SPARTA AQUIFER SUMMARY, 2019

AQUIFER SAMPLING AND ASSESSMENT PROGRAM

APPENDIX 1 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 groundwater-monitoring program established to determine 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. Sampling occurs in each aquifer every three years.

The sampling of each aquifer occurs within a specified year of the rotation, ensuring that data collection occurs within a narrow period. Summary and analysis are done separately for each aquifer. 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 Sparta aquifer, during the 2019 state fiscal year (July 1, 2018 - June 30, 2019). This summary will become Appendix I of ASSET Program Triennial Summary Report for 2021.

Thirteen Sparta aquifer wells were sampled from August of 2018 to May 2019. Nine of the 13 wells are classified as public supply, while the remaining four wells are classified as industrial use.

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 down-dip 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 726 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 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 well BI-192, CA-105, and OU-67.

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 2019 sampling. Tables 1-6 and 1-7 compare these same parameter averages to historical ASSET-derived data for the Sparta aquifer from previous 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.

Due to the variability in the laboratory's reporting detection limits caused by dilution factors, whenever an analyte in question is not detected, the standard reporting detection limit value for each analytical method is used as the DL when performing statistical calculations.

Charts 1-1 through 1-18 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 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 seven of the 13 wells sampled in the Sparta aquifer, with a total of 13 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 two wells exceeded the SMCL for pH, five wells exceeded the SMCL for total dissolved solids, three exceeded the SMCL for chloride and two 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):

W-237	8.56 SU
WB-269	6.38 SU

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

	LAB RESULTS (in mg/L)	FIELD MEASURES (in mg/L)
CA-105	790 mg/L	709 mg/L
OU-635	850 mg/L	1155 mg/L
UN-205	760 mg/L	971 mg/L
OU-67	860 mg/L (duplicate 860 mg/L)	ND
SA-570	720 mg/L	140 mg/L

Chloride (SMCL = 250 mg/L):

UN-205	468 mg/L
OU-67	282 mg/L (Duplicate 250 mg/L)
OU-635	392 mg/L

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

CA-105	75 PCU (duplicate 75 PCU)
OU-67	40 PCU (duplicate 38 PCU)

Inorganic Parameters

Table 1-3 shows the inorganic 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 inorganics.

Federal Secondary Drinking Water Standards: Laboratory data contained in Table 1-3 shows that the SMCL for iron was exceeded in two wells, as listed below:

Iron (SMCL = 300 µg/L):

BI-212	2040 µg/L
SA-570	1580 µg/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.

There were no confirmed detections of a VOC at or above its detection limit during the FY 2019 sampling of the Sparta aquifer.

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.

There were no confirmed detections of a SVOC at or above its detection limit during the FY 2019 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.

There were no confirmed detections of a pesticide or PCB at or above its detection limit during the FY 2019 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 eight previous sampling rotations. These comparisons can be found in Tables 1-6 and 1-7, and in Charts 1-1 to 1-18 of this summary.

Over the 24 year period, Temperature and Standard Conductivity measurements show a downward trend. Analytes containing non-detect values were assessed by linear regression and the Akrita-Theil-Sen (ATS) methods. The only analyte with a confirmed trend was Nitrogen, as Ammonia. ATS analysis showed an increase of 0.1887 mg/L each year. When looking at the seasonal trend analysis, there is no variance in the trend throughout the year.

The current number of wells with SMCL exceedances and the current total number of SMCL exceedances have decreased since the previous sampling event in FY 2016. Current sample results show that seven wells reported one or more SMCL exceedance with a total 14 SMCL exceedances. The FY 2016 sampling of the Sparta aquifer shows that 9 wells reported one or more SMCL exceedance with a total of 16 exceedances.

SUMMARY AND RECOMMENDATIONS

In summary, the data show that the groundwater produced from this aquifer is soft[1] 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 2019 monitoring of the Sparta aquifer exceeded an MCL. The data also show that this aquifer is of good quality when considering taste, odor, or appearance guidelines, with14 SMCLs exceeded in seven wells.

Comparison to historical ASSET-derived data shows some change in the quality or characteristics of the Sparta aquifer, with two parameters showing decreases in concentration, and one parameter increasing in concentration, with the remaining analytes showing only slight to no consistent change.

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 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 1-1: List of Wells Sampled, Sparta Aquifer–FY 2019

Well ID	Parish	Date	Owner	Depth (Feet)	Well Use
BI-192	BIENVILLE	8/30/2018	LUCKY WATER SYSTEM	153	PUBLIC SUPPLY
BI-212	BIENVILLE	8/30/2018	ROCKTENN	490	INDUSTRIAL
CA-105	CALDWELL	11/1/2018	VIXEN WATER SYSTEM	525	PUBLIC SUPPLY
CL-203	CLAIBORNE	8/29/2018	TOWN OF HOMER	460	PUBLIC SUPPLY
L-31	LINCOLN	8/29/2018	CITY OF RUSTON	636	PUBLIC SUPPLY
L-32	LINCOLN	8/29/2018	CITY OF RUSTON	652	PUBLIC SUPPLY
OU-635	OUACHITA	10/31/2018	GRAPHIC PACKAGING INT'L INC.	726	INDUSTRIAL
OU-67	OUACHITA	1/22/2019	ANGUS CHEMICAL	563	INDUSTRIAL
SA-570	SABINE	5/8/2019	BOISE - FLORIEN	545	INDUSTRIAL
UN-205	UNION	8/29/2018	D'ARBONNE WATER SYSTEM	725	PUBLIC SUPPLY
W-237	WINN	11/1/2018	TOWN OF WINNFIELD	430	PUBLIC SUPPLY
WB-241	WEBSTER	3/21/2019	TOWN OF SPRINGHILL	408	PUBLIC SUPPLY
WB-269	WEBSTER	8/29/2018	CITY OF MINDEN	280	PUBLIC SUPPLY

Table 1-2: Summary of Field and Conventional Data, Sparta Aquifer–FY 2019

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 mmhos/cm	SO4 mg/L	TDS mg/L	TKN mg/L	TSS mg/L	Turb NTU
	Laboratory Reporting Limits →					5	1	1	5	0.01	0.1	0.05	10	0.25	10	0.1	4	0.3
	Field Parameters					Laboratory Parameters												
BI-192	6.89	0.01	0.023	16.56	0.017	3.700	1.90	<DL	<DL	1.00	<DL	<DL	0.03	<DL	<DL	<DL	<DL	0.70
BI-192*	6.89	0.01	0.03	16.56	0.02	5.60	1.90	<DL	<DL	1.00	<DL	<DL	0.03	<DL	15.00	<DL	<DL	1.10
BI-212	7.26	0.09	0.20	17.78	0.13	78.00	7.90	10	20.00	<DL	0.23	0.26	0.34	8.30	120.00	1.80	<DL	0.66
CA-105	8.41	0.54	1.06	19.27	0.71	548	18.90	75	<DL	<DL	0.70	0.80	1.06	<DL	790.00	0.94	<DL	0.72
CA-105*	8.41	0.54	1.04	19.27	0.71	550	18.90	75	<DL	<DL	0.72	0.96	1.04	<DL	795.00	1.40	<DL	0.36
CL-203	7.49	0.07	0.14	18.41	0.09	50.10	7.00	<DL	16.00	<DL	<DL	<DL	0.14	9.10	90.00	<DL	<DL	0.51
L-31	6.92	0.16	0.35	20.50	0.22	134	17.00	9.00	6.00	<DL	0.20	0.22	0.34	14.30	185.00	<DL	<DL	0.76
L-32	7.53	0.16	0.33	21.21	0.214	137	9.80	11.00	<DL	1.30	0.18	0.25	0.42	14.70	190.00	<DL	8.00	4.00
OU-635	7.14	0.90	1.72	21.33	1.16	319	392	12.00	10.00	<DL	0.98	0.53	1.72	<DL	1080.00	0.81	8.00	0.54
OU-67	ND	ND	ND	ND	ND	263	282	38.00	6.00	<DL	0.77	0.59	1.43	<DL	860.00	0.95	<DL	1.30
OU-67*	ND	ND	ND	ND	ND	263	250	40.00	10.00	<DL	0.20	0.49	1.44	<DL	860.00	0.96	<DL	0.72
SA-570	6.61	0.10	0.21	20.20	0.14	51.80	10.9	11.00	16.00	<DL	0.36	0.53	0.19	17.60	720.00	<DL	<DL	<DL
UN-205	6.64	0.75	1.51	0.97	0.971	158	388	10.00	14.00	<DL	0.80	0.22	0.02	<DL	760.00	1.00	4.00	0.39
W-237	8.56	0.35	0.71	0.47	0.467	280	64.60	5.00	<DL	<DL	0.40	0.64	0.71	5.70	448.61	0.91	<DL	0.72
WB-241	7.71	0.34	0.81	0.45	0.453	264	72.30	8.00	66.00	<DL	1.20	0.24	0.81	17.30	470.57	1.40	<DL	1.10
WB-269	6.38	0.20	0.39	0.27	0.268	42.70	81.40	<DL	20.00	0.79	<DL	<DL	0.39	17.10	145.00	<DL	<DL	1.20

*Denotes Duplicate Sample   ND- No Data   Shaded cells exceed EPA Secondary Standards

Table 1-3: Summary of Inorganic Data, Sparta Aquifer–FY 2019

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	2	100	1	0.2	2	5	1	2	5
BI-192	< DL	< DL	22.30	< DL	< DL	< DL	<DL	178	<DL	< DL	< DL	< DL	< DL	< DL	15.80
BI-192*	<DL	<DL	22.30	<DL	<DL	<DL	4.40	150	1.20	<DL	<DL	<DL	<DL	<DL	26.40
BI-212	< DL	< DL	54.60	< DL	< DL	< DL	< DL	2040	< DL	< DL	< DL	< DL	< DL	< DL	57.90
CA-105	< DL	< DL	18.00	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
CA-105*	<DL	<DL	18.40	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
L-31	< DL	< DL	13.60	< DL	< DL	< DL	< DL	225	< DL	< DL	< DL	< DL	< DL	< DL	< DL
L-32	< DL	< DL	4.70	< DL	< DL	< DL	<DL	99.80	< DL	< DL	< DL	< DL	< DL	< DL	< DL
OU-635	< DL	< DL	50.10	< DL	< DL	< DL	<DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
OU-67	<DL	<DL	15.50	<DL	<DL	<DL	<DL	75.70	<DL	<DL	<DL	<DL	<DL	<DL	11.40
OU-67*	<DL	<DL	15.60	<DL	<DL	<DL	<DL	63.50	<DL	<DL	<DL	<DL	<DL	<DL	11.40
SA-570	< DL	< DL	88.00	< DL	< DL	< DL	12.10	1580	< DL	< DL	< DL	< DL	< DL	< DL	<DL
UN-205	< DL	< DL	32.20	< DL	< DL	< DL	<DL	68.20	< DL	< DL	< DL	<DL	< DL	< DL	< DL
W-237	< DL	< DL	20.90	< DL	< DL	< DL	4.80	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
WB-241	< DL	< DL	220.00	< DL	< DL	< DL	6.80	239	< DL	< DL	< DL	< DL	< DL	< DL	13.10
WB-269	< DL	< DL	134.00	< DL	< DL	< DL	5.80	< DL	1.40	< DL	5.10	< DL	< DL	< DL	18.10

*Denotes Duplicate Sample. Shaded cells exceed EPA Secondary Standards

Table 1-4: FY 2019 Field and Conventional Statistics, ASSET Wells

	PARAMETER	MINIMUM	MAXIMUM	AVERAGE
FIELD	pH (SU)	6.38	8.56	7.30
	Salinity (ppt)	0.01	0.90	0.31
	Specific Conductance (mmhos/cm)	0.03	1.78	0.61
	Temperature (^{O}C)	16.56	21.73	19.18
	Total Dissolved Solids (g/L)	0.02	1.16	0.40
LABORATORY	Alkalinity (mg/L)	3.70	548.00	179.18
	Chloride (mg/L)	1.90	392.00	103.83
	Color (PCU)	<DL	75.00	14.31
	Hardness (mg/L)	<DL	66.00	14.54
	Nitrite - Nitrate, as N (mg/L)	<DL	1.00	<DL
	Ammonia, as N (mg/L)	<DL	0.82	0.46
	Total Phosphorus (mg/L)	<DL	0.80	0.33
	Specific Conductance (µmhos/cm)	1.50	1720.00	617.28
	Sulfate (mg/L)	<DL	17.60	8.39
	Total Dissolved Solids (mg/L)	<DL	860.00	404.38
	Total Kjeldahl Nitrogen (mg/L)	<DL	1.40	0.85
	Total Suspended Solids (mg/L)	<DL	8.00	<DL
	Turbidity (NTU)	<DL	4.00	0.98

