MISSISSIPPI RIVER ALLUVIAL AQUIFER SUMMARY, 2020
AQUIFER SAMPLING AND ASSESSMENT PROGRAM

APPENDIX 8 TO THE 2021 TRIENNIAL SUMMARY REPORT
PARTIAL FUNDING PROVIDED BY THE CWA

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 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 collected from wells producing from the Mississippi River Alluvial aquifer, during the 2020 state fiscal year (July 1, 2019 - June 30, 2020), analyzed in this summary will become Appendix 8 of the ASSET Program Triennial Summary Report for 2021.

The data show 19 wells were sampled which produce from the Mississippi River Alluvial aquifer. Six of these 19 wells are domestic wells; six are irrigation wells; and seven are public supply. The wells are located in 12 parishes along or near the Mississippi River.

Figure 8-1 shows the geographic locations of the Mississippi River Alluvial aquifer and the associated wells, whereas Table 8-1 lists the wells in the aquifer along with their total depths, use made of produced waters, and date sampled.

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

GEOLOGY

Mississippi River alluvium consists of poorly to moderately well sorted fining upward sequences of gravel, sand, silt, and clay. With fine-grained to medium-grained sand near the top, grading to coarse sand and gravel in the lower portions. Confining layers of silt and clay occur at various thicknesses and extents. The Mississippi River Alluvial aquifer consists of two distinct hydrologically related components: valley trains and meander-belt deposits.

HYDROGEOLOGY

The Mississippi River Alluvial aquifer is dominated by surface water to groundwater interaction with the Mississippi River and its major streams. Recharge occurs by direct infiltration of rainfall in the river valley, lateral and upward movement of water from adjacent and underlying aquifers, and overbank stream flooding. The amount of recharge from rainfall depends on the thickness and permeability of the overlying silt and clay layers. Water levels fluctuate seasonally in response to precipitation trends and river stages. Water levels are generally within 30 to 40 feet of the land surface, and movement is down gradient towards rivers and streams. Natural discharge occurs by seepage of water into the Mississippi River and its streams, but some water moves into the aquifer when stream stages are above aquifer water levels. The hydraulic conductivity varies between 10 and 530 feet/day.

The maximum depths of occurrence of freshwater in the Mississippi River Alluvial range from 20 feet below sea level to 500 feet below sea level. The range of thickness of the fresh water interval in the Mississippi River Alluvial is 50 to 500 feet. The depths of the Mississippi River Alluvial aquifer wells monitored in conjunction with ASSET program range from 30 feet to 352 feet below land surface, with an average depth of 133 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 8-2. The inorganic (total metals) parameters analyzed in the laboratory are listed in Table 8-3. These tables also show the field and analytical results determined for each analyte. For quality control, duplicate samples were obtained for each parameter at wells AV-462, SMN-33, and AV-5495z.

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

Tables 8-4 and 8-5 provide a statistical overview of field, conventional, and inorganic data for the Mississippi River Alluvial aquifer, listing the minimum, maximum, and average results for these parameters collected in the FY 2020 sampling. Tables 8-6 and 8-7 compare these same parameter averages to historical ASSET-derived data for the Mississippi River Alluvial aquifer, for each three-year rotation since fiscal year 1996.

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 8-1 through 8-16 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 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 also set secondary standards, which are defined as non-enforceable taste, odor, or appearance guidelines. Field and laboratory data contained in Tables 8-2 and 8-3 show that one or more secondary MCLs (SMCLs) were exceeded in 16 of the 19 wells sampled in the Mississippi River Alluvial aquifer, with 25 SMCLs being exceeded.

Field and Conventional Parameters

Table 8-2 shows the field and conventional parameters for which samples are collected at each well and the analytical results for those parameters. Table 8-4 provides an overview of this data for the Mississippi River Alluvial aquifer, listing the minimum, maximum, and average results for these parameters.

<u>Federal Primary Drinking Water Standards:</u> A review of the analysis listed in Table 8-2 shows that no primary MCLs were 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.

<u>Federal Secondary Drinking Water Standards:</u> A review of the analysis listed in Table 8-2 shows that one well exceeded the SMCL for chloride, one well exceeded the SMCL for color, and eight wells exceeded the SMCL for total dissolved solids (TDS). Laboratory results override field results in exceedance determinations, thus only lab results will be counted in determining SMCL exceedance numbers for TDS. Following is a list of SMCL parameter exceedances with well number and results:

<u>Chloride (SMCL = 250 mg/L or 0.25 g/L):</u>

FR-1358 – 270 mg/L

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

TS-61 – 55.0 PCU

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

	LAB RESULTS (in mg/L)	FIELD MEASURES (in mg/L)
AV-462	911 mg/L (825 mg/L in Duplicate)	825 mg/L (911 mg/L in Duplicate)
AV-5495Z	555 mg/L (555 mg/L in Duplicate)	513.6 mg/L (Normal and Duplicate)
CO-433	865 mg/L	841.1 mg/L
IB-COM	775 mg/L	913 mg/L
MA-248	880 mg/L	498.7 mg/L
TS-61	520 mg/L	579.9 mg/L
WC-527	535 mg/L	853.7 mg/L
WC-91	575 mg/L	671.5 mg/L

Inorganic Parameters

Table 8-3 shows the inorganic parameters for which samples are collected at each well and the analytical results for those parameters. Table 8-5 provides an overview of inorganic data for the Mississippi River Alluvial aquifer, listing the minimum, average, and maximum results for these parameters.

Federal Primary Drinking Water Standards: A review of the analyses listed on Table 8-3 shows that two wells exceeded the MCL for arsenic:

Arsenic (MCL = 10 µg/L):

IB-363 – 28.50 µg/L

TS-FORTENB – 19.7 µg/L

Federal Secondary Drinking Water Standards: Laboratory data contained in Table 8-3 shows that 15 wells exceeded the secondary MCL for iron:

Iron (SMCL = 300 µg/L)

AV-126 - 12,000 µg/L

AV-462 – 5,270 µg/L (Normal and Duplicate)

CO – 433 – 14,100 µg/L

FR-1358 – 2,760 µg/L

IB-363 – 1,910 µg/L

IB-COM – 2,410 µg/L

MA-248 – 10,600 µg/L

MO-871 - 534 µg/L

PC-5515z – 5,590 µg/L

RI-RAYVILLE – 7,480 µg/L

SMN-33 – 1,630 µg/L

TS-61 – 9,860 µg/L

TS-FORTENBERRY - 11,000 µg/L

WC-527 – 4,300 µg/L

WC-91 - 705 µg/L

Volatile Organic Compounds

Table 8-8 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 any VOC at or above its detection limit during the FY 2020 sampling of the Mississippi River Alluvial aquifer.

Semi-Volatile Organic Compounds

Table 8-9 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 any SVOC at or above its detection limit during the FY 2020 sampling of the Mississippi River Alluvial aquifer.

Pesticides and PCBs

Table 8-10 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 2020 sampling of the Mississippi River Alluvial 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 Mississippi River Alluvial aquifer exhibit some fluctuations when comparing current data to that of the eight previous sampling rotations. These comparisons can be found in Tables 8-6 and 8-7, and in Charts 8-1 to 8-16 of this summary. Trend analysis charts were computed to analyze for upwards or downwards trends. Using linear regression, the charts indicate a trend - line and normality of residuals. Strong indications of a trend occur when the p value is less than 0.5. Over the twenty-four-year period, three analytes have shown a slight to general increase in concentration. These analytes are: specific conductance (field), chloride, and sulfate. For this same period, five analytes have demonstrated a nominal decrease in concentrations, which are: temperature, color, TDS, TKN, and phosphorous. All remaining analytes were stable or continue to be below detection limits.

The number of wells with secondary MCL exceedances has decreased since the previous sampling. In FY 2017, 20 wells reported one or more secondary exceedances with 38 SMCLs exceeded. Sample results for FY 2020 show that there were 25 SMCL exceedances with one or more exceedances in 16 of the wells sampled.

The number of wells with MCL exceedances in FY 2020 has also decreased since FY 2017. In FY 2017, five wells reported detections of arsenic with four wells exceeding the primary MCL of 10 µg/L. In FY 2020, 13 wells reported detections of arsenic with only two exceeding the primary MCL

Arsenic is known to be present in the Mississippi River Alluvial Aquifer. Figure 8-3 shows the statistical analysis conducted on the Arsenic found in ASSSET wells. The Maximum Likelihood Estimation technique computes a 95% lower confidence level at 9.09 µg/L. When compared to the Primary MCL of 10 µg/L, the aquifer should report levels below this limit 95 % of the time. Regression analysis results showed a downtrend of 0.06 µg/L per year.

SUMMARY AND RECOMMENDATIONS

In summary, the data show that the ground water produced from the Mississippi River Alluvial aquifer is hard.[1] Geochemical analysis shows that the wells sampled for this period are mostly Calcium Bicarbonate water. The piper diagram of this analysis is found in Figure 8-6. The primary MCL for arsenic was the only short-term or long-term health risk guideline that was exceeded; however, this exceedance occurred in two of the 19 wells sampled in this aquifer. The data also show that this aquifer is of poor quality when considering short-term or long-term health risk guidelines, and is of poor quality when considering taste, odor, or appearance guidelines, with 25 secondary MCLs exceeded in 16 wells.

Comparison to historical ASSET-derived data shows only moderate fluctuations in the quality or characteristics of the Mississippi River Alluvial aquifer. This historical comparison shows that the number of wells with SMCL exceedances and the total number of SMCL exceedances has decreased.

The occurrence of arsenic in the Mississippi River Alluvial aquifer has been established by historical activities of this program, with current sampling results supporting those previous findings. Sampling results for this reporting period, FY 2020, show that a total of 13 wells reported detections of arsenic, while two of those 13 exceeded the primary MCL for arsenic (10 µg/L). As a standard procedure of the ASSET Program, all well owners receive the results of their well sampling, while those well owners with primary MCL exceedances are given additional information about the particular compound, its health effects and possible treatment methods.

It is recommended that the wells assigned to the Mississippi River Alluvial aquifer be re-sampled as planned, in approximately three years, with continued attention given to the occurrence of arsenic in this aquifer. In addition, several wells should be added to those 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 8-1: List of Wells Sampled, Mississippi River Alluvial Aquifer–FY 2020

ASSET Site ID	Well ID	Parish	Date	Owner	Depth (Feet)	Well Use
3639	AV-126	AVOYELLES	9/25/2019	PRIVATELY OWNED	155	DOMESTIC
2881	AV-462	AVOYELLES	9/25/2019	FARM, LLC	110	IRRIGATION
4981	AV-5495Z	AVOYELLES	7/9/2020	PRIVATELY OWNED	90	DOMESTIC
4982	CO-433	CONCORDIA	7/30/2020	WHITEHALL PLANTATION	149	IRRIGATION
1862	CT-DENNIS	CATAHOULA	6/24/2020	PRIVATELY OWNED	30	DOMESTIC
3587	FR-1358	FRANKLIN	6/16/2020	MACON RIDGE RESEARCH STATION	60	IRRIGATION
2871	IB-369	IBERVILLE	1/29/2020	SYNGENTA CROP PROTECTION	225	IRRIGATION
1858	IB-COM	IBERVILLE	1/29/2020	PRIVATELY OWNED	185	DOMESTIC
4773	MA-248	MADISON	6/30/2020	TALLULAH WATER SERVICE	153	PUBLIC SUPPLY
1893	MO-871	MOREHOUSE	6/30/2020	PRIVATELY OWNED	80	IRRIGATION
4009	PC-5515Z	POINTE COUPEE	1/29/2020	PRIVATELY OWNED	156	DOMESTIC
1825	RI-469	RICHLAND	6/16/2020	LIDDIEVILLE WATER SYSTEM	90	PUBLIC SUPPLY
1935	RI-730	RICHLAND	6/18/2020	START WATER SYSTEM	101	PUBLIC SUPPLY
4499	RI-RAYVIL	RICHLAND	6/18/2020	RAYVILLE WATER DEPARTMENT	230	PUBLIC SUPPLY
1861	SMN-33	ST. MARTIN	1/29/2020	LDOTD/LAFAYETTE DISTRICT	125	PUBLIC SUPPLY
3359	TS-61	TENSAS	6/4/2020	TOWN OF ST. JOSEPH	140	PUBLIC SUPPLY
1863	TS-FORTENB	TENSAS	6/16/2020	PRIVATELY OWNED	33	DOMESTIC
2997	WC-527	WEST CARROLL	6/30/2020	PRIVATELY OWNED	85	IRRIGATION
2999	WC-91	WEST CARROLL	7/9/2020	NEW CARROLL WTR. ASSN.	115	PUBLIC SUPPLY

Table 8-2: Summary of Field and Conventional Data, Mississippi River Alluvial Aquifer–FY 2020

