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Correlation of Dry Season and Wet Season Geoelectrical Values for the ABEM Terrameter SAS 4000 at Coincident Points of Measurements

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Abstract

Workers have been engaged in year-round, all-season geoelectrical surveys at the Minna Area, which is Basement Complex in nature, and the terrameter of choice in these endeavours is the ABEM Terrameter SAS 4000. Questions have arisen whether the results of surveys carried out in the rainy season differ appreciably from those carried out in the dry season for coincident points at corresponding depths. From a database of vertical electrical sounding (VES) results for a 2 km x 2 km survey at the Gidan Kwano Campus, Federal University of Technology, Minna, the analysis here is basically restricted to six survey stations of the first cross-profile (or TT1); P1-1, P1-3, P1-5, P1-7, P1-9, and P1-11 are separated by 200 m, alternating over the even-numbered station designation. Over the period (2011, 2013, and 2014) for which the data presented herein for the present analysis was acquired, the workers stuck to field survey fidelity involving the Schlumberger array in the acquisition of the VES data; moreover, no component of the ABEM Terrameter SAS 4000 was altered over this period. Thus, for the information available from this preliminary analysis, it would be concluded that, statistically, the resistivity values computed as a result of surveying with the ABEM Terrameter SAS 4000 over the dry and the wet seasons agree fairly well with each other at coincident points of survey.

Keywords: terrameter; geoelectrical; resistivity; cross-profile

Introduction

Jonah and Saidu (2018), Jonah and Olasehinde (2017), Jonah *et al.* (2015; 2014A; 2014B; 2014C; 2014D; 2014E; 2014F; 2013B), Jonah and Jimoh (2013A) have been engaged in year-round, all-season geoelectrical surveys at the Minna Area, which is Basement Complex in nature. The terrameter of choice in these endeavours is the ABEM Terrameter SAS 4000. Naturally, questions would arise about conclusions drawn on aquifer prospects when surveys are carried out in the thick of the dry season and in the thick of the wet or rainy season. Survey activities have been particularly intense at the Planned Phase II Development, Gidan Kwano Campus, Federal University of Technology, Minna, Nigeria (Jonah and Saidu, 2018; Jonah and Olasehinde, 2017; Jonah *et al.*, 2015; Jonah *et al.*, 2014D; Jonah *et al.*, 2014F); thus, this area provides the database from whence correlation analysis was be carried out at coincident points for the ABEM Terrameter

SAS 4000 across the dual seasonal variations. According to Jonah and Saidu (2018), Jonah and Olasehinde (2017), Jonah *et al.* (2015), Jonah *et al.* (2014D), and Jonah *et al.* (2014F), the location most suited for the Phase II Development at the Gidan Kwano Campus is the 8 km^2 areal extent shown in Fig.1, defined to be a perfect rectangle on the ground with its ends corresponding to the following georeferenced co-ordinates: $09^0 30'57.8''$N, $006^0 25'39.0''$E (most extreme southwest of "perfect rectangle"); $09^0 30'57.8''$N, $006^0 26'43.8''$E (most extreme southeast of "perfect rectangle"); $09^0 33'07.4''$N, $006^0 26'43.8''$E (most extreme northeast of "perfect rectangle"); $09^0 33'07.4''$N, $006^0 25'39.0''$E (most extreme northwest of "perfect rectangle"). The standard layout for the work schedule of the 8 km^2 Phase II Development, at 100 m station-spacing of the principal stations, is as shown in Fig.2; thus far, according to Jonah and Olasehinde (2017), vertical electrical sounding (VES) data collected in tandem with induced polarisation (IP) data are available for the southern half 4 km^2 areal extent of Fig.2. The interest of the analysis of this study concerns VES data collected at the coincident location of the most extreme southwest point of Fig.2 (that is P1-1, Station 1 of Profile 1) trending eastward at 200 m station-spacing of the principal stations over the dry and wet seasons of the years 2013 (dry season) and 2014 (wet season); at 200 m station-spacing of the principal stations, data would be correlated for P1-3, P1-5, P1-7, P1-9, and P1-11. East-west survey trend is a cross-profile or transverse traverse (TT); thus, the analysis here is basically restricted to the first cross-profile (or TT1). P1-1, P1-3, P1-5, P1-7, P1-9, and P1-11 are separated by 200 m, alternating over the even-numbered station designation. Suffice to mention here that dry season data for TT1 is available for the survey conducted at 200 m station-spacing of the principal stations, completed in 2013 and discussed in Jonah *et al.* (2014D); wet season data for TT1 is available for the survey conducted at 100 m station-spacing of the principal stations, carried out in 2014 and discussed in Jonah and Olasehinde (2017).

