1-7 compare these same parameter averages to historical ASSET-derived data for the Sparta aquifer, from fiscal years 1995, 1998, 2001, 2004 and 2007.

The average values listed in the above referenced tables are determined using all valid, reported results, including non-detects. Per Departmental policy concerning statistical analysis, one-half of the detection limit (DL) is used in place of zero when non-detects are encountered. However, the minimum value is reported as less than the DL, not one-half the DL. If all values for a particular analyte are reported as non-detect, then the minimum, maximum, and average values are all reported as less than the DL. For contouring purposes, one-half the DL is also used for non-detects in the figures and charts referenced below.

Figures 1-2, 1-3, 1-4, and 1-5, respectively, represent the contoured data for pH, total dissolved solids (TDS), chloride (Cl) and iron. Charts 1-1 through 1-16 represent the trend of the graphed parameter, based on the averaged value of that parameter for each three-year reporting period. Discussion of historical data and related trends is found in the **Water Quality Trends and Comparison to Historical ASSET Data** section.

INTERPRETATION OF DATA

Under the Federal Safe Drinking Water Act, EPA has established maximum contaminant levels (MCLs) for pollutants that may pose a health risk in public drinking water. An MCL is the highest level of a contaminant that EPA allows in public drinking water. MCLs ensure that drinking water does not pose either a short-term or long-term health risk. While not all wells sampled were public supply wells, the ASSET Program uses MCLs as a benchmark for further evaluation.

EPA has also set Secondary MCLs (SMCLs), which are defined as non-enforceable taste, odor, or appearance guidelines. Field and laboratory data contained in Tables 1-2 and 1-3 show that one or more SMCLs were exceeded in 12 of the 14 wells sampled in the Sparta aquifer, with a total of 25 SMCLs being exceeded.

Field and Conventional Parameters

Table 1-2 shows the field and conventional parameters for which samples are collected at each well and the analytical results for those parameters. Table 1-4 provides an overview of this data for the Sparta aquifer, listing the minimum, average, and maximum results for these parameters.

Federal Primary Drinking Water Standards: A review of the analysis listed in Table 1-2 shows that no MCL was exceeded for field or conventional parameters for this reporting period. Those ASSET wells reporting turbidity levels greater than 1.0 NTU do not exceed the MCL of 1.0, as this standard applies to public supply water wells that are under the direct influence of surface water. The Louisiana Department of Health and Hospitals has determined that no public water supply well in Louisiana was in this category.

Federal Secondary Drinking Water Standards: A review of the analysis listed in Table 1-2 shows that 9 wells exceeded the SMCL for pH, 6 wells exceeded the SMCL for total dissolved solids, 3 exceeded the SMCL for chloride and 4 exceeded the SMCL for color. Laboratory results override field results in exceedance determination, thus only laboratory results will be counted in determining SMCL exceedance numbers for TDS. Following is a list of SMCL parameter exceedances with well number and results:

pH (SMCL = 6.5 – 8.5 Standard Units):

BI-192 – 5.77 SU	CA-105 – 8.94 SU (Original and Duplicate)
CL-203 – 6.33 SU	MO-253 – 9.04 SU
OU-506 – 9.31 SU	OU-597 – 9.02 SU
UN-205 – 8.75 SU	W-165 – 8.60 SU (Original and Duplicate)
WB-269 – 6.29 SU	

Total Dissolved Solids (SMCL = 500 mg/L or 0.5 g/L):

	<u>LAB RESULTS (in mg/L)</u>	<u>FIELD MEASURES (in g/L)</u>
CA-105	698 mg/L, Duplicate – 707 mg/L	0.90 g/L (Original and Duplicate)
MO-253	1,110 mg/L	1.28 g/L
OU-506	512 mg/L	0.57 g/L
OU-597	1,120 mg/L	1.31 g/L
UN-205	898 mg/L,	0.95 g/L
WB-241	625 mg/L, Duplicate – 636 mg/L	< SMCL

Chloride (SMCL = 250 mg/L):

MO-253 – 398 mg/L
UN-205 – 347 mg/L

OU-597 – 466 mg/L

Color (SMCL = 15 color units (PCU)):

CA-105 – 24 PCU, Duplicate 27 PCU
OU-597 – 17

MO-253 – 16 PCU
SA-534 – 31 PCU, Duplicate – 25 PCU

Inorganic Parameters

Table 1-3 shows the inorganic (total metals) parameters for which samples are collected at each well and the analytical results for those parameters. Table 1-5 provides an overview of inorganic data for the Sparta aquifer, listing the minimum, average, and maximum results for these parameters.

Federal Primary Drinking Water Standards: A review of the analyses listed on Table 1-3 shows that no MCL was exceeded for total metals.

Federal Secondary Drinking Water Standards: Laboratory data contained in Table 1-3 shows that 3 wells exceeded the SMCL for iron:

Iron (SMCL = 300 ug/L):

BI-212 – 1,960 ug/L
SA-534 – 5,130 ug/L, Duplicate – 4,560 ug/L

CL-203 – 1,160 ug/L

Volatile Organic Compounds

Table 1-8 shows the volatile organic compound (VOC) parameters for which samples are collected at each well. Due to the number of analytes in this category, analytical results are not tabulated; however, any detection of a VOC would be discussed in this section.

Several wells reported low levels of VOCs usually contributed to lab contamination. One VOC, chloromethane was reported in every sample, which supports the likelihood that the VOC detections reported by the lab are due to lab contamination and not contamination of the groundwater. Additionally, none of the VOCs reported have MCLs established for them, so no drinking water standard was exceeded.

Semi-Volatile Organic Compounds

Table 1-9 shows the semi-volatile organic compound (SVOC) parameters for which samples are collected at each well. Due to the number of analytes in this category, analytical results are not tabulated; however, any detection of a SVOC would be discussed in this section.

No SVOC was detected at or above its detection limit during the FY 2010 sampling of the Sparta aquifer.

Pesticides and PCBs

Table 1-10 shows the pesticide and PCB parameters for which samples are collected at each well. Due to the number of analytes in this category, analytical results are not tabulated; however, any detection of a pesticide or PCB would be discussed in this section.

No pesticide or PCB was detected at or above its detection limit during the FY 2010 sampling of the Sparta aquifer.

WATER QUALITY TRENDS AND COMPARISON TO HISTORICAL ASSET DATA

Analytical and field data show that the quality and characteristics of groundwater produced from the Sparta aquifer exhibit some trends when comparing current data to that of the five previous sampling rotations (three, six, nine, twelve, and fifteen years prior). These comparisons can be found in Tables 1-6 and 1-7, and in Charts 1-1 to 1-16 of this summary. Over the fifteen-year period, 12 analytes have shown a general increase in average concentration. These analytes are: pH, specific conductance (field and lab), salinity, alkalinity, chloride, sulfate, total dissolved solids, ammonia, turbidity, barium, iron, and zinc. For this same time period six analytes; temperature, color, hardness, nitrite-nitrate, TKN, and total phosphorous, have demonstrated a decrease in average concentration, while all other analytes have remained consistent for this time period.

The current number of wells with SMCL exceedances and the current total number of SMCL exceedances have increased since the previous sampling event in FY 2007. Current sample results show that 12 wells reported one or more SMCL exceedance with a total of 25 SMCL exceedances. The FY 2007 sampling of the Sparta aquifer shows that ten wells reported one or more SMCL exceedance with a total of 20 exceedances.

SUMMARY AND RECOMMENDATIONS

In summary, the data show that the groundwater produced from this aquifer is soft¹ and is of good quality when considering short-term or long-term health risk guidelines. Laboratory data show that no ASSET well that was sampled during the Fiscal Year 2010 monitoring of the Sparta aquifer exceeded an MCL. The data also show that this aquifer is of fair quality when considering taste, odor, or appearance guidelines, with 25 SMCLs exceeded in 12 wells.

Comparison to historical ASSET-derived data shows some change in the quality or characteristics of the Sparta aquifer, with 12 parameters showing increases in concentration, 6 parameters decreasing in concentration, and the remaining parameters showing no consistent change over the previous 15 years.

It is recommended that the wells assigned to the Sparta aquifer be resampled as planned, in approximately three years. In addition, several wells should be added to the 14 currently in place to increase the well density for this aquifer.

¹ Classification based on hardness scale from: Peavy, H. S. et al. *Environmental Engineering*. New York: McGraw-Hill, 1985.

Table 1-1: List of Wells Sampled, Sparta Aquifer–FY 2010

DOTD Well Number	Parish	Date	Owner	Depth (Feet)	Well Use
BI-192	BIENVILLE	8/4/2009	LUCKY WATER SYSTEM	153	PUBLIC SUPPLY
BI-212	BIENVILLE	8/4/2009	ROCKTENN	490	INDUSTRIAL
CA-105	CALDWELL	7/21/2009	VIXEN WATER SYSTEM	525	PUBLIC SUPPLY
CL-203	CLAIBORNE	8/18/2009	TOWN OF HOMER	460	PUBLIC SUPPLY
L-31	LINCOLN	8/11/2009	CITY OF RUSTON	636	PUBLIC SUPPLY
L-32	LINCOLN	8/11/2009	CITY OF RUSTON	652	PUBLIC SUPPLY
MO-253	MOREHOUSE	7/21/2009	VILLAGE OF COLLINSTON	773	PUBLIC SUPPLY
OU-506	OUACHITA	7/21/2009	ANGUS CHEMICAL	506	INDUSTRIAL
OU-597	OUACHITA	7/21/2009	GRAPHIC PACKAGING INT'L INC.	710	INDUSTRIAL
SA-534	SABINE	8/24/2009	BOISE - FLORIEN	543	PUBLIC SUPPLY
UN-205	UNION	8/11/2009	D'ARBONNE WATER SYSTEM	725	PUBLIC SUPPLY
W-165	WINN	8/4/2009	TOWN OF WINNFIELD	456	PUBLIC SUPPLY
WB-241	WEBSTER	8/18/2009	TOWN OF SPRINGHILL	408	PUBLIC SUPPLY
WB-269	WEBSTER	8/18/2009	CITY OF MINDEN	280	PUBLIC SUPPLY