Well ID	pH SU	Sal. ppt	Sp. Cond. mmhos per cm	TDS mg/L	Temp Deg. C	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. µmmhos per cm	SO4 mg/L	TDS mg/L	TKN mg/l	TSS mg/L	Turb. NTU
	LABORATORY DETECTION LIMITS† →					5	0.25/ 12.5	1	5/25	0.01/ 0.25	0.05	0.05/ 0.25	10	0.25/ 25	10	0.1	4	0.3/ 1.5
	FIELD PARAMETERS					LABORATORY PARAMETERS												
AV-126	6.92	0.37	0.74	260.00	17.45	349.00	14.20	< DL	400.00	0.05	0.47	< DL	4.94	10.10	494.00	32.00	190.00	6.92
AV-462	6.94	0.71	1.40	825.00	16.86	379.00	97.90	< DL	540.00	0.05	0.34	< DL	1.40	151.00	911.00	20.00	70.50	6.94
AV-462*	6.94	0.71	1.40	911.00	16.86	379.00	97.90	<DL	540.00	<DL	0.34	0.35	1.40	151.00	825.00	20.00	70.50	6.94
AV-5495Z	6.50	0.38	0.79	513.60	25.76	119.00	107.00	10.00	280.00	7.40	< DL	0.15	1.80	< DL	555.00	< DL	3.20	6.50
AV-5495Z*	6.52	0.38	0.79	513.60	25.71	119.00	107.00	10.00	280.00	7.40	0.10	0.15	1.80	63.20	555.00	4.00	3.20	6.52
CO-433	7.03	0.64	1.29	841.10	27.06	575.00	21.10	10.00	780.00	0.05	2.00	0.95	< DL	38.50	865.00	35.00	194.00	7.03
CT-DENNIS	7.06	0.11	0.22	145.83	21.99	79.20	16.60	< DL	90.00	0.08	0.11	< DL	0.48	5.00	195.00	< DL	2.40	7.06
FR-1358	6.82	0.79	1.56	1017.30	20.90	358.00	270.00	< DL	360.00	0.39	0.34	0.40	1.44	20.20	430.00	11.00	68.50	6.82
IB-369	7.92	0.29	0.59	384.00	13.53	189.00	35.90	< DL	222.00	< DL	0.53	0.36	0.56	18.30	270.00	6.00	11.20	7.92
IB-COM	7.66	0.71	1.40	913.00	12.38	292.00	237.00	< DL	680.00	< DL	1.10	< DL	1.21	1.00	775.00	7.00	22.10	7.66
MA-248	6.77	0.37	0.76	498.70	21.80	377.00	9.50	10.00	360.00	< DL	0.99	0.75	0.76	1.00	880.00	14.00	130.00	6.77
MO-871	6.90	0.36	0.74	484.00	21.03	245.00	53.50	10.00	220.00	0.25	0.33	0.26	0.72	37.00	420.00	11.00	21.70	6.90
PC-5515Z	6.57	0.44	0.90	582.00	14.31	377.00	41.20	< DL	620.00	< DL	1.80	< DL	0.88	1.00	420.00	15.00	48.00	6.57
RI-469	7.56	0.13	0.29	NR	NR	55.50	31.50	< DL	80.00	7.20	< DL	0.14	0.29	7.40	250.00	< DL	0.82	7.56
RI-730	7.54	0.20	0.43	278.66	21.62	165.00	34.40	< DL	166.00	1.80	0.76	0.84	0.43	21.20	345.00	< DL	1.70	7.54
RI-RAYVIL	7.52	0.25	0.53	278.66	21.60	264.00	17.40	10.00	280.00	< DL	0.71	0.69	0.50	1.00	435.00	14.00	70.00	7.52

Well ID	pH SU	Sal. ppt	Sp. Cond. mmhos per cm	TDS mg/L	Temp Deg. C	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. µmmhos per cm	SO4 mg/L	TDS mg/L	TKN mg/l	TSS mg/L	Turb. NTU
	LABORATORY DETECTION LIMITS† →					5	0.25/ 12.5	1	5/25	0.01/ 0.25	0.05	0.05/ 0.25	10	0.25/ 25	10	0.1	4	0.3/ 1.5
	FIELD PARAMETERS					LABORATORY PARAMETERS												
SMN-33	7.88	0.23	0.47	306.00	13.75	170.00	22.00	< DL	192.00	< DL	2.20	< DL	0.46	< DL	215.00	< DL	2.80	7.88
SMN-33*	7.88	0.23	0.47	306.00	13.75	170.00	21.90	<DL	204.00	0.05	1.00	0.27	0.44	1.00	190.00	4.00	3.10	7.88
TS-61	7.16	N/A	1.75	579.90	NR	434.00	22.10	55.00	440.00	< DL	1.20	0.65	1.75	< DL	520.00	24.00	130.00	7.16
TS-FORTENB	6.96	0.39	0.81	525.00	22.98	349.00	16.60	10.00	380.00	< DL	1.50	1.10	0.70	< DL	235.00	28.00	168.00	6.96
WC-527	7.09	0.65	1.31	853.70	21.30	406.00	107.00	10.00	600.00	0.09	0.43	0.22	1.35	57.40	535.00	9.00	38.70	7.09
WC-91	7.12	0.51	1.03	671.50	21.00	283.00	135.00	< DL	380.00	< DL	0.37	0.10	1.34	10.30	575.00	< DL	6.00	7.12

*Duplicate Sample R-Data Rejected Exceeds EPA Secondary Standards

Table 8-3: Summary of Inorganic Data, Mississippi River Alluvial Aquifer–FY 2020

Well ID	Antimony µg/L	Arsenic µg/L	Barium µg/L	Beryllium µg/L	Cadmium µg/L	Chromium µg/L	Copper µg/L	Iron µg/L	Lead µg/L	Mercury µg/L	Nickel µg/L	Selenium µg/L	Silver µg/L	Thallium µg/L	Zinc µg/L
Laboratory Detection Limits†	5/25	4/20	5/25	2/10	2/10	4/20	2/10	100/ 500	1/5	0.0002	3/15	5/25	1/5	2/10	6/30
AV-126	< DL	< DL	420.00	< DL	< DL	< DL	< DL	12000	< DL	< DL	< DL	< DL	< DL	< DL	27.60
AV-462	< DL	3.00	52.80	< DL	< DL	< DL	< DL	5270	< DL	< DL	< DL	< DL	< DL	< DL	6.10
AV-462*	<DL	3.00	52.80	<DL	<DL	<DL	<DL	5270	<DL	<DL	<DL	<DL	<DL	<DL	6.10
AV-5495Z	< DL	< DL	115.00	< DL	< DL	< DL	3.70	< DL	< DL	< DL	5.40	1.90	< DL	< DL	11.70
AV-5495Z*	<DL	<DL	116.00	<DL	<DL	<DL	<DL	<DL	<DL	<DL	4.80	1.90	<DL	<DL	5.50
CO-433	< DL	3.80	842.00	< DL	< DL	< DL	< DL	14100	< DL	< DL	< DL	< DL	< DL	< DL	< DL
CT-DENNIS	< DL	< DL	6.10	< DL	< DL	< DL	15.90	92	1.60	< DL	1.10	< DL	< DL	< DL	244.00
FR-1358	< DL	3.90	193.00	< DL	< DL	< DL	< DL	2760	< DL	< DL	1.80	< DL	< DL	< DL	< DL
IB-369	< DL	**28.50**	417.00	< DL	< DL	< DL	< DL	1910	< DL	< DL	< DL	< DL	< DL	< DL	< DL
IB-COM	< DL	6.90	717.00	< DL	< DL	< DL	< DL	2410	< DL	< DL	< DL	< DL	< DL	< DL	119.00
MA-248	< DL	9.00	533.00	< DL	< DL	< DL	< DL	10600	< DL	< DL	< DL	< DL	< DL	< DL	9.70
MO-871	< DL	5.80	285.00	< DL	< DL	< DL	< DL	534	< DL	< DL	1.20	< DL	< DL	< DL	13.60
PC-5515Z	< DL	5.30	1260.00	< DL	< DL	< DL	< DL	5590	< DL	< DL	< DL	< DL	< DL	< DL	< DL
RI-469	< DL	< DL	32.90	< DL	< DL	5.00	< DL	< DL	< DL	< DL	2.20	< DL	< DL	< DL	18.70
RI-730	< DL	1.70	103.00	< DL	< DL	1.20	< DL	242	< DL	< DL	1.20	< DL	< DL	< DL	5.30
RI-RAYVIL	< DL	< DL	255.00	< DL	< DL	< DL	4.10	7480	1.40	< DL	< DL	< DL	< DL	< DL	7.30
SMN-33	< DL	3.40	550.00	< DL	< DL	< DL	< DL	1630	< DL	< DL	< DL	< DL	< DL	< DL	6.30
SMN-33*	<DL	3.50	539.00	<DL	<DL	<DL	<DL	1660	<DL	<DL	<DL	<DL	<DL	<DL	5.30
TS-61	< DL	< DL	712.00	< DL	< DL	< DL	< DL	9860	< DL	< DL	< DL	< DL	< DL	< DL	< DL
TS-FORTENB	< DL	**19.70**	490.00	< DL	< DL	< DL	9.80	11000	< DL	< DL	< DL	< DL	< DL	< DL	13.20
WC-527	< DL	1.60	458.00	< DL	< DL	< DL	< DL	4300	< DL	< DL	< DL	< DL	< DL	< DL	7.90
WC-91	< DL	7.50	175.00	< DL	< DL	< DL	1.80	705	< DL	< DL	< DL	< DL	< DL	< DL	< DL

*Duplicate Sample   Exceeds EPA Primary Standard   Exceeds EPA Secondary Standards

Table 8-4: FY 2020 Field and Conventional Statistics, ASSET Wells

	PARAMETER	MINIMUM	MAXIMUM	AVERAGE
FIELD	Temperature (°C)	12.38	25.76	19.27
	pH (SU)	6.50	7.92	7.16
	Specific Conductance (µmhos/cm)	0.22	1.75	0.87
	Salinity (ppth)	0.11	0.79	0.41
	TDS (g/L)	145.83	1017.38	536.29
LABORATORY	Alkalinity (mg/L)	55.50	434.00	271.71
	Chloride (mg/L)	9.50	270.00	70.49
	Color (PCU)	5.00	55.00	11.67
	Specific Conductance (µmhos/cm)	0.29	4.94	1.17
	Sulfate (mg/L)	<DL	151.00	20.29
	TDS (mg/L)	195.00	911.00	470.00
	TSS (mg/L)	4.00	32.00	12.41
	Turbidity (NTU)	0.82	190.00	54.76
	Hardness (mg/L)	80.00	680.00	349.44
	Nitrite - Nitrate, as N (mg/L)	<DL	7.40	0.99
	TKN (mg/L)	<DL	2.20	0.78
	Total Phosphorus (mg/L)	0.05	1.10	0.44

Table 8-5: FY 2020 Inorganic Statistics, ASSET Wells

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
Antimony (µg/L)	<DL	<DL	<DL
Arsenic (µg/L)	<DL	9.00	2.29
Barium (µg/L)	11.80	1878.00	323.15
Beryllium (µg/L)	<DL	<DL	<DL
Cadmium (µg/L)	<DL	<DL	<DL
Chromium (µg/L)	0.62	1.30	0.929
Copper (µg/L)	<DL	16.60	3.05
Iron (µg/L)	<DL	4030.00	1182.78
Lead (µg/L)	<DL	8.50	<DL
Mercury (µg/L)	<DL	<DL	<DL
Nickel (µg/L)	<DL	2.20	1.03
Selenium (µg/L)	<DL	<DL	<DL
Silver (µg/L)	<DL	<DL	<DL
Thallium (µg/L)	<DL	<DL	<DL
Zinc (µg/L)	3.70	28.80	9.27

Table 8-6: 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 2020
FIELD	pH (SU)	6.70	6.63	6.91	6.98	7.22	7.35	7.22	7.03	7.16
	Salinity (ppt)	0.35	0.39	0.41	0.40	0.44	0.40	0.40	0.39	0.41
	Specific Conductance (mmhos/cm)	0.760	0.790	0.810	0.800	0.890	0.811	0.816	0.786	0.87
	Temperature (^{O}C)	19.09	20.60	20.13	19.62	20.40	19.13	18.76	11.40	19.27
	Total Dissolved Solids (g/L)	-	-	-	0.520	0.580	0.530	0.530	0.511	0.536
LABORATORY	Alkalinity (mg/L)	306	328	316	347	336	240	312	355	271.71
	Chloride (mg/L)	68.2	55.2	44.8	48.6	75.2	54.9	63.0	51.8	70.50
	Color (PCU)	26	16	48	38	17	5	16	9	11.7
	Hardness (mg/L)	300	310	304	298	341	294	286	334	349
	Nitrite - Nitrate, as N (mg/L)	0.31	0.29	0.72	0.19	0.29	0.21	0.29	0.54	0.99
	Ammonia, as N (mg/L)	1.26	1.00	0.95	1.10	0.85	0.85	0.98	0.76	
	Total Phosphorus (mg/L)	0.49	0.54	0.54	0.59	0.48	0.57	0.66	0.57	0.44
	Specific Conductance (µmhos/cm)	769	804	770	766	872	709	818	741	1170
	Sulfate (mg/L)	7.7	25.2	24.8	22.5	30.9	17.0	20.3	16.8	20.29
	Total Dissolved Solids (mg/L)	674	495	482	489	521	577	577	472	470
	Total Kjeldahl Nitrogen (mg/L)	1.34	1.43	1.27	1.36	0.99	1.24	1.41	1.04	0.78
	Total Suspended Solids (mg/L)	19	15	12	16	14	12	13	16	12.41
	Turbidity (NTU)	6.7	6.6	6.9	7.0	7.2	7.4	7.2	58.2	54.76