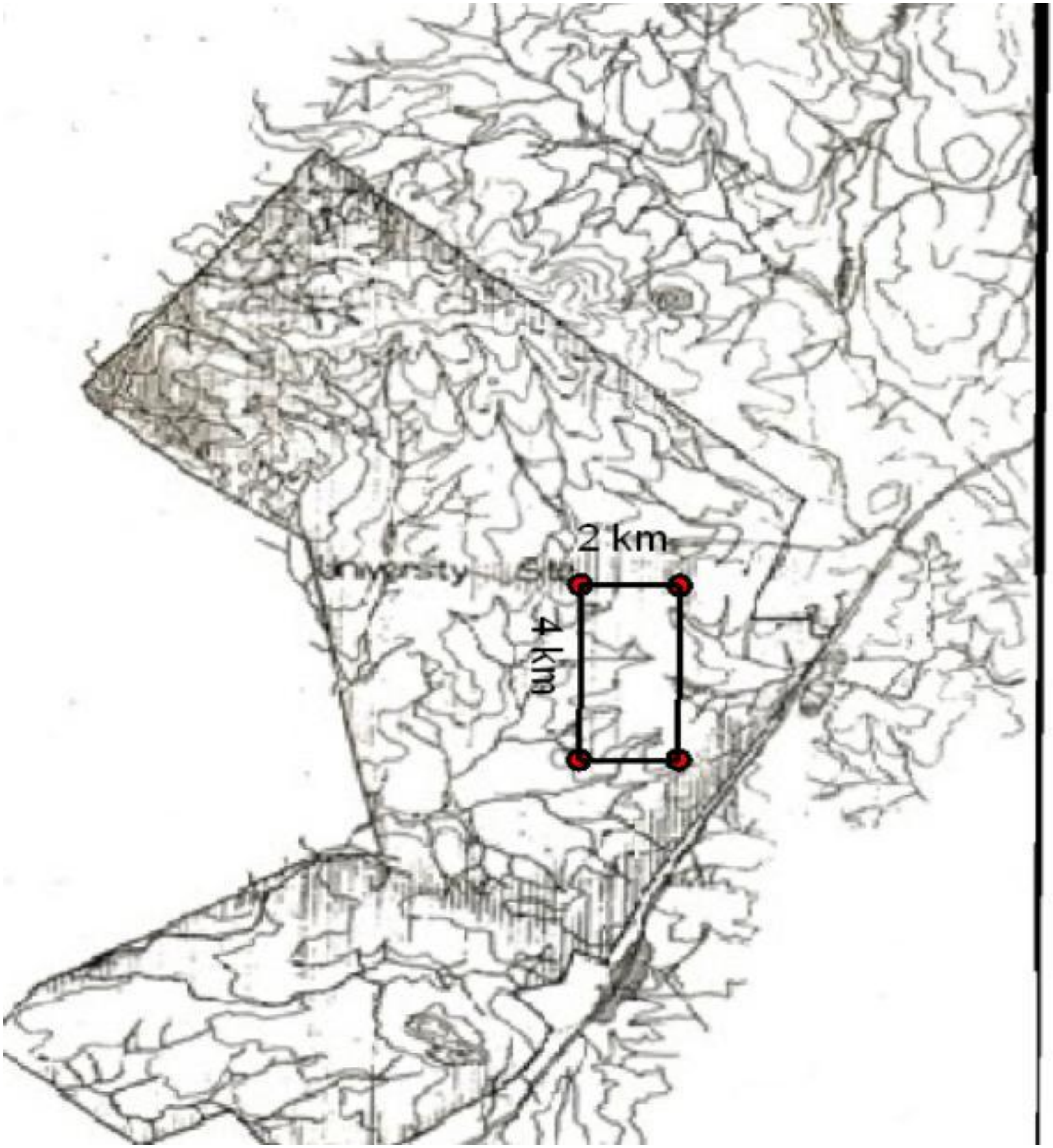

Fig.1. Location most suited for Phase II development at the Gidan Kwano Campus. (The 4 km x 2 km rectangle seen on this map is located at: $09^0 30'57.8''$N, $006^0 25'39.0''$E; $09^0 30'57.8''$N, $006^0 26'43.8''$E; $09^0 33'07.4''$N, $006^0 26'43.8''$E; $09^0 33'07.4''$N, $006^0 25'39.0''$E.)

