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## ANALYSIS OF ENGINEERING-GEOLOGICAL AND SEISMIC EXPLORATION DATA CARRIED OUT IN ALIJANCHAY AND VILASHCHAY RESERVOIR AREAS

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### Summary

The Republic of Azerbaijan is located in an active seismic zone. The seismic hazard of the construction sites should be taken into account during the design of the buildings and facilities built in this area, including water reservoirs. In order to improve the water supply, promote the creation of modern farms on arable land and support the employment of the population, it is planned to build a new dam on the old dam in order to increase the useful volume of the Alijanchay reservoir in the Oguz and Sheki regions, and the Vilashchay reservoir in the Masalli region. Before the construction of water reservoirs on the Alijanchay and Vilashchay rivers, complex seismological, geological and geophysical studies were conducted in the area and the seismic hazard level of the area was assessed.

**Key words:** *seismic-stiffness method, engineering-seismic exploration, physical-mechanical properties of soils, geological environment, reservoir.*

## ƏLİCANÇAY VƏ VİLƏŞÇAY SU ANBARI SAHƏLƏRİNDƏ APARILMIŞ MÜHƏNDİSİ-GEOLOJİ VƏ SEYSMİK KƏŞFİYYAT MƏLUMATLARININ ANALİZİ

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### Xülasə

Azərbaycan Respublikası aktiv seysmik zonada yerləşir. Bu ərazidə tikilən bina və qurğuların, o cümlədən su anbarlarının layihələndirilməsi zamanı tikinti sahələrinin seysmik təhlükəliliyi nəzərə alınmalıdır. Su təminatının yaxşılaşdırılması, əkinə yararlı torpaqlarda müasir təsərrüfatlar yaradılmasının təşviqi və əhalinin məşğulluğunun dəstəklənməsi məqsədilə Oğuz və Şəki rayonları ərazisində Əlicançay su anbarının, Masallı rayonu ərazisində isə Viləşçay su anbarının faydalı həcmnin artırılması məqsədilə II növbəsinin, yəni köhnə bənd üzərində yeni bəndin tikilməsi nəzərdə tutulub. Əlicançay və Viləşçay çayları üzərində su anbarlarının tikintisindən əvvəl ərazidə kompleks seysmoloji, geoloji və geofiziki üsullarla tədqiqatlar aparılmış və ərazinin seysmik təhlükə səviyyəsi qiymətləndirilmişdir.

**Açar sözlər:** *seysmik-sərtlük üsulu, mühəndisi-seysmik kəşfiyyat, qruntların fiziki-mexaniki xüsusiyyətləri, geoloji mühit, su anbarı.*

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## АНАЛИЗ ИНЖЕНЕРНО-ГЕОЛОГИЧЕСКИХ И СЕЙСМИЧЕСКИХ ИССЛЕДОВАТЕЛЬСКИХ ДАННЫХ, ПОЛУЧЕННЫХ В РАЙОНАХ ВОДОХРАНИЛИЩ АЛИДЖАНЧАЙ И ВИЛАШЧАЙ

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### **Аннотация**

Азербайджанская Республика расположена в активной сейсмической зоне. При проектировании зданий и сооружений в этом регионе, в том числе водохранилищ, необходимо учитывать сейсмическую опасность строительных участков. Для улучшения водоснабжения, развития современных хозяйств на пахотных землях и поддержки занятости населения в районах Огуз и Шеки предусмотрено увеличение полезного объема водохранилища на реке Алиджанчай, а в районе Масаллы — на реке Вилашчай путем строительства новой плотины на старой дамбе в рамках второго этапа. До строительства водохранилищ на реках Алиджанчай и Вилашчай были проведены комплексные сейсмологические, геологические и геофизические исследования, а также оценена степень сейсмической опасности региона.

**Ключевые слова:** *сейсмическая жесткость, инженерно-сейсмическая разведка, физико-механические свойства грунтов, геологическая среда, водохранилище.*

Taking into account the huge demand for irrigation and drinking water in the republic, one of the most urgent problems is the efficient use of water resources and the creation of new reservoirs. It should also be noted that the creation of water reservoirs is of great importance in the socio-economic development of the regions. Reservoirs to be built on Alijanchay and Vilashchay rivers will supply thousands of hectares of land with water.

