# ENVIRONMENTAL IMPACT REPORT FOR

## *„ The Project on increasing the share of electricity production from renewable sources by completing the works and ensuring permanent monitoring of the environmental impact of the hydropower plant on the Jiu river in the Livezeni - Bumbești sector" - continuation of the remaining works to be executed at the AHE Livezeni - Bumbești*

**2024**

**Contents**

## GENERAL INFORMATION ABOUT THE PROJECT BENEFICIARY

Project name: ″ **The Project on increasing the share of electricity production from renewable sources by completing the works and ensuring permanent monitoring of the environmental impact of the hydropower development of the Jiu river on the Livezeni - Bumbești sector" - continuation of the remaining works to be executed at the AHE Livezeni - Bumbești**

**Holder/Beneficiary**
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## 1. PROJECT DESCRIPTION

*1.1 Project location:*

*a) Administrative location*

The project is located in the counties of Hunedoara (Livezeni dam and MHC Livezeni) and Gorj (CHE Dumitra, Dumitra intake bottom sill, Jiu intake bottom sill, Bratcu intake bottom sill and CHE Bumbești). It is located on the territory of two territorial administrative units, namely Aninoasa in Hunedoara County, which is part of the West Development Region, and Bumbești Jiu in Gorj County, which is part of the South-West Development Region, located in the Jiu intake bottom sill area.

The project site is located in the western part of the Southern Carpathians between the Valcan Mountains - to the west and the Parâng Mountains - to the east.

The Jiu river basin is located in the south-western part of the country, bordering the Mures river basin in the north, the Banat river basin in the west, the Olt river basin in the east, the Olt river basin in the east, and Bulgaria in the south - the boundary is formed by the Danube river.

The following table shows the administrative and territorial location of the sites concerned by the remaining works.

*Table no. 1 Location of the remaining works to be carried out in relation to the a.u.t.s*

| Project components - works still to be executed | | Administrative location of sites |
|---|---|---|
| 1. Livezeni dam and power intake | | |
| | 1.1. Development of Livezeni dam technological platform | UAT Aninoasa, Hunedoara county |
| | 1.2. Development of the Livezeni reservoir basin | UAT Aninoasa, Hunedoara county |
| | 1.3. Closure of the diversion channel of the Livezeni dam with fish passage | UAT Aninoasa, Hunedoara county |
| | 1.4. Regularization of the riverbed downstream Livezeni dam | UAT Aninoasa, Hunedoara county |
| | 1.5. MHC Livezeni finishes | UAT Aninoasa, Hunedoara county |
| 2. CHE Dumitra | | |
| | 2.1. CHE Dumitra landscaping, platforms, fencing and swales | UAT Bumbești-Jiu, Gorj county |
| | 2.2. Bridge over the stilling pond CHE Dumitra | UAT Bumbești-Jiu, Gorj county |
| 3. CHE Dumitra Intervention Block | | UAT Bumbești-Jiu, Gorj county |
| 4. Dumitra intake bottom sill | | UAT Bumbești-Jiu, Gorj county |
| 5. Access roads CHE Dumitra | | |
| | 5.1. Access road to the CHE Dumitra outer platform | UAT Bumbești-Jiu, Gorj county |
| | 5.2. Access road over the Dumitra intake bottom sill | UAT Bumbești-Jiu, Gorj county |
| 6. Bumbești pressure node | | |
| | 6.1. Concreting of the superstructure of the Bumbești gate chamber | UAT Bumbești-Jiu, Gorj county |
| | 6.2. Massive concreting M1 penstock Bumbești | UAT Bumbești-Jiu, Gorj county |
| 7. CHE Bumbești | | |
| | 7.1. CHE Bumbești Arrangements | UAT Bumbești-Jiu, Gorj county |
| | 7.2. Outdoor arrangements technical block CHE Bumbești | UAT Bumbești-Jiu, Gorj county |
| | 7.3. Outdoor arrangements at CHE Bumbești, fencing, and drainage channels | UAT Bumbești-Jiu, Gorj county |
| | 7.4. Concreting of the connection between the stilling basin and the Bumbești tailrace channel | UAT Bumbești-Jiu, Gorj county |

| Project components - works still to be executed | | Administrative location of sites |
|---|---|---|
| | 7.5. 110 kV CHE Bumbești Transformer Station | UAT Bumbești-Jiu, Gorj county |
| 8. Access road to CHE Bumbești | | UAT Bumbești-Jiu, Gorj county |
| 9. Access road over the M3 CHE Bumbești massif | | UAT Bumbești-Jiu, Gorj county |
| 10. Bratcu catchment | | UAT Bumbești-Jiu, Gorj county |
| 11. Jiu secondary intake | | |
| | 11.1. Concreting of infrastructure and superstructure of Jiu secondary intake, including fish ladder | UAT Bumbești-Jiu, Gorj county |
| | 11.2. Jiu secondary intake headrace pipeline and junction box | UAT Bumbești-Jiu, Gorj county |
| 12. Access road to Jiu secondary intake | | UAT Bumbești-Jiu, Gorj county |
| 13. Site organization | | |
| | 13.1. Decommissioning of temporary bridge upstream Livezeni dam | UAT Aninoasa, Hunedoara county |
| | 13.2. Decommissioning of the technological platform upstream Livezeni dam and final connection of the wastewater pipeline | UAT Aninoasa, Hunedoara county |
| | 13.3. Development of the technological platform and access road to the Livezeni access tunnel | UAT Aninoasa, Hunedoara county |
| | 13.4. Development of a technological platform at the Murga Mica access tunnel | UAT Bumbești-Jiu, Gorj county |
| | 13.5. Decommissioning of the site organization at the Bratcu Access tunnel | UAT Bumbești-Jiu, Gorj county |
| 14. Connecting SEN | | |
| | 14.1. Connection of MHC Livezeni to SEN | UAT Aninoasa, Hunedoara county |
| | 14.2. Connecting CHE Dumitra to SEN | UAT Aninoasa, Hunedoara county |
| | 14.3. CHE Bumbești connection to SEN | UAT Bumbești-Jiu, Gorj county |
| 15. Dumitra - Bumbești headrace | | UAT Bumbești-Jiu, Gorj county |

Spatial data in vector format, shapefile type, in the national projection system Stereo 1970/Dealul Piscului 1970, related to the locations of the remaining works to be carried out will be made available to the competent authority for environmental protection by the beneficiary of the project.

