NOVATEUR PUBLICATIONS
International Journal Of Research Publications In Engineering And Technology [IJRPET]
ISSN: 2454-7875
VOLUME 2, ISSUE 4,March -2016

DEMARCATION OF SALINE BELT USING COMBINATION OF WENNER AND SCHLUMBERGER METHODS FOR 3-D MODELING

G.V.V. Rameswara Rao,
Research Scholar, Gitam Unversity.

Dr.D.Mukund,
Associate Professor, Dept of Civil Engineering. Gitam Unversity.

E.V.Raghava Rao,
Professor, Visakha Technical Campus.

Dr.R.P.Das,
Professor, VIIT.

ABSTRACT
In many areas of the India, ground water is been used as a main source of water and as per Indian rituals it is also considered as fresh and well filtered source of water. The ground water supply is continually depleted. It calls for increasing the awareness for increasing the importance of ground water management and increase the water restoration capacity in the ground. A cost effective solution has been proposed optimize Wenner array and Schlumberger array methods of resistivity measurements. Sample data taken in coastal areas have been analysis for simple 3D modeling.
KEY WORDS: Wenner array, Schlumberger array, Resistivity, Sea water.

I. INTRODUCTION

Most of the populated areas of the world use groundwater as the main source of freshwater .Freshwater is getting continuously depleted as the population is increasing .The importance of groundwater monitoring and management are becoming all the more important . A major concern in a wasted belts in the included flow of saltwater into freshwater aquifer due to mainly pumping .In areas where groundwater is pumped from aquifer connected sea ,induced effect causes a gradient for migration of saltwater. The controlling mechanism rest on the balance between water pumped from aquifer and amount of water buy replenished. Geophysical methods are very useful for coastal areas. A proper matching has to be done between geophysical methods and surveying objects. Extensive surveying has been done by Vacquier and others (1957).

II. RESEARCH METHODOLOGY:

To achieve an objective of the study, Intrusion of seawater implies the movement of seawater into freshwater aquifers due to natural processes human actions. Fresh water is less dense than seawater and so it floats on top of seawater when the unconfined aquifer contacts the sea at the shoreline. Freshwater recharge move down gradient and eventually gets into low lying areas. Migration of seawater into freshwater aquifer is known as seawater intrusion. The interface zone is like a transition zone which depends on

a) Tide, b) Relative density, c) Pumping of wells & d) Rate of recharge and other parameters like hydraulic features of aquifer.

Pumping out of freshwater diminishes the weight of overlying freshwater which can decrease on even reverse the seawater movement. In that case, sea water moves landward into freshwater aquifer. Seawater rises 40m for every 1meter freshwater depression and forms cone of ascension.

III. CONDITIONS OF DEMARCATION:

Resistivity of fresh ground water varies from 10 to 100ohm m depending on concentration of salts. Alluvium has 10 to 800ohm m. salty sea water has approx 0.2ohm m resistivity.

In marine clay we have to consider hydraulic conductivity $K = c(d_{10})^2$

MN= potential electrodes
AB =outer electrode
AR = apparent resistivity
k= hydraulic conductivity 0.004 to 0.1 $cmsec^{-1}$
C= constant
C value 40-100 ($cmsec^{-1}$)
Soil shows moderate permeability ($4*10^{-5}$ to $1*10^{-4}$ $msec^{-1)}$
d10= 0.001 cm ($cmsec^{-1}$)

IJRPET

Table 1: Representing about Apparent Resistivity values

Sr. no	AB/2	MN	AR
1	1	10	60
2	10	100	50
3	20	200	55
4	50	500	55
5	100	1000	65
6	100	1000	10
7	500	5000	3

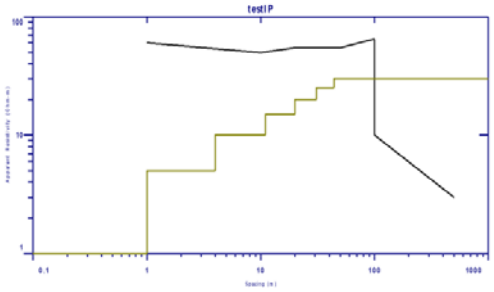

Figure 1:1D Image of site

Array selection:

Wenner array is the obvious choice as the ground transverse given by it provides a dense near surface covers of resistivity data. This also provides a good vertical resolution and provide very clear image of groundwater and sand clay boundaries as horizontal structures.

