Appendixes 1 One-way ANOVA values for physic-chemical parameters

ANOVA

		Sum of squares	df	Mean square	F	Sig.
pH	Between Groups	7.852	2	3.926	16.288	0.004
	Within Groups	1.446	6	0.241		
	Total	9.298	8			
Temp	Between Groups	38.389	2	19.194	5.315	0.047
	Within Groups	21.667	6	3.611		
	Total	60.056	8			
EC	Between Groups	3598176.602	2	1799088.301	14924.138	0
	Within Groups	723.293	6	120.549		
	Total	3598899.896	8			
Turb	Between Groups	1018568	2	509284	18188.714	0
	Within Groups	168	6	28		
	Total	1018736	8			
TDS	Between Groups	8269754.893	2	4134877.447	73505.143	0
	Within Groups	337.517	6	56.253		
	Total	8270092.411	8			
Color	Between Groups	429.556	2	214.778	31.177	0.001
	Within Groups	41.333	6	6.889		
	Total	470.889	8			
Salin	Between Groups	8910273.469	2	4455136.734	104170.405	0
	Within Groups	256.607	6	42.768		
	Total	8910530.076	8			
Nitrite	Between Groups	0.465	2	0.233	13.092	0.006
	Within Groups	0.107	6	0.018		
	Total	0.572	8			
Nitrate	Between Groups	148137.487	2	74068.743	3002.922	0
	Within Groups	147.993	6	24.666		
	Total	148285.48	8			

Sulphate	Between Groups	11327.442	2	5663.721	244.7	0
	Within Groups	138.873	6	23.146		
	Total	11466.316	8			
Phosphate	Between Groups	31142.389	2	15571.194	276.657	0
	Within Groups	337.7	6	56.283		
	Total	31480.089	8			
Ammonia	Between Groups	147.886	2	73.943	30.726	0.001
	Within Groups	14.439	6	2.407		
	Total	162.325	8			

Appendix 2 Correlation between physic-chemical parameters among the selected sites of the river

		pH	**Temp**	**EC**	**Turb**	**TDS**	**Color**	**Salin**	**Nitrite**	**Nitrate**	**Sulphate**	**Phosphate**	**Ammonia**
pH	Pearson Correlation	1	.845**	.870**	.867**	.904**	.939**	.903**	.796*	.924**	.906**	.699*	.809**
	Sig. (2-tailed)		0.004	0.002	0.002	0.001	0	0.001	0.01	0	0.001	0.036	0.008
	N	9	9	9	9	9	9	9	9	9	9	9	9
Temp	Pearson Correlation	.845**	1	.679*	.794*	.734*	.736*	.734*	0.618	.803**	.820**	0.468	0.648
	Sig. (2-tailed)	0.004		0.044	0.011	0.024	0.024	0.024	0.076	0.009	0.007	0.204	0.059
	N	9	9	9	9	9	9	9	9	9	9	9	9
EC	Pearson Correlation	.870**	.679*	1	.767*	.989**	.948**	.989**	.818**	.896**	.777*	.915**	.701*
	Sig. (2-tailed)	0.002	0.044		0.016	0	0	0	0.007	0.001	0.014	0.001	0.035
	N	9	9	9	9	9	9	9	9	9	9	9	9
Turb	Pearson Correlation	.867**	.794*	.767*	1	.854**	.816**	.855**	.872**	.972**	.995**	0.451	.955**
	Sig. (2-tailed)	0.002	0.011	0.016		0.003	0.007	0.003	0.002	0	0	0.224	0
	N	9	9	9	9	9	9	9	9	9	9	9	9
TDS	Pearson Correlation	.904**	.734*	.989**	.854**	1	.956**	1.000**	.866**	.952**	.861**	.846**	.789*
	Sig. (2-tailed)	0.001	0.024	0	0.003		0	0	0.003	0	0.003	0.004	0.011
	N	9	9	9	9	9	9	9	9	9	9	9	9
Color	Pearson Correlation	.939**	.736*	.948**	.816**	.956**	1	.956**	.883**	.914**	.842**	.840**	.768*
	Sig. (2-tailed)	0	0.024	0	0.007	0		0	0.002	0.001	0.004	0.005	0.016
	N	9	9	9	9	9	9	9	9	9	9	9	9

