COCKFIELD AQUIFER SUMMARY, 2011

AQUIFER SAMPLING AND ASSESSMENT PROGRAM

DEQ LOUISIANA

APPENDIX 9 TO THE 2012 TRIENNIAL SUMMARY REPORT

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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 ground water 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 Cockfield aquifer, during the 2011 state fiscal year (July 1, 2010 - June 30, 2011). This summary will become Appendix 9 of ASSET Program Triennial Summary Report for 2012.

These data show that beginning in November, 2010 and continuing through April of 2011, 14 wells were sampled which produce from the Cockfield aquifer. Nine of these 14 are classified as public supply, 4 are classified as domestic use, and 1 is classified as irrigation. The wells are located in 10 parishes in the northeast and north-central to western Louisiana.

Figure 9-1 shows the geographic locations of the Cockfield aquifer and the associated wells, whereas Table 9-1 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 Resource’s Water Well Registration Data file.

GEOLOGY

The Cockfield aquifer is within the Eocene Cockfield formation of the Claiborne Group, which consists of sands, silts, clays, and some lignite. The aquifer units consist of fine sand with interbedded silt, clay, and lignite, becoming more massive and containing less silt and clay with depth. Beneath the Ouachita River, the Cockfield aquifer has been eroded by the ancestral Ouachita River and replaced by alluvial sands and gravels. The regional confining clays of the overlying Vicksburg and Jackson Groups confine the Cockfield.

HYDROGEOLOGY

In the Mississippi River valley, the Cockfield is overlain by and hydraulically connected to the alluvial aquifers. Recharge to the Cockfield aquifer occurs primarily by the direct infiltration of rainfall in interstream, upland outcrop-subcrop areas, the movement of water through the alluvial and terrace deposits, and vertical leakage from the underlying Sparta aquifer. The Cockfield contains fresh water in north-central and northeast Louisiana in a narrowing diagonal band extending toward Sabine Parish. Saltwater ridges under the Red River valley and the eastern Ouachita River valley divide areas containing fresh water in the Cockfield aquifer. The hydraulic conductivity varies between 25 and 100 feet/day.

The maximum depths of occurrence of freshwater in the Cockfield range from 200 feet above sea level, to 2,150 feet below sea level. The range of thickness of the fresh water interval in the Cockfield is 50 to 600 feet. The depths of the Cockfield wells that were monitored in conjunction with the ASSET Program range from 80 to 445 feet.

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 9-2. The inorganic (total metals) parameters analyzed in the laboratory are listed in Table 9-3. 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-35, MO-479, and RI-450.

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 9-8, 9-9 and 9-10 list the target analytes for volatiles, semi-volatiles and pesticides/PCBs, respectively.

Tables 9-4 and 9-5 provide a statistical overview of field and conventional data, and inorganic data for the Cockfield aquifer, listing the minimum, maximum, and average results for these parameters collected in the FY 2011 sampling. Tables 9-6 and 9-7 compare these same parameter averages to historical ASSET-derived data for the Cockfield aquifer, from fiscal years 1996, 1999, 2002, 2005, and 2008.

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 9-2, 9-3, 9-4, and 9-5, respectively, represent the contoured data for pH, total dissolved solids (TDS), chloride (Cl), and iron. Charts 9-1 through 9-16 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 Office of Environmental Assessment does use the MCLs as a benchmark for further evaluation.

EPA has set secondary standards, which are defined as non-enforceable taste, odor, or appearance guidelines. Field and laboratory data contained in Tables 9-2 and 9-3 show that one or more secondary MCLs (SMCLs) were exceeded in 13 of the 14 wells sampled in the Cockfield aquifer, with a total of 21 SMCLs being exceeded.

Field and Conventional Parameters

Table 9-2 shows the field and conventional parameters for which samples are collected at each well and the analytical results for those parameters. Table 9-4 provides an overview of this data for the Cockfield aquifer, listing the minimum, maximum, and average results for these parameters.

Federal Primary Drinking Water Standards: A review of the analysis listed in Table 9-2 shows that no primary 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 Primary 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 is in this category.

Federal Secondary Drinking Water Standards: A review of the analysis listed in Table 9-2 shows that 4 wells exceeded the SMCL for pH, 2 wells exceeded the SMCL for color, and 7 wells exceeded the SMCL for total dissolved solids (TDS). 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):

CA-35	5.98 SU (Original and Duplicate)	NA-5449Z	8.82 SU
UN-167	5.12 SU	W-5239Z	5.65 SU

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

SA-BYRD	41 PCU	W-5239Z	82 PCU

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

	LAB RESULTS (in mg/L)	FIELD MEASURES (in g/L)
EC-233	629 mg/L	0.540 g/L
G-441	680 mg/L	0.585 g/L
MO-479	541 mg/L, Duplicate – 680 mg/L	0.480 g/L (<SMCL)

NA-5449Z	492 mg/L (<SMCL)	0.570 g/L
RI-127	669 mg/L	0.570 g/L
SA-BYRD	889 mg/L	0.830 g/L
WC-187	857 mg/L	0.780 g/L
WC-487	660 mg/L	0.630 g/L

Inorganic Parameters

Table 9-3 shows the inorganic (total metals) parameters for which samples are collected at each well and the analytical results for those parameters. Table 9-5 provides an overview of inorganic data for the Cockfield aquifer, listing the minimum, maximum, and average results for these parameters.

Federal Primary Drinking Water Standards: A review of the analyses listed on Table 9-3 shows that no primary MCL was exceeded for total metals.

Federal Secondary Drinking Water Standards: Laboratory data contained in Table 9-3 shows that 8 wells exceeded the secondary MCL for iron:

Iron (SMCL = 300 ug/L):

CA-35	5,780 ug/L, Duplicate – 5,410 ug/L	MO-479	2,120 ug/L, Duplicate – 2,160 ug/L
RI-450	752 ug/L, Duplicate – 742 ug/L	UN-167	1,640 ug/L
W-198	1,230 ug/L	W-5239Z	3,410 ug/L
WC-187	448 ug/L	WC-487	770 ug/L

Volatile Organic Compounds

Table 9-8 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.

During the previous sampling of the Cockfield aquifer (FY 2008), two wells reported low concentrations of VOCs (NA-5449Z, methylene chloride and toluene; SA-BYRD, tetrachloroethene). For the FY 2011 sampling, neither of these wells reported any detectable VOCs. However, one well, W-198, reported toluene at 1.1 ug/L, which is just above the reporting limit of 0.5 ug/L for toluene and well below the drinking water limit (MCL) of 1,000 ug/L. Due to this low concentration of toluene and because it is almost a thousand times below the MCL established for toluene, the well was not resampled.

As with the previous sampling, close attention will be given to this well in future ASSET operations. No other wells had confirmed detections of a VOC at or above its detection limit during the FY 2011 sampling of the Cockfield aquifer.

Semi-Volatile Organic Compounds

Table 9-9 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 2011 sampling of the Cockfield aquifer.

Pesticides and PCBs

Table 9-10 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 2011 sampling of the Cockfield aquifer.

WATER QUALITY TRENDS AND COMPARISON TO HISTORICAL ASSET DATA

Analytical and field data show that the quality and characteristics of ground water produced from the Cockfield aquifer exhibit some changes 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 9-6 and 9-7, and in Charts 9-1 to 9-16 of this summary. Over the fifteen-year period, 7 analytes have shown a general increase in average concentration. These analytes are: alkalinity, chloride, hardness, nitrite-nitrate, salinity, specific conductance (field and lab), and TDS. For this same time period, 10 analytes have demonstrated a decrease in average concentration: ammonia, color, copper, iron, pH, sulfate, TKN, total phosphorus, turbidity, and zinc. Barium remained consistent for this time period.

The current number of wells with secondary MCL exceedances and the current total number of secondary exceedances has not changed significantly since the previous sampling event in FY 2008. Current sample results show that 13 wells reported one or more secondary exceedances with a total of 21 SMCL exceedances. The FY 2008 sampling of the Cockfield aquifer shows that 12 wells reported one or more SMCL exceedances with a total of 22 exceedances.

SUMMARY AND RECOMMENDATIONS

In summary, the data show that the ground water produced from this aquifer is moderately hard[1]. The data also show that this aquifer is of poor quality when considering taste, odor, or appearance guidelines, with 21 Secondary MCLs exceeded in 13 of the 14 wells sampled.

Comparison to historical ASSET-derived data shows some change in the quality or characteristics of the Cockfield aquifer, with 7 parameters showing consistent increases in concentration, 10 parameters decreasing in concentration, while remaining parameters have shown no consistent change or have remained below detection levels over the fifteen-year period.

It is recommended that the wells assigned to the Cockfield aquifer be re-sampled as planned, in approximately three years, with close attention given to the occurrence of VOCs in this aquifer.

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

In addition, several wells should be added to the 14 currently in place to increase the well density for this aquifer.

Table 9-1: List of Wells Sampled, Cockfield Aquifer–FY 2011

Well ID	Parish	Date	Owner	Depth (Feet)	Well Use
1937 / CA-35	Caldwell	11/3/2010	City Of Columbia	298	Public Supply
1709 / EC-233	East Carroll	1/25/2011	Town Of Lake Providence	371	Public Supply
3360 / G-441	Winn	11/3/2010	Red Hill Water System	212	Public Supply
1869 / MO-479	Morehouse	1/24/2011	Bayou Bonne Idee Water System	258	Public Supply
3646 / NA-5449Z	Natchitoches	4/12/2011	Private Owner	170	Domestic
1940 / OU-FRITH	Ouachita	11/15/2010	Private Owner	80	Domestic
1805 / RI-127	Richland	11/15/2010	Delhi Water Works	416	Public Supply
1936 / RI-450	Richland	11/15/2010	River Road Waterworks	283	Public Supply
1939 / SA-BYRD	Sabine	2/14/2011	Private Owner	150	Domestic
1803 / UN-167	Union	1/24/2011	Private Owner	110	Irrigation
1873 / W-198	Winn	11/3/2010	Atlanta Water System	445	Public Supply
4010 / W-5239Z	Winn	11/15/2010	Private Owner	145	Domestic
1785 / WC-187	West Carroll	1/25/2011	New Carroll Water System	110	Public Supply
1894 / WC-487	West Carroll	1/25/2011	Town Of Oak Grove	396	Public Supply

