COCKFIELD AQUIFER SUMMARY, 2020

AQUIFER SAMPLING AND ASSESSMENT PROGRAM

DEQ
LOUISIANA

APPENDIX 9 TO THE 2021 TRIENNIAL SUMMARY REPORT

PARTIAL FUNDING PROVIDED BY THE CWA

ASSET
AQUIFER SAMPLING AND ASSESSMENT PROGRAM

Contents

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 across the state. The sampling process is designed so that all 14 aquifers 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 make up, in part, the ASSET Program's Triennial Summary Report.

Analytical and field data contained in this summary were collected from wells producing from the Cockfield aquifer, during the 2020 state fiscal year (July 1, 2019 - June 30, 2020). This summary will become Appendix 9 of ASSET Program Triennial Summary Report for 2021.

These data show that 13 wells were sampled which produce from the Cockfield aquifer. Nine of these 13 are classified as public supply, three are classified as domestic use, and one 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 RI-127, RI-450, W-192, WC-487, and CA-35.

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 2020 sampling. Tables 9-6 and 9-7 compare these same parameter averages to historical ASSET-derived data for the Cockfield aquifer, from previous fiscal years.

The average values listed in the above referenced tables are determined using all valid, reported results, including those reported as non-detect, or less than the detection limit (< DL). The average values listed in the above referenced tables are determined using all valid, reported results, including those reported as non-detect, or less than the detection limit (< DL). The method used to generate the descriptive statistics varies, depending on the dataset and the proportion of values that are <DL. When estimating a dataset with more than 50 observations, the Maximum Likelihood Estimation (MLE) method is used. This is used to describe Upper and Lower confidence intervals or historical descriptive statistics. For datasets of less than 50 observations, the Kapan-Meier method is used. This is used to calculate descriptive statistics of a single sampling round. If all values for a particular analyte are reported as < DL, then the minimum, maximum, and average values are all reported as < DL.

Charts 9-1 through 9-18 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 primary standards, or 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 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 six of the 11 wells sampled in the Cockfield aquifer, with 16 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 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 four wells exceeded the SMCL for pH, one well exceeded the SMCL for color, and three wells exceeded the SMCL for total dissolved solids. Laboratory results override field results in exceedance determination, thus only laboratory results are counted in determining SMCL exceedance numbers for total dissolved solids. Following is a list of SMCL parameter exceedances with well number and results:

pH (SMCL = 6.5 – 8.5 Standard Units):

NA-5243Z	8.92 SU
UN-5332Z	6.30 SU
W-192	8.67 SU (Lab and Duplicate)
W-198	8.52 SU

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

NA-5243Z	20 PCU

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

	LAB RESULTS (in mg/L)	FIELD MEASURES (in g/L)
NA-5243Z	695 mg/L	0.677 g/L
SA-5710Z	980 mg/L	1.150 g/L
WC-187	695 mg/L	0.844 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 eight wells exceeded the secondary MCL for iron:

Iron (SMCL = 300 ug/L):

CA-35	5710 µg/L	Duplicate – 5020 µg/L
EC-233	916 µg/L	
MO-479	1140 µg/L	
RI-450	922 µg/L	Duplicate – 891 µg/L
SA-5710Z	1160 µg/L	
UN-5332Z	23900 µg/L	
WC-187	528 µg/L	
WC-487	614 µg/L	Duplicate – 562 µg/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.

In SA-5710Z trichloroethylene was found at a concentration of 5.7 ppb. This is above the MCL of 2 ppb. In addition, multiple VOCS were found in EC-233. These chemicals were bromoform (0.65 µg/L), dibromochloromethane (2.6 µg/L), bromodichloromethane (3.7 µg/L), and chloroform (6 µg/L). None of these chemicals have MCLs.

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.

There were no confirmed detections of a SVOC at or above its detection limit during the FY 2020 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.

There were no confirmed detections of a pesticide or PCB at or above its detection limit during the FY 2020 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 seven previous sampling rotations. These comparisons can be found in Tables 9-6 and 9-7, and in Charts 9-1 to 9-18 of this summary. Increasing or decreasing trend statements made here are based on an R-square value of 0.03 or greater and a p-value of < 0.05.

Over the 24-year period, one analyte has shown a general increase in average concentration. Nitrate-Nitrite values trend upwards at a rate of 0.001637 μg/L every month. For this same period, temperature exhibited a downward trend at a rate of 0.1959 μg/L every month.

The current total number of secondary exceedances have decreased since the previous sampling event in FY 2017. Current sample results show that 11 wells reported one or more secondary exceedances with 16 SMCL exceedances. The FY 2017 sampling of the Cockfield aquifer shows that nine wells reported one or more SMCL exceedances with 14 exceedances.

SUMMARY AND RECOMMENDATIONS

In summary, the data show that the ground water produced from this aquifer is moderately hard[1], but is of mediocre quality when considering short or long-term health risk guidelines given that multiple VOCs were present in samples. The data also show that this aquifer is of poor quality when considering taste, odor, or appearance guidelines, with 16 Secondary MCLs exceeded in 11 of the 13 wells sampled.

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 previously sampled wells. In addition, several wells should be added to the 13 currently in place to increase the well density for 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.

Table 9-1: List of Wells Sampled, Cockfield Aquifer–FY 2020

Well ID	Parish	Date	Owner	Depth (Feet)	Well Use
CA-35	Caldwell	6/4/2020	City of Columbia	298	Public Supply
EC-233	East Carroll	6/9/2020	Town of Lake Providence	371	Public Supply
MO-479	Morehouse	6/30/2020	Bayou Bonne Idee Water System	258	Public Supply
NA-5243Z	Natchitoches	6/29/2020	Private Owner	171	Domestic
OU-FRITH	Ouachita	6/2/2020	Private Owner	80	Domestic
RI-127	Richland	6/30/2020	Delhi Water Works	416	Public Supply
RI-450	Richland	6/18/2020	River Road Waterworks	283	Public Supply
SA-5710Z	Sabine	6/29/2020	Private Owner	150	Domestic
UN-5332Z	Union	6/2/2020	Private Owner	160	Irrigation
W-192	Winn	10/23/2019	Red Hill Water System	210	Public Supply
W-198	Winn	10/23/2019	Atlanta Water System	445	Public Supply
WC-187	West Carroll	6/9/2020	New Carroll Water System	110	Public Supply
WC-487	West Carroll	6/9/2020	Town of Oak Grove	396	Public Supply

Table 9-2: Summary of Field and Conventional Data, Cockfield Aquifer–FY 2020

Well ID	pH SU	Sal ppt	Sp Cond µmhos/cm	Temp Deg C	TDS mg/L	Alk mg/L	Cl mg/L	Color PCU	Hard mg/L	Nitrate - Nitrite (as N) mg/L	NH3 mg/L	Tot P mg/L	Sp Cond µmhos/cm	SO4 mg/L	TDS mg/L	TKN mg/L	TSS mg/L	Turb NTU
	Laboratory Reporting Limits →					2	1	5	5	0.05	0.1	0.05	1	1	10	0.1	4	0.1
	Field Parameters					Laboratory Parameters												
CA-35	6.59	ND	ND	ND	197.7	71.30	18.10	< DL	110	< DL	< DL	0.51	590	34	280	0.72	4.00	7.70
CA-35*	6.54	ND	ND	ND	ND	75.30	17.70	< DL	88	< DL	< DL	0.50	604	34.70	240	0.27	< DL	2.00
EC-233	7.25	0.42	854.61	27.01	555.5	358	42.40	10	190	0.05	0.41	0.33	1090	< DL	490	1.50	< DL	3.90
MO-479	7.40	0.34	687.98	21.42	440	245	31.80	10	220	0.34	ND	0.17	653	27.30	435	0.19	< DL	0.62
NA-5243Z	8.92	0.51	1042.01	24.97	677.3	424	22.50	20	20	< DL	0.92	1.10	2.40	39.20	695	0.89	< DL	0.48
OU-FRITH	ND	ND	ND	ND	ND	245	2.60	< DL	64	< DL	0.64	ND	933	< DL	315	0.66	5.00	6.80
RI-127	7.93	0.44	899.00	22.96	580	330	68.30	10	16	< DL	0.98	0.23	899	< DL	415	1.00	< DL	6.50
RI-127*	7.92	0.44	898.99	23.00	580	321	68.00	10	18	< DL	0.99	0.21	877	< DL	495	1.40	< DL	0.29
RI-450	7.70	0.20	418.70	21.60	272.2	226	5.10	< DL	174	< DL	0.16	0.15	384	< DL	320	0.24	< DL	3.40
RI-450*	7.63	0.20	418.95	21.62	272.3	208	5.10	< DL	178	< DL	0.13	0.13	411	< DL	320	0.28	< DL	8.60
SA-5710Z	7.72	0.79	1562.63	23.35	1015	292	96.00	10	164	< DL	1.60	0.09	3.40	250	980	2.00	6.00	7.10
UN-5332Z	6.30	0.09	182.49	22.06	118.6	81.20	3.20	10	66	< DL	0.34	4.20	309	< DL	185	0.64	57.00	2.20
W-192	8.67	0.46	0.92	16.21	600	290	99.20	< DL	< DL	< DL	1.30	< DL	915	12.20	470	0.85	< DL	1.10
W-192*	8.67	0.46	0.92	16.21	600	280	99.80	<DL	< DL	< DL	1.00	< DL	895	12.10	425	0.82	< DL	0.74
W-198	8.52	0.42	0.41	18.27	270	172	14.20	< DL	< DL	< DL	0.59	< DL	425	< DL	205	0.39	< DL	158
WC-187	7.09	0.65	1298.54	21.08	844	292	197	< DL	420	0.15	< DL	0.09	1760	13.40	695	1.90	< DL	3.20
WC-487	7.26	0.38	785.27	22.65	510.4	321	40.70	< DL	200	< DL	0.44	0.13	990	< DL	440	0.69	< DL	8.50
WC-487*	7.23	0.38	785.29	22.84	510.4	321	41.50	< DL	180	< DL	0.44	0.14	1040	< DL	460	1.20	< DL	3.50

* Duplicate sample **Resample ***Resample duplicate Shaded cells exceed EPA Secondary Standards

Table 9-3: Summary of Inorganic Data, Cockfield Aquifer–FY 2020

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	1	1	1	0.5	1	1	3	50	1	0.2	1	1	0.5	0.5	5
CA-35	< DL	< DL	124	< DL	< DL	< DL	< DL	5710	< DL	< DL	< DL	< DL	< DL	< DL	11.40
CA-35*	< DL	< DL	117	< DL	< DL	< DL	< DL	5020	< DL	< DL	< DL	< DL	< DL	< DL	12.80
EC-233	< DL	< DL	408	< DL	< DL	0.93	26.10	916	2.80	< DL	< DL	< DL	< DL	< DL	86
MO-479	0.12	2.10	166	< DL	< DL	2.60	< DL	1140	< DL	< DL	1.80	2.50	< DL	< DL	79.90
NA-5243Z	< DL	< DL	27.70	< DL	< DL	< DL	10.10	< DL	< DL	< DL	< DL	< DL	< DL	< DL	29.10
OU-FRITH	< DL	< DL	125	< DL	< DL	0.74	4.70	178	< DL	< DL	< DL	< DL	< DL	< DL	7.00
RI-127	< DL	< DL	42.50	< DL	< DL	0.26	0.76	67.40	0.10	< DL	< DL	< DL	< DL	< DL	3.80
RI-127*	< DL	< DL	44	< DL	< DL	0.34	0.79	46.30	0.12	< DL	< DL	< DL	< DL	< DL	2.80
RI-450	< DL	< DL	142	< DL	< DL	< DL	4.50	922	4.50	< DL	< DL	< DL	< DL	< DL	6.30
RI-450*	< DL	< DL	139	< DL	< DL	< DL	5.50	891	3.90	< DL	< DL	< DL	< DL	< DL	6.90
SA-5710Z	< DL	< DL	53.20	< DL	< DL	< DL	99.30	1160	6.70	< DL	1.8	< DL	< DL	< DL	59.50
UN-5332Z	< DL	< DL	286	< DL	< DL	0.74	< DL	23900	< DL	< DL	< DL	< DL	< DL	< DL	9.80
W-192	< DL	< DL	11.50	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	3.50
W-192*	< DL	< DL	13.20	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	4.50
W-198	< DL	< DL	4.30	< DL	< DL	4.10	< DL	< DL	< DL	< DL	0.94	< DL	< DL	< DL	16.30
WC-187	< DL	5.80	211	< DL	< DL	< DL	3.10	528	< DL	< DL	< DL	1.90	< DL	< DL	11.10
WC-487	< DL	< DL	358	< DL	< DL	2.00	< DL	614	< DL	< DL	1.10	< DL	< DL	< DL	51.70
WC-487*	< DL	< DL	365	< DL	< DL	< DL	1.60	562	< DL	< DL	< DL	< DL	< DL	< DL	5.50

*Duplicate Sample   Exceeds EPA Secondary Standards.