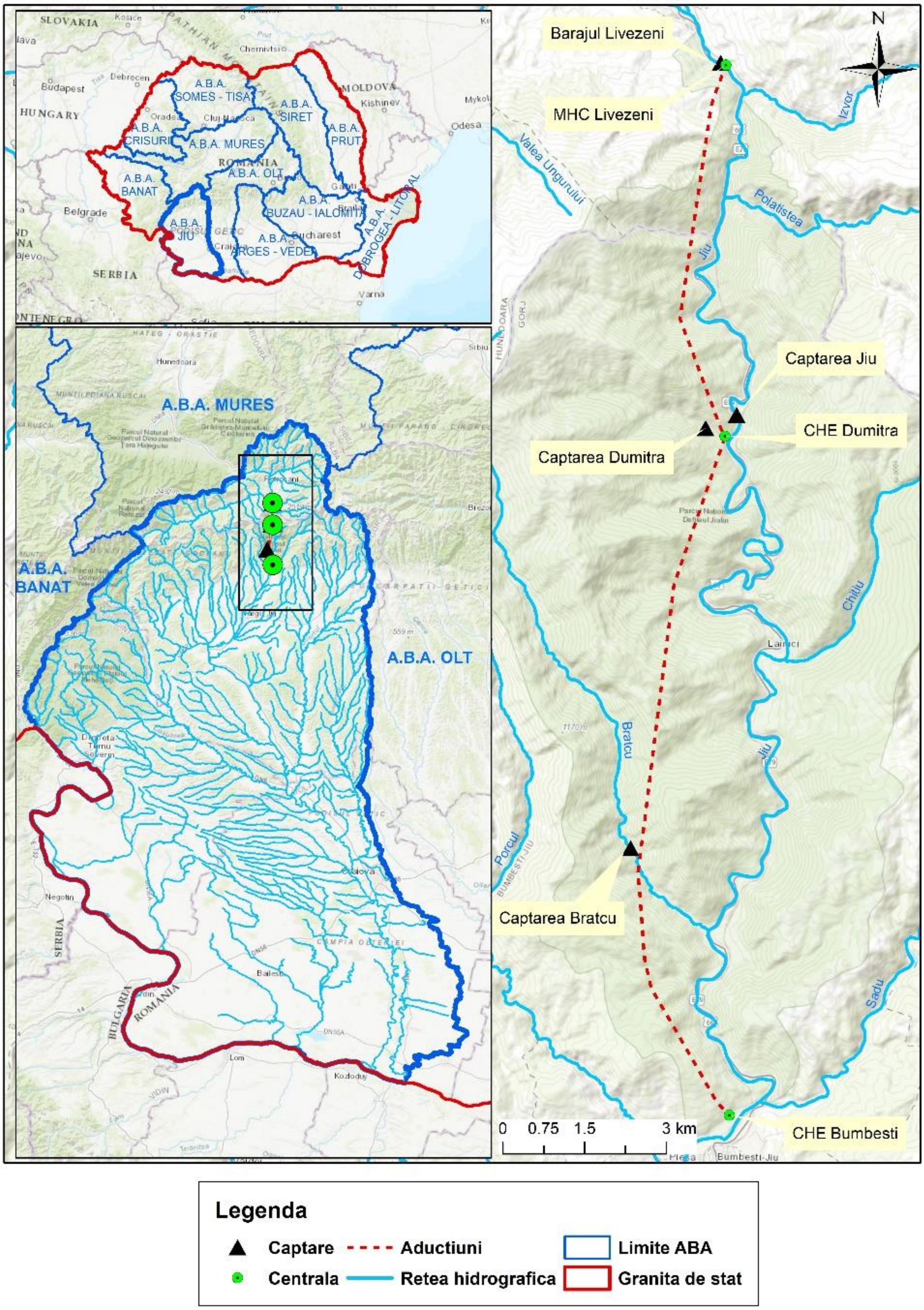



Fig. 1 - Localization of Livezeni Bumbești E.H.W.A. within the Jiu river basin

The Stereo 70 coordinates of the contour points of the sites of the remaining works to be carried out are shown in the table below, and the shp-file GIS locations in Stereo 70 coordinates are attached to this study.

*b) Location in relation to protected natural areas*

The sites concerned by the realization of the execution remaing works are located within the perimeter of the ROSCI0063 Defileul Jiului Site of Community Importance, the Defileul Jiului National Park and in their immediate vicinity.

In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului there are the Livezeni dam (including the Livezeni dam diversion channel with fish passage), the Livezeni MHC, the Livezeni reservoir, the Livezeni technological platform, the Livezeni access tunnel, the Bumbești CHE and the connection routes to the SEN of the Livezeni MHC and Bumbești CHE, and in the vicinity of the Defileul Jiului National Park there are only the Livezeni dam (including the Livezeni dam diversion canal with fish passage), the Livezeni MHC, the Livezeni reservoir, the Livezeni reservoir, the Livezeni technological platform, the Livezeni access tunnel, because in the CHE Bumbești area the park boundaries are wider than those of the SCI, including the CHE Bumbești area.

The Jiu River is connected upstream, through its tributary Jiul de Vest, by the Site of Community Importance ROSCI0217 Retezat, a site that partially overlaps with the Special Protection Area for Birds ROSPA0084 Munții Retezat. The Natura 2000 site ROSCI0217 Retezat, located about 33 km upstream on the Jiul de Vest watercourse, cannot be affected by the possible longitudinal fragmentation at the level of the Livezeni dam. In addition to the long distance, the watercourse crosses a number of localities (Vulcani, Lupeni, etc.) where there are numerous barriers interrupting the longitudinal connectivity of the watercourse.