Table 1-2: Summary of Field and Conventional Data, Sparta Aquifer–FY 2010

DOTD Well Number	Temp Deg C	pH SU	Sp Cond mmhos/cm	Sal ppt	TDS g/L	Alk mg/L	NH3 mg/L	Cl mg/L	Color PCU	Sp Cond umhos/cm	Hard mg/L	Nitrite-Nitrate (as N) mg/L	SO4 mg/L	TDS mg/L	TSS mg/L	TKN mg/L	Tot P mg/L	Turb NTU
	LABORATORY DETECTION LIMITS →					2	1	1.25	1	10	5	0.01	5	10	4	0.3	0.05	0.3
	FIELD PARAMETERS					LABORATORY PARAMETERS												
BI-192	19.98	5.77	0.025	0.01	0.016	10	<1	<1.25	<1	27	<5	0.968	<5	23	<4	<0.3	<0.05	0.45
BI-212	20.92	6.65	0.204	0.10	0.133	8	<1	10.2	5	197	<5	<0.01	11.0	161	<4	<0.3	0.177	1.06
CA-105	22.71	8.94	1.061	0.53	0.690	538	<1	19.1	24	1,020	<5	<0.01	<5	698	<4	0.63	0.821	1.24
CA-105*	22.71	8.94	1.061	0.53	0.690	530	<1	19.1	27	966	<5	<0.01	<5	707	6	0.70	0.816	1.25
CL-203	21.10	6.33	0.134	0.06	0.087	50	<1	6.8	<1	126	20	<0.01	8.02	94	<4	<0.3	0.066	0.52
L-31	26.85	7.46	0.405	0.19	0.263	156	<1	33.8	<1	401	<5	0.067	10.9	251	<4	0.35	0.528	1.49
L-31*	26.85	7.46	0.405	0.19	0.263	160	<1	33.8	<1	402	<5	0.103	11.5	256	<4	0.49	0.520	1.58
L-32	25.64	7.94	0.325	0.15	0.211	144	<1	11.8	<1	317	<5	0.013	13.6	239	16	<0.3	0.297	4.40
MO-253	24.78	9.04	1.963	1.00	1.276	370	<1	398.0	16	1,920	<5	<0.01	<5	1,110	<4	0.91	0.554	<0.3
OU-506	22.35	9.31	0.879	0.43	0.571	282	<1	115.0	7	850	<5	<0.01	<5	512	<4	0.77	0.522	1.26
OU-597	24.75	9.02	2.012	1.02	1.308	322	<1	466.0	17	1,950	<5	<0.01	<5	1,120	<4	0.70	0.554	1.57
SA-534	22.57	7.53	0.188	0.09	0.122	76	<1	13.5	31	179	12	<0.01	<5	111	9	<0.6	0.055	34.30
SA-534*	22.57	7.53	0.188	0.09	0.122	74	<1	13.5	25	178	20	<0.01	<5	104	8	<0.6	0.060	34.00
UN-205	24.67	8.75	1.456	0.73	0.946	160	<1	347.0	<1	1,430	<5	<0.01	<5	898	<4	0.35	0.201	0.75
W-165	22.89	8.60	0.678	0.33	0.441	270	<1	54.5	7	664	<5	0.768	7.5	404	<4	1.05	0.606	0.61
W-165*	22.89	8.60	0.678	0.33	0.441	254	<1	54.5	6	665	<5	1.300	8.9	433	<4	0.63	0.501	0.67
WB-241	20.68	7.62	0.749	0.37	0.486	246	<1	76.7	<1	699	60	<0.01	18.6	625	<4	<0.3	0.072	1.65
WB-241*	20.68	7.62	0.749	0.37	0.486	260	<1	76.7	<1	707	60	<0.01	18.8	636	<4	<0.3	0.074	1.59
WB-269	19.82	6.29	0.394	0.19	0.256	44	<1	106.0	<1	460	28	1.660	20.0	252	<4	<0.3	0.053	2.18

*Denotes Duplicate Sample

Shaded cells exceed EPA Secondary Standards

Table 1-3: Summary of Inorganic Data, Sparta Aquifer–FY 2010

DOTD Well Number	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Cadmium ug/L	Chromium ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Mercury ug/L	Nickel ug/L	Selenium ug/L	Silver ug/L	Thallium ug/L	Zinc ug/L
Laboratory Detection Limits	5	4	5	2	2	4	2	100	1	0.0002	3	5	1	2	6/10/20
BI-192	<5	<4	22.7	<2	<2	<4	<2	<100	<1	<0.0002	<3	<5	<1	<2	16.2
BI-212	<5	<4	69.3	<2	<2	4.71	<2	1,960	<1	<0.0002	<3	<5	<1	<2	<10
CA-105	<5	<4	16.5	<2	<2	<4	<2	<100	<1	<0.0002	<3	<5	<1	<2	<6
CA-105*	<5	<4	18.0	<2	<2	<4	<2	<100	<1	<0.0002	<3	<5	<1	<2	<6
CL-203	<5	<4	59.9	<2	<2	<4	<2	1,160	<1	<0.0002	<3	<5	<1	<2	<20
L-31	<5	<4	13.9	<2	<2	<4	<2	107	<1	<0.0002	<3	<5	<1	<2	7.7
L-31*	<5	<4	13.5	<2	<2	<4	<2	<100	<1	<0.0002	<3	<5	<1	<2	<6
L-32	<5	<4	11.4	<2	<2	<4	8.46	<100	<1	<0.0002	<3	<5	<1	<2	10.1
MO-253	<5	<4	25.7	<2	<2	<4	2.85	<100	<1	0.000222	13.2	<5	<1	<2	29.1
OU-506	<5	<4	9.3	<2	<2	5.32	2.19	<100	<1	<0.0002	26.3	<5	<1	<2	231.0
OU-597	<5	<4	64.5	<2	<2	4.39	3.64	<100	<1	0.000232	22.2	<5	<1	<2	<6
SA-534	<5	<4	30.5	<2	<2	<4	2.82	5,130	1.83	<0.0002	<3	5.23	<1	<2	184.0
SA-534*	<5	<4	29.5	<2	<2	<4	<2	4,560	<1	<0.0002	<3	<5	<1	<2	103.0
UN-205	<5	<4	43.0	<2	<2	<4	2.68	<100	<1	<0.0002	<3	5.31	<1	<2	<6
W-165	<5	<4	26.1	<2	<2	5.07	13.20	<100	<1	<0.0002	<3	<5	<1	<2	<10
W-165*	<5	<4	22.9	<2	<2	<4	10.60	<100	<1	<0.0002	<3	<5	<1	<2	<6
WB-241	<5	<4	205.0	<2	<2	<4	<2	254	<1	<0.0002	<3	<5	<1	<2	<20
WB-241	<5	<4	217.0	<2	<2	<4	<2	294	<1	<0.0002	<3	<5	<1	<2	<20
WB-269	<5	<4	92.9	<2	<2	<4	40.50	<100	9.23	<0.0002	4.8	<5	<1	<2	21.4

*Denotes Duplicate Sample.

Shaded cells exceed EPA Secondary Standards

Table 1-4: FY 2010 Field and Conventional Statistics, ASSET Wells

	PARAMETER	MINIMUM	MAXIMUM	AVERAGE
FIELD	Temperature (°C)	19.82	26.85	22.92
	pH (SU)	5.77	9.31	7.86
	Specific Conductance (mmhos/cm)	0.025	2.012	0.71
	Salinity (ppt)	0.01	1.02	0.35
	TDS (g/L)	0.016	1.308	0.46
LABORATORY	Alkalinity (mg/L)	8	538	208.11
	Chloride (mg/L)	<1.25	466	97.72
	Color (PCU)	<1	31	8.92
	Specific Conductance (umhos/cm)	26.5	1950	692.50
	Sulfate (mg/L)	<5	20	7.97
	TDS (mg/L)	23	1120	454.42
	TSS (mg/L)	<4	16	<4
	Turbidity (NTU)	<0.3	34.3	4.77
	Ammonia, as N (mg/L)	<1	<1	<1
	Hardness (mg/L)	<5	60	12.24
	Nitrite - Nitrate, as N (mg/L)	<0.01	1.66	0.26
	TKN (mg/L)	<0.3	1.05	0.43
	Total Phosphorus (mg/L)	<0.05	0.821	0.34

Table 1-5: FY 2010 Inorganic Statistics, ASSET Wells

	PARAMETER	MINIMUM	MAXIMUM	AVERAGE
	Antimony (ug/L)	<5	<5	<5
	Arsenic (ug/L)	<4	<4	<4
	Barium (ug/L)	9.3	217.0	52.2
	Beryllium (ug/L)	<2	<2	<2
	Cadmium (ug/L)	<2	<2	<2
	Chromium (ug/L)	<4	5.3	2.6
	Copper (ug/L)	<2	40.5	5.1
	Iron (ug/L)	<100	5130.0	740.3
	Lead (ug/L)	<1	9.2	1.0
	Mercury (ug/L)	<0.0002	0.000232	<0.0002
	Nickel (ug/L)	<3	26.3	4.7
	Selenium (ug/L)	<5	5.3	<5
	Silver (ug/L)	<1	<1	<1
	Thallium (ug/L)	<2	<2	<2
	Zinc (ug/L)	<6	298.0	48.9

Table 1-6: Triennial Field and Conventional Statistics, ASSET Wells

PARAMETER		AVERAGE VALUES BY FISCAL YEAR					
		FY 1995	FY 1998	FY 2001	FY 2004	FY 2007	FY 2010
FIELD	Temperature (°C)	23.10	23.65	23.49	23.50	23.78	22.92
	pH (SU)	7.23	7.76	7.86	7.45	8.02	7.86
	Specific Conductance (mmhos/cm)	0.646	0.654	0.654	0.65	0.89	0.71
	Salinity (Sal.) (ppt)	0.30	0.32	0.32	0.32	0.44	0.35
	TDS (Total dissolved solids) (g/L)	-	-	-	0.420	0.580	0.460
LABORATORY	Alkalinity (Alk.) (mg/L)	185.5	203.2	178.3	185.5	202.6	208.1
	Chloride (Cl) (mg/L)	85.8	89.0	90.0	94.2	126.5	97.7
	Color (PCU)	25.9	21.7	17.7	16.1	14.6	8.9
	Specific Conductance (umhos/cm)	619.1	687.7	660.0	646.9	794.5	692.5
	Sulfate (SO4) (mg/L)	6.55	8.21	7.42	9.30	6.22	7.97
	TDS (Total dissolved solids) (mg/L)	356.5	442.7	391.1	405.7	461.4	454.4
	TSS (Total suspended solids) (mg/L)	<4	<4	<4	<4	<4	<4
	Turbidity (Turb.) (NTU)	1.32	2.21	1.45	1.18	<1	4.77
	Ammonia, as N (NH3) (mg/L)	0.34	0.46	0.33	0.48	0.44	<1
	Hardness (mg/L)	21.7	10.0	13.6	15.9	13.2	12.2
	Nitrite - Nitrate, as N (mg/L)	0.28	0.32	0.30	0.31	0.17	0.26
	TKN (mg/L)	0.58	0.52	0.45	0.59	0.50	0.43
	Total Phosphorus (P) (mg/L)	0.36	0.31	0.31	0.35	0.29	0.34