Table 9-4: FY 2020 Field and Conventional Statistics, ASSET Wells

	PARAMETER	MINIMUM	MAXIMUM	AVERAGE
FIELD	pH (SU)	6.30	8.92	7.61
	Salinity (ppt)	0.20	0.79	0.41
	Specific Conductance (mmhos/cm)	0.41	1298.54	702.96
	Temperature (^{O}C)	16.21	27.01	21.96
	Total Dissolved Solids (g/L)	0.27	844.10	349.45
LABORATORY	Alkalinity (mg/L)	71.30	424	257.50
	Chloride (mg/L)	2.60	99.20	49.32
	Color (PCU)	< DL	20.00	8.64
	Hardness (mg/L)	<DL	420	127.23
	Nitrite - Nitrate, as N (mg/L)	< DL	0.34	0.08
	Ammonia, as N (mg/L)	< DL	1.30	0.59
	Total Phosphorus (mg/L)	< DL	4.20	0.64
	Specific Conductance (µmhos/cm)	2.40	1760	688.91
	Sulfate (mg/L)	<DL	250	29.47
	Total Dissolved Solids (mg/L)	185	980	455.77
	Total Kjeldahl Nitrogen (mg/L)	0.10	1.90	0.90
	Total Suspended Solids (mg/L)	< DL	57	8.31
	Turbidity (NTU)	0.48	158	16.12

Table 9-5: FY 2020 Inorganic Statistics, ASSET Wells

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
Antimony (µg/L)	< DL	0.12	< DL
Arsenic (µg/L)	< DL	5.80	< DL
Barium (µg/L)	4.30	408	150.71
Beryllium (µg/L)	< DL	< DL	< DL
Cadmium (µg/L)	< DL	< DL	< DL
Chromium (µg/L)	< DL	4.10	1.18
Copper (µg/L)	< DL	99.30	11.78
Iron (µg/L)	< DL	23900	2714.26
Lead (µg/L)	< DL	6.70	1.15
Mercury (µg/L)	< DL	< DL	< DL
Nickel (µg/L)	< DL	1.8	< DL
Selenium (µg/L)	< DL	1.9	1.18
Silver (µg/L)	< DL	< DL	< DL
Thallium (µg/L)	< DL	< DL	< DL
Zinc (µg/L)	3.50	79.90	28.88

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	FY 2014	FY 2017	FY 2019
FIELD	pH (SU)	6.77	6.99	7.39	7.46	7.38	7.17	7.54	7.47	7.61
	Salinity (ppt)	0.27	0.30	0.32	0.35	0.32	0.33	0.38	0.36	0.41
	Specific Conductance (mmhos/cm)	0.564	0.613	0.647	0.700	0.650	0.668	0.770	0.720	702.96
	Temperature (^{O}C)	19.91	19.76	20.30	19.82	19.90	18.08	18.59	12.32	21.96
	Total Dissolved Solids (g/L)	-	-	-	0.460	0.430	0.430	0.498	0.468	349.45
LABORATORY	Alkalinity (mg/L)	219	224	262	294	257	258	283	302	257.50
	Chloride (mg/L)	35.9	52.0	42.2	52.5	48.6	41.3	58.9	51.5	49.32
	Color (PCU)	38	12	12	11	15	16	17	13	8.64
	Hardness (mg/L)	115	79	90	140	112	130	211	114	127.23
	Nitrite - Nitrate, as N (mg/L)	0.11	0.08	0.30	0.50	0.44	0.60	0.06	< DL	0.08
	Ammonia, as N (mg/L)	0.66	0.50	0.62	0.36	0.40	0.51	0.55	0.57	0.59
	Total Phosphorus (mg/L)	0.32	0.59	0.30	0.30	0.38	0.36	0.34	1.23	0.64
	Specific Conductance (µmhos/cm)	561	619	643	737	641	590	741	648	688.91
	Sulfate (mg/L)	33.4	35.5	98.9	21.9	22.0	22.2	23.9	26.9	29.47
	Total Dissolved Solids (mg/L)	320	430	396	438	402.	485	481	457	455.77
	Total Kjeldahl Nitrogen (mg/L)	0.80	0.71	0.94	0.47	0.53	0.54	0.43	0.63	0.90
	Total Suspended Solids (mg/L)	5	< DL	< DL	< DL	< DL	< DL	2	< DL	8.31
	Turbidity (NTU)	7.1	9.7	4.7	5.4	3.9	6.3	3.7	6.0	16.12

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	FY 2014	FY 2017	FY2019
Antimony (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Arsenic (µg/L)	5.4	< DL	< DL	< DL	< DL	< DL	1.1	< DL	< DL
Barium (µg/L)	121	124	141	162	112	144	145	126	150.71
Beryllium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Cadmium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Chromium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	10.6	1.3	1.18
Copper (µg/L)	39.6	5.9	11.8	8.3	5.1	4.0	10.9	9.3	11.78
Iron (µg/L)	1,836	1,623	1,320	1,084	1,324	1,470	951	1047	2714.26
Lead (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	1.0	< DL	1.15
Mercury (µg/L)	< DL	< DL	< DL	< DL	0.08	< DL	< DL	< DL	< DL
Nickel (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	8.1	< DL	< DL
Selenium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	1.18
Silver (µg/L)	< DL	< DL	< DL	4.72	< DL	< DL	< DL	< DL	< DL
Thallium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Zinc (µg/L)	117.5	34.1	30.7	< DL	25.6	93.8	141.7	11.2	28.88

Table 9-8: Volatile Organic Compound List

VOC ANAYTICAL PARAMETERS	METHOD	REPORTING LIMIT (µg/L)
1,1,1-TRICHLOROETHANE	624	0.50
1,1,2,2-TETRACHLOROETHANE	624	0.50
1,1,2-TRICHLOROETHANE	624	0.50
1,1-DICHLOROETHANE	624	0.50
1,1-DICHLOROETHENE	624	0.50
1,2-DICHLOROBENZENE	624	0.50
1,2-DICHLOROETHANE	624	0.50
1,2-DICHLOROPROPANE	624	0.50
1,3-DICHLOROBENZENE	624	0.50
1,4-DICHLOROBENZENE	624	0.50
BENZENE	624	0.50
BROMODICHLOROMETHANE	624	0.50
BROMOFORM	624	0.50
BROMOMETHANE	624	1.0
CARBON TETRACHLORIDE	624	0.50
CHLOROBENZENE	624	0.50
CHLOROETHANE	624	0.50
CHLOROFORM	624	0.50
CHLOROMETHANE	624	1.0
CIS-1,3-DICHLOROPROPENE	624	1.0
DIBROMOCHLOROMETHANE	624	0.50
ETHYL BENZENE	624	0.50
METHYLENE CHLORIDE	624	1.0
O-XYLENE (1,2-DIMETHYLBENZENE)	624	0.50
STYRENE	624	0.50
TERT-BUTYL METHYL ETHER	624	0.50
TETRACHLOROETHYLENE (PCE)	624	0.50
TOLUENE	624	0.50
TRANS-1,2-DICHLOROETHENE	624	0.50
TRANS-1,3-DICHLOROPROPENE	624	0.50
TRICHLOROETHYLENE (TCE)	624	0.50
TRICHLOROFLUOROMETHANE (FREON-11)	624	0.50
VINYL CHLORIDE	624	0.50
XYLENES, M & P	624	1.0

Table 9-9: Semi-Volatile Organic Compound List

SVOC ANAYTICAL PARAMETERS	METHOD	REPORTING LIMIT (µg/L)
1,2,4-TRICHLOROBENZENE	625	5.0
2,4,6-TRICHLOROPHENOL	625	5.0
2,4-DICHLOROPHENOL	625	5.0
2,4-DIMETHYLPHENOL	625	5.0
2,4-DINITROPHENOL	625	20.0
2,4-DINITROTOLUENE	625	5.0
2,6-DINITROTOLUENE	625	5.0
2-CHLORONAPHTHALENE	625	5.0
2-CHLOROPHENOL	625	5.0
2-NITROPHENOL	625	5.0
3,3'-DICHLOROBENZIDINE	625	5.0
4,6-DINITRO-2-METHYLPHENOL	625	10.0
4-BROMOPHENYL PHENYL ETHER	625	5.0
4-CHLORO-3-METHYLPHENOL	625	5.0
4-CHLOROPHENYL PHENYL ETHER	625	5.0
4-NITROPHENOL	625	20.0
ACENAPHTHENE	625	0.20
ACENAPHTHYLENE	625	0.20
ANTHRACENE	625	0.20
BENZIDINE	625	20.0
BENZO(A)ANTHRACENE	625	0.20
BENZO(A)PYRENE	625	0.20
BENZO(B)FLUORANTHENE	625	0.20
BENZO(G,H,I)PERYLENE	625	0.20
BENZO(K)FLUORANTHENE	625	0.20
BENZYL BUTYL PHTHALATE	625	5.0
BIS(2-CHLOROETHOXY) METHANE	625	5.0
BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	625	5.0
BIS(2-ETHYLHEXYL) PHTHALATE	625	5.0
CHRYSENE	625	0.20
DIBENZ(A,H)ANTHRACENE	625	0.20
DIETHYL PHTHALATE	625	5.0
DIMETHYL PHTHALATE	625	5.0
DI-N-BUTYL PHTHALATE	625	5.0
DI-N-OCTYLPHTHALATE	625	5.0
FLUORANTHENE	625	0.20
FLUORENE	625	0.20

SVOC ANAYTICAL PARAMETERS	METHOD	REPORTING LIMIT (µg/L)
HEXACHLOROBENZENE	625	5.0
HEXACHLOROBUTADIENE	625	5.0
HEXACHLOROCYCLOPENTADIENE	625	10.0
HEXACHLOROETHANE	625	5.0
INDENO(1,2,3-C,D)PYRENE	625	0.20
ISOPHORONE	625	5.0
NAPHTHALENE	625	0.20
NITROBENZENE	625	5.0
N-NITROSODIMETHYLAMINE	625	5.0
N-NITROSODI-N-PROPYLAMINE	625	5.0
N-NITROSODIPHENYLAMINE	625	5.0
PENTACHLOROPHENOL	625	5.00
PHENANTHRENE	625	0.20
PHENOL	625	5.0
PYRENE	625	0.20

Table 9-10: Pesticides and PCB List

Pest/PCB Analytical Parameters	METHOD	REPORTING LIMIT (µg/L)
ALDRIN	608	0.025
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	608	0.025
ALPHA ENDOSULFAN	608	0.025
ALPHA-CHLORDANE	608	0.025
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	608	0.025
BETA ENDOSULFAN	608	0.025
CHLORDANE	608	0.20
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	608	0.025
DIELDRIN	608	0.025
ENDOSULFAN SULFATE	608	0.025
ENDRIN	608	0.025
ENDRIN ALDEHYDE	608	0.025
ENDRIN KETONE	608	0.025
GAMMA-CHLORDANE	608	0.025
HEPTACHLOR	608	0.025
HEPTACHLOR EPOXIDE	608	0.025
METHOXYCHLOR	608	0.25
P,P'-DDD	608	0.025
P,P'-DDE	608	0.025
P,P'-DDT	608	0.025
PCB-1016 (AROCHLOR 1016)	608	0.80
PCB-1221 (AROCHLOR 1221)	608	0.80
PCB-1232 (AROCHLOR 1232)	608	0.80
PCB-1242 (AROCHLOR 1242)	608	0.80
PCB-1248 (AROCHLOR 1248)	608	0.80
PCB-1254 (AROCHLOR 1254)	608	0.80
PCB-1260 (AROCHLOR 1260)	608	0.80
TOXAPHENE	608	1.0

