Geophysical Survey in Camp Sakhi Town, Nahr- e-Shahi District of Balkh Province

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List of Abbreviation and Technical Terms

Roh	Apparent Resistivity (ohm.m)
Sp	Self Potential (mV)
Vp	Voltage Potential (mV)
In	Current (m A)
VES	Vertical Electrical Sounding
DACAAR	Danish Committee for Aid to Afghan Refugee
WASH	Water Sanitation and Hygiene
WSG	Water and Sanitation Group
WHO	World Heath Organisation

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1.Introduction

DACAAR performed geophysical survey (vertical electrical sounding) for provision of safe drinking water for Camp SakhiTown. This Town is located about 18 Km to the northeast of Mazarisharifcenter of Balkh province. There is settled more than 2000 families and most of them are displaced and refugee.The people of this Town have safe drinking water problems because of saline groundwater.The hydro geologic condition of this Town is very complex for groundwater development due to having saline and fresh water bearing formation. The tube wells were drilled to the depth between 64 – 145m and constructed elevated reservoirs and pipe schemes, but the water being pumped and distributed is saline and they are potentially a threat to the health of the people. The people are using their drinking water from these tube wells, because there is no alternative water resources (fresh groundwater and surface water) for provision of safe drinking water.

On 18 - 20 November 2012, DACAAR were performed Vertical Electrical Sounding (VES) survey in Camp SakhiTown for provision of drinking water using Shlumbergerelectrodes arrangement (Figure 1). SYSCAL Pro resistivity meter measured the field data and the data interpreted by IPI2 win software.

Figure 1 Recording VES profile field data using SYSCAL Pro resistivty meter

2.Surface Geological setting of area

The surface geological formations of the survey area are:

- Recent Quaternary:gravel, sand, clay, clay sand and loess.
- Upper-recent Quaternary: gravel, sand, sand clay, silt and loess.
- Upper-recent Quaternary: sand, sand clay, silt and loess.
- Middle Quaternary: sand, clay sand, loess and loam
- Lower Quaternary:gravel, sand, clay sand, breccia, siltstone and gypsum
- Middle Miocen:Boron clay, siltstone, sandstone andconglomerate.

The Geological setting of the area is shown in the figure 2.

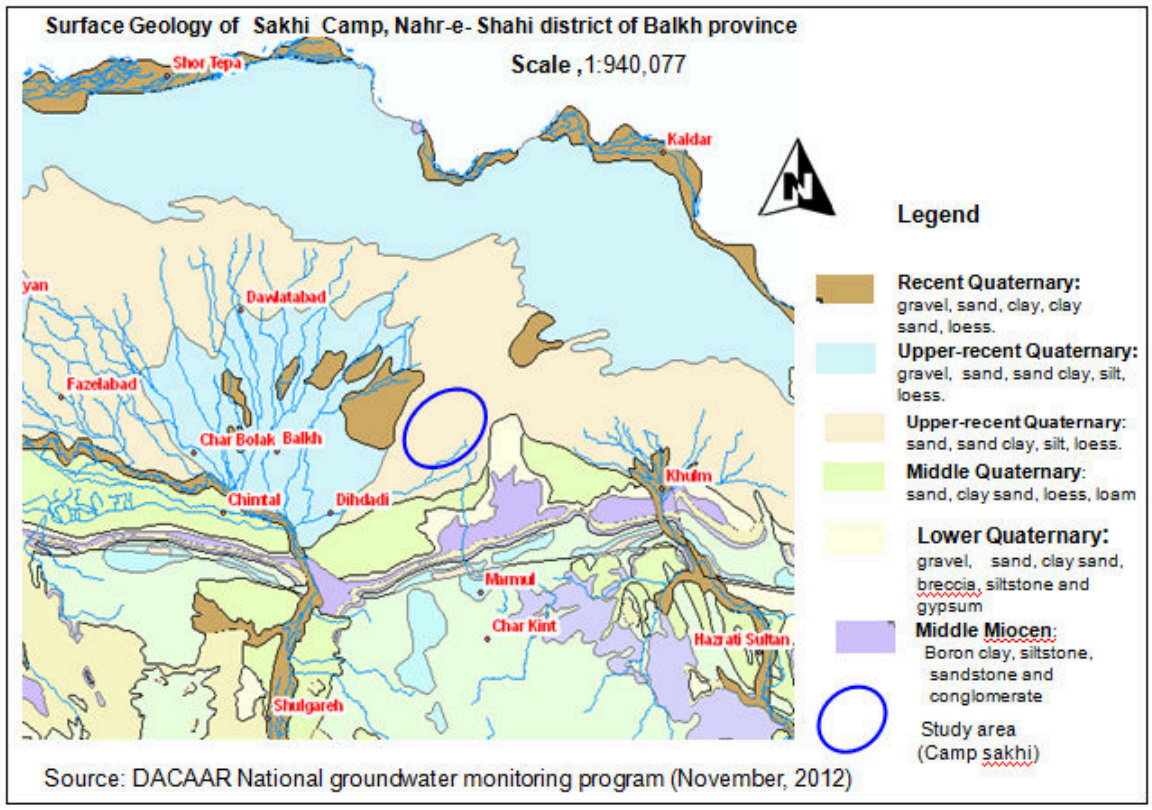


Figure 2 Surface Geological setting of the survey area (Balkh Province)

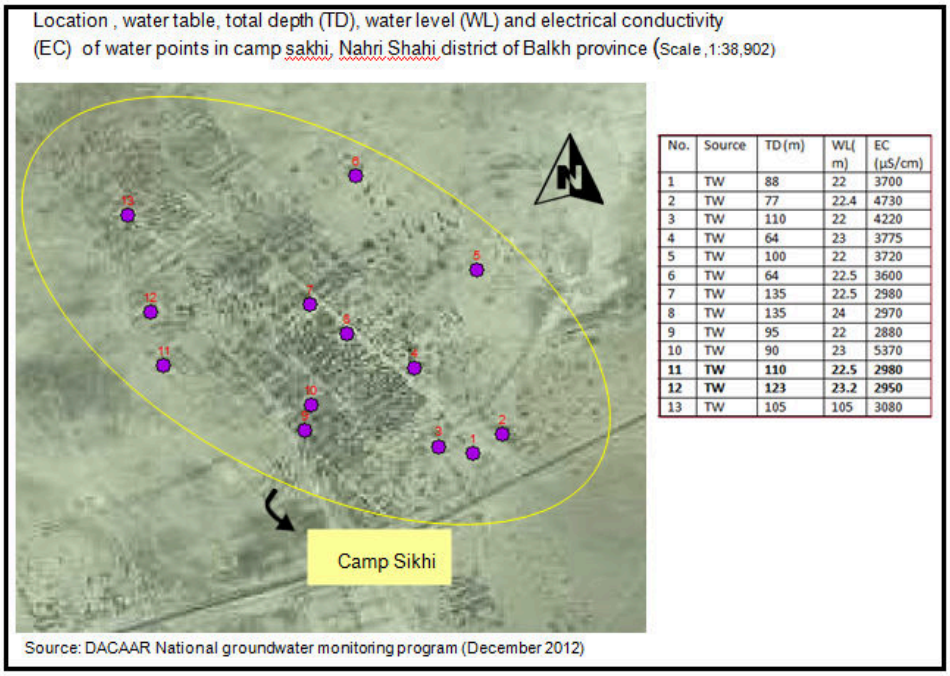
3. Hydro geological setting of the study area

The natural groundwater system in the survey area is characterized by Upper-recent Quaternary which is made of sand, sand clay, silt and loess. The water table ranges from 22 - 24 m and the aquifer (water bearing formation) has saline water.The groundwater salinity ranges from 2880 µS/cm to 5370 µS/cm. The study area is a problematic area from the groundwater point of view. Table 1 and figure 3 indicate water tables and salinity of groundwater in Camp Sakhi& in the town of Nahr-e-Shahi of Balkh Province.