Table 8-7: 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	FY2020
Antimony (µg/L)	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL	<DL
Arsenic (µg/L)	12.7	14.6	9.2	14.3	9.5	10.5	5.7	6.0	2.29
Barium (µg/L)	474	412	404	524	404	403	457	453	323.15
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	< DL	< DL	0.929
Copper (µg/L)	9.9	8.6	6.2	< DL	< DL	< DL	2.2	2.5	3.05
Iron (µg/L)	5022	4690	6008	8726	5985	5045	6143	6679	1182.78
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)	< DL	< DL	< DL	< DL	< DL	5.1	1.9	< DL	1.03
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)	43.5	177.2	48.3	29.6	28.0	61.8	40.0	13.4	9.27

Table 8-8: 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 8-9: 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 8-10: 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 8-1: Location Plat, Mississippi River Alluvial Aquifer

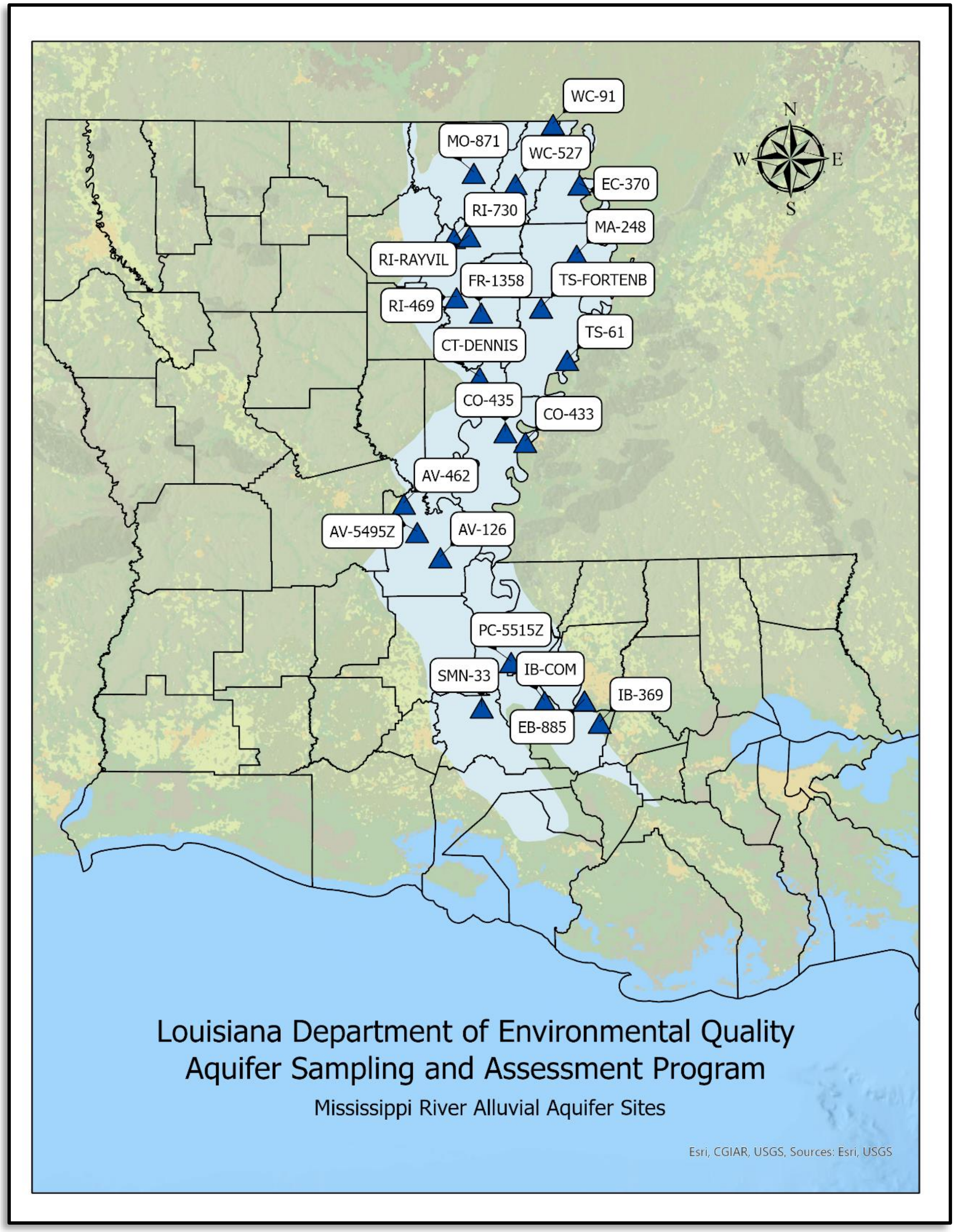


Figure 8-2: Piper Diagram

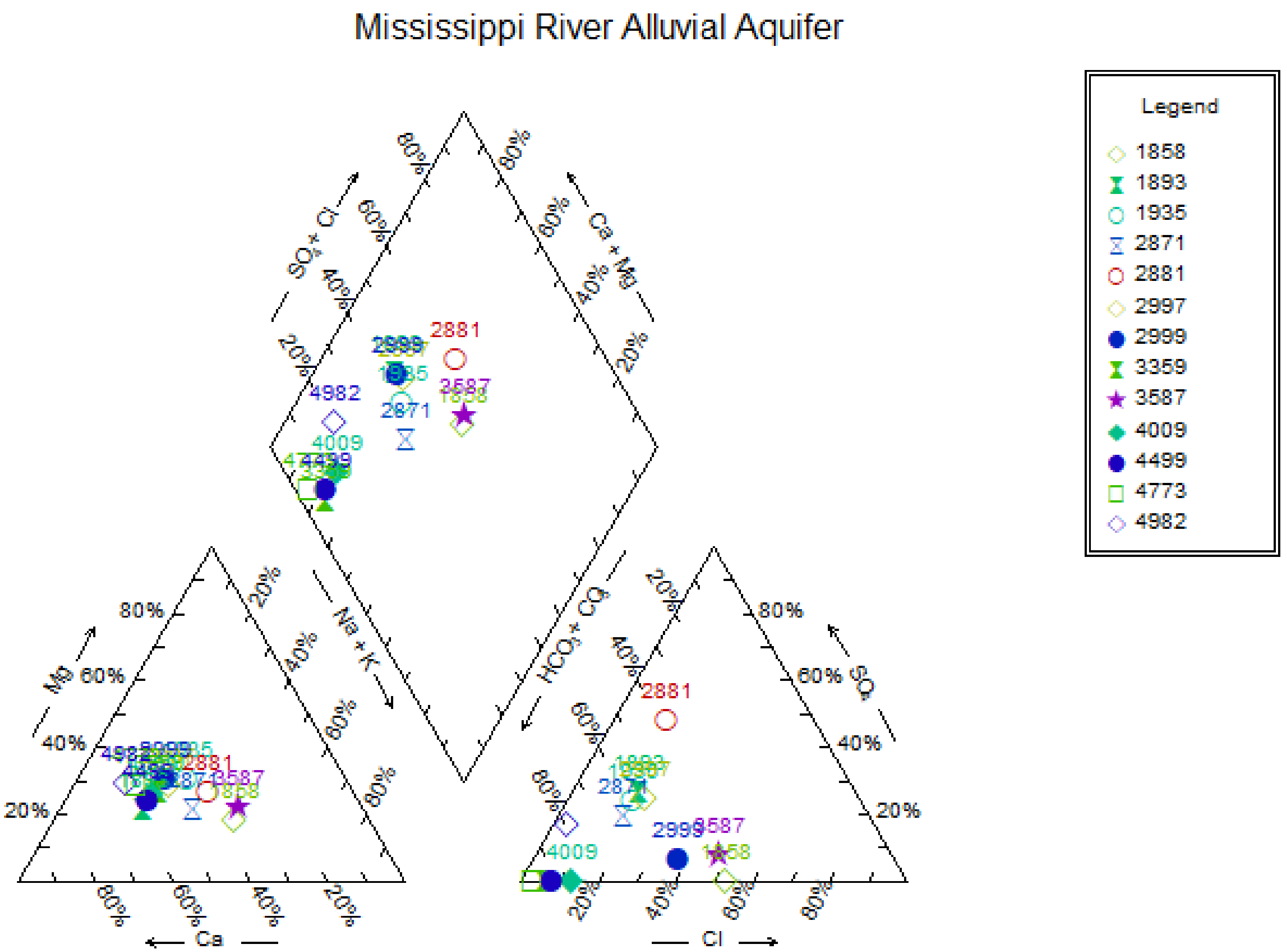


Chart 8-1: Temperature Trend

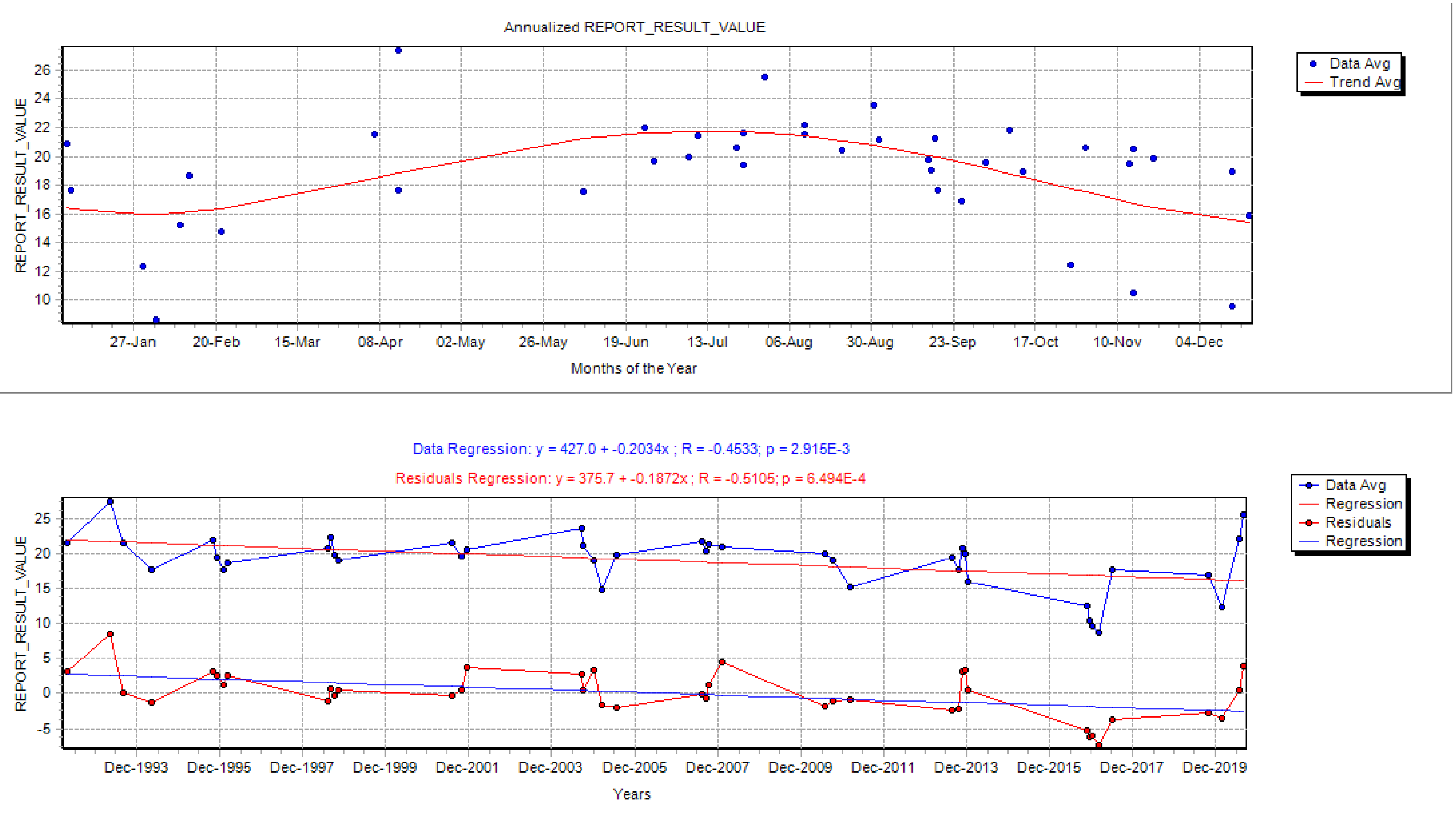
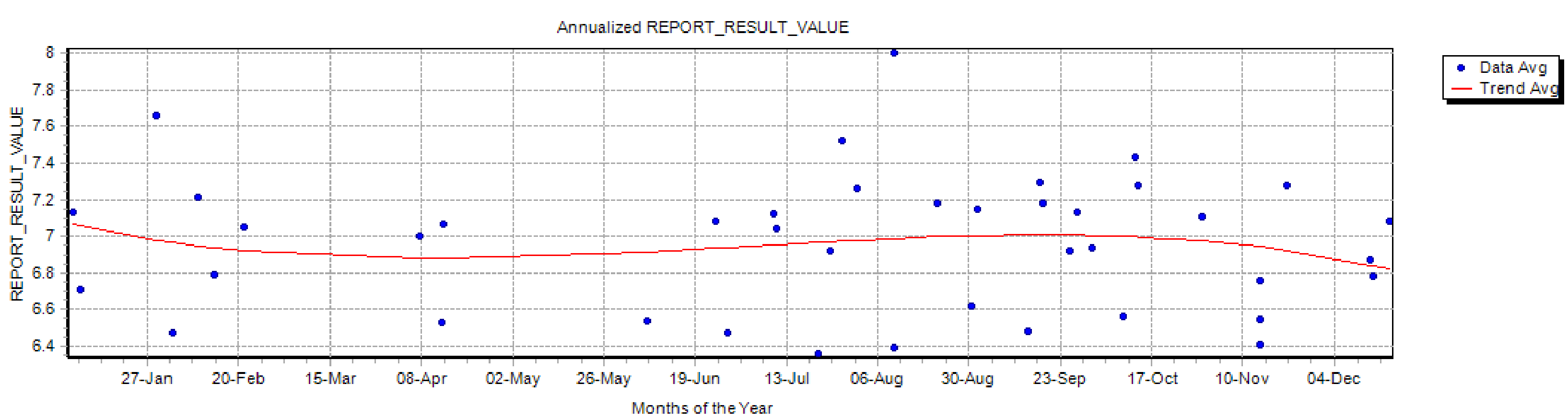