*Table nr. 2 - Geographical coordinates of the project - Jiu catchment, CHE Bumbești*

| **Objective name** | **Stereo 70 coordinates** | | **Objective name** | **Stereo 70 coordinates** | |
|---|---|---|---|---|---|
| | **X** | **Y** | | **X** | **Y** |
| **Livezeni Dam** | 372836.885 | 430311.211 | **Captare Jiu** | 373171.625 | 423728.958 |
| | 372822.947 | 430276.322 | | 373233.583 | 423727.260 |
| | 372782.595 | 430334.435 | | 373225.294 | 423685.573 |
| | 372721.970 | 430357.755 | | 373171.161 | 423678.563 |
| | 372759.889 | 430343.559 | **CHE Dumitra** | 373014.785 | 423351.724 |
| | 372720.173 | 430293.563 | | 373041.288 | 423381.683 |
| | 372700.043 | 430313.478 | | 373008.043 | 423357.688 |
| | 372761.537 | 430277.289 | | 372983.303 | 423347.788 |
| | 372790.547 | 430289.284 | | 372994.912 | 423342.845 |
| | 372784.083 | 430273.127 | | 373032.141 | 423389.775 |
| **MHC Livezeni** | 372770.157 | 430297.441 | | 373008.045 | 423411.994 |
| | 372755.307 | 430303.380 | | 372972.517 | 423370.514 |
| | 372751.221 | 430293.167 | | 373019.706 | 423412.645 |
| | 372766.160 | 430287.408 | | 373059.217 | 423421.892 |
| **Jiu connection pipeline** | 373064.348 | 423436.120 | | 373040.018 | 423435.610 |
| | 373084.377 | 423462.991 | **CHE Bumbesti** | 373131.044 | 411013.149 |
| | 373022.197 | 423387.892 | | 373138.614 | 411021.059 |
| | 373043.040 | 423411.449 | | 373107.477 | 411057.486 |

| Objective name | Stereo 70 coordinates | | Objective name | Stereo 70 coordinates | |
|---|---|---|---|---|---|
| | X | Y | | X | Y |
| | 373115.420 | 423508.356 | | 373040.298 | 411003.963 |
| | 373177.730 | 423637.039 | | 373141.760 | 410900.660 |
| | 373180.693 | 423680.190 | | 373194.494 | 410948.989 |
| | 373127.899 | 423527.051 | | | |
| | 373145.903 | 423554.295 | | | |

*Table no. 3 - Geographical coordinates of the project - Connection to SEN - CHE Bumbești (LEA)*

| Final pole no. | Post type | coordinates stereographic system 1970 | | | H pole | Sup pole |
|---|---|---|---|---|---|---|
| | | X | Y | Z | | |
| 1 | ENn_110264 | 410903.279 | 373133.587 | 301.65 | 28.80 | 38 |
| 2 | ICn+6_110263 | 410722.116 | 373007.349 | 299.22 | 35.40 | 40 |
| 3 | ICn-3_110262 | 410656.671 | 372824.022 | 297.48 | 25.55 | 22 |
| 4 | ICn_l10262 | 410522.365 | 372678.142 | 296.89 | 28.55 | 27 |
| 5 | Sn-3_110252 | 410426.411 | 372514.048 | 298.60 | 27.70 | 15 |
| 6 | ICn+6_110263 | 410320.452 | 372332.844 | 297.18 | 35.40 | 40 |
| 7 | ICn+6_110263 | 410133.499 | 372298.953 | 296.25 | 35.40 | 40 |
| 8 | Sn_l10252 | 409882.888 | 372430.040 | 294.69 | 30.70 | 17 |
| 9 | Sn_110252 | 409649.108 | 372552.323 | 292.90 | 30.70 | 17 |
| 10 | ICn_110263 | 409412.470 | 372676.102 | 290.90 | 29.40 | 27 |
| 11 | Sn__110252 | 409160.238 | 372664.903 | 289.18 | 30.70 | 17 |
| 12 | Sn_110252 | 408870.852 | 372652.055 | 290.85 | 30.70 | 17 |
| 13 | Sn_110252 | 408635.566 | 372641.609 | 287.94 | 30.70 | 17 |
| 14 | ICn_110262 | 408361.699 | 372629.449 | 298.57 | 28.55 | 27 |
| 15 | Sn_110252 | 408197.028 | 372554.606 | 298.57 | 30.70 | 17 |
| 16 | Sn-3_110252 | 408042.180 | 372484.228 | 298.94 | 27.70 | 15 |
| 17 | ICn-3_110262 | 407844.419 | 372394.345 | 295.58 | 25.55 | 22 |
| 18 | ICn+3_110263 | 407643.078 | 372350.847 | 294.58 | 32.40 | 33 |
| 19 | ICn_l10263 | 407565.090 | 372414.952 | 295.42 | 29.40 | 27 |
| 20 | Sn+3_110252 | 407280.738 | 372371.639 | 293.54 | 33.70 | 21 |
| 21 | Sn+3_110252 | 406999.168 | 372328.749 | 292.05 | 33.70 | 21 |
| 22 | ICn_l10262 | 406721.180 | 372286.405 | 290.45 | 28.55 | 27 |
| 23 | Sn+3_110252 | 406452.346 | 372190.533 | 287.85 | 33.70 | 21 |
| 24 | Sn_l10252 | 406183.325 | 372094.595 | 288.60 | 30.70 | 17 |
| 25 | Sn_l10252 | 405918.198 | 372000.045 | 287.19 | 30.70 | 17 |
| 26 | Sn_l10252 | 405664.931 | 371909.725 | 285.06 | 30.70 | 17 |
| 27 | Sn_l10252 | 405381.665 | 371808.706 | 280.06 | 30.70 | 17 |
| 28 | Sn+3_110252 | 405099.588 | 371708.111 | 278.34 | 33.70 | 21 |
| 29 | ICn+3_110262 | 404819.980 | 371608.397 | 274.98 | 31.55 | 33 |
| 30 | Sn-3_110252 | 404714.393 | 371511.759 | 275.06 | 27.70 | 15 |
| 31 | Sn-3_110252 | 404568.233 | 371377.987 | 275.25 | 27.70 | 15 |
| 32 | Sn_l10252 | 404388.289 | 371213.295 | 271.72 | 30.70 | 17 |
| 33 | Sn_110252 | 404208.138 | 371048.412 | 270.24 | 30.70 | 17 |
| 34 | ICn+3_110263 | 403993.896 | 370852.326 | 266.66 | 32.40 | 33 |
| 35 | ICn_110262 | 403881.347 | 370866.346 | 266.15 | 28.55 | 27 |
| 36 | ICn_110263 | 403652.715 | 370894.827 | 265.95 | 29.40 | 27 |
| 35a | ITn_110244 | 403587.404 | 370848.626 | 264.25 | 33.27 | 41 |

