REPUBLIC OF BULGARIA

MINISTRY OF THE ENVIRONMENT AND WATER BASIN

DIRECTORATE "EASTERN BLACK SEA REGION"

Ref. N.• **PU-10-182** (8)
LOVDIV, 12.05.2024

Classification level: i(TLP-GREEN)

TO
ENG. PETAR DIMITROV
DEPUTY MINISTER
OF THE ENVIRONMENT AND
WATER RESOURCES 22 KH. MARIA
LUIZA BLVD.
re. sooya looo

COPY:
U-JA NLKPHAHA VULCHEVA
DIRECTOR OF RIOSV-HASEOVO
BUL. "DOBRUJA" 14
CITY OF XACKOBO 6300

MR. DANIEL MARINOV
TIITAVA Eï SPLORAYSHN AD UL. "B-
TI SEPTEMVRI" №1
6570 IVAYLOVGRAD 6570

Dear Mr. Dimitrov*,*

DEAR MR. DIMITROV,

In response to your letter ref. No. 99-00-587/01.03.2024 and after reviewing the attached materials (letters ref. *No.* 99-00-587/23.02.2024 and *No*. 99-00-587/29.02.2024 (MOCB)), the East Aegean Sea Basin Directorate (EASBD) expresses the following opinion:

I. By letter ref. N. 99-00-587/29.02.2024r. (MOCB), the following were submitted:

1. "Report on the hydrogeological conditions in the area of the IP for the Rozino deposit," "Jess E" EOOD, 2023.

2. "Hydrological survey of the outflow in the Biala River and its tributary Arpa Dere near the village of Gugutka, municipality of Ivaylovgrad, Haskovo region", "Design and Analysis" EOOD, 20l9r.

II. By letter ref. *No*. 99-00-587/23.02.2024 (MOCB), an expert opinion was submitted by "Jess E" EOOD, prepared on the basis of available public information on water, detailed geological, hydrogeological and seismic studies carried out in the "Tintyava" area and at the "Rozipo" site, as well as a report on the project "Study of transboundary groundwater bodies between Bulgaria and Greece BG-GRGWB". "Rozipo," as well as a report on the project "Study of Transboundary Groundwater Bodies between Bulgaria and Greece BG-GRGWB."

III. The "Report on the hydrogeological conditions in the area of the investment proposal for the Rozino deposit" summarizes the results of hydrogeological studies conducted in the area of the Rozino deposit.

The groundwater in the studied area of the investment proposal for the Rozino deposit is linked to the groundwater body (GWB) BG3G000PtPg049 - Fractured waters - Eastern Rhodope complex.

The general direction of groundwater drainage is south-southeast.

The following hydrogeological conditions are presented:

- The filtration parameters of the geological varieties (Paleogene sedimentary complex and metamorphic foundation) form the underground water body (UWB) BG3G000PtPg049 - Fractured waters - Eastern Rhodope complex, the groundwater levels flowing in them and their chemical composition are characterized in accordance with Annex 1 of Ordinance *No.* 1 of 10.10.2007. The structure, hydrogeological conditions at the top of the aquifer, and filtration properties of the groundwater body within the boundaries of the study area have been determined.
- The filtration parameters of the alluvial sediments (boulders, mixed-grain gravel and sand, including sandy-clay lenses and interlayers) formed on the terrace of the Biala River and its tributary Arpa Dere have been determined. The dependence of the levels of groundwater flow in the alluvium and water levels in the rivers has been established. The chemical composition of groundwater has been studied in accordance with Annex 1 of Regulation *No.* 1 of 10.10.2007.
- The filtration parameters of the deluvial and colluvial soils (sandy clays with inclusions of angular rock fragments of various sizes) form the cover of PBT BG3G000PtPg049 - Fissured waters - Eastern Rhodope Complex. It has been established that no groundwater flows through it.

Based on the facts presented and analyzed, the characteristics of the natural hydrogeological conditions in the Rosino deposit area have been determined.

In an expert opinion from "Jess E" EOOD, presented in letter ref. *No*. 99-00-587/23.02.2024 (MOCB), the following hydrogeological conditions in the area of the IP were examined:

- <u>Groundwater in the Paleogene rocks and metamorphic basement.</u> The geological formations are represented by a metamorphic basement — composed of a diverse range of migmatites, serpentinites, amphibolites, marbles, gneisses, and granites, and a Paleogene sedimentary complex — which includes breccias and conglomerates, coarse-grained to silt-sized sandstones, marls, and coal seams.

Groundwater is classified as fissure-fed. The recharge of groundwater accumulated in the Paleogene sediments in the study area is mainly through fissures and tectonic disturbances from adjacent horizons and metamorphic rocks. The highly dissected relief, combined with the very low filtration characteristics of the rocks, is a prerequisite for very little infiltration recharge.

The groundwater levels are established at a depth of 31.33 m to 4.82 m below the surface, generally following the terrain line. The general direction of groundwater drainage is south-southeast towards the terrace of the Byala River. The filtration parameters of the water-bearing rocks are very low.

The results of the chemical analyses (eight samples tested in 2019 and one sample tested in 2022) show lower concentrations of the tested parameters compared to the quality standard according to Ordinance *No.* 1 of 10.10.2007r.

The "Report on the hydrogeological conditions in the area of the Rosino deposit" states that there are several exceptions to the overall picture regarding the contents of the indicators studied, which are explained in the cited document. In most samples, manganese is present in concentrations higher than the quality standard, and in one of the samples and iron. Both elements are rock-forming and are often mobilized in groundwater when slopes are weathered. It should be noted that in fractured waters, such mobilization also occurs when both elements are deposited in rock fractures in the form of hydroxides. In one sample, arsenic is present in a low concentration (34 pg/1). Arsenic, selenium, and antimony usually show increased contents together with heavy metals in rocks with hydrothermal deposits. This is observed both in the Sredna Gora ore zone and in the ore mineralizations in the Rhodopes. In this case, selenium and antimony do not show increased contents, only arsenic. In one sample, nickel is also slightly increased. It is concluded that, as these are isolated results of increase, no clear trends can be derived from them. This can be done when a monitoring network for groundwater is established for the Rozino deposit and regular results are collected over time.

According to the report, **the** main **conclusion** from the review of data on the chemical composition of groundwater in Paleogene sediments and metamorphic bedrock is that the values of the indicators studied in the individual boreholes are very similar and reflect a relatively constant chemical composition of groundwater, which has not been altered by human activity. The important thing in this case is that these results can be used as a basis for determining the background characteristics of the chemical composition of groundwater in the area during the future development of the deposit.

- Groundwater in the alluvial deposits in the Bela Peka area. The alluvial deposits consist of boulders, mixed-grain gravel, and sand in various proportions, including sandy-clayey layers and interlayers. In some areas, their thickness exceeds 5-6 m.

The water levels in the observed formations in the study area vary at depths ranging from 0.04 to 4.24 m below the surface. The groundwater is in direct hydraulic connection with the waters of the Biala River and the Appa Dere River.

The results of the chemical analyses (two samples) show low levels of the indicators studied compared to the quality standard according to Regulation N-1 of 10.10.2007. The "Report on the hydrogeological conditions in the area of the IP for the Rozino deposit" states that for two of the parameters (aluminum and iron) there is a slight increase in the content in one of the samples and the quality standard. According to the authors of the report, the increase is minimal and most likely corresponds to natural variations for the two indicators (which are also basic rock-forming elements).

According to the report, the values of the indicators studied at the sampling sites are very similar and reflect a relatively constant chemical composition of the groundwater in the alluvial sediments. The data show that these groundwater resources are in good condition and their quality has not been impaired as a result of human activity (agricultural or geological exploration). It should be added that these results can be used as a background characteristic of the chemical composition of alluvial groundwater in the area.

The factual material presented above shows that the groundwater in the study area of the IP for the Rosino site has the characteristic features of PBT BG3G000RPg049 - Fractured waters - Eastern Rhodope Complex. They are fractured, flowing through watertight rocks through their fractured zones. This results in low groundwater flow characteristics. These waters are mainly associated with the upper (more weathered and fractured) part of the geological formations and follow the relief, draining in the direction of the lower (more compact) part of the formations. These waters are mainly attached to the upper (more weathered and fractured) part of the geological formations and follow the relief, draining towards the local erosion base - in this case, towards the terrace of the Biala River and its tributaries. The opinion includes a graph of water levels depending on the terrain elevation in the study area of the IP based on data from monitoring wells. The marked trend outlines the direction of groundwater flow towards the erosion base of the Biala River.

The opinion draws the following conclusions:

• There is no data available on the basis of which a risk of transboundary pollution of surface and groundwater can be identified.

• No impact on surface waters is expected, either in terms of quality or quantity. The planned construction of hydraulic structures for water management (drainage ditches, sumps) during the implementation of **the investment proposal will minimize and localize the impact on water quality.** The investment proposal **provides for the construction of two** sequentially **located** reservoirs (the second of which is for non-contact water, i.e., conditionally clean), which will eliminate even the slightest possibility of water separated from the investment proposal entering water bodies.
• No discharge of waste water into water bodies or into the sewage system of populated areas is envisaged. All collected water will be used in **the technological cycles.**

For the water supply of the site **for technological needs,** a **hydrological** survey has **been carried out to determine the availability of** water **resources from surface water bodies. The possibility of** such water use has been **established** without causing a decrease in water quantities and disruption of **the natural water flow. Water use** will **only** be **possible after obtaining** a permit in accordance with the Water Act.
• No impact on groundwater bodies is expected, either in terms of quality or quantity.
quantity.

The hydrogeological survey conducted in the area of the pasture establishes that the groundwater **has an insignificant flow rate. Given** the **planned** depth of the ore deposit, there is no reason to believe that there could be any direct impact on underground water bodies or drinking water sources, with corresponding sanitary protection zones and permits for exploitation in accordance with the Water Act.
• To determine the explosive seismic impact during the implementation of the IP, experimental explosions were carried out on site. Based on the results obtained from measurements with specialized equipment, a report was prepared on "Assessing the side effects of blasting technologies on the environment and managing these effects within acceptable safety levels for the Rozino deposit, Ivaylovgrad municipality, Haskovo region." According to the opinion, the analysis of the results obtained gives grounds for concluding that the project will not have a significant negative impact on the environment.

According to the opinion, the analysis of the results obtained gives grounds for concluding that, provided the recommended maximum mass of BB is observed in a delay interval, the vibration velocity in the borehole is not expected to exceed the level that would have a seismic impact on groundwater and water supply sources, and the implementation of the investment project will not have a negative impact on

ENVIRONMENT AND GROUNDWATER.

IV. A "Hydrological assessment of the outflow in the Biala River and its tributary, the Appa Dere River, near the village of Gugutka, Ivaylovgrad Municipality, Haskovo Region" has been presented, prepared by "Proektiraneto i Analizi" EOOD, 2019. The purpose of the engineering-hydrological study is to establish the hydrological and drainage characteristics of the Biala River and its tributary, the Appa Dere River. The purpose of the engineering and hydrological study is to establish the hydrological and runoff characteristics of the Biala River and its tributary, the Appa Dere River, at the site (gorges, cross-sections). The conclusion of the study defines the hydrographic characteristics of the catchment area, the average annual runoff, represented by a runoff module, the runoff norm, the annual runoff, minimum water volumes, represented by an eco-minimum of 10% of the runoff norm and 90% security of the minimum quantity, and maximum water quantities with security of 0.1%, 1% and 5%, respectively.

With regard to groundwater and surface water:

- Groundwater — in the above-mentioned opinion presented by Jess E EOOD (hired to conduct a study of the hydrogeological conditions in the area of the IP), it was concluded that there is no data on the basis of which to identify a risk of transboundary pollution of surface and groundwater, and no impact on groundwater bodies is expected, neither in terms of quality nor quantity.