Chart 8-2: pH Trend



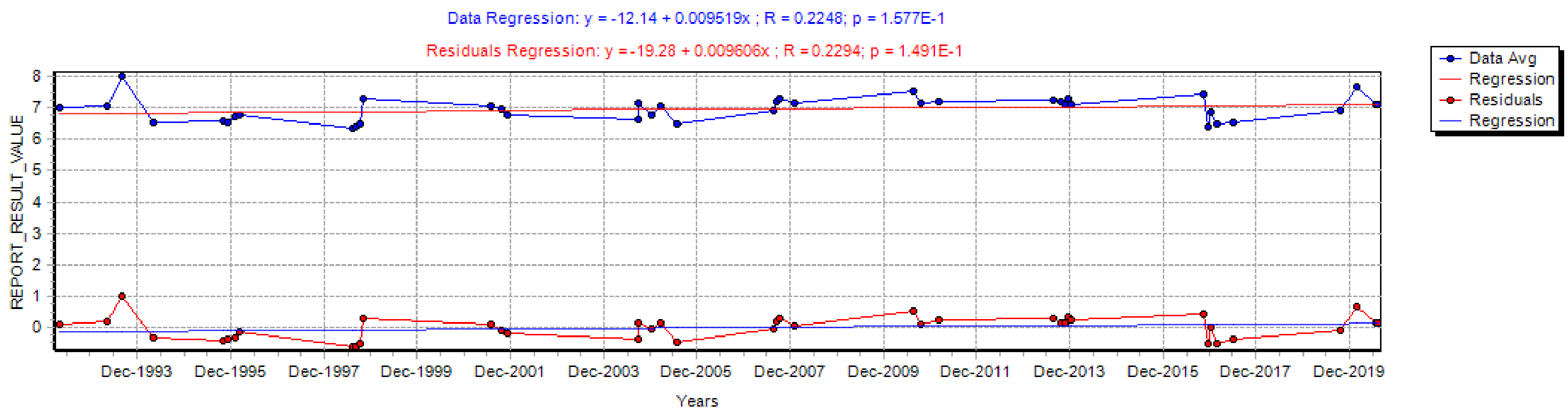
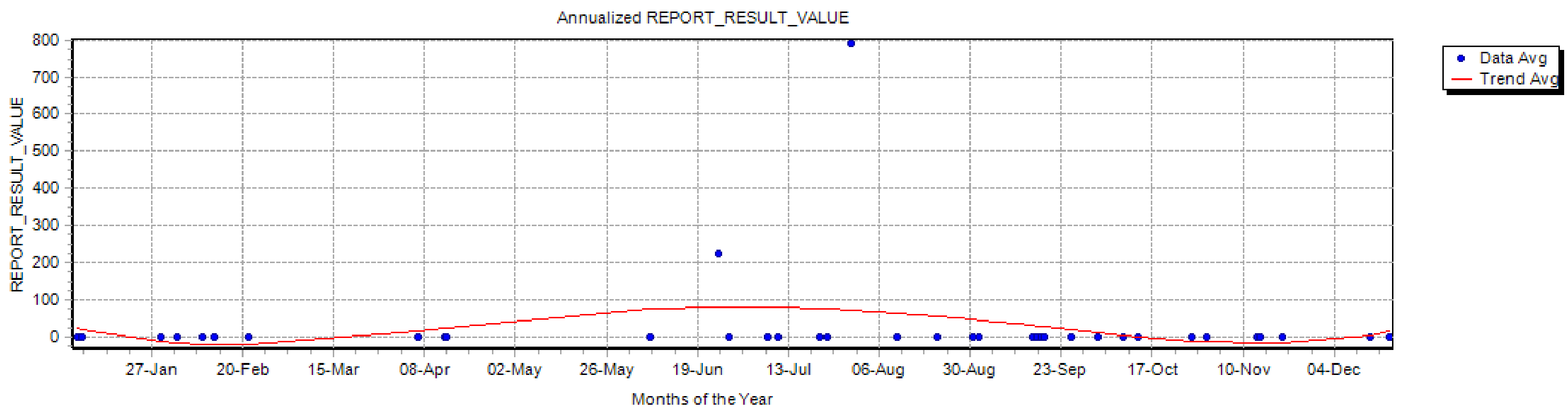


Chart 8-3: Field Specific Conductance Trend



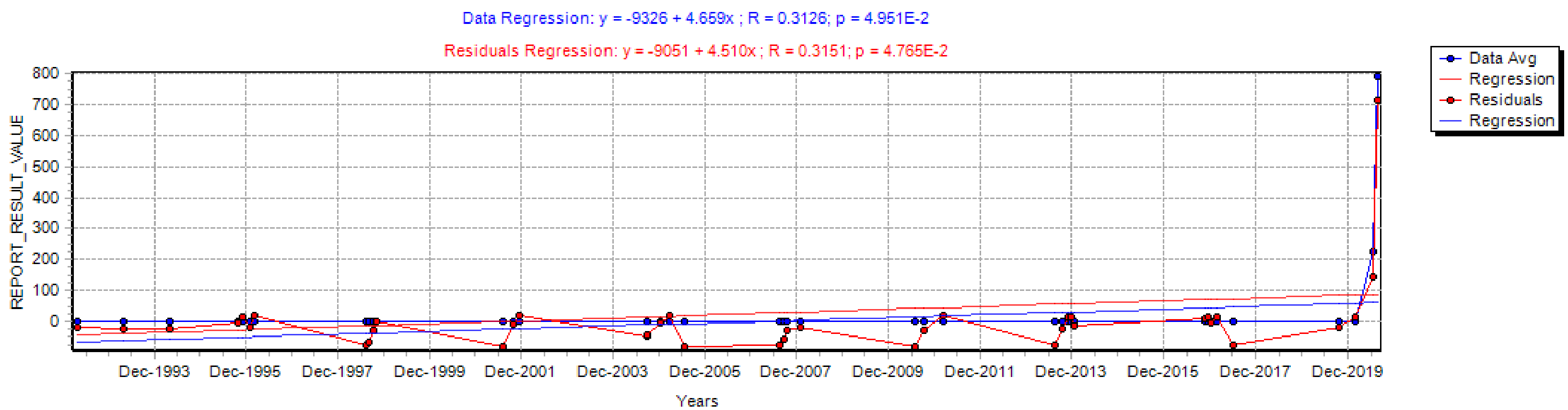
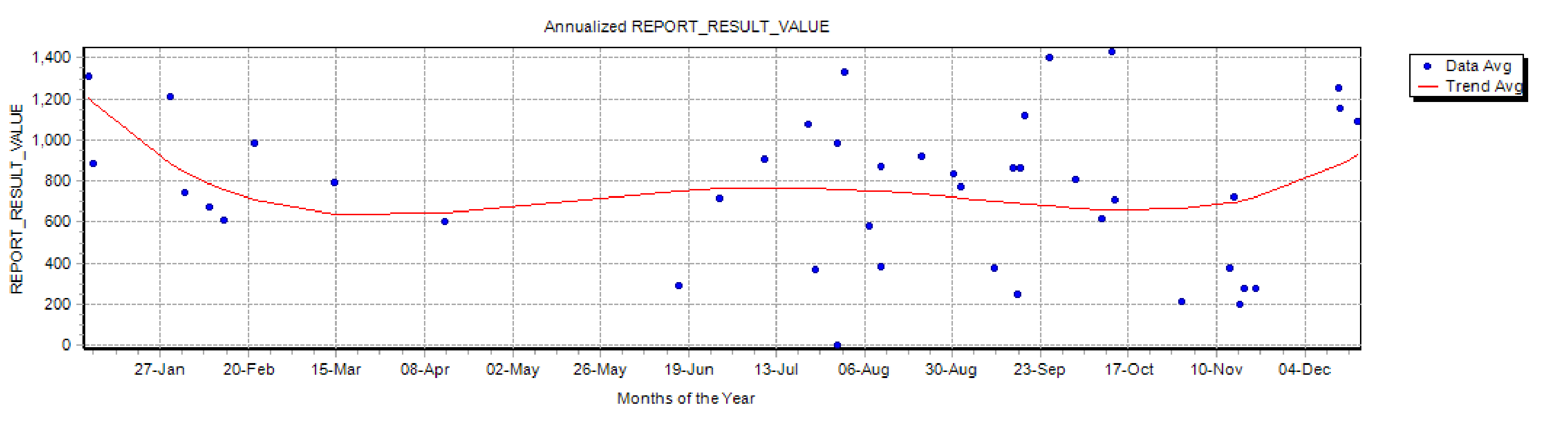