Table 1-5: FY 2019 Inorganic Statistics, ASSET Wells

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
Antimony (µg/L)	<DL	<DL	<DL
Arsenic (µg/L)	<DL	<DL	<DL
Barium (µg/L)	4.70	220.00	56.40
Beryllium (µg/L)	<DL	<DL	<DL
Cadmium (µg/L)	<DL	<DL	<DL
Chromium (µg/L)	<DL	<DL	<DL
Copper (µg/L)	<DL	12.10	4.35
Iron (µg/L)	<DL	2040.00	455.05
Lead (µg/L)	<DL	<DL	<DL
Mercury (µg/L)	<DL	<DL	<DL
Nickel (µg/L)	<DL	<DL	<DL
Selenium (µg/L)	<DL	<DL	<DL
Silver (µg/L)	<DL	<DL	<DL
Thallium (µg/L)	<DL	<DL	<DL
Zinc (µg/L)	<DL	57.90	12.02

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	FY 2013	FY 2016	FY 2019
FIELD	pH (SU)	7.23	7.76	7.86	7.45	8.02	7.86	7.78	7.78	7.30
	Salinity (ppt)	0.30	0.32	0.32	0.32	0.44	0.35	0.31	0.31	0.31
	Specific Conductance (mmhos/cm)	0.650	0.650	0.654	0.650	0.890	0.710	0.680	0.680	0.61
	Temperature (^{O}C)	23.10	23.65	23.49	23.50	23.78	22.92	21.27	21.27	19.18
	Total Dissolved Solids (g/L)	-	-	-	0.420	0.580	0.460	0.412	0.412	0.40
LABORATORY	Alkalinity (mg/L)	186	203	178	186	203	208	186	186	179.18
	Chloride (mg/L)	85.8	89.0	90.0	94.2	126.5	97.7	62.9	62.9	103.83
	Color (PCU)	26	22	18	16	15	9	20	20	14
	Hardness (mg/L)	22	10	14	16	13	12	21	21	14.54
	Nitrite - Nitrate, as N (mg/L)	0.28	0.32	0.30	0.31	0.17	0.26	0.12	0.12	< DL
	Ammonia, as N (mg/L)	0.34	0.46	0.33	0.48	0.44	< DL	0.58	0.58	0.46
	Total Phosphorus (mg/L)	0.36	0.31	0.31	0.35	0.29	0.34	0.24	0.24	0.33
	Specific Conductance (µmhos/cm)	619	688	660	647	79	692	590	590	617.28
	Sulfate (mg/L)	6.6	8.2	7.4	9.3	6.2	8.0	8.8	8.8	8.39
	Total Dissolved Solids (mg/L)	356	443	391	406	461	454	325	325	404.38
	Total Kjeldahl Nitrogen (mg/L)	0.58	0.52	0.45	0.59	0.50	0.43	1.02	1.02	0.85
	Total Suspended Solids (mg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
	Turbidity (NTU)	1.32	2.21	1.45	1.18	< DL	4.77	0.96	0.96	0.98

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	FY 2013	FY 2016	FY 2019
Antimony (µg/L)	< DL	< DL	< DL	Invalid Data	< DL	< DL	< DL	< DL	< DL
Arsenic (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Barium (µg/L)	36.5	30.7	50.4	61.8	46.9	52.2	55.1	70.0	56.40
Beryllium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Cadmium (µg/L)	< DL	1.00	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Chromium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Copper (µg/L)	10.2	10.2	< 5	5.8	3.1	5.1	< DL	2.5	4.35
Iron (µg/L)	213	284	517	406	410	740	898	578	455.05
Lead (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Mercury (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Nickel (µg/L)	5.1	< DL	< DL	5.4	< DL	4.7	< DL	< DL	< DL
Selenium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Silver (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Thallium (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Zinc (µg/L)	16.2	20.8	14.2	16.5	< DL	48.9	144.0	7.5	12.02

Table 1-8: 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 1-9: 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

SVOC ANAYTICAL PARAMETERS	METHOD	REPORTING LIMIT (µg/L)
FLUORANTHENE	625	0.20
FLUORENE	625	0.20
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 1-10: Pesticide 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 1-1: Location Plat, Sparta Aquifer

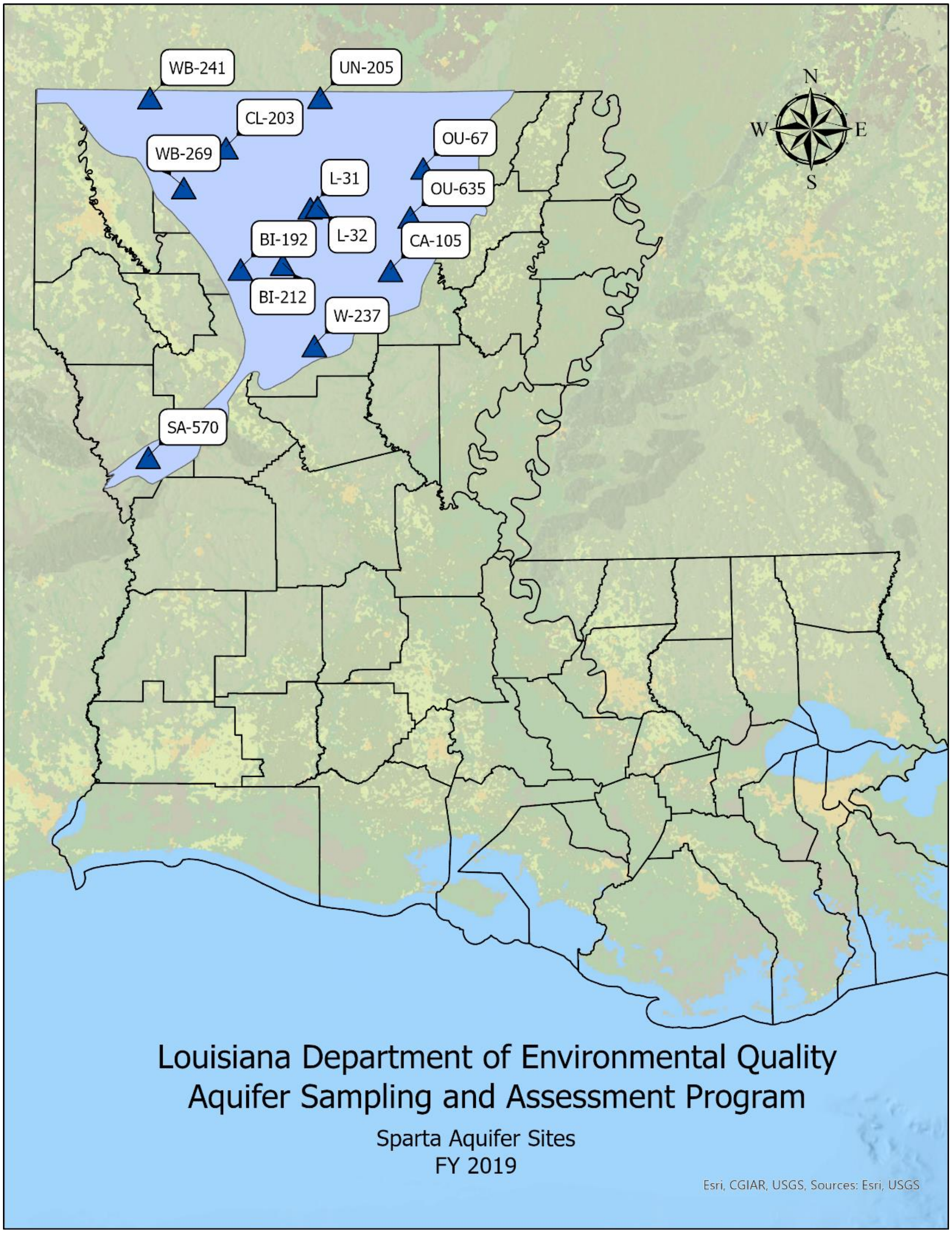
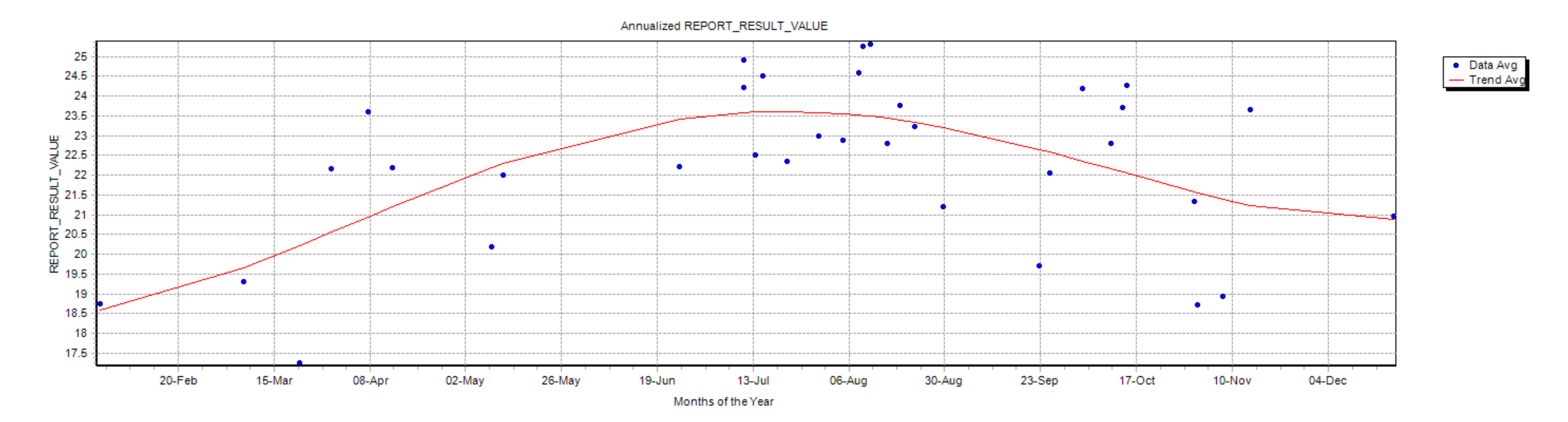