Table 1 Location of water table and physical parameters of water points in Camp Sakhi&town of Nahr-e Shahi

No.	LAT.	LON.	Ele.	Source	TD (m)	WL(m)	EC (µS/cm)	pH	T
1	36.77345	67.32539	364	TW	88	22	3700	7.17	14.5
2	36.77450	67.32710	339	TW	77	22.4	4730	8.2	19.1
3	36.77383	67.32345	337	TW	110	22	4220	8.30	19.4
4	36.77826	67.32206	337	TW	64	23	3775	8.23	18.4
5	36.78382	67.32564	336	TW	100	22	3720	8.32	19.4
6	36.78919	67.31880	336	TW	64	22.5	3600	8.22	18.7
7	36.78188	67.31620	335	TW	135	22.5	2980	7.83	18.5
8	36.78024	67.31827	334	TW	135	24	2970	7.89	18
9	36.77472	67.31586	338	TW	95	22	2880	8.04	17.3
10	36.77619	67.31621	339	TW	90	23	5370	8.2	18
11	36.77839	67.30784	338	TW	110	22.5	2980	8.9	18
12	36.78145	67.30717	337	TW	123	23.2	2950	8.4	17
13	36.78693	67.30583	337	TW	105	105	3080	8.4	17.4

Note: Ele = Elevation



No.	Source	TD (m)	WL(m)	EC (µS/cm)
1	TW	88	22	3700
2	TW	77	22.4	4730
3	TW	110	22	4220
4	TW	64	23	3775
5	TW	100	22	3720
6	TW	64	22.5	3600
7	TW	135	22.5	2980
8	TW	135	24	2970
9	TW	95	22	2880
10	TW	90	23	5370
11	**TW**	**110**	**22.5**	**2980**
12	**TW**	**123**	**23.2**	**2950**
13	TW	105	105	3080

Figure 3 Groundwater level and salinity distribution

4. Vertical electrical sounding survey

4.1 Vertical Electrical sounding method

In this method the applied Schlumberger techniques was used. Current was transmitted into the ground from DC or low frequency sources by two electrodes (A and B) and the potential difference between a second pair of electrodes (M and N) was measured (figure 4).

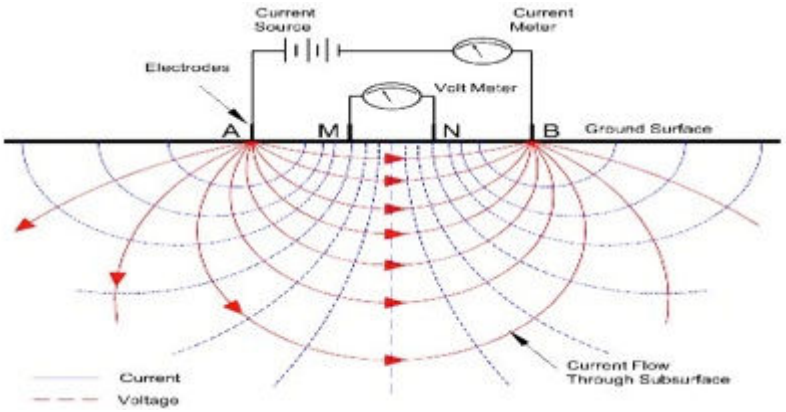


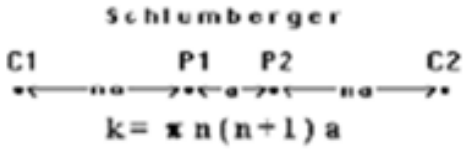
Figure 4 Vertical Electrical Sounding Method

Apparent resistivity value is calculated:

Pa= K V / I

Where:
Pa is the apparent resistivity
K is the geometric factor,
V is a voltage or potential difference between a second pair of electrodes in volts

Iis the current from DC or low frequency sources by two electrodes in ampere.



The field data interrelated according to the following resistivity scale for water and rocks (see figure 5).

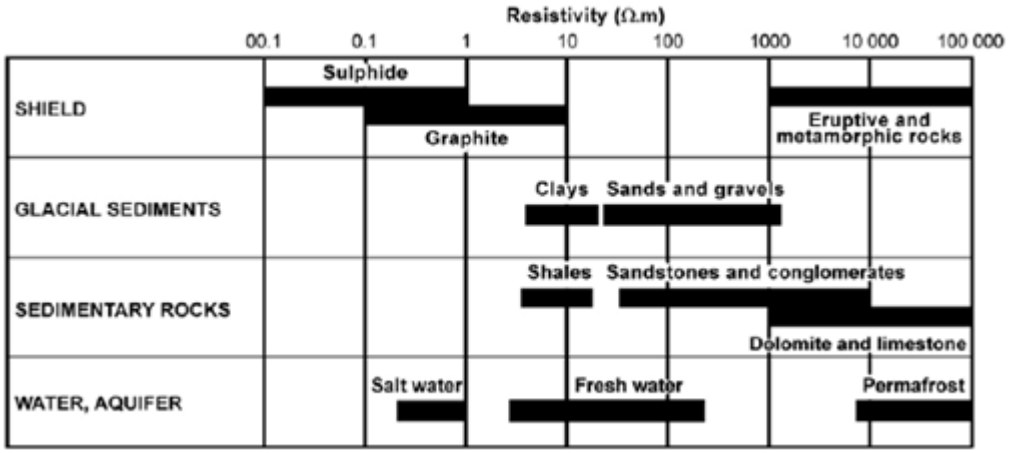


Figure 5 Resistivity scale for water and rocks

4.2 Field study

On18 -20 November 2012, 8 Vertical Electrical sounding (VES) profiles (VES-1, VES-2, VES-3, VES-4, VES-5, VES-6, VES-7 and VES-8) were performed in Camp SakhiTown,Nahr- e-ShahiDistrict of Balkh Province using Shlumbergerelectrodes arrangement.The lengths and locations of VES profiles are indicated in Table 2 and Figure 6.