Chart 8-4: Lab Specific Conductance Trend



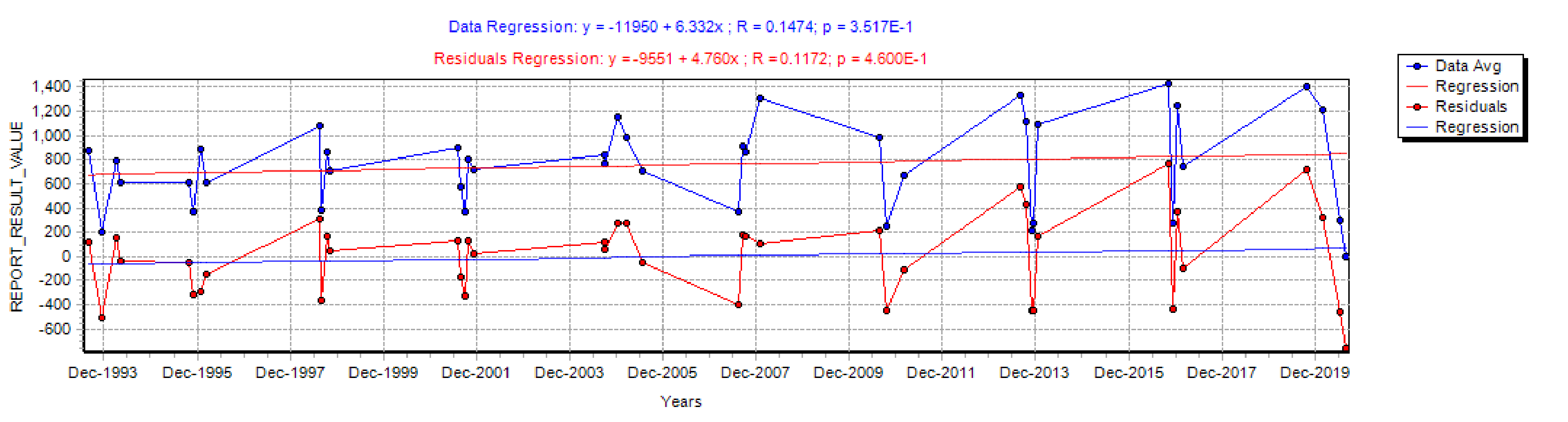


Chart 8-5: Field Salinity Trend

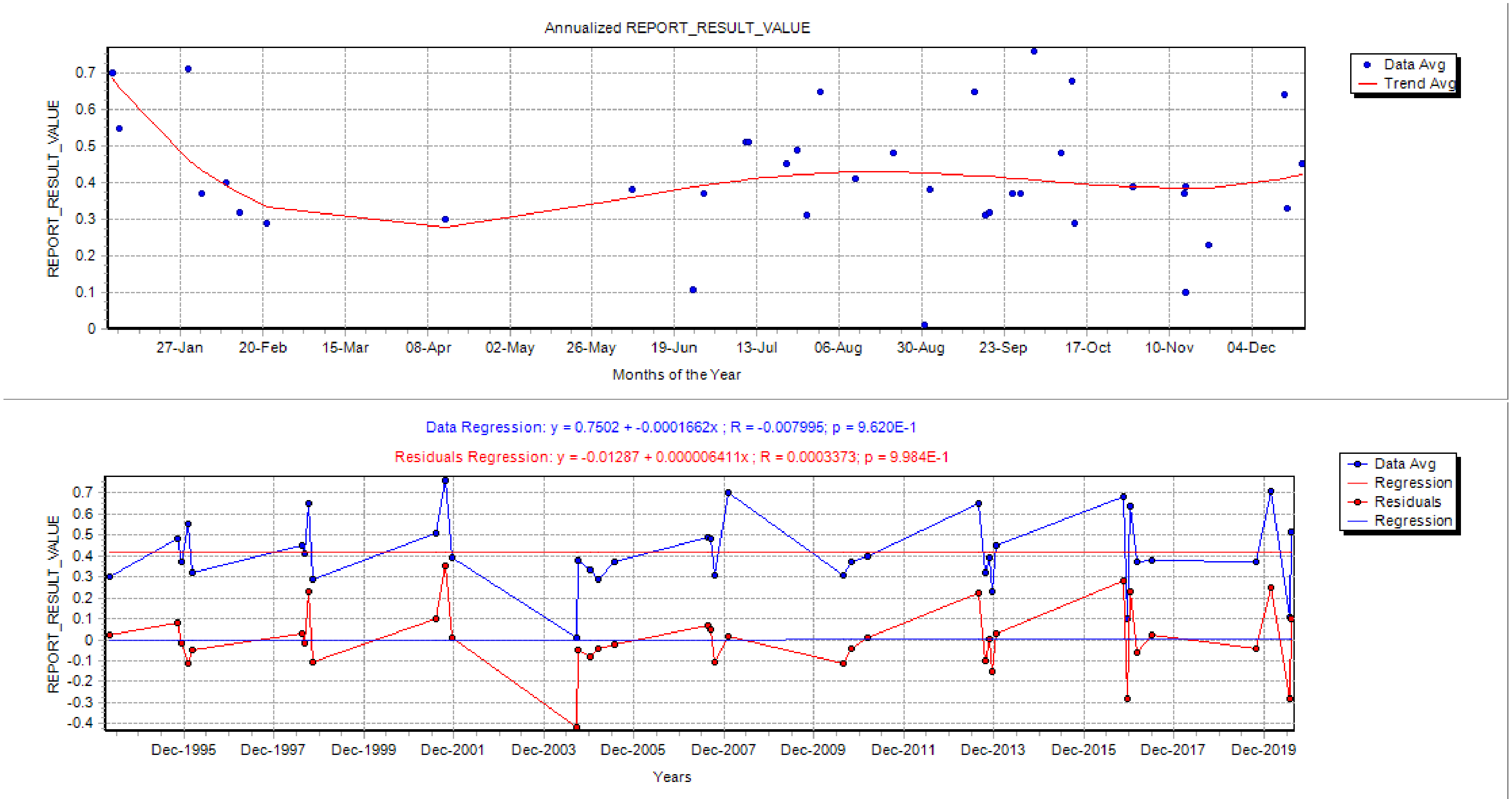
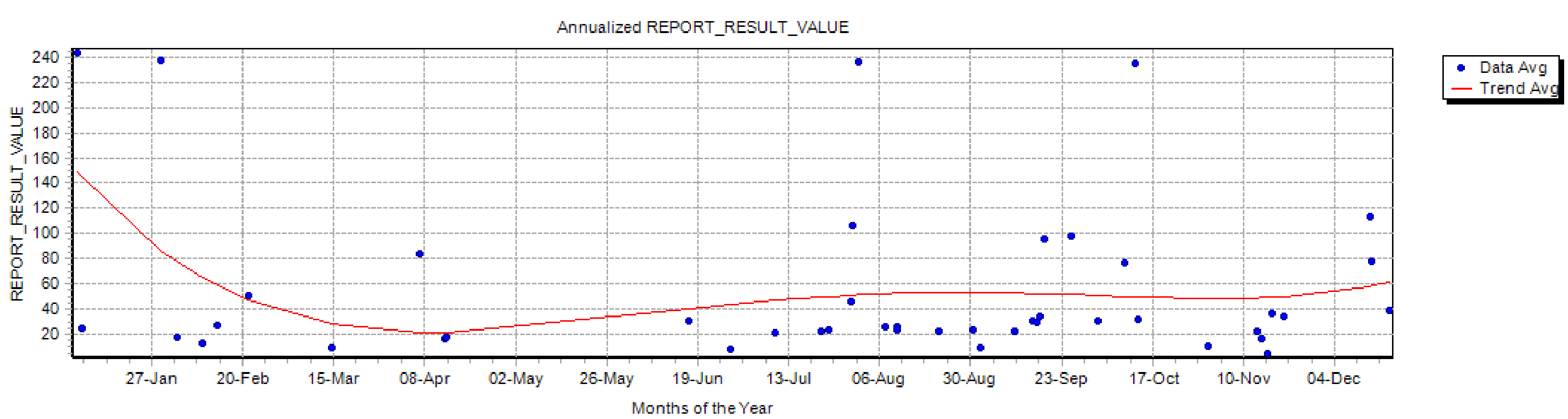


Chart 8-6: Chloride Trend



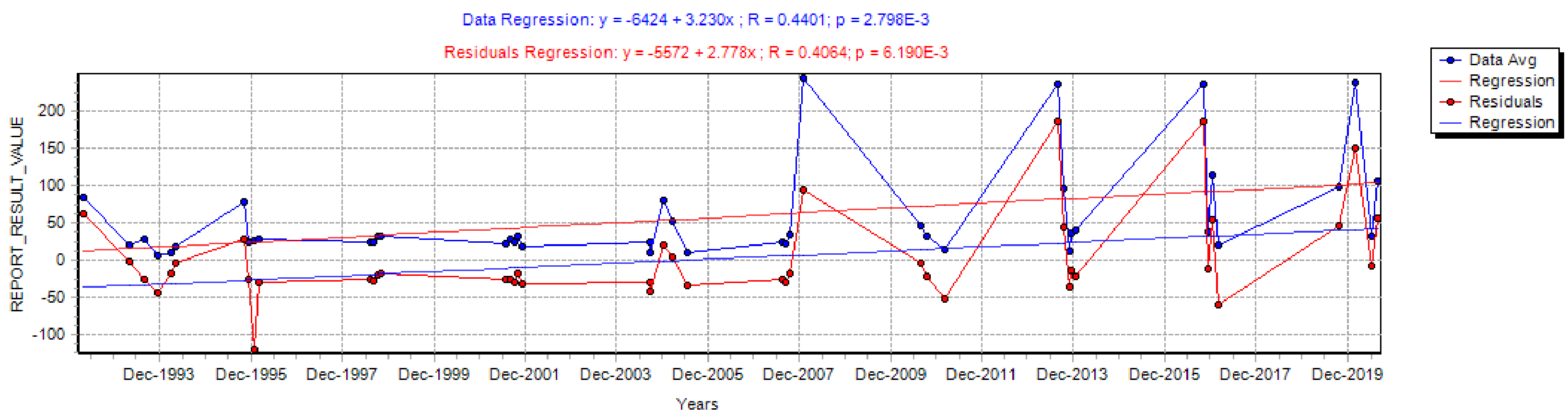
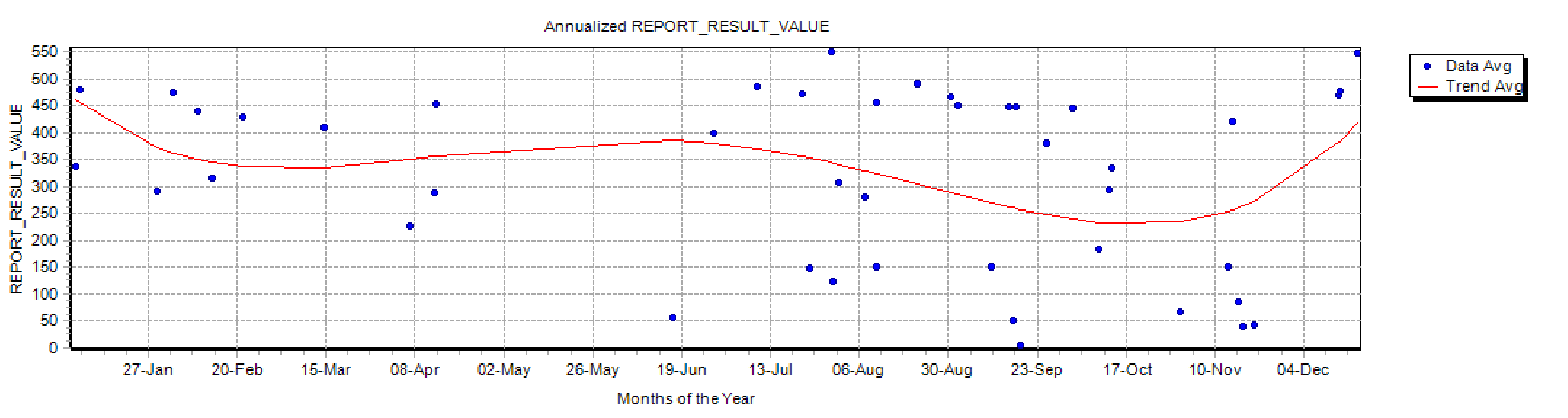


Chart 8-7: Alkalinity Trend



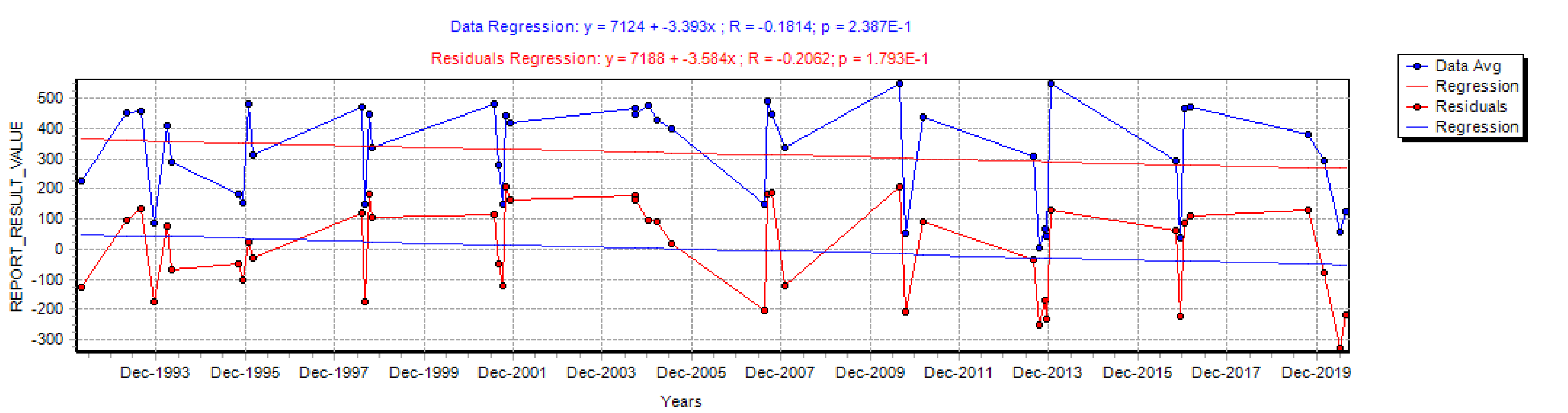
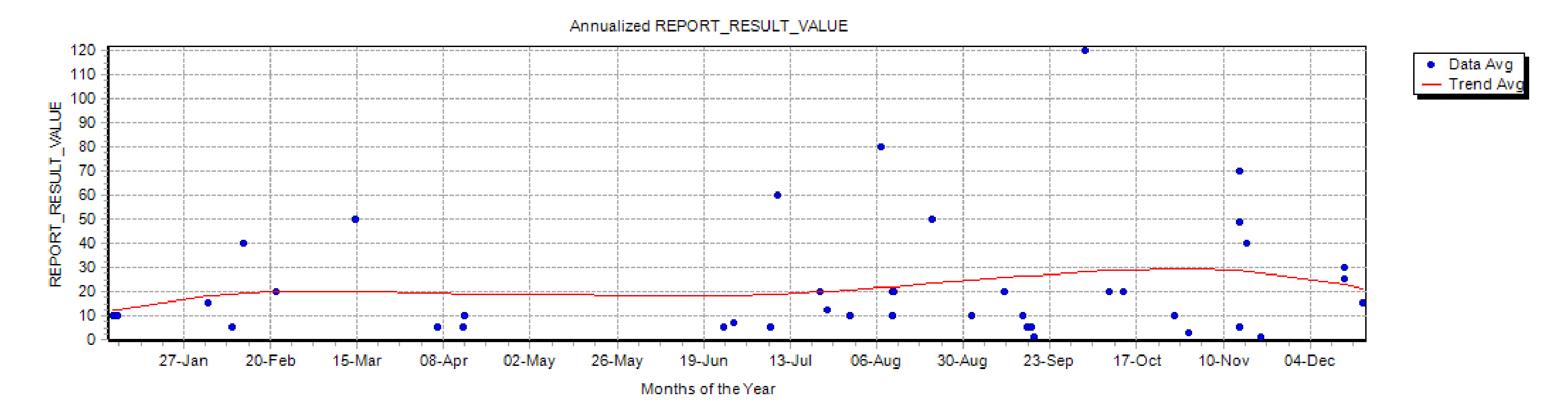


