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DETERMINATION OF THE GROUNDWATER LEVEL BY THE VES METHOD IN THE CHERNORECHENSKY FOREST OF THE GROZNY

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Abstract. *This article presents the results of a VES survey conducted in the Chernorechensky forest area of Grozny. A brief description of the study site is provided, along with information on the survey methods and equipment. The study's findings, including high-quality apparent resistivity sections and geoelectrical sections, were analyzed to draw certain conclusions.*

Key words: *engineering geophysics, VES, apparent resistivity, data processing.*

Introduction

Engineering geophysical methods have recently been increasingly used to study environmental issues. This is primarily due to the fact that geophysical methods allow for a more detailed study of the study object, while maintaining the integrity of the object [1, 2, 4]. Electrical prospecting methods have become the most widely used engineering geophysical method.

At the "Chernorechye" site (Grozny), we conducted vertical electrical sounding (VES) to determine groundwater levels and study engineering and geological conditions. The site is located in the Chernorechensky forest within a water protection zone.

The trees in the study area consist of perennial stands of oak, ash, several species of maple, hornbeam, alder, and other trees. Shrub vegetation is widespread.

The main waterway in the study area is the Sunzha River, which flows from southwest to northeast through the central part of Grozny and is glacially fed. The average river depth is 1.5 meters, and the average flow velocity is 0.8 m/s.

Within the study area, the geological profile is represented by rocks of the Quaternary and Neogene systems, predominantly loams, clays, coarse-grained soils (pebbly, gravelly, or crushed rock with clay and sandy-clay aggregate), and, in places, sand, sandstone, and limestone.

Methodology and equipment

VES was conducted using a symmetrical Schlumberger array consisting of two supply electrodes (grounding electrodes) through which direct current was passed into the ground, and two measuring electrodes between which the potential difference was measured. A battery was used as a current source in the supply line. A portable electrical survey station was used to measure the potential difference and the current passing through the ground [3].

The AB/2 spacing varied from 1.5 to 150 m. At each spacing, the current in the AB line and the voltage in the MN line were measured. The measurement results were recorded in the measuring equipment's memory and in a field log.

The measuring equipment used during the study included the following: the "MERI-24" station and the "Astra-100" generator.

The MERI-24 measuring device allows for signal parameters to be measured and processing results to be obtained in real time. The Astra-100 generator is capable of depth surveys ranging from a few meters to a few hundred meters.

Sounding was conducted using a profile diagram (fig. 1). To more accurately evaluate the results, the profiles were constructed with multiple overlaps.