Table 2 Location of VES Profiles

NO	Location Name	VES Profiles	LAT	LON	Elevation (m)	VES Length (m)
1	Camp Sakhi	VES-1	36.77377	67.32578	342	600
2	Camp Sakhi	VES-2	36.77608	67.32362	337	680
3	Camp Sakhi	VES-3	36.77610	67.31688	339	600
4	Camp Sakhi	VES-4	36.78168	67.31715	337	600
5	Camp Sakhi	VES-5	36.78196	67.31611	322	600
6	Camp Sakhi	VES-6	36.77929	67.31992	340	600
7	Camp Sakhi	VES-7	36.78240	67.32468	365	600
8	Camp Sakhi	VES-8	36.78173	67.31544	337	6

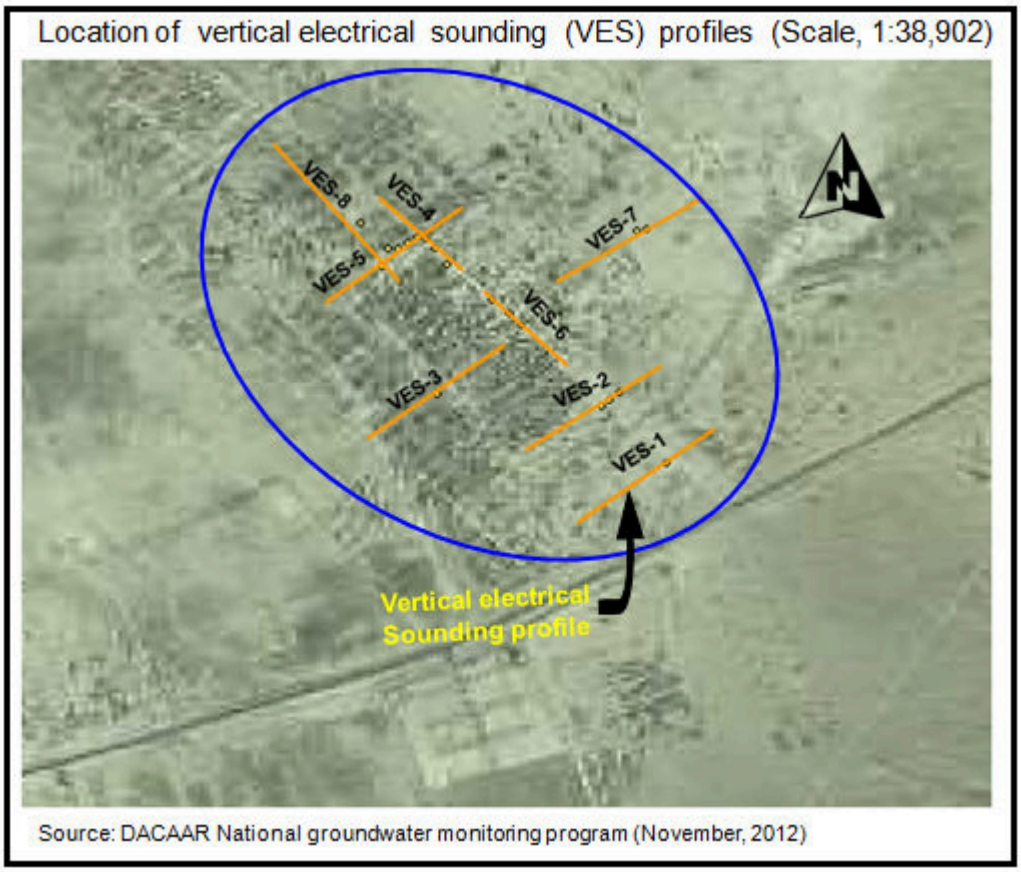


Figure 6 Location and length of VES profiles in Camp Sakhi area

4.3 Measured VES field data

SYSCAL Pro resistivity meter measured the field data and the measured data are shown in Table 3, Table 4, Table 5 and Table 6.

Table 3VES 1 & 2 measured field data

VES-1, Camp Sakhi
Lat:36.77377 Lon:36.32578 Ele:342 m

AB/2	MN/2	Rho (ohm.m)	Sp (mV)	Vp (mV)	In (mA)	K (m)
1.5	0.5	321.52	18.1	1248.142	24.391	13.7
2	0.5	285.52	3.5	736.072	30.371	24.7
3	0.5	184.88	4.7	176.052	26.177	56.2
4	0.5	101.77	7.6	13.02	6.331	100
5	0.5	67.06	4.6	10.972	12.721	157
6	0.5	52.62	5.5	12.548	26.781	226
8	0.5	41.1	5.5	6.474	31.547	402
8	2	47.39	5.5	32.407	32.227	99
10	2	40.58	19.3	21.829	40.562	156
12	2	35.18	23.7	14.094	44.049	225
15	2	30.52	25.7	2.478	14.093	352
20	2	22.91	26.7	2.737	37.166	627
20	5	25.26	12.3	7.935	37.015	247
25	5	21.6	3.2	5.321	46.443	389
30	5	20.34	2.8	3.38	45.687	562
40	5	17.25	2.2	0.948	27.186	1001
50	5	15.1	1.4	1.468	75.605	778
50	10	16.39	6.7	3.345	76.937	778
60	10	13.68	15.3	2.127	85.458	1123
80	10	11.17	16.9	1.745	154.604	2003
100	10	11.46	17.5	0.696	94.54	3134
120	10	11.21	15.5	4.988	49.315	4516
120	25	11.81	112.1	0.562	41.213	1790
150	25	10.4	97	0.281	37.157	2808
200	25	9.72	96.3	0.251	63.822	5007
250	25	9.5	97.5	0.154	63.014	7834
300	25	10.11	95.3	0.238	132.222	11290

VES- 2 Camp Sakhi
Lat:36.77608 Lon:67.32362 Ele:337 m

AB/2	MN/2	Rho (ohm.m)	Sp (mV)	Vp (mV)	In (mA)	K (m)
1.5	0.5	73.64	9.7	911.744	77.793	13.7
2	0.5	51.89	4.7	457.713	103.91	24.7
3	0.5	56.99	4.4	237.064	114.338	56.2
4	0.5	74.66	3.9	206.382	136.77	100
5	0.5	89.23	3.5	192.754	167.963	157
6	0.5	100.76	3.3	121.543	135.474	226
8	0.5	117.22	2.8	35.277	60.273	402
8	2	114.21	-10.9	276.704	114.166	99
10	2	123.31	-39	169.069	103.379	156
12	2	120.19	-52	80.141	73.314	225
15	2	117.34	-60.4	50.634	74.897	352
20	2	89.92	-68.3	31.154	107.758	627
20	5	87.32	31.7	79.324	107.017	247
25	5	71.01	32.3	31.555	83.758	389
30	5	57.16	31.5	15.419	74.152	562
40	5	35.75	28.6	5.25	72.655	1001
50	5	23.36	25.6	2.12	70.548	778
50	10	25.94	1.3	4.849	70.455	778
60	10	13.96	2.8	0.63	24.819	1123
80	10	8.56	2.3	0.113	13.044	2003
100	10	9.36	1.5	0.537	89.202	3134
120	10	9.79	8.1	-3.864	51.116	4516
120	25	10.16	-5.1	0.598	50.963	1790
150	25	10.45	2.6	0.211	27.794	2808
200	25	9.59	6.2	0.131	33.706	5007
250	25	10.97	7.8	0.602	213.263	7834
300	25	10.12	9.1	0.159	88.448	11290
340	25	8.27	11.3	0.05	43.783	-