Chart 8-8: Color Trend



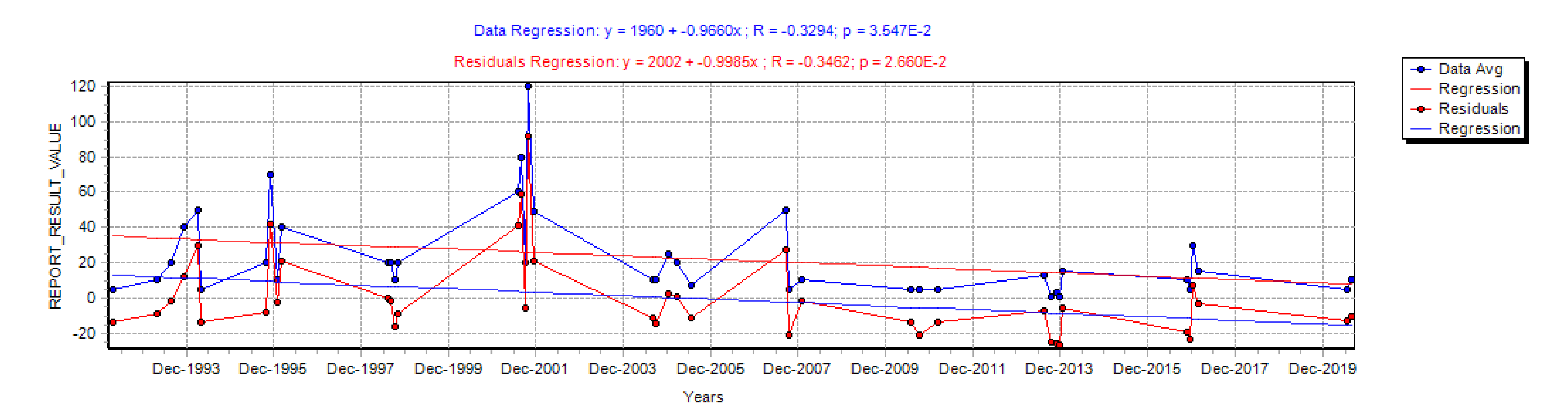
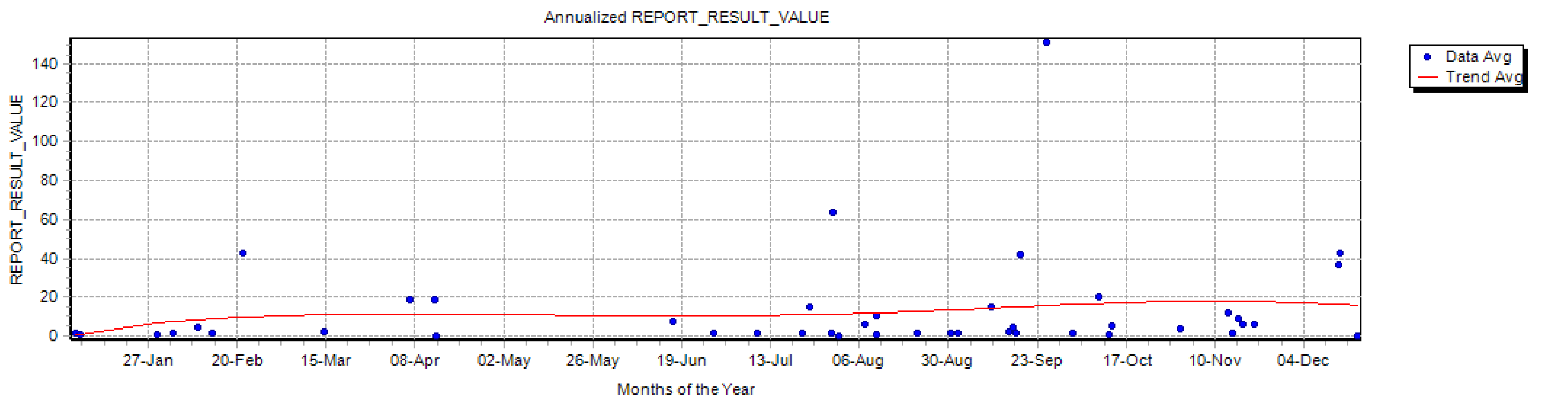


Chart 8-9: Sulfate Trend



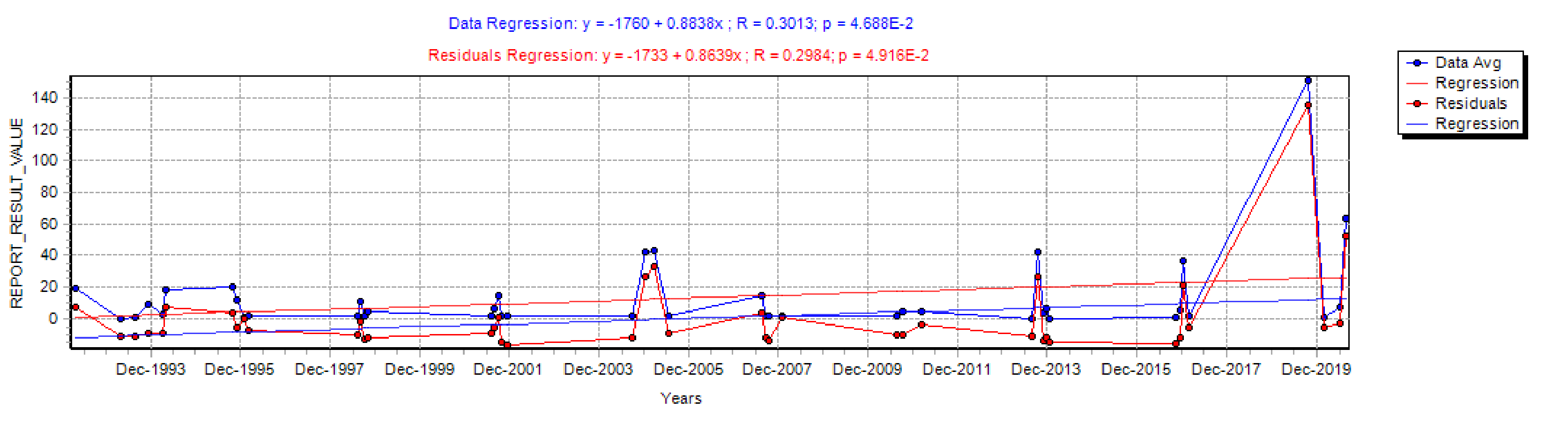
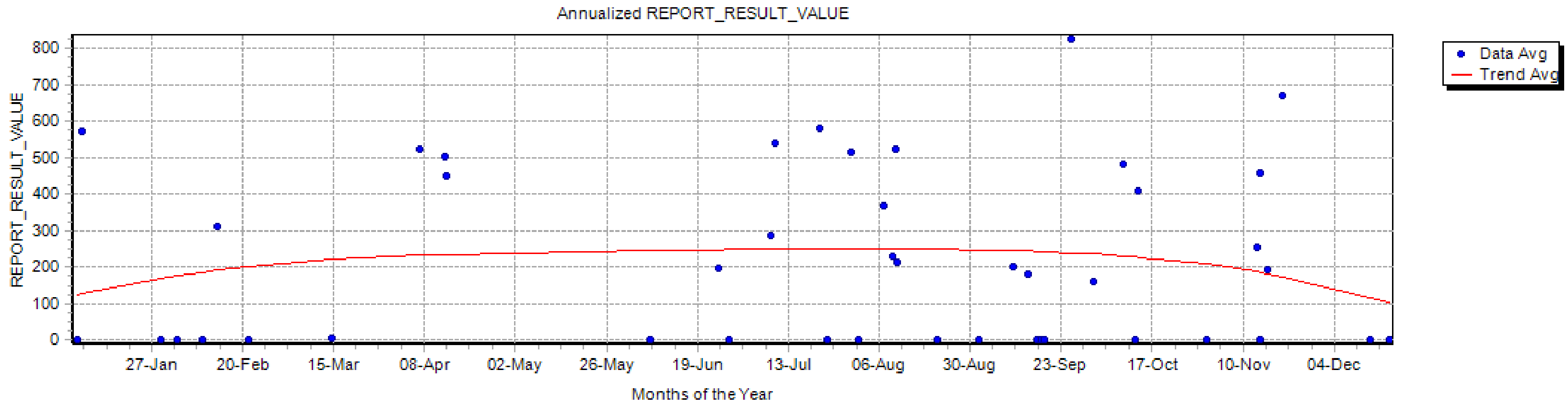


Chart 8-10: Total Dissolved SolidsTrend



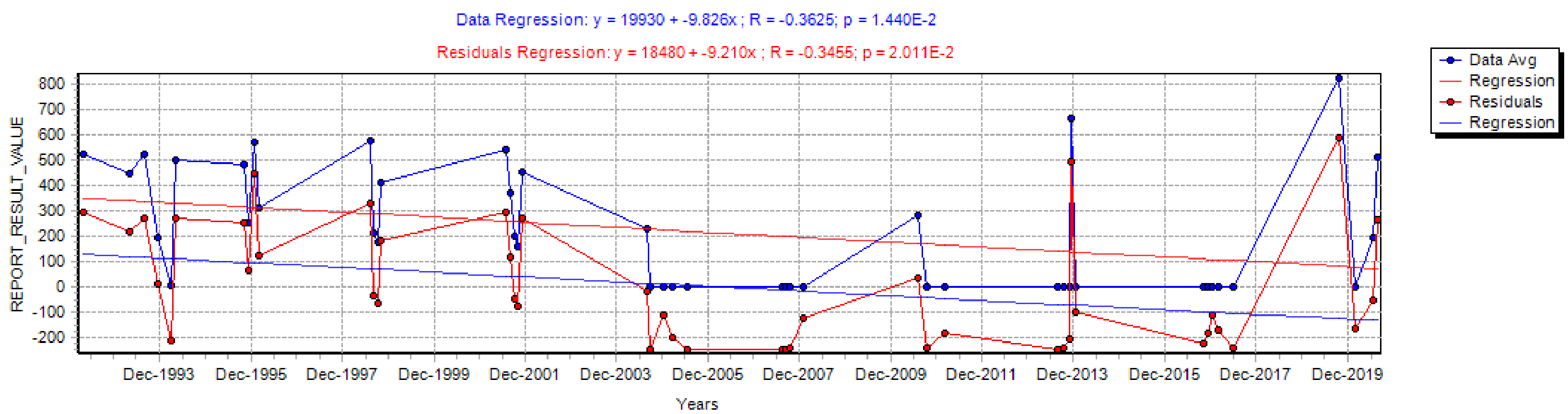
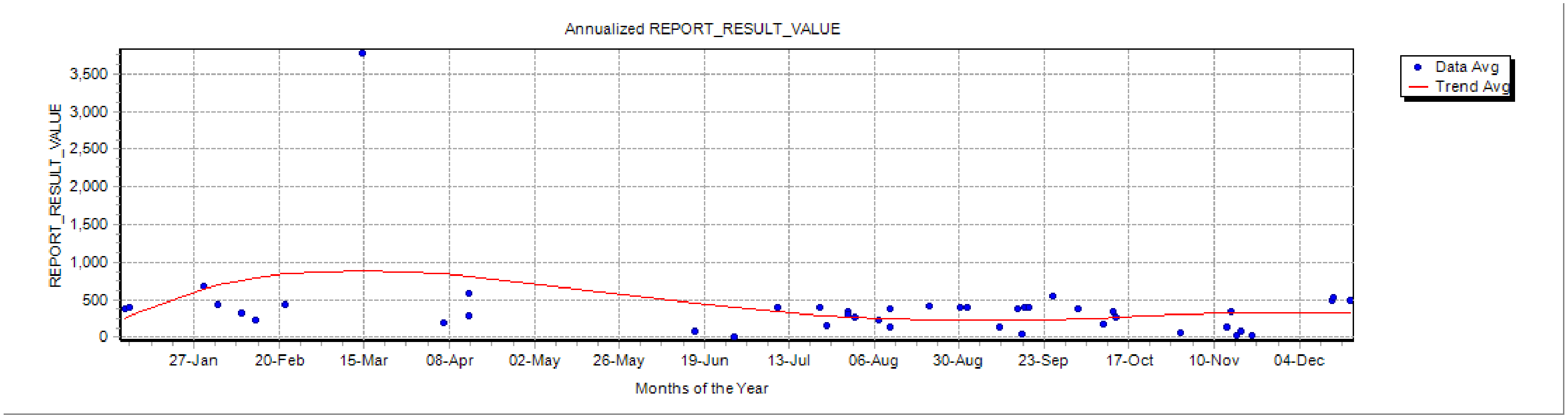