- Surface waters — the general section of the study presented contains findings regarding the presence or absence of constructed dams (water regulation facilities) and the absence of water abstraction in the catchment areas at present, but there is no analysis or assessment of the specific amount of water abstraction envisaged in the IP and the impact it will have on runoff, which is why it is not possible to assess the absence/presence of transboundary impact on the hydrological regime of the river.

Yours
sincerely,

морски район"

4000, Plovdiv, 35 Yanko Sakazov St. Tel: (+359) 032 604 733
Fax: (+359) 032 604 721, www.earbd.bg; e-mail: bdщlovdiv@earbd.bg

NO tAPI

TINTYAVA EXPLORATION AD

Report on the hydrogeological conditions in the area of the investment proposal for the Rozino deposit,

Issue #	Date	Main modifications		
# #	10/11/2023 27/11/2023	Initial edition Final edition		***Jess E EOOD*** Sofia 1404 Strelbishte Residential Complex, Tulcha Street, Block 112, Entrance B, Apartment 57 E-mail: E-mail: jes-e@abv.bg

Prepared by:

Eng. Petar Delov

Dr. Emanuil Kozhuharov

Approved by:

Eng. Ivan Kozhuharov

Sofia, 2023

Contents

1. Introduction

Tintyava Exploration AD is in the process of a second two-year extension of its contract with the Ministry of Energy for exploration and research in the Tintyava area in the Eastern Rhodopes. Following the submission of the gold ore reserves report to the Bulgarian Ministry of Energy for registration of the commercial discovery of the Rozino gold deposit, Tintyava Exploration AD began preparations for the development of the deposit. Under the Underground Resources Act, a commercial discovery certificate is issued after a positive environmental impact assessment decision has come into force. At this stage, Tintyava Exploration AD has initiated the procedure under Chapter 6 of the Environmental Protection Act, and the company has submitted an investment proposal for the development of the Rosino deposit in the municipality of Ivaylovgrad.

The consulting firm Jess E EOOD was hired to conduct a study of the hydrogeological conditions in the area of the investment proposal for the Rozino deposit, to be used by a team of experts who will assess the impact on the environment of the development and extraction of the deposit.

This report presents the results of the work carried out to describe the hydrogeological conditions in the area of the investment proposal for the Rozino deposit.

2. Location of the investment proposal for the Rozino deposit

The location of the investment proposal (IP) is in the municipality of Ivaylovgrad, Haskovo region (Fig. 1).

The area of the IP for the Rozino deposit is 3044.7 decares in the territories of the villages of Rozino and Gugutka (Fig. 2), of which 1736.2 decares are a buffer zone and 1308.5 decares are for mining sites. There are asphalt roads to the two villages, and then the area can be reached by third-class, forest, and dirt roads. The settlements are electrified. The main waterway in the area is the Byala River.

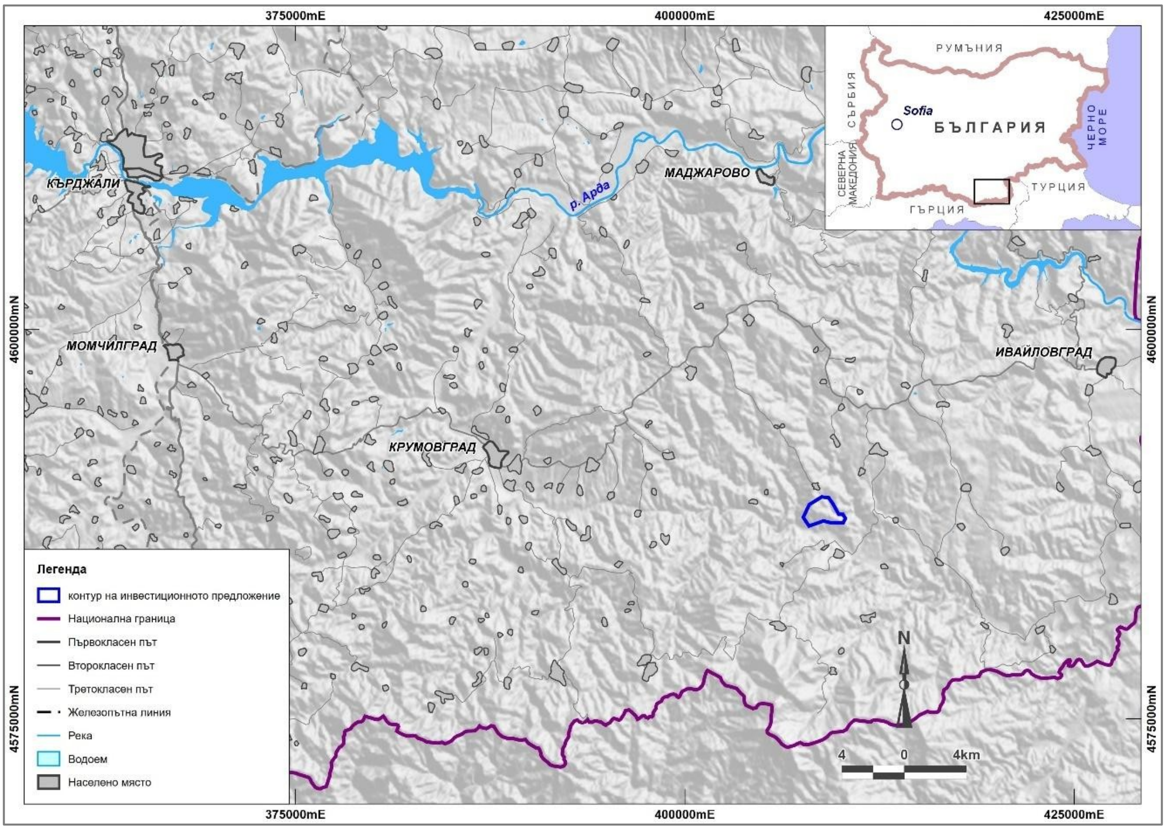


Fig. 1. Location of the area of the investment proposal for the Rozino deposit.

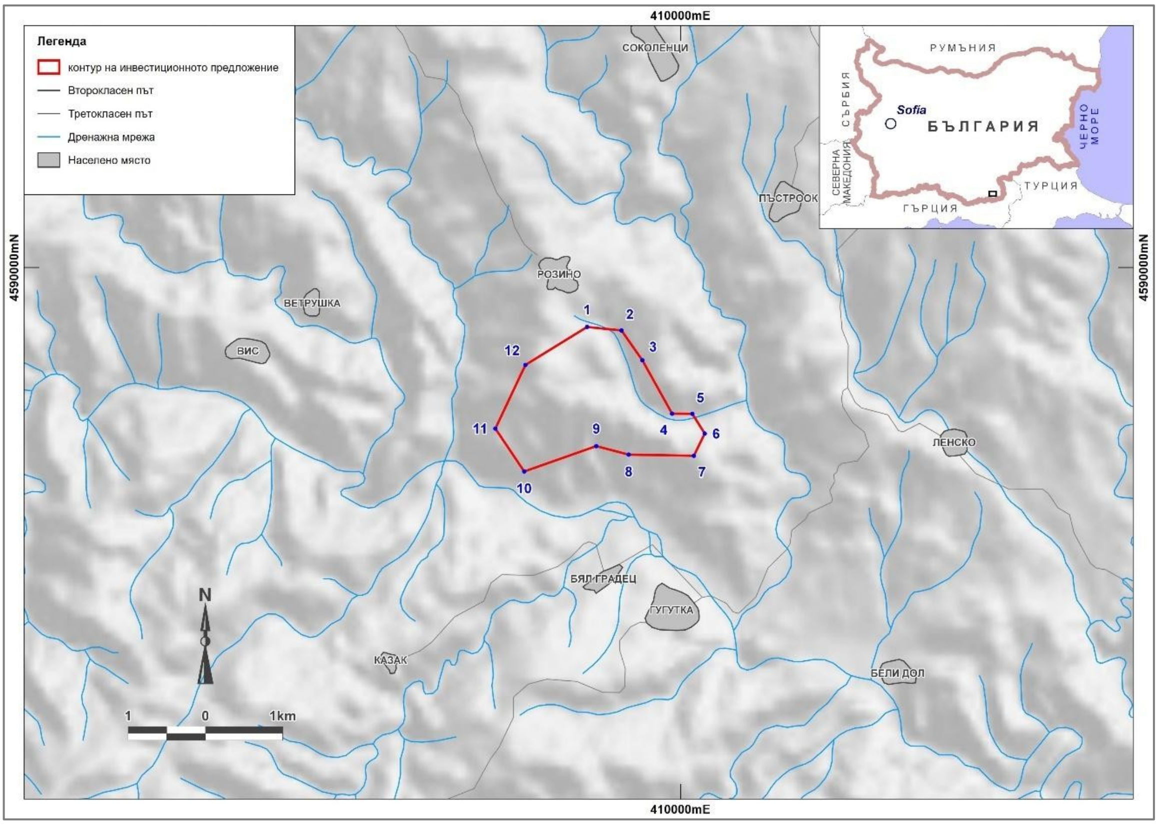


Fig. 2. Contour of the investment proposal for the Rozino deposit and infrastructure in the area.

3. General physical and geographical information about the area

The relief in the area is low mountainous and hilly, with flat hills predominating. In a wider geographical scope, the altitude varies from 70 to 700 m, with an average of 320 m. The altitudes in the area of the investment proposal are also around the average value. The highest point is Tashlaka Peak at 457.7 m (Fig. 3). The area around it is divided by the tributaries of the Byala River, with the river terrace at an elevation of 230-235 m to the south (outside the scope of the investment proposal).

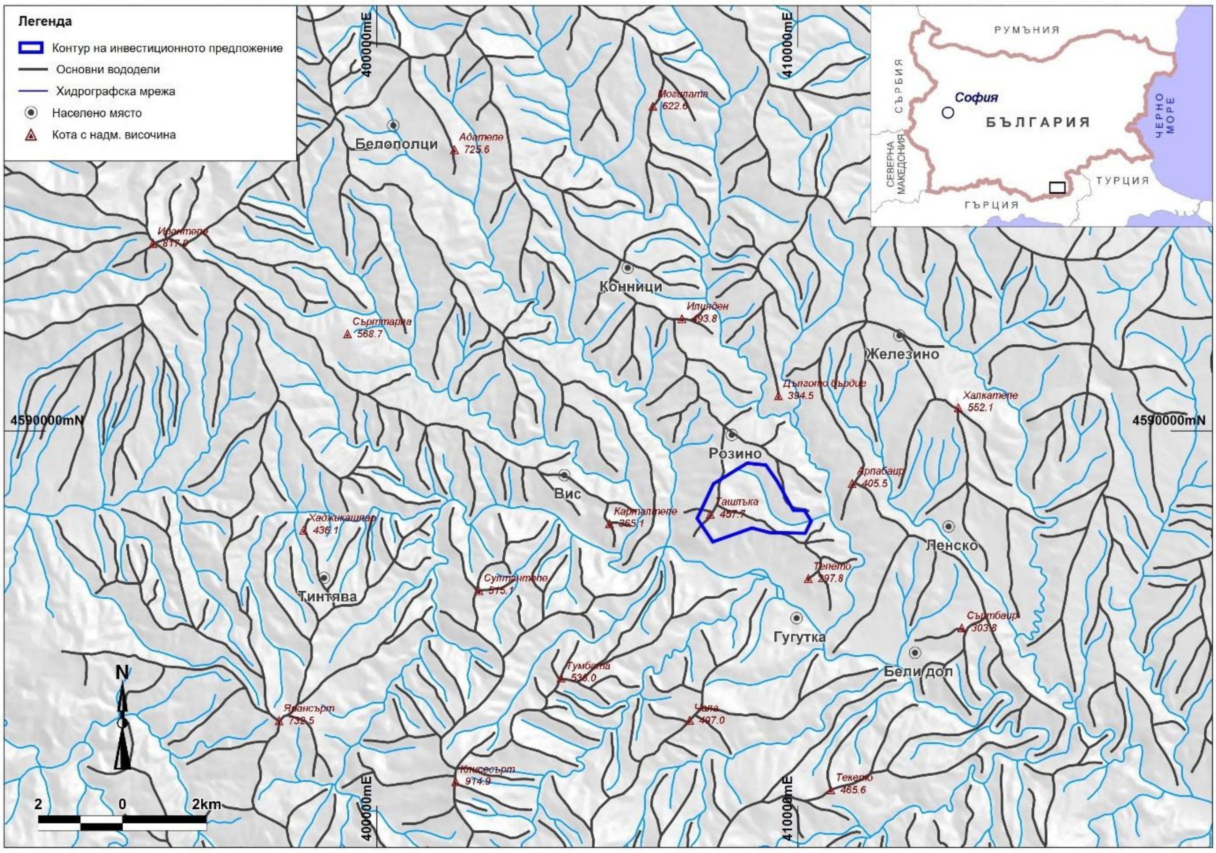


Fig. 3. Hydrographic network and main watersheds in the study area.