Table 4VES 3 & 4 measured field data

VES-3 Camp Sakhi
Lat:36.77610 Lon:67.31688 Ele:339 m

AB/2	MN/2	Rho (ohm.m)	Sp (mV)	Vp (mV)	In (mA)	K (m)
1.5	0.5	42.9	11.4	827.514	121.206	13.7
2	0.5	44.52	6.2	310.551	82.184	24.7
3	0.5	42.25	7.9	133.095	86.586	56.2
4	0.5	50.21	6.7	134.936	132.968	100
5	0.5	49.82	5.8	53.606	83.656	157
6	0.5	48.76	5.8	49.488	113.991	226
8	0.5	43.25	5.4	31.483	145.799	402
8	2	47.68	10.3	147.426	145.71	99
10	2	34.9	16.3	51.2	110.624	156
12	2	26.45	16.8	36.017	149.754	225
15	2	22.42	16.3	23.562	182.434	352
20	2	16.26	15.5	7.455	142.615	627
20	5	20.97	45.8	25.296	142.132	247
25	5	18.66	37.2	12.189	123.121	389
30	5	17.97	32.9	8.888	135.946	562
40	5	12.62	30.5	1.611	63.186	1001
50	5	9.41	29.1	0.931	76.898	778
50	10	11.59	85.7	2.07	67.315	778
60	10	9.49	61.7	1.719	99.554	1123
80	10	7.76	46.4	0.802	102.243	2003
100	10	8.22	38.2	1.01	196.25	3134
120	10	8.96	53.5	35.992	100.31	4516
120	25	6.7	35	0.756	97.7	1790
150	25	7.47	11.4	0.773	142.28	2808
200	25	8.37	6.1	0.467	138.077	5007
250	25	7.71	2.6	0.064	32.504	7834
300	25	7.86	1.8	0.082	58.822	11290

VES-4 Camp Sakhi
Lat:36.78168 Lon:67.31715 Ele:337 m

AB/2	MN/2	Rho (ohm.m)	Sp (mV)	Vp (mV)	In (mA)	K (m)
1.5	0.5	130.34	9.1	1785.072	86.048	13.7
2	0.5	129.13	9.2	308.832	28.175	24.7
3	0.5	117.69	28.7	93.44	21.824	56.2
4	0.5	97.05	19.1	175.171	89.307	100
5	0.5	87.17	19.5	116.831	104.21	157
6	0.5	80.86	18	71.217	98.918	226
8	0.5	73.28	17.2	30.968	84.64	402
8	2	76.53	47.9	137.407	84.606	99
10	2	63.94	30.8	76.667	90.41	156
12	2	56.38	24.3	37.163	72.483	225
15	2	43.61	15.8	20.132	80.136	352
20	2	26.47	12.6	8.215	96.524	627
20	5	27.14	16	22.273	96.672	247
25	5	17.4	6.2	9.002	97.515	389
30	5	11.59	0.9	4.175	99.029	562
40	5	6.7	4.6	1.69	124.802	1001
50	5	5.49	1.3	6.886	175.588	778
50	10	5.98	50.5	2.786	175.559	778
60	10	6.04	22.1	0.406	36.95	1123
80	10	6.53	13.3	1.094	165.927	2003
100	10	7.22	10.8	0.646	139.253	3134
120	10	2.34	4.3	0.179	171.861	4516
120	25	8.3	54.4	1.662	173.348	1790
150	25	9.75	38.7	1.127	158.891	2808
200	25	11.97	36.6	0.224	46.25	5007
250	25	13	39.2	0.5	149.391	7834
300	25	10.31	103.1	0.299	162.917	11290

Table 5VED 5 & 6 measured field data

VES-5 Camp Sakhi
Lat:36.78196 Lon:67.31611 Ele:322 m

AB/2	MN/2	Rho (ohm.m)	Sp (mV)	Vp (mV)	In (mA)	K (m)
1.5	0.5	106.98	12	1280.643	75.212	13.7
2	0.5	92.85	27.4	577.172	73.234	24.7
3	0.5	157.55	28	376.648	65.715	56.2
4	0.5	71.75	25.7	97.028	37.176	100
5	0.5	51.24	28.8	67.665	65.343	157
6	0.5	40.79	31	27.68	52.764	226
8	0.5	36.76	32.3	26.105	79.765	402
8	2	29.62	31.9	7.427	50.221	99
10	2	33.19	37	35.845	50.888	156
12	2	25.98	25.8	17.496	50.785	225
15	2	23.73	23.4	38.581	178.8	352
20	2	21.36	21.8	7.405	60.177	627
20	5	17.31	21.4	7.355	132.156	247
25	5	17.8	85	19.924	131.901	389
30	5	12.56	52.6	10.549	158.267	562
40	5	8.28	44.4	3.552	118.001	1001
50	5	5.82	38.2	1.103	93.761	778
50	10	5.54	24.9	2.238	45.147	778
60	10	5.67	51	0.68	45.243	1123
80	10	4.67	37	0.367	43.175	2003
100	10	7.06	31.2	0.449	98.958	3134
120	10	7.3	30.2	0.233	71.575	4516
120	25	7	162.4	0.236	29.103	1790
150	25	8.2	131.2	0.974	163.189	2808
200	25	9	102.3	0.449	123.483	5007
250	25	8.98	65	0.247	106.985	7834
300	25	10.81	49.5	0.317	164.689	11290

VES-6, Camp Sakhi
Lat:36.77929 Lon:67.31992 Ele:340 m

AB/2	MN/2	Rho (ohm.m)	Sp (mV)	Vp (mV)	In (mA)	K (m)
1.5	0.5	156.93	3.4	970.951	38.876	13.7
2	0.5	141.01	10.8	429.481	35.881	24.7
3	0.5	132.54	10.8	413.904	85.845	56.2
4	0.5	123.14	18.4	303.798	122.067	100
5	0.5	130.39	20.9	155.813	92.914	157
6	0.5	123.36	19.9	97.723	88.972	226
8	0.5	107.68	20.6	17.453	32.461	402
8	2	102.74	4.6	5.178	31.516	99
10	2	83.09	13.9	22.932	20.81	156
12	2	82.12	3.7	108.888	145.797	225
15	2	79.05	3.5	41.839	91.873	352
20	2	60.31	3.3	25.833	133.214	627
20	5	50.99	31.4	57.774	133.478	247
25	5	43.22	23.3	45.85	199.988	389
30	5	39.11	20.3	15.785	110.952	562
40	5	24.17	17.7	9.611	196.797	1001
50	5	14.78	16.1	2.371	124.683	778
50	10	16.59	20.5	5.586	126.97	778
60	10	12.16	32.2	1.948	88.052	1123
80	10	10.09	33.8	0.482	47.259	2003
100	10	8.19	32	0.543	102.954	3134
120	10	8.47	4.1	26.624	184.311	4516
120	25	7.61	96.5	1.619	184.072	1790
150	25	8.4	52.7	0.881	144.223	2808
200	25	8.81	26.1	0.544	152.925	5007
250	25	9.73	13.7	0.265	105.91	7834
300	25	9.25	6	0.15	91.268	1129(

Table 6VES 7 & 8 measured field data

VES-7, Camp Sakhi
Lat:36.78240 Lon:67.32468 Ele:365 m

AB/2	MN/2	Rho (ohm.m)	Sp (mV)	Vp (mV)	In (mA)	K (m)
1.5	0.5	65.38	25.8	522.506	50.216	13.7
2	0.5	57.84	16.4	218.536	44.511	24.7
3	0.5	63.65	12.7	55.297	23.882	56.2
4	0.5	72.41	14.9	55.296	37.788	100
5	0.5	98.02	22.5	41.954	33.279	157
6	0.5	84.55	91.1	23.727	31.518	226
8	0.5	82.21	4.8	24.171	58.886	402
8	2	84.98	44.8	105.623	58.571	99
10	2	78.54	39.4	35.036	33.633	156
12	2	65.71	35.3	26.563	44.451	225
15	2	53.84	33.4	11.753	37.888	352
20	2	36	31.7	4.87	42.08	627
20	5	39.97	42.8	14.581	42.976	247
25	5	26.71	25	4.412	31.128	389
30	5	16.61	14.8	1.475	24.411	562
40	5	8.91	9.2	0.688	38.2	1001
50	5	6.81	6.2	0.58	66.26	778
50	10	7.39	21.1	1.554	79.293	778
60	10	6.89	21.5	0.96	76.594	1123
80	10	7.04	15.3	0.688	96.649	2003
100	10	7.04	13.6	0.265	58.565	3134
120	10	8	10.6	0.584	163.956	4516
120	25	7.49	30.4	1.432	165.538	1790
150	25	7.55	33.3	0.093	16.958	2808
200	25	6.94	32.9	0.043	15.319	5007
250	25	8.92	31	0.081	35.104	7834
300	25	3.33	29.4	0.007	12.091	11290