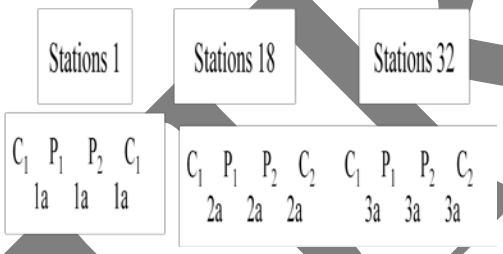

Table 3 Positions of electrodes

Electrode number	1	2	3	…	…	20
n=1		1				
n=2			18			
n=3				32		
n=4					56	
n=5						

Table 2: Represents the resistivity model

ρ_0	Thickness	Depth	Elevation
1	1.000	1	-1
5	3.000	4	-4
10	7.000	11	-11
15	9.000	20	-20
20	11.00	31	-31
25	13.00	44	-44
30	15.00	59	-59

Steps for developing seawater-freshwater infrastructure:

1) Estimate transition region of one hundred years 1950
2) Estimate transition region of when pumping is done 1960-1990
3) Low pumping rates 1990-2015

In ERT it was fixed that up gradient change is 0mg/l where as TDS transparent down gradient is 30mg/l

Choice of configuration:

$$\Delta V = \frac{\rho}{< \pi}\left(\frac{1}{r_1} - \frac{1}{r_2} - \frac{1}{r_3} + \frac{1}{r_4}\right)$$

It is in the form that dipole - dipole or pole dipole have more semi huts for 3d freeze.

Inverse method:

Sankarnaryan (1974) discussed these techniques methods for modeling:

1) Plotting a/ρ a against a
2) Plotting 1/a against of ρ

$$\frac{a}{\rho_a} = \frac{1}{2R} * 3.14$$

For Plotting 1/r , the results must be multiplied by 2*3.14 for quality resistivity value as

$$\frac{1}{R} = \frac{a}{\rho_a} * 2 * 3.14$$

ERT studies/3-D modeling

Pole electrode array is used with 2 remote electrodes so that reductions of telluric effects are also taken into consideration.

IJRPET

Inverted resistivity studies give the following results.

$h_1 = (0 - 0.65)$	$\rho_1 = 220$
$h_2 = (0.65 - 1.4)$	$\rho_2 = 130$
$h_3 = (1.4 - 2.4)$	$\rho_3 = 50$ -80
$h_4 = (2.4 - 3.5)$	$\rho_4 = 20 - 50$
$h_5 = (3.50 - 4.7)$	$\rho_5 = 7 - 18$

For salinity of 1.2ppt, electrical resistivity of aquifer was found to be arrow 1.00ohm. For salinity of 0.5ppt, it was around 2.0ohm.