During the engineering activity carried out in the geological environment, taking into account the fact that the engineering assessment of the area is initially determined by the geological conditions and geological structure, the study of the seismic resistance of the reservoirs, the study and evaluation of the geological conditions to ensure their normal operating conditions, the selection of a suitable area for construction and environmental risk management expresses the relevance of research.

The first research area, the projected area on Alijanchay river, is located 10 km southwest of Oguz city.

The second research area is a reservoir located on the Vilashchay river, near the village of Garibler, in the Masalli district. The volume of this reservoir is 46.0 mln. m<sup>3</sup>, the height of the earth embankment is 37 m. With the construction of the 2nd turn of the reservoir, the height of the dam will be increased by 15 m and the volume of the reservoir will increase to 130 mln. m<sup>3</sup>.

During the construction of water reservoirs, it is planned to assess the seismic risk in the area, conduct complex seismological-geophysical research, identify areas that may create risk and take preventive measures.

Since the creation of water, human life has been as an integral part, access to water, efficient use of water has been an urgent issue in all ages of history 6.

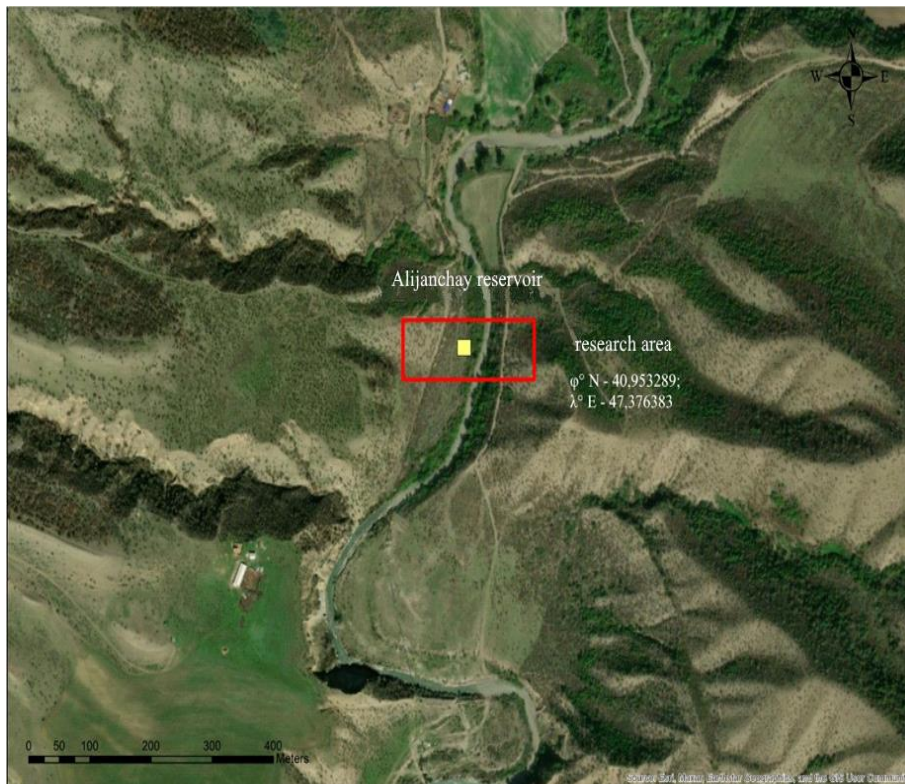


Figure 1. Research area in Alijanchay reservoir (M 1:5000)