Salin	Pearson Correlation	.903**	.734*	.989**	.855**	1.000**	.956**	1	.865**	.952**	.861**	.845**	.790*
	Sig. (2-tailed)	0.001	0.024	0	0.003	0	0		0.003	0	0.003	0.004	0.011
	N	9	9	9	9	9	9	9	9	9	9	9	9
Nitrite	Pearson Correlation	.796*	0.618	.818**	.872**	.866**	.883**	.865**	1	.901**	.866**	0.619	.878**
	Sig. (2-tailed)	0.01	0.076	0.007	0.002	0.003	0.002	0.003		0.001	0.003	0.075	0.002
	N	9	9	9	9	9	9	9	9	9	9	9	9
Nitrate	Pearson Correlation	.924**	.803**	.896**	.972**	.952**	.914**	.952**	.901**	1	.974**	0.647	.916**
	Sig. (2-tailed)	0	0.009	0.001	0	0	0.001	0	0.001		0	0.06	0.001
	N	9	9	9	9	9	9	9	9	9	9	9	9
Sulphate	Pearson Correlation	.906**	.820**	.777*	.995**	.861**	.842**	.861**	.866**	.974**	1	0.475	.950**
	Sig. (2-tailed)	0.001	0.007	0.014	0	0.003	0.004	0.003	0.003	0		0.196	0
	N	9	9	9	9	9	9	9	9	9	9	9	9
Phosphate	Pearson Correlation	.699*	0.468	.915**	0.451	.846**	.840**	.845**	0.619	0.647	0.475	1	0.396
	Sig. (2-tailed)	0.036	0.204	0.001	0.224	0.004	0.005	0.004	0.075	0.06	0.196		0.292
	N	9	9	9	9	9	9	9	9	9	9	9	9
Ammonia	Pearson Correlation	.809**	0.648	.701*	.955**	.789*	.768*	.790*	.878**	.916**	.950**	0.396	1
	Sig. (2-tailed)	0.008	0.059	0.035	0	0.011	0.016	0.011	0.002	0.001	0	0.292	
	N	9	9	9	9	9	9	9	9	9	9	9	9

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 3 Post Hoc Tests for physico-chemical parameters

Multiple comparisons

Tukey HSD

Dependent variable	**(I) Site**	**(J) Site**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% confidence interval**	
						Lower Bound	**Upper Bound**
pH	A	B	-2.283333*	0.400851	0.003	-3.51325	-1.05341
		C	-1.266667*	0.400851	0.045	-2.49659	-0.03675
	B	A	2.283333*	0.400851	0.003	1.05341	3.51325
		C	1.016667	0.400851	0.097	-0.21325	2.24659

	C	A	1.266667*	0.400851	0.045	0.03675	2.49659
		B	-1.016667	0.400851	0.097	-2.24659	0.21325
Temp	A	B	-5.000000*	1.551582	0.041	-9.76068	-0.23932
		C	-1.833333	1.551582	0.505	-6.59401	2.92735
	B	A	5.000000*	1.551582	0.041	0.23932	9.76068
		C	3.166667	1.551582	0.183	-1.59401	7.92735
	C	A	1.833333	1.551582	0.505	-2.92735	6.59401
		B	-3.166667	1.551582	0.183	-7.92735	1.59401
EC	A	B	-1421.133333*	8.964704	0	-1448.63951	-1393.62716
		C	-1243.833333*	8.964704	0	-1271.33951	-1216.32716
	B	A	1421.133333*	8.964704	0	1393.62716	1448.63951
		C	177.300000*	8.964704	0	149.79382	204.80618
	C	A	1243.833333*	8.964704	0	1216.32716	1271.33951
		B	-177.300000*	8.964704	0	-204.80618	-149.79382
Turb	A	B	-790.000000*	4.320494	0	-803.25646	-776.74354
		C	-192.000000*	4.320494	0	-205.25646	-178.74354
	B	A	790.000000*	4.320494	0	776.74354	803.25646
		C	598.000000*	4.320494	0	584.74354	611.25646
	C	A	192.000000*	4.320494	0	178.74354	205.25646
		B	-598.000000*	4.320494	0	-611.25646	-584.74354
TDS	A	B	-2269.896667*	6.123882	0	-2288.68642	-2251.10691
		C	-1655.096667*	6.123882	0	-1673.88642	-1636.30691
	B	A	2269.896667*	6.123882	0	2251.10691	2288.68642
		C	614.800000*	6.123882	0	596.01025	633.58975
	C	A	1655.096667*	6.123882	0	1636.30691	1673.88642
		B	-614.800000*	6.123882	0	-633.58975	-596.01025
Color	A	B	-16.333333*	2.143034	0.001	-22.90875	-9.75792
		C	-12.000000*	2.143034	0.003	-18.57542	-5.42458
	B	A	16.333333*	2.143034	0.001	9.75792	22.90875
		C	4.333333	2.143034	0.188	-2.24208	10.90875
	C	A	12.000000*	2.143034	0.003	5.42458	18.57542