Table 9-2: Summary of Field and Conventional Data, Cockfield Aquifer–FY 2011

Well ID	pH SU	Sal. ppt	Sp. Cond. mmhos/cm	Temp Deg. C	TDS g/L	Alk mg/L	Cl mg/L	Color PCU	Hard. mg/L	Nitrite-Nitrate (as N) mg/L	NH3 mg/L	Tot. P mg/L	Sp. Cond. umhos/cm	SO4 mg/L	TDS mg/L	TKN mg/L	TSS mg/L	Turb. mg/L
	LABORATORY REPORTING LIMITS →					5	1.25	1	5	0.01	0.05	0.05	10	1.25	10	0.1	4	0.3
	FIELD PARAMETERS					LABORATORY PARAMETERS												
CA-35	5.98	0.16	0.335	18.49	0.218	76	18.1	21	110	< 0.01	0.239	0.523	290	44.40	240	0.269	< 4	9.55
CA-35*	5.98	0.16	0.335	18.49	0.218	80	18.4	24	122	< 0.01	0.258	0.510	294	45.30	239	0.296	< 4	10.20
EC-233	7.69	0.41	0.830	18.27	0.540	382	43.5	3	96	< 0.01	1.420	0.200	719	< 0.25	629	1.920	< 4	< 0.3
G-441	8.06	0.44	0.899	18.81	0.585	350	56.6	28	< 5	0.036	1.150	0.499	817	32.50	680	0.307	< 4	0.75
MO-479	7.27	0.37	0.750	18.19	0.480	306	49.7	< 1	314	< 0.01	0.372	0.139	626	10.60	541	0.398	7	21.10
MO-479*	7.27	0.37	0.750	18.19	0.480	308	49.7	< 1	306	< 0.01	0.367	0.158	632	9.70	600	0.422	8	22.10
NA-5449Z	8.82	0.43	0.877	19.85	0.570	350	13.5	40	< 5	< 0.01	0.881	0.914	856	51.90	492	1.280	< 4	1.25
OU-FRITH	7.16	0.26	0.541	17.26	0.352	284	2.9	2	54	< 0.01	0.670	0.133	501	< 0.25	420	0.706	< 4	< 0.3
RI-127	7.45	0.43	0.878	19.96	0.570	364	67.7	3	< 5.00	< 0.01	1.030	0.316	802	< 0.25	669	1.100	< 4	0.38
RI-450	7.16	0.23	0.484	18.63	0.315	258	7.7	11	160	< 0.01	0.161	0.206	438	< 0.25	358	0.192	< 4	6.37
RI-450*	7.16	0.23	0.484	18.63	0.315	248	7.7	12	170	< 0.01	0.147	0.227	434	< 0.25	360	0.171	< 4	6.86
SA-BYRD	8.08	0.64	1.280	13.50	0.830	460	49.7	41	< 5	0.153	0.911	0.216	1,150	142.00	889	0.924	< 4	4.12
UN-167	5.12	0.12	0.240	17.83	0.160	< 5	23.6	< 1	60	9.770	< 0.05	< 0.05	235	23.50	205	0.116	7	5.75
W-198	8.28	0.18	0.380	20.41	0.247	198	12.4	82	< 5	0.012	0.451	1.530	367	< 0.25	315	0.514	< 4	2.75
W-5239Z	5.65	0.06	0.123	17.24	0.080	42	4.5	3	128	< 0.01	0.066	0.299	118	4.33	93	< 0.1	9	8.18
WC-187	7.27	0.60	1.200	16.78	0.780	324	199.0	< 1	470	0.093	0.161	0.127	996	12.50	857	0.163	< 4	4.20
WC-487	7.50	0.48	0.970	16.88	0.630	350	77.1	2	200	< 0.01	0.404	0.077	758	0.38	660	0.417	< 4	2.96

*Denotes Duplicate Sample   Shaded cells exceed EPA Secondary Standards

Table 9-3: Summary of Inorganic Data, Cockfield Aquifer–FY 2011

Well ID	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 Reporting Limits	5	4	5	2	2	4	2	100	1	0.0002	3	5	1	2	6
CA-35	< 5	< 4	129.0	< 2	< 2	< 4	< 2	5,780	< 1	< 0.0002	< 3	< 5	< 1	< 2	29.0
CA-35*	< 5	< 4	137.0	< 2	< 2	< 4	< 2	5,410	< 1	< 0.0002	< 3	< 5	< 1	< 2	27.8
EC-233	< 5	< 4	227.0	< 2	< 2	< 4	< 2	< 100	< 1	< 0.0002	< 3	< 5	< 1	< 2	< 6
G-441	< 5	< 4	12.5	< 2	< 2	< 4	2.09	< 100	< 1	< 0.0002	< 3	< 5	< 1	< 2	< 6
MO-479	< 5	< 4	304.0	< 2	< 2	< 4	< 2	2,120	< 1	< 0.0002	< 3	< 5	< 1	< 2	8.9
MO-479*	< 5	< 4	310.0	< 2	< 2	< 4	< 2	2,160	< 1	< 0.0002	< 3	< 5	< 1	< 2	7.4
NA-5449Z	< 5	< 4	15.7	< 2	< 2	< 4	< 2	< 100	< 1	< 0.0002	< 3	< 5	< 1	< 2	< 6
OU-FRITH	< 5	< 4	118.0	< 2	< 2	< 4	< 2	< 100	< 1	< 0.0002	< 3	< 5	< 1	< 2	< 6
RI-127	< 5	< 4	31.2	< 2	< 2	< 4	< 2	< 100	< 1	< 0.0002	< 3	< 5	< 1	< 2	< 6
RI-450	< 5	< 4	146.0	< 2	< 2	< 4	< 2	752	< 1	< 0.0002	< 3	< 5	< 1	< 2	< 6
RI-450*	< 5	< 4	142.0	< 2	< 2	< 4	< 2	742	< 1	< 0.0002	< 3	< 5	< 1	< 2	< 6
SA-BYRD	< 5	< 4	50.7	< 2	< 2	< 4	16.20	280	< 1	< 0.0002	< 3	< 5	< 1	< 2	612.0
UN-167	< 5	< 4	331.0	< 2	3.74	< 4	< 2	1,640	< 1	< 0.0002	11.5	< 5	< 1	< 2	45.3
W-198	< 5	< 4	7.9	< 2	< 2	< 4	2.06	1,230	< 1	< 0.0002	< 3	< 5	< 1	< 2	34.0
W-5239Z	< 5	< 4	83.7	< 2	< 2	< 4	21.40	3,410	1.42	< 0.0002	< 3	< 5	< 1	< 2	797.0
WC-187	< 5	6.96	169.0	< 2	< 2	< 4	4.68	448	< 1	< 0.0002	< 3	< 5	< 1	< 2	< 6
WC-487	< 5	< 4	226.0	< 2	< 2	< 4	10.40	770	< 1	< 0.0002	< 3	< 5	< 1	< 2	9.2

*Denotes Duplicate Sample. Exceeds EPA Secondary Standards.

Table 9-4: FY 2011 Field and Conventional Statistics, ASSET Wells

	PARAMETER	MINIMUM	MAXIMUM	AVERAGE
FIELD	Temperature (^{o}C)	13.50	20.41	18.08
	pH (SU)	5.12	8.82	7.17
	Specific Conductance (mmhos/cm)	0.123	1.280	0.668
	Salinity (ppt)	0.06	0.64	0.33
	TDS (g/L)	0.08	0.83	0.43
LABORATORY	Alkalinity (mg/L)	< 5	460.0	257.8
	Chloride (mg/L)	2.9	199.0	41.3
	Color (PCU)	< 1	82	16
	Specific Conductance (umhos/cm)	118	1,150	590
	Sulfate (mg/L)	< 1.25	142.0	22.2
	TDS (mg/L)	93	889	485
	TSS (mg/L)	< 4	9	< 4
	Turbidity (NTU)	< 0.3	22.1	6.3
	Ammonia, as N (mg/L)	< 0.05	1.42	0.51
	Hardness (mg/L)	< 5	470	130
	Nitrite - Nitrate, as N (mg/L)	< 0.01	9.77	0.60
	TKN (mg/L)	< 0.1	1.92	0.54
	Total Phosphorus (mg/L)	< 0.05	1.53	0.36

Table 9-5: FY 2011 Inorganic Statistics, ASSET Wells

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
Antimony (ug/L)	< 5	< 5	< 5
Arsenic (ug/L)	< 4	6.96	< 4
Barium (ug/L)	7.9	331.0	143.6
Beryllium (ug/L)	< 2	< 2	< 2
Cadmium (ug/L)	< 2	3.74	< 2
Chromium (ug/L)	< 4	< 4	< 4
Copper (ug/L)	< 2	21.40	3.99
Iron (ug/L)	< 100	5,780.0	1,470.1
Lead (ug/L)	< 1	1.42	< 1
Mercury (ug/L)	< 0.0002	< 0.0002	< 0.0002
Nickel (ug/L)	< 3	11.5	< 3
Selenium (ug/L)	< 5	< 5	< 5
Silver (ug/L)	< 1	< 1	< 1
Thallium (ug/L)	< 2	< 2	< 2
Zinc (ug/L)	< 6	797.0	93.8

Table 9-6: Triennial Field and Conventional Statistics, ASSET Wells

	PARAMETER	AVERAGE VALUES BY FISCAL YEAR					
		FY 1996	FY 1999	FY 2002	FY 2005	FY 2008	FY 2011
FIELD	Temperature (^{O}C)	19.91	19.76	20.30	19.82	19.90	18.08
	pH (SU)	6.77	6.99	7.39	7.46	7.38	7.17
	Specific Conductance (mmhos/cm)	0.564	0.613	0.647	0.70	0.65	0.668
	Salinity (Sal.) (ppt)	0.27	0.30	0.32	0.35	0.32	0.33
	TDS (Total dissolved solids) (g/L)	-	-	-	0.46	0.430	0.43
LABORATORY	Alkalinity (Alk.) (mg/L)	219.2	223.9	262.4	293.7	257.4	257.8
	Chloride (Cl) (mg/L)	35.9	52.0	42.2	52.5	48.6	41.3
	Color (PCU)	38	12	12	11	15	16
	Specific Conductance (umhos/cm)	561	619	643	737	641	590
	Sulfate (SO4) (mg/L)	33.4	35.5	98.9	21.9	22.0	22.2
	TDS (Total dissolved solids) (mg/L)	320	430	396	438	402.	485
	TSS (Total suspended solids) (mg/L)	5.3	<4	<4	<4	<4	< 4
	Turbidity (Turb.) (NTU)	7.14	9.74	4.71	5.4	3.9	6.3
	Ammonia, as N (NH3) (mg/L)	0.66	0.50	0.62	0.36	0.40	0.51
	Hardness (mg/L)	115	79	90	140	112	130
	Nitrite - Nitrate , as N (mg/L)	0.11	0.08	0.30	0.50	0.44	0.60
	TKN (mg/L)	0.80	0.71	0.94	0.47	0.53	0.54
	Total Phosphorus (P) (mg/L)	0.32	0.59	0.30	0.30	0.38	0.36

