EurAsian Journal of BioSciences
Eurasia J Biosci 13, 459-467 (2019)

Detecting saline and sweet underground water by geoelectric method and preventing mixing them (case study: Zahkolat District, Roodbar, Kerman)

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Abstract
Identification of low or high soluble layers is among the applications of geophysical science, in addition to determining the depth and amount of water, as well as checking the path of the hydrous layer and the genus of the layers of the earth. In order to study the characteristics of groundwater such as depth, thickness and area of aquifer and determining the layers of sweet water and saline water and their salts and their separation, a hydrologic survey was conducted in the area of a well in the Roodbar city of southern Kerman province (Zahhkolt region). Also in this research, areas with high discharge potential are determined based on geophysical data. Hydrology studies were conducted to determine the complexity of the aquifer, to determine the depth and thickness of the hydrous layer, to determine the boundary of saline and sweet water, and to determine suitable sites for drilling wells. By determining the surface and deep salty water layer, a solution was necessary to isolate the salty water layer surface to prevent penetration into the deep-water layer and the maximum depth of drilling for freshwater extraction was determined.

Keywords: salty water layer, electrical resistivity method, Schulmemberger array, catheterization and profiles composition, Geophysics ecological, stable level

Mostafavi SA, Fallahpour M, Banadkouki FB (2019) Detecting saline and sweet underground water by geoelectric method and preventing mixing them (case study: Zahkolat District, Roodbar, Kerman). Eurasia J Biosci 13: 459-467.

INTRODUCTION

Underground water is one of the most important sources in every country. Several factors affect the quality of aquifers, the most important of which is the penetration of saline water into freshwater aquifers. This causes many ecological problems that should be followed by suitable methods for controlling and determining their spread.

As a result, the excessive withdrawal of sweet water from the beaches of the seas, lakes, as well as around the deserts, saltines and the like, the state of balance between salt and sweet water, and saline waters advance to the sweet groundwater resources (Hojjat and Ranjbar 2011).

Due to the fact that it is located in a dry area, the country has a significant surface area covered with pasture lands. Also, the groundwater of most parts of it has high levels of salts. Given the natural economic and social conditions of the country, there is a strong need for sweeter drinking and can be consumed in industry and agriculture. Since natural freshwater is not needed at all points and is really rare in some places, using the appropriate techniques and techniques, the identification of the boundaries of sweet and salty water, the type of table, and the quality and amount of salts The water available to decide on the optimal use of freshwater and the adoption of measures for the use of salt water (Hojat and Sakhi 2003).

Special electrical resistance techniques have been starting since the early 1900's and have been expanding since 1970 with regard to computer processing that was used to analyze its data. This method, in addition to mining exploration, is widely used in groundwater resource studies (Noroozi 2013).

Undoubtedly, the most widely used method is the special resistance to exploration of groundwater resources. With this method, we can obtain important information in hydrology and groundwater resources and reduce the cost of exploratory boreholes. This method answers the following objectives well:

Understanding homogeneous hydrous sand

- Determine the depth of groundwater and the hydrous layers
- Determine salinity and salinity levels and assess the degree of salinity of water

Received: November 2018
Accepted: April 2019
Printed: May 2019

Other sources of saline penetration and contamination of agricultural and drinking water wells can be named the return flow of salt water from agriculture and animal wastes and solid and solid waste of industrial and urban and desalinates and permeance (including permeance of oil and sewage) and road washing of ice.

Also, salty water may attack sweet aquifers and cause a spill or diffuse source, especially if there is a salty water flow in the upper layers. The records of the first studies of salty and sweet water are as follows:

The first example of the study of Van Dam and Molen Camp in the Netherlands has identified the nature of the hydrology of the western part of the Alkmaar region of the Netherlands. To determine the vertical distribution of saline and sweet water sources, as well as their lateral expansion in this broad area, more than 50 electric gauge boreholes have been taken. The data obtained from a number of exploratory boreholes according to the special resistance tables shows that in the west of Alchemar, a thickness of 30 meters from salty water sands with a Natura clay layer separated from sweet sands (about 10 meters thick) (Noruzi 2013)

The second example relates to water exploration studies at Grand Cayman Island in the northern part of Caribbean, which Bog and Lloyd did in 1976. Here, water is located in the calcareous layer that has accumulated below due to the difference in the density of salty water and sweet water has accumulated at up of it (Noruzi 2013).