*Table no. 4 Tabular presentation of PP interventions and components - works still to be executed*

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| Execution of the remaining works to be carried out and included in the project "The Project on increasing the share of electricity production from renewable sources by completing the works and ensuring permanent monitoring of the environmental impact of the hydropower development of the Jiu river on the Livezeni - Bumbești sector" - continuation of the remaining works to be executed at the | 1.1. Development of Livezeni dam technological platform | The development of the outer platform of the Livezeni dam consists in laying a 30 cm thick layer of ballast, over which a 20 cm thick layer of C25/30 concrete reinforced with Buzău 08 100 x 100 mm Buzău 08 100 x 100 mm mesh will be poured, and the completion of the canopy. The area of the concreted technological platform is 330 square meters.<br>Installation of measuring and control devices (AMC) - aimed at monitoring the evolution of the main behavioral parameters (parameters that give actions on the construction and parameters of response of the construction to external actions), early detection of negative phenomena that by their evolution over time could affect the safety of the dam.<br>Fencing of the platform on a length of 22 m will be completed with:<br>- metal posts made of rectangular pipe, 50 x 50 x 4 mm in cross-section and 2 m high, embedded in a concrete foundation 40 x 40 cm in plan and 90 cm deep.<br>- 2.00 x 2.00 m galvanized metal edged mesh panels. | The Livezeni dam technological platform is located outside the Livezeni dam, adjacent to the national road DN66 Târgu Jiu - Petroşani | In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului, at least 25 m away. | Near Defileul Jiului National Park, at least 25 m away. |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| AHE Livezeni - Bumbești | 1.2. Development of the Livezeni reservoir basin | The work is now 99% complete.<br>In order to arrange the basin of the reservoir, it is necessary to remove the vegetation on the banks of the Jiu river which delimits the reservoir Livezeni. | The Livezeni reservoir is about 1,000 m long and is located upstream of the Livezeni dam. The right bank is bordered by the national road DN 66 Târgu Jiu - Petroșani, and the left bank by the railroad Bumbești - Livezeni. | In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului, at least 6 m away. | In the vicinity of the Defileul Jiului National Park, at least 6 m away. |
| | 1.3. Closure of the diversion channel of the Livezeni dam with fish passage | The fish passage through the Livezeni dam will be built through the diversion channel of the river Jiu used for the construction works. The diversion channel is 10.00 m wide and 75.00 m long. | Livezeni dam. | In the vicinity of the Site of Community Importance ROSCI0063 Defileul Jiului, at least 65 m away. | In the vicinity of Defileul Jiului National Park, at least 65 m away. |
| | 1.4. Regularization of the Jiu river bed downstream Livezeni dam | Downstream of the mobile rhizberm up to the outlet of the access and outlet gallery from the underground settling tank, for a length of approximately 228.00 m, the river bed of the Jiu river will be channelized, corresponding to the IVth class of importance, according to STAS 4273/83.<br>The proposed works to calibrate the riverbed are:<br>- Excavation works: to rectify and calibrate the river bed;<br>- bank protections made of gabion boxes;<br>- removal of dry vegetation in the river bed to decrease its roughness. | Downstream of the Livezeni dam, downstream of the mobile rhizberm up to the outlet of the access and outlet gallery from the underground settling tank, for a length of about 228.00 m. | In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului, at least 15 m away. | In the vicinity of Defileul Jiului National Park, at least 15 m away. |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | 1.5. MHC Livezeni finishes | The work is now 99% complete.<br>For this objective, the works necessary to complete the investment will be carried out. In their category are interior and exterior finishes.<br>Once the construction works are completed, interior, exterior and PSI installations will be installed. | The Livezeni MHC is a completed underground/aboveground concrete construction that is located on the technological platform adjacent to the Livezeni dam and the related water intake. | In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului, at least 10 m away. | In the vicinity of the Defileul Jiului National Park, at least 10 m away. |
| | 2.1. CHE Dumitra landscaping, platforms, fences and gullies and decommissioning Site organization Dumitra | **The platform will be concreted over the entire surface and fenced with edged mesh panels and metal posts set in individual concrete foundations.**<br>The power plant platform is equipped with a **concrete drainage channel** for rainwater, which will be collected in a stormwater collector. The Site Organization related to **CHE Dumitra** will be dismantled. | On the right side of the Jiu river; on the left side of the Dumitra watercourse, in the immediate vicinity of the confluence with the Jiu river. | Within the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |
| | 2.2. Bridge over the stilling pond CHE Dumitra | The surface of the bridge over the stilling basin will be concrete, with the same structure as the rest of the plant platform. The bridge will be fitted with handrailing on the side with the power station building. On the side facing the river the railing is already installed. | On the right side of the Jiu river; on the left side of the Dumitra watercourse, in the immediate vicinity of the confluence with the Jiu river. | Within the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |
| | 3. CHE Dumitra Intervention Block | Work has not yet started on the intervention block. This object will be fully realized. The building has the function of housing composed of: basement, ground floor, first floor, being category of importance "C" - | On the right side of the Jiu river; on the right side of the Dumitra watercourse, in the immediate vicinity of | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | construction of normal importance and class of importance III having a rectangular shape in plan with sides of 20.5 m x 11.00 m. The sewer network will be connected to a compact sewage treatment plant. These plants will be drainable at certain intervals with authorized economic operators. | the confluence with the Jiu river. | | |
| | 4. Dumitra catchment | The Dumitra catchment is about 80% complete.<br>This component of the project requires the completion of the concreting of the spillway dam guardrail (towards the river) and the headrace loading house. Following the spillway dam is the automation (sluice gate) chamber, measuring 2.60 x 3.90 m, which has not been executed. Also, the connection of the sewer to this spillway dam is not executed.<br>The catchment spillway field requires the construction of a concrete plug to close the water diversion and the dismantling of the remaining PREMO pipes in the riverbed.<br>The remaining works to be executed at the Dumitra catchment consist of:<br>- mounting mechanical equipment mechanical equipment overflow threshold and winter outlet;<br>- Mounting of the mechanical equipment of the sand trap and automation chamber. | On the Dumitra stream, about 50 m upstream the confluence with the Jiu river. | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | For the connection of the Dumitra catchment sill with the concrete channel area is required:<br>- downstream regularization by excavation works;<br>- concreting the connecting wall on the left bank between the sluice chamber and the concreted channel. | | | |