Table 1-7: Triennial Inorganic Statistics, ASSET Wells

PARAMETER		AVERAGE VALUES BY FISCAL YEAR					
		FY 1995	FY 1998	FY 2001	FY 2004	FY 2007	FY 2010
Antimony (ug/L)		<5	<5	<5	Invalid Data	<1	<5
Arsenic (ug/L)		<5	<5	<5	<5	<3	<4
Barium (ug/L)		36.5	30.7	50.4	61.8	46.9	52.2
Beryllium (ug/L)		<1	<1	<1	<1	<1	<2
Cadmium (ug/L)		<1	1.00	<1	<1	<0.5	<2
Chromium (ug/L)		<5	<5	<5	<5	<3	2.6
Copper (ug/L)		10.2	10.2	<5	5.8	3.1	5.1
Iron (ug/L)		212.5	283.7	517.4	405.8	410.1	740.3
Lead (ug/L)		<10	<10	<10	<10	<3	1.0
Mercury (ug/L)		<0.05	<0.05	<0.05	0.06	<0.05	<0.0002
Nickel (ug/L)		5.1	<5	<5	5.4	<3	4.7
Selenium (ug/L)		<5	<5	<5	<5, <30	<4	<5
Silver (ug/L)		<1	1.2	<1	<1	<0.5	<1
Thallium (ug/L)		<5	<5	<5	<5, <30	<1	<2
Zinc (ug/L)		16.2	20.8	14.2	16.5	<10	48.9

Table 1-8: VOC Analytical Parameters

COMPOUND	METHOD	DETECTION LIMIT (ug/L)
ETHYL BENZENE	624	0.5
CIS-1,3-DICHLOROPROPENE	624	0.5
TRANS-1,3-DICHLOROPROPENE	624	0.5
1,4-DICHLOROBENZENE	624	0.5
1,2-DICHLOROETHANE	624	0.5
TOLUENE	624	0.5
CHLOROBENZENE	624	0.5
DIBROMOCHLOROMETHANE	624	0.5
TETRACHLOROETHYLENE (PCE)	624	0.5
TRANS-1,2-DICHLOROETHENE	624	0.5
TERT-BUTYL METHYL ETHER	624	0.5
1,3-DICHLOROBENZENE	624	0.5
CARBON TETRACHLORIDE	624	0.5
CHLOROFORM	624	0.5
BENZENE	624	0.5
1,1,1-TRICHLOROETHANE	624	0.5
BROMOMETHANE	624	0.5
CHLOROMETHANE	624	0.5
CHLOROETHANE	624	0.5
VINYL CHLORIDE	624	0.5
METHYLENE CHLORIDE	624	0.5
BROMOFORM	624	0.5
BROMODICHLOROMETHANE	624	0.5
1,1-DICHLOROETHANE	624	0.5
1,1-DICHLOROETHENE	624	0.5
TRICHLOROFLUOROMETHANE (FREON-11)	624	0.5
1,2-DICHLOROPROPANE	624	0.5
1,1,2-TRICHLOROETHANE	624	0.5
TRICHLOROETHYLENE (TCE)	624	0.5
1,1,2,2-TETRACHLOROETHANE	624	0.5
1,2,3-TRICHLOROBENZENE	624	0.5
1,2-DICHLOROBENZENE	624	0.5
ETHYL BENZENE	624	0.5
CIS-1,3-DICHLOROPROPENE	624	0.5

Table 1-9: SVOC Analytical Parameters

COMPOUND	METHOD	DETECTION LIMIT (ug/L)
1,2,4-TRICHLOROBENZENE	625	5
2,4,6-TRICHLOROPHENOL	625	5
2,4-DICHLOROPHENOL	625	5
2,4-DIMETHYLPHENOL	625	5
2,4-DINITROPHENOL	625	20
2,4-DINITROTOLUENE	625	5
2,6-DINITROTOLUENE	625	5
2-CHLORONAPHTHALENE	625	5
2-CHLOROPHENOL	625	5
2-NITROPHENOL	625	10
3,3'-DICHLOROBENZIDINE	625	5
4,6-DINITRO-2-METHYLPHENOL	625	10
4-BROMOPHENYL PHENYL ETHER	625	5
4-CHLORO-3-METHYLPHENOL	625	5
4-CHLOROPHENYL PHENYL ETHER	625	5
4-NITROPHENOL	625	20
ACENAPHTHENE	625	5
ACENAPHTHYLENE	625	5
ANTHRACENE	625	5
BENZIDINE	625	20
BENZO(A)ANTHRACENE	625	5
BENZO(A)PYRENE	625	5
BENZO(B)FLUORANTHENE	625	5
BENZO(G,H,I)PERYLENE	625	5
BENZO(K)FLUORANTHENE	625	5
BENZYL BUTYL PHTHALATE	625	5
BIS(2-CHLOROETHOXY) METHANE	625	5
HEXACHLOROCYCLOPENTADIENE	625	5
HEXACHLOROETHANE	625	5
INDENO(1,2,3-C,D)PYRENE	625	5
ISOPHORONE	625	5
NAPHTHALENE	625	5
NITROBENZENE	625	5
N-NITROSODIMETHYLAMINE	625	5
N-NITROSODI-N-PROPYLAMINE	625	5
N-NITROSODIPHENYLAMINE	625	5

Table 1-9: SVOCs (Continued)

COMPOUND	METHOD	DETECTION LIMIT (ug/L)
PENTACHLOROBENZENE	625	5
PENTACHLOROPHENOL	625	10
PHENANTHRENE	625	5
PHENOL	625	5
PYRENE	625	5
TETRACHLOROBENZENE(S), TOTAL	625	10

Table 1-10: Pesticides and PCBs

COMPOUND	METHOD	DETECTION LIMITS (ug/L)
4,4'-DDD	8081	0.1
4,4'-DDE	8081	0.1
4,4'-DDT	8081	0.1
Aldrin	8081	0.05
Alpha-Chlordane	8081	0.05
alpha-BHC	8081	0.05
beta-BHC	8081	0.05
delta-BHC	8081	0.05
gamma-BHC	8081	0.05
Dieldrin	8081	0.1
Endosulfan I	8081	0.05
Endosulfan II	8081	0.1
Endosulfan Sulfate	8081	0.1
Endrin	8081	0.1
Endrin Aldehyde	8081	0.1
Endrin Ketone	8081	0.1
Heptachlor	8081	0.05
Heptachlor Epoxide	8081	0.05
Methoxychlor	8081	0.5
Toxaphene	8081	2
Gamma-Chlordane	8081	0.05
PCB-1016	8082	1
PCB-1221	8082	1
PCB-1232	8082	1
PCB-1242	8082	1
PCB-1248	8082	1
PCB-1254	8082	1
PCB-1260	8082	1