Chart 1-1: Temperature Trend



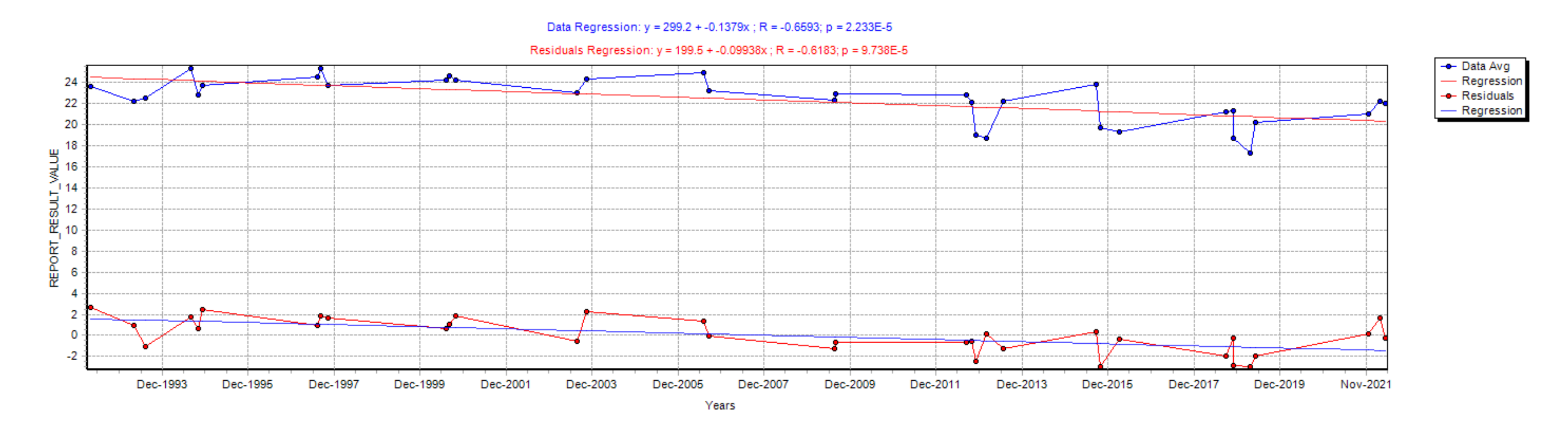
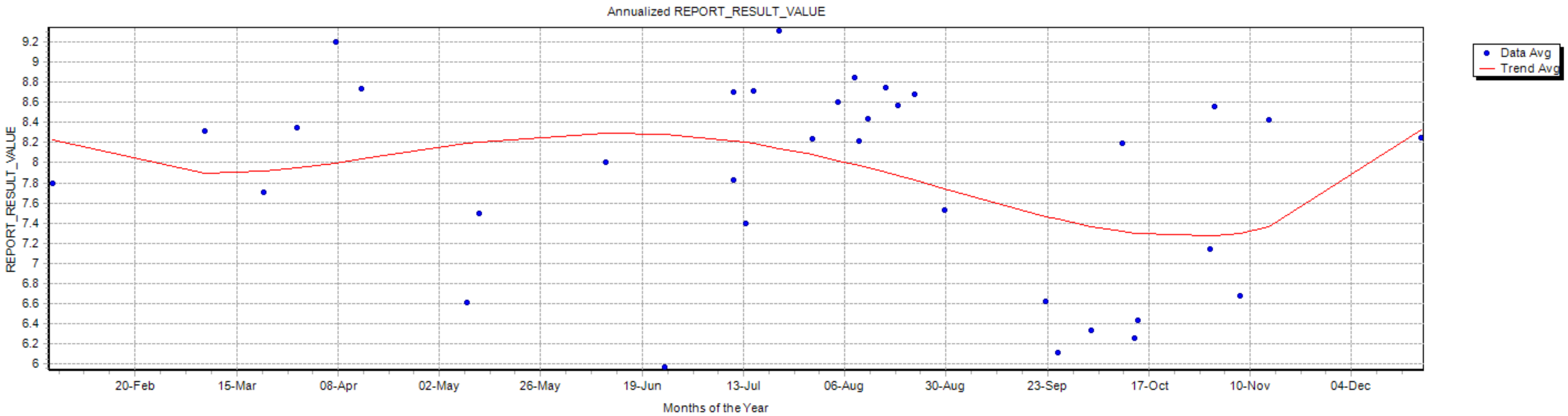


Chart 1-2: pH Trend



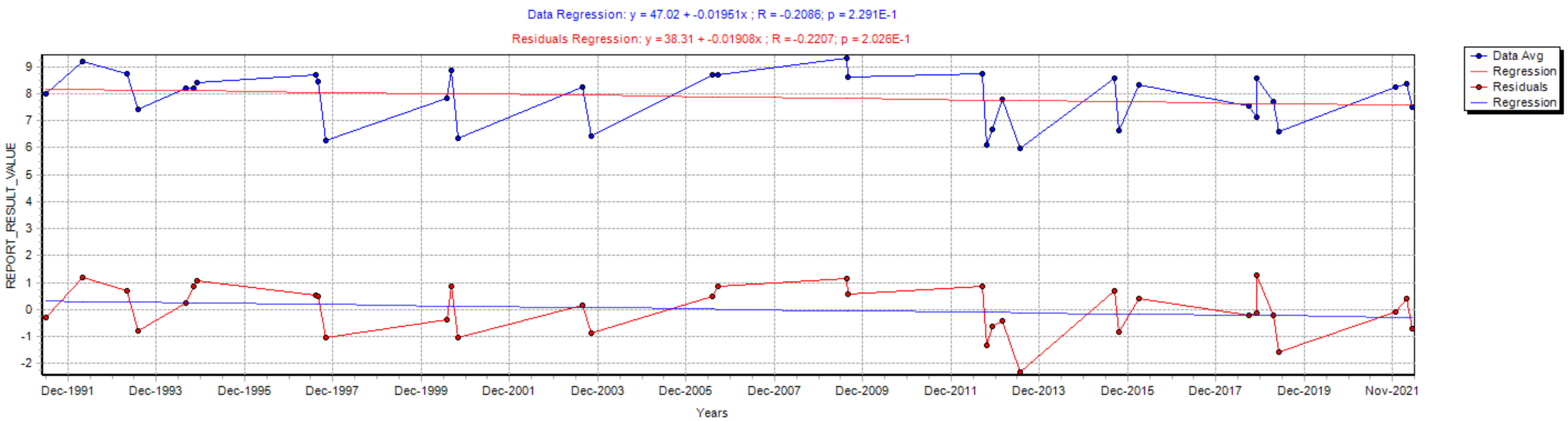
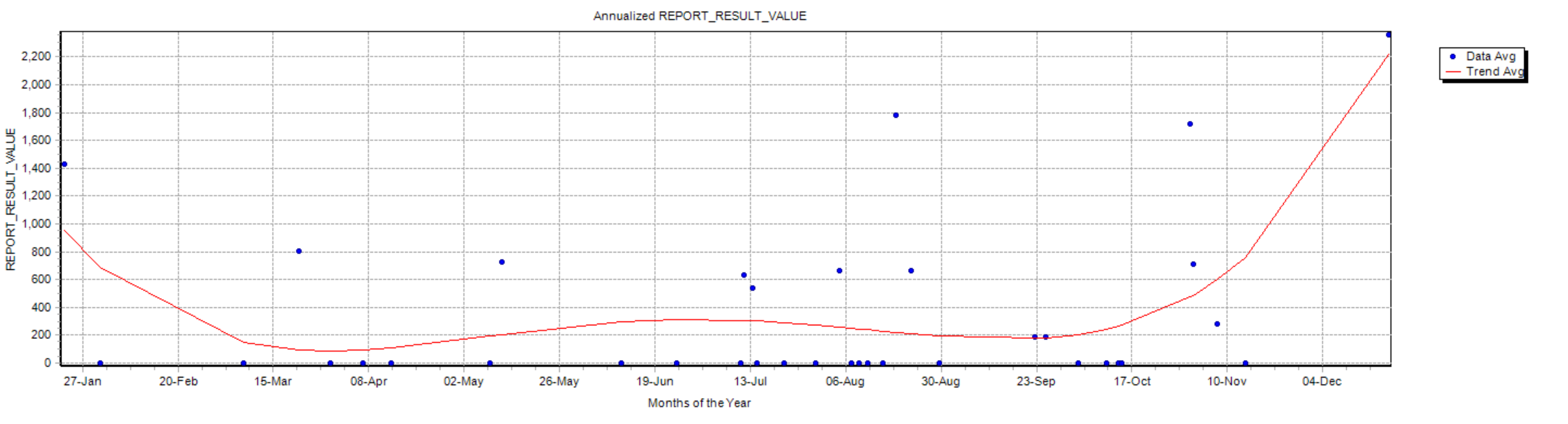


Chart 1-3: Specific Conductance Trend



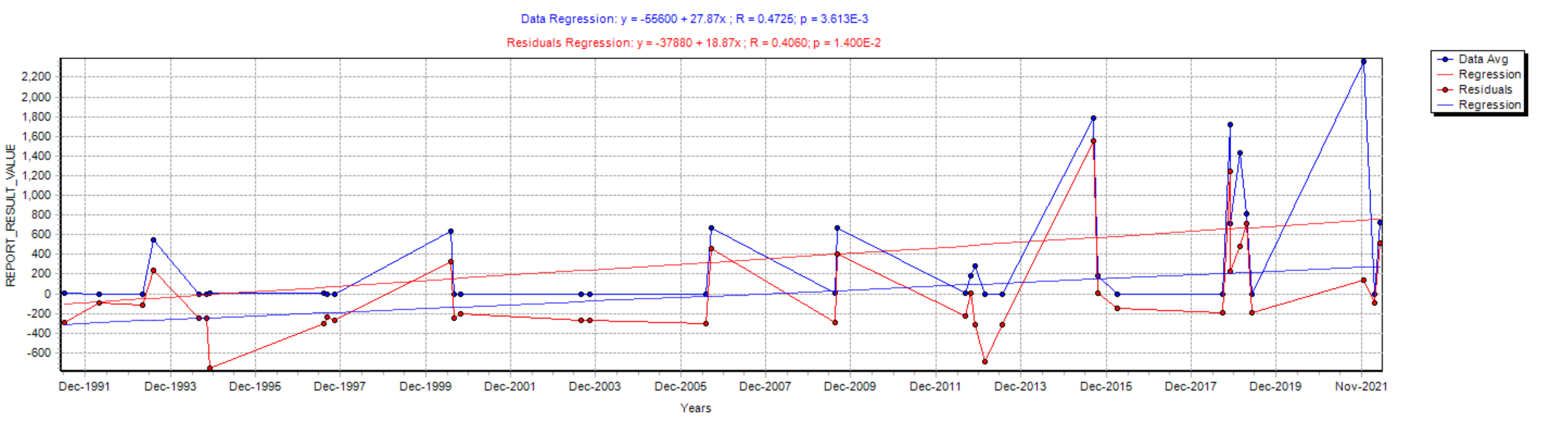
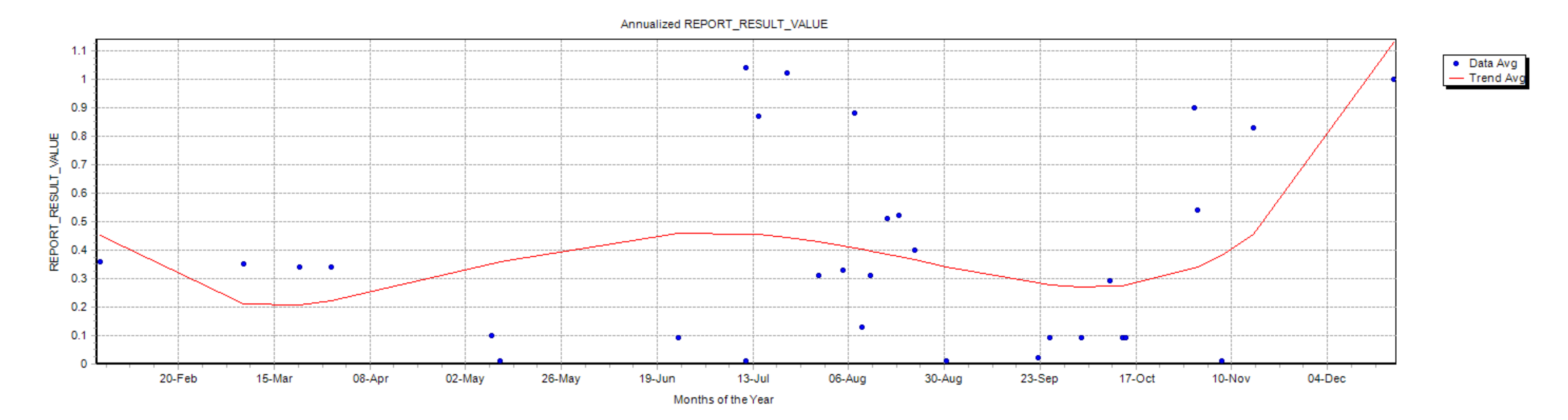