Figure 9-1: Location Plat, Cockfield Aquifer

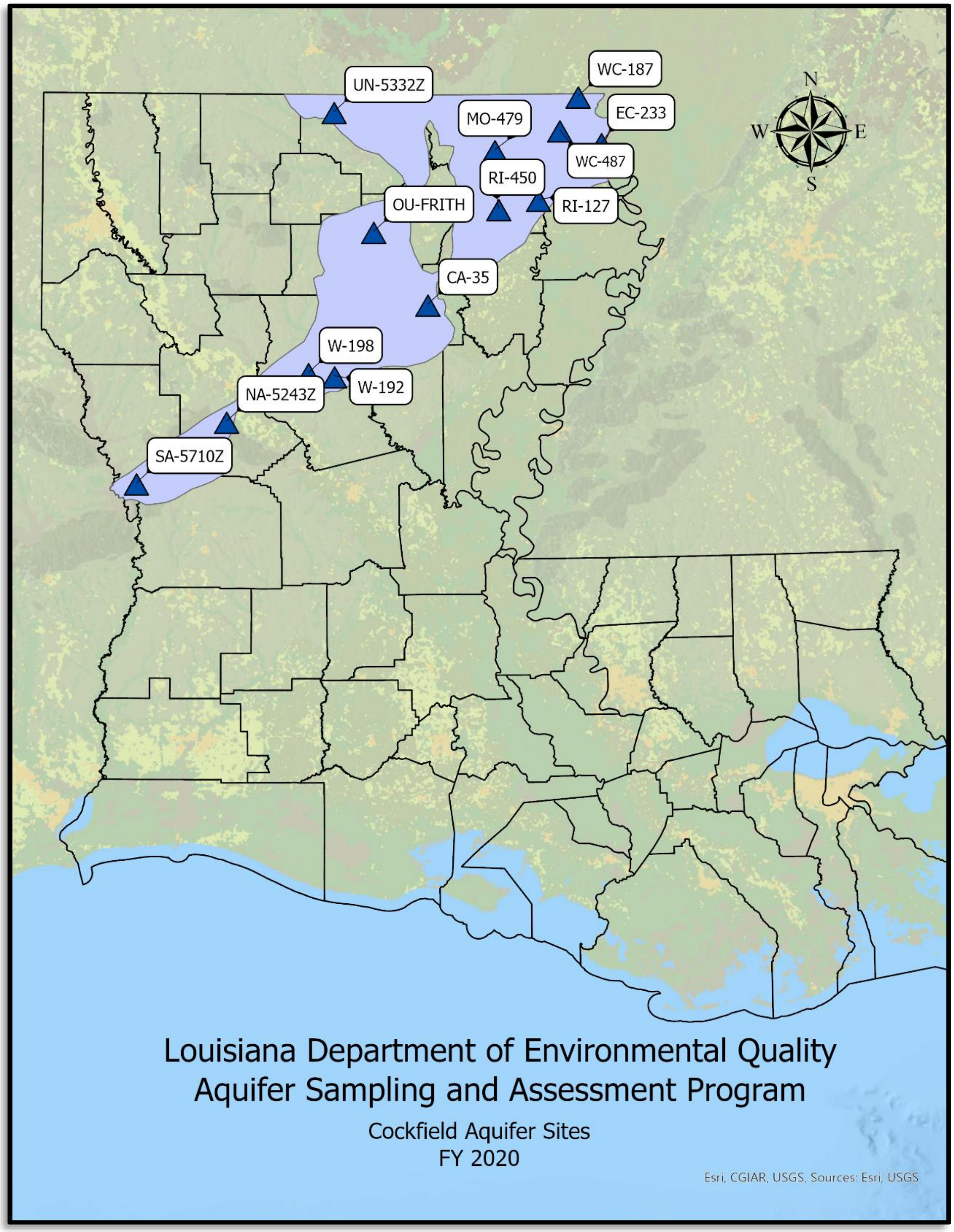
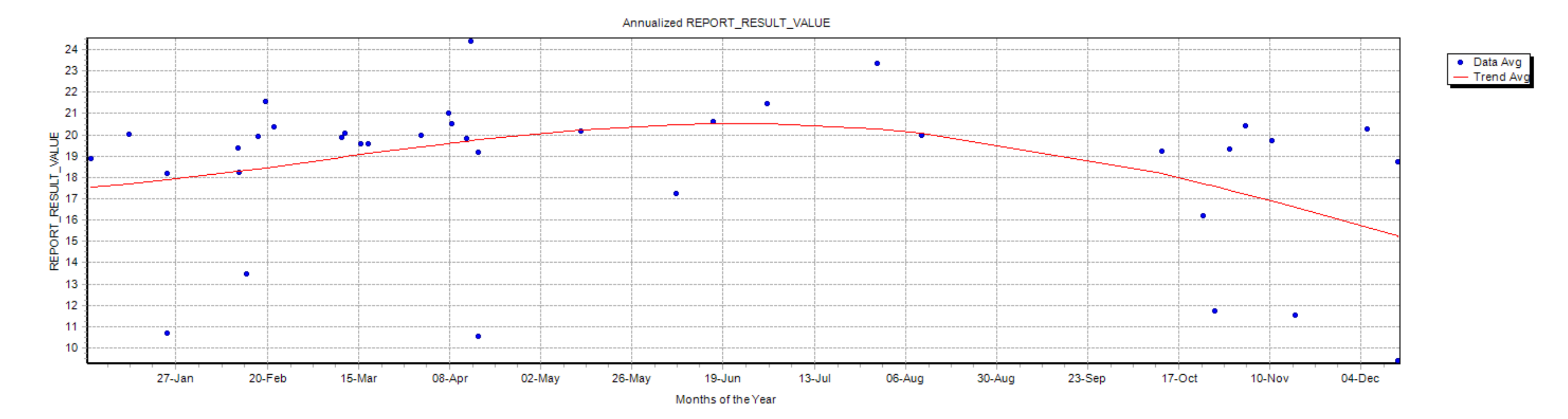


Chart 9-1: Temperature Trend



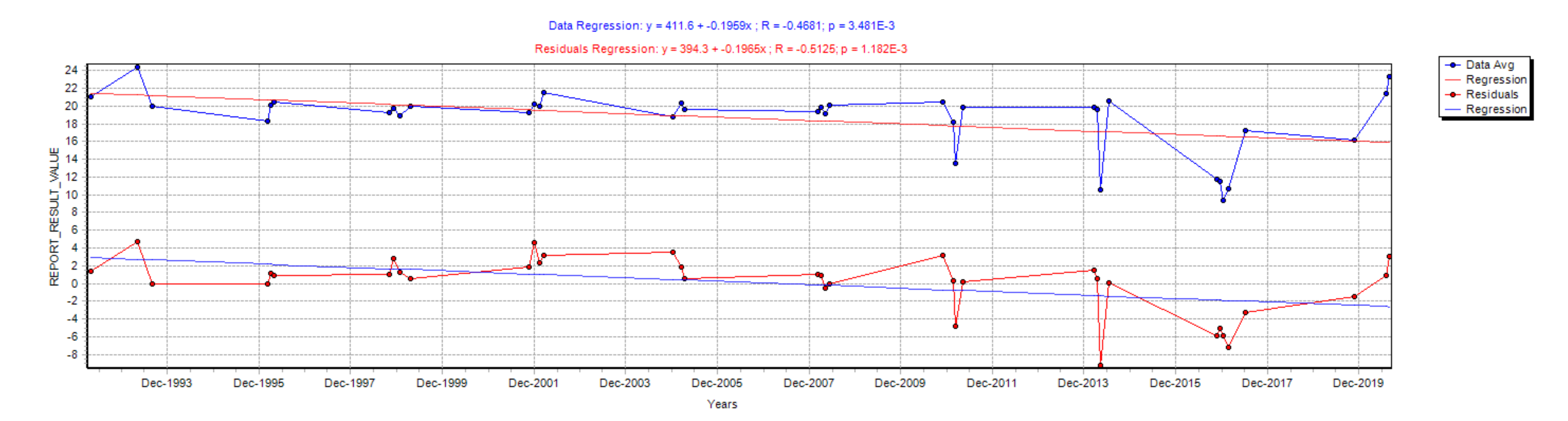
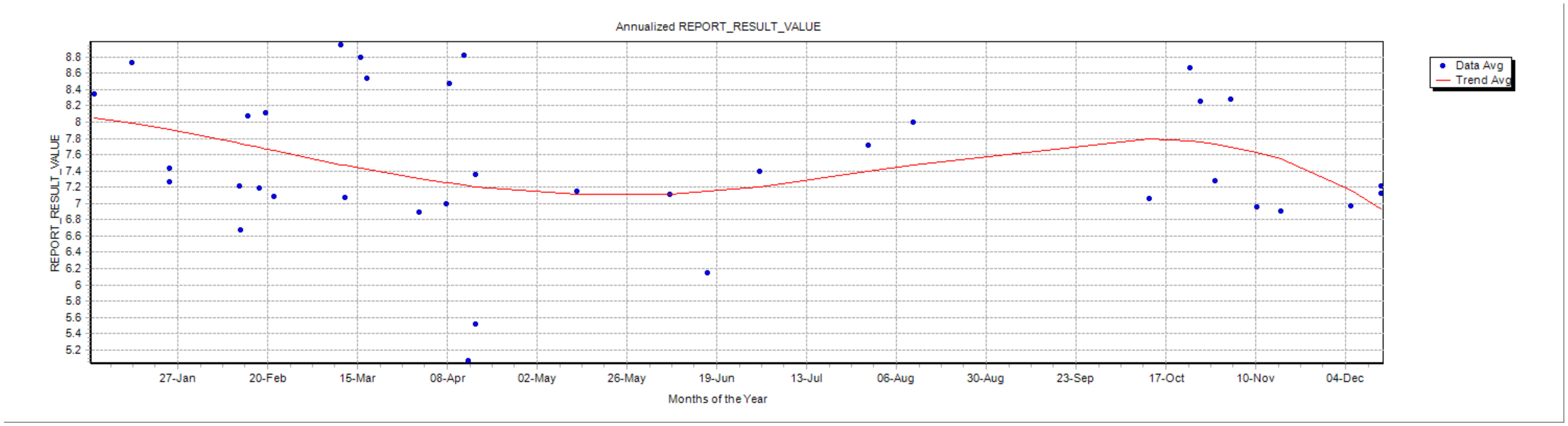


Chart 9-2: pH Trend



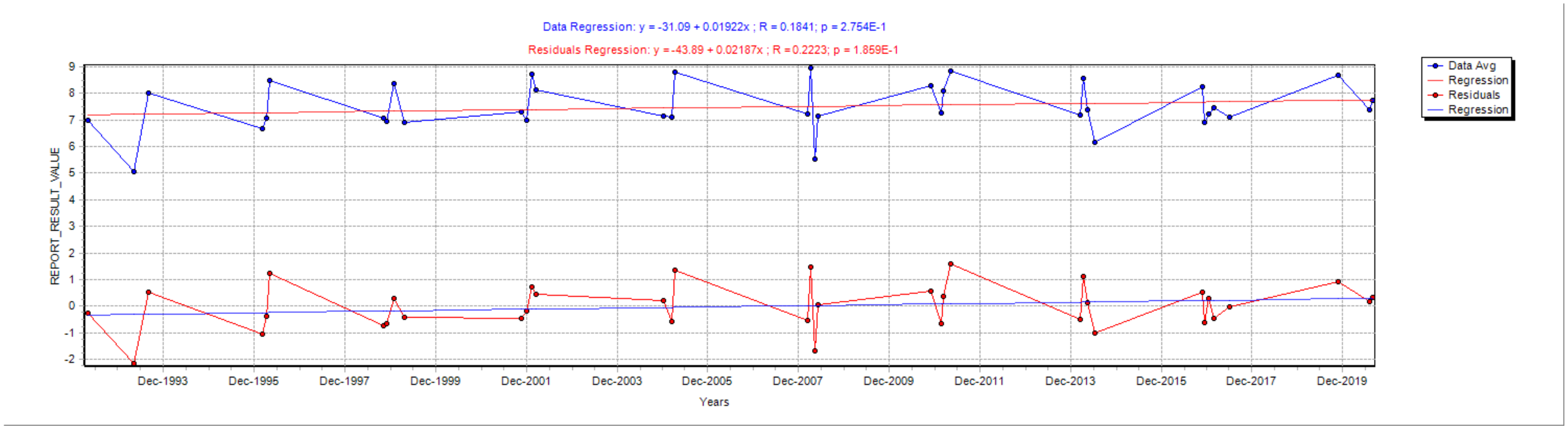
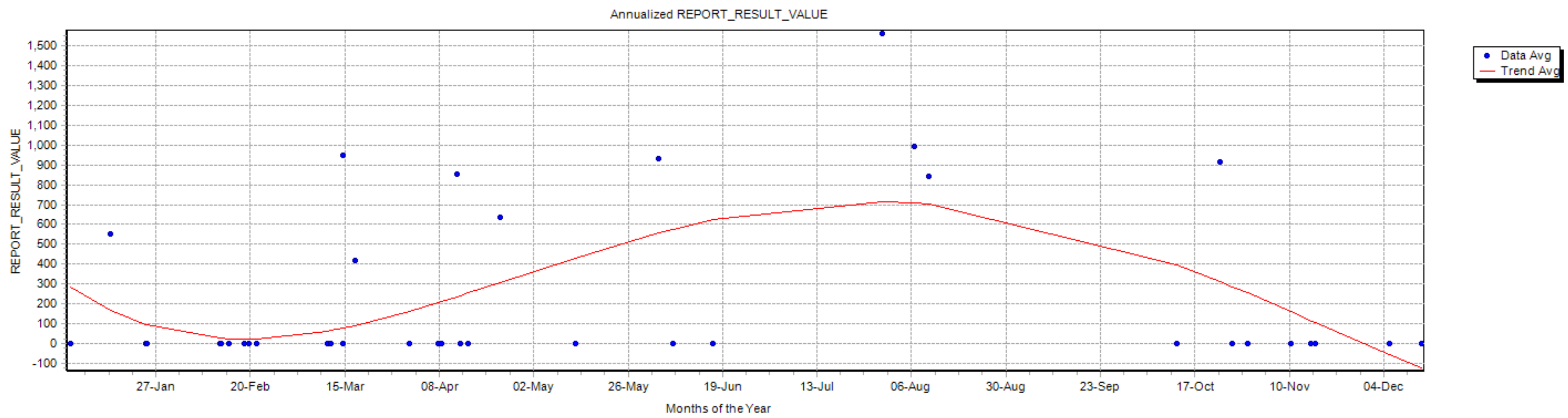