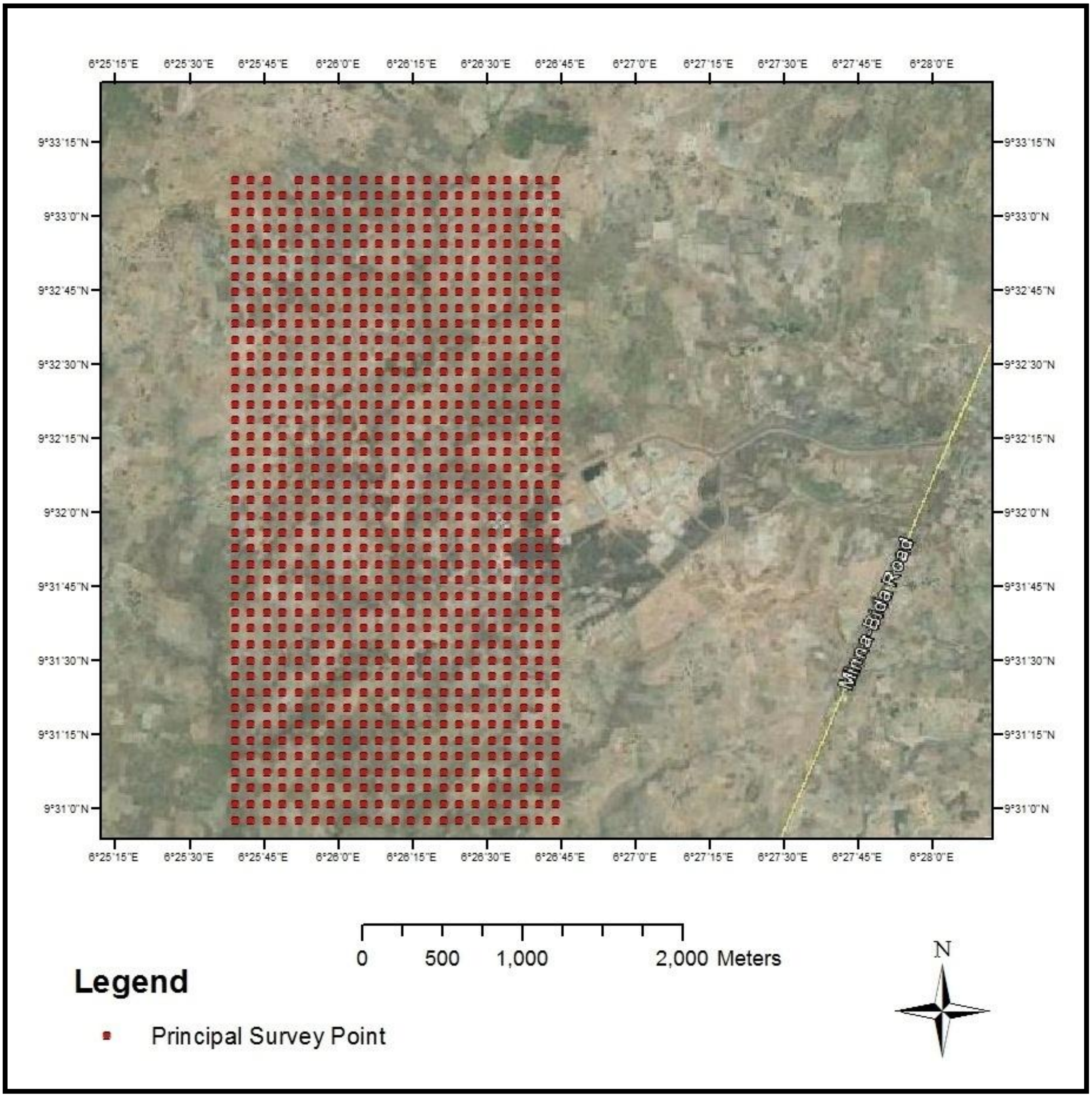

Fig.2. Locations of the principal stations of the 8km^2 areal extent of Phase II against the backdrop of a satellite imagery map showing Phase I. (The tadpole-shaped feature is Phase I, the present developed portion of the GKC, seen to the east of the red-dotted grid of the 8km^2 areal extent; the Minna-Kateregi-Bida Road is seen as the linear slope in the bottom right of this figure.)

Results and Discussion

The appropriate tables of values of TT1 for the dry season and the wet season spells are as shown in Tables 1 to 12.

Table 1. Dry Season Result for Cross-Profile 1: P1-1 (Date: 26/02/2013)

AB/2	MN/2	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY Ωm
1	.50	2.36	69.795Ω	0.074%	10mA	2	164.716
2	.50	11.8	5.722Ω	0.013%	10mA	2	67.528
3	.50	27.8	1.9181Ω	0.422%	10mA	2	53.323
5	.50	77.8	823.73mΩ	0.786%	10mA	3	64.086
6	.50	112	577.05mΩ	0.254%	10mA	2	64.630
6	1.00	55	1.1134Ω	0.346%	10mA	2	61.237
8	1.00	99	749.76mΩ	0.043%	10mA	2	74.226
10	1.00	156	663.36mΩ	0.0269%	2mA	2	103.484
10	2.50	58.9	1.5391Ω	0.452%	2mA	2	90.653
15	2.50	137	999.58mΩ	0.193%	10mA	2	136.942
20	2.50	245	831.39mΩ	0.167%	10mA	2	302.691
30	2.50	562	487.62mΩ	0.395%	10mA	2	274.042
40	2.50	1001	365.15mΩ	0.567%	10mA	2	365.515
40	7.50	323	1.2385Ω	1.63%	10mA	4	400.036
50	7.50	512	761.45mΩ	0.562%	10mA	2	389.862
60	7.50	742	511.15mΩ	0.419%	10mA	2	379.273
70	7.50	1014	420.15mΩ	1.12%	10mA	4	426.032
80	7.50	1329	384.81mΩ	1.78%	10mA	4	511.412
80	15.00	647	784.39mΩ	0.942%	10mA	2	507.500
90	15.00	825	601.39mΩ	38.1%	2mA	4	496.147
100	15.00	1024	627.84mΩ	10.8%	10mA	4	642.908

Table 2. Dry Season Result for Cross-Profile 1: P3-1

Date: 26/02/2013

AB/2	MN/2	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY Ωm
1	.50	2.36	5.5292 Ω	0.161%	10mA	2	13.049
2	.50	11.8	1.2891Ω	0.330%	10mA	2	15.211
3	.50	27.8	664.49mΩ	1.71%	5mA	4	18.473
5	.50	77.8	300.68mΩ	0.11%	10mA	2	23.393
6	.50	112	238.08mΩ	0.30%	10mA	2	26.665
6	1.00	55	470.08mΩ	0.226%	2mA	2	25.854
8	1.00	99	382.82mΩ	0.131%	10mA	2	37.899
10	1.00	156	307.98mΩ	0.151%	5mA	2	48.045
10	2.50	58.9	618.64mΩ	0.692%	5mA	2	36.440
15	2.50	137	421.57mΩ	0.829%	10mA	2	57.755
20	2.50	245	323.74mΩ	0.441%	10mA	2	79.316
30	2.50	562	216.84mΩ	0.658%	10mA	2	121.864
40	2.50	1001	96.84mΩ	0.000%	10mA	2	96.917
40	7.50	323	485.65mΩ	0.956%	10mA	2	156.865
50	7.50	512	398.30mΩ	0.054%	10mA	2	203.930
60	7.50	742	316.56mΩ	0.372%	10mA	2	234.591
70	7.50	1014	234.10mΩ	0.690%	2mA	2	237.377
80	7.50	1329	184.42mΩ	0.348%	10mA	2	245.094
80	15.00	647	458.04mΩ	0.171%	10mA	2	296.352
90	15.00	825	356.39mΩ	1.12%	10mA	2	294.022
100	15.00	1024	297.27mΩ	2.23%	10mA	2	304.404