Table 9-7: Triennial Inorganic Statistics, ASSET Wells

PARAMETER	AVERAGE VALUES BY FISCAL YEAR					
	FY 1996	FY 1999	FY 2002	FY 2005	FY 2008	FY 2011
Antimony (ug/L)	<5	<5	<5	<10	<1	< 5
Arsenic (ug/L)	5.43	<5	<5	<10	<3	< 4
Barium (ug/L)	121.3	124.5	140.9	161.9	111.8	143.6
Beryllium (ug/L)	<5	<5	<5	<1	<1	< 2
Cadmium (ug/L)	<5	<5	<5	<1	<0.5	< 2
Chromium (ug/L)	<5	<5	<5	<5	<3	< 4
Copper (ug/L)	39.62	5.86	11.77	8.34	5.11	3.99
Iron (ug/L)	1,835.8	1,623.2	1,319.5	1,084.1	1,323.9	1,470.1
Lead (ug/L)	<10	<10	<10	<10	<3	< 1
Mercury (ug/L)	<0.05	<0.05	<0.05	<0.05	0.08	< 0.0002
Nickel (ug/L)	<5	<5	<5	<5	<3	< 3
Selenium (ug/L)	<5	<5	<5	<5	<4	< 5
Silver (ug/L)	<5	<5	<5	4.72	<0.5	< 1
Thallium (ug/L)	<5	<5	<5	<5	<1	< 2
Zinc (ug/L)	117.5	34.1	30.7	<20	25.6	93.8

Table 9-8: VOC Analytical Parameters

COMPOUND	METHOD	DETECTION LIMIT (ug/L)
1,1,1-TRICHLOROETHANE	624	0.5
1,1,2,2-TETRACHLOROETHANE	624	0.5
1,1,2-TRICHLOROETHANE	624	0.5
1,1-DICHLOROETHANE	624	0.5
1,1-DICHLOROETHENE	624	0.5
1,2,3-TRICHLOROBENZENE	624	0.5
1,2-DICHLOROBENZENE	624	0.5
1,2-DICHLOROETHANE	624	0.5
1,2-DICHLOROPROPANE	624	0.5
1,3-DICHLOROBENZENE	624	0.5
1,4-DICHLOROBENZENE	624	0.5
BENZENE	624	0.5
BROMODICHLOROMETHANE	624	0.5
BROMOFORM	624	0.5
BROMOMETHANE	624	0.5
CARBON TETRACHLORIDE	624	0.5
CHLOROBENZENE	624	0.5
CHLOROETHANE	624	0.5
CHLOROFORM	624	0.5
CHLOROMETHANE	624	0.5
CIS-1,3-DICHLOROPROPENE	624	1.5
DIBROMOCHLOROMETHANE	624	0.5
ETHYL BENZENE	624	0.5
METHYLENE CHLORIDE	624	0.5
TERT-BUTYL METHYL ETHER	624	0.5
TETRACHLOROETHYLENE (PCE)	624	0.5
TOLUENE	624	0.5
TRANS-1,2-DICHLOROETHENE	624	0.5
TRANS-1,3-DICHLOROPROPENE	624	0.5
TRICHLOROETHYLENE (TCE)	624	0.5
TRICHLOROFLUOROMETHANE (FREON-11)	624	0.5
VINYL CHLORIDE	624	0.5

Table 9-9: SVOC Analytical Parameters

COMPOUND (SVOC)	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
BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	625	5
BIS(2-CHLOROISOPROPYL) ETHER	625	5
BIS(2-ETHYLHEXYL) PHTHALATE	625	5
CHRYSENE	625	5
DIBENZ(A,H)ANTHRACENE	625	5
DIETHYL PHTHALATE	625	5
DIMETHYL PHTHALATE	625	5
DI-N-BUTYL PHTHALATE	625	5
DI-N-OCTYLPHTHALATE	625	5

COMPOUND (SVOC)	METHOD	DETECTION LIMIT (ug/L)
FLUORANTHENE	625	5
FLUORENE	625	5
HEXACHLOROBENZENE	625	5
HEXACHLOROBUTADIENE	625	5
HEXACHLOROCYCLOPENTADIENE	625	10
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	10
N-NITROSODIPHENYLAMINE	625	5
PENTACHLOROPHENOL	625	10
PHENANTHRENE	625	5
PHENOL	625	5
PYRENE	625	5

Table 9-10: Pesticides and PCBs

COMPOUND	METHOD	DETECTION LIMITS (ug/L)
ALDRIN	608	0.05
ALPHA BHC	608	0.05
ALPHA ENDOSULFAN	608	0.05
ALPHA-CHLORDANE	608	0.05
BETA BHC	608	0.05
BETA ENDOSULFAN	608	0.05
CHLORDANE	608	0.2
DELTA BHC	608	0.05
DIELDRIN	608	0.05
ENDOSULFAN SULFATE	608	0.05
ENDRIN	608	0.05
ENDRIN ALDEHYDE	608	0.05
ENDRIN KETONE	608	0.05
GAMMA BHC	608	0.05
GAMMA-CHLORDANE	608	0.05
HEPTACHLOR	608	0.05
HEPTACHLOR EPOXIDE	608	0.05
METHOXYCHLOR	608	0.05
P,P'-DDD	608	0.05
P,P'-DDE	608	0.05
P,P'-DDT	608	0.05
PCB-1016 (AROCHLOR 1016)	608	0.5
PCB-1221 (AROCHLOR 1221)	608	0.5
PCB-1232 (AROCHLOR 1232)	608	0.5
PCB-1242 (AROCHLOR 1242)	608	0.5
PCB-1248 (AROCHLOR 1248)	608	0.5
PCB-1254 (AROCHLOR 1254)	608	0.5
PCB-1260 (AROCHLOR 1260)	608	0.5
TOXAPHENE	608	3

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Figure 9-1: Location Plat, Cockfield Aquifer