The study area falls within the Gyumyurdzhina-Măglena physical-geographical sub-region. Its proximity to the Black Sea basin determines its transitional Mediterranean climate, which north of the Biala River has elements of a transitional continental climate. The average annual temperature is 12-13°C, with an average January temperature of 1-2°C and an average July temperature of 23-24°C.

Winters are relatively mild, with January and February being the coldest months. Snowfall during this period accounts for 30-50% of total precipitation, with snow cover lasting no more than 4-6 days. In spring, temperatures remain above 5°C in the second half of March. Summer is sunny and warm, with an average monthly temperature of 24°C in the warmest months (July and August), maximum temperatures of 36-38°C are rarely reached. Autumn is also a warm season, with an average temperature for October of 10.5°C. Temperatures remain below 5°C towards the end of November.

The wind direction in open areas is mainly from the north and northwest, with a second maximum from the south-southeast. The relief has an influence, as the winds often follow the direction of the valleys.

The annual cloud cover shows a maximum during the winter months (52-65%) and a minimum during the summer (30-35%).

Relative humidity is highest during the cold part of the year, when values for all months are similar and fluctuate around 80%. In summer, the average monthly relative humidity ranges from 65% to 70%, with the minimum occurring in August.

The annual pattern of the number of foggy days is well defined, with a maximum during the winter months (3.3-3.5 days) and a minimum in July and August, when fog does not form in the entire region or the average number of foggy days is 0.1-0.3 days.

Average annual precipitation varies widely. It shows a winter maximum (November, December), when the average monthly amount is 95 to 135 mm/m^2. Spring precipitation is slightly lower than winter precipitation, but the accumulation of part of the winter precipitation in the form of snow cover and spring melting are prerequisites for equalizing the runoff conditions during the two seasons. The minimum monthly rainfall is observed in August or September, with values of 45-55 mm/m^2.

The main factors determining the hydrological regime are the climate, geological and geomorphological conditions, and relief, while a secondary factor is the soil and vegetation structure of the catchment basin. The area is characterized by the so-called Mediterranean type of annual runoff distribution. A significant part of the runoff occurs between November and March-April, with a pronounced early spring maximum, which is caused by the melting of snow cover and rainfall. With an average annual rainfall of 700 to 1100 l/m^2 , the runoff module varies from 5 to 25 l/sec/m^2 .

4. Study of the area

The Rosino deposit area has been studied in detail in terms of its geological structure, both in the past and in recent years. Unfortunately, the level of study in terms of engineering-geological and hydrogeological conditions is extremely low. The hydrogeological tests and design studies carried out in the past for the water supply of the villages of Gugutka and Rozino have not been archived and are not available at "VIK" EOOD, Haskovo. The geological structure in the area of the Rozino deposit in the past has been the subject of geological mapping at a scale of 1:100,000 and later at a scale of 1:50,000.

The geological structure in the area of the Rozino deposit was previously mapped at a scale of 1:100,000 and later at a scale of 1:25,000, with geological maps published at scales of 1:100,000 and 1:50,000.

In 2001, the right to explore and prospect in the Rosino area, which overlaps with the current Tintyava license area, was granted by the Ministry of Environment and Water to Herward Ventures Bulgaria AD (HVB) and subsequently transferred to Karakal Cambridge Bulgaria EAD (formerly Ivanhoe Herward Bulgaria EAD). The data from these geological studies are presented in the relevant reports from 2004, 2006, 2008, and 2009 (see Section 10 Literature).

During the period 2017-2020, the right to prospect and explore was granted to Gorubso-Kardzhali AD, and subsequently transferred to Tintyava Exploration AD in 2018. During this period, exploration and evaluation activities were mainly carried out at the Rozino deposit and, to a lesser extent, exploration work was carried out in the rest of the area. As a result of this activity, a preliminary economic assessment was carried out and reserves at the Rozino deposit were calculated and registered. Work has also begun on the pre-project feasibility study and monitoring for data collection for the preparation of an EIA.

The period after 2017 is also associated with hydrological and hydrogeological studies in the license area.

A hydrological assessment of the outflow in the Byala River and its tributary, the Arpa Dere River, was carried out in 2019, presenting data on the various parameters of the outflow distribution in typical years (V. Slavov, 2019).

In 2019, during exploratory drilling, hydrogeological tests were carried out in boreholes and pits around the project pit at the Rozino deposit. Water inflows and water pressures were measured in these works, and the parameters of the filtration coefficient of rocks and soils in the study area were determined (Golder Associates, 2019).

Projektiraane i analizi EOOD is conducting a preliminary study on the possibilities for constructing a pumping station to provide the necessary water.

resources for the site. The main conclusion is that the construction of a fresh water pumping station is a technically feasible solution for providing the necessary water volumes for the site while complying with the environmental requirements for minimum water flow in the riverbed (Projektiraane i analizi EOOD, 2020).

An initial hydrogeological study of the alluvial deposits in the area was conducted at two locations - one borehole in the terrace materials of the Biala River and a second in the terrace of the Arpa Dere River (JES E EOOD, 2020). The results of this study show greater potential for the alluvial sediments of the Biala River.

In 2020, hydrogeological tests were carried out on the groundwater in the Paleogene sediments in three exploratory boreholes (JES E EOOD, 2020). The data obtained show low filtration characteristics of these groundwater resources, which means they cannot be considered a potential resource for water supply.

Experimental filtration works were carried out by pumping water in two tube wells in the alluvial deposits of the Byala River (Jess E EOOD, 2021).

In 2020, GCS reviewed the water resource assessments made for the Rozino deposit project (GCS, 2020). This report reviews the available hydrological and hydrogeological data, as well as possible scenarios for water resource management for the needs of the mining project.

5. Geological characteristics

The Rozino deposit is located in the Eastern Rhodope Depression, east of the Belorechko Swelling. It was formed in a Paleogene graben typical of the Eastern Rhodopes, filled with thick terrigenous coarse-grained sediments and volcanogenic-sedimentary materials. At the end of the Oligocene, as a result of the intrusion of hypabyssal medium-acid intrusions, hydrothermal activity developed, which formed the epithermal gold mineralization.

Fig. 4 below shows a geological map of the area. Within the Paleogene basin, several superimposed high-metamorphic complexes, Mesozoic (?) schists, and aplitoid granites are distinguished. The following foundation sequences were described during the exploratory work: Upper layer of migmatites, serpentinites, amphibolite complex and marbles, and Lower layer of gneisses and granites.

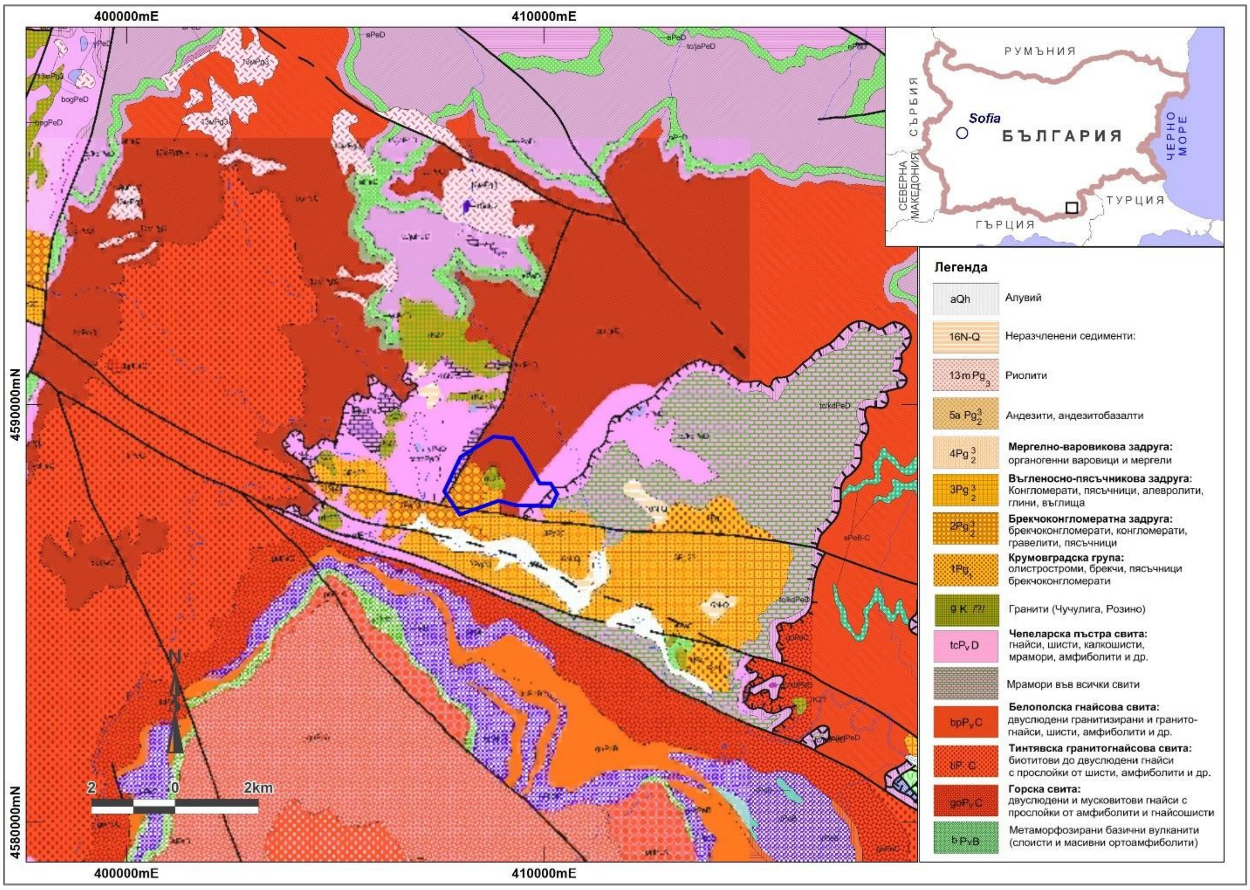


Fig. 4. Geological map of the area from the 1:100,000 scale mapping.

In the area, Paleogene sediments are represented by two formations – breccia conglomerate and coal-bearing sandstone of Pliocene age. These formations have a thickness of 800–1000 m for the first and 100–800 m for the second, respectively.