VES-8 Camp Sakhi
Lat:36.78173 Lon:67.31544 Ele:337 m

AB/2	MN/2	Rho (ohm.m)	Sp (mV)	Vp (mV)	In (mA)	K (m)
1.5	0.5	107.33	15.2	1638.87	95.936	13.7
2	0.5	101.86	28.6	684.028	79.111	24.7
3	0.5	97.79	13.2	649.428	78.239	56.2
4	0.5	70.06	21.9	358.349	140.599	100
5	0.5	51.76	13	100.617	96.176	157
6	0.5	34.69	13.3	30.724	99.472	226
8	0.5	22.8	13	4.24	37.247	402
8	2	18.06	3.1	5.472	22.839	99
10	2	14.22	0.7	1.583	12.237	156
12	2	10.84	0.8	2.256	36.108	225
15	2	8.7	1.3	1.139	40.705	352
20	2	8.97	52.3	3.108	40.814	627
20	5	7.58	27.9	2.986	74.269	247
25	5	6.21	21.9	1.01	44.712	389
30	5	4.8	15.1	0.637	65.736	562
40	5	4.92	8.9	18.191	34.421	1001
50	5	4.46	50.2	0.24	20.268	778
50	10	4.5	15	0.709	86.716	778
60	10	5.1	3	0.362	70.139	1123
80	10	5.91	1.8	0.419	110.205	2003
100	10	6.1	5.6	0.095	34.941	3134
120	10	6.98	46.3	6.041	35.573	4516
120	25	6.45	49.2	0.134	18.017	1790
150	25	5.83	53.3	0.066	15.617	2808
200	25	7.82	62.8	0.143	45.328	5007
250	25	8.33	73.2	0.131	61.024	7834
300	25	10.62	81.1	0.002	0.007	11290

4.4 Interpreted field data

The collected field data were interpreted by IPI2 wins software. The interpreted data were used to calculate apparent resistivity, thickness, depth and boundaries of layers.The interpreted data are shown in Table 7.

Table 7 Interpreted data

No	VES Profiles	Vertical Electrical Sounding data interpretation results				Expected lithology of layers
		App-Resistivity (Ohm.m)	Layer	Thickness (m)	Depth (m)	
1	VES-1 LAT: 36.77377 LON: 67.32578	111	1	0.75	0.75	Loess, sand, gravel
		1.4	2	0.05	0.806	Silt clay (evaporative)
		701	3	2.23	3.14	Dry sand and gravel
		6.64	4	54.5	57.1	Silt clay
		25.2	5	87.1	145	Sand, silt clay
		0.0661	6	?	?	?
2	VES-2 LAT: 34.37914 LON: 67.32362	111	1	0.75	0.75	Loess, sand, gravel
		1.01	2	0.0411	0.791	Silt clay (evaporative)
		724	3	2.25	3.05	Dry sand and gravel
		6.65	4	56.8	59.9	Silt clay
		30	5	72.6	132	Sand, silt clay
		0.0666	?	?	?	?
3	VES-3 LAT: 36.77610 LON: 67.31688	39.6	1	1.74	1.74	Loess, sand, gravel
		0.565	2	1.28	3.02	Silt clay (evaporative)
		148	3	1.86	4.88	Dry sand and gravel
		4.11	4	7.44	12.3	Silt clay
		1.47	5	5.16	17.5	silt clay

No	VES Profiles	Vertical Electrical Sounding data interpretation results				Expected lithology of layers
		App-Resistivity *(Ohm.m)*	Layer	Thickness *(m)*	Depth *(m)*	
		8.25	?	?	?	?
4	VES-4 LAT: 36.78168 LON: 67.31715	143	1	1.45	1.45	Clay, silt sand
		77.1	2	7.26	8.71	Silt sand, clay
		4.64	3	55.3	64	Clay, silt sand
		20.6	4	?	?	Silt sand, sand
	VES-5 LAT:36.78196 LON: 67.31611	128	1	2.39	2.39	Clay, silt sand
		25.2	2	17.4	19.8	Silt sand, clay
		1.21	3	15.4	35.2	Clay, silt sand
		14.5	4	?	?	Silt sand, sand
6	VES-6 LAT: 36.77929 LON: 67.31992	137	1	1.91	1.91	Clay, silt sand
		73.2	2	6.36	8.27	Silt sand, clay
		10.2	3	28	36.3	Clay, silt sand
		4.14	4	39.1	75.4	Silt sand, sand
		30.6	*5*	*?*	*?*	Silt sand, sand
7	VES-7 LAT.36.78240 LON.67.32468	104	1	0.785	0.75	Clay, silt sand
		7.71	2	0.177	0.927	Silt sand, clay
		344	3	1.95	2.88	Clay, silt sand
		18	4	10.6	13.5	Silt sand, sand
		2.7	5	20.5	34	Silt sand, sandandclay
		31.7	6	35.8	69.8	Sand, silt sand
		0.918	7	?	?	?
7	VES-8 LAT.36.78173L ON .67.31544	121	1	2.18	2.18	Dry sand, gravel and clay sand
		10.2	2	10.6	12.78	Silt clay and clay
		1.2	3	4.8	17.6	Clay, silt clay
		6.6	4	169	187	Clay, silt clay
		425	5	?	?	?

Table 8VES#1, VES#2, VES#3, VES#4, VES#5, VES#6, VES#7, and VES#8 interpreted data

4.5 Vertical Electrical sounding field data Graphic interpretation

The VES -1, VES-2, VES-3, VES-4, VES-5, VES-6, VES-7 and VES-8 field data (apparent resistivity versus Electrodes distance) were interpreted withIPI2 win software as well as manually. The boundaries, thickness and depth of rocks layers were determined according to the measured and computed apparent resistivity and geo electrical model (Table 7). The rock types were specified according to the computed apparent resistivity based on the geophysical interpretation principles. The Apparent resistivity versus Electrodes distance curves for VES -1, VES-2, VES-3, VES-4, VES-5, VES-6, VES-7and VES-8are shown in the Figure 7, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13 and figure 14.