Chart 1-4: Field Salinity Trend



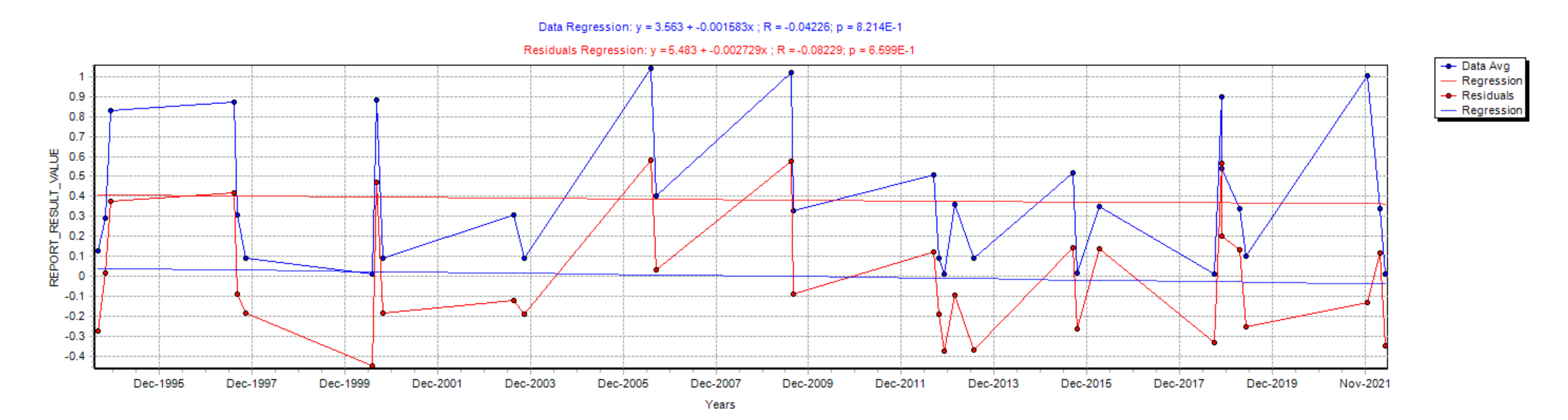
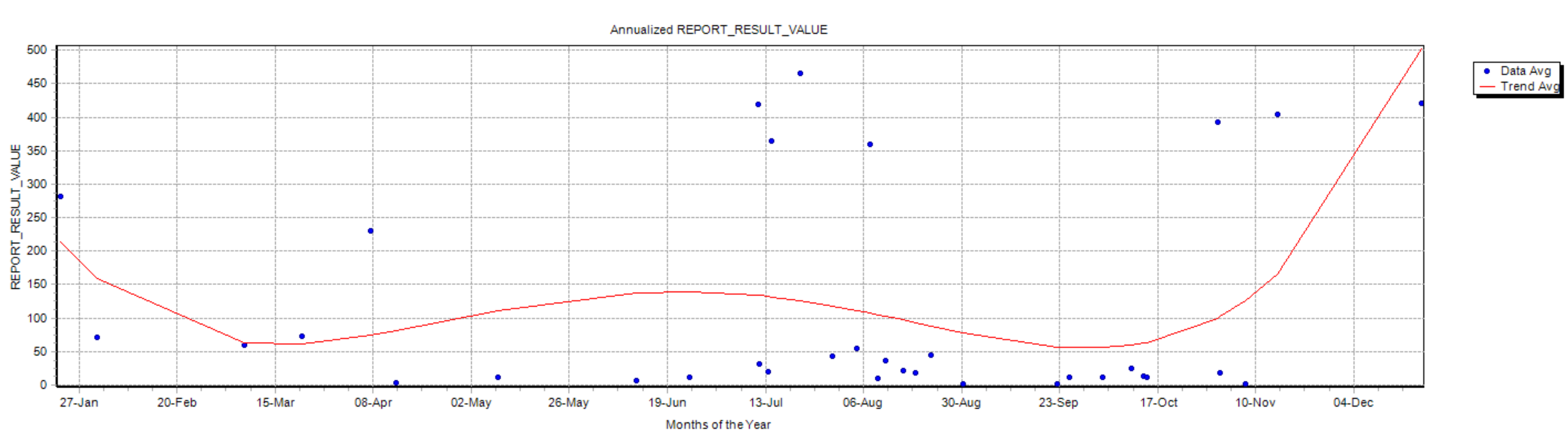


Chart 1-5: Chloride Trend



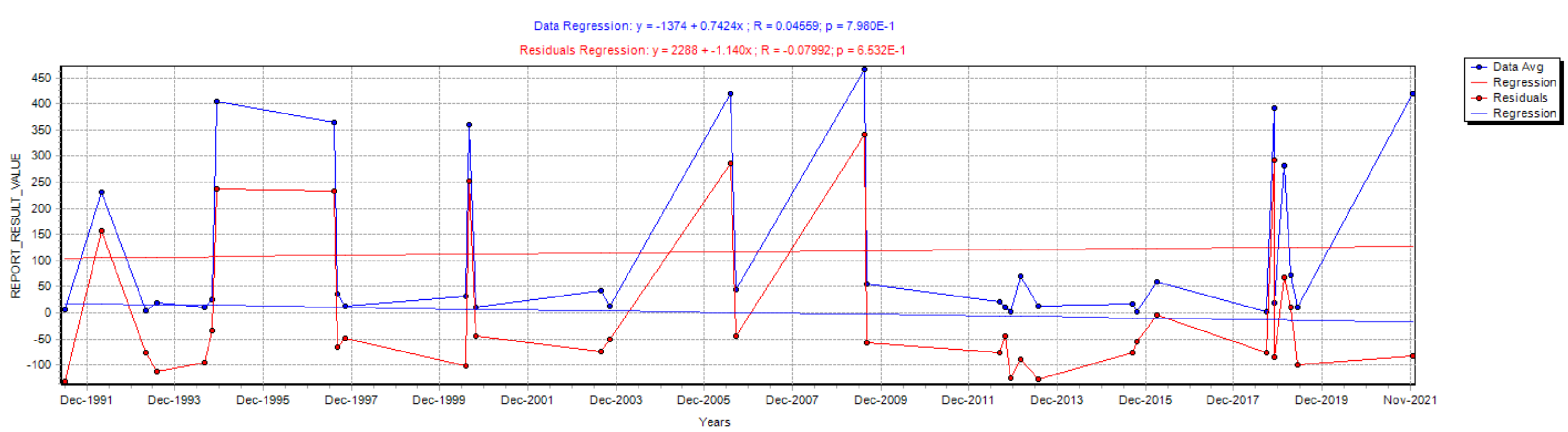
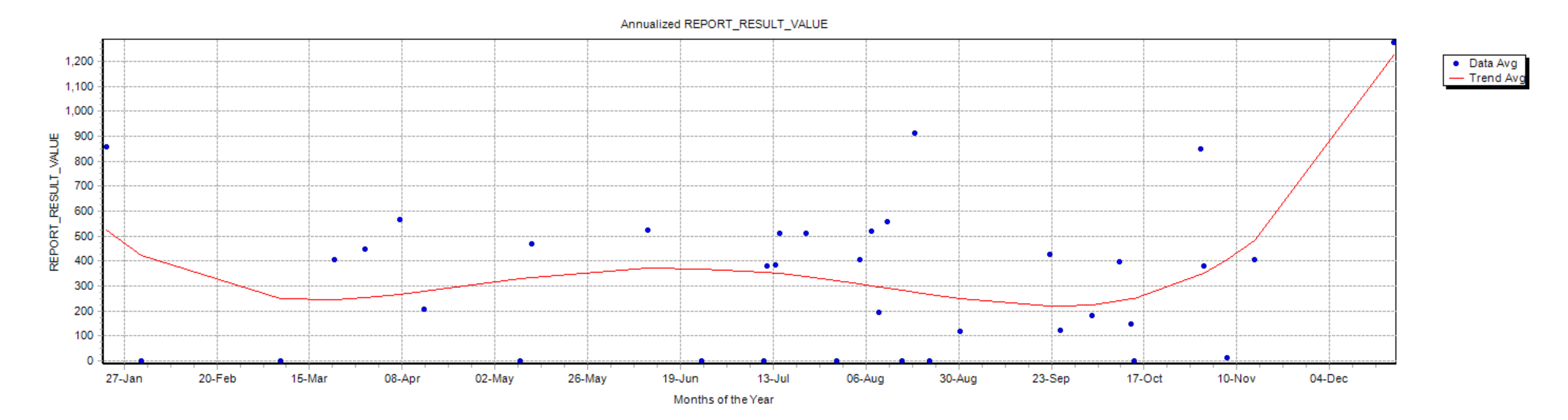


Chart 1-6: Total Dissolved Solids Trend



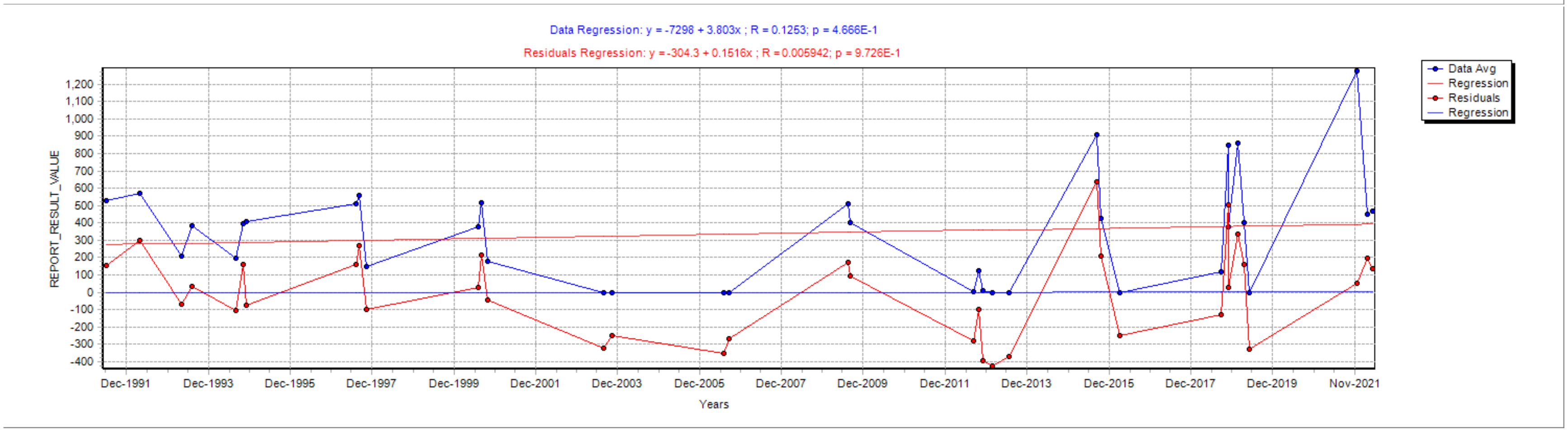
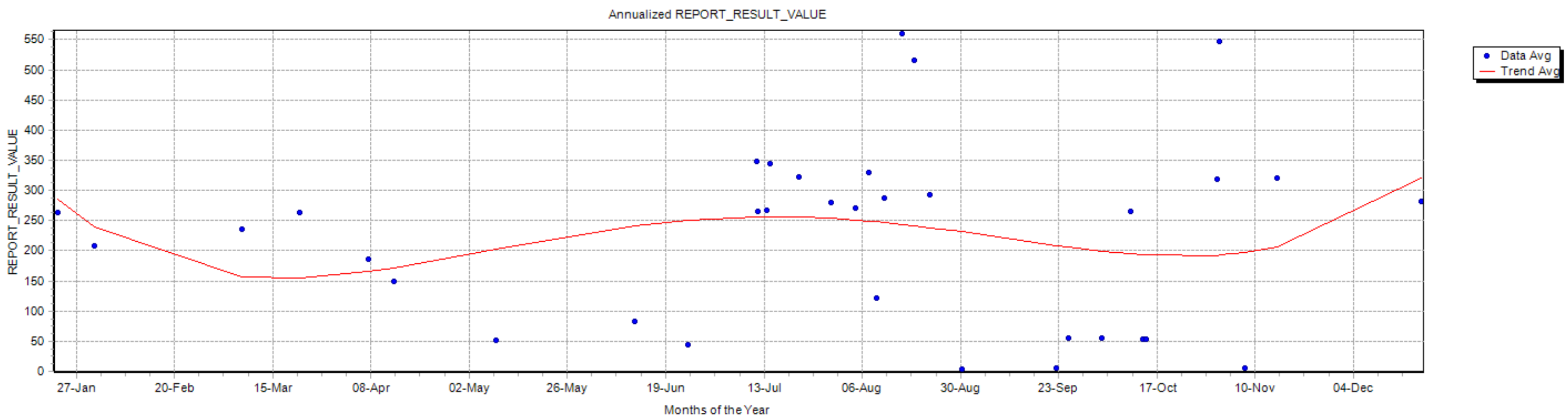