The breccia conglomerate formation consists of fragments of the metamorphic basement, granite fragments, ultrabasites, and diaphorites with sandy and carbonate-sandy cement.

The coal-sandstone formation is composed of polymictic sandstones with calcareous-clayey cement, gravelly-cobbly conglomerates, aleuritic sandstones, marls, coal shales, and coals.

Quaternary deposits are represented by deluvial, eluvial, and alluvial clays, sands, and gravels. Deluvial and colluvial deposits are mainly silt and sandy-gravel clays and form an almost continuous surface cover of insignificant thickness. Alluvial sediments are represented by gravel and sand in varying proportions, rarely interspersed with clayey silt layers. They form the riverbeds and terraces of the Biala River and its tributaries.

As mentioned above, the deposition of precious metals and polymetallic ores in the area is the result of hydrothermal activity. The concentration of gold in the deposit occurs in parallel with the processes of formation of quartz-adularian metasomatites, and that of lead, zinc, and copper - simultaneously with argillization and the formation of argillite-type metasomatic replacements. A favorable environment for the deposition of ore mineralization is provided by breccia conglomerates for gold and metamorphic rocks for lead-zinc mineralization. The geological scheme of the deposit is shown in Fig. 5 below.

The ore bodies of the deposit have a complex morphology, being divided into steeply dipping and almost horizontal ones. The main ore body falls within a significant geochemical anomaly along a secondary geochemical halo.

Ore mineralization is scarce. Pyrite, marcasite, chalcopyrite, sphalerite, galena, magnetite, and secondary copper sulfides have been identified. The ore minerals are finely dispersed or form fine veins. No visible gold has been observed. Native gold occurs as irregular and oval inclusions in pyrite with dimensions of 0.01-0.1 mm.

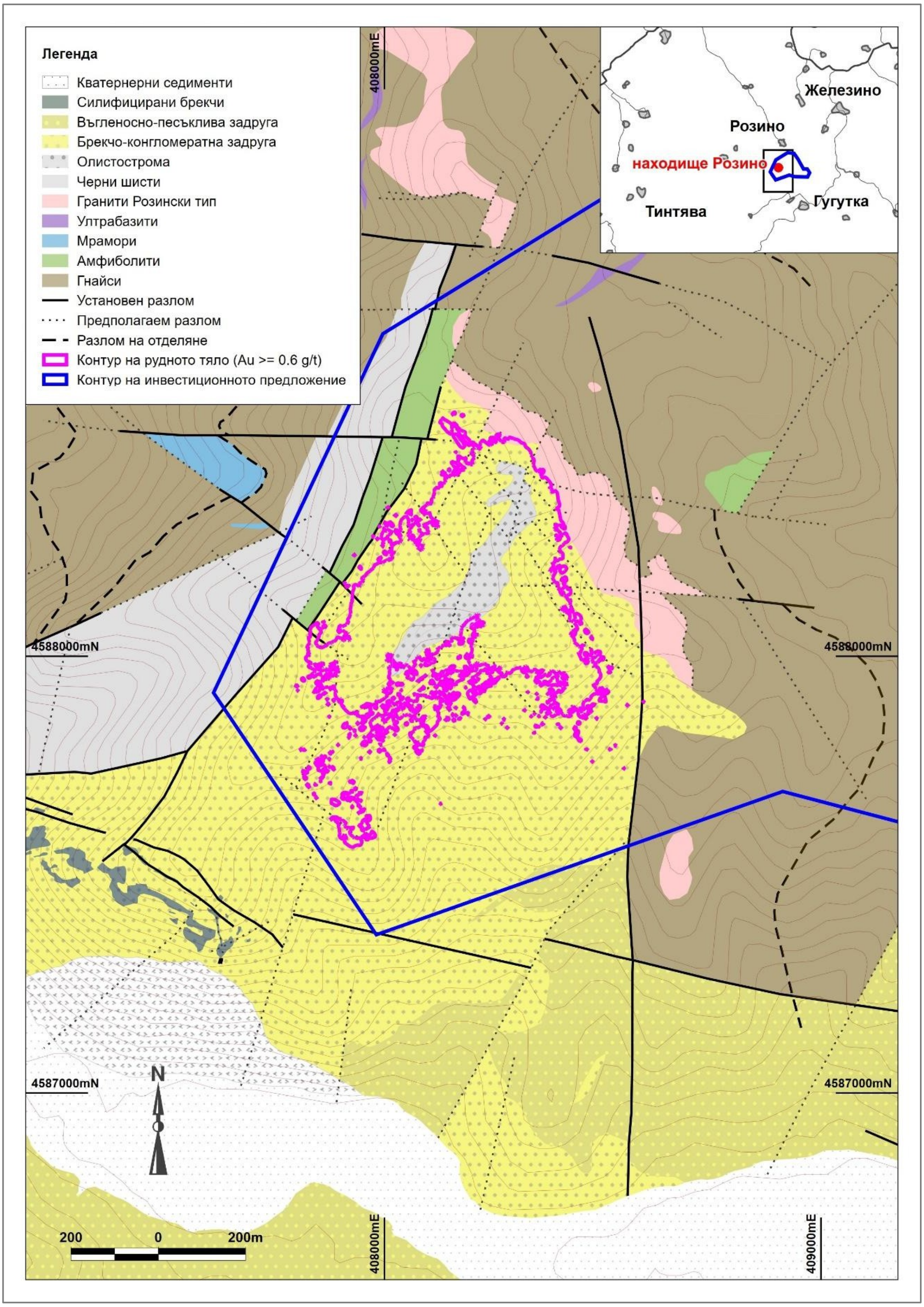


Fig. 5. Geological diagram of the Rozino deposit
(based on data from the mapping of Tintyava Exploration AD).

6. Regional hydrogeological conditions

According to the accepted classification of groundwater bodies in the Republic of Bulgaria, the groundwater in the studied area around the Rozino deposit is associated with a single groundwater body - Groundwater Body (GWB) with code BG3G000PtPg049 - Fractured waters - Eastern Rhodope Complex.

In the studied area, in separate places along the course of the Byala River, alluvial deposits have formed, consisting of boulders, mixed-grain gravel, and sand in various proportions, including sandy-clay lenses and interlayers. In some sections, their thickness exceeds 5-6 m. These deposits are outside the boundaries of the groundwater body BG3G000000Q010 - Porous waters in the Quaternary - Arda River. Due to their lack of consistency in terms of area, they are not of economic interest, are not nominated as a separate groundwater body, and are not included in the List of groundwater bodies in the Eastern Black Sea region:

Groundwater body **BG3G000PtPg049** - Fissure waters - Eastern Rhodope complex.

During the initial delineation of aquifers into groundwater bodies, in accordance with the guidelines set out in point 2 of Annex II to the Water Framework Directive 2000/60/EC, the following were nominated in the area under consideration: PVT-BG3G00000Pt046 - fissured waters in Proterozoic gneisses, gneiss schists, migmatites, and PVT-BG3G00000Pg028 - fissured waters in Paleogene sediments and volcanics. (Basin Directorate Eastern Black Sea Region, RBMP 2010-2015, Section 1, Annexes 1-6 and 1.7). Following the implementation of the project "Study of transboundary groundwater bodies between Bulgaria and Greece BG-GRGWB", 8 of the initially designated GWBs, including GWB-BG3G00000Pt046 and GWB-BG3G00000Pg028, were merged and nominated as GWB BG3G000PtPg049 (BDIBR - RBMP 2016-2021, Section 1, App. 23 and 24). With this merger, the generalized geological-lithological section of PWT BG3G000PtPg049 includes lithological types that are very diverse in terms of type and age. In the studied area, the geological formations are represented by a metamorphic foundation (migmatites, serpentinites, amphibolites, marbles, gneisses, and granites) and a Paleogene sedimentary complex (breccias and conglomerates, polymictic coarse-grained to silt-sized sandstones, marls, and coal shales).

Among these practically impermeable lithological types, groundwater circulates exclusively through mechanical disturbances – cracks and tectonic faults. The uneven water-bearing capacity of rock formations is determined by the geological structure and lithological composition of the rocks and mainly by their uneven fracturing and faulting.

Fracture waters, depending on the depth of movement and accumulation, can be conditionally divided into waters in the zone of active water exchange above the local erosion base and waters with deep circulation below the erosion base.

The waters from the zone of active water exchange are cold, with a temperature of up to 15-17ºC. The main source for the formation of groundwater in this aquifer is the infiltration of atmospheric precipitation. The replenishment and regime of the waters are directly dependent on the precipitation regime. Given the transitional Mediterranean climate in the area, the most significant recharge of groundwater comes from direct infiltration during the winter period, with longer periods of precipitation and snowmelt. During the summer, due to the short duration of rainfall and significant transpiration and evaporation, groundwater recharge is low.

Fissure waters in the active water exchange zone are most often unpressurized. They drain above the local erosion base and feed small springs with a flow rate of up to 0.050-0.200 l/s. Most of the springs dry up during the dry season and increase their flow during the rainy season.

Deep-circulating fissure waters in gneisses and Paleogene sediments are accumulated below the erosion base, in the zone of tectonic fracturing. The deep circulation fissure waters are also fed by the infiltration of precipitation and surface runoff. The temperature of these waters reaches 20ºC. These waters form an aquifer, which is classified as fissure, low water yield.

From a hydrogeological point of view, the lithological types forming PBT BG3G000PtPg049 are characterized by high water tightness and are a prerequisite for the low water abundance of this PBT. For this reason, this water body is not of interest for water supply purposes. No targeted, exploratory, or assessment hydrogeological studies of fresh groundwater have been conducted in it. This makes it one of the least studied PWB in Bulgaria, as can be seen from Appendices 23 and 24 to Section 1 of the 2016-2021 RBMP of the East Aegean Basin Directorate in Plovdiv. Average values of some parameters of the lithological types from PWB BG3G000PtPg049, determined mainly during the study of mineral resources. The average values of some parameters of the lithological types from GWB BG3G000PtPg049, determined mainly during studies of mineral resources, hydraulic engineering, etc., are as follows: porosity 1-2%, filtration coefficient 0.0001-1 m/day, infiltration rate <8%, thickness of the aquifer from several meters to several tens of meters.

7. Hydrogeological conditions in the area of the investment proposal for the Rozino deposit

This section presents the results of the hydrogeological studies conducted in the area of the investment proposal for the Rozino deposit. These were carried out in the period 2019-2021 by Golder Associates Ltd. and Jess E EOOD.

For this purpose, the results of the experimental filtration tests conducted during the aforementioned hydrogeological studies are presented to determine the filtration parameters of the lithological types (alluvial deposits of the Byala River, deluvial and colluvial soils covering the bedrock, Paleogene sediments - limestones, sandstones, and conglomerates, and Precambrian metamorphic rocks). Based on these results, ranges of filtration parameters for the identified lithological types in the area of the investment proposal for the Rozino deposit were specified.

During the studies, water samples were taken and analyzed to determine the chemical composition of the groundwater flowing in PWT BG3G000PtPg049 and the alluvial deposits in the Rosino area.

7.1. Filtration parameters of lithological types

Quaternary lithological types

Alluvial deposits

In 2019 and 2021, Jess E EOOD conducted a hydrogeological study of groundwater in alluvial sediments that formed terraced areas of the Byala River and its tributary Arpa Dere in the area around the Rozino deposit. Two boreholes were drilled, constructed as piezometers (HPR 01 and HPR 02), and two tube wells (AW 001 and AW 003) were constructed, in which tests were carried out to determine the filtration parameters of the alluvial deposits. The terraces are composed of mixed-grain sands with abundant gravel and rare thin clayey-sandy lenses. The thickness of the alluvium in the studied areas is 6.0–7.0 m around the Byala River and 4.0–5.0 m in the section near Arpa Dere. Table 1 below presents the results of the tests conducted:

Table No. 1.