| | 5.1. Access road to the CHE Dumitra outer platform | Along the route of the access road there are 2 typical cross profiles:<br>- Type 1 profile on soil with a road system consisting of a 20 cm concrete cover and a 20 cm thick crushed stone foundation;<br>- Type 2 profile on rocky areas, with the road system consisting of 20 cm concrete cover and 10 cm thick crushed stone foundation.<br>For the collection and discharge of rainwater and seepage water, longitudinal ditches will be built towards the slope, which will be discharged into the Jiu riverbed through 3 culverts under the road. | The access road to the CHE Dumitra connects the existing forest road at the end of the right bank of the bridge over the Jiu that connects with DN 66 Târgu Jiu - Petroșani, in the area of Livezeni and Bumbești with the end of the bridge over the Dumitra stream. Longitudinally, the road connects elevation 451.18 mdMN (Dumitra forest road) with elevation 458.00 mdMN (bridge over the Dumitra river) over a length of 583 m. | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |
| | 5.2. Access road over the Dumitra catchment | The width of the roadway, including two 0.375 m shoulders, is 3.50 m. The road system consists of a 15 cm thick ballast sub-base and an 8 cm thick layer of crushed stone | The access road over the Dumitra catchment represents a section of the access road to the butterfly | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | as a wearing course. The slope of the road surface is 3%. Rainwater, both from the road and from the slope, is collected in triangular ditches with a 15 cm dry-walled wall and discharged through the existing culverts into the Dumitra stream.<br>The protection of the embankments after the crossing area of the enclosure wall from the right bank will be done with a reinforced concrete retaining wall, The wall has a total length of 10.00 m. The elevation height of the wall elevation is 3.40 m and the foundation is 1.00 m. The foot of the foundation is 1.70 m. At the back of the wall is planned to be executed a drain of rough stone discharging through weep holes. | valve chamber and the upper chamber of the Dumitra surge chamber. | | |
| | 6.1. Concreting of the superstructure of the Bumbești gate chamber | The remaining to be executed on this item consists of:<br>- concreting of the superstructure - consists of a concrete frame placed between the two diaphragms stiffened longitudinally by beams. The roof slab is supported by a network of beams and diaphragms;<br>- external works - execution of the perimeter protection pavement, with a surface area of 23.45 square meters, made of concrete slabs measuring 1.00 x 0.50 m, bordered by prefabricated kerbs. The slabs will be poured | The valve chamber, with an area of about 125 square meters, is located on the platform at 420.00 mdMN, at the point where the Dumitra-Bumbești headrace gallery comes out at the day. | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | over a drainage layer of sand and gravel about 10 cm thick;<br>- repairing the embankments of the access road to the ramp and the technological platform of the valve chamber, with an area of 1.571,27 square meters by laying a 10 cm thick layer of ballast. | | | |
| | 6.2. Massive concreting M1 penstock Bumbești | The elbow in the vertical plane at point M1 and the elbow at point M2 shall be fixed in reinforced concrete anchorage piles, founded on sound rock and connected to the ground by Ø 20 mm anchors made of PC 52 steel concrete, 3.50 m long (2.50 m in rock and 1.00 m in concrete). | Headrace pipeline, upstream of CHE Bumbești | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |
| | 7.1. CHE Bumbești | The remaining works to be carried out consist of work on the infrastructure and superstructure of the power plant building. The following types of infrastructure works are required: interior compartmentalization, interior carpentry, interior finishing.<br>The drinking water supply to the sanitary group in the plant is provided from the external city water supply network in the area supplying the intervention block.<br>The domestic wastewater from the sanitary group in the plant is discharged outside into a STAS 2448 sewage pipe. From here, through PVC pipes with D = 200 mm and sewage pipes, it is led to a compact, modern sewage | CHE Bumbești | In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului, at least 20 m away. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | treatment plant adjoining the intervention block. | | | |
| | 7.2. Outdoor arrangements technical block CHE Bumbești | The landscaping works concern the realization of:<br>- access to the road access, respectively to the access platform to the intervention block and implicitly to the power plant;<br>- parking areas;<br>- pedestrian access to the intervention block and therefore to the power plant. | CHE Bumbești | In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului, at least 20 m away. | Inside Defileul Jiului National Park |
| | 7.3. CHE Bumbești landscaping, fencing and swales | The landscaping works related to the hydroelectric power plant concern:<br>- realization of the external concrete platform providing access to the power plant;<br>- realization of the macadam platform;<br>- storm water drainage channels;<br>- realization of the guard sidewalk around the building. | CHE Bumbești | In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului, at least 1 m away. | Inside Defileul Jiului National Park |
| | 7.4. Concreting of the connection between the stilling basin and the Bumbești tailrace channel | The connection area between the stilling basin of the CHE Bumbești and the tailrace channel is 70% completed. About 10 m of the outlet channel and partially the left and right bank connecting walls between the stilling basin and the outlet channel are still not completed. | CHE Bumbești | In the vicinity of the Site of Community Importance ROSCI0063 Defileul Jiului, at least 38 m away. | Inside Defileul Jiului National Park |
| | 7.5. 110 kV CHE Bumbești Transformer Station | The 110 kV transformer substation at CHE Bumbești has not yet started construction. The part of construction related to this object involves stripping, excavation and | CHE Bumbești | In the vicinity of the Site of Community Importance ROSCI0063 | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | backfilling as well as concrete for the transformer tank, raceway for transformer positioning, collection (hydrocarbon), cable ducts and channels and other independent foundations (lightning arrester, metal stela, zero arrester, etc.). For safety reasons, the substation will be fenced with mesh fencing with metal posts in individual concrete foundations.<br>The construction works for the realization of the transformer station consist of:<br>- foundations for voltage transformers, arrester, earthing knife, hybrid module, metal pole with lightning arrester;<br>- foundation for the 63MVA transformer tank and the transformer runway<br>- cable pulling fireplaces;<br>- Cable ducts with roadway covers (within the transformer station). | | Defileul Jiului, at least 2 m away. | |