Table 3. Dry Season Result for Cross-Profile 1: P5-1

Date: 26/02/2013

AB/2	MN/2	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY Ωm
1	.50	2.36	4.0311Ω	0.35%	10mA	2	9.513
2	.50	11.8	678.40mΩ	13.0%	10mA	4	8.00512
3	.50	27.8	310.68Ω	3.84%	5mA	4	8.637
5	.50	77.8	149.84mΩ	0.381%	10mA	2	11.658
6	.50	112	112.96mΩ	0.032%	10mA	2	12.652
6	1.00	55	252.14mΩ	0.000%	2mA	2	13.868
8	1.00	99	179.52mΩ	16.7%	10mA	4	17.772
10	1.00	156	175.49mΩ	3.93%	5mA	4	27.376
10	2.50	58.9	442.29mΩ	2.80%	5mA	4	26.051
15	2.50	137	248.41mΩ	0.187%	10mA	2	34.032
20	2.50	245	171.44mΩ	0.083%	10mA	2	42.003
30	2.50	562	109.85mΩ	0.950%	10mA	4	61.736
40	2.50	1001	80.091mΩ	1.08%	10mA	4	80.172
40	7.50	323	234.37mΩ	0.411%	10mA	2	75.702
50	7.50	512	186.74mΩ	0.268%	10mA	2	95.611
60	7.50	742	167.00mΩ	2.25%	10mA	4	123.914
70	7.50	1014	156.88mΩ	8.24%	2mA	4	159.076
80	7.50	1329	134.59mΩ	2.30%	10mA	4	178.870
80	15.00	647	281.93mΩ	0.798%	10mA	2	182.409
90	15.00	825	262.39mΩ	0.359%	10mA	2	74.781
100	15.00	1024	235.30mΩ	1.03%	10mA	4	240.947

Table 4. Dry Season Result for Cross-Profile 1: P7-1

Date: 26/02/2013

AB/2	MN/2	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY Ωm
1	.50	2.36	86.00Ω	0.053%	10mA	2	202.965
2	.50	11.8	1.2654Ω	0.217%	10mA	2	14.932
3	.50	27.8	595.15mΩ	0.516%	10mA	2	16.545
5	.50	77.8	258.98mΩ	0.551%	10mA	2	20.148
6	.50	112	191.36mΩ	0.354%	10mA	2	21.432
6	1.00	55	423.08mΩ	0.21%	10mA	2	23.269
8	1.00	99	272.34mΩ	0.562%	10mA	2	27.060
10	1.00	156	173.24mΩ	0.268%	10mA	2	27.025
10	2.50	58.9	460.51mΩ	0.186%	10mA	2	27.124
15	2.50	137	245.98mΩ	0.189%	10mA	2	33.699
20	2.50	245	143.70mΩ	0.869%	10mA	2	35.207
30	2.50	562	76.887mΩ	0.836%	10mA	2	43.210
40	2.50	1001	-20.799mΩ	8.64%	10mA	4	-20.820
40	7.50	323	317.62mΩ	1.76%	10mA	4	102.591
50	7.50	512	266.88mΩ	0.013%	10mA	2	136.643
60	7.50	742	218.47mΩ	0.114%	10mA	2	162.105
70	7.50	1014	181.49mΩ	11.9%	10mA	4	184.031
80	7.50	1329	159.00mΩ	0.202%	10mA	2	211.311
80	15.00	647	331.81mΩ	3.49%	10mA	4	214.681
90	15.00	825	279.37mΩ	1.99%	10mA	4	230.480
100	15.00	1024	218.85mΩ	2.19%	10mA	4	224.102

Table 5. Dry Season Result for Cross-Profile 1: P9-1

Date: 26/02/2013

AB/2	MN/2	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY Ωm
1	.50	2.36	156.42Ω	0.092%%	10mA	2	369.151
2	.50	11.8	45.556Ω	2.15%	10mA	4	537.561
3	.50	27.8	15.723Ω	47.9%	10mA	4	437.099
5	.50	77.8	10.275Ω	0.014%	5mA	2	799.395
6	.50	112	6.7655Ω	0.612%	5mA	2	757.736
6	1.00	55	14.991Ω	8.52%	5mA	4	824.505
8	1.00	99	7.5772Ω	0.129%	10mA	2	750.143
10	1.00	156	4.5953Ω	1.34%	10mA	4	716.867
10	2.50	58.9	9.7929Ω	0.029%	10mA	2	576.749
15	2.50	137	4.1602Ω	0.344%	10mA	2	569.947
20	2.50	245	1.6580Ω	0.344%	10mA	2	406.210
30	2.50	562	969.21mΩ	0.147%	10mA	2	544.696
40	2.50	1001	606.13mΩ	2.20%	10mA	4	606.736
40	7.50	323	2.4993Ω	0.181%	10mA	2	807.2739
50	7.50	512	1.3350Ω	0.455%	2mA	2	683.52
60	7.50	742	951.52mΩ	0.503%	10mA	2	706.028
70	7.50	1014	722.93mΩ	0.356%	10mA	2	733.051
80	7.50	1329	502.67mΩ	5.18%	10mA	4	668.048
80	15.00	647	989.38mΩ	0.144%	10mA	2	640.129
90	15.00	825	759.43mΩ	4.30%	10mA	4	624.055
100	15.00	1024	693.88mΩ	0.41%	10mA	2	710.533

Table 6. Dry Season Result for Cross-Profile 1: P11-1

Date: 26/02/2013

AB/2	MN/2	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY Ωm
1	.50	2.36	35.987Ω	0.016%	10mA	2	84.929
2	.50	11.8	2.0804Ω	5.52%	5mA	4	24.549
3	.50	27.8	-1.6304Ω	252%	1mA	4	-45.325
5	.50	77.8	709.70mΩ	0.453%	10mA	2	55.215
6	.50	112	1.5678Ω	48.4%	1mA	4	175.594
6	1.00	55	1.7009Ω	0.514%	2mA	2	93.5495
8	1.00	99	877.16mΩ	0.256%	10mA	2	86.839
10	1.00	156	614.19mΩ	1.96%	10mA	4	95.814
10	2.50	58.9	1.3085Ω	1.96%	10mA	4	77.071
15	2.50	137	766.49mΩ	3.95%	2mA	4	105.009
20	2.50	245	530.49mΩ	0.000%	10mA	2	129.970
30	2.50	562	BATTERY	DOWN	BATTERY	DOWN	BATTERY
40	2.50	1001	BATTERY	DOWN	BATTERY	DOWN	BATTERY
40	7.50	323	BATTERY	DOWN	BATTERY	DOWN	BATTERY
50	7.50	512	BATTERY	DOWN	BATTERY	DOWN	BATTERY
60	7.50	742	BATTERY	DOWN	BATTERY	DOWN	BATTERY
70	7.50	1014	BATTERY	DOWN	BATTERY	DOWN	BATTERY
80	7.50	1329	BATTERY	DOWN	BATTERY	DOWN	BATTERY
80	15.00	647	BATTERY	DOWN	BATTERY	DOWN	BATTERY
90	15.00	825	BATTERY	DOWN	BATTERY	DOWN	BATTERY
100	15.00	1024	BATTERY	DOWN	BATTERY	DOWN	BATTERY