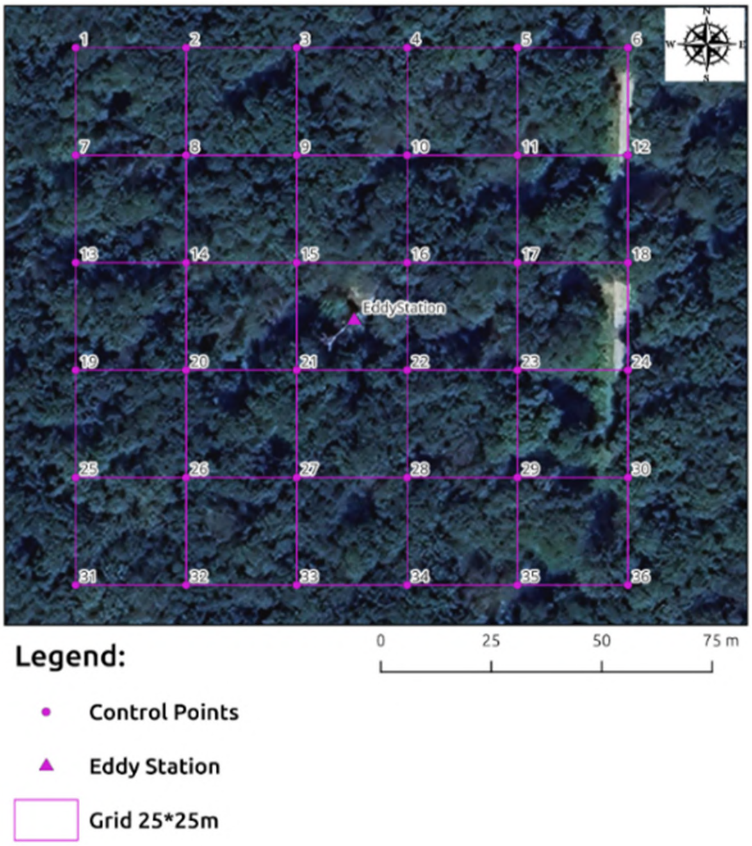


Fig. 1. Profile scheme

A 1:25000 scale topographic map was used as a reference for fieldwork. The coordinate system was WGS84. Geophysical observation points were marked on the ground with wooden pegs or painted, where possible.

The initial evaluation of the VES results was conducted in the field, with repeat measurements taken if necessary.

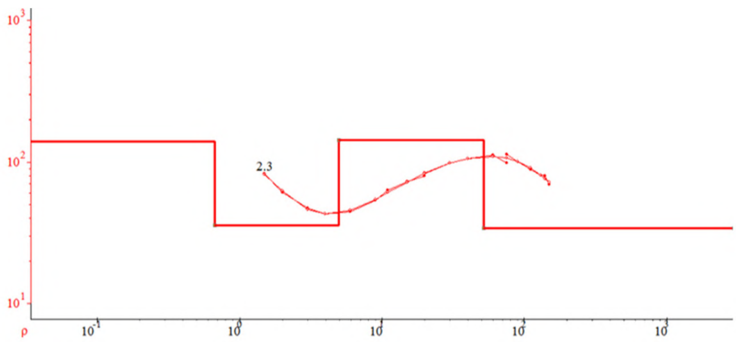
The initial stage of office processing was the conversion of the obtained potential difference values into apparent resistivity values using the formula:

$$\rho_A = K\,(\Delta U)/I,$$

Where: ρ_a – the apparent resistance (Ohm m); K – the installation factor; ΔU and I – are the measured potential difference (in millivolts) and current in the supply line (in milliamperes), respectively.

Field data was processed using ZOND-IP1D, a specialized program designed for one-dimensional interpretation of profile data from various VES modifications. A user-friendly interface and extensive data presentation capabilities enabled the geological task to be solved with maximum efficiency.

The VES data processing and interpretation process consisted of the following: a calculated curve is selected for the VES field curve (Fig. 2). If any point on the VES field curve significantly deviates from the calculated curve, it is adjusted. Such deviations can be caused by local inhomogeneities, underground utilities, interference, terrain features, etc.