Figure 1-1: Location Plat, Sparta Aquifer

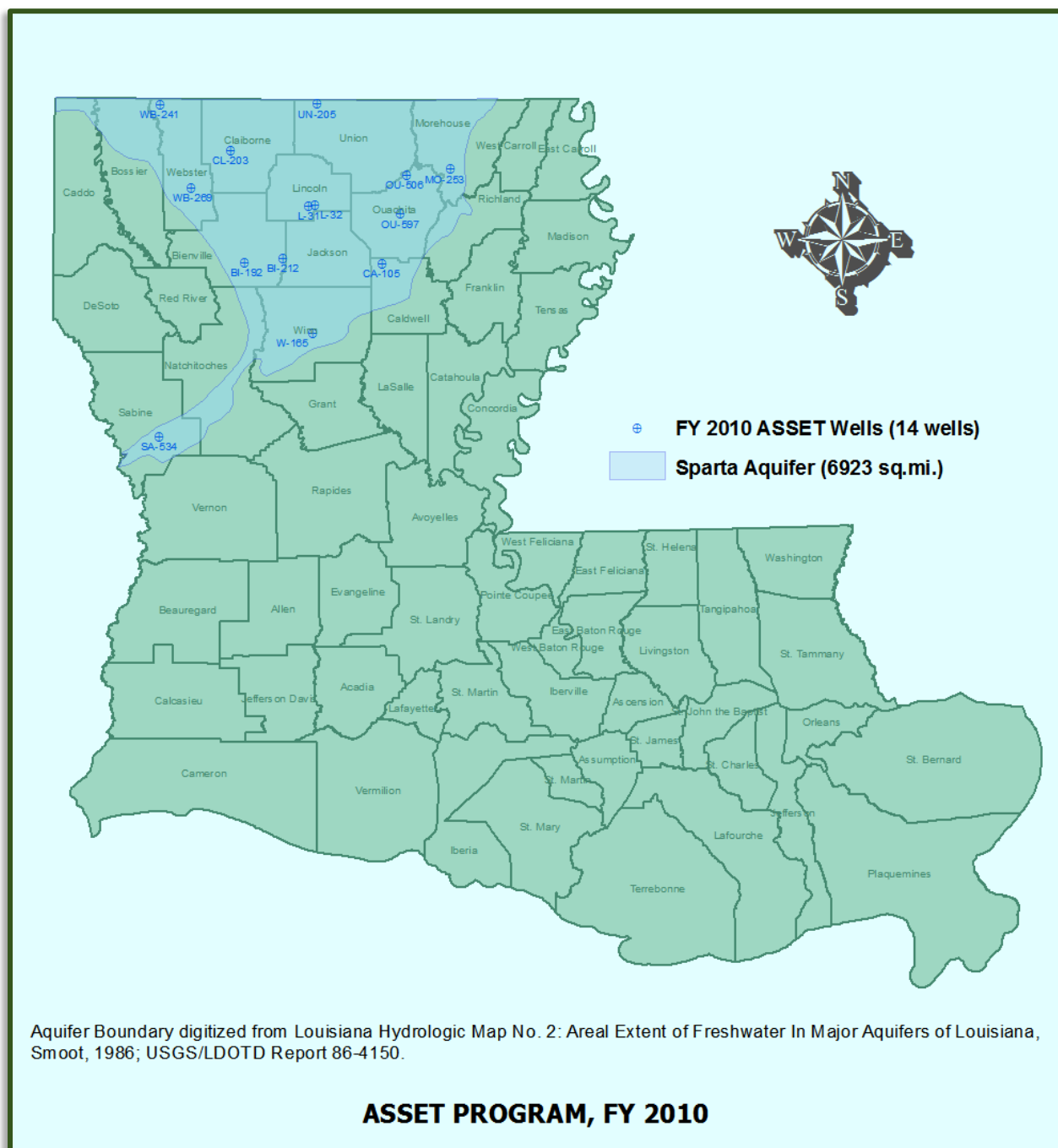


Figure 1-2: Map of pH Data

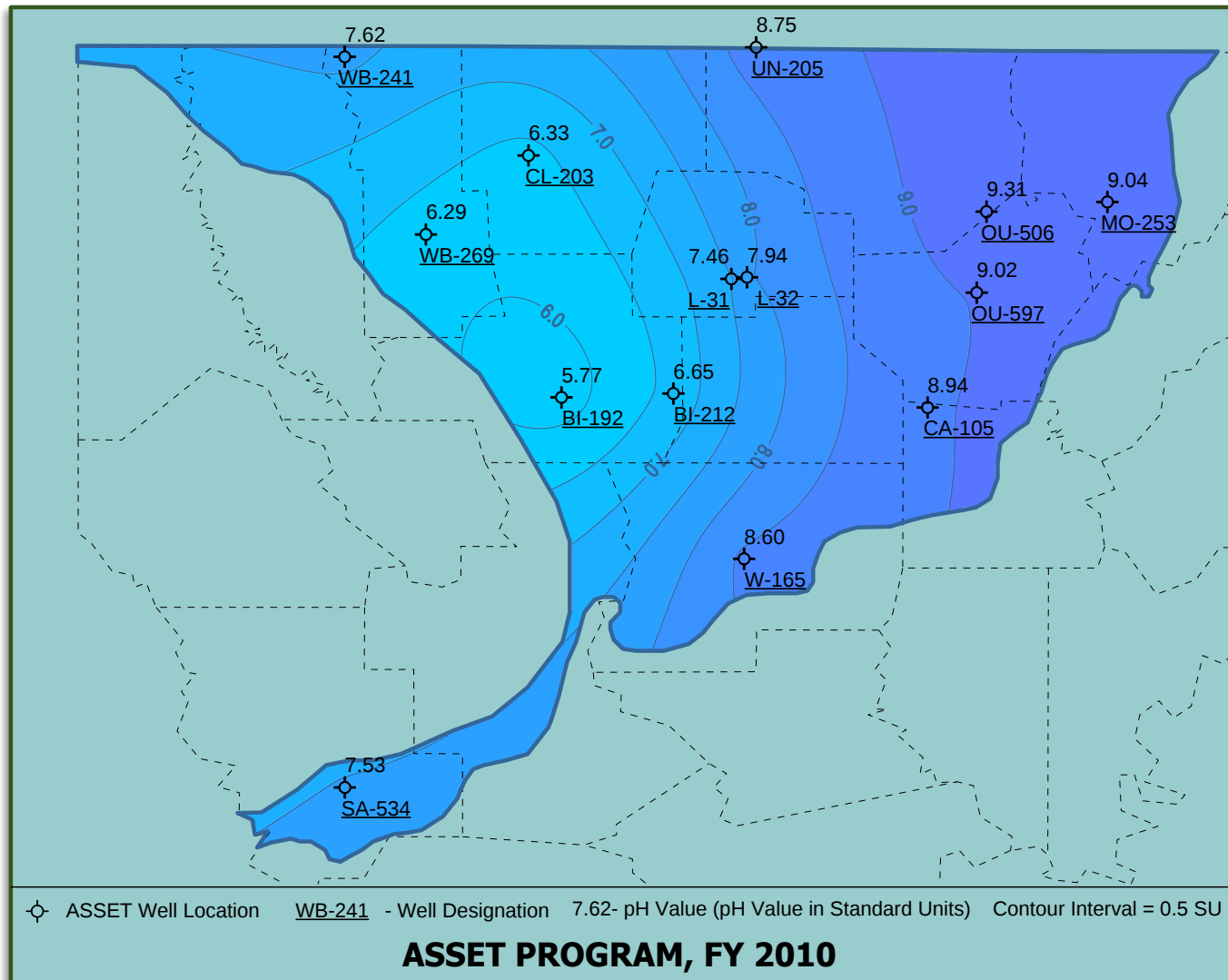


Figure 1-3: Map of TDS Lab Data

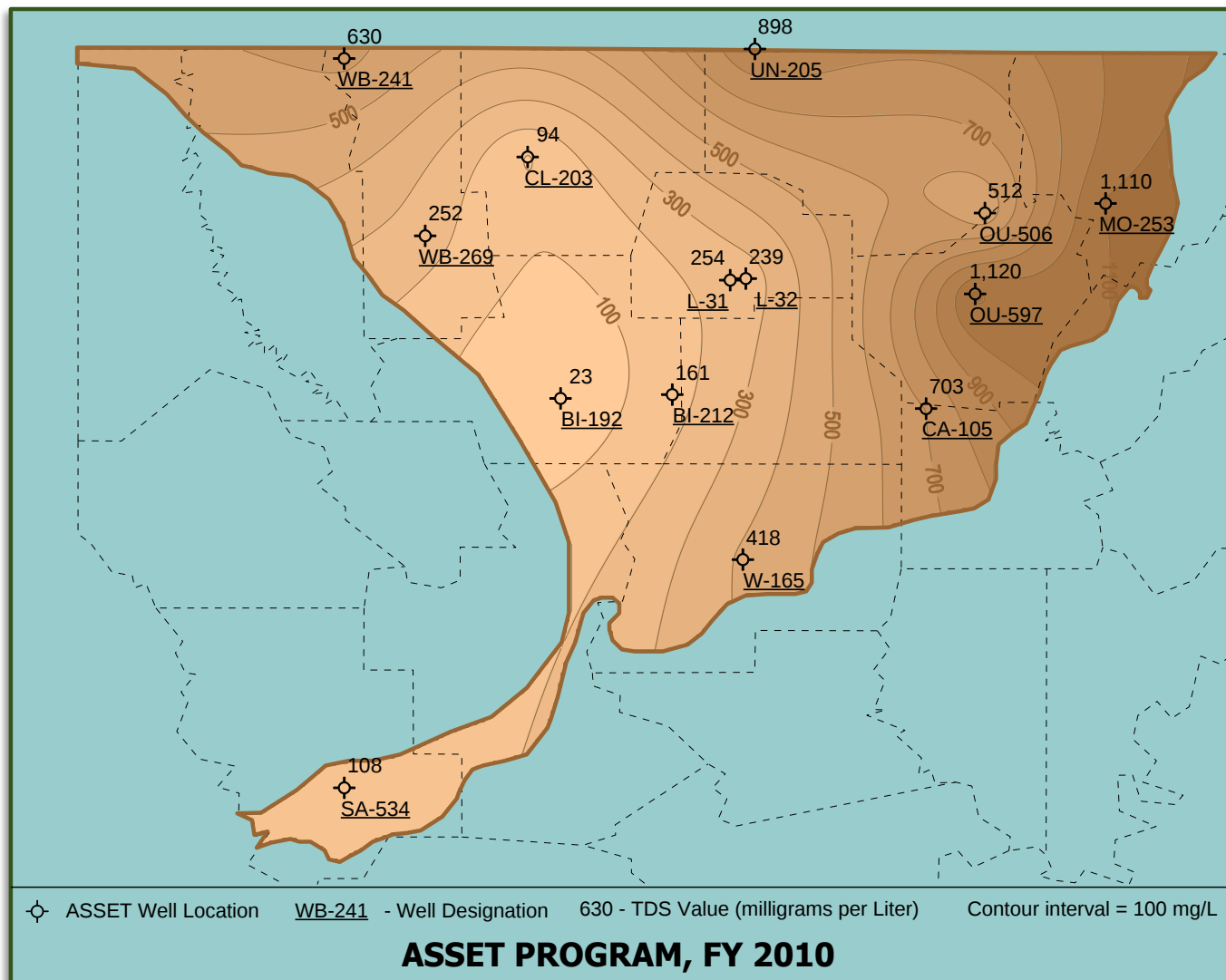


Figure 1-4: Map of Chloride Data

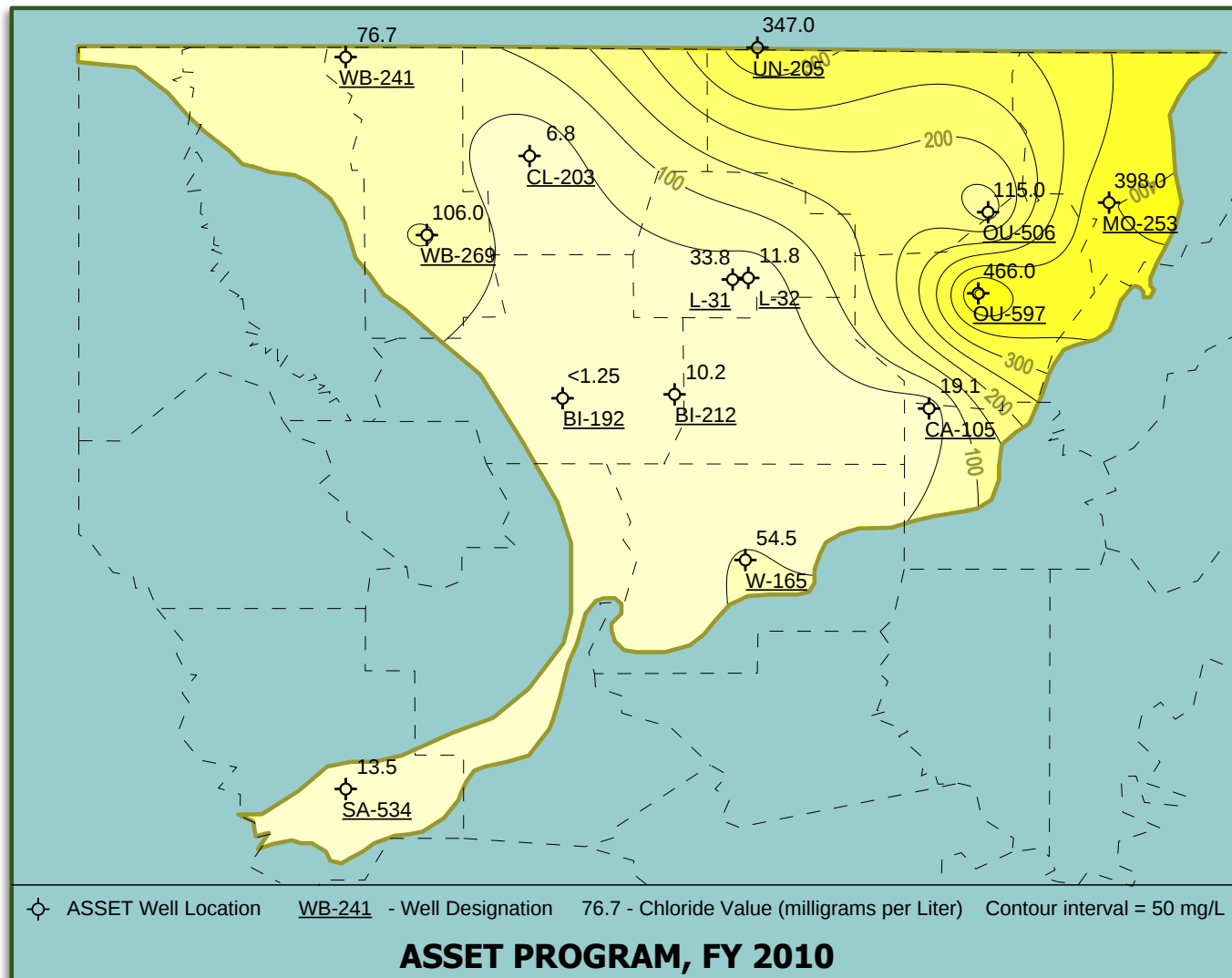