Table 7. Wet Season Result for Cross-Profile 1: P1-1

Date: 14/05/2014

AB/2 (m)	MN/2 (m)	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY (Ωm)
1	.50	2.36	WET	STREAM	BARRIER	WET	STREAM
2	.50	11.8	WET	STREAM	BARRIER	WET	STREAM
3	.50	27.8	WET	STREAM	BARRIER	WET	STREAM
5	.50	77.8	WET	STREAM	BARRIER	WET	STREAM
6	.50	112	WET	STREAM	BARRIER	WET	STREAM
6	1.00	55	WET	STREAM	BARRIER	WET	STREAM
8	1.00	99	WET	STREAM	BARRIER	WET	STREAM
10	1.00	156	WET	STREAM	BARRIER	WET	STREAM
10	2.50	58.9	WET	STREAM	BARRIER	WET	STREAM
15	2.50	137	WET	STREAM	BARRIER	WET	STREAM
20	2.50	245	WET	STREAM	BARRIER	WET	STREAM
30	2.50	562	WET	STREAM	BARRIER	WET	STREAM
40	2.50	1001	WET	STREAM	BARRIER	WET	STREAM
40	7.50	323	WET	STREAM	BARRIER	WET	STREAM
50	7.50	512	WET	STREAM	BARRIER	WET	STREAM
60	7.50	742	WET	STREAM	BARRIER	WET	STREAM
70	7.50	1014	WET	STREAM	BARRIER	WET	STREAM
80	7.50	1329	WET	STREAM	BARRIER	WET	STREAM
80	15.00	647	WET	STREAM	BARRIER	WET	STREAM
90	15.00	825	WET	STREAM	BARRIER	WET	STREAM
100	15.00	1024	WET	STREAM	BARRIER	WET	STREAM

Table 8. Wet Season Result for Cross-Profile 1: P3-1

Date: 14/05/2014

AB/2 (m)	MN/2 (m)	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY (Ωm)
1	.50	2.36	27.998Ω	0.04	100mA	4	66.075
2	.50	11.8	2.7377Ω	0.09	100mA	4	32.304
3	.50	27.8	916.51mΩ	0.21	50mA	4	25.578
5	.50	77.8	254.44 mΩ	3.80	50mA	4	19.795
6	.50	112	194.25 mΩ	0.13	50mA	4	21.756
6	1.00	55	346.00 mΩ	6.10	50mA	4	19.030
8	1.00	99	255.20 mΩ	0.19	50mA	4	25.264
10	1.00	156	206.76 mΩ	6.00	50mA	4	32.254
10	2.50	58.9	393.74 mΩ	1.40	50mA	4	23.191
15	2.50	137	276.06 mΩ	29.0	50mA	4	37.820
20	2.50	245	203.93 mΩ	0.63	50mA	4	49.962
30	2.50	562	149.49 mΩ	4.80	50mA	4	84.013
40	2.50	1001	116.28 mΩ	2.10	50mA	4	116.39
40	7.50	323	504.95 mΩ	0.62	50mA	4	163.09
50	7.50	512	392.39 mΩ	3.60	50mA	4	200.90
60	7.50	742	290.05 mΩ	4.50	100mA	4	215.21
70	7.50	1014	214.18 mΩ	6.90	100mA	4	217.18
80	7.50	1329	169.14 mΩ	0.71	50mA	4	224.78
80	15.00	647	346.78 mΩ	2.20	50mA	4	224.37
90	15.00	825	292.01 mΩ	0.32	100mA	4	240.90
100	15.00	1024	249.60 mΩ	0.30	100mA	4	255.59

Table 9. Wet Season Result for Cross-Profile 1: P5-1

Date: 14/05/2014

AB/2 (m)	MN/2 (m)	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY (Ωm)
1	.50	2.36	25.073Ω	0.00	100mA	2	59.172
2	.50	11.8	1.5704Ω	0.07	100mA	4	18.530
3	.50	27.8	506.13mΩ	1.30	100mA	4	14.070
5	.50	77.8	219.99 mΩ	0.07	100mA	4	17.115
6	.50	112	176.82 mΩ	0.08	100mA	4	19.803
6	1.00	55	310.29 mΩ	1.20	100mA	4	17.065
8	1.00	99	240.26 mΩ	0.13	100mA	4	23.785
10	1.00	156	179.72 mΩ	0.27	100mA	4	28.036
10	2.50	58.9	501.81 mΩ	0.16	100mA	4	29.556
15	2.50	137	291.54 mΩ	0.24	100mA	4	39.940
20	2.50	245	205.53 mΩ	0.13	100mA	4	50.354
30	2.50	562	135.09 mΩ	0.22	100mA	4	75.921
40	2.50	1001	104.93 mΩ	0.38	100mA	4	105.03
40	7.50	323	291.19 mΩ	1.30	100mA	4	94.054
50	7.50	512	233.29 mΩ	0.40	100mA	4	119.44
60	7.50	742	192.17 mΩ	0.49	100mA	4	142.59
70	7.50	1014	169.47 mΩ	0.59	100mA	4	171.84
80	7.50	1329	152.25 mΩ	0.41	100mA	4	202.34
80	15.00	647	323.13 mΩ	0.36	100mA	4	209.07
90	15.00	825	296.90 mΩ	1.10	100mA	4	244.94
100	15.00	1024	274.22 mΩ	0.63	100mA	4	280.80