| | 8. Access road to CHE Bumbești | The natural relief conditions and the geologic structure of the terrain encountered on the route imposed three typical cross-sectional profiles, applicable in the earth, earth and rock and rock and rock areas: mixed, in debble and in embankment.<br>The road system consists of a 20 cm thick concrete wearing course laid on a 20 cm thick layer of ballast, to be used both during | The access road to CHE Bumbești Bumbești, with a length of 1.37 km, starts from DC 149 Bumbești Jiu - Pleșa and continues along the right bank of the Jiu river up to CHE Bumbești | In the vicinity of the site of community importance ROSCI0063 Defileul Jiului.<br>On a length of about 620 m, the existing road runs along the boundary of the protected natural area. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | the works and after the commissioning of the plant.<br>The access road is equipped with heavy metal guardrails and stone masonry guardrails of h = 70cm for traffic safety.<br>On the road route, the geological profile has imposed the need to carry out works to support and defend the road:<br>- Stone masonry retaining walls L = 250 m, h = 2,50 -e- 3,00 m, with drainage channels;<br>- Gabion defensive walls L = 410 m, mattress or box type.<br>For the collection and discharge of rainwater and seepage water, longitudinal ditches will be built towards the slope, which will be discharged through culverts under the road to the Jiu riverbed. The culverts will be made of PREMO Dn 800 and BUCOV Dn 1400 pipes. A backfill at least 50 cm thick will be built above the outer surface of the pipes. | | | |
| | 9. Access road over the M3 CHE Bumbești massif | The road is 101.76 m long. The road has a single carriageway with a width of 3.50 m: carriageway 2.75 m and two shoulders of 0.375 m each. The longitudinal profile of the road has gradients of max. 6.7%.<br>In order to collect rainwater, the cross-section of the road has a 4% slope (inclination) towards the slope, where the concrete swale is laid along the entire length | The access road over the M3 CHE Bumbești Bumbești CHE restores the continuity of access to households in the immediate north-western vicinity of the CHE Bumbești CHE enclosure, interrupted by the execution | For a length of 40 m inside the site of Community importance ROSCI0063 Defileul Jiului, close to the boundary of the protected natural area.. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | of the rehabilitated road section. The ruler is made of C12/15 concrete with a cross-section varying between 50 and 100 cm. The swale will be connected to the existing channels.<br>The infrastructure of the road is made of local material (fill, ballast) over which the road system (superstructure) is applied.<br>The road system consists of: 12 cm crushed stone (wearing course), 25 cm ballast ballast foundation layer and 10 cm sand insulating layer. | of works at the power structure. | | |
| | 10. Bratcu catchment | In the area of the closure of the catch sill on the right bank, washing of the downstream wall fills was observed. To strengthen and protect the area, excavation and rock fill works are required to protect the closure in the right slope. The catchment platform is covered with ballast and leveled. | The water catchment is located on the Bratcu stream, about 2,100 m upstream of the confluence with the Jiu river. | Within the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |
| | 11.1. Concreting of infrastructure and superstructure of Jiu secondary intake, including fish ladder | The continuation works at the Jiu catchment consist of:<br>- completion of the spillway threshold (from elevation 452.50 mdM to the final elevation);<br>- the execution of the ladder to ensure the passage of ichthyofauna;<br>- finalizing the power dissipator;<br>- execution of the intake;<br>- downstream regularization. | The location of the Jiu secondary intake is located on the Jiu river at ca. 400 m upstream of CHE Dumitra | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | Downstream of the catchment, a regularization of the Jiu River is necessary to better transit the flood flow, without affecting the stability of the national road DN 66, as well as to ensure a level to be able to carry out the flushing of the spillway dam. | | | |
| | 11.2. Jiu secondary intake headrace pipeline and junction box | The connection pipe between the catchment desilter and the stilling basin of the CHE Dumitra is assembled in approx. 50%, but the fills are only partially filled. Excavation and backfilling works are required for 50% of the length of the headrace in order to install the DN2000 GRP DN2000 pipes, while the remaining 50% of the headrace needs to be filled in.<br>The execution works for the completion of the connection box object with the main headrace consist of:<br>- rock excavations on the remaining length of 127,00 m;<br>- laying 127.00 m of DN 2000 diameter pipeline;<br>- backfilling from useful excavations above the pipeline. | The location of the Jiu secondary intake is located on the Jiu river at approx. 400 m upstream of CHE Dumitra | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |
| | 12. Access road to Jiu secondary intake | The total length of the road will be 333.00 m. The road will be 5.00 m wide. The road system will be composed of 12 cm crushed stone, 25 cm ballast and local fill. | The access from CHE Dumitra to the catchment will be via an existing road, located at 459.00 mdM, on | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | For stormwater runoff, the roadway superstructure will have a 4° cross-slope to the slope. The gully will be located at the base of the slope and will convey the rainwater to a catch basin. From the catch basin, the waters are directed to the Jiu river through a reinforced concrete pipe type PREMO, Dn 600 mm.<br>Protection of the slope of the road to the river will be done as follows:<br>- up to the water level with Q5% assurance, anrocracks with a minimum thickness of 1.50, d > 60cm, > 1000 kg/piece;<br>- between the water level with Q5% Q5% assurance and the road surface of the road, stone with a minimum thickness of 0.50, > 400 kg/piece shall be laid. | the right bank of the Jiu River. | | |
| | 13.1. Decommissioning of the temporary bridge upstream Livezeni dam | The temporary bridge was built to carry out works on the Livezeni dam.<br>The decommissioning of the bridge involves the removal of the bridge beams and gabions that form the embankment defense on the right bank. | Across the Jiu river, about 150 m upstream of the Livezeni dam. | In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului, at least 50 m away. | Inside Defileul Jiului National Park |
| | 13.2. Decommissioning of technological platform upstream Livezeni dam | Removal of 2 metal containers for the foreman's office and a shed, 2 ecological toilets, trafo station 20/0,4-630 KVA, compressor station and realization of the final connection of the waste water pipe. | The platform for the technological organization is located on the right bank of the Jiu River, about 300 m upstream from the Livezeni dam. | In the vicinity of the site of Community importance ROSCI0063 Defileul Jiului, at least 15 m away. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | 13.3. Construction of the technological platform and access road to the Livezeni access tunnel and concreting of the closing plug | The works on this object consist in stripping the topsoil, filling around the undercrossing box and concreting the platform and access ramp (access road to the platform) and concreting the closing plug of the Livezeni access tunnel. | The technological platform is located on the right bank of the Jiu river, about 200 m downstream from the Livezeni dam. | In the vicinity of the Site of Community Importance ROSCI0063 Defileul Jiului, at least 5 m away. | Inside Defileul Jiului National Park |