Chart 8-11: Hardness Trend



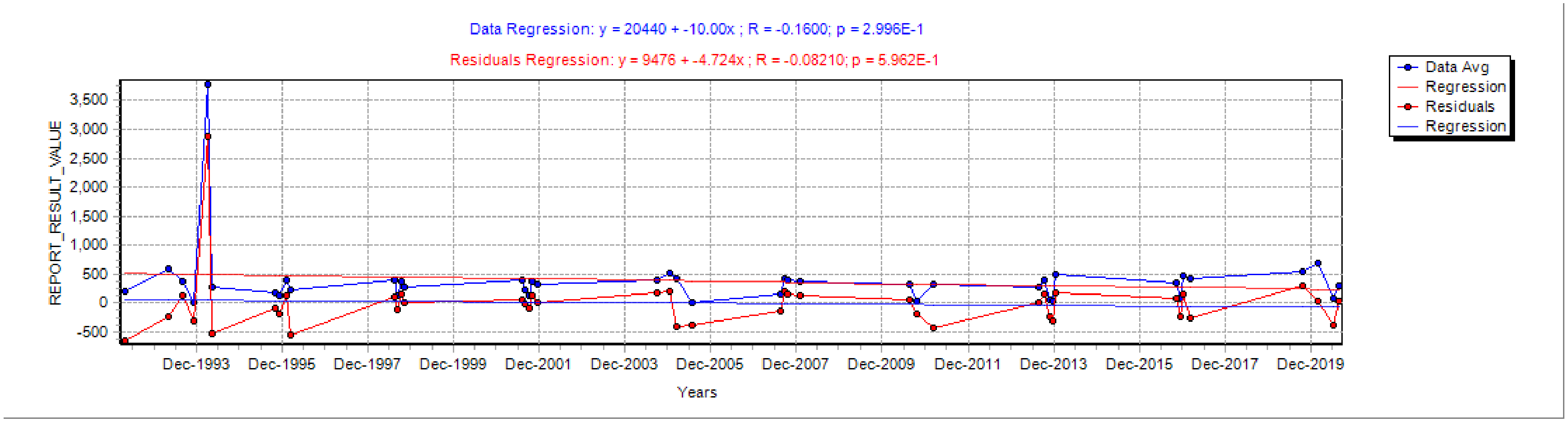
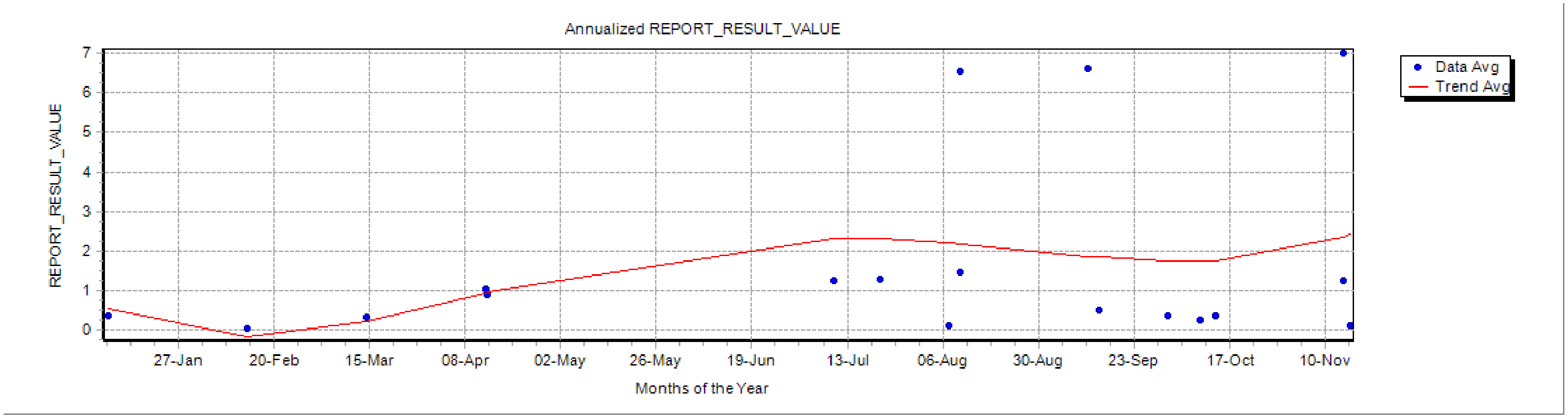


Chart 8-12: Ammonia Trend



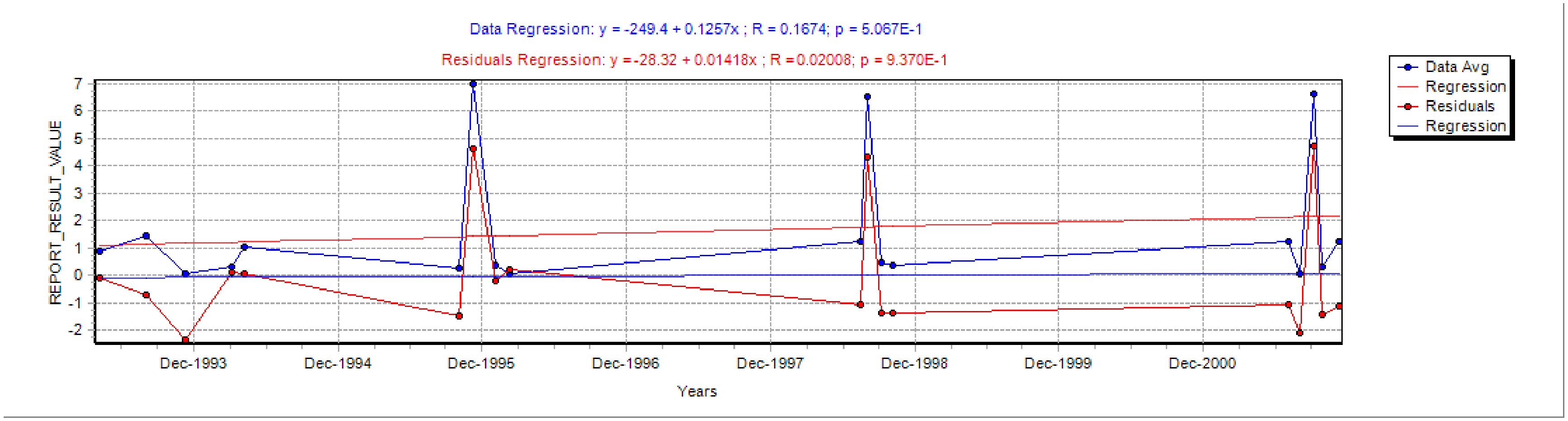
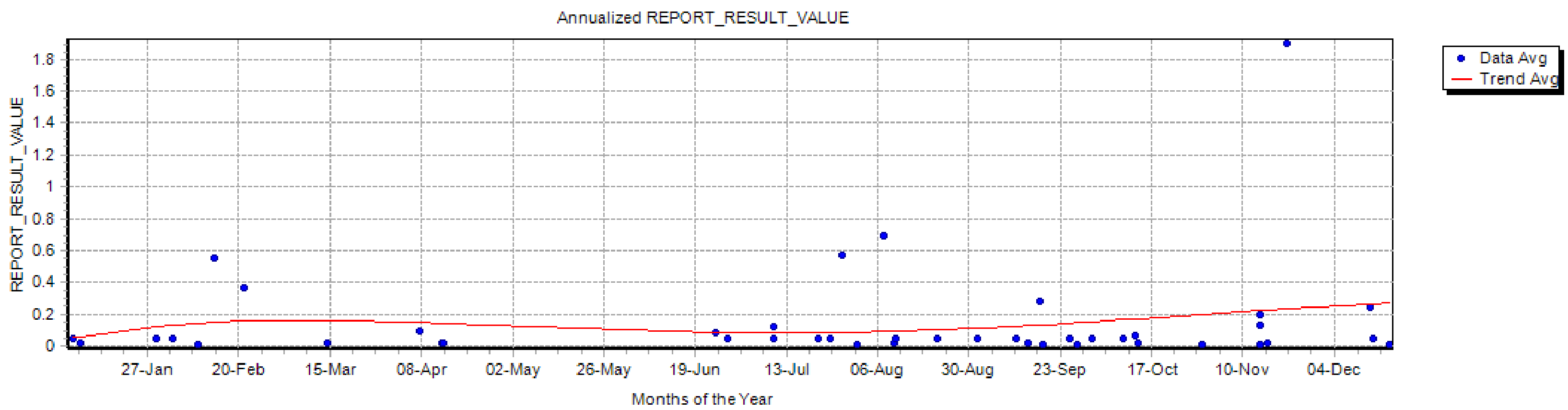


Chart 8-13: Nitrate-Nitrite Trend



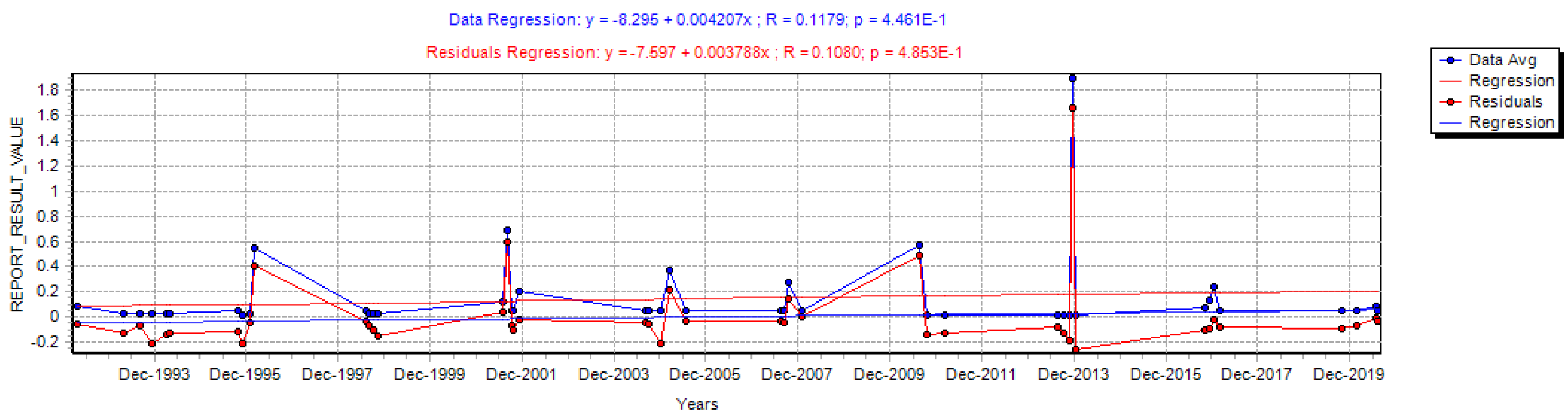
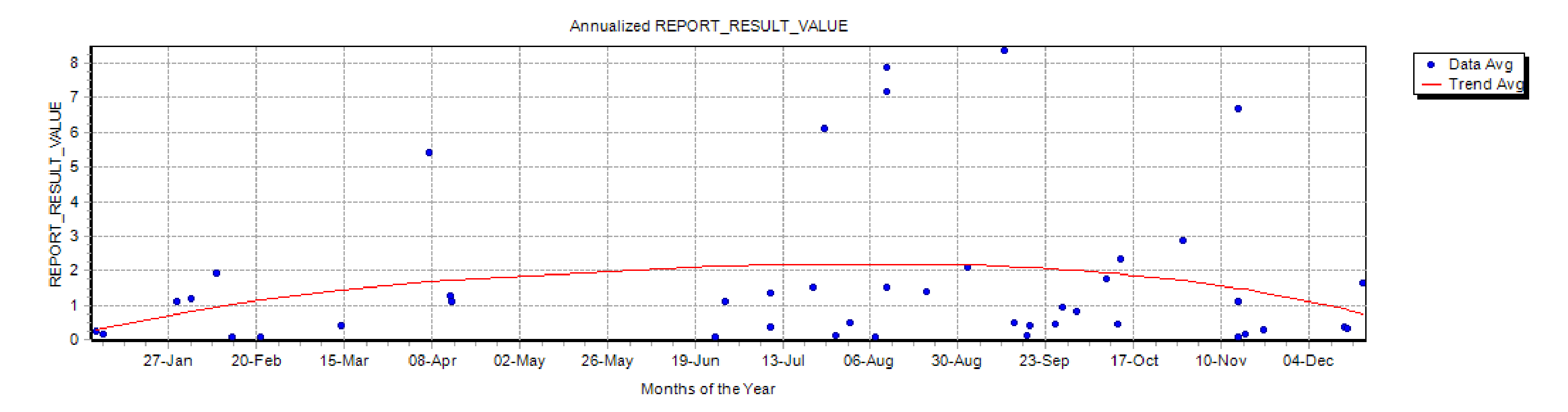