		B	-4.333333	2.143034	0.188	-10.90875	2.24208
Salin	A	B	-2356.833333*	5.339649	0	-2373.21684	-2340.44982
		C	-1716.133333*	5.339649	0	-1732.51684	-1699.74982
	B	A	2356.833333*	5.339649	0	2340.44982	2373.21684
		C	640.700000*	5.339649	0	624.31649	657.08351
	C	A	1716.133333*	5.339649	0	1699.74982	1732.51684
		B	-640.700000*	5.339649	0	-657.08351	-624.31649
Nitrite	A	B	-.556667*	0.108827	0.005	-0.89058	-0.22276
		C	-0.265333	0.108827	0.11	-0.59924	0.06858
	B	A	.556667*	0.108827	0.005	0.22276	0.89058
		C	0.291333	0.108827	0.082	-0.04258	0.62524
	C	A	0.265333	0.108827	0.11	-0.06858	0.59924
		B	-0.291333	0.108827	0.082	-0.62524	0.04258
Nitrate	A	B	-313.833333*	4.055084	0	-326.27544	-301.39122
		C	-142.766667*	4.055084	0	-155.20878	-130.32456
	B	A	313.833333*	4.055084	0	301.39122	326.27544
		C	171.066667*	4.055084	0	158.62456	183.50878
	C	A	142.766667*	4.055084	0	130.32456	155.20878
		B	-171.066667*	4.055084	0	-183.50878	-158.62456
Sulphate	A	B	-83.833333*	3.928151	0	-95.88598	-71.78069
		C	-22.100000*	3.928151	0.003	-34.15265	-10.04735
	B	A	83.833333*	3.928151	0	71.78069	95.88598
		C	61.733333*	3.928151	0	49.68069	73.78598
	C	A	22.100000*	3.928151	0.003	10.04735	34.15265
		B	-61.733333*	3.928151	0	-73.78598	-49.68069
Phosphate	A	B	-99.000000*	6.125539	0	-117.79483	-80.20517
		C	-140.166667*	6.125539	0	-158.9615	-121.37183
	B	A	99.000000*	6.125539	0	80.20517	117.79483
		C	-41.166667*	6.125539	0.001	-59.9615	-22.37183
	C	A	140.166667*	6.125539	0	121.37183	158.9615
		B	41.166667*	6.125539	0.001	22.37183	59.9615

Ammonia	A	B	-9.363333*	1.266623	0.001	-13.24968	-5.47699
		C	-1.82	1.266623	0.382	-5.70635	2.06635
	B	A	9.363333*	1.266623	0.001	5.47699	13.24968
		C	7.543333*	1.266623	0.002	3.65699	11.42968
	C	A	1.82	1.266623	0.382	-2.06635	5.70635
		B	-7.543333*	1.266623	0.002	-11.42968	-3.65699

*. The mean difference is significant at the 0.05 level.