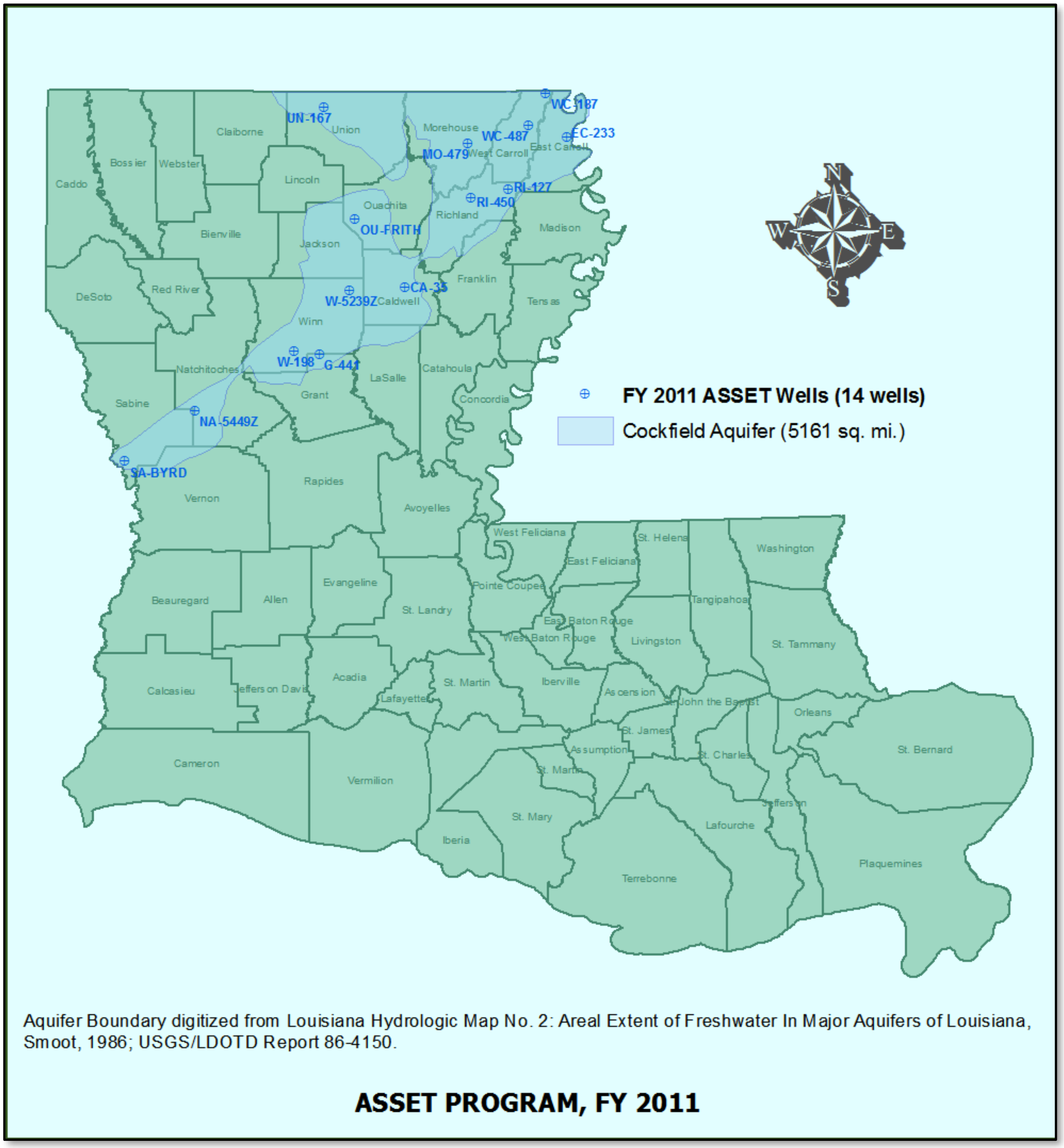

Figure 9-2: Map of pH Data

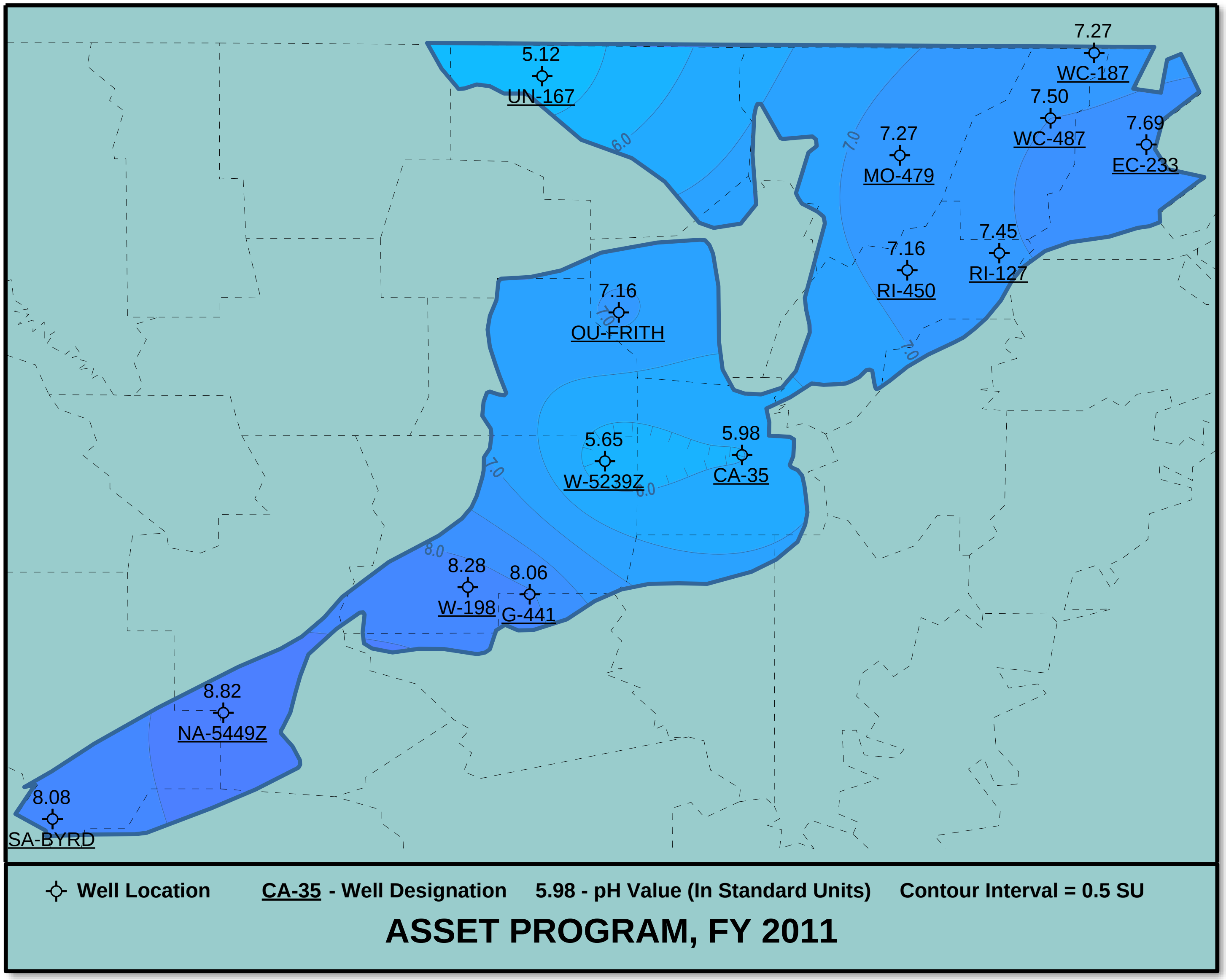

Figure 9-3: Map of TDS Lab Data

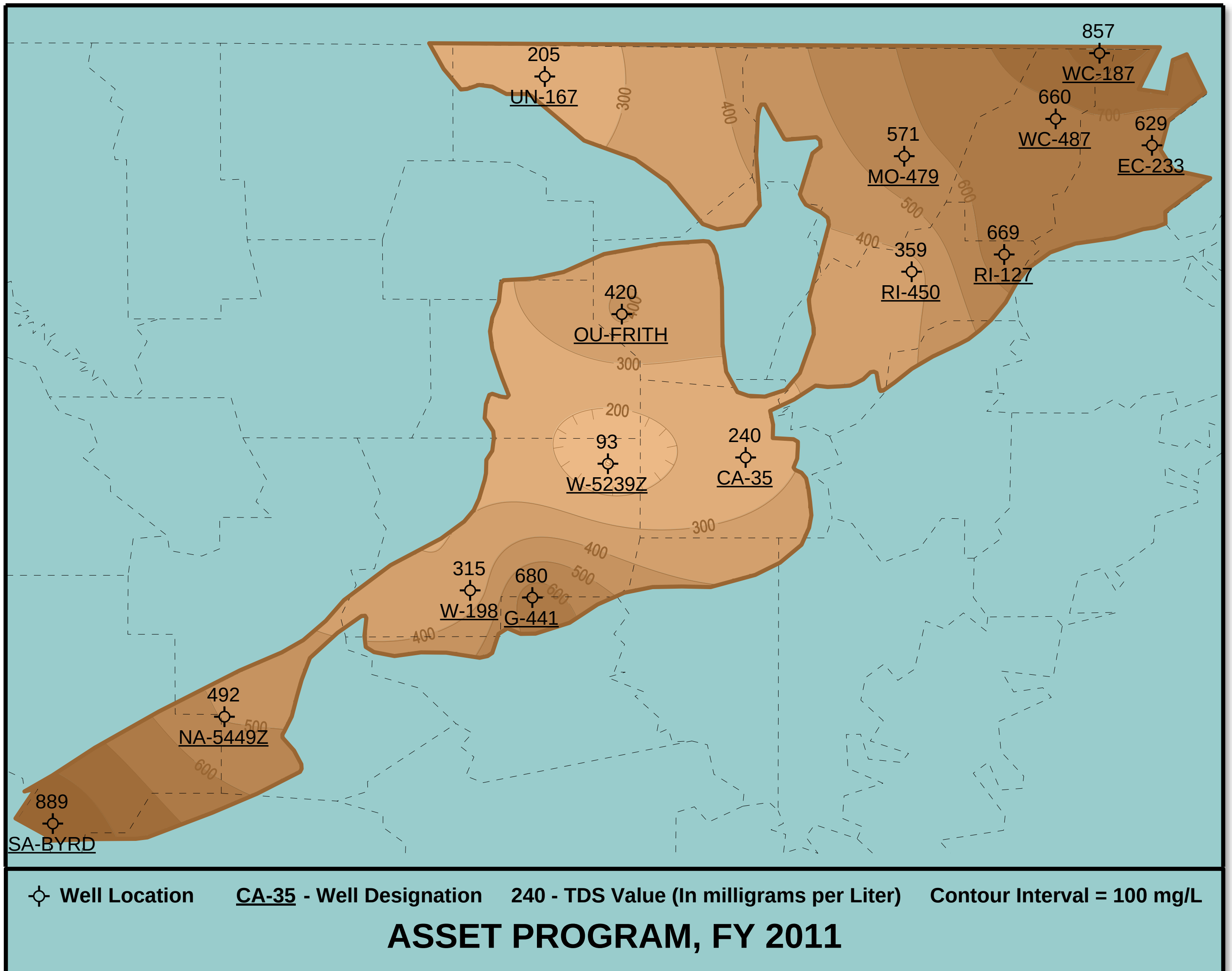

Figure 9-4: Map of Chloride Data

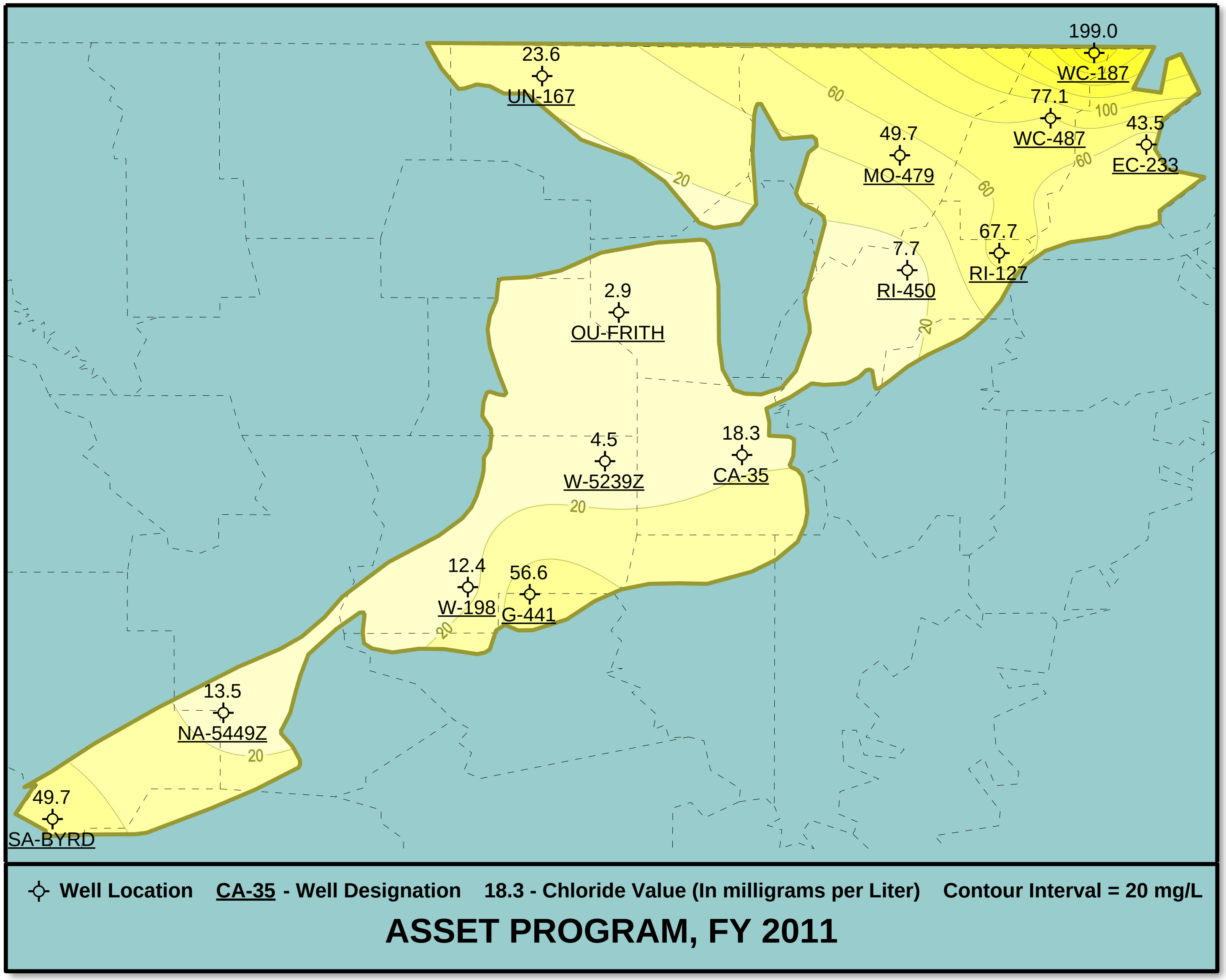

Figure 9-5: Map of Iron Data