Chart 8-14: Total Kjedahl Nitrogen Trend



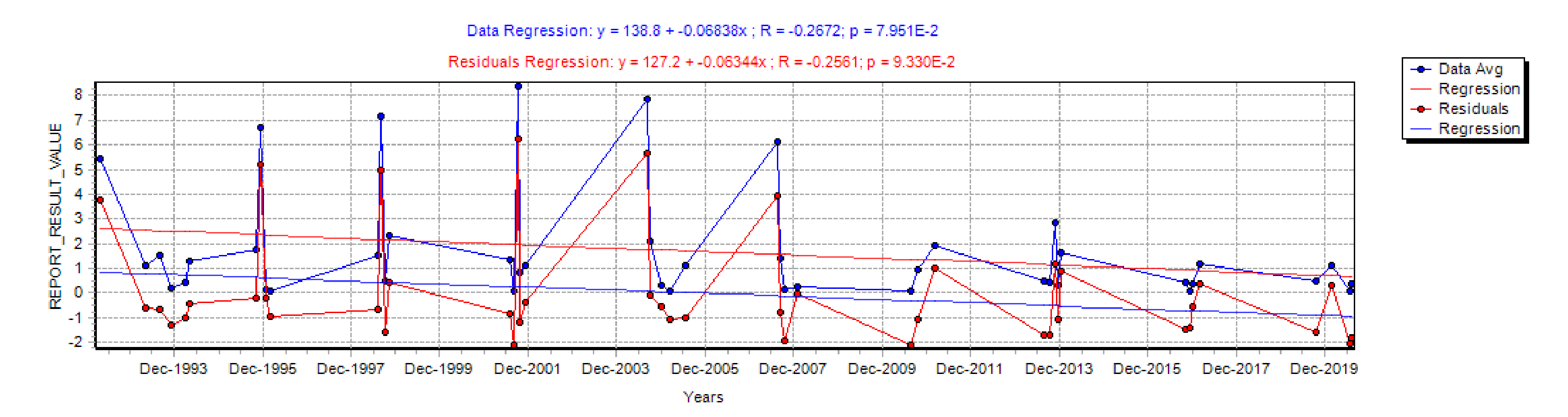
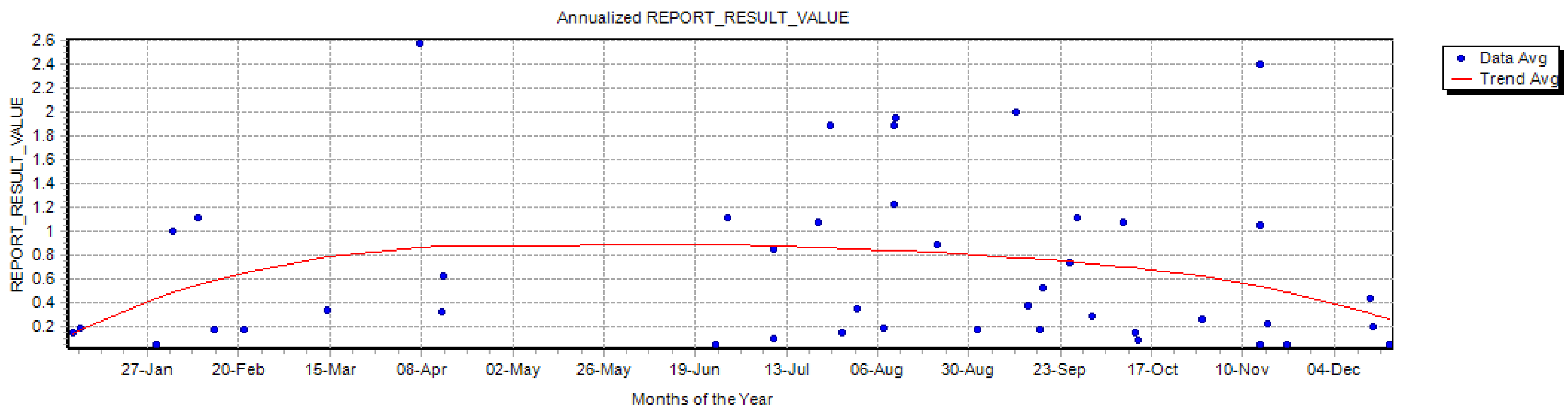


Chart 8-15: Total Phosphorous Trend



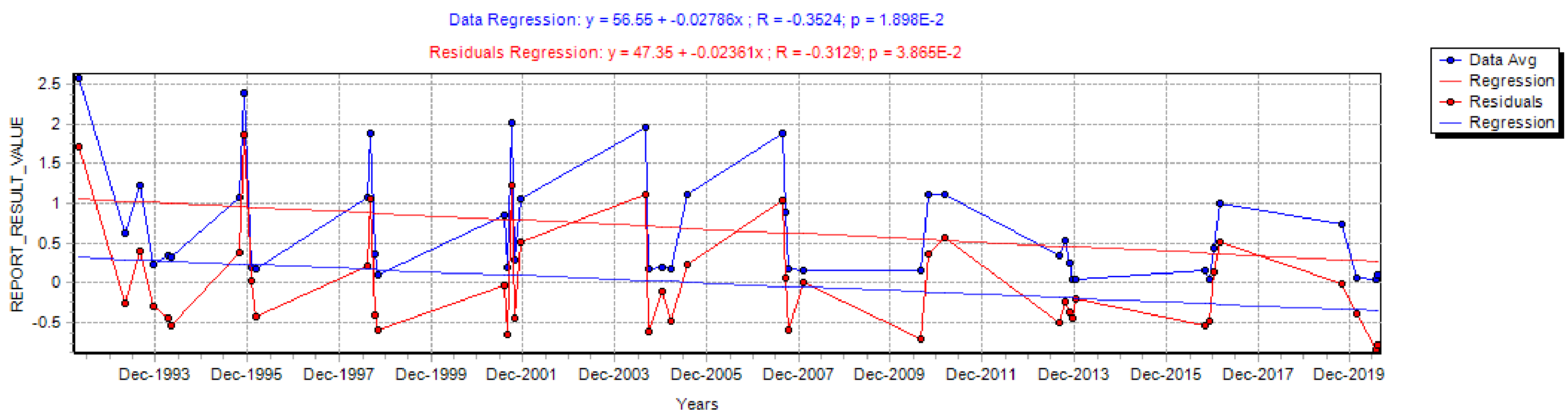
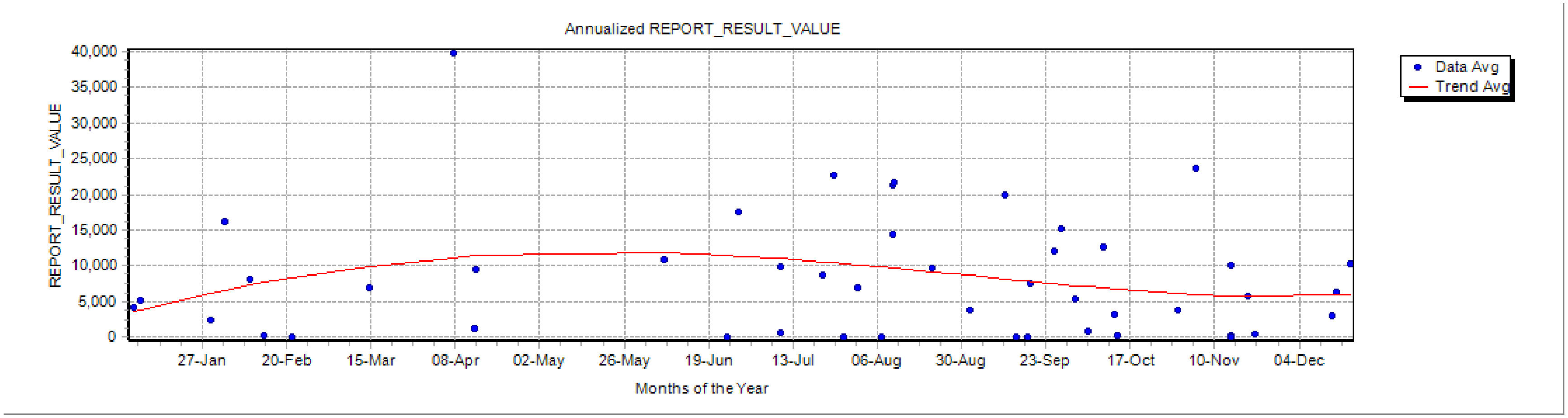


Chart 8-16: Iron Trend



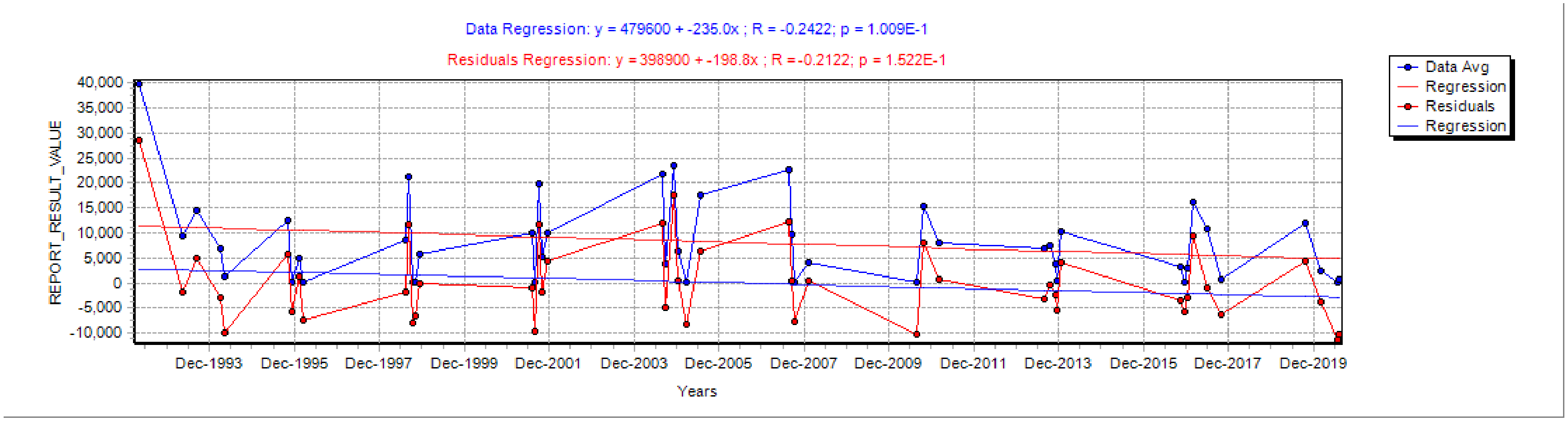
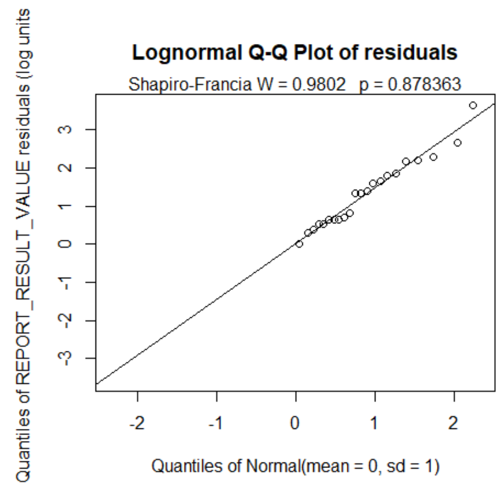


Figure 8-3: Historical Arsenic Trend and Statistics

Descriptive Statistics	Value
Distribution	Log Normal
Sample Size	49
Multiple Censoring Levels	Yes
Method Used	MLE
Percent Censored	55.10%
Mean	16.98
LCL	9.90
UCL	27.71



	Value	P-Value
Intercept	135.98	0.035
DECTIME	-0.0672	0.037