Figure 1-5: Map of Iron Data

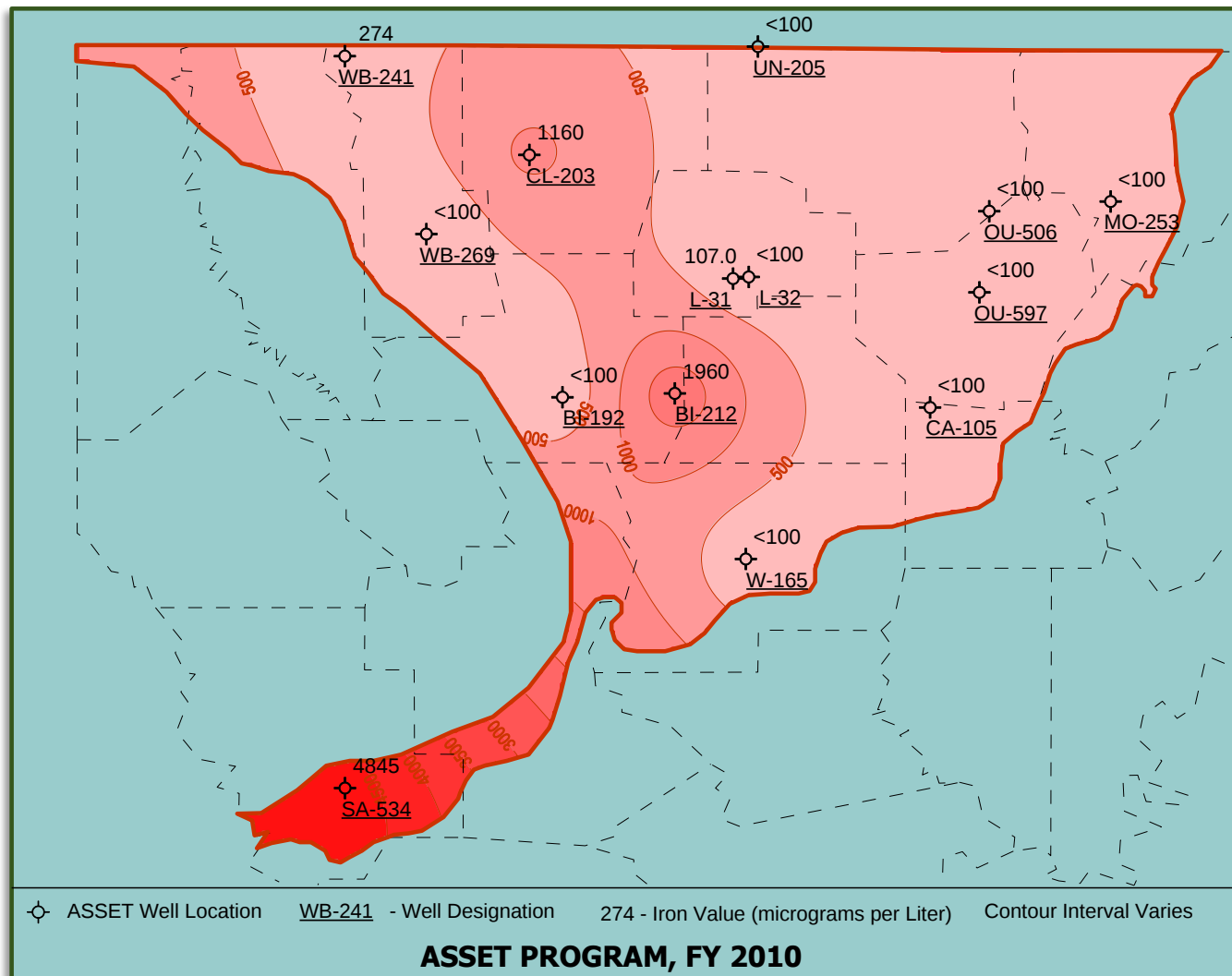


Chart 1-1: Temperature Trend

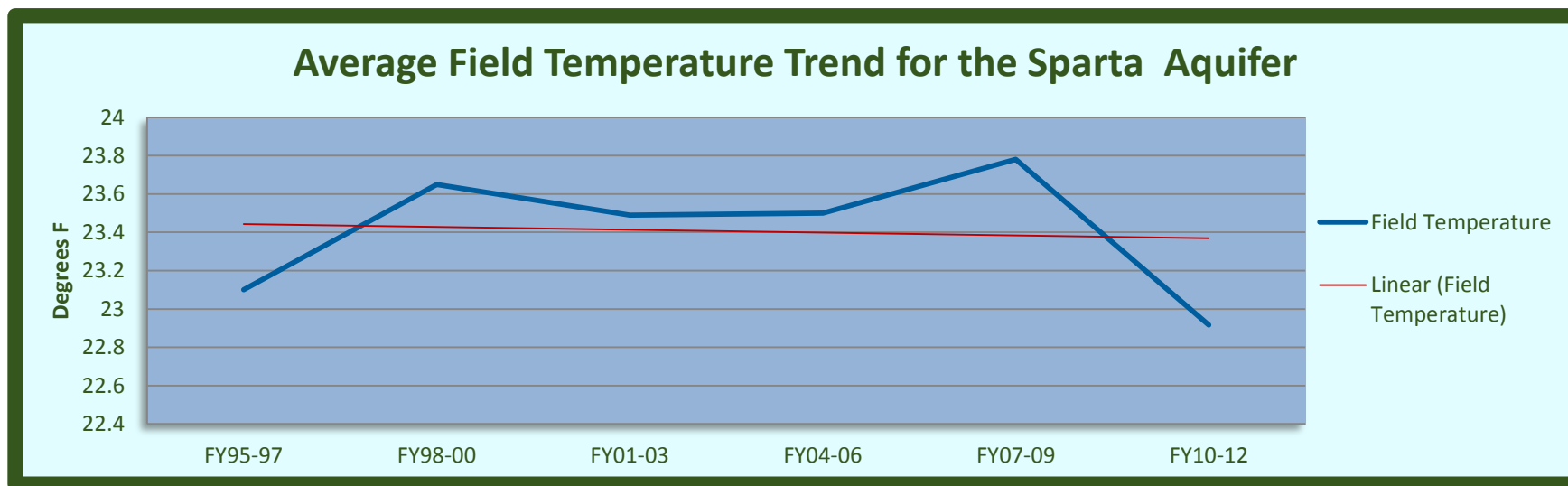


Chart 1-2: pH Trend

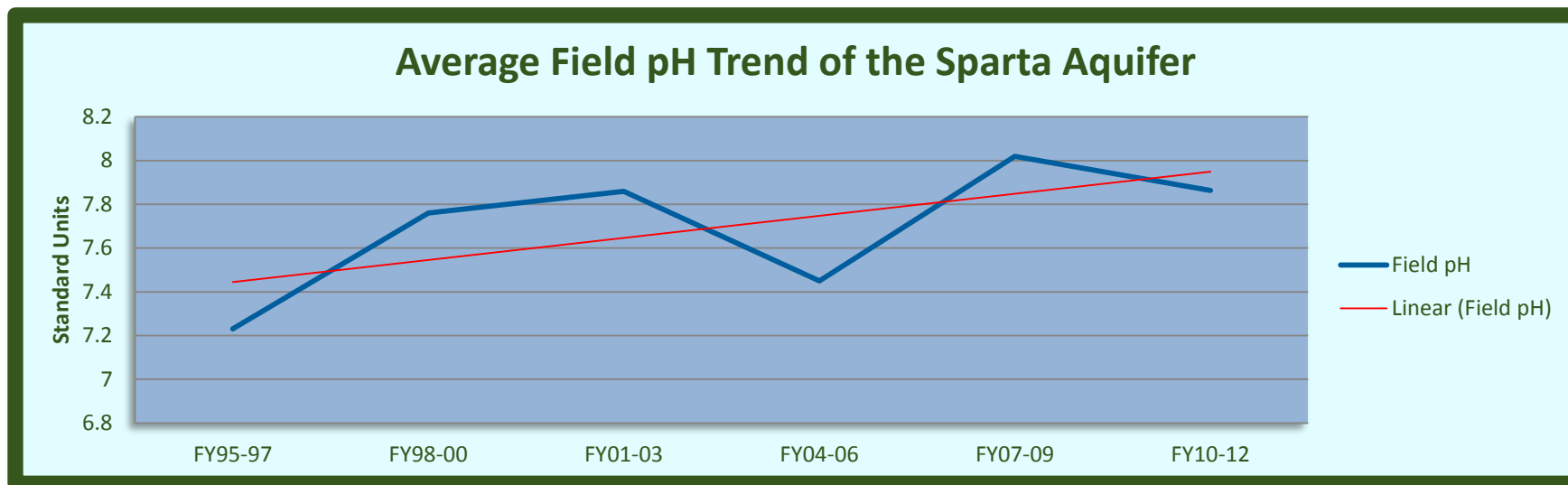


Chart 1-3: Field Specific Conductance Trend

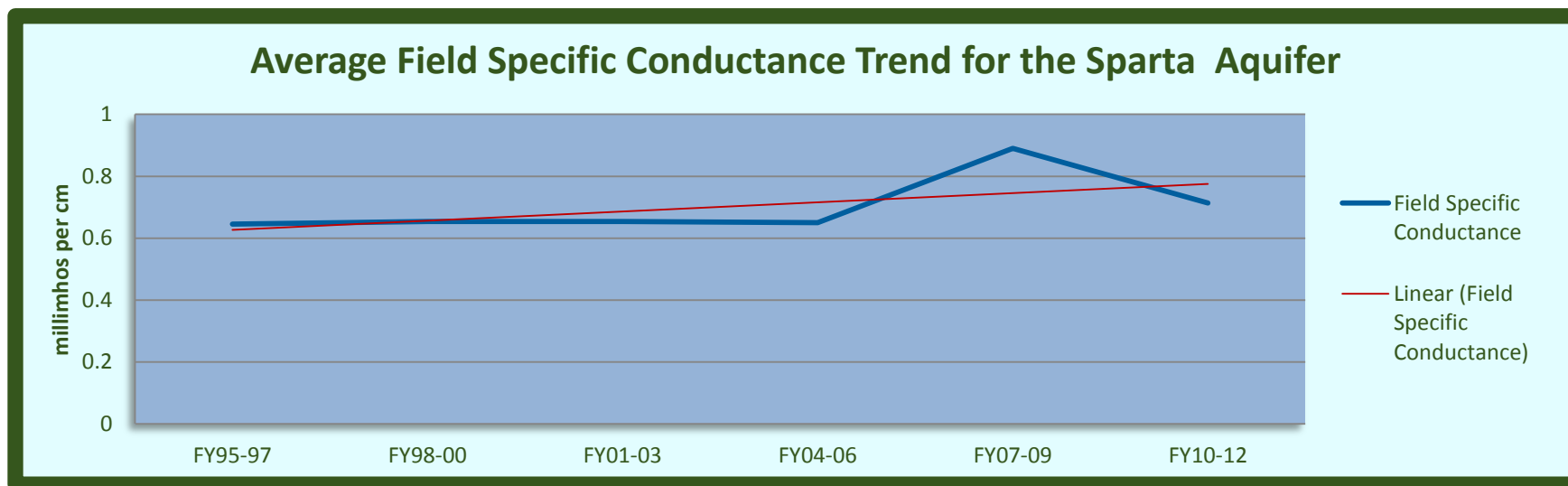