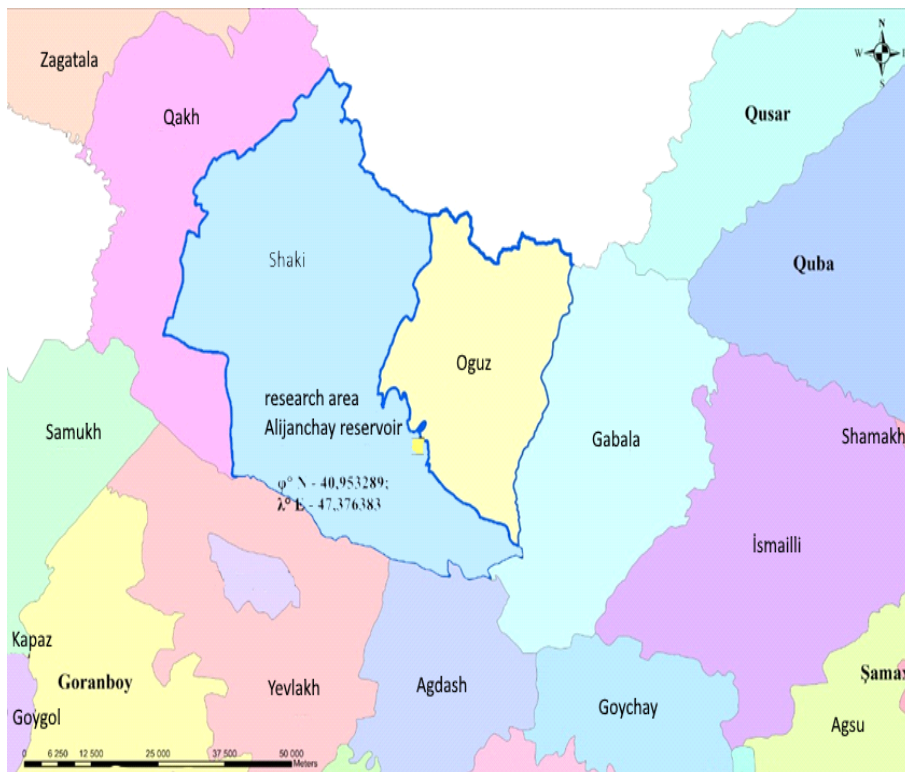


Figure 2. The area where the Alijanchay reservoir (M 1:570000)

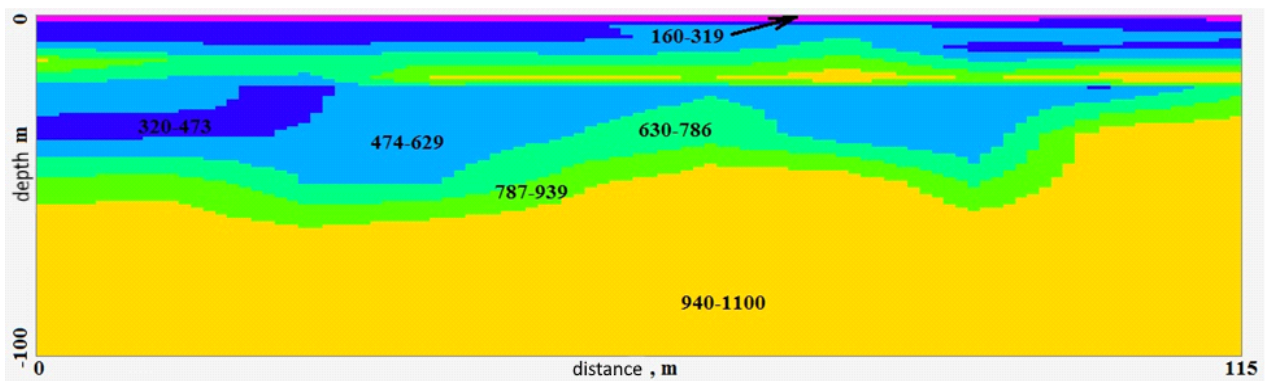


Figure 3. Velocity cut of transverse waves on profile No.1 in Alijanchay reservoir area (in m/s)