| | 13.4. Development of a technological platform at the Murga Mica access tunnel | A small technological platform was set up in front of the Murga Mica access tunnel.<br>Of the works planned for the final fitting out of this technological platform, there are still to be carried out:<br>- platform protection barricade located at the top of the embankments bordering the platform. The barricade is made of steel profiles anchored in concrete foundations;<br>- protection of the rock slope, located upstream of the portal of the Murga Mică attack gallery, with a shotcrete applied on a metal mesh, anchored to the rock;<br>- surface water (meteoric and exfiltration) collecting swales at the top and base of the slopes bordering the platform;<br>- the final canalization of the Murga Mica river under the platform, through a canal of prefabricated frames type C2, located between the valley of this stream and the | The technological platform is located at the side of the national road DN 66 Târgu Jiu - Petroșani on the sector between the dam Livezeni and CHE Dumitra, in the area of the confluence of the Murga Mica stream with the Jiu river. | Within the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | existing connection and from which the captured waters drain further towards the Jiu, through the bridge under the DN66;<br>- Final landscaping of the platform surface by cleaning and leveling it and then laying a 10 cm layer of ballast. | | | |
| | 13.5. Decommissioning of the site organization at the Bratcu Access tunnel | Decommissioning of the concrete plant, 10 metal containers (batch headquarters, foreman's office, sampling laboratory, showers and cloakroom, dining room, lamp room) and an aggregate store for the concrete plant. | The platform for technological organization, set up at the Bratcu access tunnel, has a total area of 3.360 sqm and is located on the right bank of the Bratcu stream, about 1.300 m upstream of the confluence with the Jiu river. | Within the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |
| | 14.1. Connection of MHC Livezeni to SEN | The discharge of power from the MHC Livezeni will be realized in the 6 kV zonal distribution network by means of a utilization installation for connection to the SEN consisting of:<br>- A prefabricated connection point with three compartments, located on a precast concrete foundation placed on a ballast cushion, with access from the public road;<br>- LES 20 KV of copper between the metering cell in the connection compartment and the incoming cell in the user compartment, shown through the connection point; | Between the Livezeni dam and the bridge crossing the Jiul de Vest watercourse, at the side of the national road DN 66 Târgu Jiu - Petroșani. | In the vicinity of the Site of Community Importance ROSCI0063 Defileul Jiului, at least 110 m away. | In the vicinity of Defileul Jiului National Park, at least 110 m away. |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | - Identification and insertion of the existing 20 kV LES 3 x (1x150) mmp A1, from MHC Livezeni (approx. 1 km) into the newly designed Connection Point in the line cell.<br>The evacuation of the power from the MHC Livezeni will be realized by means of a SEN connection installation consisting of:<br>- Realization of MV connection between the existing 6 kV PA 3 Petroșani Sud LEA and the projected connection point, by planting 1 pc. 14G31 type pole between poles no. 52 and 53 of the existing 6 kV LEA, equipped with switchgear and grounding, and MV LES of approx. 50 m with three-core AL cable laid underground in a polyethylene protection tube;<br>- Realization of MV connection between the existing 6 kV L2-PA 1 Vulcan and the planned connection point, by planting 1 pc. 14G31 type pole between poles no. 81 and 82 of the existing 6 kV LEA, equipped with switchgear and grounding, and MV LES of approx. 60 m with three-core AL cable laid underground in a polyethylene protection tube. | | | |
| | 14.2. Connecting CHE Dumitra to SEN | The remaining works to be executed: the second cable section will be an LES consisting of three single-phase buried power cables, laid in line, with a symmetrical load | Between the Livezeni dam and the bridge crossing the Jiul de Vest watercourse, at the side of the national road | In the vicinity of the site of community importance ROSCI0063 Defileul Jiului. | Near Defileul Jiului National Park.<br>On a length of about 100 m, the site is |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | distribution on the three phases. This section will be about 900 meters long and will connect the 110 kV GIS cubicle mounted on the downstream platform of the Livezeni Dam with the installation to be executed on the connection tariff, consisting of a 110 kV substation input - output in the 110 kV Vulcan - Livezeni LEA and the input and output circuits through which the connection between this substation and the Pylon 41 where the LEA is sectioned will be made. These circuits will be LES with 2 streams of buried cables on a route as shown in the attached drawing. Each cable run will consist of 3 single-phase 110 kV cables with XLPE insulation, approximately 250 meters in length. | DN 66 Târgu Jiu - Petroșani. | On a length of about 100 m, the site is adjacent to the boundary of the protected natural area. | adjacent to the boundary of the protected natural area. |
| | 14.3. Connection of CHE Bumbești to SEN | The main stages carried out for the execution of the 110 kV d.c. CHE Bumbești - terminal 35 bis include:<br>- Temporary re-design of temporary access paths to access the proposed overhead power line sections;<br>- picketing the pole sites;<br>- stripping the topsoil from the foundations and temporary storage of the cover in the work area until the completion of the foundation pouring and pillar erection works, | The evacuation of power from CHE Bumbești will be realized by means of a 110 kV LEA connected to the LEA110 KV Tg. Jiu Nord-Parângu circuit 2 (pole nr.35 bis). | In the vicinity of the Site of Community Importance ROSCI0063 Defileul Jiului, at least 75 m away (in the area after the crossing on the left bank of the Jiu river). | Partially overlaps with the Defileul Jiului National Park (only the pillars on the technical right side of the R. Jiu River overlap) |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | after which the land is restored to its original state;<br>- platform leveling;<br>- realization of the line route;<br>- clearing the LEA safety lane of spontaneous vegetation. | | | |
| | 15. The Dumitra - Bumbești pipeline | The Dumitra-Bumbești pipeline is an underground construction.<br>The execution works to complete the headrace are:<br>- Downstream Valea Rea markings and finishing - deburring and installation of hectometric plates;<br>- Markings and finishing Bratcu upstream - deburring and installation of hectometric plates;<br>- Injections Bratcu upstream 2+400 - 3+000, Valea Rea access tunnel intersection, Bratcu access tunnel intersection - the following works will be carried out: filling injections in order to fill any voids between the concrete liner and the rock; consolidation injections to ensure the homogeneity of the concrete lining; control injections to check the capacity of the lining to withstand the pressure of the water flowing through the gallery and to bring the land related to the Valea Rea technological platform to its initial state; | The Dumitra-Bumbești pipeline is an underground construction linking CHE Dumitra to CHE Bumbești | Inside the site of Community importance ROSCI0063 Defileul Jiului. | Inside Defileul Jiului National Park |