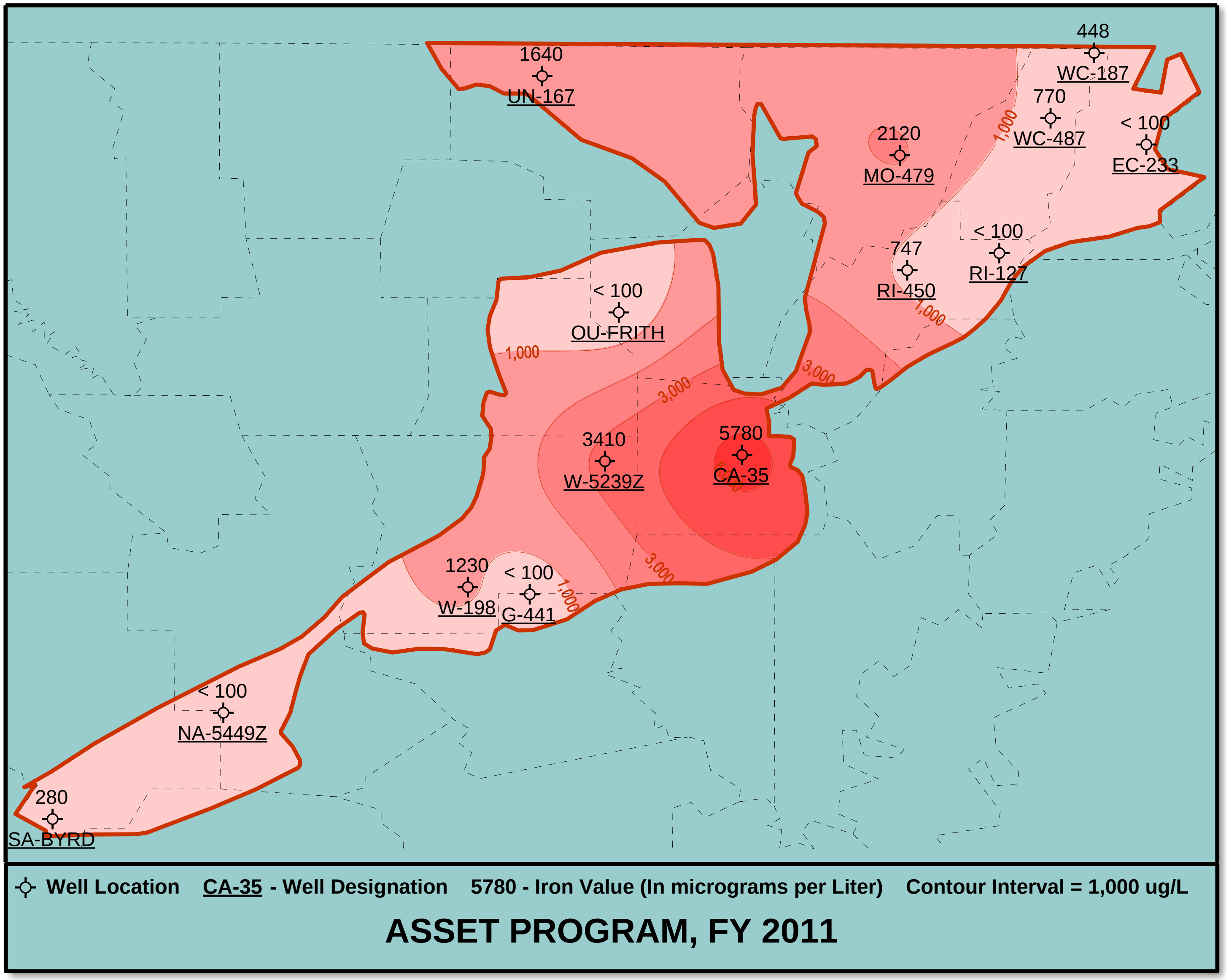

Chart 9-1: Temperature Trend

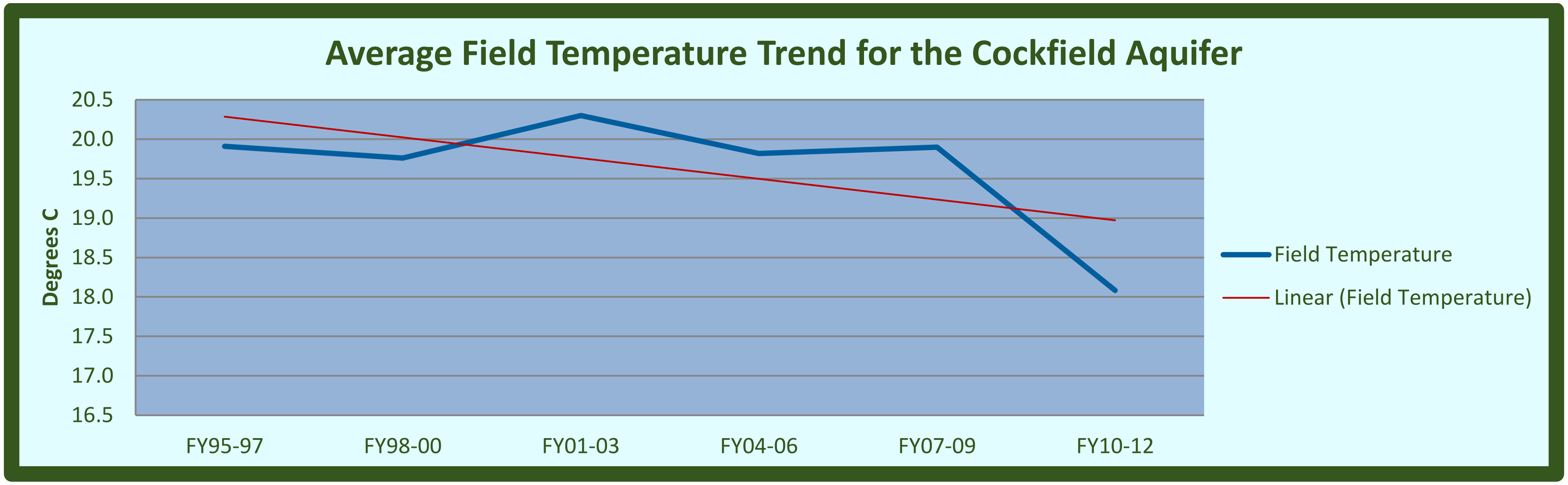

Chart 9-2: pH Trend

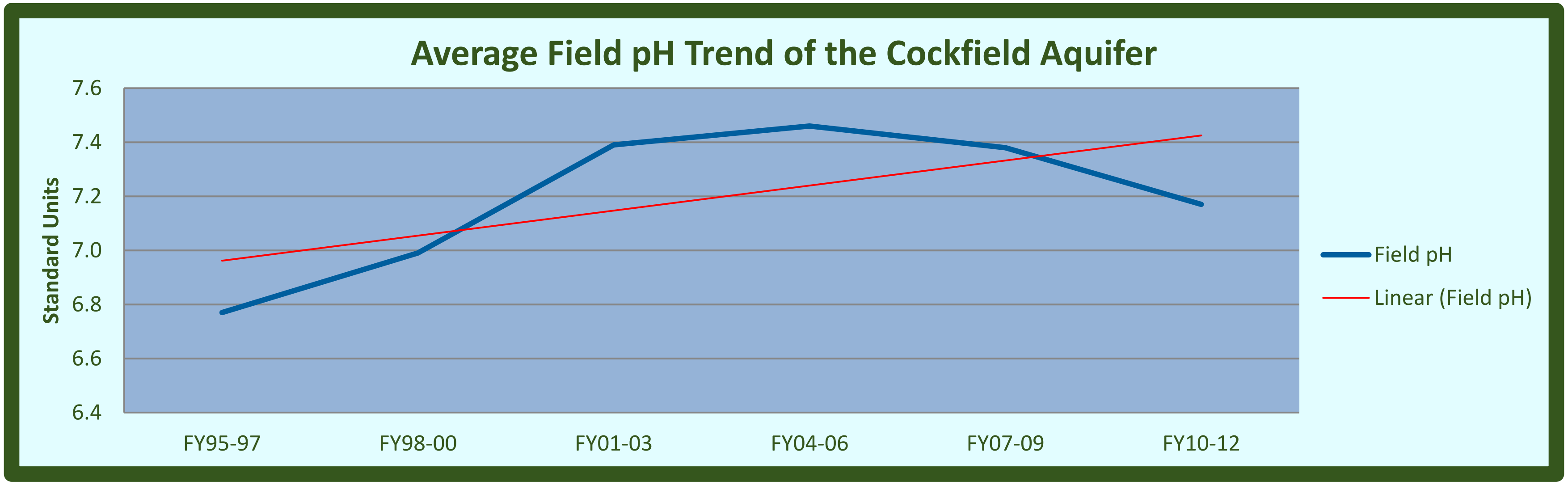

Chart 9-3: Field Specific Conductance Trend

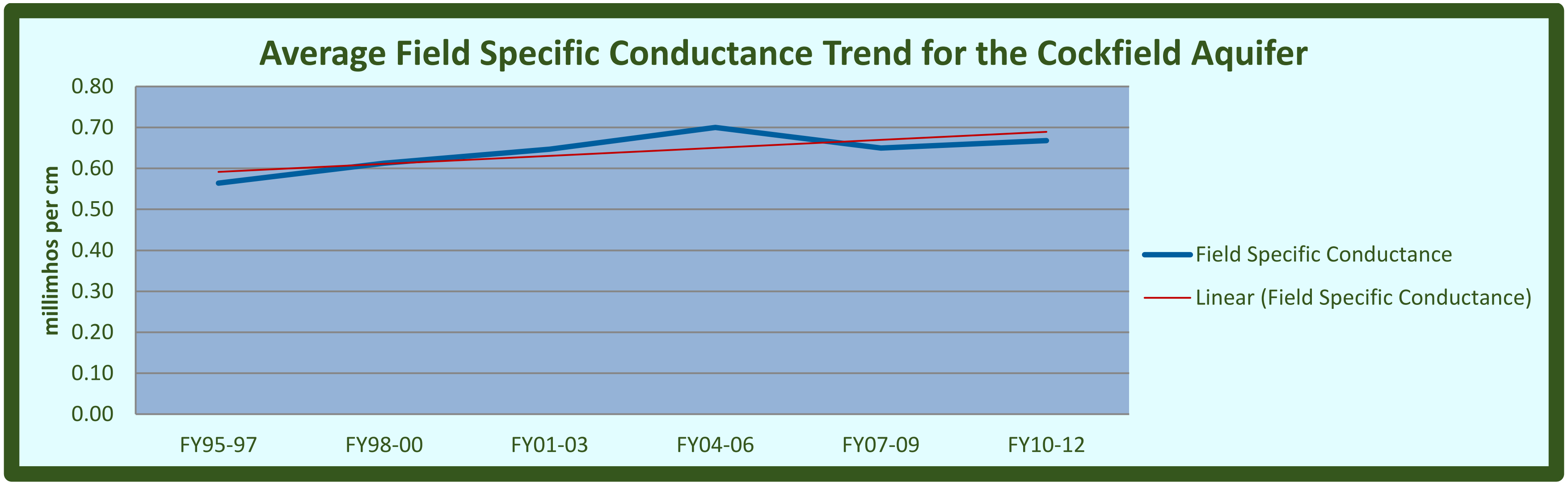

Chart 9-4: Lab Specific Conductance Trend