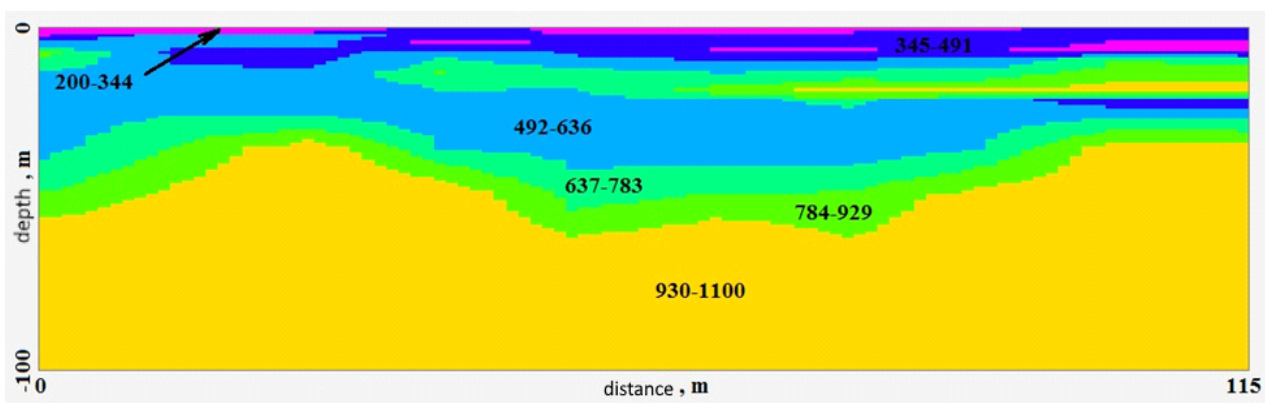


Figure 4. Velocity cut of transverse waves (in m/s) on profile No.2 in Alijanchay reservoir area

### Alijanchay reservoir

Alijanchay River is the left branch of Kura River and is formed by the union of Oguz, Dashağıl, and Khalkhal rivers. It flows through the territory of Oguz, Sheki, Yevlakh regions and the city of Mingachevir (pictures 1, 2).

Alijanchay reservoir will contribute to the irrigation of thousands of hectares of land, improve the water supply of the population, and will also play an important role in preventing fires.

In order to study the seismo-geological structure of the reservoir area to be built on the Alijanchay river, research works were carried out using the "Refraction Microtremor (REMI)" method of engineering-seismic exploration. During the research work, seismic profiles were connected to geological exploration wells dug in the area, and the heterogeneity of the environment was monitored in the space between the wells, and characteristic sections were established by calculating the bedding, thicknesses and corresponding transverse wave velocities of the layers 2].

Geophysical measurements, processing and interpretation of received data were performed using high-quality devices, equipment and software that meet modern requirements.

By carrying out geophysical prospecting in geologically risky areas, the seismo-geological structure of the area up to 100 m depth was studied, the stratigraphic and lithological dividing boundaries of the layers were determined, seismic cross-sections were established at depth, and the seismic characteristics of the layered environment were studied.

Using the seismic-stiffness method, the change (increase-decrease) in the intensity of earthquake vibrations of the construction site was calculated based on the physical mechanical and seismic characteristics of the rocks (clay, clay, sand, sandstone, sandstone, gravel) involved in the lithological sections of the research area 1].

Table 1.

Wells №	Soil Composition	Plasticity (I <sub>p</sub> )	Consistency (I <sub>L</sub> )	Soil density $\rho$ (q/sm <sup>3</sup> )	Wave speed V <sub>s</sub> (m/san)	Water level (m)	Well deoth h(m)
The main axis of the dam							
1, 2, 3,4	Clay (solid and semi-solid)	0,16	<0	1,75	500	-	50,0-60,0 -75,0
	Pebbles	0,18	<0	2,18	800		
Upper control bed							
4,5, 6,7,8	Gravels, the composition is gravel	0,14	<0	1,63	500	4,45	30,0-55,0
	Clays, gravel composition	0,20	<0	1,70	600		
	Sandstone, weathered		<0	1,90	850		
Lower control bed							
9,10, 11,12	Sandstone, weathered			1,80	900	3,25	30,0-60,0
	Clay (solid and semi-solid)	0,15	<0	1,73	400		
	Sand		<0	1,67	350		
	Clay, poorly moist	0,21	<0	1,85	580		
The route of the construction-operation tunnel							
1, 4	Clay (solid and semi-solid)	0,11	<0	1,58	470	4,0-4,80	30,0
	Clay, solid and poorly moist	0,21	<0	1,68	500		

Engineer-geological and geophysical data of Alijanchay reservoir area in Oguz region are shown in table 1

Based on the conducted research, the seismic hazard of the area was assessed with 9 intensity points on the 12-point CEC-64 table.

### Vilashchay Reservoir

The second research area is the construction of the second phase of the Vilashchay Reservoir located in Masalli district, one of the ancient settlements of Azerbaijan 3].

Masalli district is located 232 km from Baku and its area is 720 km<sup>2</sup>. Masalli district located in the south of the republic borders Lankaran, Lerik, Yardimli, Jalilabad, Neftchala districts. It is surrounded by the Caspian Sea (Little Kizilagach Bay) from the east, and the Talysh range of mountains from the west. Vilashchay, Shina-Parada, Godmanchay, Goytepechay, Metalchay, etc. rivers flow. Vilashchay Reservoir was created in a very picturesque place where Vilashchay River exits the sloping plain.