Chart 1-7: Alkalinity Trend



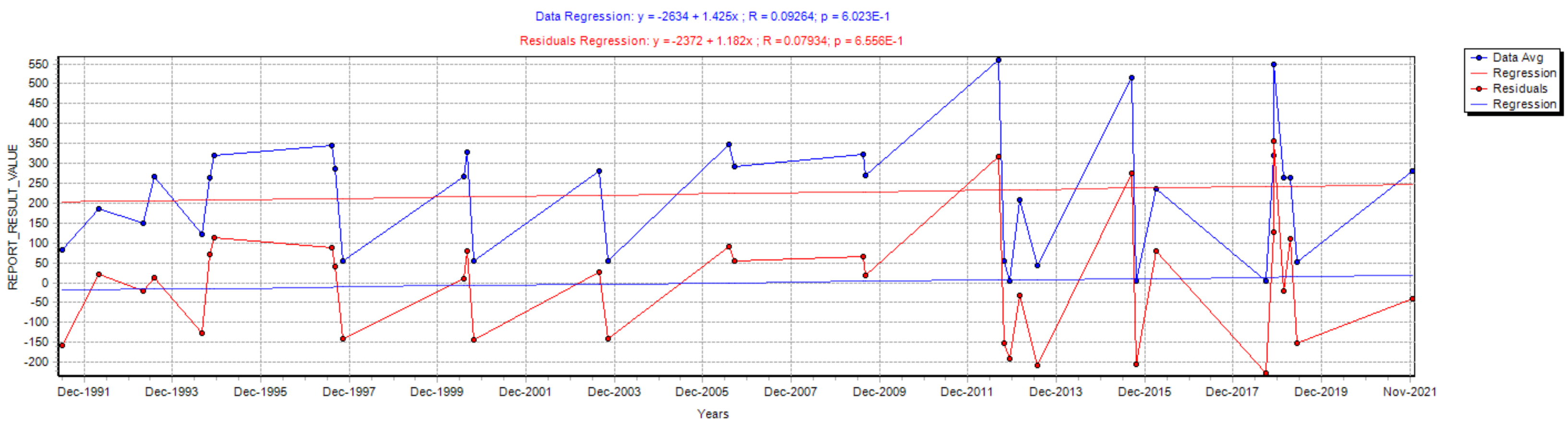
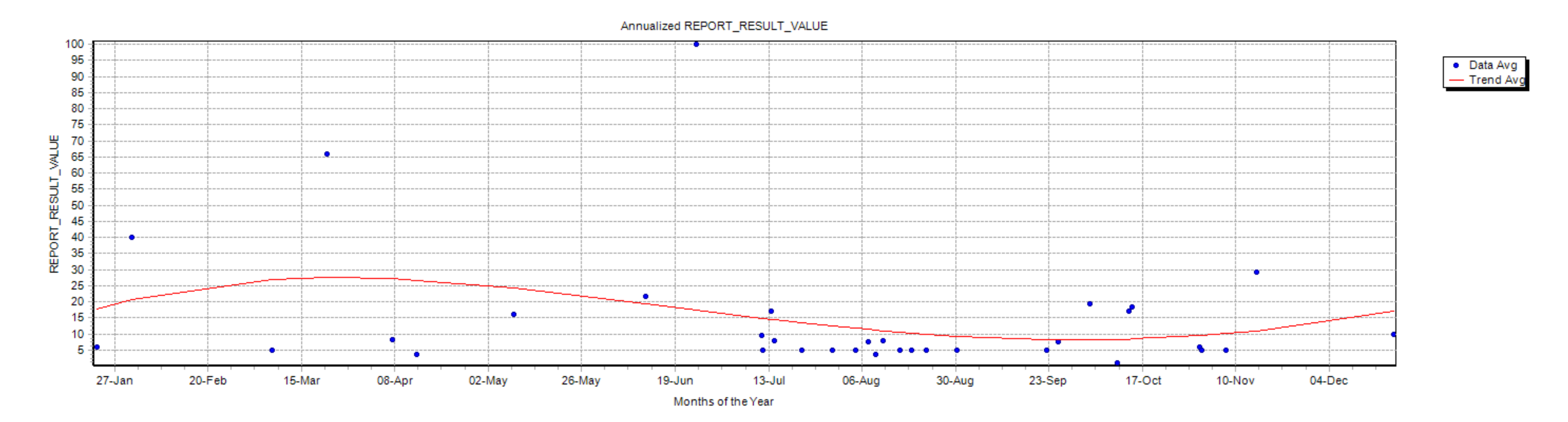


Chart 1-8: Hardness Trend



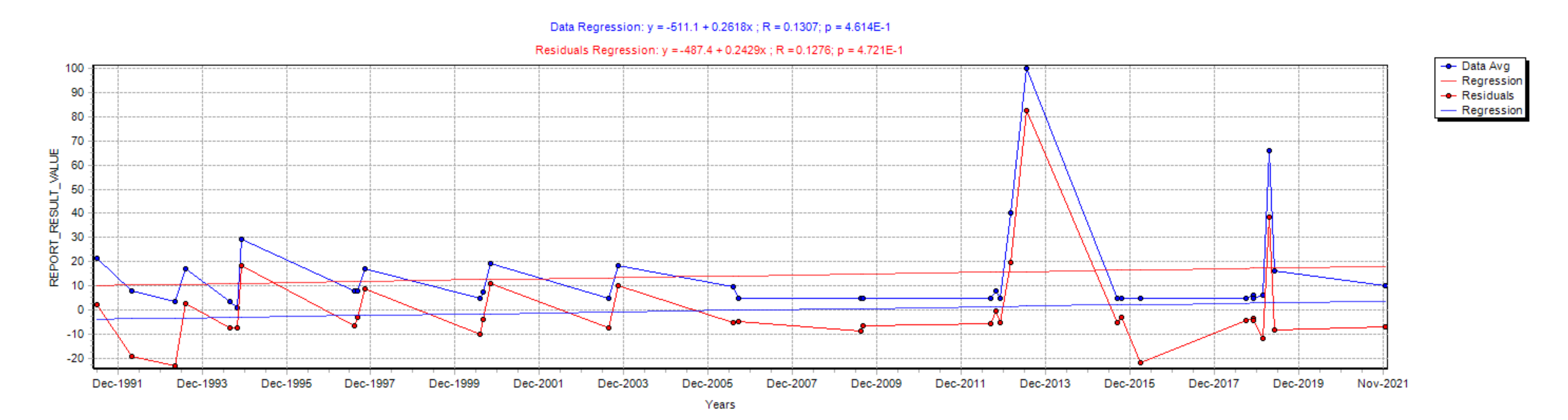
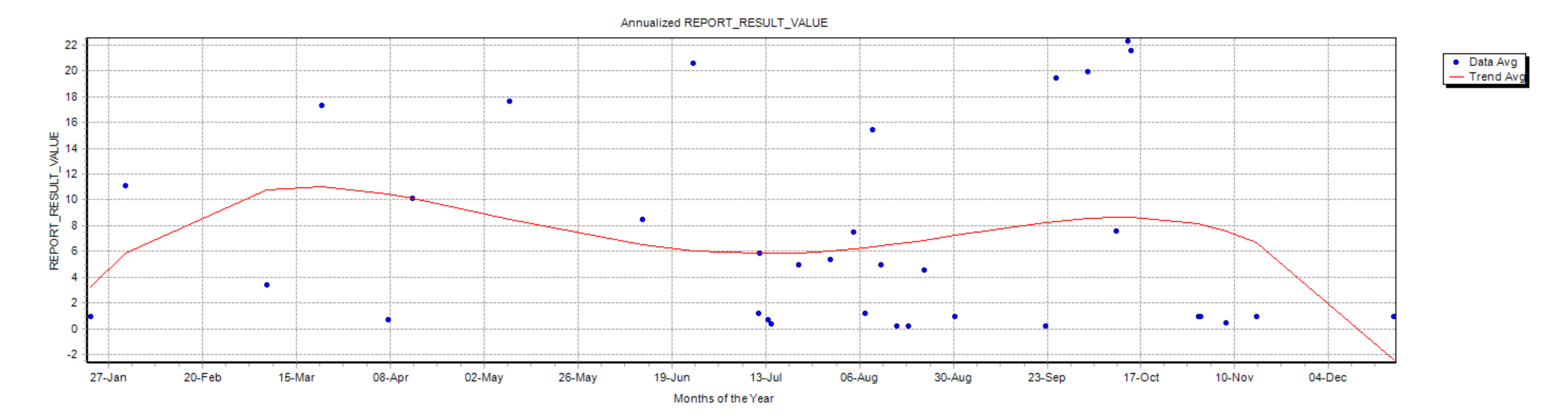


Chart 1-9: Sulfate Trend



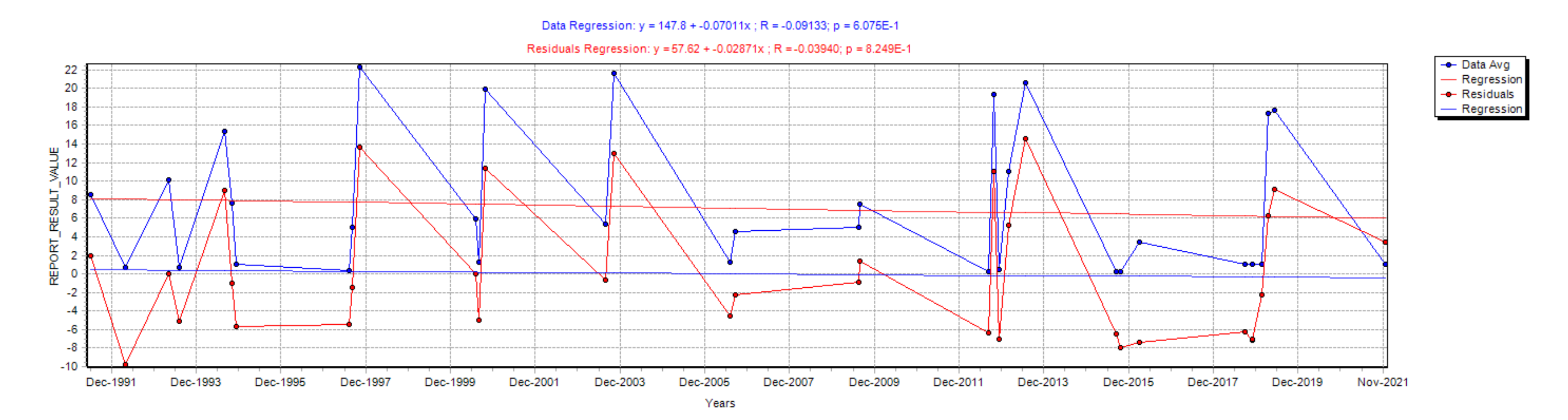
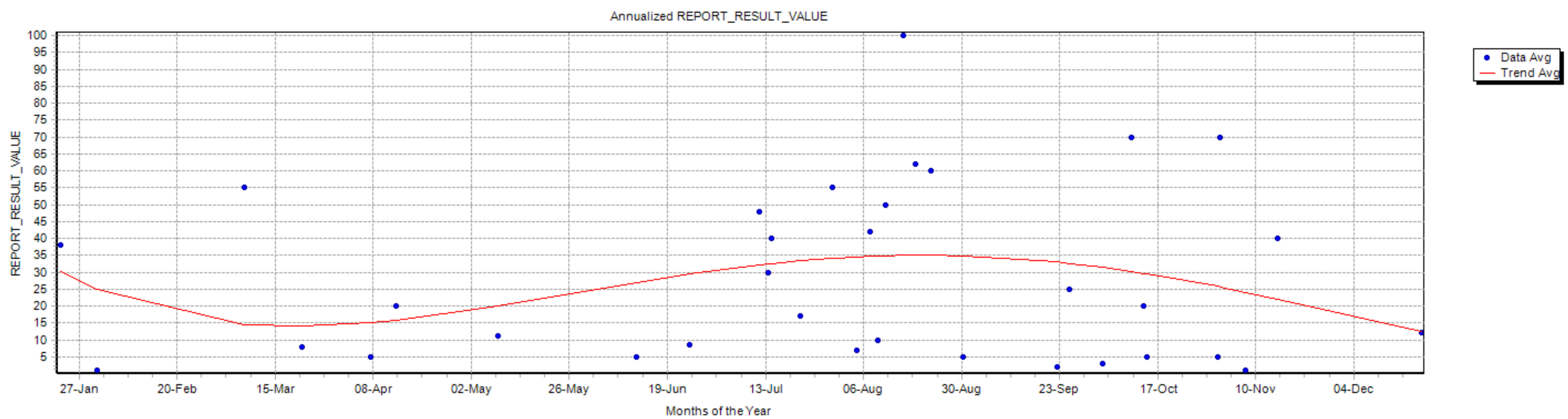