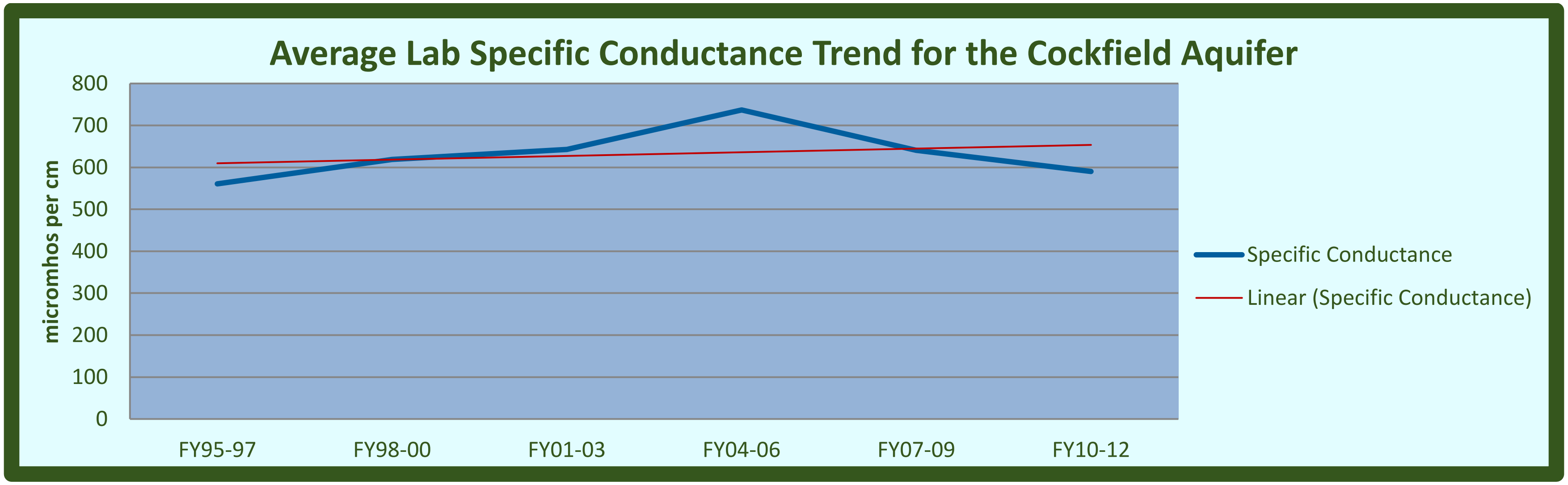

Chart 9-5: Field Salinity Trend

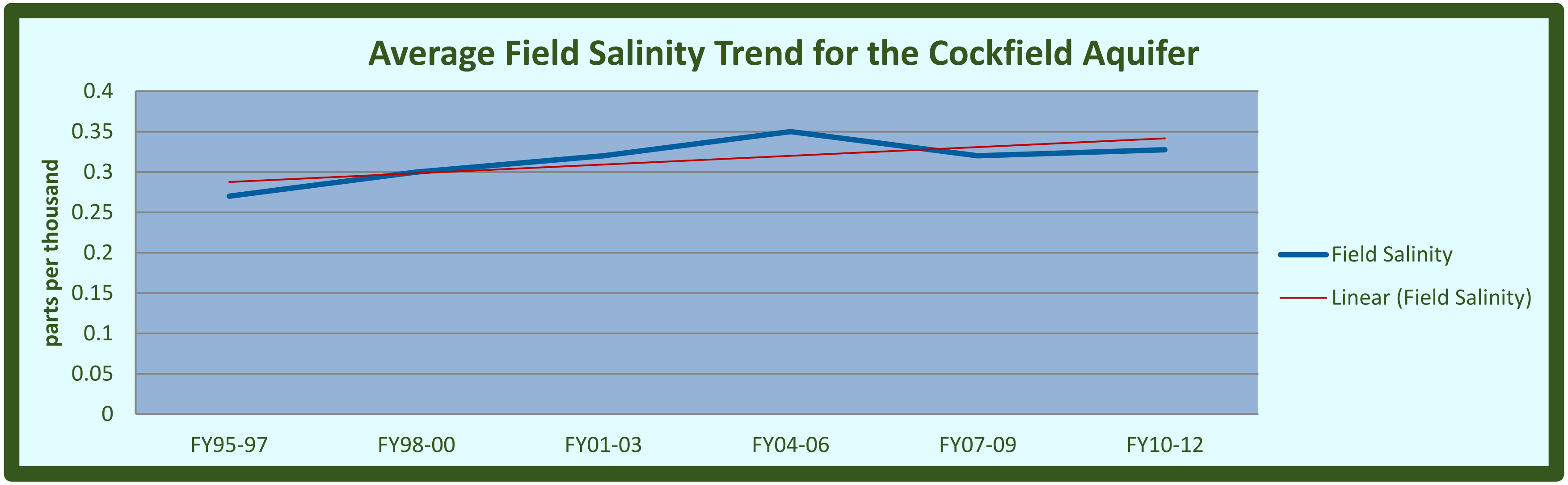

Chart 9-6: Alkalinity Trend

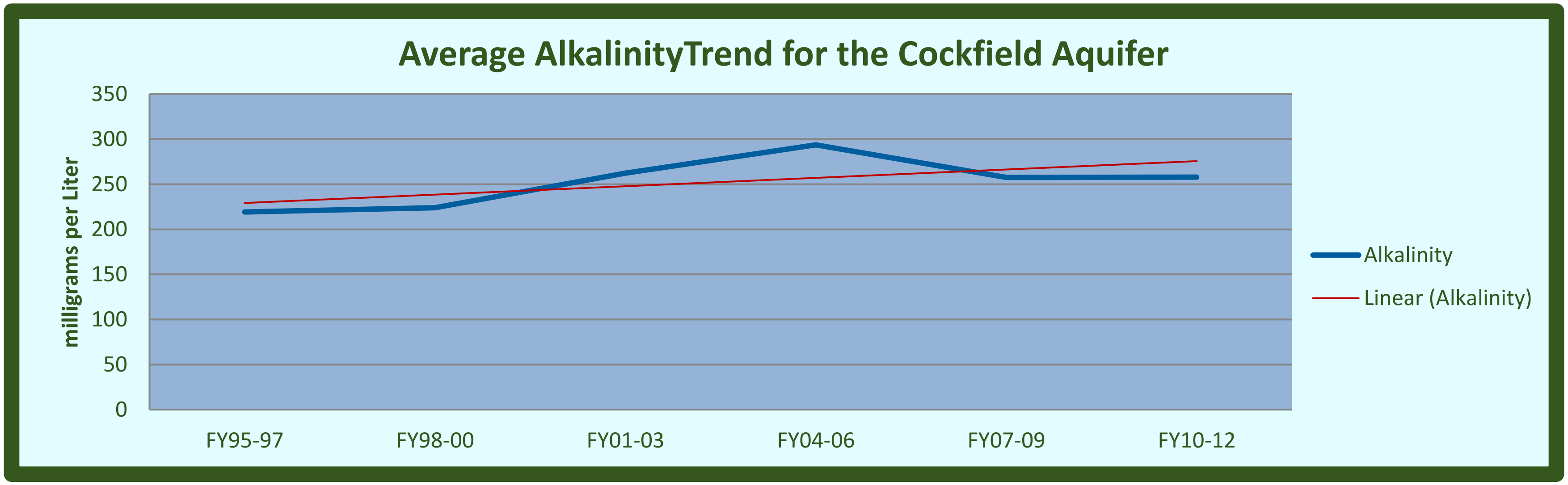

Chart 9-7: Chloride Trend

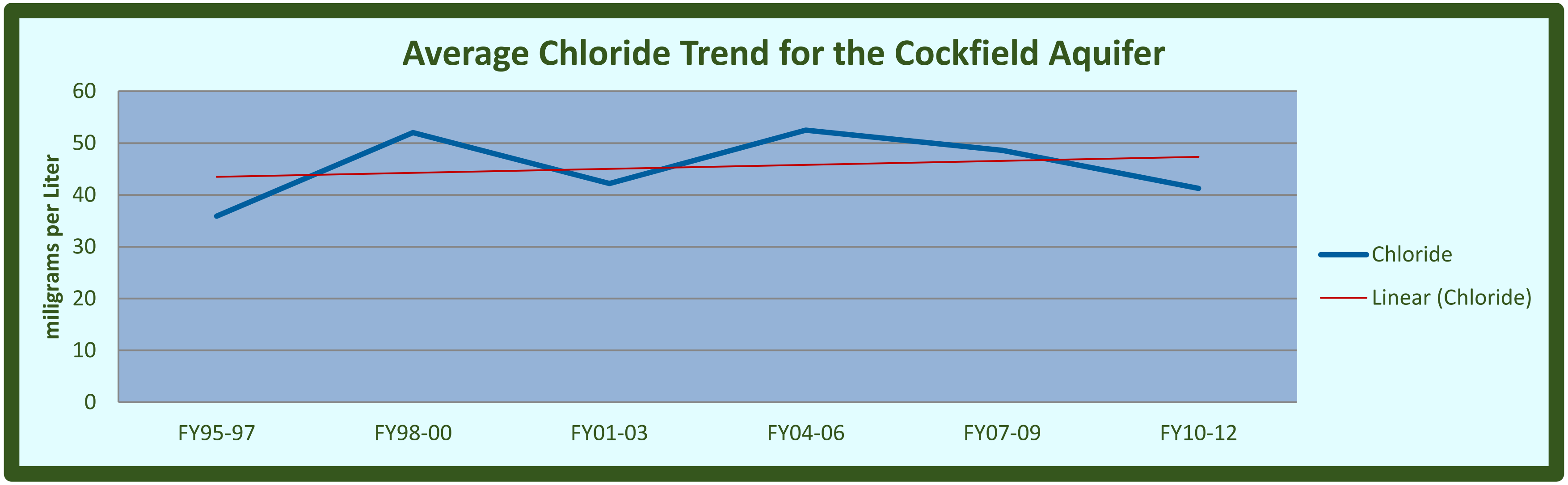

Chart 9-8: Color Trend