Appendix 4 One-way ANOVA values of the measured metals

		Sum of squares	**df**	**Mean square**	**F**	**Sig.**
Cu	Between Groups	0.004	2	0.002	8.237	0.019
	Within Groups	0.002	6	0		
	Total	0.006	8			
Fe	Between Groups	0.154	2	0.077	2.356	0.176
	Within Groups	0.196	6	0.033		
	Total	0.35	8			
Zn	Between Groups	0.045	2	0.023	15.344	0.004
	Within Groups	0.009	6	0.001		
	Total	0.054	8			
Pb	Between Groups	0.012	2	0.006	5.245	0.048
	Within Groups	0.007	6	0.001		
	Total	0.019	8			
Mn	Between Groups	0.835	2	0.417	15.435	0.004
	Within Groups	0.162	6	0.027		
	Total	0.997	8			
Na	Between Groups	3511271.122	2	1755635.561	621.837	0
	Within Groups	16939.823	6	2823.304		
	Total	3528210.945	8			
K	Between Groups	546.599	2	273.299	28.895	0.001
	Within Groups	56.749	6	9.458		

	Total	603.348	8

Appendix 5 Correlation between measured metals among the three sample sites Correlations

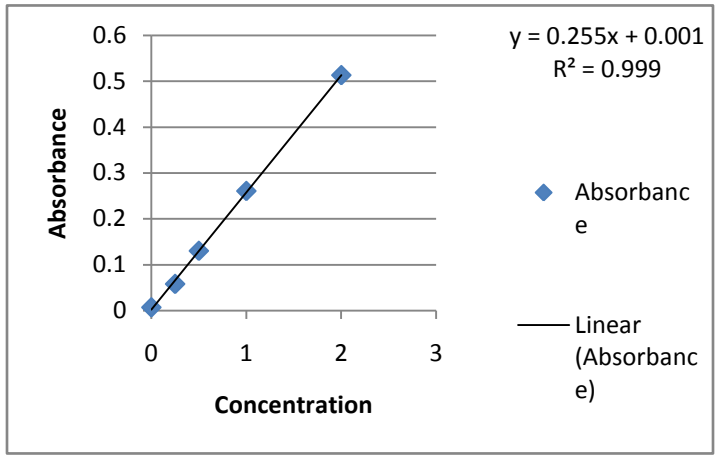
		Site	**Cu**	**Fe**	**Zn**	**Pb**	**Mn**	**Na**	**K**
Cu	Pearson Correlation	0.331	1	-0.5	.760*	-0.567	0.139	-0.485	-0.614
	Sig. (2-tailed)	0.384		0.171	0.018	0.112	0.721	0.185	0.078
	N	9	9	9	9	9	9	9	9
Fe	Pearson Correlation	0.347	-0.5	1	-0.395	0.61	-.745*	0.651	0.506
	Sig. (2-tailed)	0.36	0.171		0.293	0.081	0.021	0.058	0.165
	N	9	9	9	9	9	9	9	9
Zn	Pearson Correlation	0.498	.760*	-0.395	1	-0.351	-0.069	-0.364	-0.463
	Sig. (2-tailed)	0.173	0.018	0.293		0.354	0.86	0.336	0.21
	N	9	9	9	9	9	9	9	9
Pb	Pearson Correlation	0.397	-0.567	0.61	-0.351	1	-0.636	.804**	.674*
	Sig. (2-tailed)	0.29	0.112	0.081	0.354		0.066	0.009	0.046
	N	9	9	9	9	9	9	9	9
Mn	Pearson Correlation	-.848**	0.139	-.745*	-0.069	-0.636	1	-.742*	-0.581
	Sig. (2-tailed)	0.004	0.721	0.021	0.86	0.066		0.022	0.101
	N	9	9	9	9	9	9	9	9
Na	Pearson Correlation	0.54	-0.485	0.651	-0.364	.804**	-.742*	1	.938**
	Sig. (2-tailed)	0.133	0.185	0.058	0.336	0.009	0.022		0
	N	9	9	9	9	9	9	9	9
K	Pearson Correlation	0.346	-0.614	0.506	-0.463	.674*	-0.581	.938**	1
	Sig. (2-tailed)	0.362	0.078	0.165	0.21	0.046	0.101	0	
	N	9	9	9	9	9	9	9	9

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 6 Image showing physical parameters measurement at field of the three sampling sites of the river