Table 10. Wet Season Result for Cross-Profile 1: P7-1

Date: 12/05/2014

AB/2	MN/2	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY (Ωm)
1	.50	2.36	14.978 Ω	0.02	100mA	4	35.348
2	.50	11.8	3.2670 Ω	0.01	100mA	2	38.550
3	.50	27.8	1.4451 Ω	0.17	100mA	4	40.171
5	.50	77.8	547.91mΩ	0.42	100mA	4	42.627
6	.50	112	403.73 mΩ	0.27	100mA	4	45.218
6	1.00	55	825.10 mΩ	0.32	100mA	4	45.381
8	1.00	99	527.25 mΩ	0.43	100mA	4	52.198
10	1.00	156	404.11 mΩ	0.22	100mA	4	63.041
10	2.50	58.9	350.69 mΩ	0.39	100mA	4	20.655
15	2.50	137	201.65 mΩ	0.01	100mA	4	27.626
20	2.50	245	134.9 mΩ	0.16	100mA	4	33.051
30	2.50	562	108.51 mΩ	1.10	100mA	4	60.983
40	2.50	1001	88.298 mΩ	2.90	100mA	4	88.386
40	7.50	323	204.33 mΩ	0.87	100mA	4	65.999
50	7.50	512	143.70 mΩ	0.57	100mA	4	73.574
60	7.50	742	108.71 mΩ	0.46	100mA	4	80.662
70	7.50	1014	92.881 mΩ	1.70	100mA	4	94.180
80	7.50	1329	61.578 mΩ	0.43	100mA	4	81.826
80	15.00	647	410.05 mΩ	0.42	100mA	4	265.30
90	15.00	825	348.92 mΩ	0.14	100mA	4	287.859
100	15.00	1024	312.99 mΩ	0.39	100mA	4	320.501

Table 11. Wet Season Result for Cross-Profile 1: P9-1

Date: 12/05/2014

AB/2	MN/2	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY (Ωm)
1	.50	2.36	62.726 Ω	0.29	100mA	4	148.033
2	.50	11.8	30.11 Ω	0.00	100mA	2	355.298
3	.50	27.8	20.268 Ω	0.01	100mA	2	563.450
5	.50	77.8	9.26 Ω	0.00	100mA	2	720.428
6	.50	112	2.647 Ω	0.07	100mA	4	296.464
6	1.00	55	3.926 Ω	0.04	100mA	4	215.93
8	1.00	99	2.775 Ω	0.07	100mA	4	274.725
10	1.00	156	2.344 Ω	0.05	100mA	4	365.664
10	2.50	58.9	5.266 Ω	0.03	100mA	4	310.167
15	2.50	137	2.506 Ω	0.08	100mA	4	343.322
20	2.50	245	1.079 Ω	0.07	100mA	4	264.355
30	2.50	562	364.44 mΩ	0.67	100mA	4	204.815
40	2.50	1001	160.64 mΩ	1.50	100mA	4	160.801
40	7.50	323	473.97 mΩ	0.24	100mA	4	153.092
50	7.50	512	271.73 mΩ	0.15	100mA	4	139.126
60	7.50	742	182.48 mΩ	3.20	100mA	4	135.400
70	7.50	1014	159.83 mΩ	2.50	100mA	4	162.068
80	7.50	1329	110.14 mΩ	0.95	100mA	4	146.376
80	15.00	647	223.90 mΩ	0.51	100mA	4	144.863
90	15.00	825	249.84 mΩ	3.70	100mA	4	206.118
100	15.00	1024	235.60 mΩ	8.00	100mA	4	241.254

Table 12. Wet Season Result for Cross-Profile 1: P11-1

Date: 27/05/2011

AB/2	MN/2	GEOM. FACTOR, K	RESISTANCE	STANDARD DEVIATION	CURRENT (I)	STACKS	RESISTIVITY (Ωm)
1	.50	2.36	117.70 mΩ	3.25%	10 mA	4	0.178
2	.50	11.8	24.131 mΩ	0.29%	10mA	2	0.285
3	.50	27.8	11.990 mΩ	3.08%	10mA	4	0.333
5	.50	77.8	5.2503 mΩ	2.87%	10mA	4	0.408
6	.50	112	8.9356 mΩ	2.35%	10mA	4	1.001
6	1.00	55	8.8347 mΩ	0.000%	10mA	2	0.486
8	1.00	99	11.384 mΩ	0.314%	10mA	2	1.127
10	1.00	156	9.3395 mΩ	1.79%	10mA	4	1.457
10	2.50	58.9	10.955 mΩ	0.652%	10mA	2	0.645
15	2.50	137	11.611 mΩ	0.615%	10mA	2	1.591
20	2.50	245	7.3959 mΩ	3.20%	10mA	4	1.812
30	2.50	562	16.104 mΩ	4.53%	10mA	4	9.050
40	2.50	1001	27.387 mΩ	6.72%	10mA	4	27.414
40	7.50	323	24.788 mΩ	6.27%	10mA	4	8.001
50	7.50	512	18.073 mΩ	1.42%	10mA	4	9.253
60	7.50	742	45.208 mΩ	0.553%	10mA	2	33.544
70	7.50	1014	51.796 mΩ	0.414%	10mA	2	52.521
80	7.50	1329	13.934 mΩ	0.512%	10mA	2	18.518
80	15.00	647	17.493 mΩ	7.80%	10mA	4	11.318
90	15.00	825	178.64 mΩ	0.659%	10mA	2	147.378
100	15.00	1024	6.3357 mΩ	76.7%	10mA	4	6.488