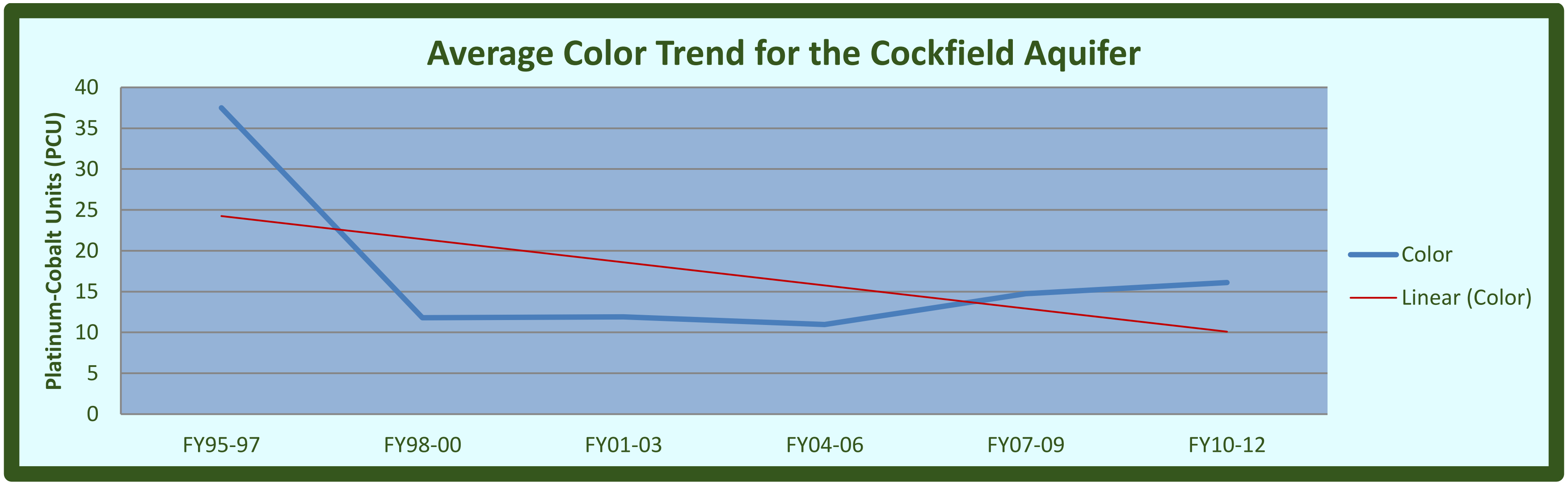

Chart 9-9: Sulfate Trend

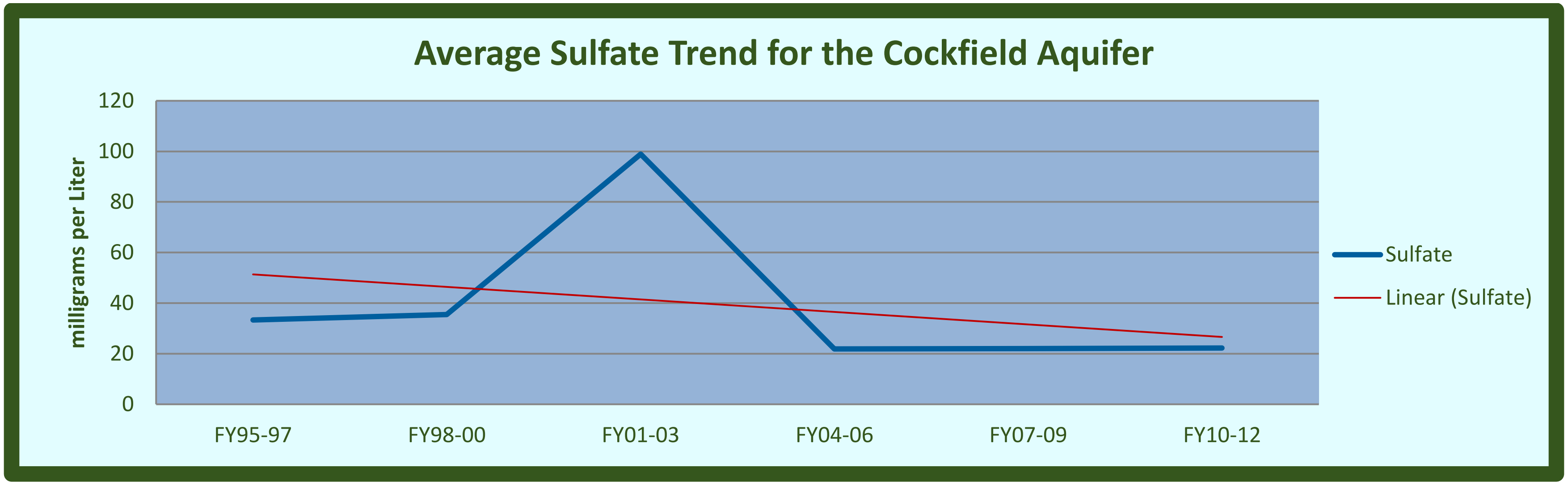

Chart 9-10: Total Dissolved Solids Trend

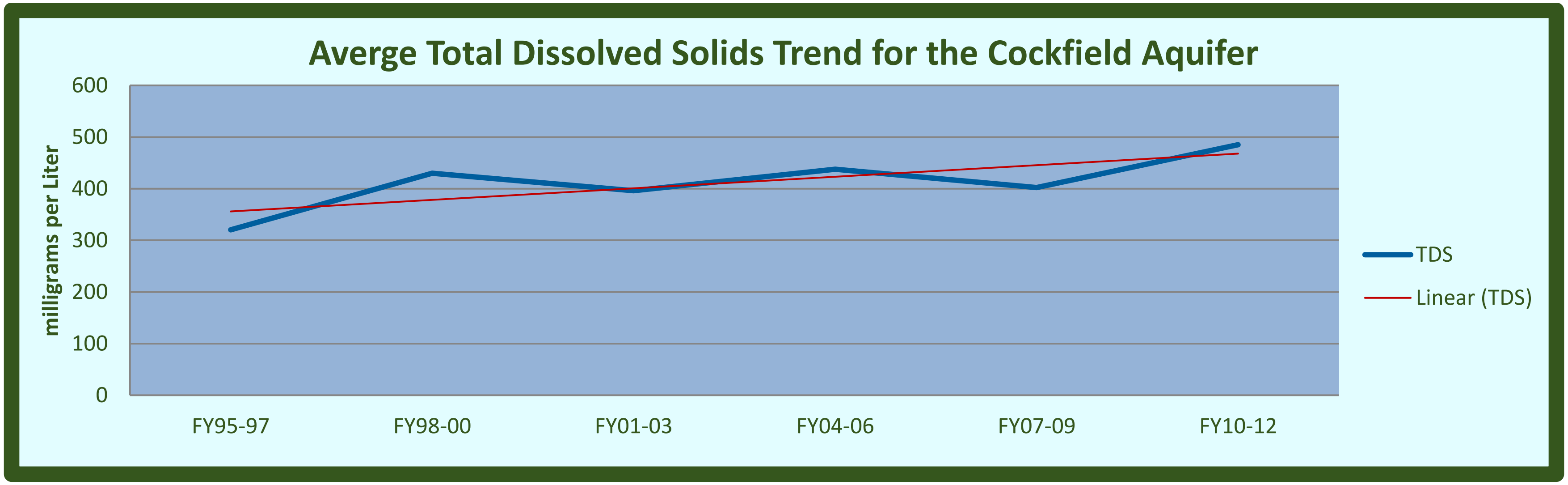

Chart 9-11: Ammonia Trend

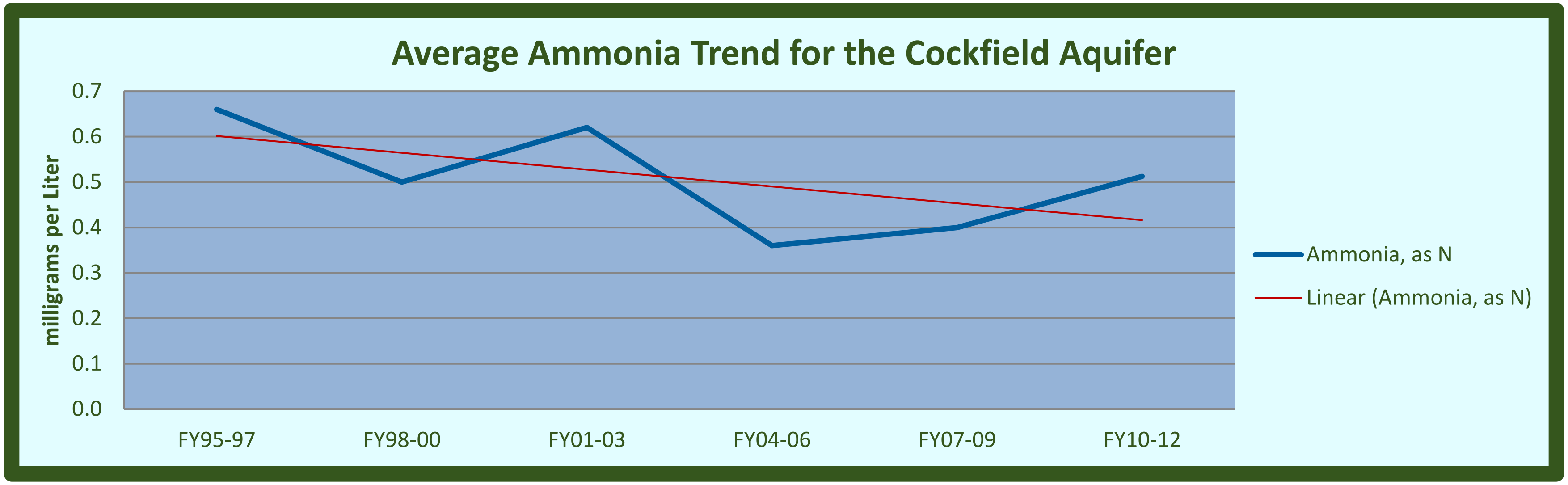

Chart 9-12: Hardness Trend