METHOD OF GEOPHYSICS STUDIES (MATERIALS AND METHODS)

Geoelectrics is one of the main branches of Geophysics applied. Geophysics is used to provide a map of the underground resistance structure. Determining the strength of soil and water for hydro-geological purposes is very suitable.

Apart from the electrode array used to measure a special power with direct current, there are two measurement trends in special resistance studies. One examines deep-seated variation of the resistivity, which is called an electric field speculation. Another way to follow the variations of the specific resistance is at a relatively constant depth, which is known as profile resistance. Combining these two methods can also be used to visualize the Earth's electrical properties. (Noruzi 2013).

Water resources surveys are carried out in the case of topography that are not picked up and layers have a slight slope. One of the most famous of these is the Schulmemberger array and Wenger (Noruzi 2013).

Given the advantages of the empirical method, they often use "Schulmemberger" symmetrical arrangement for vertical hydrographic surveying. Geophysics studies do not directly determine the type of rocks, porosity, permeability, and similar properties. However, by measuring some of the physical properties of the soil layers and rocks, it is possible to identify the locations where the probability of an optimal aquifer is greater. For more detailed information, the results of the Geophysics surveys should be combined with the results of the exploratory wells. Geophysics studies can identify more suitable locations for well drilling.

Table 1. Resistivity values (in terms of ohm-meter) of groundwater and various materials

Row	Layer Gender	resistivity
1	Groundwater	1 - 100
2	rain's water	30 - 1000
3	sea water	About 0.2
4	Sweet water	14 - 100
5	salty water	0.2 - 14
6	Salty water with salty water	0.1 - 4
7	Incomplete sediments	1 - 100
8	Dense sediments	10 -1000
9	Clay	1 - 8
10	Igneous rock and metamorphosis	100 - 10000
11	Sodium chloride M0.01	0.843
12	Acetic acid M0.01	6.13
13	Granite	1500 – 1,000,000
14	Loose sand	500 - 1500
15	Sandstone	8 - 4000

The method used in this research is the Schulmemberger method, which is based on the transfer of electric current to the ground and the measurement of the potential difference created between two points to obtain the specific strength of different depths of the earth.

By performing a woman's slander operation in two perpendicular directions, one can check for changes in resistivity. If the resistivity is changed only with depth, the results of the two perpendicular impressions are exactly the same. But the difference between the results of two orthogonal views indicates the lateral variation of the resistivity. Given the difference in the two-dimensional data, the intensity of lateral resistivity variations and their effect can be estimated. Only one of these two impressions may be affected by lateral resistivity changes, in which case other harvest data will be interpreted. This technique is especially recommended for catheterization with the Wenner array (Hojjat and Ranjbar 2011).

In geoelectric models, low-resistivity sites indicate the presence of salty water and areas with higher resistivity, reflecting the location of sweet water tables. Usually, sweet water tables float above the salty water, due to the lower sweetness of the water than the salty water (Hojjat and Ranjbar 2011).

In some cases, however, the salty water layer is placed above the sweet water layer, as in the same study, which isolates the pipe and drill tricks, should prevent the penetration of salty water into the sweet water layer. Using geoelectric data, we can conclude In which areas there is a need to stop or limit pumping operations, and also suitable solutions can be provided for water supply projects. Well-rings located at Tekkel