Tables 13 to 19 are the resultant tables of correlation for the dry and wet seasons derived from a consideration of Tables 1 to 12; in these tables are columns for "Difference," "% Conformance," "% Conformance Range," and "% Conformance Mean." The "Difference" column indicates the difference in absolute values of resistivities for the dry and wet seasons for coincident points of measurements. The "% Conformance" column indicates by what percentage is there agreement in absolute values of resistivities for the dry and wet seasons for coincident points of measurements. The "% Conformance Range" and "% Conformance Mean" are typical statistical routes by which final deduction could be made. For the coincident point of P1-1, the dry season survey of 2013 was conducted smoothly but by the time of the wet season survey of 2014 that particular location could not be surveyed because the linear survey path that cut a swath through an otherwise dry-stream was now flooded (see Table 13); because of this fact, the columns for "Difference," "% Conformance," "% Conformance Range," and "% Conformance Mean" are designated "Nil." Suffice to point out that, in the correlation scheme that has been adopted herein, a negative percentage correlation value implies values that disagree appreciably with each other.

In Table 14, for P3-1, an 80% conformance mean was determined.

In Table 15, for P5-1, an 87% conformance mean was determined.

In Table 16, for P7-1, a 64% conformance mean was determined.

In Table 17, for P9-1, a -361% conformance mean was determined.

In Table 18, for P11-1, a 14% conformance mean was determined; at this survey station, during the dry season survey spell of 2013, equipment battery glitch was experienced starting from the 30m-depth mark.

Table 19 is the summary table of conformance mean.

Table 13. Table of values for P1-1

AB/2 (m)	Dry season Ωm (February 2013)	Wet season Ωm (May 2014)	Difference	% Conformance	% Conformance Range	% Conformance Mean
1	164.716	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
2	67.528	WET STREAM BARRIER	NIL	NIL	NIL	NIL
3	53.323	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
5	64.086	WET STREAM BARRIER	NIL	NIL	NIL	NIL
6	64.630	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
6	61.237	WET STREAM BARRIER	NIL	NIL	NIL	NIL
8	74.226	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
10	103.484	WET STREAM BARRIER	NIL	NIL	NIL	NIL
10	90.653	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
15	136.942	WET STREAM BARRIER	NIL	NIL	NIL	NIL
20	302.691	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
30	274.042	WET STREAM BARRIER	NIL	NIL	NIL	NIL
40	365.515	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
40	400.036	WET STREAM BARRIER	NIL	NIL	NIL	NIL
50	389.862	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
60	379.273	WET STREAM BARRIER	NIL	NIL	NIL	NIL
70	426.032	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
80	511.412	WET STREAM BARRIER	NIL	NIL	NIL	NIL
80	507.500	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL
90	496.147	WET STREAM BARRIER	NIL	NIL	NIL	NIL
100	642.908	NO DATA-FIELD DUE TO	NIL	NIL	NIL	NIL

Table 14. Table of values for P3-1

AB/2 (m)	Dry season Ωm (February 2013)	Wet season Ωm (May 2014)	Difference	% Conformance	% Conformance Range	% Conformance Mean
1	13.049	66.075	53.026	47%	28%	
2	15.211	32.304	17.093	83%	47%	
3	18.473	25.578	7.105	93%	47%	
5	23.393	19.795	3.598	96%	51%	
6	26.665	21.756	4.909	95%	62%	
6	25.854	19.030	6.824	93%	71%	
8	37.899	25.264	12.635	87%	71%	
10	48.045	32.254	15.791	84%	71%	
10	36.440	23.191	13.249	87%	80%	
15	57.755	37.820	19.935	80%	80%	
20	79.316	49.962	29.354	71%	80%	**80%**
30	121.864	84.013	37.851	62%	83%	
40	96.917	116.39	19.473	71%	84%	
40	156.865	163.09	6.225	94%	87%	
50	203.930	200.90	3.03	97%	87%	
60	234.591	215.21	19.381	71%	93%	
70	237.377	217.18	20.197	80%	93%	
80	245.094	224.78	20.314	80%	94%	
80	296.352	224.37	71.982	28%	95%	
90	294.022	240.90	53.122	47%	96%	
100	304.404	255.59	48.814	51%	97%	

Table 15. Table of values for P5-1

AB/2 (m)	Dry season Ωm (February 2013)	Wet season Ωm (May 2014)	Difference	% Conformance	% Conformance Range	% Conformance Mean
1	9.513	59.172	49.659	50%	-70%	
2	8.00512	18.530	10.52488	89%	50%	
3	8.637	14.070	5.433	95%	60%	
5	11.658	17.115	5.457	95%	72%	
6	12.652	19.803	7.151	93%	73%	
6	13.868	17.065	3.197	97%	75%	
8	17.772	23.785	6.013	94%	76%	
10	27.376	28.036	0.66	99%	77%	
10	26.051	29.556	3.505	96%	81%	
15	34.032	39.940	5.908	94%	86%	
20	42.003	50.354	8.351	92%	87%	**87%**
30	61.736	75.921	14.185	86%	89%	
40	80.172	105.03	24.858	75%	92%	
40	75.702	94.054	18.352	72%	93%	
50	95.611	119.44	23.829	76%	94%	
60	123.914	142.59	18.676	81%	94%	
70	159.076	171.84	12.764	87%	95%	
80	178.870	202.34	23.47	77%	95%	
80	182.409	209.07	26.661	73%	96%	
90	74.781	244.94	170.159	-70%	97%	
100	240.947	280.80	39.853	60%	99%	