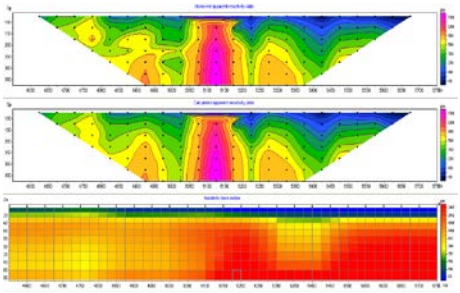

Figure 2: The boundaries layers under focus are marine clay, sand of salt clay

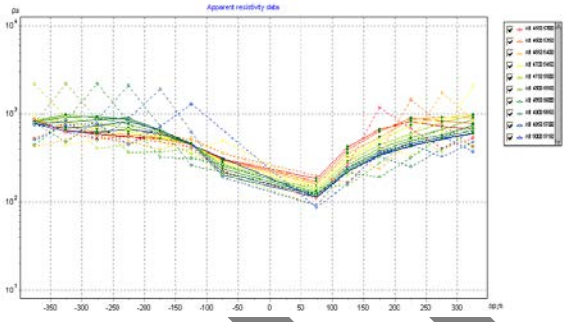

Figure 3: Apparent Resistivity Data

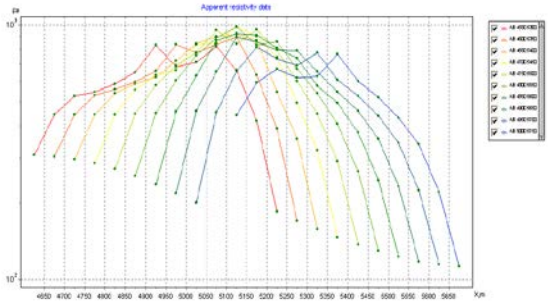

Figure 4: Apparent Resistivity data

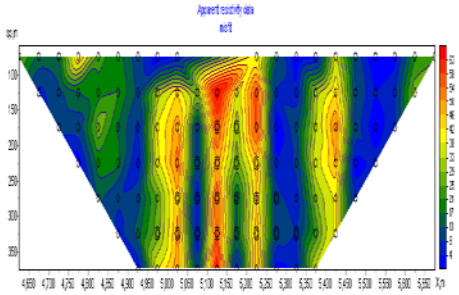

Figure 5: Apparent resistivity data misfit

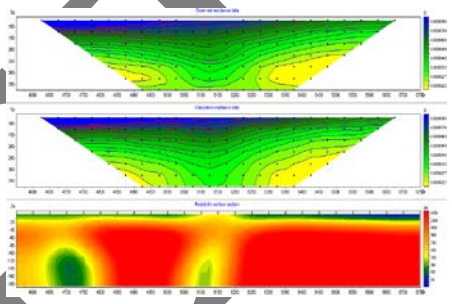

Figure 6: Resistivity in Contour

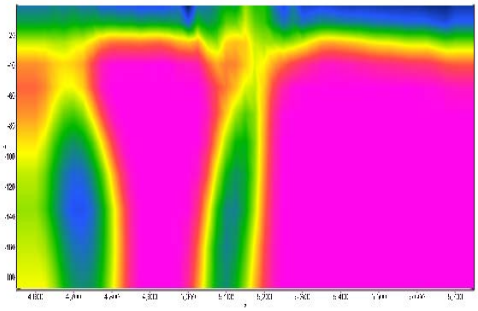

Figure 7: Output in 3D View

CONCLUSION: A detailed electrical resistivity imagining was carried out on the site. While working on this project, BTSK WDDS-2/2B instrument which gives digital reading has been used approximately at every 1.5 mtr to 5 mtr. A method suggested by great scientist wenner has been adopted for carrying out this study and while adopting this method care is taken that profiles must be perpendicular to shore line. The depth of the investigation ranged from 25mtr to 50 mtr. The nice representation of the pseudo section is been drawn by using RES2DINV software. It's been observed that saline water intrusion was approximately at 20 mtr. This is indication of up coning of saline water in the formation of sandstone.