Chart 9-3: Specific Conductance Trend



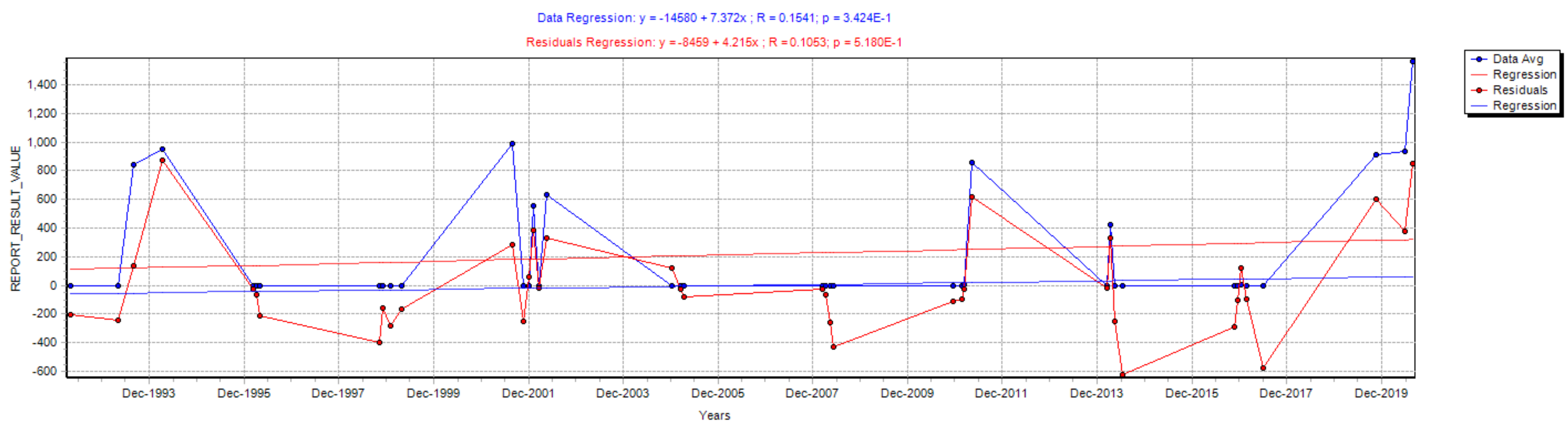
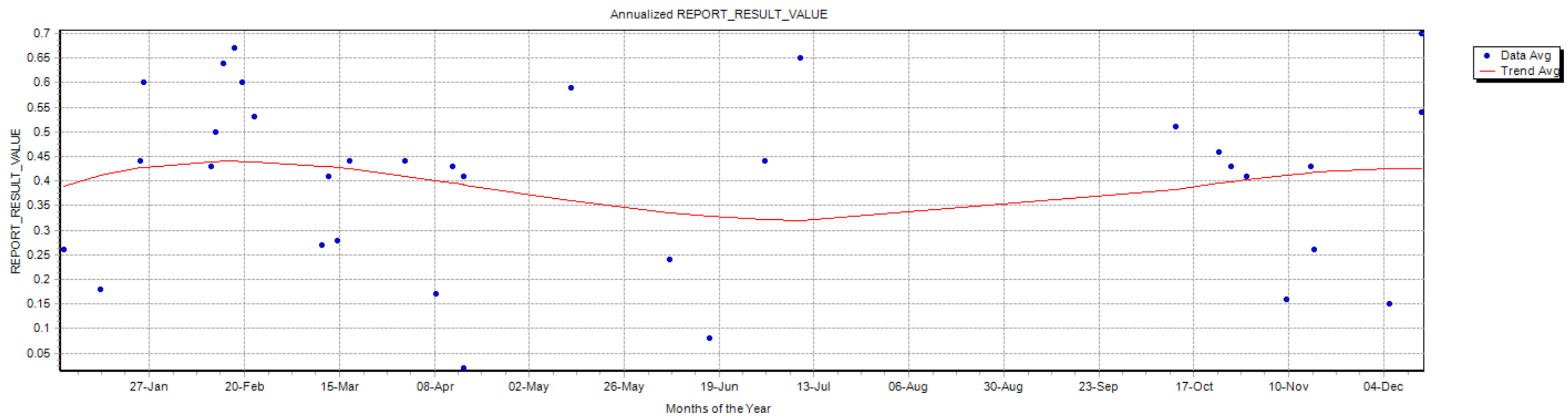


Chart 9-4: Salinity Trend



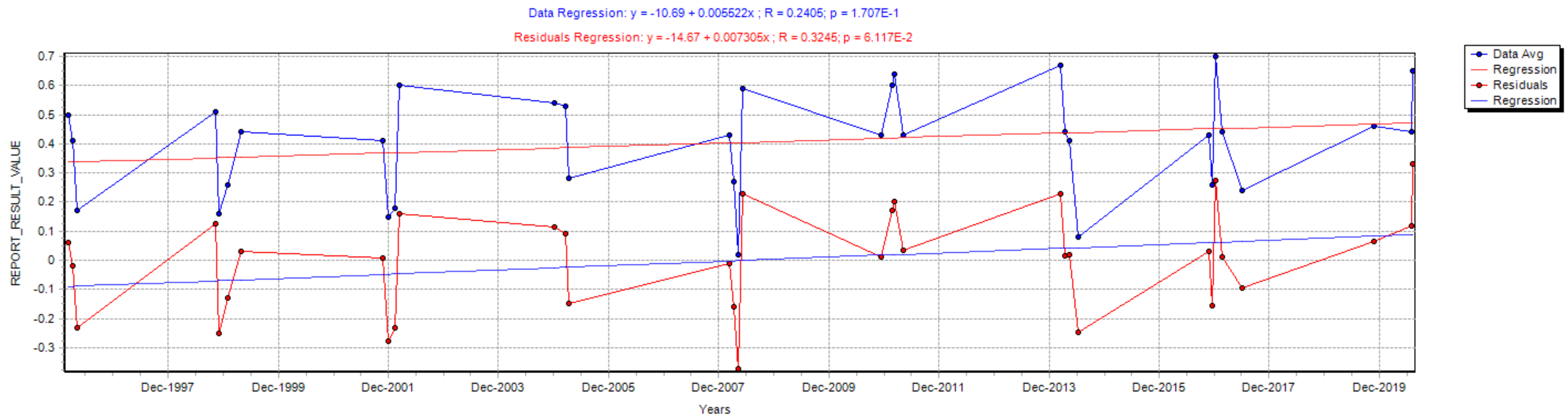
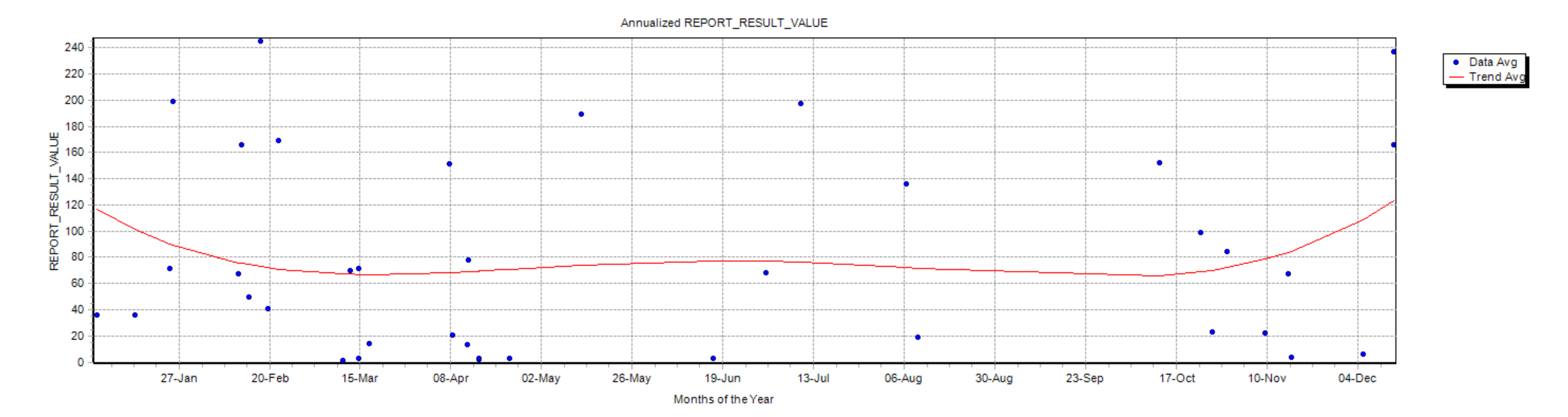


Chart 9-5: Chloride Trend



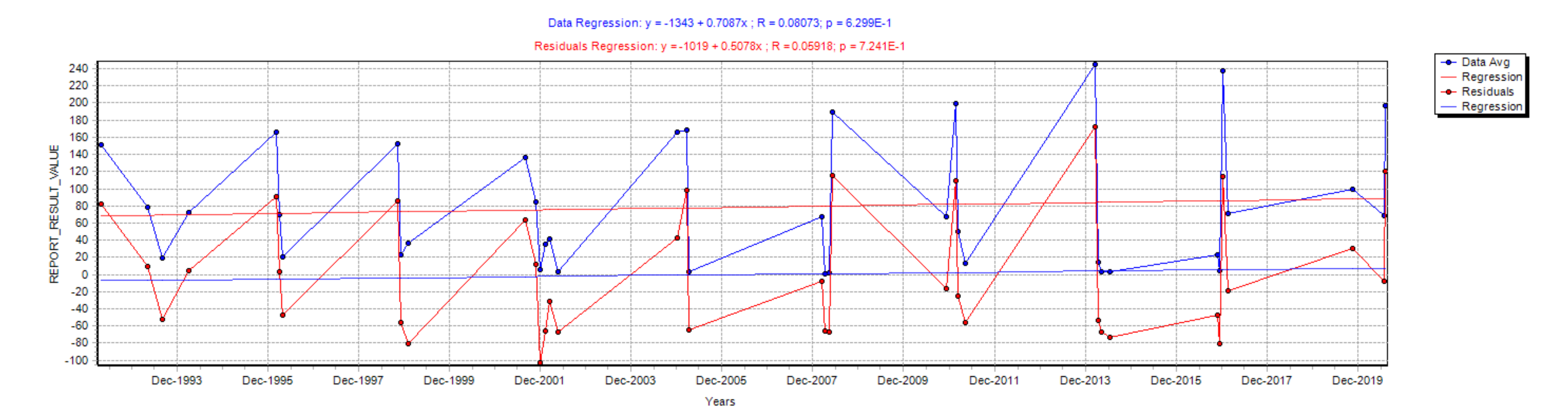
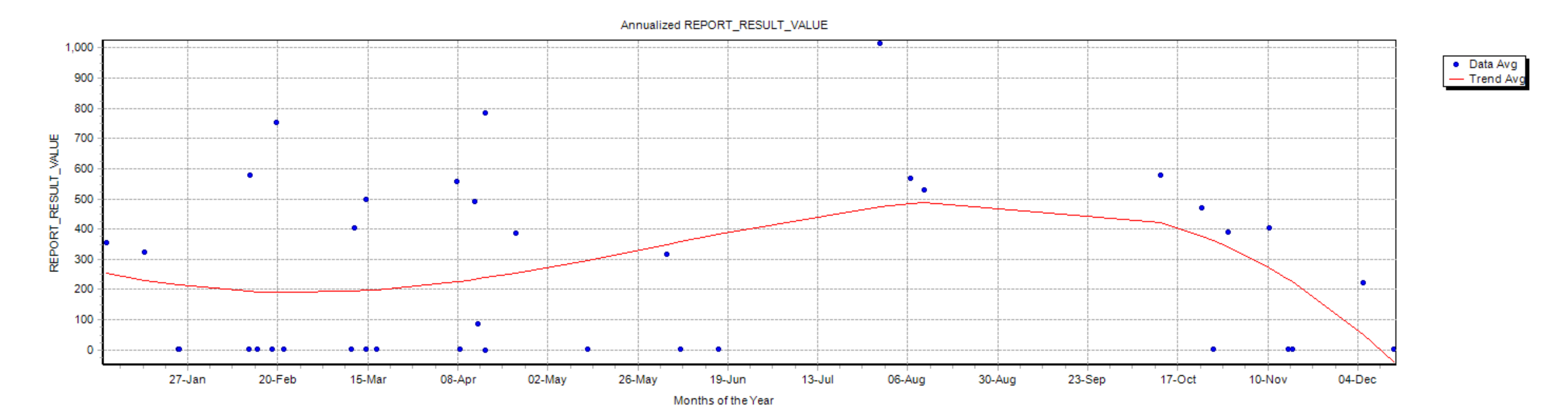