Chart 1-4: Lab Specific Conductance Trend

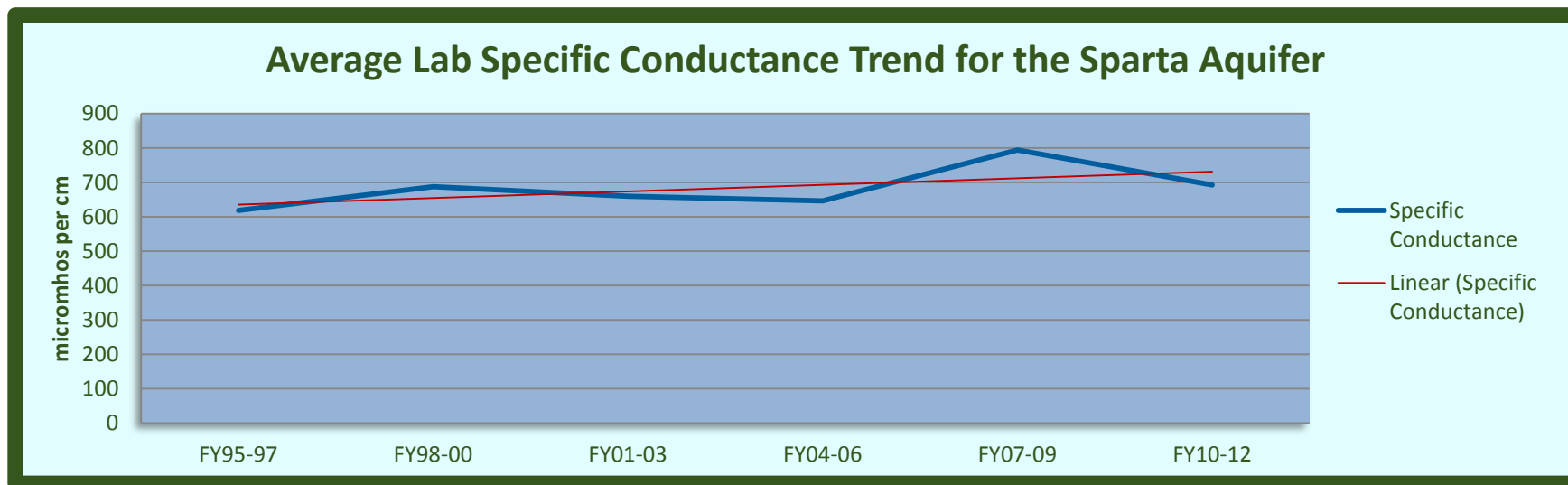


Chart 1-5: Field Salinity Trend

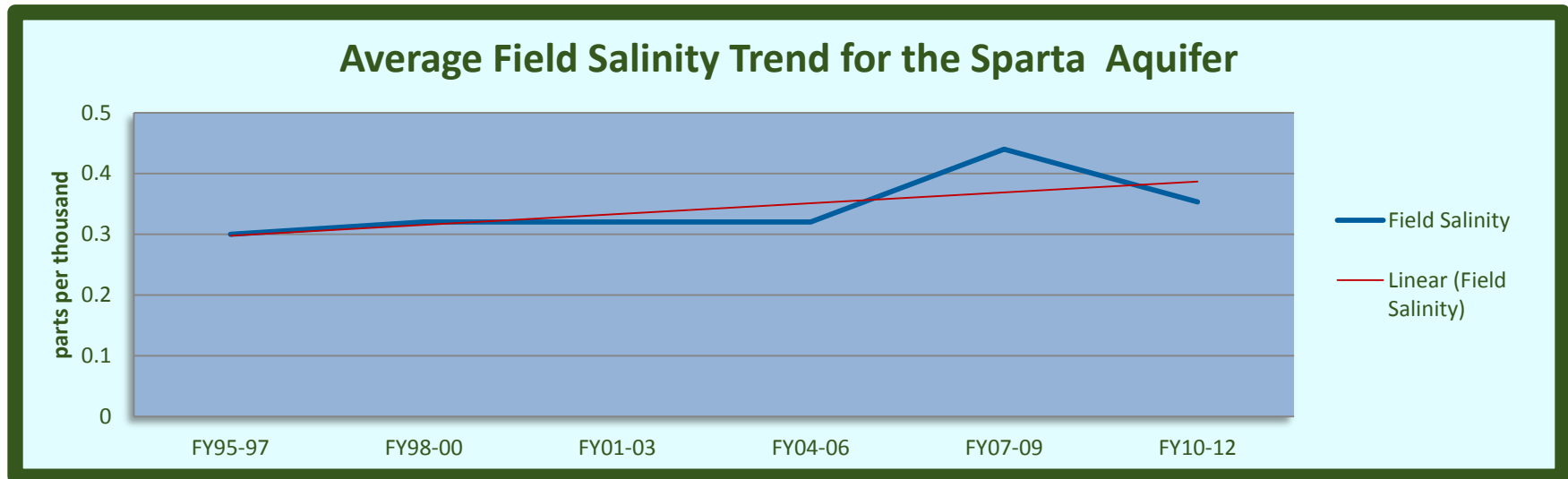


Chart 1-6: Alkalinity Trend

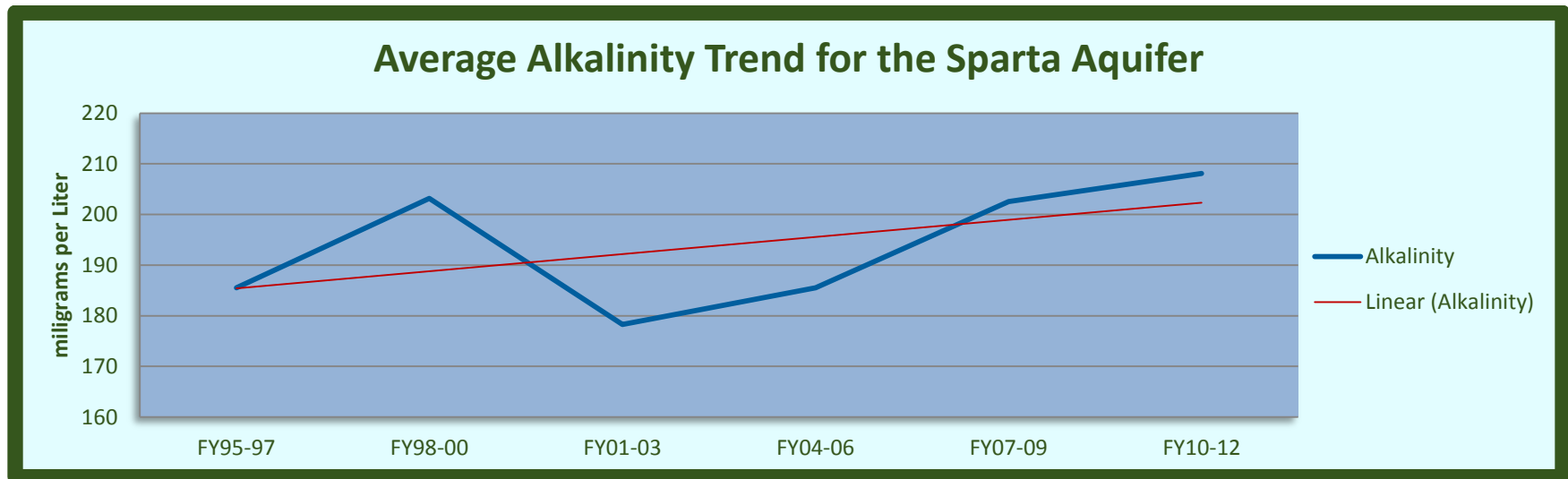


Chart 1-7: Chloride Trend

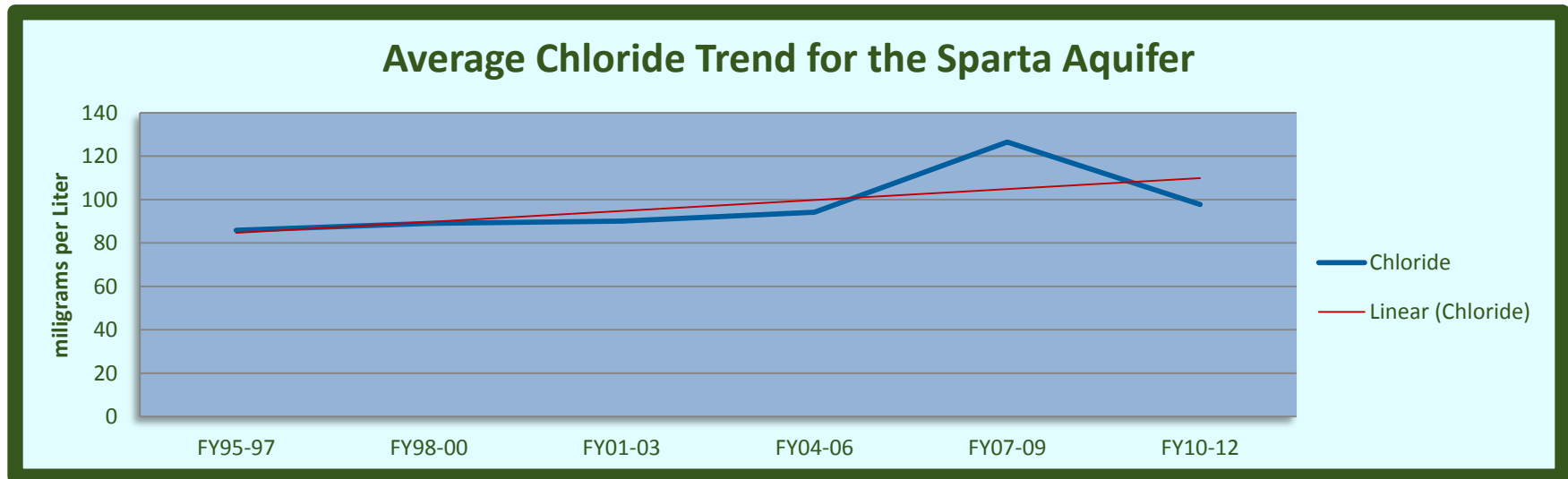


Chart 1-8: Color Trend