REFERENCES:

1. Zohra Kraiem, Najiba Chkir, Kamel Zouar, Jean Claude Parisot, Aissa Agoun and Daniel Hermitte (2012)Tomographic, *hydrochemical and isotopic investigations of the salinization processes in the oasis shallow aquifers*, Nefzaoua region, southwestern Tunisia, J. Earth Syst. Sci. 121(5):1185–120.0
2. Satriani, A., Loperte, A., Proto, M., 2011. *Electrical resistivity tomography for coastal salt Water intrusion characterization along the Ionian Coast of basilicata region (southern italy)*, Fifteenth International Water Technology Conference, IWTC-15 2011, Alexandria, Egypt.
3. Pujari, P. R., Pardhi, P., Muduli, P., Harkare, P., & Nanoti, M. V. 2007. *Assessment of pollution near landfill site in Nagpur, India by resistivity imaging and GPR. Environmental Monitoring and Assessment,* 13, 489–500. doi:10.1007/s10661-006-9494-0
4. Parasnis, D. S., 1997. *Principles of Applied Geophysics. Chapman and Hall London.* PrenticeHall, p. 413-416.
5. Nur Islami., 2011. *Geoelectrical Resistivity Method For Salt/Brackish Water Mapping*, Journal of Coastal Development, 14(2): 104-114.
6. Naudet,V., Revil, A., Rizo, E., Bottero, J.Y., and Begassat, P., 2004. *Groundwater redox-conditions and conductivity in a contaminant plume from geoelectrical investigations*, Hydrol. Earth Syst. Sci., 8 (1): 8–22.
7. Loke, M.H., 2004. *Rapid2-D resistivity and IP inversion using the least-square method*; Manual for Res2dinv, 3(54):53.
8. Loke, M. H, 1996. Res2dInv, *Rapid 2D resistivity inversion using the least-squares method. Software distributed by Iris Instruments*, Orleans, France.
9. Li, Y., and Oldenburg, D.W., 1992. *Approximate inverse mappings in DC resistivity problems*. Geophy. J. 109: 343-362.
10. Kelly William, E., 1976. *Geoelectric sounding for delineating groundwater contamination. Groundwater*. 14(1):6–10.
11. Keller, G. V., and Frischknecht, F.C., 1966. *Electrical Methods in Geophysical Prospecting, Pergamon*, Oxford, U. K.
12. Harikrishna, K., Ramprasad Naik, D., Venkateswara Rao, T., Jaisankar, G., Venkateswara Rao, V., 2012. *A Study on Saltwater Intrusion Around Kolleru Lake*, Andhra Pradesh, India, Int. J. Eng. and Tech. 4(3):133-139
13. Hallof, P.G., 1957. *On the interpretation of the resistivity and induced polarization measurements*, Ph.D. Thesis, MIT, Cambridge.
14. Griffiths, D.H., and Turnbull, J., and Olayinka, A.I., 1990. *Two-dimensional resistivity mapping with a computer controlled array*. First break, 8:121-129.
15. Ginzburg, A., Levanon, A., 1976. *Determination of a salt-water interface by electric resistivity depth soundings, hydrological sciences-bulletin- des sciences*, hydrologiques, 19(4):12.
16. Flint, R.C., Jackson, P.D., and McCann, D.M., 1999. *Geophysical imaging inside masonry structures*. NDT&E International. 32: 469-479.
17. Dey, A., and Morrison, H. F., 1979. *Resistivity modeling for arbitrarily shaped three-dimensional short training course lecture notes*.
18. Dahlin, T., and Loke, M.H., 1998. *Resolution of 2D Wenner resistivity imaging as assessed by numerical modeling*. J. Appl. Geophy.38: 249.
19. Bear, J., Sorek, S., and Ouazar, D., 1999. *Seawater intrusion in coastal aquifers: Concepts, methods, and practices.* Kluwer academic publishers.
20. Balasubramanian, A., 1980. *Some aspects of Groundwater Investigations applied in the Swedish International development Authority Assisted Project*, Central Groundwater Board, Coimbatore, Unpublished M.Sc. Thesis, Annamalai University. pp95
21. Avila, M. A., Bud'ko, S. L., Canfield, P. C., 2004. *Anisotropic magnetization, specific heat and resistivity of RFe 2Ge 2 single crystals*, Journal of Magnetism and Magnetic Materials, Volume 270, Issue 1-2: 51-76.

IJRPET