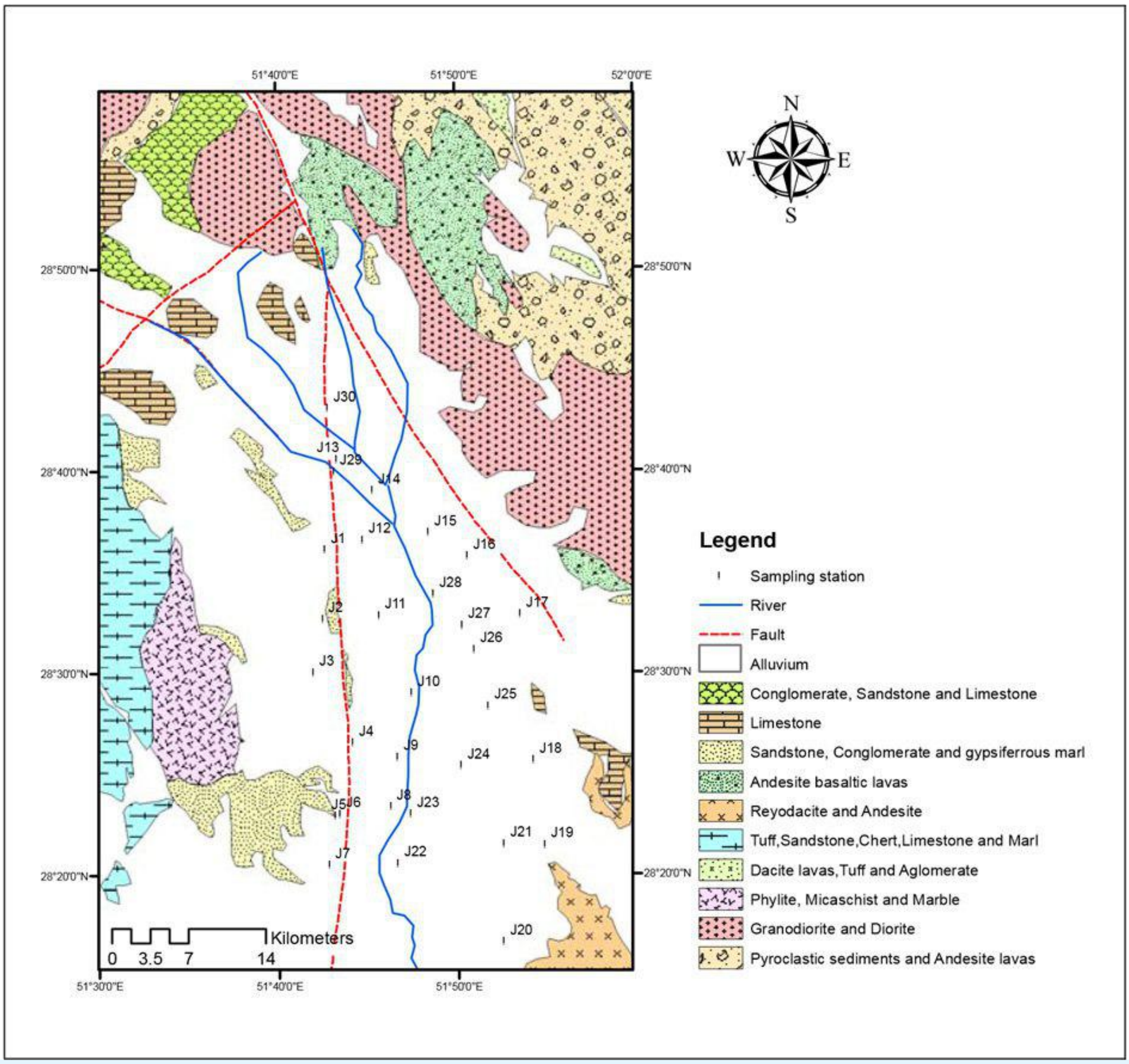

Fig. 1. Geological map of Kerman province

Hassan farm in the Zahhkolt range of Roodbar in the southern province of Kerman That is, the depth of the old well is about 100 meters, and it has a problem of excessive watering and excessive salinity. Performing a bachelor of geophysics and laminarology and providing technical, geological and engineering solutions. The existence of a difference between the specific electrical resistivity between the layers, the design of both the resilient and apparent resistance maps, and the real resistance and the drawing of sections of Geophysics led to the identification of the aquifer and the determination of suitable areas for well drilling with acceptable accuracy.