Table 16. Table of values for P7-1

AB/2 (m)	Dry season Ωm (February 2013)	Wet season Ωm (May 2014)	Difference	% Conformance	% Conformance Range	% Conformance Mean
1	202.965	35.348	167.617	-68%	-29%	
2	14.932	38.550	23.618	76%	-68%	
3	16.545	40.171	23.626	76%	4%	
5	20.148	42.627	22.479	78%	10%	
6	21.432	45.218	23.786	76%	19%	
6	23.269	45.381	22.112	78%	32%	
8	27.060	52.198	25.138	75%	37%	
10	27.025	63.041	36.016	64%	43%	
10	27.124	20.655	6.469	93%	49%	
15	33.699	27.626	6.073	94%	63%	
20	35.207	33.051	2.156	98%	64%	**64%**
30	43.210	60.983	17.773	82%	75%	
40	-20.820	88.386	67.556	32%	76%	
40	102.591	65.999	36.592	63%	76%	
50	136.643	73.574	63.069	37%	76%	
60	162.105	80.662	81.443	19%	78%	
70	184.031	94.180	89.851	10%	78%	
80	211.311	81.826	129.482	-29%	82%	
80	214.681	265.30	50.619	49%	93%	
90	230.480	287.859	57.279	43%	94%	
100	224.102	320.501	96.399	4%	98%	

Table 17. Table of values for P9-1

AB/2 (m)	Dry season Ωm (February 2013)	Wet season Ωm (May 2014)	Difference	% Conformance	% Conformance Range	% Conformance Mean
1	369.151	148.033	221.118	-121%	-26%	
2	537.561	355.298	182.263	-82%	-42%	
3	437.099	563.450	126.351	-26%	-82%	
5	799.395	720.428	78.967	21%	-121%	
6	757.736	296.464	461.272	-361%	-127%	
6	824.505	215.93	608.575	-509%	-167%	
8	750.143	274.725	475.418	-375%	-240%	
10	716.867	365.664	351.203	-251%	-251%	
10	576.749	310.167	266.582	-167%	-318%	
15	569.947	343.322	226.625	-127%	-346%	
20	406.210	264.355	141.855	-42%	-361%	**-361%**
30	544.696	204.815	339.881	-240%	-369%	
40	606.736	160.801	445.935	-346%	-375%	
40	807.274	153.092	654.182	-554%	-395%	
50	683.52	139.126	544.394	-444%	-422%	
60	706.028	135.400	570.628	-471%	-444%	
70	733.051	162.068	570.983	-471%	-471%	
80	668.048	146.376	521.980	-422%	-471%	
80	640.129	144.863	495.266	-395%	-509%	
90	624.055	206.118	417.937	-318%	-554%	
100	710.533	241.254	469.279	-369%	21%	

Table 18. Table of values for P11-1

AB/2 (m)	Dry season Ωm (February 2013)	Wet season Ωm (May 2011)	Difference	% Conformance	% Conformance Range	% Conformance Mean
1	84.929	0.178	84.751	15%	-3%	
2	24.549	0.285	24.264	76%	-28%	
3	-45.325	0.333	44.992	55%	-75%	
5	55.215	0.408	54.807	45%	6%	
6	175.594	1.001	174.593	-75%	7%	
6	93.550	0.486	93.064	7%	14%	**14%**
8	86.839	1.127	85.714	14%	14%	
10	95.814	1.457	94.357	6%	15%	
10	77.071	0.645	76.426	14%	45%	
15	105.009	1.591	103.418	-3%	55%	
20	129.970	1.812	128.158	-28%	76%	
30	BATTERY	9.050	NIL	NIL	NIL	NIL
40	DOWN	27.414	NIL	NIL	NIL	NIL
40	BATTERY	8.001	NIL	NIL	NIL	NIL
50	DOWN	9.253	NIL	NIL	NIL	NIL
60	BATTERY	33.544	NIL	NIL	NIL	NIL
70	DOWN	52.521	NIL	NIL	NIL	NIL
80	BATTERY	18.518	NIL	NIL	NIL	NIL
80	DOWN	11.318	NIL	NIL	NIL	NIL
90	BATTERY	147.378	NIL	NIL	NIL	NIL
100	DOWN	6.488	NIL	NIL	NIL	NIL

Table 19. Summary table of conformance mean

Survey Point	Conformance Mean
P3-1 (09^{0}30′57.80″N; 006^{0}25′45.48″E)	80%
P5-1 (09^{0}30′57.80″N; 006^{0}25″51.96″E)	87%
P7-1 (09^{0}30′57.80″N; 006^{0}25′58.44″E)	64%
P9-1 (09^{0}30′57.80″N; 006^{0}26′04.92″E)	-361%
P11-1 (09^{0}30′57.80″N; 006^{0}26′11.40″E)	14%

Conclusion

There is no doubt that Station P9-1 is a real anomaly case; otherwise, along the three contiguous linear points of P3-1, P5-1., and P7-1 there is observed acceptable levels of correlation of resistivity values over the dual seasonal variation under consideration; for Station P11-1, the correlation level is at 14%. Over the period (2011, 2013, and 2014) for which the data presented herein for the present analysis was acquired, the workers stuck to field survey fidelity involving the Schlumberger array in the acquisition of the geoelectrical data; moreover, no component of the ABEM Terrameter SAS 4000 was altered over this period. Thus, for the information available from this preliminary analysis, it would be concluded that, statistically, the resistivity values computed as a result of surveying with the ABEM Terrameter SAS 4000 over the dry and the wet seasons agree fairly well with each other at coincident points of survey. Actually, ABEM (1999), pp 17 and 18, gave no indication that surveying during a wet spell would be inadvisable; what was advised herein was to terminate survey in the event of a thunderstorm or a gathering cloud.

Recommendation

The idea for this paper arose out of the need to dispel doubts about the behaviour of the ABEM Terrameter SAS 4000 over the dry and the wet seasons in the course of any resistivity survey. Of the database of VES points that workers have acquired since 2011, only a linear, contiguous configuration of five points was used in this study. It is recommended that more arbitrarily spread of VES points at the area of study of this study be analysed in the fashion discussed here in order to test for data correlation.

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