Chart 9-6: Total Dissolved Solids Trend



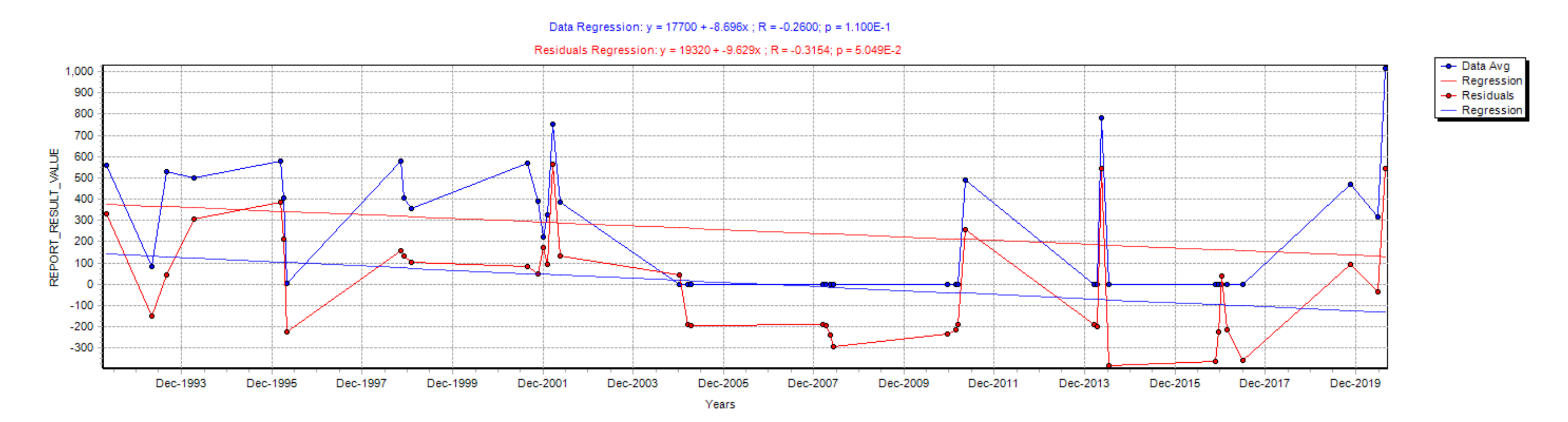
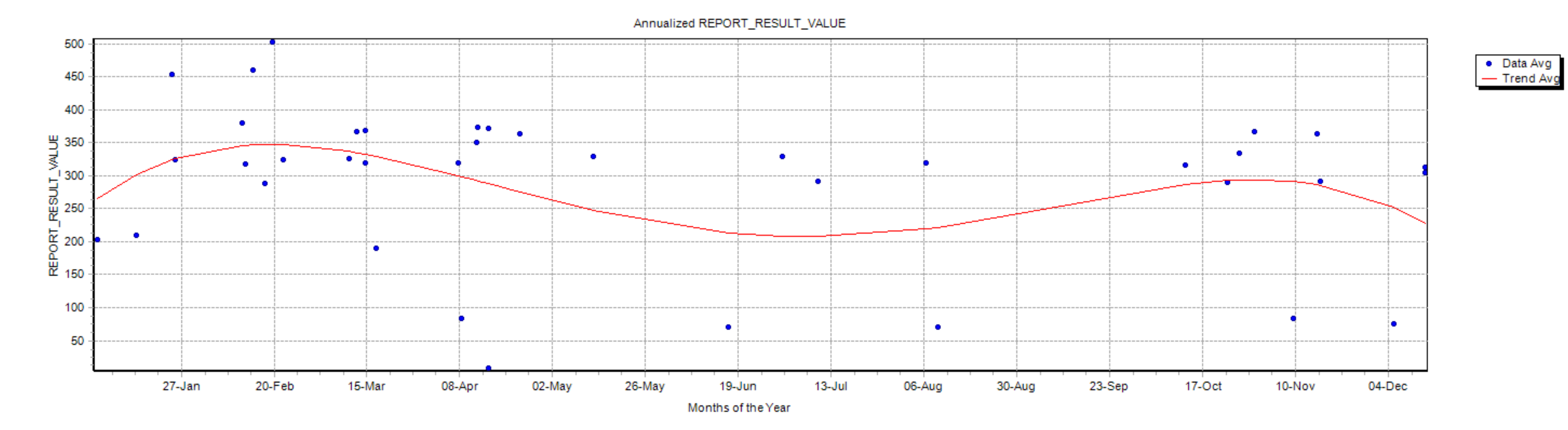


Chart 9-7: Alkalinity Trend



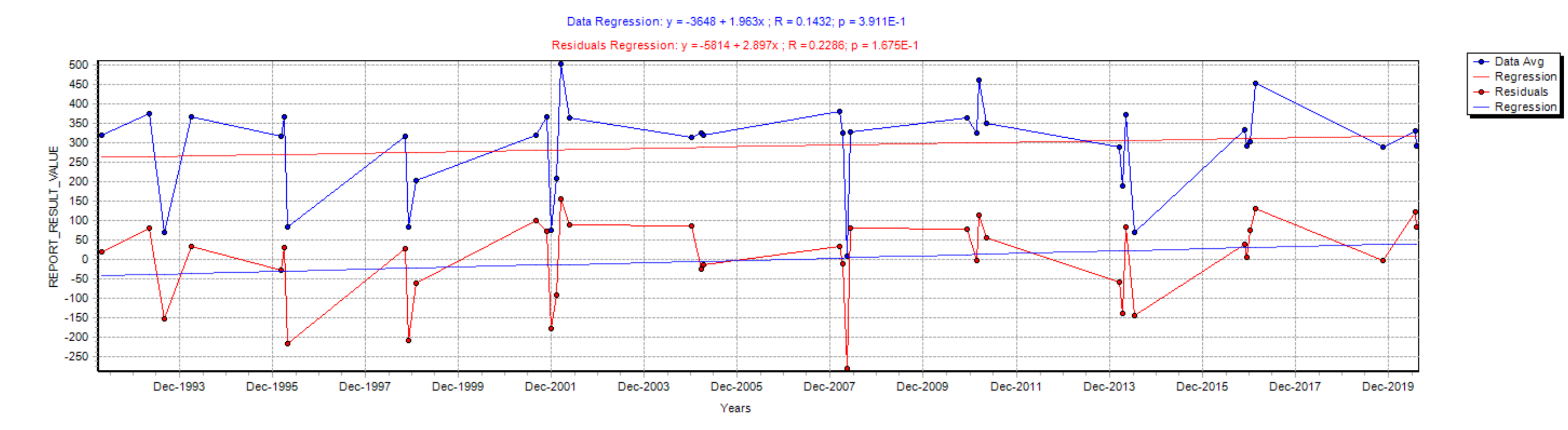
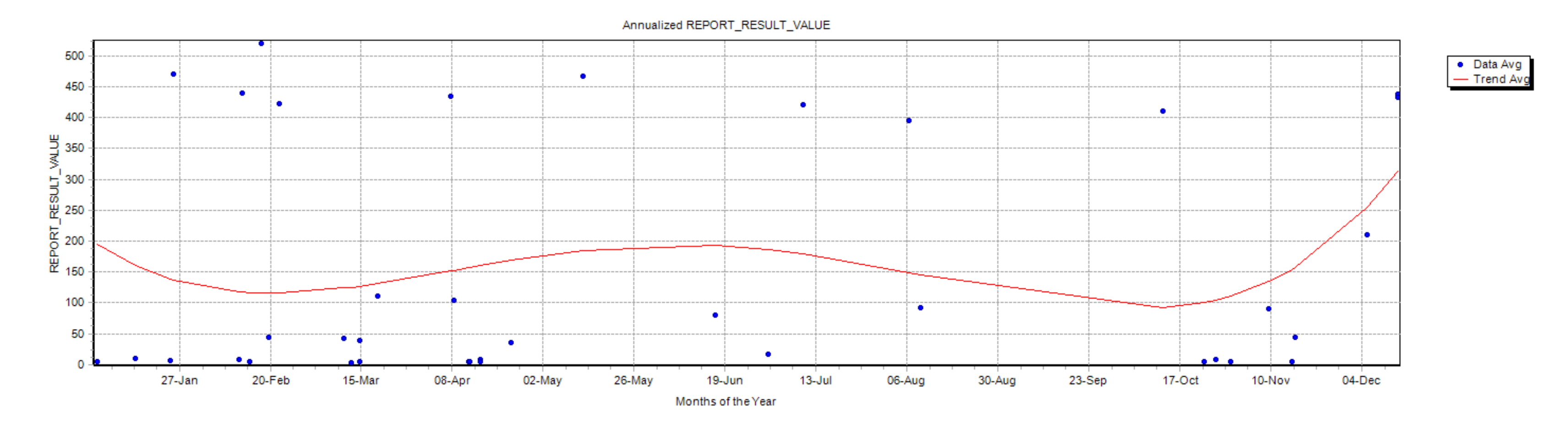


Chart 9-8: Hardness Trend



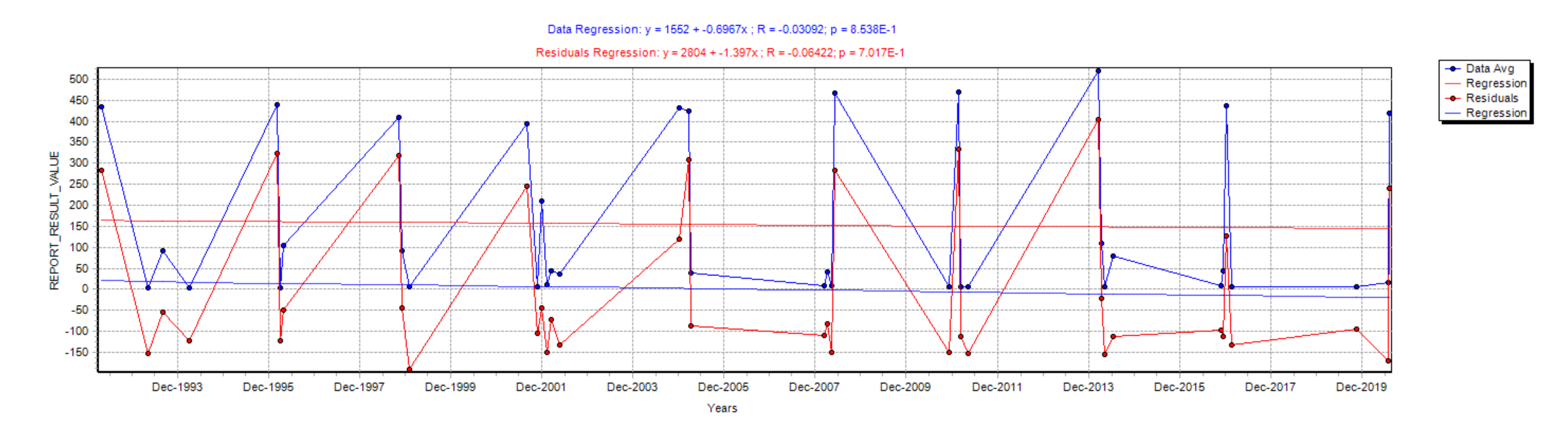
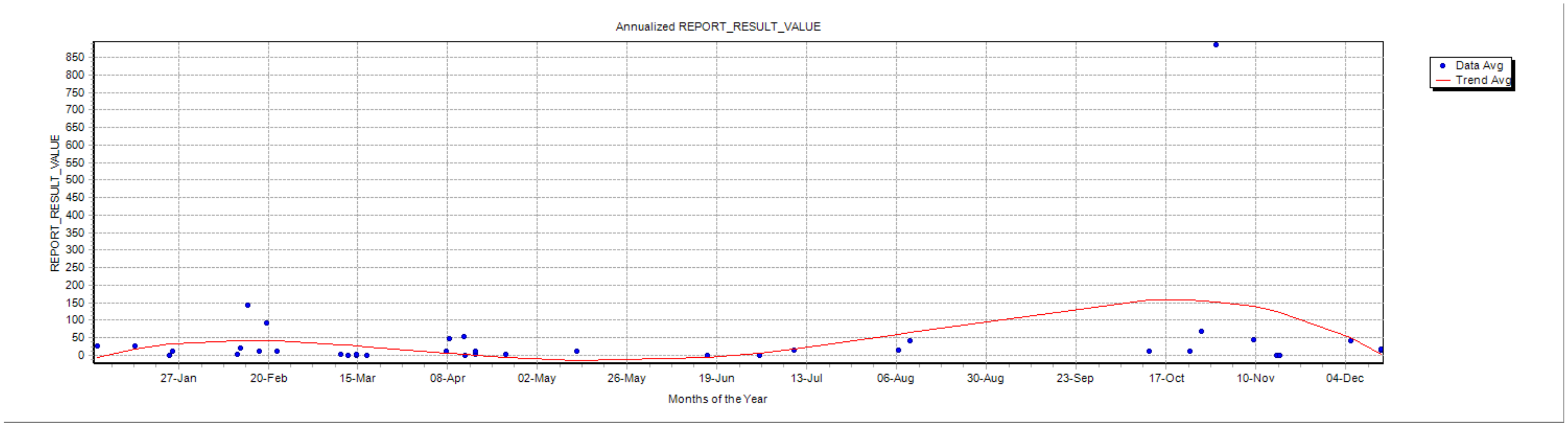