Preparation No	Tested interval from...to...	Test performed	Static water level	Filtration coefficient
-	m	-	m	m/sec
HPR 01	0.7 – 6.1	*Water pumping*	0.7	2.8×10^{-4}
		Recovery		2.6×10^{-4}
HPR 02	1.84 – 4.36	*Water pumping*	1.84	1.5×10^{-4}
		Recovery		1.6×10^{-4}
AW 001	1.15 – 3.8	*Water pumping*	1.15	3.8×10^{-4}
		Recovery		3.8×10^{-4}
AW 003	0.58 – 3.40	*Water pumping*	0.5	5.8×10^{-4}
		Recovery		4.8×10^{-4}

The level transfer coefficient – "a" of the alluvial deposits of the Biala River is 2.63 x 103 m^2 /day, and that of the alluvial deposits of the Arpa Dere River is 2.36 x 103 m^2 /day.

In 2021, other boreholes were drilled in the alluvial sediments, which were constructed as piezometers for monitoring groundwater in the area. The results of the measurements of their levels are presented in section 7.2, and the data on their chemical composition are presented in section 7.3 of this report.

<u>Deluvial and colluvial soils</u>

In 2019, Golder Associates Ltd. conducted hydrogeological studies of the deluvial and colluvial soils that formed the cover of Paleogene sediments and Precambrian metamorphic rocks, which constitute the bedrock of the Rozino section. Filtration tests were conducted in six boreholes specifically drilled for the hydrogeological survey.

The deluvial and colluvial soils are represented by sandy clays with inclusions of angular rock fragments of various sizes. In places, they transition into clayey sands. The Quaternary cover is developed everywhere, with only a few small, steeper areas denuded and bedrock exposed on the surface. The thickness of the deluvial and colluvial soils varies widely, reaching up to 6-7 m in some places.

Table 2 presents the results of the filtration tests conducted:

Table No. 2.

Manufacturing No	Tested interval from...to	Test performed	Water level	Filtration coefficient
-	m	-	m	m/sec
PP_BH 01	0 - 1.6	FHT	dry	1.38×10^{-7}
PP_BH 02	0 - 1.6	FHT	dry	1.06×10^{-6}
RWD_ BH 03	0 - 5.3	FHT	dry	3.4×10^{-7}
TSF_BH 03	0.6 – 1.4	FHT	dry	1.52×10^{-6}
WRD_BH 01	0 – 1.75	FHT	dry	4.25×10^{-7}
WRD_BH 02	0 -1.0	FHT	dry	8.24×10^{-7}

*FHT – Water filling with decreasing pressure.

All tests in quaternary deluvial and colluvial soils were conducted in dry intervals, i.e., no groundwater was found in these materials.

Paleogene sedimentary and Proterozoic metamorphic rocks

In 2019, Golder Associates Ltd. and Jess E EOOD conducted hydrogeological studies of the rocks forming the bedrock of the study area. The groundwater in these rocks is designated as GWB BG3G000PtPg049 according to the List of Groundwater Bodies in the Eastern Black Sea Region.

Tests have been conducted to clarify the filtration characteristics of the lithological varieties that make up the study area. They are represented by a variety of Paleogene sediments and metamorphic rocks. The filtration tests were carried out in exploratory boreholes, as well as in boreholes specifically drilled for hydrogeological research.

The data from measurements of their levels in the period 2020–2022 are presented in Section 7.2, and the results of the study of their chemical composition are presented in Section 7.3 of this report.

Table No. 2.

Preparation No	Test No	Lithological type	Test performed	Filtration coefficient m/sec
RDD-148	1	olistostrom	packer	2.13×10^{-9}
	2	gnaisi	FHT	1.02×10^{-8}
RDD-164	1	sediments	packer	5.64×10^{-8}
	2	gneiss	FHT	1.11×10^{-8}
RDD-153	1	sediments	FHT	4.29×10^{-7}
RDD-160	1	gnaysis	FHT	2.11×10^{-7}
RDD-162	1	sediments	FHT	1.45×10^{-7}
	2	sediments	packer	1.27×10^{-8}
	3	olistostrom	FHT	9.67×10^{-10}
RDD-151	2	gneiss	packer	3.54×10^{-8}
RDD-156	2	gnays	FHT	3.09×10^{-8}
PP-BH-01	2	gnays	FHT	5.0×10^{-8}
PP-BH-02	2	gnays	FHT	2.94×10^{-8}
RWD-BH-01	1	gnays	FHT	7.15×10^{-9}
TSF-BH-01	1	gnays	FHT	5.35×10^{-7}
	2	gnays	FHT	1.28×10^{-6}
TSF-BH-03	2	gnays	FHT	4.42×10^{-7}
WRD-BH-01	2	gnaysis	FHT	4.75×10^{-8}
WRD-BH-02	2	gnays	FHT	4.42×10^{-8}
RDD 172	1	sediments	water intake	2.66×10^{-9}
RDD 173	1	sediments	water pumping	7.71×10^{-10}

*FHT – Water filling with decreasing pressure

Some of the tests conducted also determined the integral conductivity of the lithological types forming PWT BG3G000PtPg049 to be between 0.02 and 0.069 m^2 /day.

7.2. Groundwater levels

Quaternary sediments

The groundwater levels flowing in the alluvial materials that form the terraces of the Byala River and its tributary Arpa Dere are measured at 9 monitoring points. Two of the piezometers were constructed in 2019 and the rest in 2021. The location of the structures in the alluvial sediments is shown in Fig. 6 below.

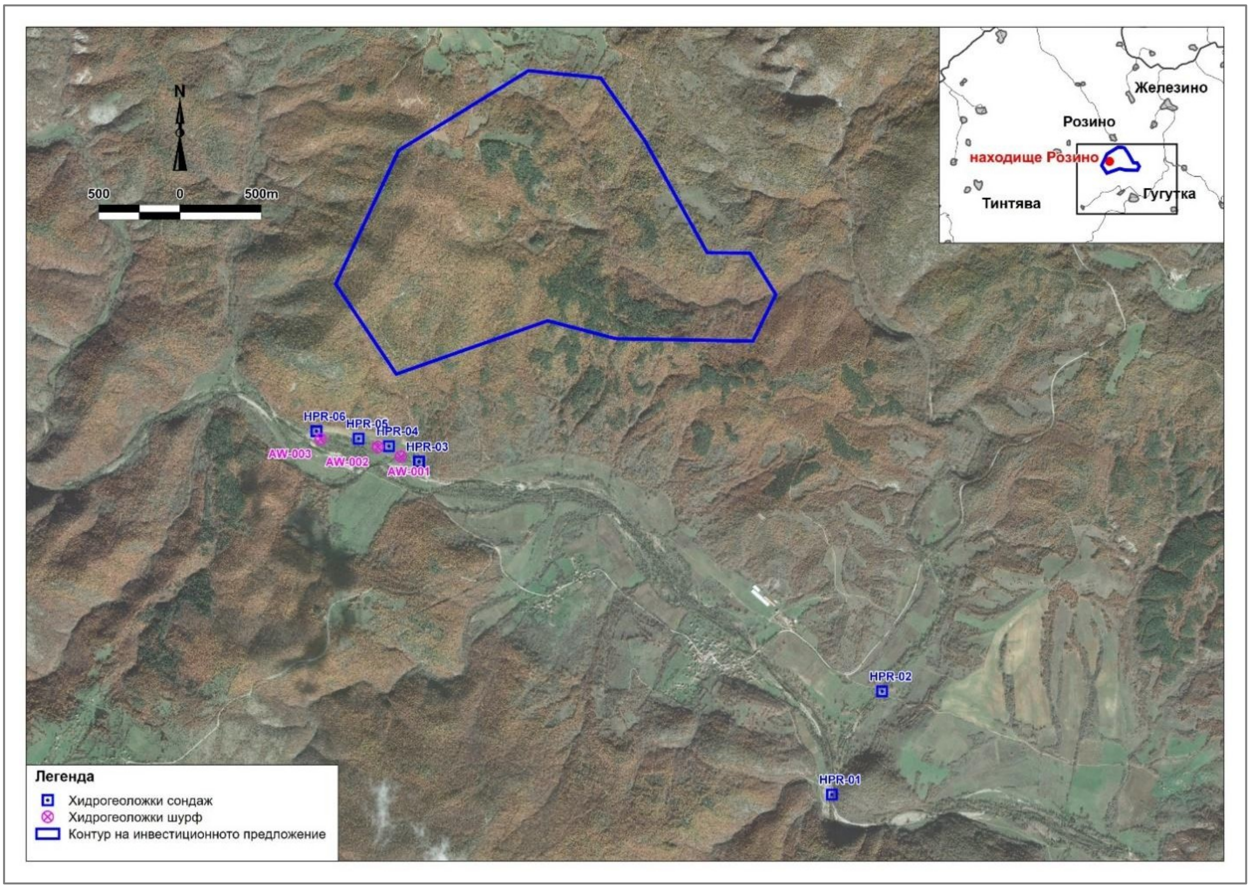


Fig. 6. Location of monitoring points for groundwater in the alluvial deposits of the Byala River.

The results of the measurements taken at the monitoring points are presented in Table 3 below.

Table 3.

No.	Elevation, m	Lowest water level from the surface, m	Highest water level from the surface, m	Average values for the period, m
HPR-01	221.26	0.90	0.04	0.58
HPR-02	220.54	2.18	0.90	1.39
HPR-03	231.90	3.40	0.86	1.56
HPR-04	233.14	3.48	0.97	1.75
HPR-05	233.93	3.70	0.84	1.62
HPR-06	235.81	4.15	1.23	2.16
AW-001	233.53	3.27	0.85	1.59
AW-002	234.05	2.91	0.44	1.18
AW-003	236.96	4.24	1.65	2.47

The water levels in the monitored boreholes are established at depths of 0.04 to 4.24 m from the surface and are directly dependent on the water levels in the Biala and Arpa Dere rivers.

During the hydrogeological studies of the *deluvial* and *colluvial* soils forming the Quaternary cover of the Rozino section, it was established that no groundwater flows through them.

Paleogene sedimentary and Proterozoic metamorphic rocks PVT BG3G000PtPg049

During the period 2019-2023, Tintyava Exploration AD will periodically measure the groundwater levels in 12 of the exploratory boreholes drilled.

The profile established by the boreholes is entirely represented by Paleogene sediments and metamorphic rocks forming PVT BG3G000PtPg049. During this period, 4 of the boreholes were compromised and measurements continue to be carried out in the remaining 8.

The location of these boreholes is shown in Fig. 7 below, and the measurement results are presented in Table 4.