In this study, according to resistivity measurements in a relatively large number of points measured to determine how to extend the zones of hydrous, passion and sweet, the resistivity data are correlated with exploratory boreholes, which the researcher followed in this study. The layering characteristics of the two suitable hydrous sites were expressed by separating the salty and sweet water layers and the following results were obtained from the ground layer scan:

1. The first point (at a distance of 16 meters north of the well) with a volume of 40 R 0637245 3070369

This is as follows:

Scanning ground layers at the first point at a distance of 16 meters north of the current well is as follows:

From the surface of the earth to a depth of 4 meters, the surface soil is dry, from 4 meters to a depth of 40 meters, the semi-hard part of the soil and compact pebbles, located 40 meters down to a depth of 67 meters, a fine gravel layer and clay with a very low drainage and a drainage with salts It is abundant and is

Table 2. Layer resistance, gender layer and layer thickness of soil

Row	Layer resistance	Gender Layer	Layer thickness
1	24	Surface Soil	From ground to depth of 4 meters
2	12	The pebble and fine sand and the sweet water flow	From a depth of 4 meters to 40 meters
3	6	Clay layer and salty water	From depths of 40 to a depth of 67 meters
4	20	Medium and coarse sand layers along with sweet water (sweet layers)	From 67 to 125 yards
5	8	The fine and medium layer with low to moderate water and salts (deep water salinity layer)	From 125 yards to 140 meters
6	8	Salty water layer and saltiness have high levels of salts	From 140 yards later

found from a depth of 67 meters to 125 meters of medium and coarse sand, along with water (abrasive layer). From 125 meters to 140 meters, the sandy and medium layer is seen with a moderate weakness (semi-saline alluvial layer) and From 140 meters below, the salty layer of clay and saltines have high levels of salts.

2. Scan the ground in the second position of the machine with the dimensions of 40 R 0637131 in this way

3070391, is:

The second point is 120 meters west of the well at the location of the device as follows:

From the surface of the earth to a depth of 5 m, the surface of the soil is dry, from 5 m to a depth of 35 m, the soil layer of the clay and water is a weak drain, located 35 m below and down to 83 m, a layer of mixture of clay and salty water with abundant salts, and from the depth 83 meters to 208 meters of clay layer and water with moderate salts

From 208 meters below, the fine and medium layer with medium drainage (medium alluvium layer and low to moderate salts) is seen. The height of the site is 397 m above sea level.

Table 3. Specifications of the material of the second point layers at a distance of 120 meters west of the well

Row	Layer resistance	Layer Gender	Layer thickness
1	24	Surface Soil	From ground to depth of 5 meters
2	12	Smooth and clay layer with poor drainage water (Surface Alluvial layer)	From a depth of 5 meters to 35 meters
3	5	A mixture of clay and salty water with a lot of alkali	From depths of 35 to 83 meters
4	13.5	The fine and medium layer with medium drainage (low to medium moderate alluvial layers)	From 83 to 208 meters

Table 4. Tables of resistivity catheterizations performed

Error = 4.46%

N	ρ	h	d	Alt
1	24.9	5	5	-5
2	12.4	30	35	-35.02
3	6.24	32.9	67.9	-67.91
4	20.1	57.1	125	-125
5	8.27			

سونداژ شماره1

Error = 3.06%

N	ρ	h	d	Alt
1	24.4	5.09	5.09	-5.085
2	12.8	30.2	35.3	-35.3
3	5.71	47.7	83	-83
4	13.5	125	208	-208
5	13.5			

سونداژ شماره 2

Error = 3.15%

N	ρ	h	d	Alt
1	25.3	4.2	4.2	-4.198
2	14.3	25.8	30	-29.96
3	4.01	32.9	62.9	-62.89
4	54.5	57	120	-119.9
5	1.08			