Chart 9-9: Sulfate Trend



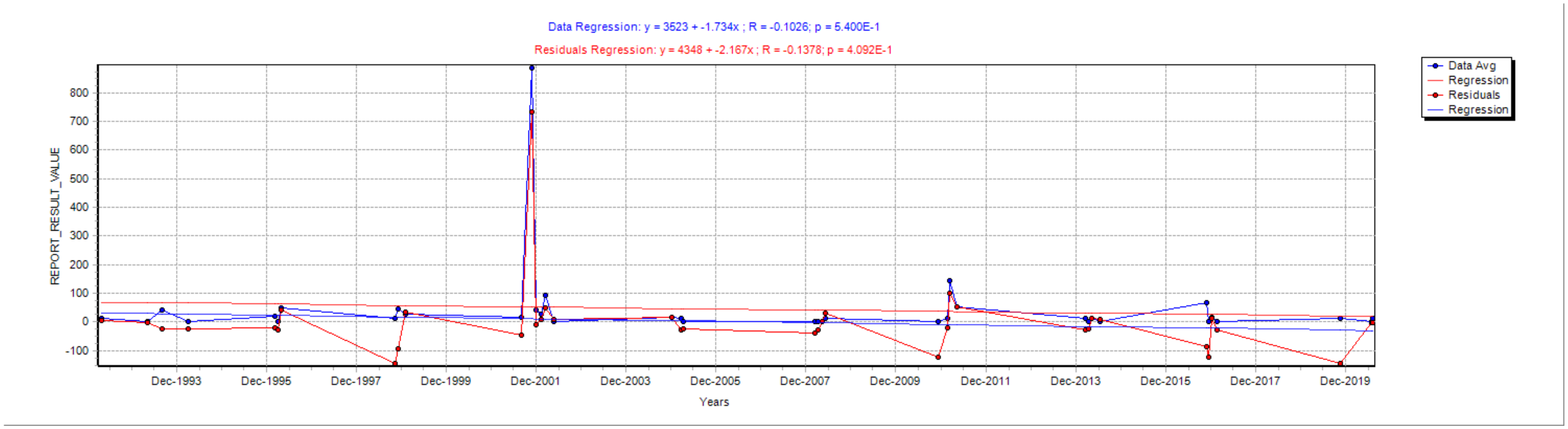
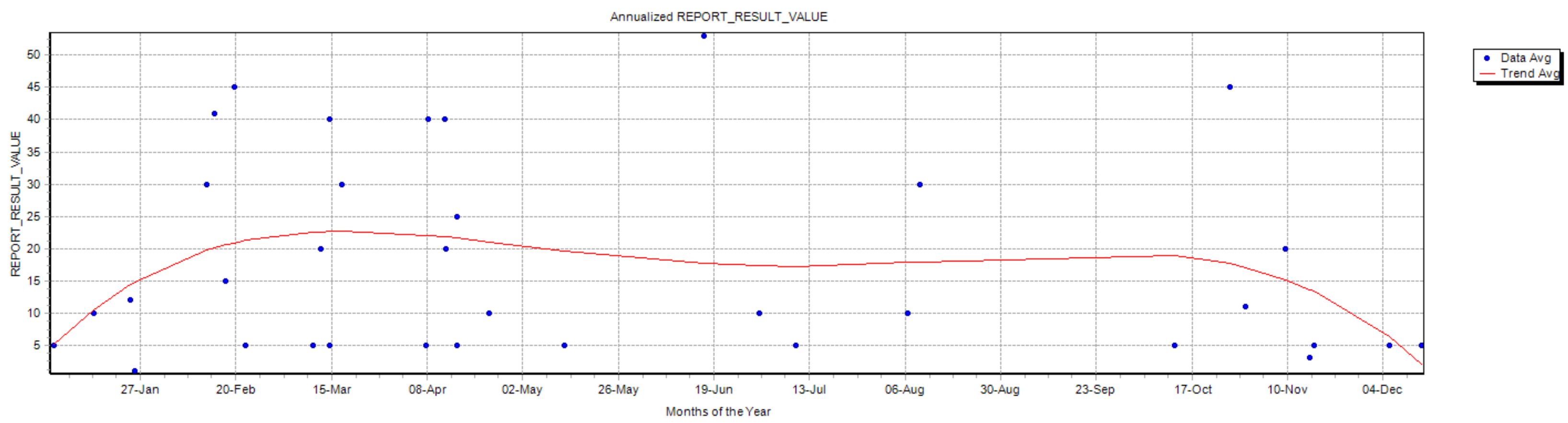


Chart 9-10: Color Trend



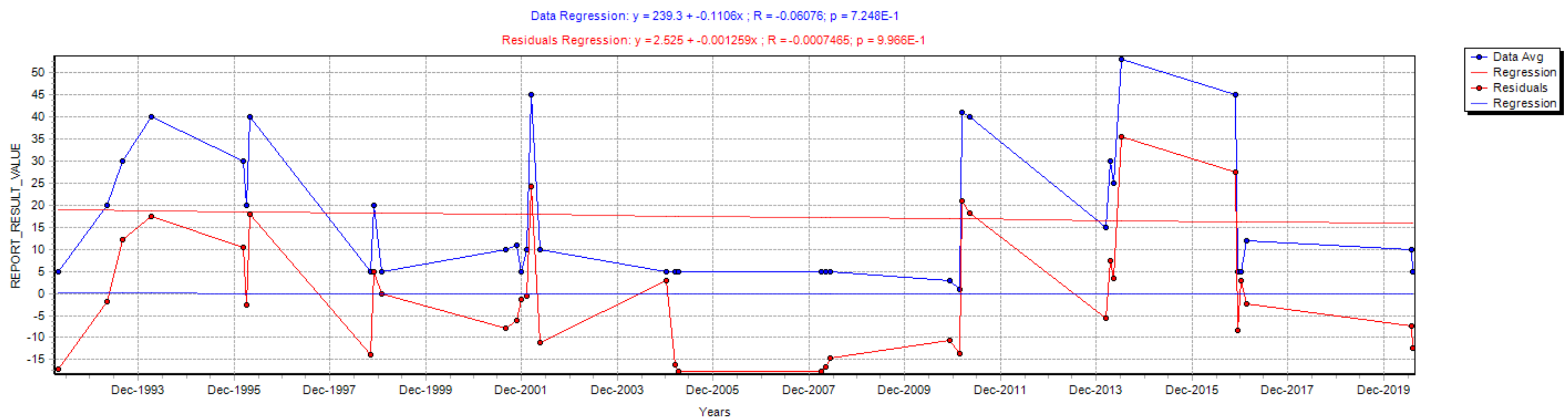
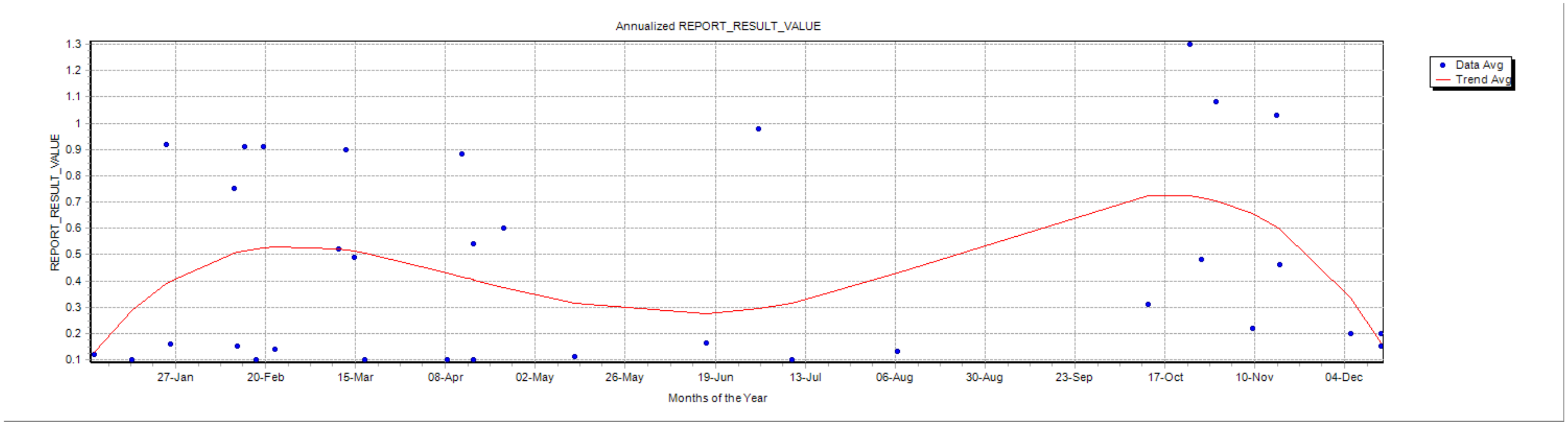


Chart 9-11: Ammonia Trend



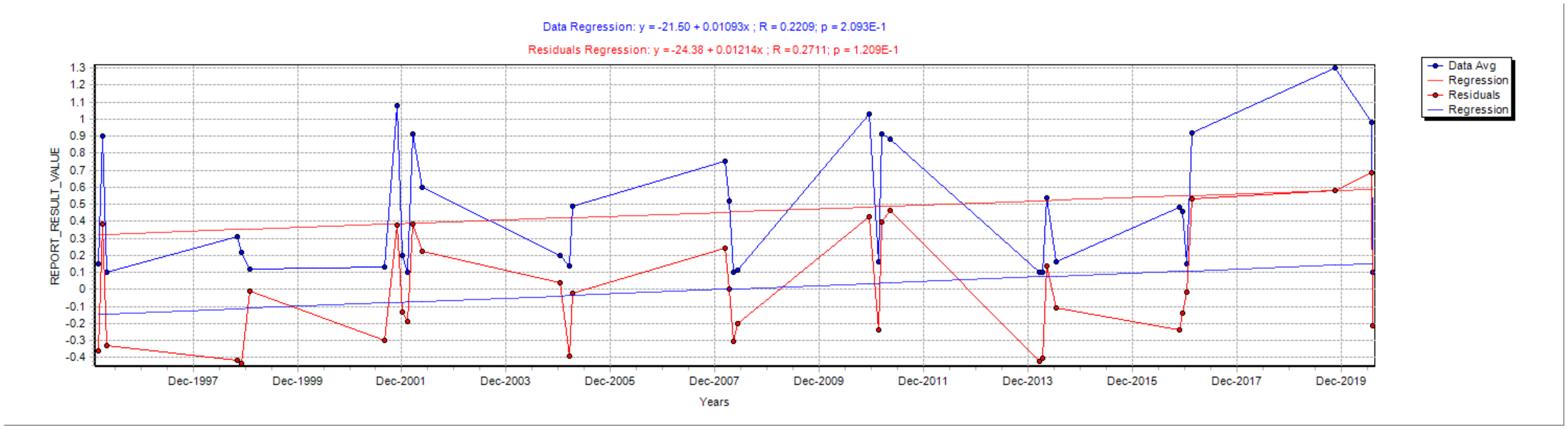
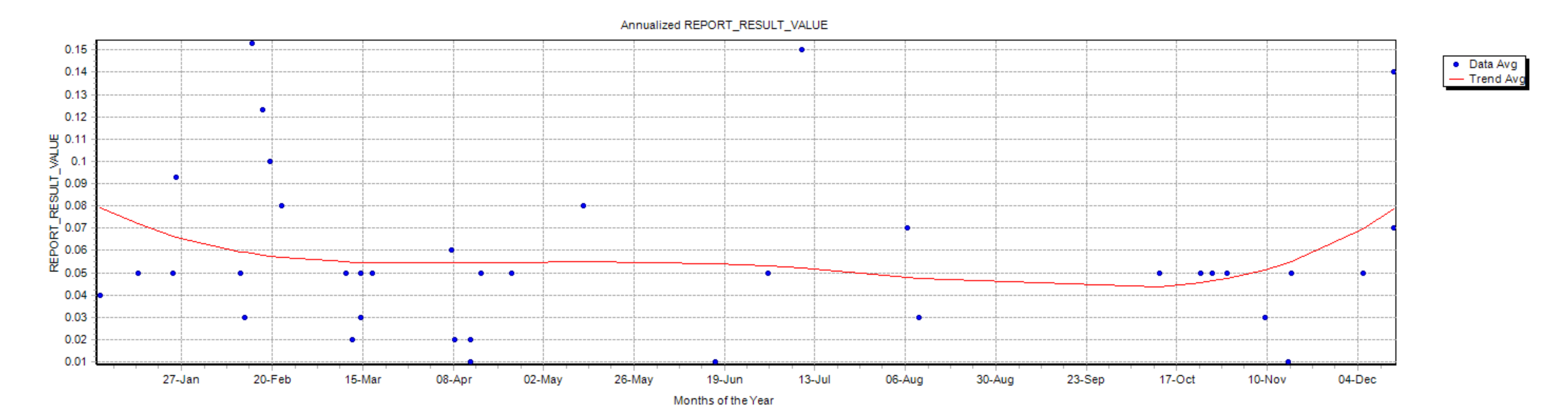