The main hydrographic element of the studied area is the Vilashchay River, its length is 115 km, and the catchment area is 344.6 km<sup>2</sup>. The upper part of the river is located in the mountainous zone (picture 5). The water of Vilashchay and its tributaries is sweet (mineralization up to 1.0 g/l).

The studied area is part of the Yardimli synclinorium, which is one of the main geological structures of the Talysh region, and the geological structure of the region includes tufogenic-sedimentary, sedimentary continental sediments of different genesis of the Paleogene, Neogene and Quaternary systems.

Clay and gravel soils of alluvial (aQIV) origin are spread in the research area. The researched reservoir area on the Vilashchay River is shown in Figure 4.





Figure 5. Vilashchay reservoir area (M 1:17 000)

By conducting research, the normative values of the physical and mechanical indicators of the soil in the area were determined (Table 2).

Geological engineering activity carried out in the environment has an impact on the geological environment and creates relevant changes in this environment. Therefore, it has become necessary to study the changes in the geological environment, to effectively use the geological environment and to solve problems related to its preservation. 7].

On the basis of laboratory studies, 4 engineering-geological elements with a depth of 10.0-40.0 m have been separated in the research area.

M 1:220 000

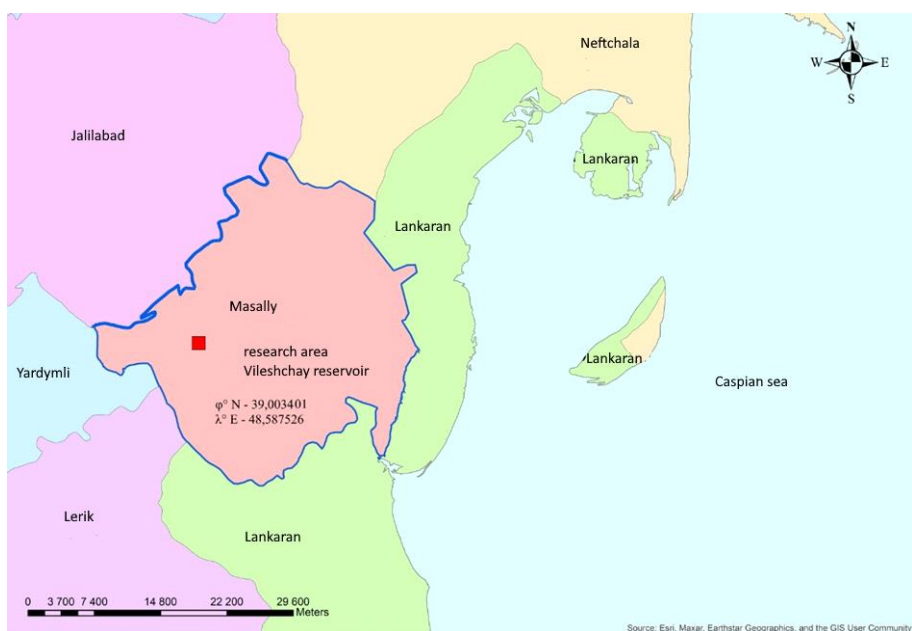


Figure 6. The area of Vilashchay reservoir

Table 2.

Wells №	Soil composition	Soil density, $\rho_a$ (q/sm <sup>3</sup> )	Transverse wave speed, $V_s$ (m/sec)	Well Depth h(m)
1-23	Pebbles, interspersed with sand and clay	1,71	620	10,0-40,0
	Clay, semi-solid consistency, containing small pebbles	1,58	450	

Based on the conducted seismic studies, the seismic hazard of the area where the Vilashchay reservoir is located was assessed with an intensity of 8 points on the 12-point CEC-64 table, and the importance of considering the engineering-geological and geophysical conditions during construction was assessed.

Studying the characteristic regime of water reservoirs, their hydrodynamics, protection and efficient use of water resources is one of the important issues in our republic 5].

### Conclusion

- Based on the conducted geophysical and seismological studies, the seismic hazard of the Alijanchay reservoir area was assessed as 9 points on the 12-point CEC-64 table, and the seismic danger of the area where the Vilashchay reservoir is located was assessed as 8 points.

- Based on the conducted engineering-seismic exploration studies, it was determined that the soils of Alijanchay and Vilashchay reservoir areas are class II (according to Az.DTN 2.3.-1).

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