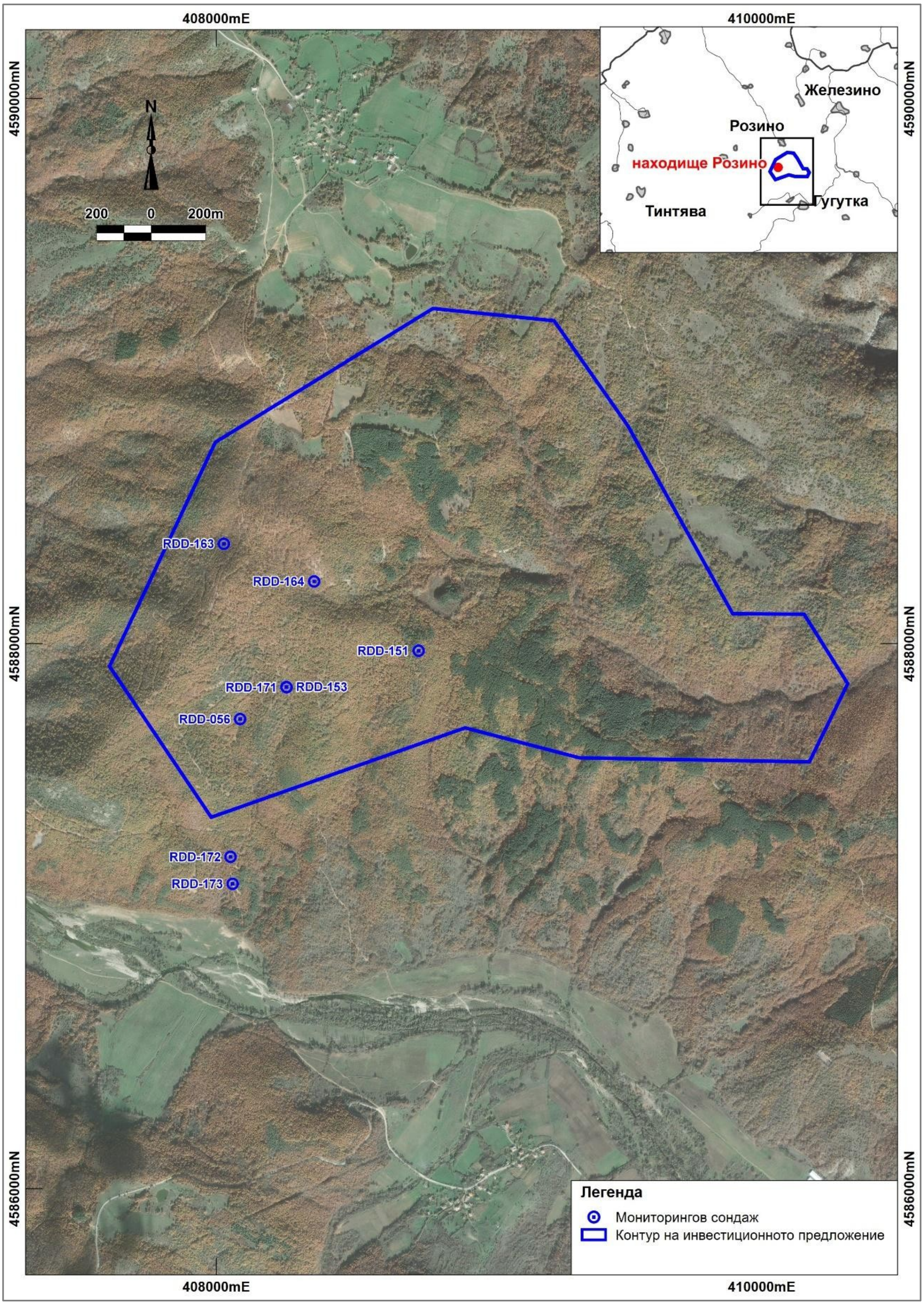


Fig. 7. Location of monitoring points in PWT BG3G000PtPg049.

Table No. 4.

Borehole No.	Ground elevation, m	Lowest water level from the surface, m	Highest water level from the surface, m	Average values for the period, m
RDD-056	368.75	self-discharge		
RDD-151	416.19	31.33	29.25	29.94
RDD-153	413.07	14.31	7.19	9.88
RDD-163	477.55	14.43	10.52	9.83
RDD-164	457.98	17.40	9.83	15.99
RDD-171	413.25	20.25	4.82	6.67
RDD-172	295.72	11.66	6.67	10.19
RDD-173	270.66	11.39	5.57	7.70

The water levels in the monitored boreholes were recorded at 4.82 to 31.33 m below the surface, with the range of average values for the period being 6.67 to 29.94 m. The water levels are in the range of 259.27 to 467.03 m. An exception is borehole RDD-056, where groundwater is drained by self-flow at an elevation of 368.75 m.

7.3. Chemical composition of groundwater

Alluvial sediments

The chemical composition of the groundwater flowing in the alluvial sediments of the Biala River was studied using two samples taken from boreholes HPR 03 and HPR 06.

The results of the chemical tests are presented in Table 5 below.

Table No. 5.

Indicator	Units of measurement	Standard according to Regulation 1	Drilling HPR 03	Drilling HPR 06
pH	pH units	≥ 6.5 and ≤ 9.5	7.11	7.28 ± 0.11
Electrical conductivity	µS/cm	2000	357	267 ± 8
Total hardness	mgeqv/l	12	3.03 ± 0.15	2.37 ± 0.24
Permanganate oxidizability	mgO_2/l	5	0.88	1.9
Sodium	mg/l	200	15.2	10.9 ± 1.5
Calcium	mg/l	15	40.2 ± 2.0	28.2 ± 2.8
Magnesium	mg/l	80	12.4 ± 1.2	11.7 ± 1.2
Aluminum	µg/l	200	174 ± 17	336 ± 34
Antimony	µg/l	5.	<1.0	<1.0
Arsenic	µg/l	10	<3.0	<3.0
Boron	mg/l	1.0	0.008 ± 0.001	0.004 ± 0.001
Iron	µg/l	20	163	357
Mercury	µg/l	1.	<0.05	<0.05
Cadmium	µg/l	5	0.32 ± 0.06	0.40 ± 0.08
Manganese	µg/l	5	8.4	26
Copper	mg/l	0.	0.004 ± 0.001	0.009 ± 0.001
Nickel	µg/l	2	<2.0	<2.0
Lead	µg/l	10	<2.0	<2.0
Selenium	µg/l	10	<3.0	<3.0
Chromium	µg/l	50	<1.0	<1.0
Zinc	mg/l	1.0	0.004 ± 0.001	0.004 ± 0.001
Nitrates	mg/l	50	15.4	0.93 ± 0.14
Nitrites	mg/l	0.5	<0.05	<0.05
Sulfates	mg/l	25	23.4	20.2
Fluorides	mg/l	1.5	<0.10	<0.10
Phosphates	mg/l	0.5	<0.10	<0.10
Chlorides	mg/l	250	11.1	7.6
Cyanides	µg/l	50	<5	<5
Natural uranium	mg/l	0.06	<0.020	<0.020

A comparison of the concentrations of the parameters studied with the normative values according to the quality standard under Ordinance No. 1 of October 10, 2007, on the study, use, and protection of groundwater shows good chemical status of groundwater in alluvial sediments. The results obtained correspond to low contents for the parameters studied in comparison with the quality standard under Ordinance No. 1.

The contents of volatile organic compounds (VOC), organochlorine pesticides, organophosphorus and organonitrogen pesticides, total pesticides, benzopyrenes, polycyclic aromatic hydrocarbons (PAHs) are below 0.010 µg/l, and petroleum products below 20 mg/l, which is why, as low contents below the standard values, they are not reflected in the table. These concentrations, together with the low levels of petroleum products, heavy metals, and nutrients (ammonium, nitrates, nitrites, phosphates), indicate that the groundwater in the studied area is not affected by human activity. For two of the indicators (aluminum and iron), there is a slight increase in the content in the HPR 06 sample compared to the results for HPR 03 and the quality standard. The increase is minimal and most likely corresponds to natural variations for the two indicators (which are also basic rock-forming elements).

The values of the indicators studied at the sampling sites are very close and reflect a relatively constant chemical composition of the groundwater in the alluvial sediments. The data show that these groundwater resources are in good condition and their quality has not been impaired by human activity (agricultural or geological exploration activities). In this regard, it should be added that, as noted above, these results can be used as a background characteristic of the chemical composition of alluvial groundwater in the area.

Groundwater in Paleogene sediments and metamorphic basement

The chemical composition of groundwater flowing in Paleogene sediments and the metamorphic basement is represented by the results of eight samples tested in 2019 and one sample tested in 2022. The data are presented in Table 6.

Table No. 6.

Indicator	Units of measure ment	Standard Regulation 1	RDD 005	RDD 011	RDD 016	RDD 021	RDD 027
pH	pH units	≥ 6.5 and ≤ 9.5	7.25	7.09	6.99	6.96	7.27
Electrical conductivity	μS/cm	2000	474	894	611	504	615
Total hardness	mgeqv/l	12	5.36	9.3	7.48	5.31	7.18
Permanganate oxidizability	mgO_2/l	5	3.6	4.7	5.3	0.7	2.7
Sodium	mg/l	200	10.8	42.1	7.5	19.9	14.4
Calcium	mg/l	150	92	147	125	82	104
Magnesium	mg/l	80	9.3	23.9	14.9	14.8	23.8
Aluminum	μg/l	200	<8.0	<8.0	<8.0	25	<8.0
Antimony	μg/l	5	<2.0	<2.0	<2.0	<2.0	<2.0
Arsenic	μg/l	10	<5.0	<5.0	<5.0	34	<5.0
Boron	mg/l	1.	0.011	0.013	0.01	0.0094	0.0095
Iron	μg/l	20	14	5.	5.1	6.3	14
Mercury	μg/l	1.0	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	μg/l	5.0	<1.0	<1.0	<1.0	<1.0	<1.0
Manganese	μg/l	50	1200	2600	70	300	1200
Copper	mg/l	0.2	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Nickel	μg/l	20	26	15	2.5	11	4.8
Lead	μg/l	10	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	μg/l	10	<5.0	<5.0	<5.0	<5.0	<5.0
Chromium	μg/l	50	<1.0	<1.0	2.2	<1.0	<1.0
Zinc	mg/l	1.0	0.21	0.88	0.7	0.4	0.72
Nitrates	mg/l	50	<0.50	2.2	2.2	<0.50	1.9
Nitrites	mg/l	0.5	<0.05	<0.05	<0.05	<0.05	<0.05
Sulfates	mg/l	250	10.1	50.0	20.7	13.3	10.2
Fluorides	mg/l	1.5	<0.10	0.13	0.13	0.11	0.14
Phosphates	mg/l	0.5	<0.10	<0.10	<0.10	<0.10	<0.10
Chlorides	mg/l	25	5.5	40.8	112	13.5	11.7
Cyanides	μg/l	50	<5	<5	<5	<5	<5
Natural uranium	mg/l	0.06	<0.020	<0.02	<0.020	<0.020	<0.020

Table No. 6 – continued.

Indicator	Units of measure ment	Standard Regulation 1	RDD 035	RDD 049	RDD 056	RDD 202
pH	pH units	≥ 6.5 and ≤ 9.5	7.02	7.02	7.63	7.04
Electrical conductivity	µS/cm	2000	534	410	658	640
Total hardness	mgeqv/l	12	6.21	4.57	7.02	5.69
Permanganate oxidizability	mgO_2/l	5	<0.50	4.7	<0.50	1.8
Sodium	mg/l	200	12.2	10.4	18.8	10.7
Calcium	mg/l	150	80.4	64	96	75
Magnesium	mg/l	80	26.8	16.7	27.1	23.4
Aluminum	µg/l	200	<8.0	62	<8.0	61
Antimony	µg/l	5	<2.0	<2.0	<2.0	<1.0
Arsenic	µg/l	10	<5.0	6.4	7.6	8.4
Boron	mg/l	1.0	0.013	0.022	0.0072	<0.003
Iron	µg/l	20	34	48	5.0	1410
Mercury	µg/l	1.0	<0.05	<0.05	<0.05	<0.05
Cadmium	µg/l	5.0	<1.0	<1.0	<1.0	0.34
Manganese	µg/l	50	600	670	9.6	152
Copper	mg/l	0.2	<0.0030	<0.0030	<0.0030	0.0006
Nickel	µg/l	20	13	26	<2.0	<2.0
Lead	µg/l	10	<2.0	<2.0	<2.0	<2.0
Selenium	µg/l	10	<5.0	<5.0	<5.0	<3.0
Chromium	µg/l	50	<1.0	<1.0	<1.0	<1.0
Zinc	mg/l	1.0	0.11	0.34	0.16	<0.001
Nitrates	mg/l	50	<0.50	<0.50	<0.50	1.9
Nitrites	mg/l	0.5	0.06	<0.05	<0.05	<0.05
Sulfates	mg/l	250	24.2	34.6	32.2	15.1
Fluorides	mg/l	1.5	<0.10	0.21	0.1	<0.10
Phosphates	mg/l	0.5	<0.10	<0.10	<0.10	<0.10
Chlorides	mg/l	25	12.9	10.3	30.2	15.6
Cyanides	µg/l	50	<5	<5	<5	<5
Natural uranium	mg/l	0.06	<0.020	<0.02	<0.020	<0.020

The data on the concentrations of the parameters studied are compared with the normative values according to the quality standard under Ordinance No. 1 of 10.10.2007 on the study, use, and protection of groundwater. The results obtained show low contents of the parameters studied. This comparison reflects the good chemical status of the groundwater.