سونداژ شماره 4

Error = 3.93%

N	ρ	h	d	Alt
1	23.9	5.96	5.96	-5.96
2	11.1	294	300	-300
3	46.6			

سونداژ شماره 3

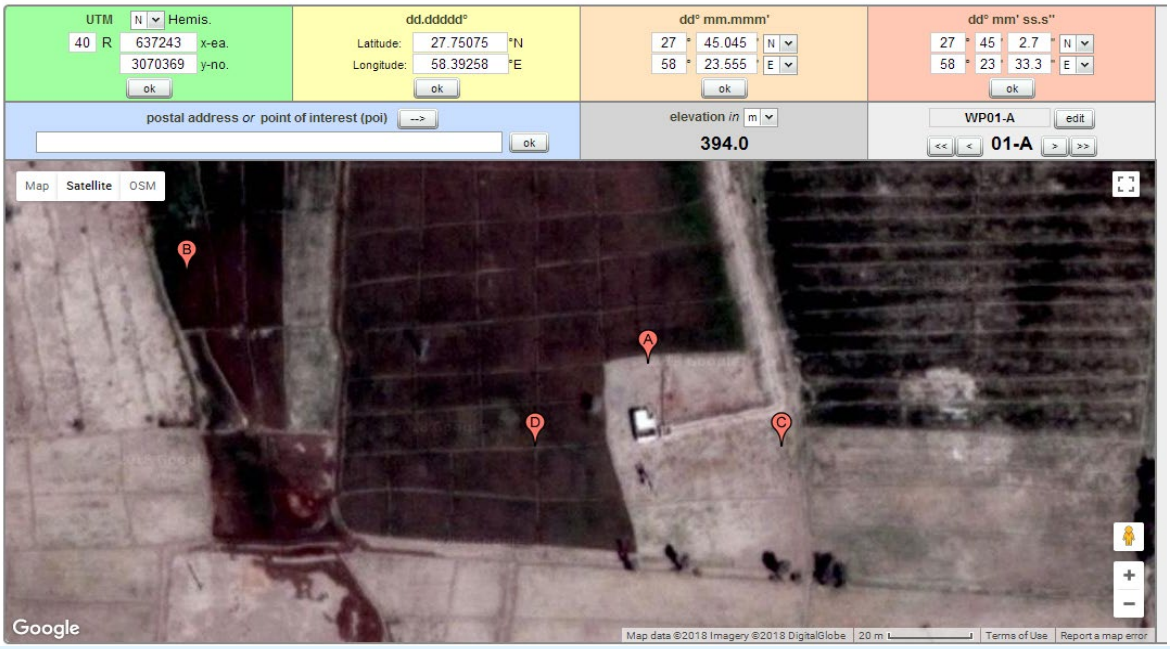

Fig. 2. Wells Aerial Map and Location of Electric Catheterizations and Conversion of GPS Units

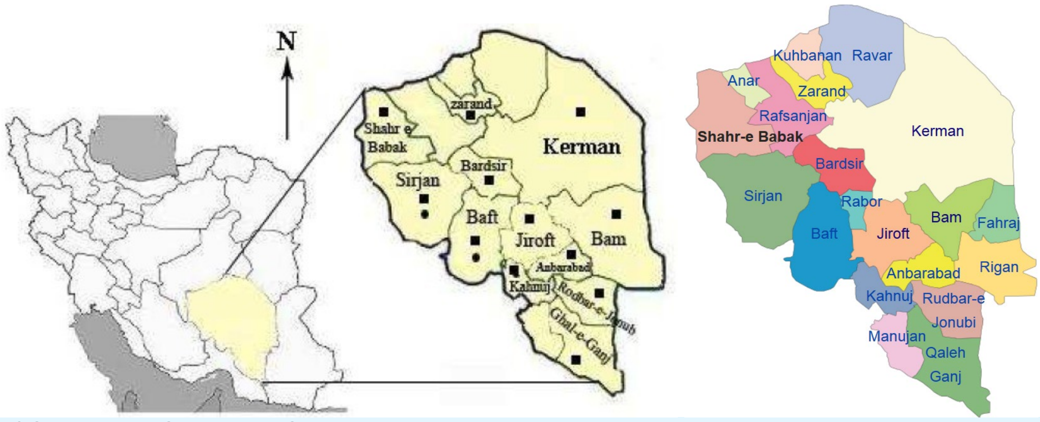

Fig. 3. Map of Geophysics Geography Studies to divisions

Fig. 4. Map of access roads to the location of studies

To detect salty water layer and sweet and provide solutions for the extraction of sweet water, it has been found that in the area around the well and the hydrous layer number contained in the buried river, the hydrous sweet layer was found in the field of geophysics. Point number 1 is extended. Point number 1 is located 16 meters north of the current well (located on the site of the above-mentioned apparatus). The other hydrous is located at 120 meters west of the current well with the above coordinates. And the Water flow has salts and salts in the depths of 20 meters to 70 meters, and its water flow sweet flows at depths between 70 and 125 meters and runs from a depth of 125 to 140 meters in water with moderate salts to medium to high discharge.

