Focus on CSIR Research in Water Resources

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Groundwater resistivity

Resistivity is a non-invasive geophysical method that can be used to provide additional information on the subsurface. This can then lead to cost-effective answers to geological questions. The bulk resistivity of different subsurface units varies mostly because of either changes in salinity of the groundwater, changes in porosity or changes in water saturation. The resistivity tomography technique is a rapid resistivity acquisition system that provides a pseudo-section ("picture") of the subsurface in terms of changes in resistivity. These changes in resistivity are then related to expected changes in the properties of the subsurface.

The resistivity tomography technique is widely used by the groundwater research group to characterise the subsurface. This includes delineating drilling positions for water supply purposes (changes in both porosity and water saturation); defining pollution plumes around waste sites (changes in salinity of the groundwater) to enable more effective management; aiding in the understanding of surface water/groundwater interaction and groundwater dependant ecosystems (changes in salinity, porosity and water saturation).

The resistivity tomography technique was used on the research project into aquifer dependant ecosystems in South Africa. The Langebaan Lagoon, West Coast National Park, has been classified as a wetland of international importance in terms of the Ramsar Convention because of its diverse bird life. The reed beds, next to the Lagoon, sustain a wide variety of bird life and are fed by groundwater. Langebaan Road aquifer, to the east of the Lagoon, is used for large scale groundwater abstraction and

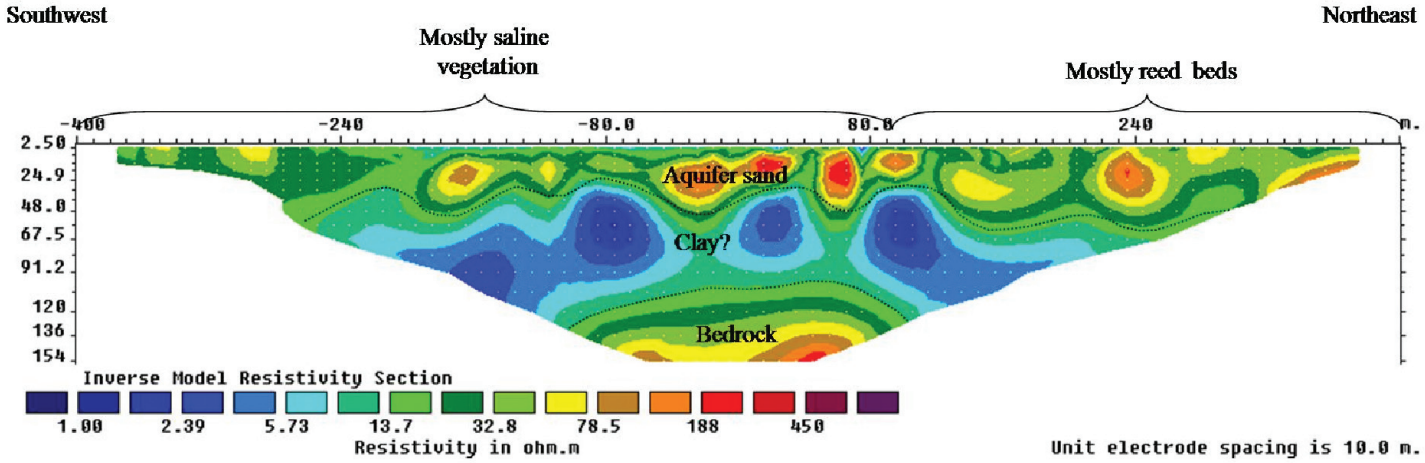

Figure 1: Deep resistivity profile next to Langebaan Lagoon showing vegetation types.

this abstraction might impact on the lagoon. The resistivity technique was used to define controls on vegetation zonation next to the lagoon. The resistivity profile (Figure 1) was acquired next to the reed beds.

The resistivity profile shows an increase in the thickness of the aquifer material that coincides with the reed beds. The geology has been verified by a borehole. Resistivity data were also collected next to the Lagoon where no reeds occur. On this profile the aquifer material was totally absent. The pseudo-section showed a thick succession of clay grading into bedrock. A shallow profile was acquired traversing from saline vegetation to the reed beds to define any local changes in subsurface conditions that control this particular zonation of vegetation. This profile is shown in Figure 2.

The profile shows a clear change in resistivity of the subsurface related to the change in vegetation at the surface. This change is probably related to saline water influx. The lower resistivity of the shallow subsurface where the reeds occur can also be seen. This clearly indicates a mixture of hypersaline lagoon water with fresh groundwater.

The technique has provided sufficient information on the above project, to allow for some management decisions to be made regarding the abstraction of groundwater from the Langebaan Road aquifer to the east of the Lagoon.

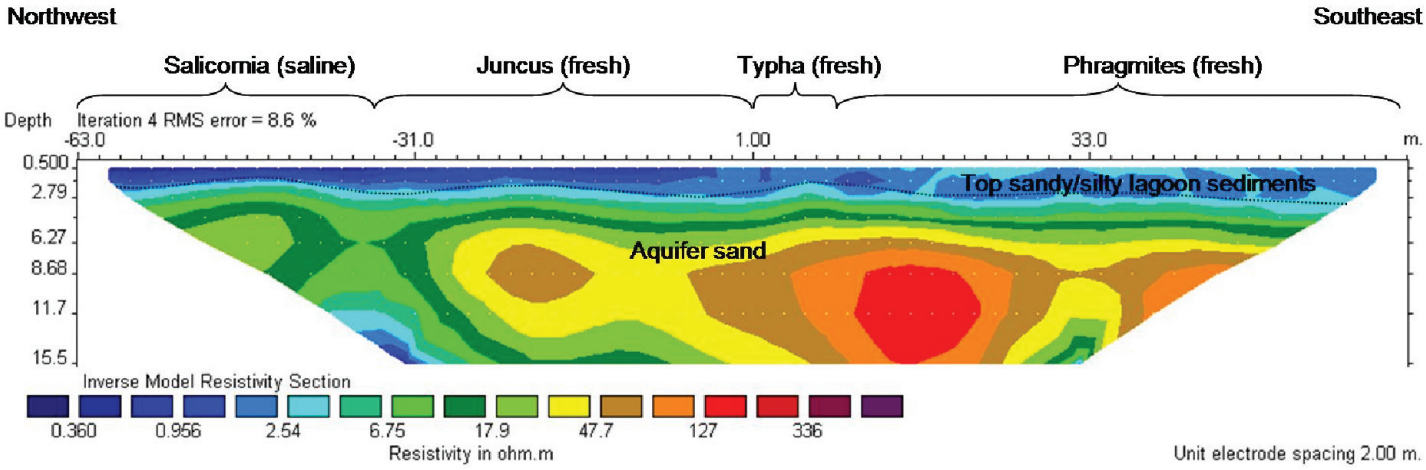

Figure 2: Shallow resistivity tomography profile next to the Langebaan Lagoon to access sub-surface controls on changes in vegetation on a local scale.

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