Most of the parameters studied are below the lower limit for determining a given indicator. This group includes antimony, mercury, cadmium, lead, selenium, phosphates, cyanides, and natural uranium. The contents of volatile organic compounds (VOC), organochlorine pesticides, organophosphorus and organonitrogen pesticides, total pesticides, benzopyrenes, and polycyclic aromatic hydrocarbons (PAHs) are also below the lower limit for determining the indicator (<0.010 µg/l). The rest of the elements studied show lower concentrations than the groundwater quality standard.

There are several exceptions to the overall picture regarding the contents of the indicators studied, which should be commented on. In most samples, manganese is present in concentrations higher than the quality standard, and in one of the samples, iron is also present in higher concentrations. Both elements are rock-forming and are often mobilized in groundwater when rocks weather. In this regard, it is important to note that in fissure waters, such an increase also occurs when both elements are deposited in rock fissures in the form of hydroxides. In one of the samples (from RDD 021), arsenic is present in elevated concentrations (µg/l 34). Arsenic, selenium, and antimony usually show increased contents together with heavy metals in rocks with hydrothermal mineralization. This is observed both in the Sredna Gora ore zone and in the ore mineralizations in the Rhodopes. In this case, selenium and antimony do not show increased contents, only arsenic. In one of the samples, nickel is also slightly increased. As these are isolated results of increase, no clear trends can be deduced from them. This can be done when a monitoring network for groundwater is established for the Rozino deposit and regular results are collected over time.

The main conclusion from the review of the data on the chemical composition of groundwater in Paleogene sediments and the metamorphic basement is that the values of the indicators studied in the individual boreholes are very close and reflect a relatively constant chemical composition of groundwater, which has not been altered by human activity. The important thing in this case is that these results can be used as a basis for determining the background characteristics of the chemical composition of groundwater in the area during the future development of the deposit.

8. Summary hydrogeological characteristics

According to the accepted classification of groundwater bodies in the Republic of Bulgaria, groundwater in the study area is associated with one groundwater body (GWB) with code BG3G000PtPg049 - Fractured waters - Eastern Rhodope Complex. The lithological composition of the rocks of the groundwater body is diverse in type and age. The geological formations are represented by a metamorphic basement and a Paleogene sedimentary complex. The metamorphic rocks are represented by a colorful range of migmatites, serpentinites, amphibolites, marbles, gneisses, and granites. The Paleogene sedimentary complex includes breccias and conglomerates, coarse-grained to aleuritic sandstones, marls, and coal shales.

A characteristic feature of this GWB is that it is one of the poorest in groundwater in the country, with an underground runoff module of <0.5 $l/s/km^2$. This explains the lack of water intake facilities built in the Paleogene sediments and metamorphic rocks in the study area.

During the period 2019-2022, the groundwater levels flowing in GWB BG3G000PtPg049 were regularly measured in 8 boreholes. The results of the measurements, as well as the data from the overall study, allow for the characterization of PWT BG3G000PtPg049 in the study area of IP Rozino. During the specified period, groundwater levels were found at a depth of 4.82 to 31.33 m below the surface, generally following the terrain line. Water levels ranged from 259.27 to 467.03 m. An exception is borehole RDD-056, where groundwater is drained by self-flow at an elevation of 368.75 m. Groundwater is classified as fissure type.

The filtration parameters of the water-bearing rocks are very low – filtration coefficient ranging from 2.11×10^{-7} to 2.13×10^{-9} m/sec and conductivity in the range of 0.02 – 0.069 m^2 /day.

The waters flowing in PWT BG3G000PtPg049 are fresh with mineralization <1 g/l, neutral (pH 7.02 – 7.65). The results of the chemical analyses show lower concentrations of the parameters studied compared to the quality standard according to Ordinance No. 1 of 10.10.2007. This circumstance reflects the good chemical status of the groundwater, as the values of the parameters studied in the individual boreholes are very close and reflect a relatively constant chemical composition of the groundwater, which has not been altered by human activity.

The recharge of groundwater accumulated in the Paleogene sediments in the study area occurs mainly through fractures and tectonic disturbances from adjacent horizons and from the metamorphic rocks forming their base. The highly dissected relief, combined with the very low filtration characteristics of the rocks, is a prerequisite for very little infiltration recharge from surface waters.

The general direction of groundwater drainage is south-southeast. The hydrogeological characteristics of PVT BG3G000PtPg049 in the study area of IP Rozino has been prepared on the basis of a summary of the results of hydrogeological studies conducted in the area of the site in accordance with Article 17 (1) (1) of Ordinance No. 1 of 10.10.2007 on the study, use, and protection of groundwater. According to Articles 13, 14, 15, and 16 of the same Regulation, PVT BG3G000PtPg049, the area is: according to structure – heterogeneous, according to filtration properties – non-homogeneous, according to hydrogeological conditions – pressurized-unpressurized, with complex boundary conditions, and according to the degree of study, it is in Group III – poorly studied hydrogeological conditions.

Alluvial deposits have formed on the terrace of the Byala River. They consist of boulders, mixed-grain gravel, and sand in various proportions, including sandy-clay lenses and interlayers. In some areas, their thickness exceeds 5-6 m. These deposits occur sporadically and, due to their inconsistency in terms of area, are of no economic interest, which is why they have not been nominated as a separate groundwater body and are not included in the List of groundwater bodies in the Eastern Black Sea region. During the hydrogeological studies, two sections of the alluvial terraces of the Biala River and its tributary Arpa Dere were also investigated, and the groundwater levels in them were measured in the period 2021-2022.

Clear peaks in water levels were recorded in October-November. No clear trend was observed for low levels, but they were recorded in February-March.

During this period, water levels in the monitored boreholes varied at depths of 0.04 to 4.24 m from the surface. Groundwater is in direct hydraulic connection with the waters of the Biala and Arpa Dere rivers.

Alluvial deposits have a filtration coefficient of 1.5×10^{-4} – 5.8×10^{-4} m/sec and a level transfer coefficient of 2.36 – 2.63 m^2 /day.

The water circulating in the alluvial deposits is fresh with a total mineralization of <1 g/l, neutral (pH 7.11 – 7.28), and with a relatively constant chemical composition, which is not affected by human activity and is of good quality compared to the standard according to Annex 1 of Ordinance No. 1 of 10.10.2007.

The deluvial and colluvial soils are represented by a sandy clay matrix with inclusions of angular rock fragments of varying sizes. The Quaternary cover is developed everywhere, but in some small and steep areas it is denuded. The thickness of the deluvial and colluvial soils varies widely, reaching up to 6-7 m in some places. No groundwater has been found in these materials.

9. Conclusion

9.1. Hydrogeological parameters and filtration coefficients

The hydrogeological studies and experimental filtration tests confirm that the aquifers in the Rosino deposit, Tintyava area, have very low water conductivity and limited water abundance. The filtration coefficients determined for the Paleogene sediments and the metamorphic basement are in the range of 2.11×10^{-7} to 2.13×10^{-9} m/s, which indicates a highly limited underground flow and a lack of potential for significant groundwater migration.

9.2. Potential risk of seepage from the tailings pond

Based on the geological parameters, low natural water permeability, and planned waterproofing measures (HDPE membrane, drainage layers, infiltrate collector), it has been established that the potential for seepage from the tailings storage facility into groundwater is minimal. The rock masses form a natural hydrogeological barrier which, in combination with the engineering measures, eliminates the risk of impact on groundwater.

9.3. Potential seepage during backfilling of the pit

Backfilling will be carried out with non-aggressive, inert sterile rock mass with no potential for acid drainage. The low filtration capacity of the surrounding rocks and the absence of local aquifers ensure that no infiltration or contamination of groundwater is expected during backfilling.

9.4. Impact of blasting

Analysis of the structural-geological and hydrogeological conditions shows that the existing fracturing is poorly developed and inherited. Controlled application of blasting will not generate significant new water-conducting fractures and will not alter the mechanical or filtration properties of the water-bearing rocks.

9.5. Impact on drinking water sources

The development of the Rozino deposit does not and cannot affect the drinking water sources in the area. This is evidenced by:

- the lack of a hydraulic connection between the IP zone and the water intake facilities;
- the different depth and nature of the aquifers;
- the absence of established groundwater in the mine area outside the limited local occurrences.

The flow rate of water sources will not be reduced by the IP's activities and no change in groundwater regimes is expected.

9.6. Impact on the chemical status of water

Chemical analyses of groundwater and surface water (2019–2023) show stable parametric composition, with no traces of pollution or negative trends. The project has no potential to deteriorate the chemical status or pH of groundwater and surface water.

Summary conclusion

Based on all studies, tests, and analyses conducted, it has been established that:

- The hydrogeological conditions are characterized by low water conductivity and limited underground runoff.
- No seepage or contamination from the tailings pond or reverse filling is expected.
- The blasting work have affect affect negatively on the and filtration properties.
- The IP does not affect the drinking water supply in the area and does not pose a risk to water intake facilities.
- The chemical status of groundwater and surface water will not be impaired.

The development of the Rozino deposit does not pose a risk to groundwater, drinking water sources, or the quality and quantity of groundwater and surface water in the area.

10. References

Herward Ventures Bulgaria AD. 2004. Final report on field work in the Rosino prospect area, conducted in 2001-2003

Avonhoe Herward Bulgaria EAD. 2006. Final report on field work in the Rosino prospect area, conducted in 2004-2005.

Karakal Cambridge Bulgaria EAD. 2008. Final report on field work in the prospective area of Rosino, conducted in 2006-2007.

Karakal Cambridge Bulgaria EAD. 2009. Technical and economic assessment of the Tashlaka section, Rosino prospective area.

V. Slavov. 2019. "Hydrological assessment of the outflow in the Biala River and its tributary, the Arpa Dere River, near the village of Gugutka, municipality of Ivaylovgrad, Haskovo region."

Golder Associates report. 2019. Rozino Pre-Feasibility Study – Hydrogeological Testing Factual Report.

Projektiraye i analizi EOOD. 2020. Fresh water pumping station for the Rozino site – Preliminary study.

"Jess E" EOOD. 2020. Report on the results of hydrogeological tests of alluvial sediments in the Biala Reka and Arpa Dere rivers.

Jess E EOOD. 2020. Report on the results of hydrogeological tests on Paleogene sediments in the Tintyava exploration area, Ivaylovgrad municipality.

Jess E Ltd. 2021. Report on the results of hydrogeological tests in the alluvial sediments of the Byala River.

GCS. 2020. Review of Water Resources Assessments conducted for the Rozino PFS Project, Tintyava Property, Bulgaria.

Tintyava Exploration AD. 2020. Comprehensive report on the results of the search and exploration for metal minerals for the three-year period 2017–2020 in the prospective area "TINTYAVA," located in the municipality of Ivaylovgrad, Haskovo region, and the municipality of Krumovgrad, Kardzhali region.