The rest of the Earth's underground zone is due to the presence of silicate clay loamy layers that have a large volume, length, width and thickness in the depths. Water flow sweet is suitable as a weak drain with a low layer thickness or no sweet discharge.

Then the point 2, at a distance of 120 meters west of the well, the sandy layer has a moderate thickness and is finely divided and medium. Its sweet water layer is from 15 meters to 35 meters in depth, and its salty water layer is up to depth 83 meters in length and after a depth of 83 meters to a depth of about 200 meters, the water layer is medium in salty and clay-containing clay.

Due to the fact that the hydrous sweet layer in Harvest No. 1 has a coarse aggregate and the intensity of the Water flow, and consequently its discharge rate is higher, a drilling offer was given at point 1.

Providing a solution to avoid the mixing of salty and sweet water in a well borehole is that the best point for drilling a single point 1 is 16 meters north of the current well that should be drilled first to a depth of 120 meters with a drill 24 inches and a diameter of at least 55 centimeter to be done.

From the surface of the earth to a depth of 70 meters, it should be done by a non-lattice wall, preferably double-walled tubing (so-called blind) and absorbed to a depth of 70 meters, without a lattice, and then from a depth of 70 meters to 120 meters, And then inside the wall, using a 14-inch double-spaced tube pipe, in such a way that a depth of 70 meters from the ground surface of the seamless pipework and from 70 meters to 120 meters of the lattice tube is placed and the intubation is carried out in this depth as a lattice Accepted and from a depth of 70 to 120 meters, the pipework should be latched to allow the sweet water to enter the pipe. The maximum drilling depth should be 120 meters.

Then, between two pipe walls, from a depth of 120 meters (bottom of well) to a depth of 70 meters of coarse gravel, then from a depth of 70 meters to the surface of the earth (Wall tube without netted), bentonite soil and concrete or cement as a mixture to insulate. From the surface of the earth to a depth of 70 meters should be a non-lattice wall and blinded so that the salt water does not get into the well. It is called as "wells isolation" in drilling.

CONCLUSION

With the proposal of the researcher, a well at point 1 was drilled at a distance of 16 meters north of the current well with the above coordinates. Then, by placing two hollow tubes from a depth of 120 meters to 70 meters, it has been latched and from the 70 meters to the ground, a non-lattice pipe was placed. Then, two tubes (with lattice) were poured from a depth of 120 meters from the bottom of the well to a depth of 70 meters of coarse gravel, and from a depth of 70 meters to the surface of the earth (which is a non-lattice pipe) Bentonite soil and concrete or cement were injected in a mixture for insulation, and the ends of the wall pipes were sealed by a metal bundle attached to the wall pipe to prevent deep salty water penetration.

After drilling the well with the specification and type of drilling mentioned, and observing the technical principles of laminar and double-conductor intubation with insulation, it was determined that not only the discharge of the wells reached more than 30 liters per second (discharge of the previous well was 8 liters per second), But its salinity has decreased from 10,800 to 1,450 from the previous well.

This was done by insulating and preventing the penetration of saline and semi-deep saline waters (from 20 meters to a depth of 70 meters, the salty water layer was detected) to the hydrous layer with less soluble (sweet water layer and low salinity had been detected from 70 meters to 120 meters). With this, the water obtained and pumped is suitable for the cultivation of horticultural and crop products, which, of course, is due to crop cultivation of this well that is more crops and the cultivation of crops with EC less than 4000 is a good success in the repair of this well Agriculture.

Considering that most of Iran's desert and dry areas, as well as areas with silty clay layers, have high solubility and salinity problems, it is very difficult and time-consuming to detect and determine the salty and sweet water layers without Geophysics operations. According to the researcher Deploying Geophysics operations is very useful in detecting high discharge points as well as determining the sweet and salty water layers. Geophysics studies reveal the characteristics of the layers of the earth and the thickness of the salty and sweet water layers and the stable level of highly soluble aquifers and sweet water tables are recognizable.

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