Chart 1-10: Color Trend



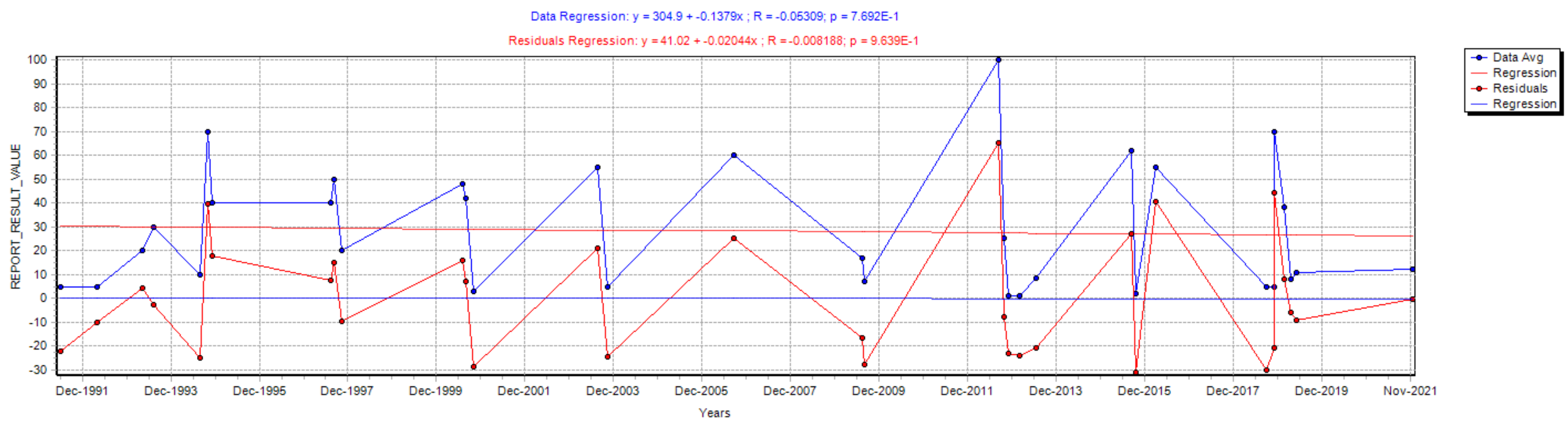
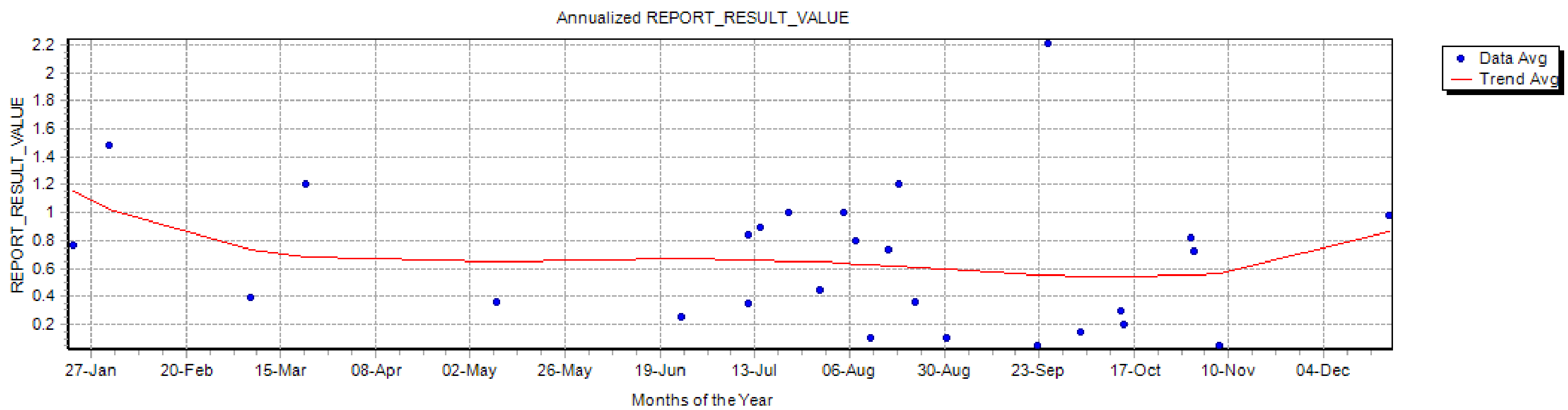


Chart 1-11: Ammonia Trend



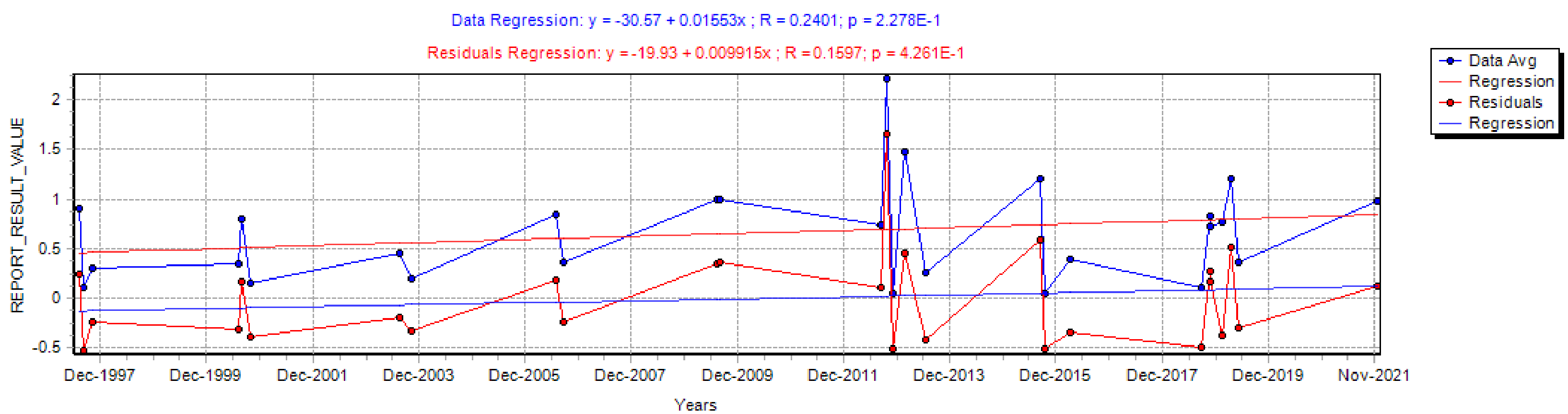
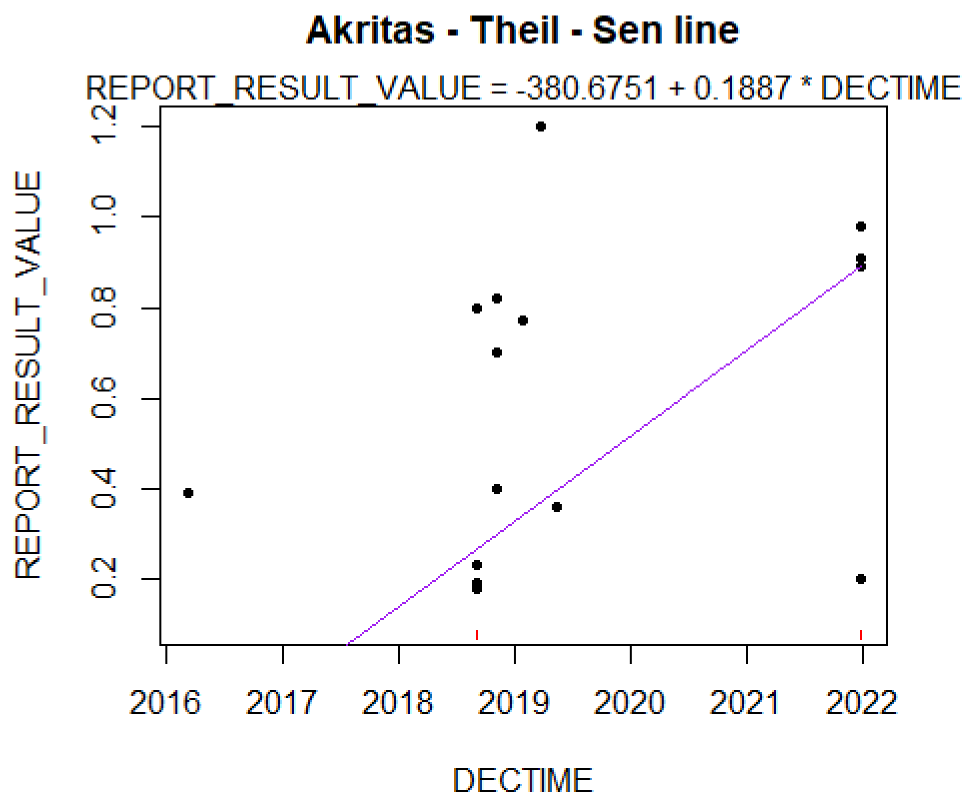
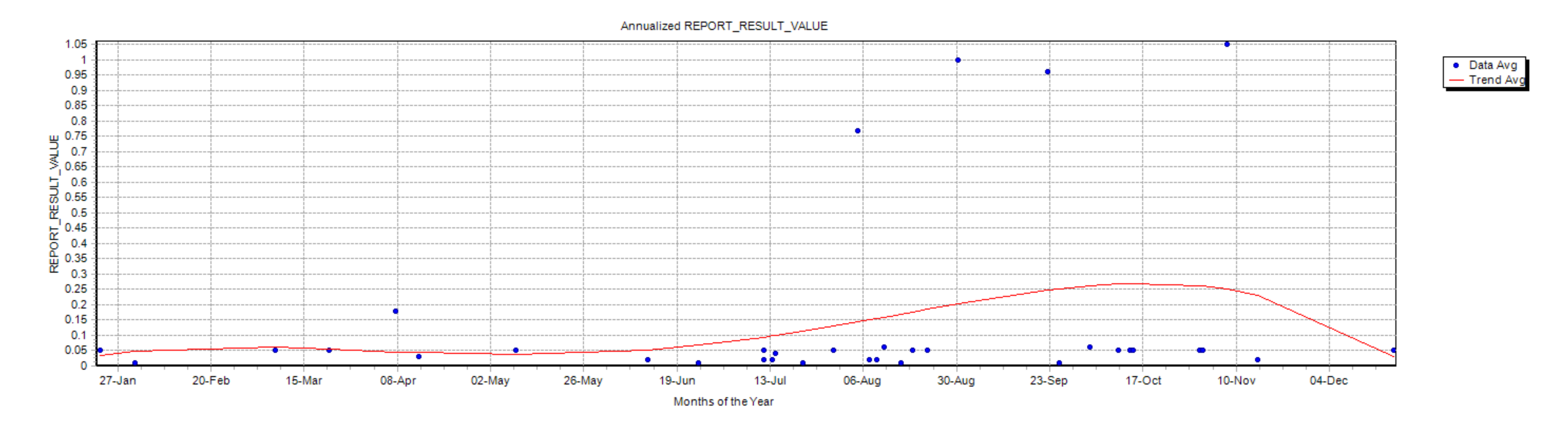