Tintyava Exploration AD. 2022. Comprehensive report on the results of the exploration and prospecting for metal minerals for a two-year period 2021-2022 in the prospective area "TINTYAVA", located in the territory of the municipality of Ivaylovgrad, Haskovo region, and the municipality of Krumovgrad, Kardzhali region

Regulation No. 1 of 10.10.2007 on the exploration, use, and protection of groundwater, Published in State Gazette No. 87 of 30.10.2007, amended in State Gazette No. 2 of 8.01.2010, amended and supplemented in State Gazette No. 15 of 21.02.2012, amended and supplemented in State Gazette No. 28 of 19.03.2013, amended and supplemented State Gazette No. 90 of 31.10.2014, amended and supplemented State Gazette No. 102 of 23.12.2016.

“JES E” Ltd *Sofia, Strelbishte residential area,*

Tulcha Street No. -, Block 112, Entrance B, Floor 1, Apartment 57 JES E Ltd
Email: jes-e@abv.bg

Opinion

By "JES E" Ltd, hired to conduct a study of the hydrogeological conditions in the area of the investment proposal for the Rozino deposit, to be used for the purposes of a team of experts who will assess the impact on the components of the environment from the development and extraction of the deposit.

This Opinion has been prepared on the basis of

- the information available on the websites of the Ministry of Regional Development and Public Works, the Ministry of Environment and Water, the Basin Directorate for Water Management in the Eastern Black Sea Region and other public information on water
- Detailed geological, hydrogeological and seismic surveys carried out in the "Tintyava" in the "Rozino" deposit located 1.2 km south of the village of Rozino, Ivaylovgrad municipality, Haskovo region. Ivaylovgrad Municipality
- Report on the project "Study of transboundary groundwater bodies between Bulgaria and Greece BG-GRGWB";

According to the adopted nomination of groundwater bodies in Bulgaria, the groundwater in the study area of the investment proposal for the Rozino deposit is linked to one groundwater body - Groundwater body (GWB) with code BG3G000PtPg049 - Fractured waters - Eastern Rhodope complex.

During the initial separation of the aquifers into groundwater bodies, the following were nominated in the area under consideration: AWB-BG3G00000Pt046 - fissured waters in Proterozoic gneisses, gneiss schists, migmatites, and AWB-BG3G00000Pg028 - fissured waters in Palaeogene sediments and volcanics. (Basin Directorate Eastern Black Sea Region, RBMP 2010-2015, Section 1, Annexes 1-6 and 1.7). Following the implementation of the project "Study of transboundary groundwater bodies between Bulgaria and Greece BG-GRGWB", 8 of the initially designated GWBs, including GWB-BG3G00000Pt046 and GWB-BG3G00000Pg028, were merged and nominated as GWB BG3G000PtPg049 (BDIBR - PURB 2016-2021, Section 1, Annexes 23 and 24).

Among these practically watertight lithological types, groundwater circulates exclusively through mechanical disturbances – cracks and tectonic disturbances. The uneven water-bearing capacity of the rock formations is determined by the geological structure and lithological composition of the rocks and mainly by the uneven fracturing.

From a hydrogeological point of view, the lithological types forming the BG3G000PtPg049 aquifer are characterised by high impermeability and are a prerequisite for the low water abundance of this aquifer. This PWT is characterised by being one of the poorest in groundwater in the country, with an underground runoff module of <0.5 $l/s/km^2$. This explains the lack of water intake facilities built in the Palaeogene sediments and metamorphic rocks in the study area.

In the studied area, in certain places along the course of the Biala River, alluvial deposits have formed, consisting of boulders, mixed-grain gravel and sand in varying proportions. Porous waters flow through these deposits, which are in direct hydraulic connection with the Biala River and its tributaries. They are outside the boundaries of groundwater body BG3G000000Q010 - Porous waters in the Quaternary - Arda River. Due to inconsistency in terms of area

, they are not nominated as a separate groundwater body and are not included in the List of groundwater bodies in the Eastern Black Sea region.

Hydrogeological conditions

In regional terms, the average values of some parameters of the lithological types from PWT BG3G000PtPg049, determined mainly during the exploration of mineral resources, hydraulic engineering and other economic activities, are as follows:

- porosity 1-2%, filtration coefficient 0.0001-1 m/24h, infiltration rate below 8%, thickness of the aquifer from several metres to several tens of metres.

Groundwater in the Palaeogene rocks and metamorphic basement

The geological formations are represented by a metamorphic foundation and a Palaeogene sedimentary complex. The metamorphic rocks comprise a diverse range of migmatites, serpentinites, amphibolites, marbles, gneisses and granites. The Palaeogene sedimentary complex includes breccias and conglomerates, coarse-grained to silt-sized sandstones, marls and coal shales.

In the study area of the investment proposal, groundwater is classified as fissured. The recharge of groundwater accumulated in the Palaeogene sediments in the study area is mainly through fissures and tectonic disturbances from adjacent horizons and metamorphic rocks. The highly dissected relief, combined with the very low filtration characteristics of the rocks, is a prerequisite for very little infiltration recharge.

The groundwater levels are established at a depth of 31.33 m to 4.82 m below the surface, generally following the terrain line. The general direction of groundwater drainage is south-southeast towards the terrace of the Byala River.

The filtration parameters of the water-bearing rocks are very low – a filtration coefficient ranging from 2.11×10^{-7} to 2.13×10^{-9} m/sec and conductivity in the range 0.02 – 0.069 m^2 /24 h.

The waters flowing in PWT BG3G000PtPg049 are fresh with mineralisation <1 g/l, neutral (pH 7.02 – 7.65). The results of the chemical analyses show lower concentrations of the parameters studied compared to the quality standard according to Ordinance No. 1 of 10.10.2007.

Groundwater in the alluvial deposits on the terrace of the Biala River

The alluvial deposits consist of boulders, mixed-grain gravel and sand in various proportions, including sandy-clay lenses and interlayers. In some areas, their thickness exceeds 5-6 m.

The water levels in the observed formations in the study area vary at depths from 0.04 to 4.24 m from the surface. The groundwater is in direct hydraulic connection with the waters of the Biala and Arpa Dere rivers.

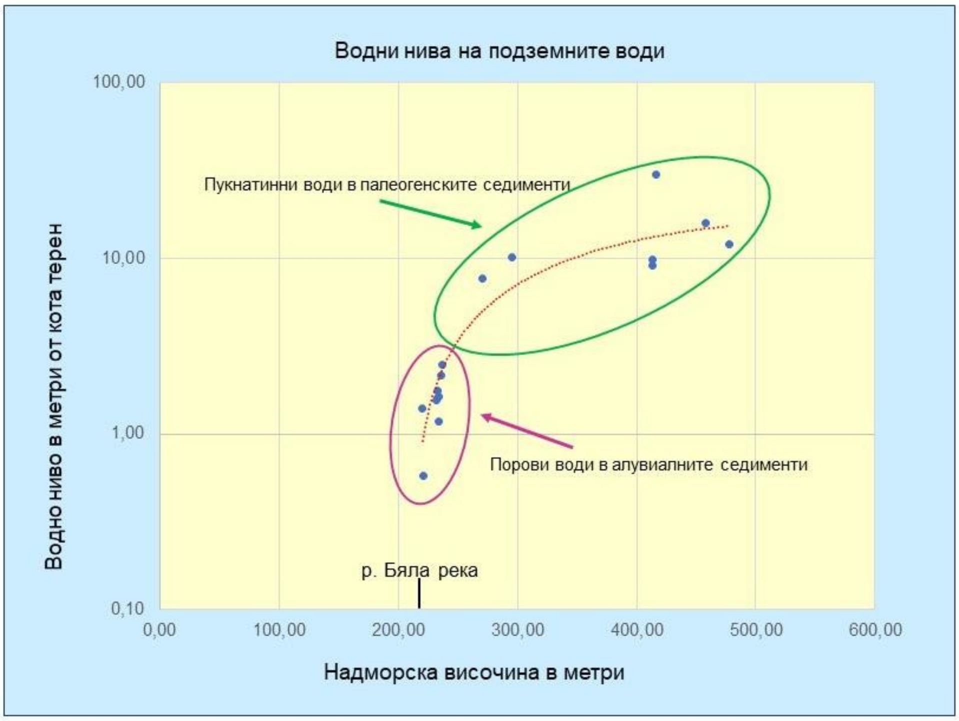
Alluvial deposits have a filtration coefficient of 1.5×10^{-4} – 5.8×10^{-4} m/sec and a level transfer coefficient of 2.36 – 2.63 m^2 / 24 h.

The water circulating in the alluvial deposits is fresh with a total mineralisation of <1 g/l, neutral (pH 7.11 – 7.28), and with a relatively constant chemical composition, which is not affected by human activity and is of good quality when compared to the standard according to Annex 1 of Ordinance No. 1 of 10.10.2007.

As can be seen from the factual material presented above, the groundwater in the study area of the investment proposal for the Rozino deposit has the characteristic features of PWT BG3G000PtPg049. These waters are fractured, flowing through watertight rocks through their fractured zones. This determines the low flow characteristics of the groundwater

. These waters are mainly attached to the upper (more weathered and fractured) part of the geological formations and follow the relief, draining towards the local erosion base – in this case, towards the terrace of the Biala River and its tributaries.

The figure below shows a graph of water levels depending on the terrain elevation in the study area of the investment proposal based on data from monitoring boreholes. The indicated trend outlines the direction of groundwater flow towards the erosion base of the Biala River.



In view of the above, the following conclusions can be drawn:

There is no data on the basis of which a risk of transboundary pollution of surface and groundwater can be identified.

No impact on surface waters is expected, either in terms of quality or quantity. The planned construction of hydraulic structures for water management (drainage ditches, sumps) during the implementation of the investment proposal will minimise and localise the impact on water quality. The investment proposal provides for the construction of two consecutively located reservoirs (the second of which is for non-contact water, i.e. conditionally clean), which will eliminate even the slightest possibility of water separated from the investment proposal entering water bodies.

No discharge of waste water into water bodies or into the sewage system of populated areas is envisaged. All collected water will be used in the technological cycles.

For the water supply of the site for technological needs, a hydrological survey has been carried out to determine the availability of water resources from surface water bodies. **The possibility of such water use has been established without causing a decrease in water quantities and disruption of the natural water flow.** Water use will only be possible after obtaining a permit in accordance with the Water Act.

No impact on groundwater bodies is expected, either in terms of quality or quantity.

The hydrogeological survey conducted in the area of the deposit, **which will be presented during the EIA procedure,** establishes that the groundwater has an insignificant flow rate. Given the planned depth of the mine, **there is no reason to believe**

that there could be a direct impact on the groundwater body or on drinking water sources, with corresponding sanitary protection zones and permitted for exploitation in accordance with the Water Act.

To determine the explosive seismic impact during the implementation of the investment project, experimental blasting was carried out on site. Based on the results obtained from measurements with specialised equipment, a report was prepared on "Assessment of the side effects of technological blasting works on the environment and management of these effects within the permissible safe levels for the Rosino deposit, Ivaylovgrad municipality, Haskovo region", which will also be presented during the EIA procedure. Haskovo region" was prepared, **which will also be presented during the EIA procedure.**

The analysis of the results obtained gives grounds to conclude that, subject to compliance with the recommended maximum mass of the explosive in a delay interval, no exceeding of the vibration velocity in depth is expected, which could have a seismic impact on groundwater and water supply sources, and **the implementation of the IP will not have a negative impact on surface and groundwater**.

Yours sincerely,
Dr. Emanuil Kozhuharov Manager
of Jess E EOOD

06.02.2024
Sofia