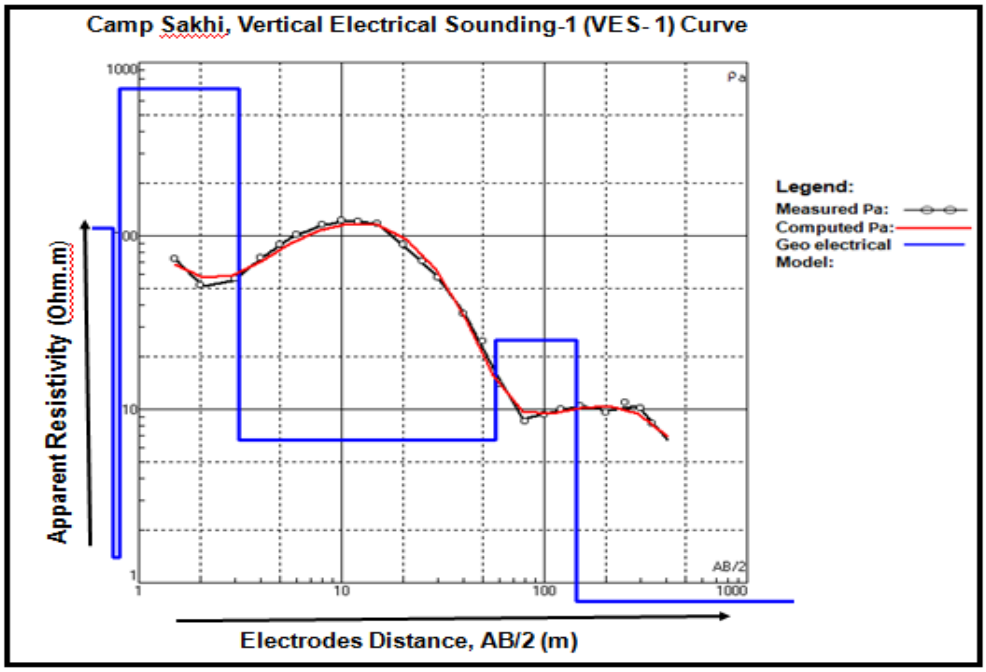


Figure 7VES 1 Curve

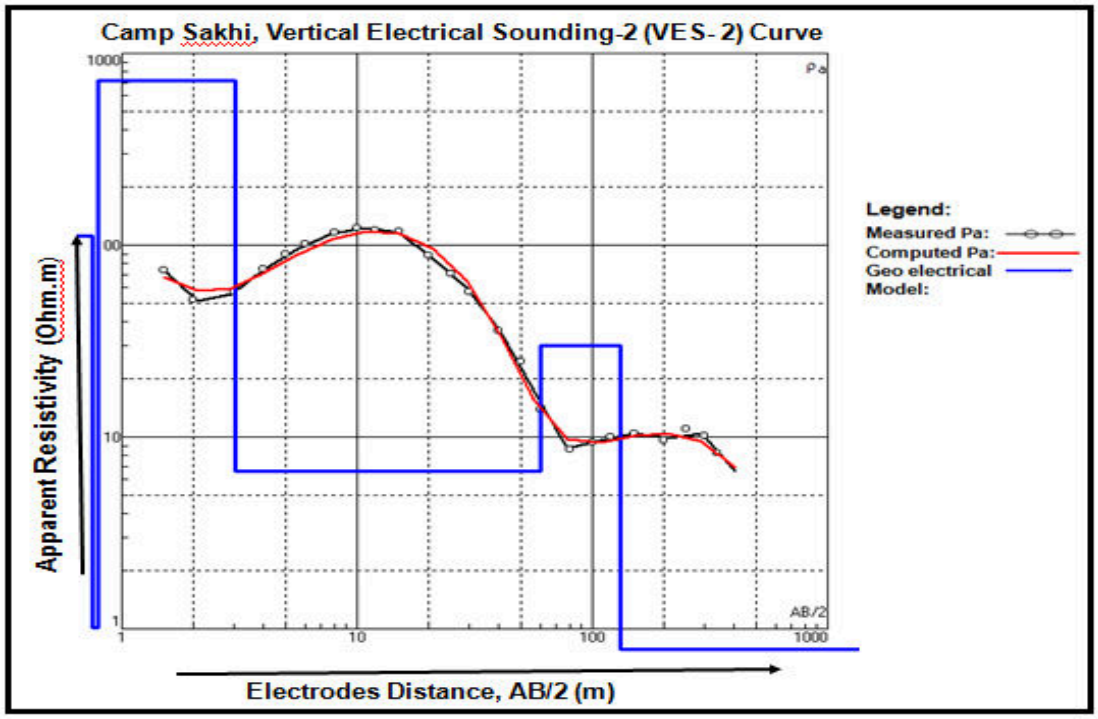


Figure 8VES 2 Curves

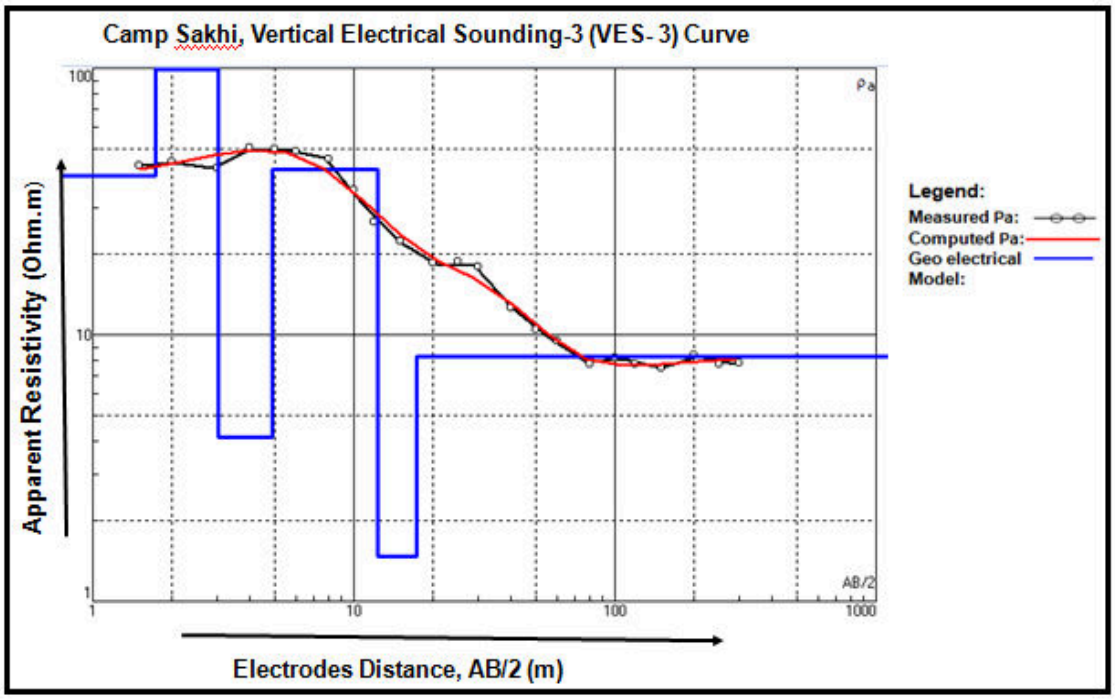


Figure 9VES 3 Curves

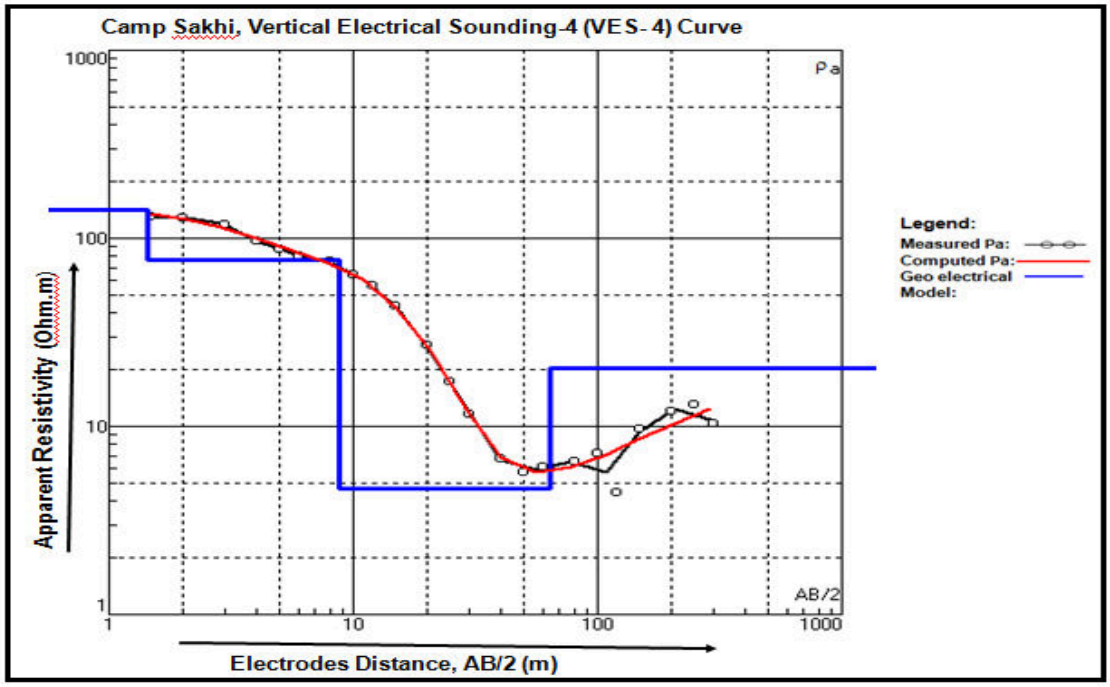


Figure 10VES 4 Curves

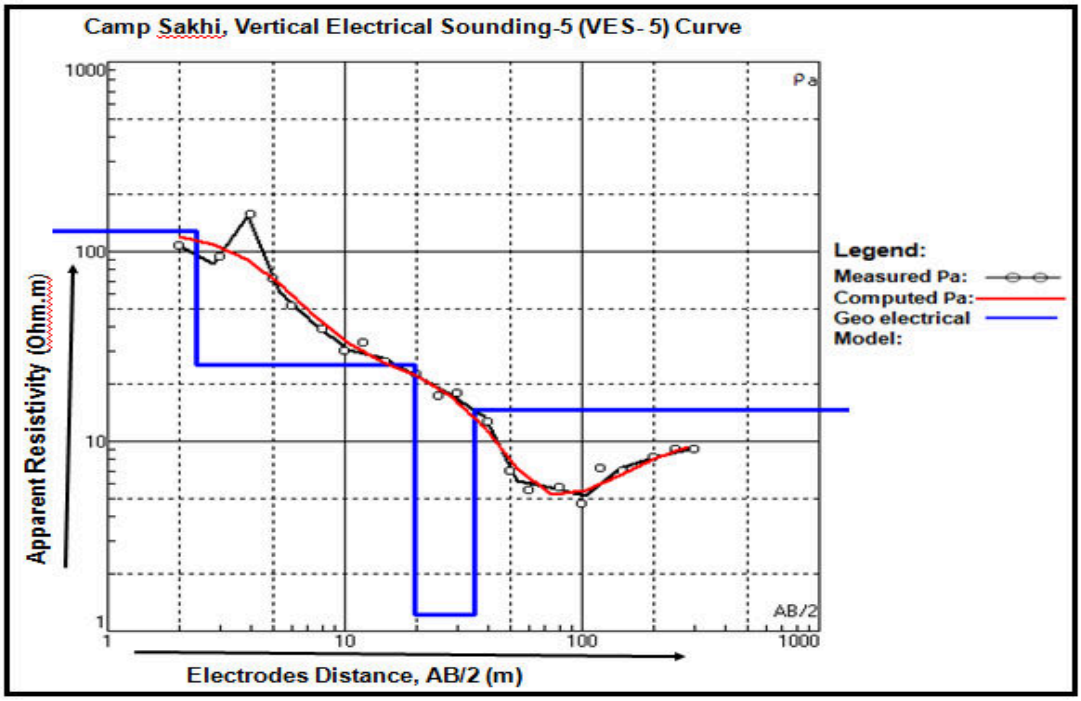


Figure 11VES 5 Curves

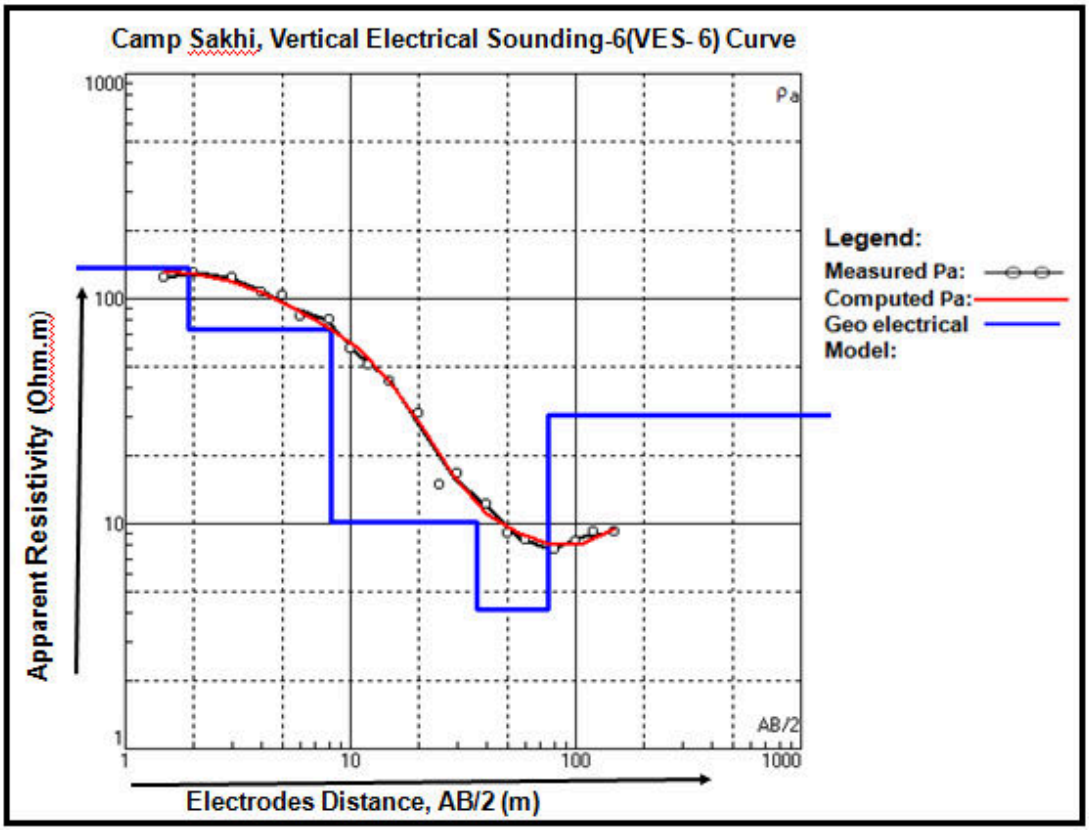


Figure 12VES 6 Curves

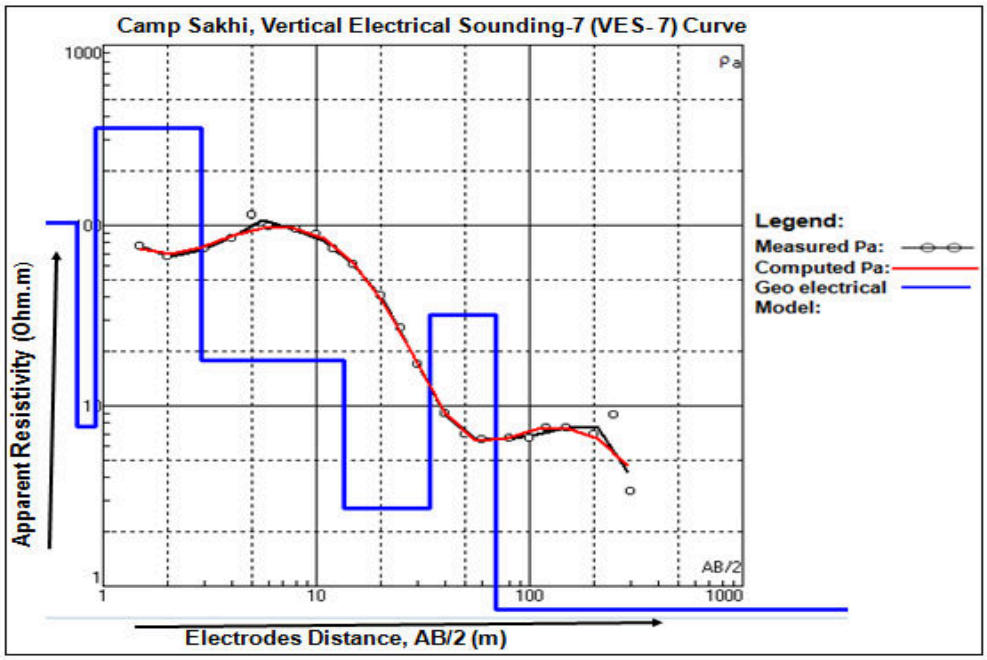


Figure 13VES 7 Curves

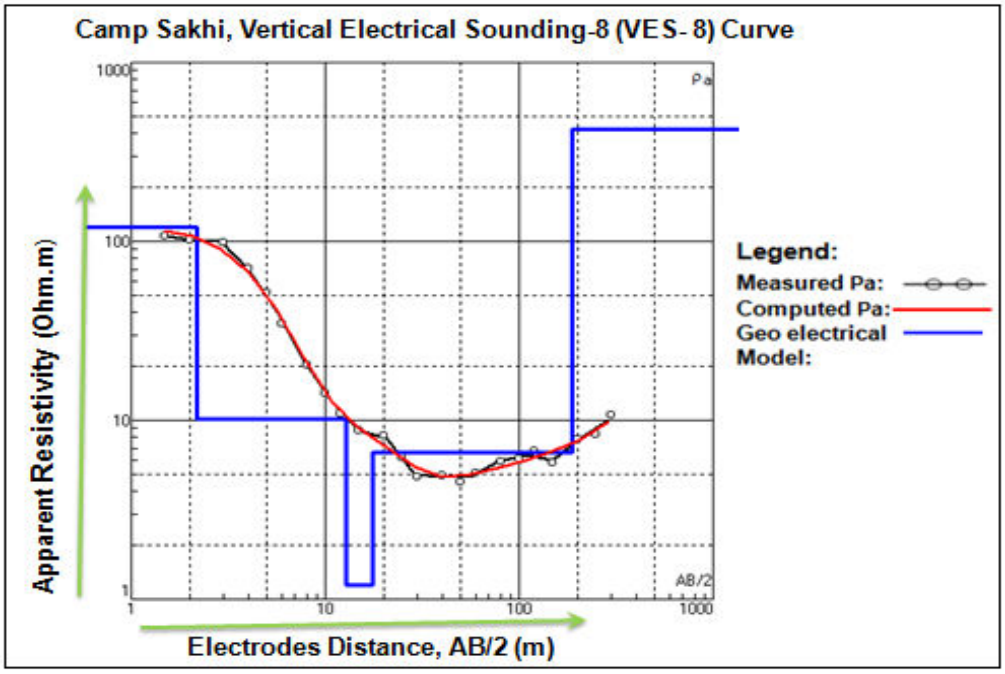


Figure 14VES 8 Curves

4.6 VES profiles field data Graphic interpretation results

The measured, computed apparent resistivity and geo electrical curves show:

- The field data graphic interpretation ofprofiles VES-1, VES-2, VES-3, VES-7 andVES-8 show that the aquiferconsists of silt, silt clay and has saline water. The groundwater salinity ranges from 3800 µS/cm to 5370 µS/cm. The water table range from 21 m to

24m. Therefore groundwater couldn't be developed for drinking purposes due to having high salinity.

- The field data graphic interpretation ofprofiles VES-4, VES-5 and VES-6 shows that the upper part of aquifer layers consists of clay, sand, silt and clay sandand the aquifer consist of sand, silt, somewhat thenlayers of gravel and clay sand. The upper part of aquifer has saline