Chart 9-12: Nitrite - Nitrate Trend



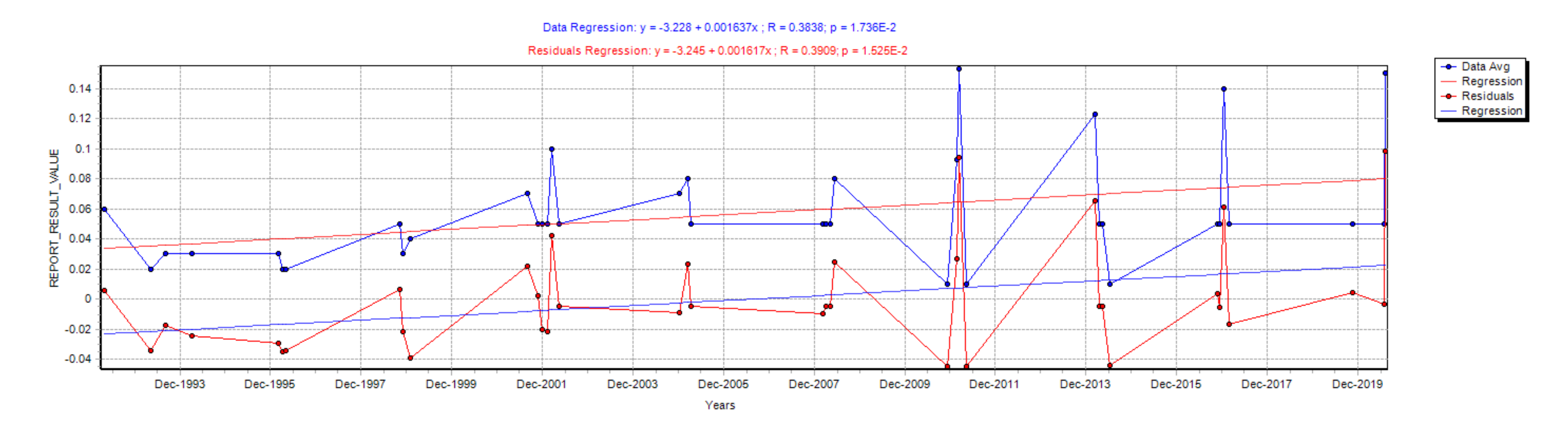
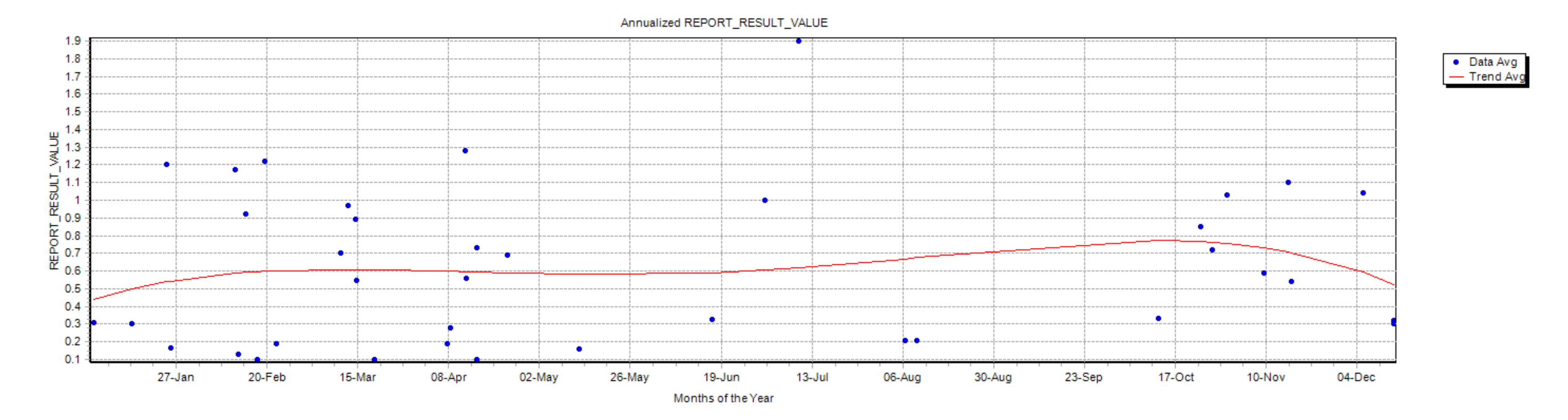


Chart 9-13: Total Kjeldahl Nitrogen Trend



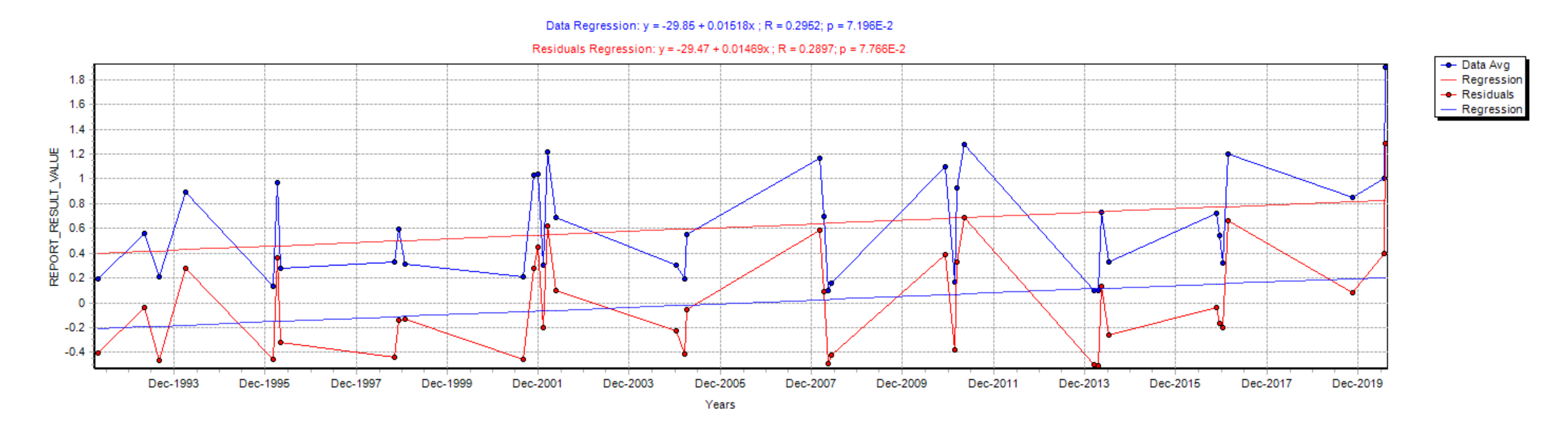
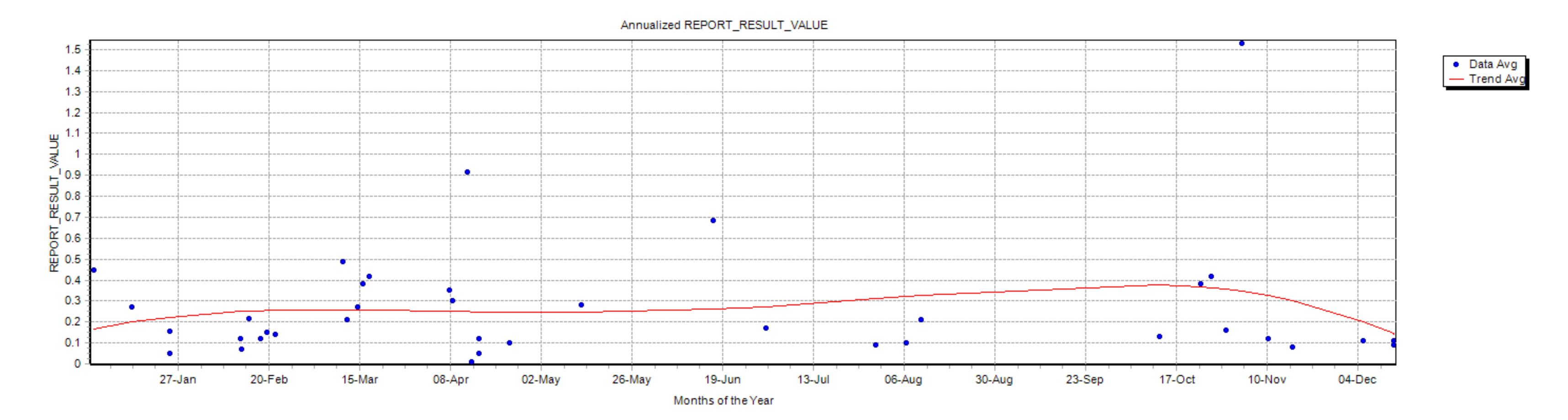


Chart 9-14: Total Phosphorus Trend



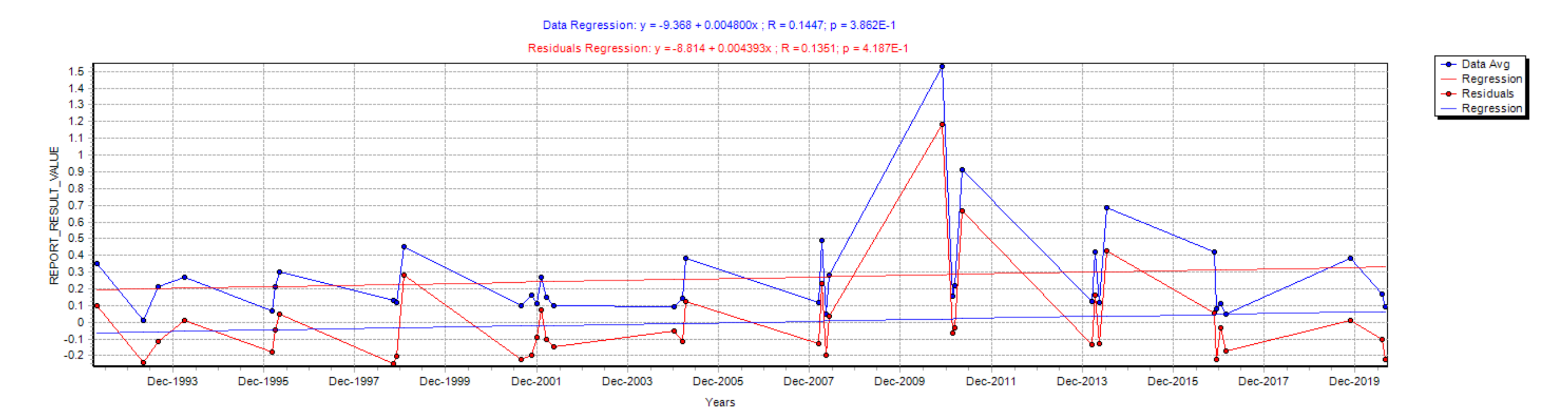
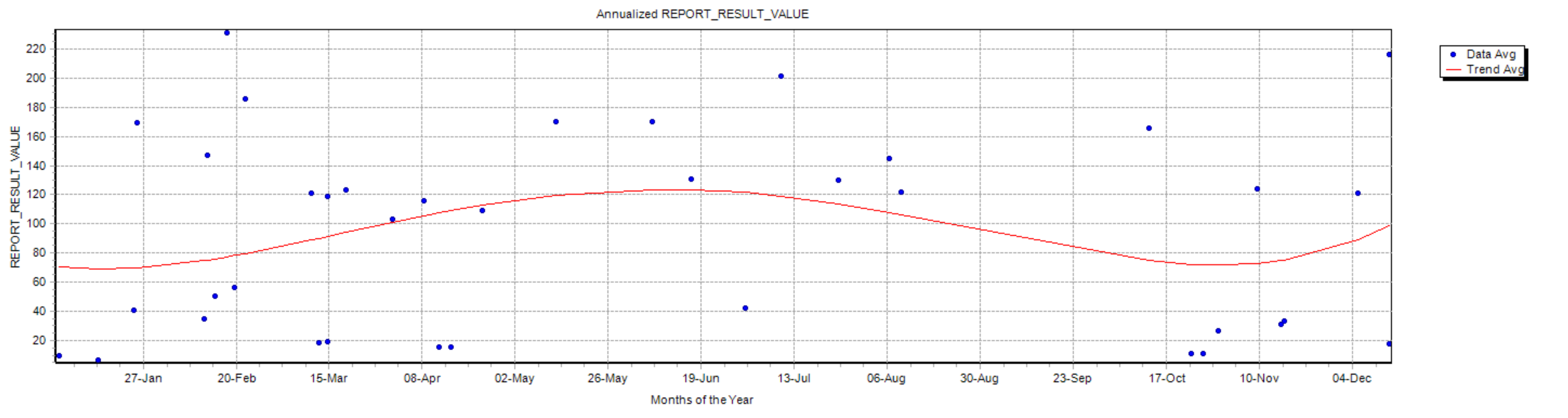