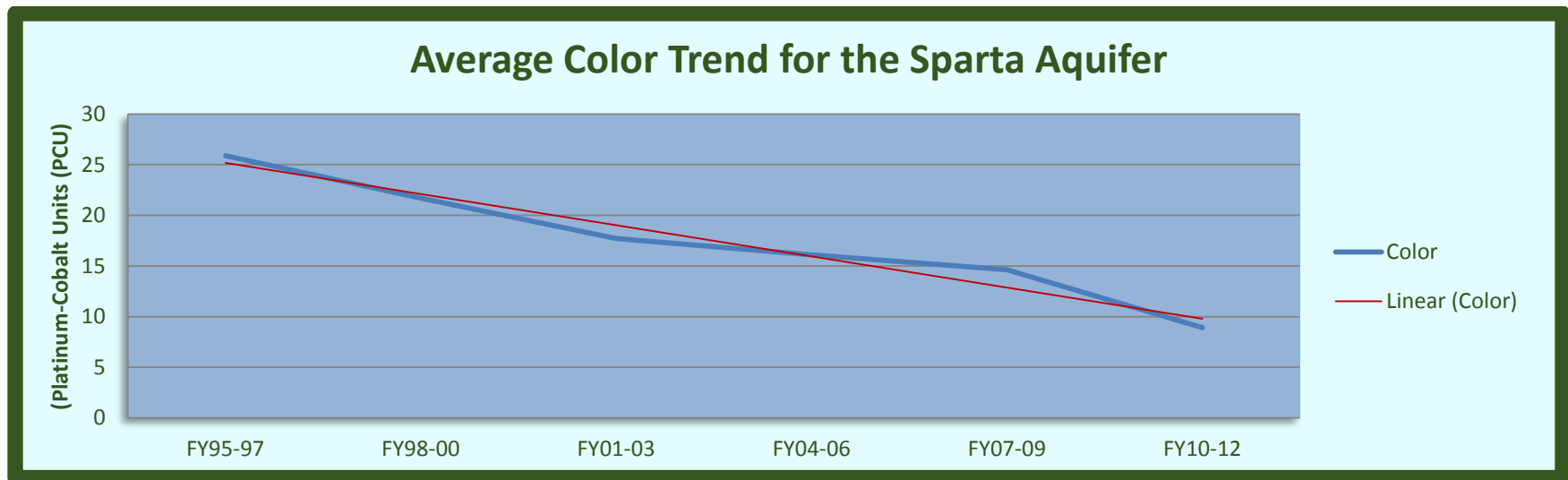


Chart 1-9: Sulfate (SO₄) Trend

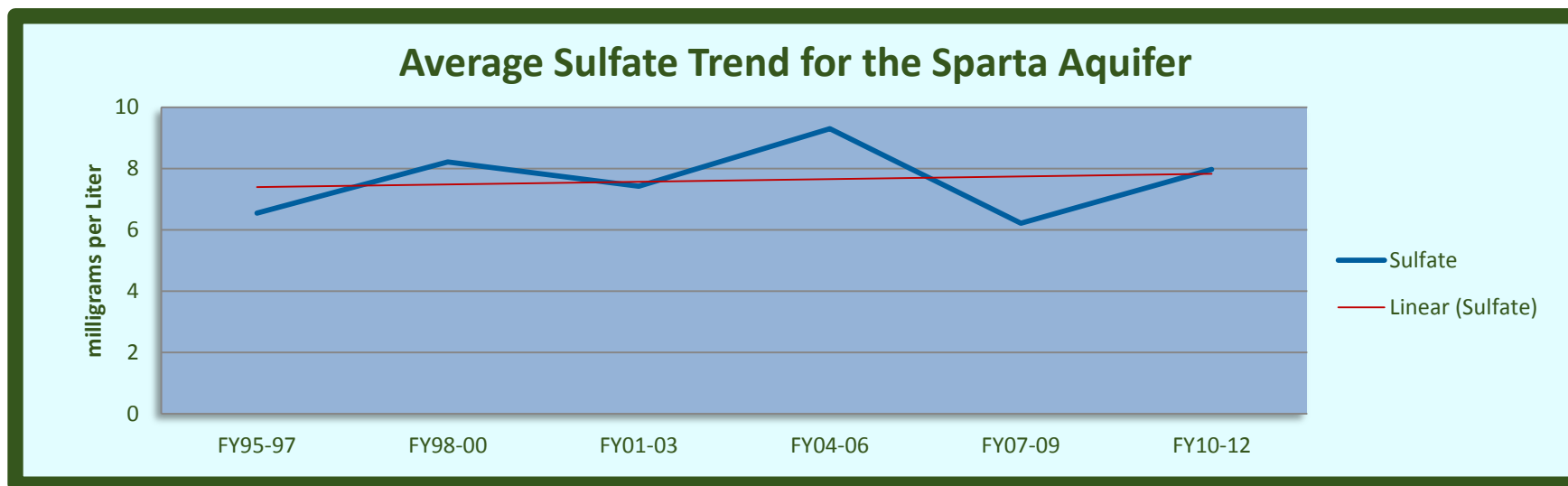


Chart 1-10: Total Dissolved Solids (TDS) Trend

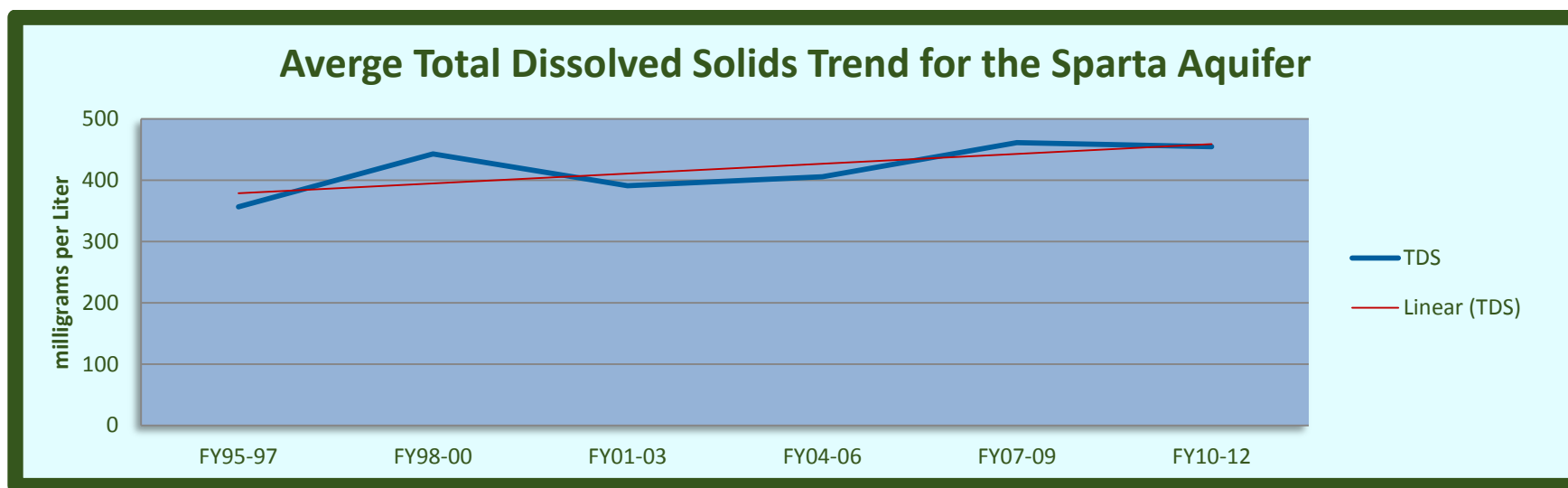


Chart 1-11: Ammonia (NH3) Trend

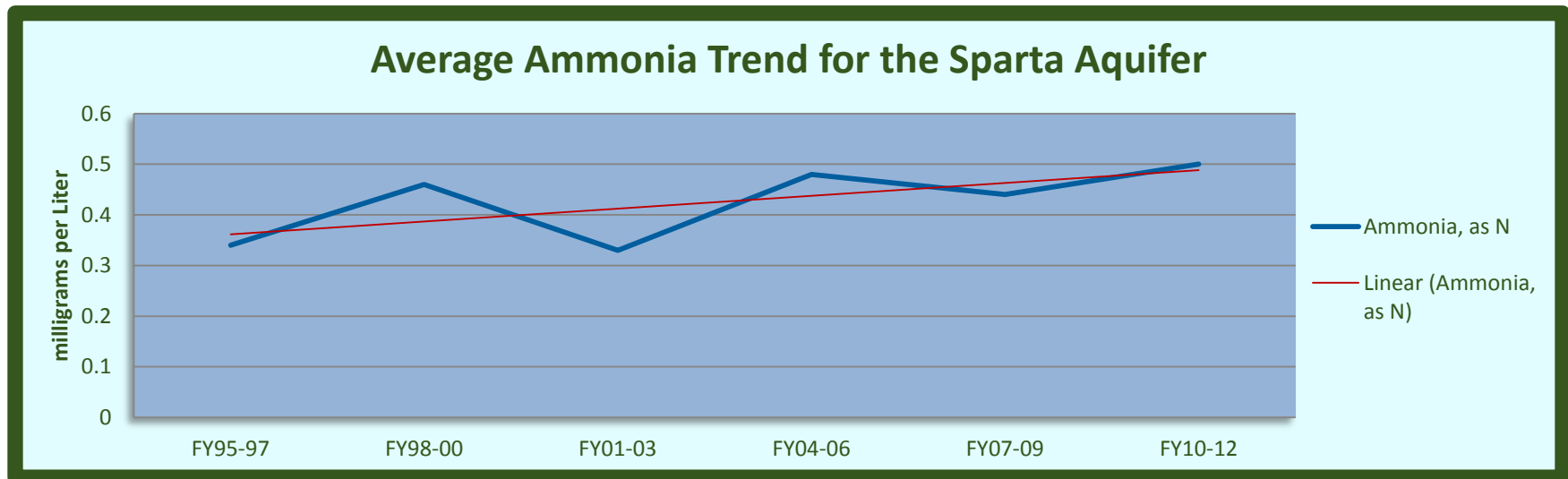