water and the lower part of aquifer has tolerance drinking water (2800 -3100 µS/cm). The water table range from22 m to 25 m. Therefore, these VES profileshave relatively good possibility for development of groundwater than the other VES profiles.

5. Conclusion

1. The VES -1, VES-2, VES-3,VES-7 and VES-8 field data (apparent resistivity, computed resistivity and geo electrical model)interpretation results show:

    - The aquifer layers consist of sand, silt and clay sand.
    - The water table ranges from 21 m to 24 m.
    - The groundwater salinity ranges from 3800 µS/cm to 5370 µS/cm.
    - The aquifer has saline water and groundwater couldn't be developed for drinkingpurposes due to having high salinity.

2. 2.The VES -4, VES-2 and VES-8 field data (apparent resistivity, computed resistivity and geo electrical model) graphicinterpretation results show:
    - The aquifer layers consist ofsand, silt, somewhat then layers ofgravel and clay sand.
    - The water table ranges from 22 m to 25 m.
    - The upper part of aquifer has saline water and the lower part of aquifer has relatively fresh water (2800 - 3100 µS/cm), this range is not according to WHO limit, but it is according to the upper limit of WSG
    - These VES profiles have relatively a good possibility for groundwater development than the other VES profiles

6.Recommendation

- The Camp Sakhi Town (study area) is one of problematic area due having saline groundwater. The salinity of groundwater is not according to the WHO limit, but the profiles VES-4, VES-5 and VES-6 show relatively good possibilities than the other VES profiles, and the groundwater salinity (2800 - 3100 µS/cm)is tolerancefor drinking according to the upper limit of WSG.
- In the study area (as well as in the surrounding of this camp) is not available other alternative water resources (fresh groundwater and surface water) for provision of safe drinking water. The groundwater is only source of drinking water in this area.
- The discharge of groundwater couldn't determine by this study (Geophysical survey). We couldn't find the existing drilled well hydraulic properties which were drilled by deferent organizations in this area, thereforethe discharge of well willbe determined after performingof pumping test.
- The well should be drilled to the depth of 140 m. The salinity of water bearing formation should be monitored during the drilling process.
- If the well drills by Rotary Rig. It is suggested to perform the well logging geophysics for finding suitable intervals of screen installation and blocking of saline water.