Appendix 7 Image showing water sample measurement in the laboratory

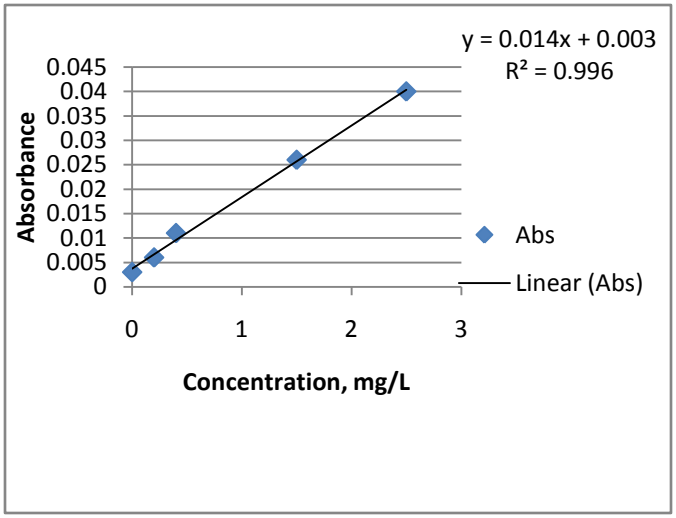
Appendix 8 calibration curve for standard solution of the analyzed metals



concentration	Absorbance
0.00	0.0004
0.25	0.0580
0.50	0.1301

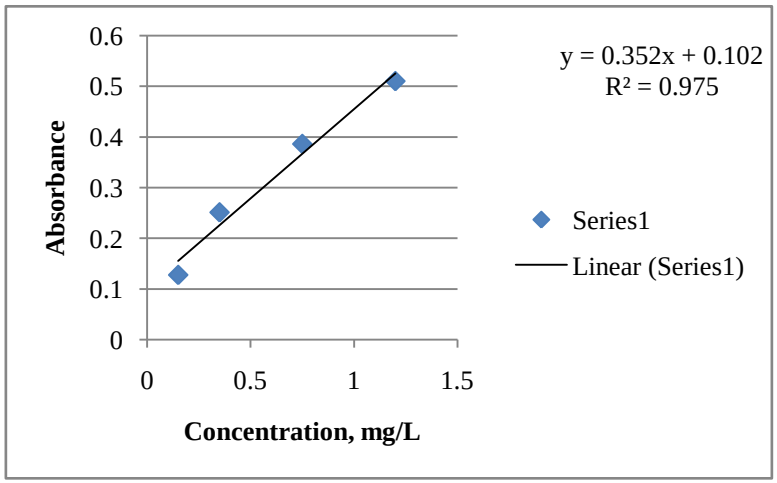
1.00	0.2605
2.00	0.5128

Copper calibration curve



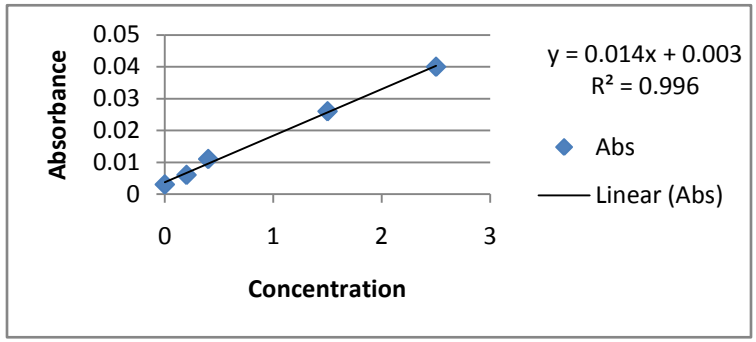
Concentration	Absorbance
0.00	0.0001
0.25	0.0035
0.75	0.0052
1.50	0.0089
3.50	0.0175