Chart 1-11a: Ammonia Trend



Kendall's Tau = 0.3275	P-Value = 0.536

Chart 1-12: Nitrate – Nitrite Trend



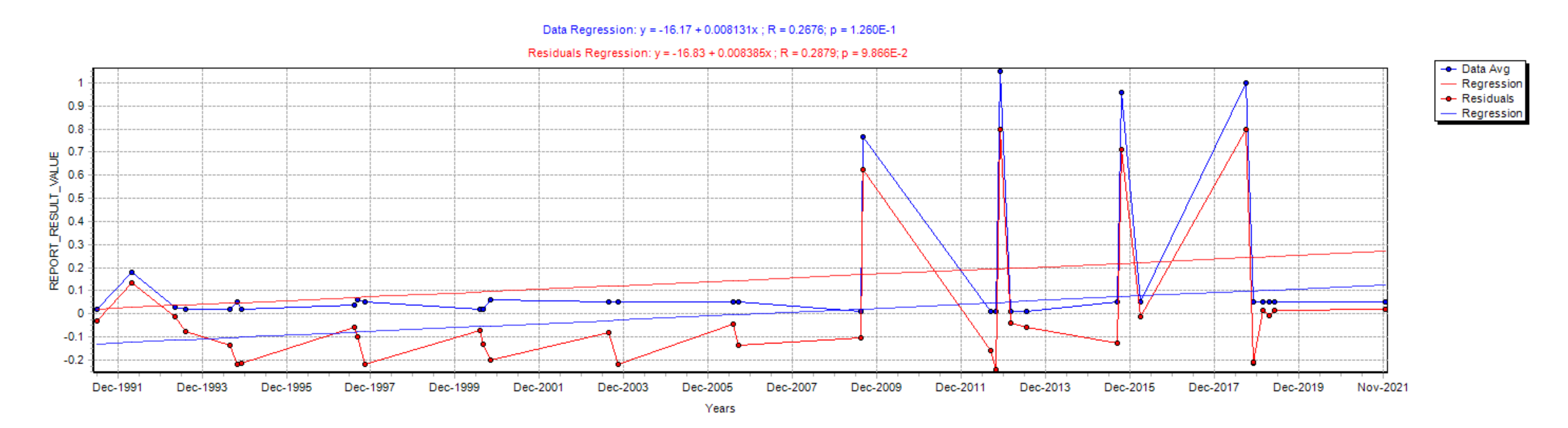
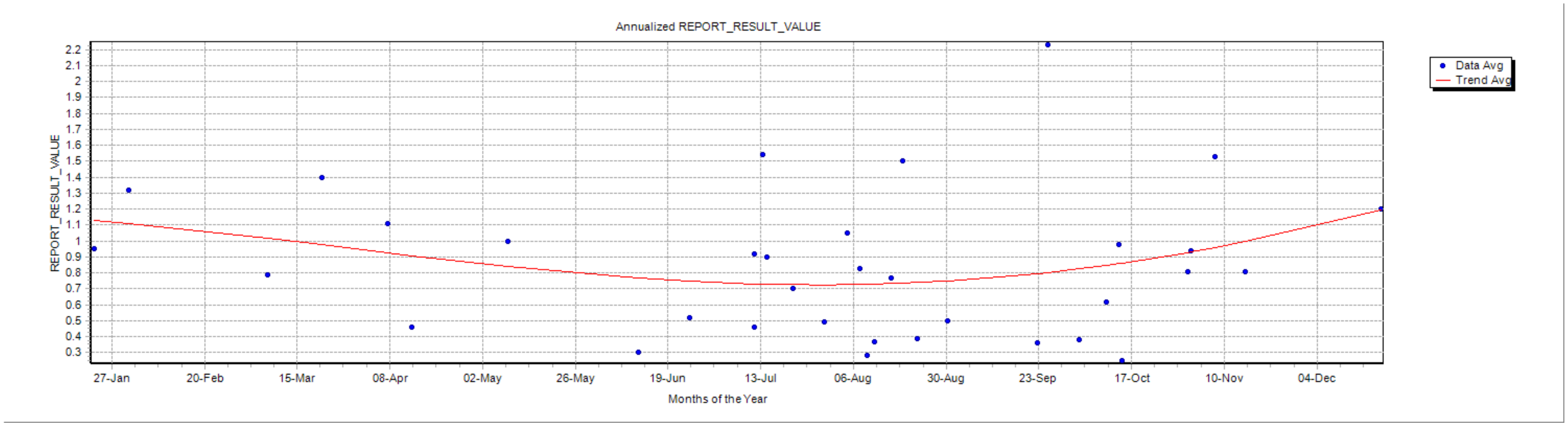


Chart 1-13: Total Kjeldahl Nitrogen Trend



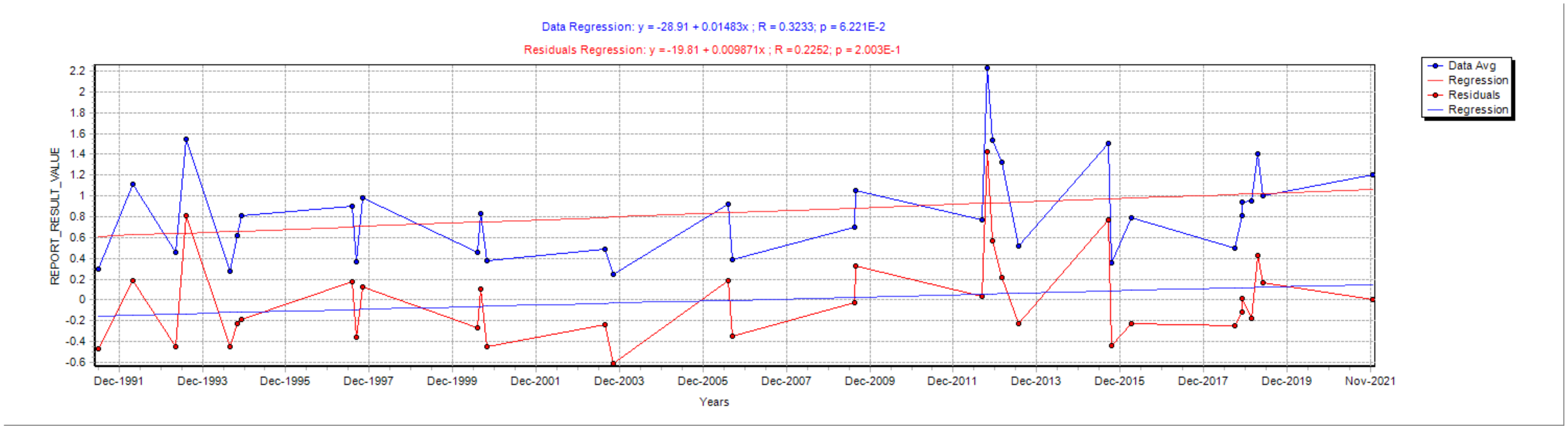
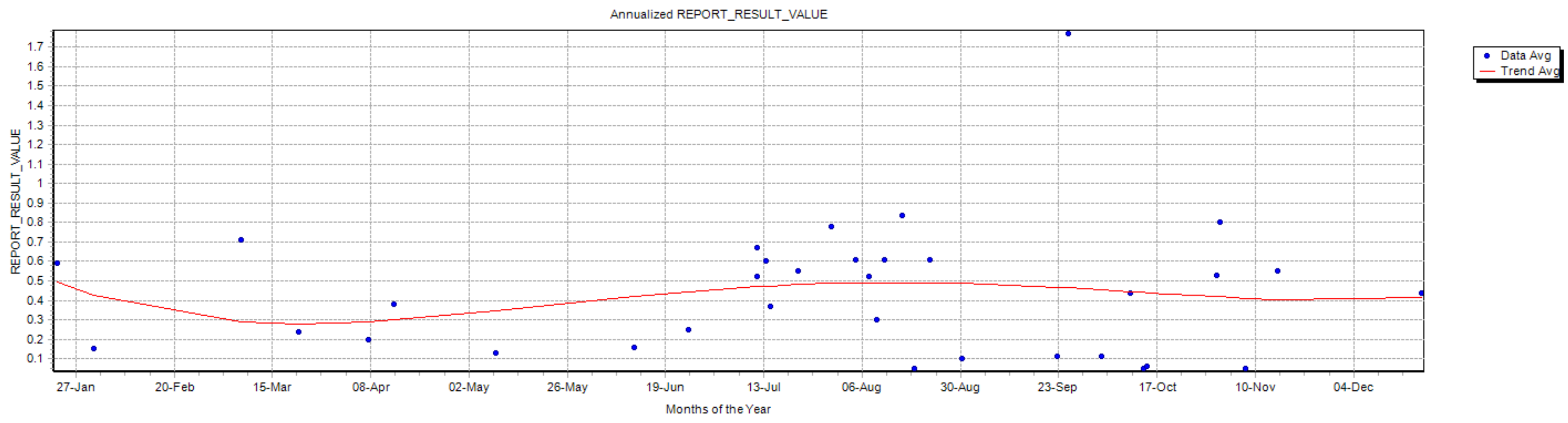


Chart 1-14: Total Phosphorus Trend



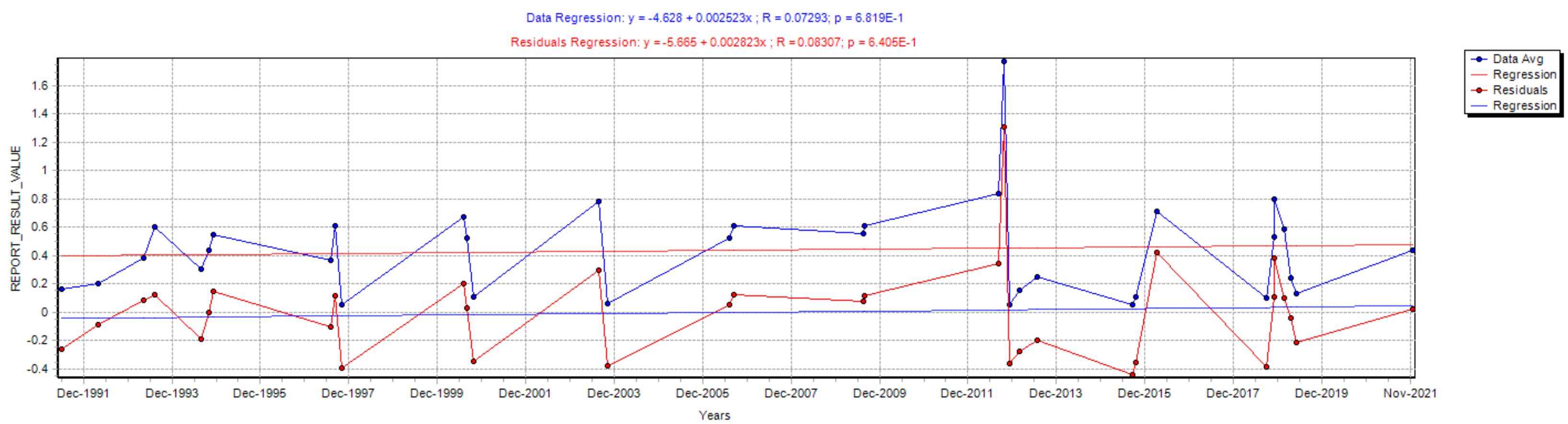
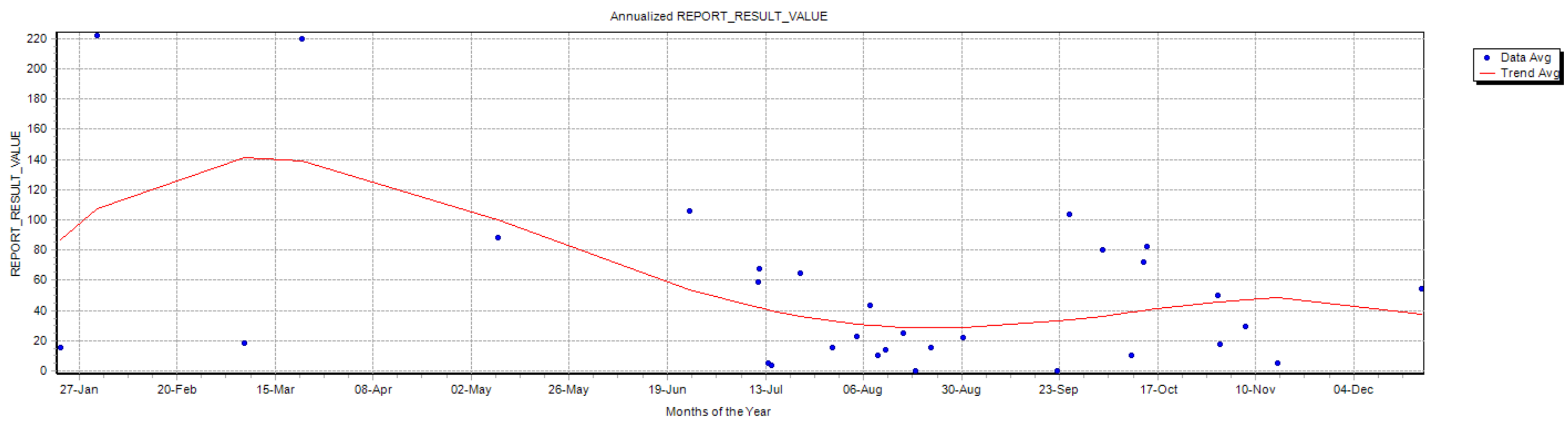