Chart 1-12: Hardness Trend

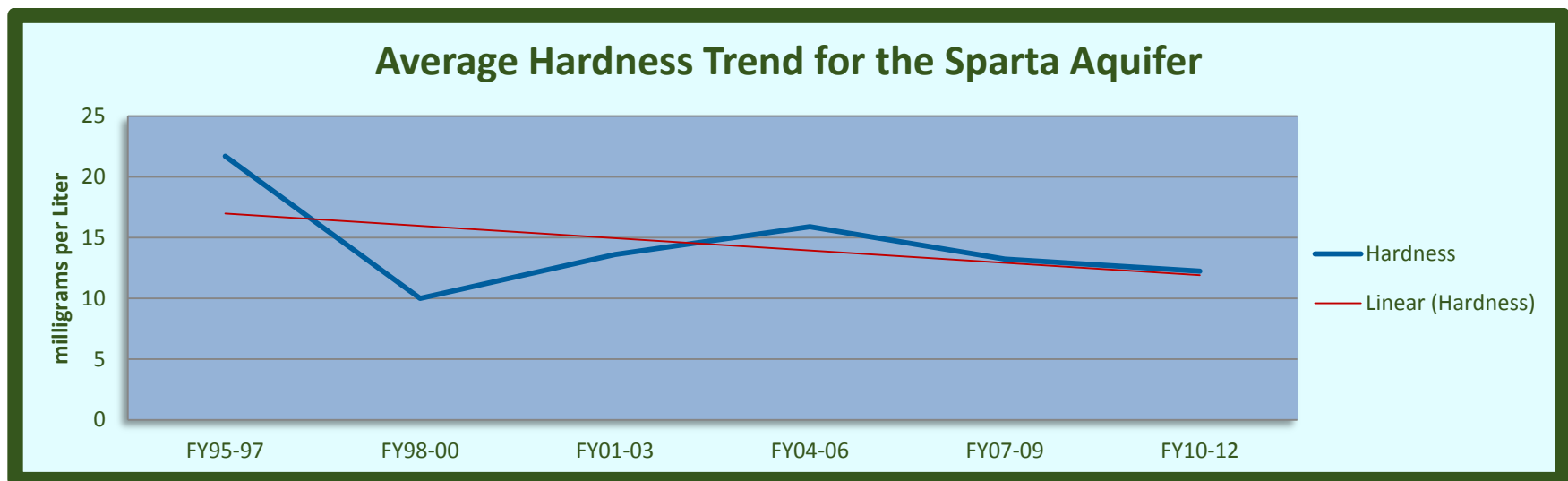


Chart 1-13: Nitrite – Nitrate Trend

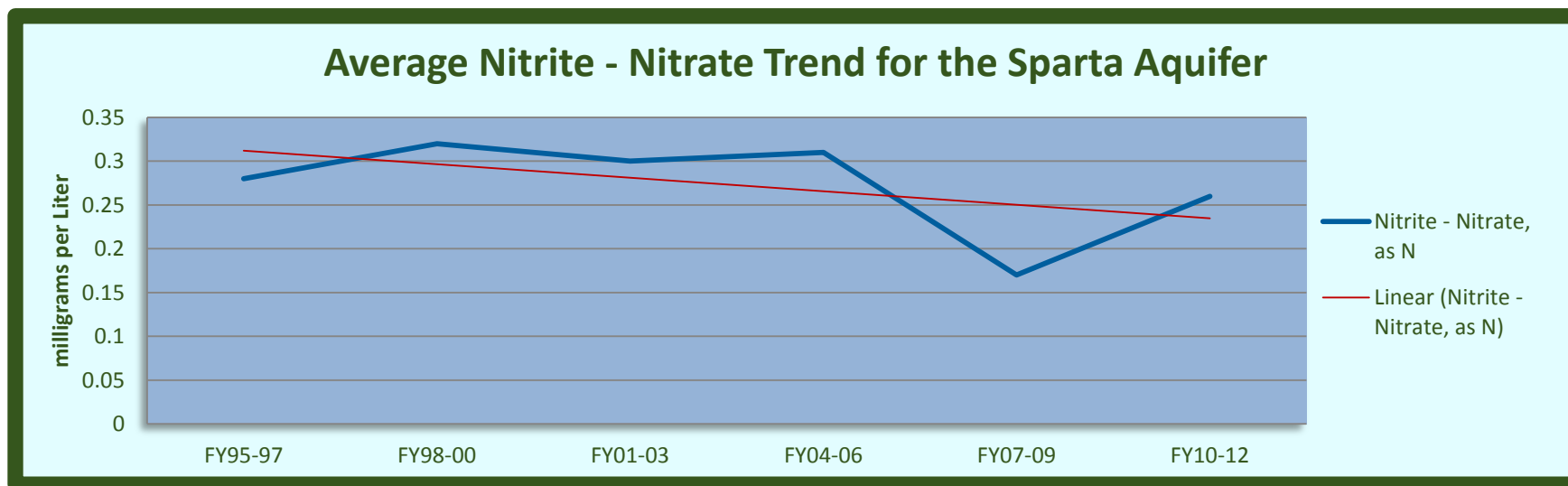


Chart 1-14: TKN Trend

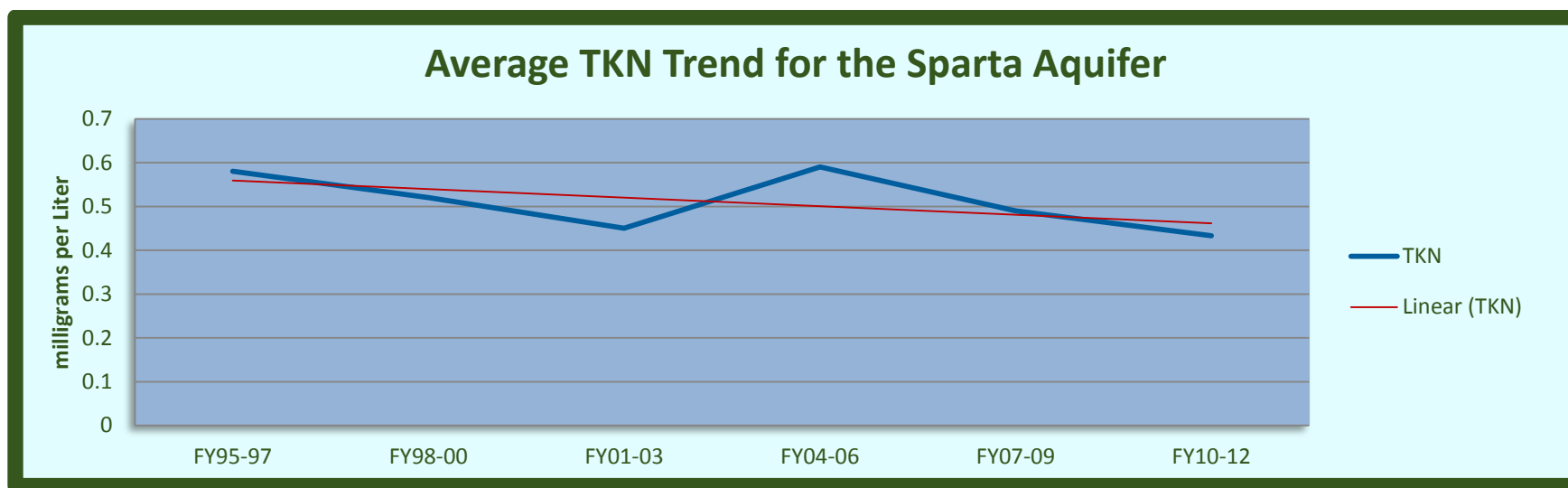


Chart 1-15: Total Phosphorus Trend

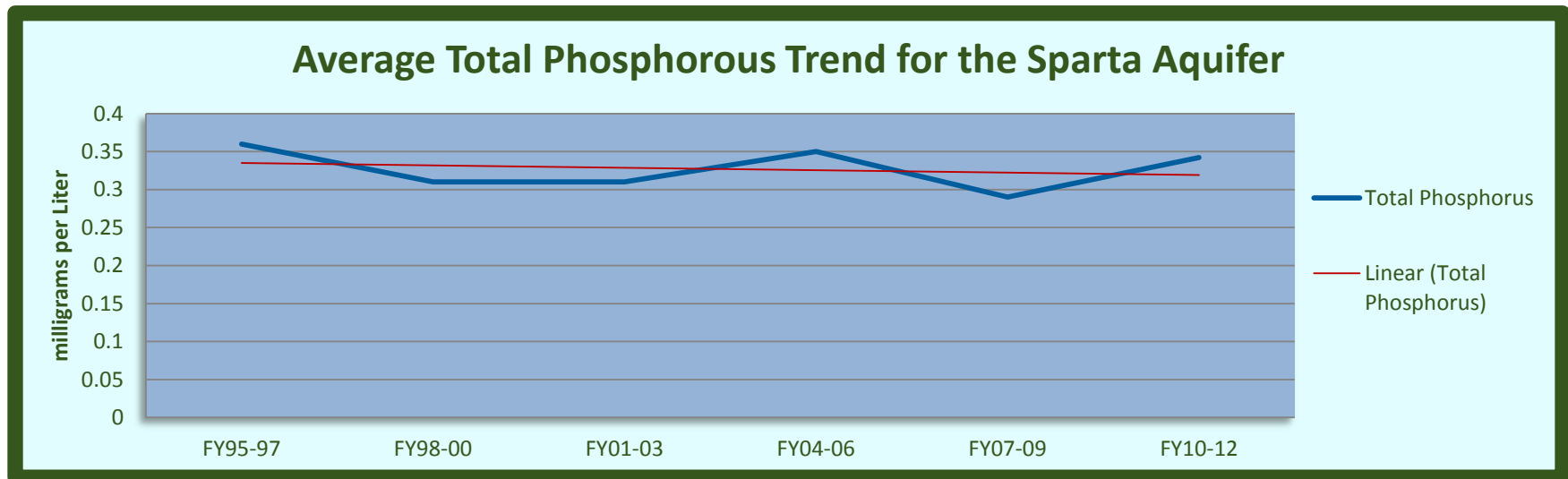


Chart 1-16: Iron Trend