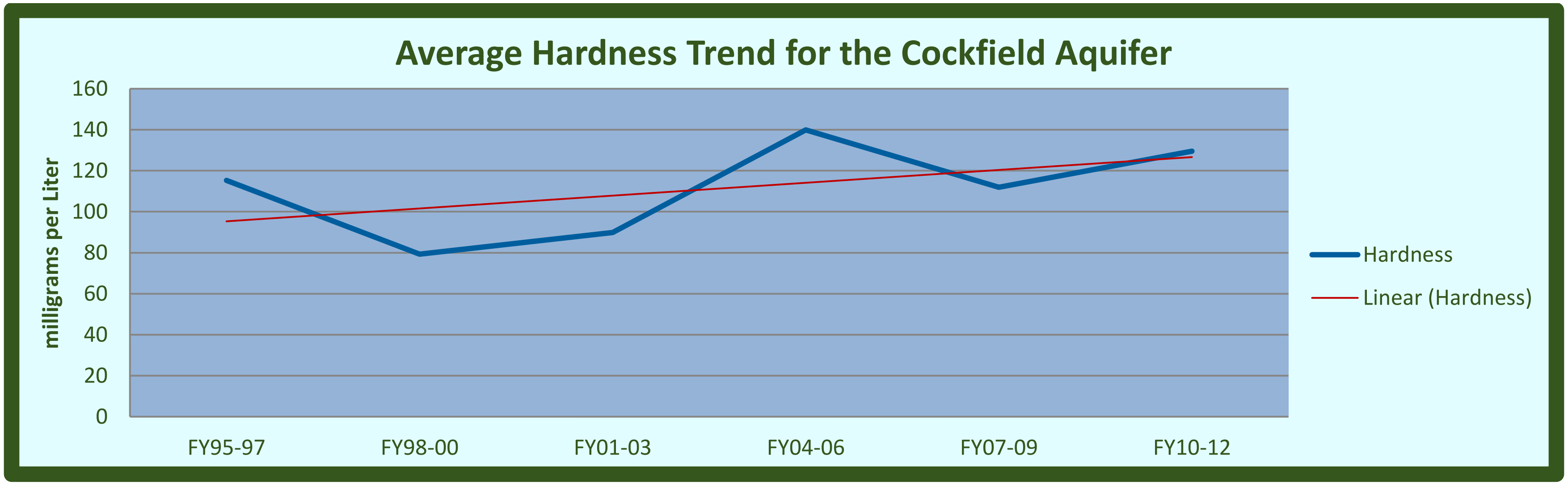

Chart 9-13: Nitrite – Nitrate Trend

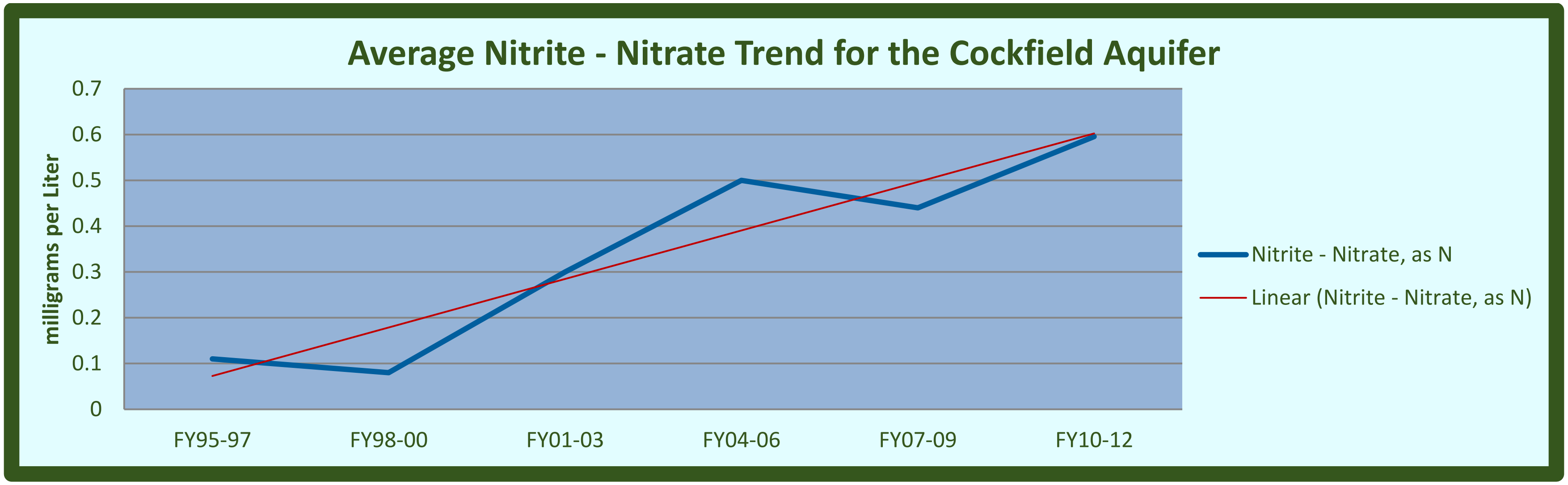

Chart 9-14: TKN Trend

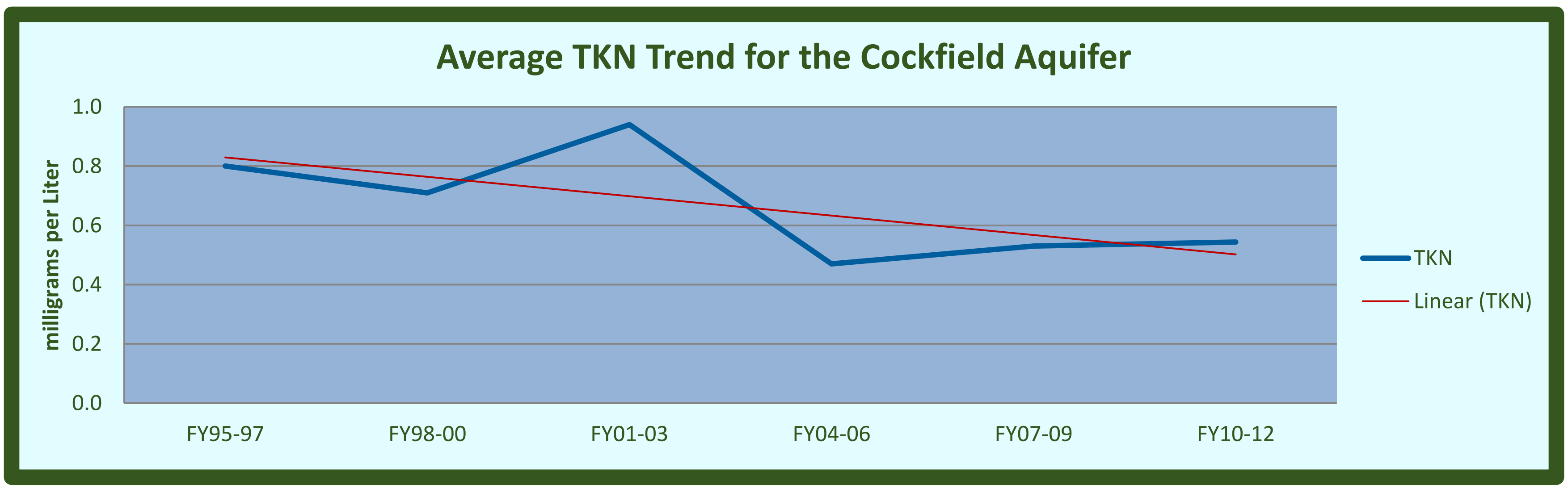

Chart 9-15: Total Phosphorus Trend

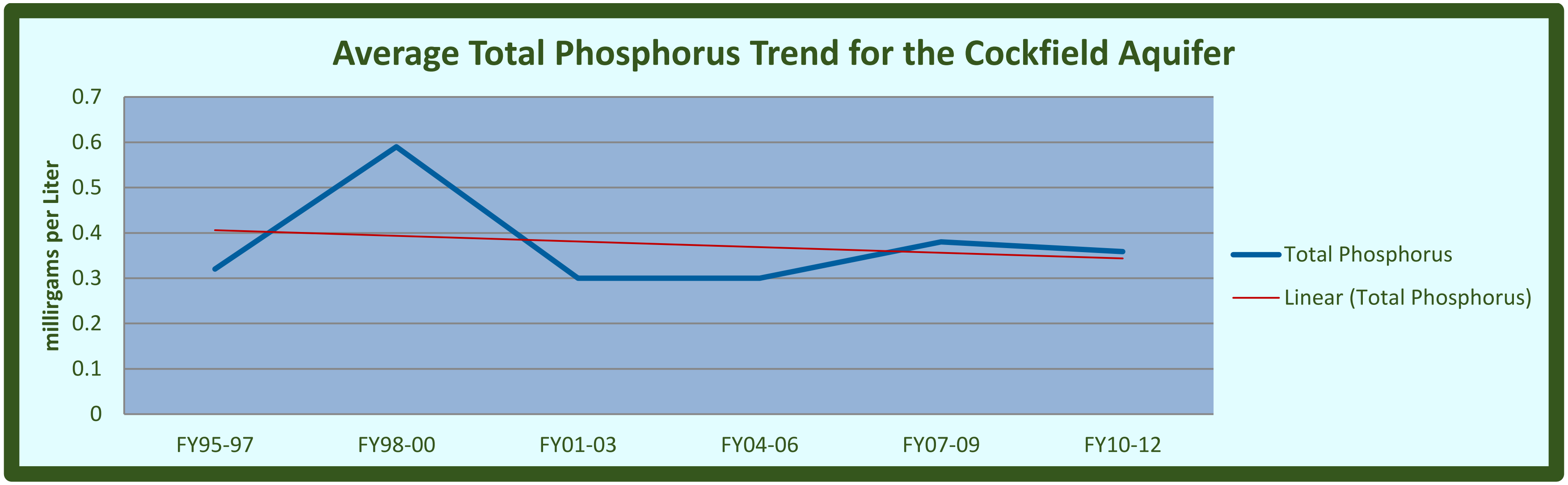

Chart 9-16: Iron Trend