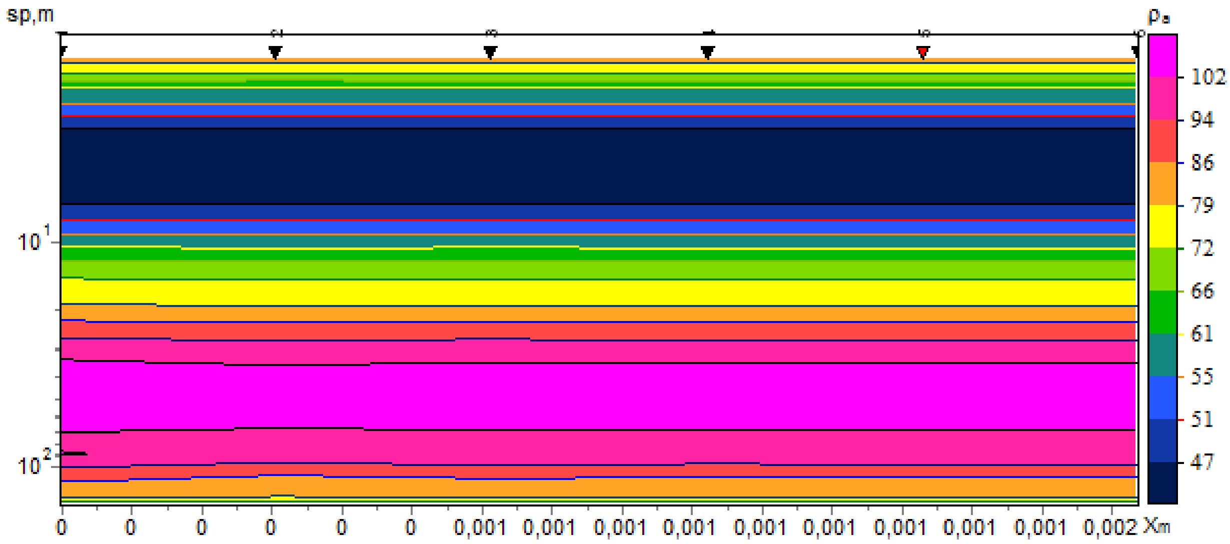


N	ρ	h	z
1	139.24	0.67	0/0
2	35.55	4.28	0.67
3	142.68	47.07	4.94
4	33.99		52.01

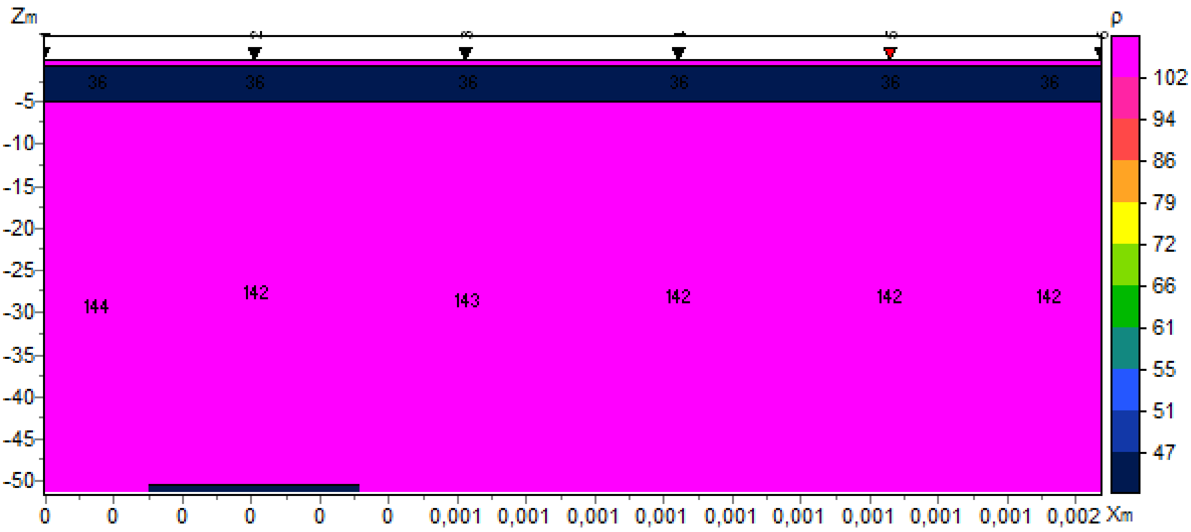
Fig. 2. Result of field (primary) processing of VES

Results

The geophysical surveys conducted at the "Chernorechye" site resulted in apparent resistivity (AR) and geoelectrical sections along all six profiles. As an example, Fig. 3. shows an apparent resistivity section (a) and a geoelectrical section (b) along the first profile.



a)



b)

Fig. 3. Result of processing electrical sounding data along profile 1:
a – apparent resistivity section; b – geoelectric section

Conclusions

Analysis of the obtained sections showed that:

1. The study area was investigated using the VES method to a depth of 55 m;
2. Geoelectric sections constructed from the results obtained at electrical sounding points with a step of 25 m are characterized as uniform;
3. The upper layer of the section of the study area is lithologically represented by sand. This is indicated by the recorded apparent resistivity values.
4. The apparent resistivity values of the second layer are characteristic of gravel and pebble deposits.
5. The third (lower) layer, like the upper layer, is represented by sand.
6. The upper part of the section from a depth of 4.28 m is low-resistivity (35.55 Ohm m), which is typical of water-saturated soils.

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