Iron calibration curve



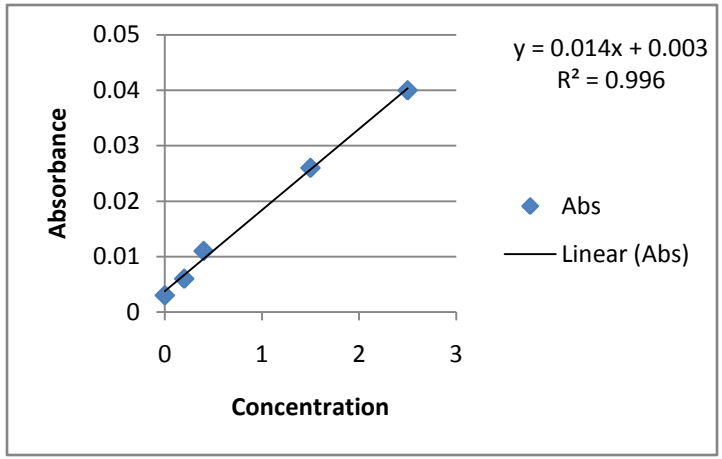
Concentration	Absorbance
0.25	0.1273
0.50	0.2508
0.75	0.3857
1.00	0.5097

Zinc calibration curve



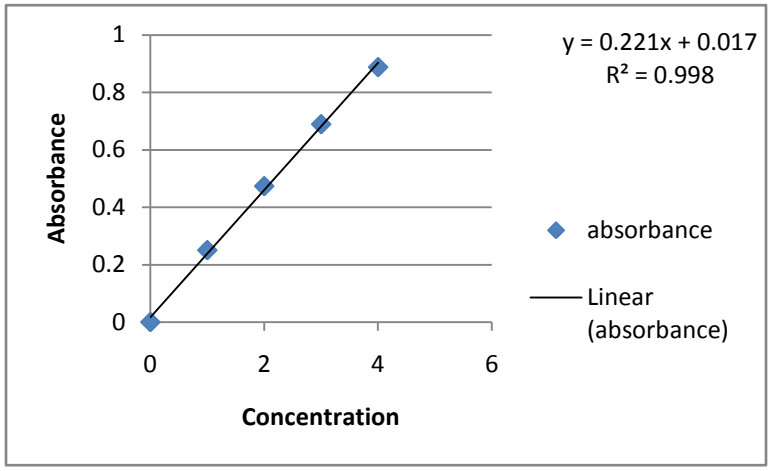
Concentration, mg/L	absorbance
0.00	0.0030
1.00	0.0268
2.00	0.0531
3.00	0.0803
4.00	0.1091

Lead calibration curve



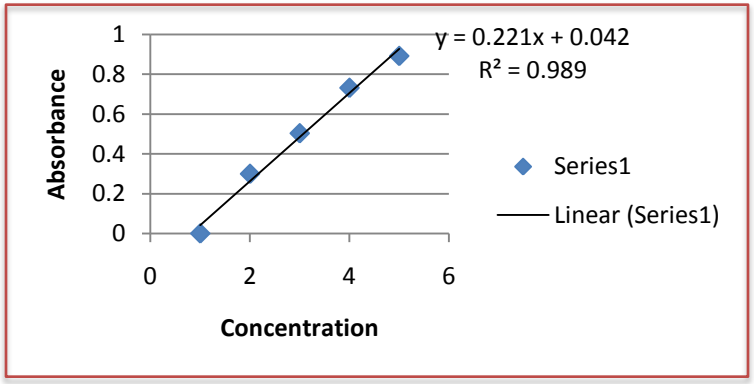
Concentration	Absorbance
0.20	0.0060
0.40	0.0110
1.50	0.0260
2.50	0.0400

Manganese calibration curve



Sodium calibration curve

Concentration, mg/L	Absorbance
0.00	0.0005
1.00	0.2996
2.00	0.5030
3.00	0.7310
4.00	0.8908



Potassium calibration curve

Concentration, mg/L	**Absorbance**
0.00	0.0000
1.00	0.2506
2.00	0.4736
3.00	0.6895
4.00	0.8882

Appendix 9 Dilution factor for both sodium and potassium ions standard solution

Laboratory code	**Sodium**	**Dilution factor for Na**	**potassium**	**Dilution factor for K**
819621A	0.6981	10	1.111	1

819621B	1.0927	10	1.659	1
819622A	3.988	400	1.15	20
819622B	3.8179	400	1.1	20
819623A	2.0433	400	0.578	20
819623B	2.0718	400	0.564	20
819624A	3.3858	1	0.416	1
819624B	3.2806	1	0.463	1
819625A	3.4664	1	0.404	1
819625B	3.415	1	0.416	1
819626A	1.6017	1	0.476	1
819626b	1.651	1	0.498	1