Chart 1-15: Barium Trend



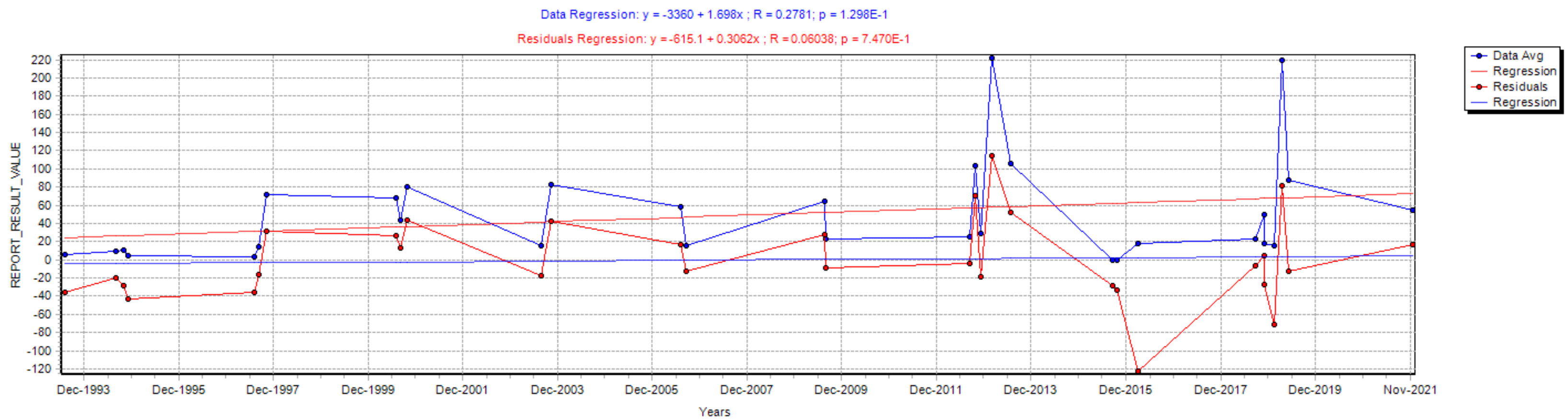
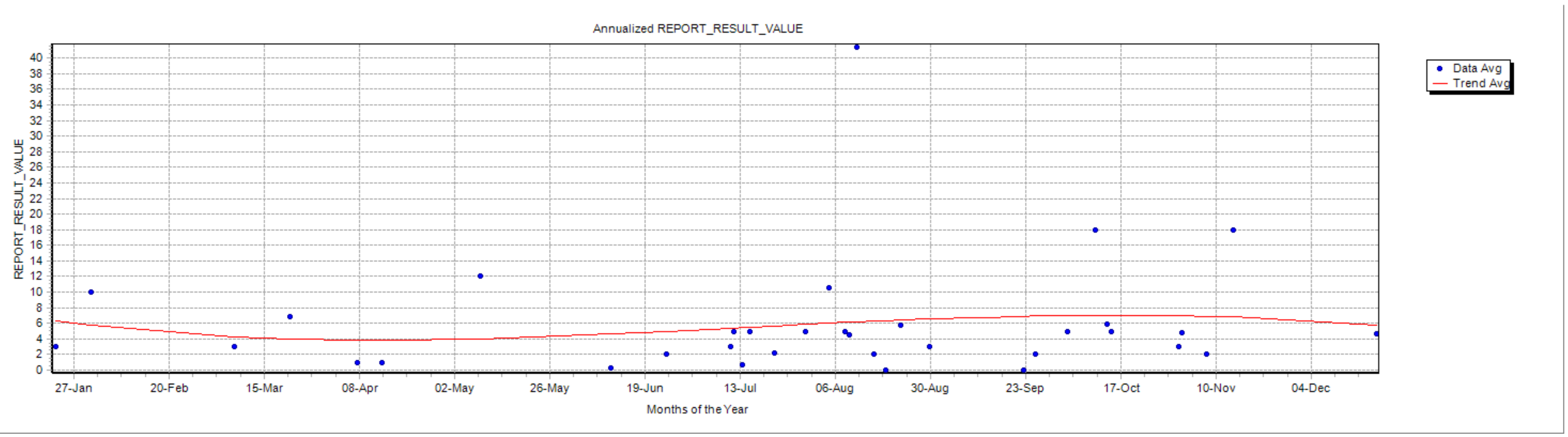


Chart 1-16: Copper Trend



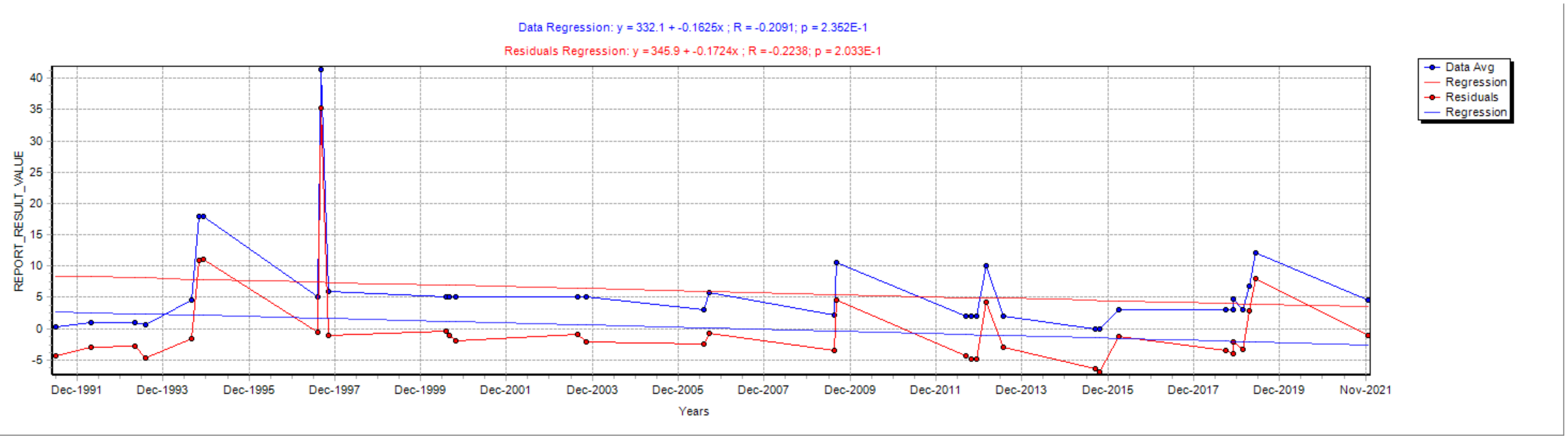
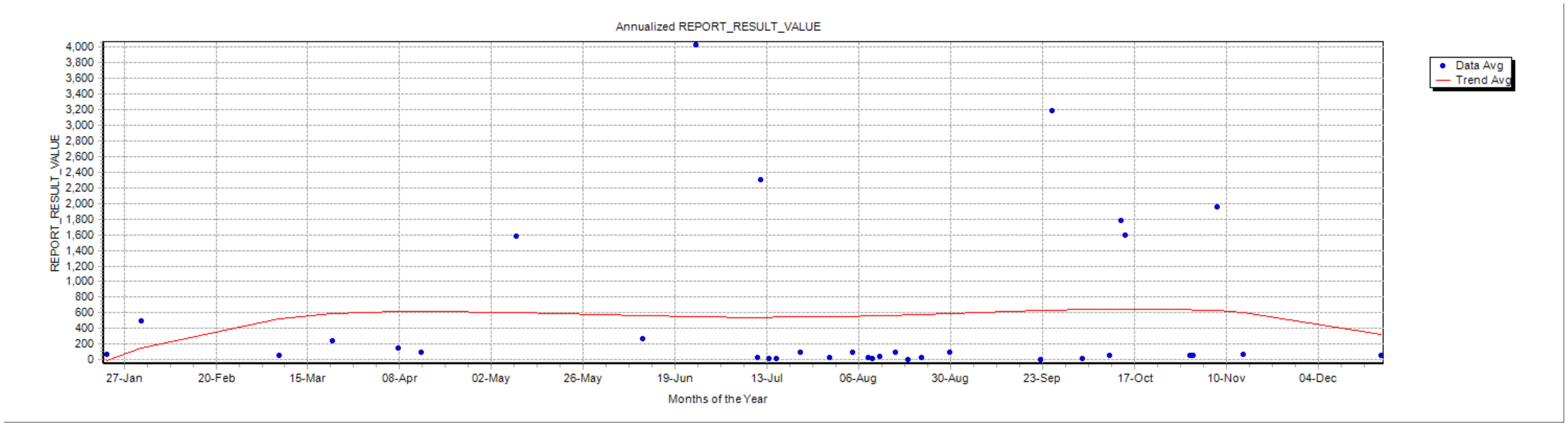


Chart 1-17: Iron Trend



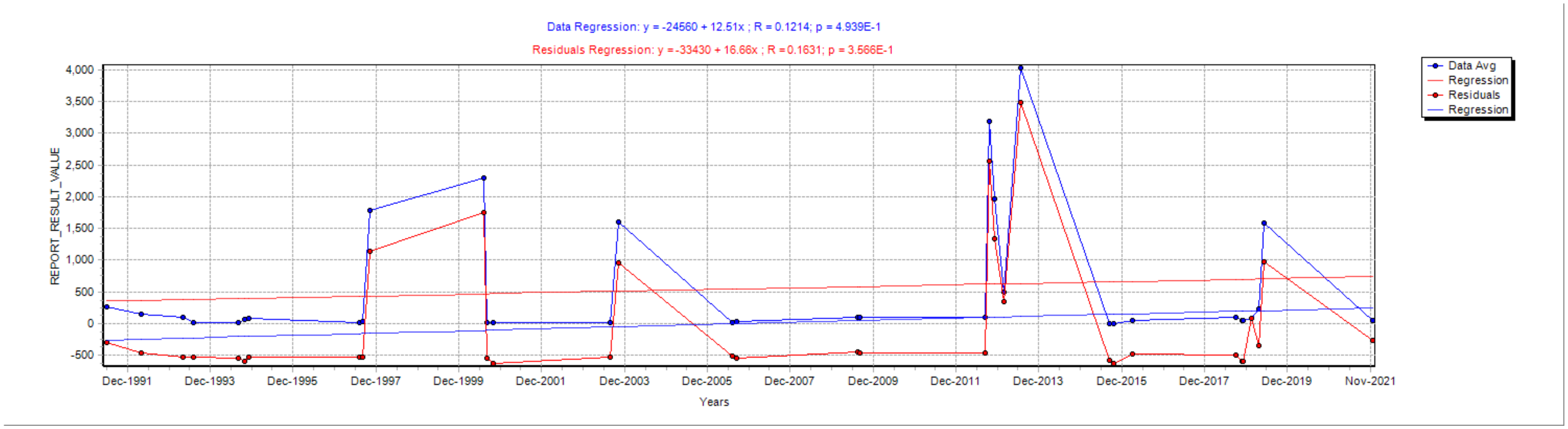


Chart 1-18: Zinc Trend