Chart 9-15: Barium Trend



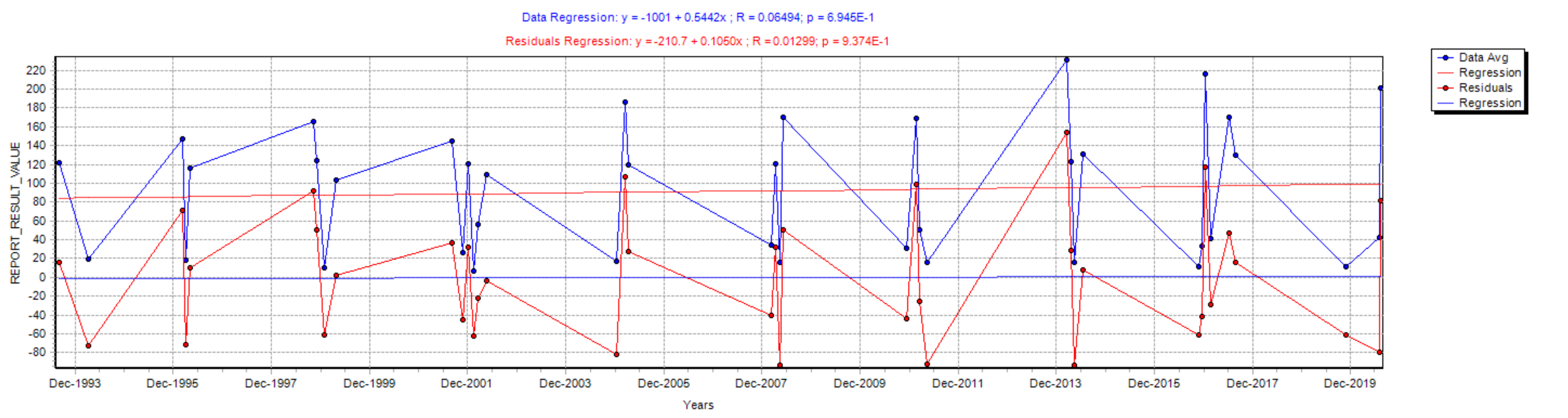
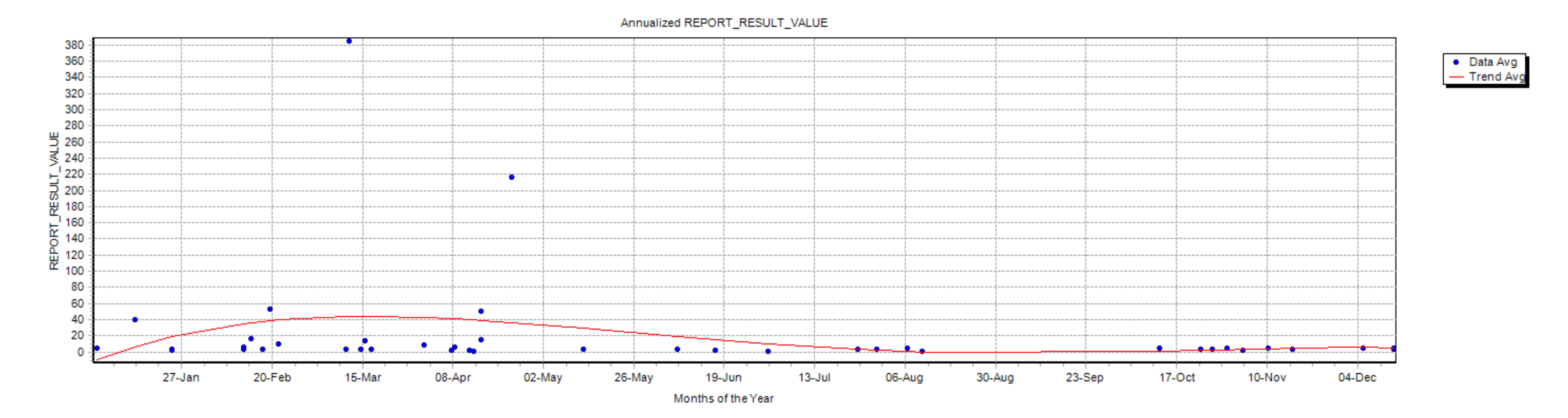


Chart 9-16: Copper Trend



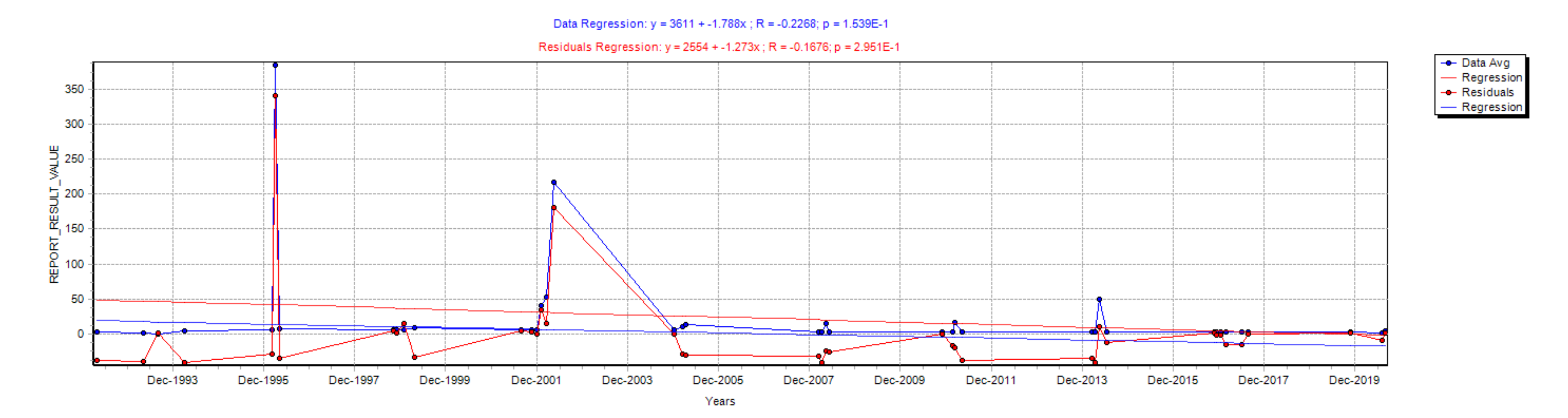
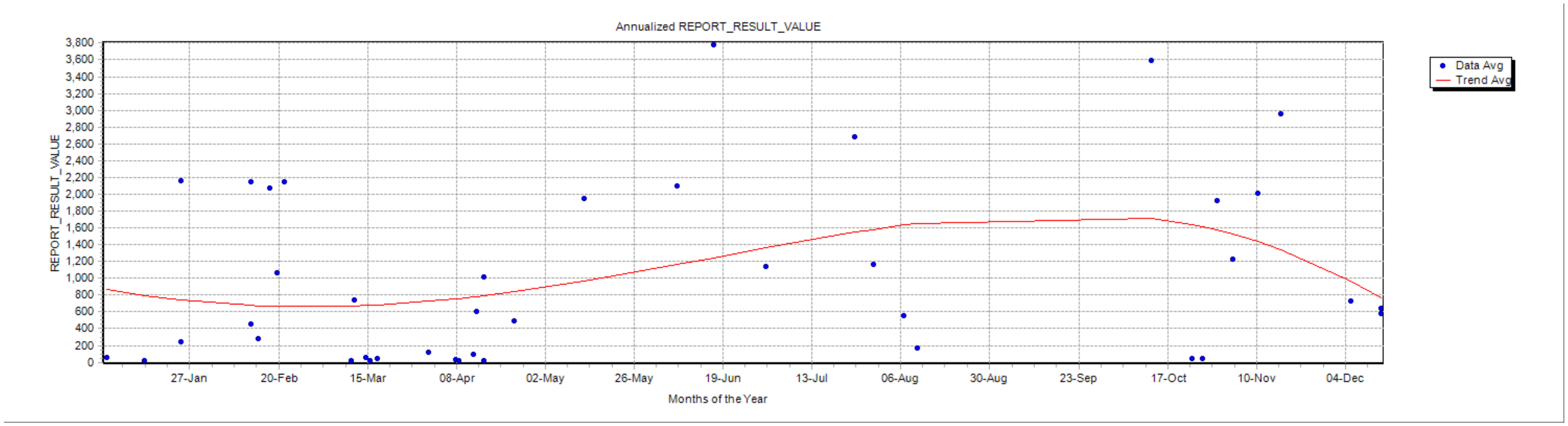


Chart 9-17: Iron Trend



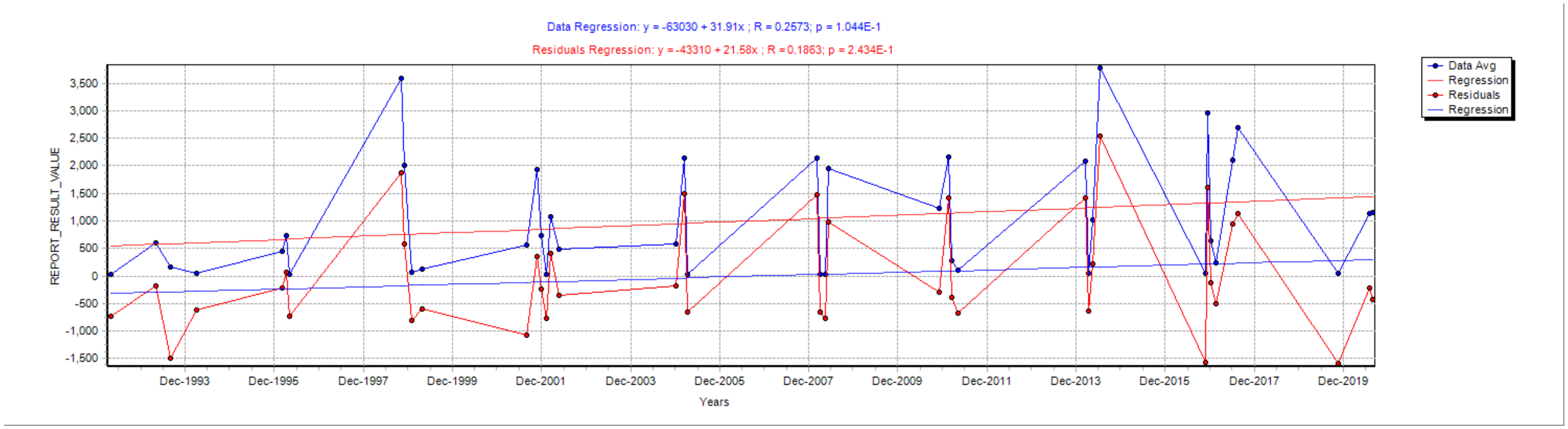


Chart 9-18: Zinc Trend