| Stage | Type of intervention | Component | Location | Relation to protected natural areas of community interest | Relation to protected natural areas of national interest |
|---|---|---|---|---|---|
| | | - Concreting of the intersection plug Valea Rea - upon completion of the works, the access will be permanently closed by a concrete plug, thus ensuring the continuity of the supply;<br>- Concreting of the Bumbești chamber intersection - concreting ensures the stability of the watertight gate to the pressure of the water from the headrace;<br>- Bratcu well injections - filling injections, consolidation injections, control injections;<br>- Bratcu watertight gate concreting - concreting ensures the stability of the watertight gate at the pressure of the water in the headrace. | | | |

*b.1.) Natura 2000 sites*

***ROSCI0063 Defileul Jiului***

*The* location of *the Project "Increasing the share of electricity production from renewable energy sources by completing the works and ensuring permanent monitoring of the environmental impact of the hydropower development of the Jiu River in the Livezeni - Bumbești sector*" partially overlaps with the Natura 2000 Site ROSCI0063 Defileul Jiului , according to the information presented in Table no. 4

The sites concerned by the realization of the execution remaing works are located within the perimeter of the ROSCI0063 Defileul Jiului site of Community importance and in its immediate vicinity.

The Natura 2000 site ROSCI0063 Defileul Jiului was declared a site of Community importance by the Order of the Ministry of Environment and Sustainable Development no. 1.964/2007 on the establishment of the protected natural area regime of sites of Community importance as an integral part of the Natura 2000 European ecological network in Romania.

The Site of Community Importance ROSCI0063 Defileul Jiului has a total area of 10,914.42 ha and is located in the western part of the Southern Carpathians, between the Valcan Mountains to the west and the Parâng Mountains to the east, respectively the adjacent perimeter in the north of Gorj County and the south of Hunedoara County. The altitudinal range is between 295 m (Luncani/Bumbești Jiu area, at the southern end of the protected natural area) and 1,621 m (Pasul Vâlcan, at the western end of the protected natural area).

The Site of Community Importance ROSCI0063 Defileul Jiului is managed by the Defileul Jiului National Park.

Currently, the draft management plan of the Defileul Jiului National Park and the site of community importance ROSCI0063 Defileul Jiului is in the environmental approval procedure.

In the following table are presented, according to the Natura 2000 Standard Form of the site of Community importance ROSCI0063 Defileul Jiului revised on 14.02.2024, the types of habitats of Community interest within the perimeter of the protected natural area.

*Table no. 5 List of habitat types of community interest in the perimeter of ROSCI0063 Defileul Jiului and assessment of criteria according to the Order of the Minister of Environment and Water Management no. 207/2006 on the approval of the content of the Natura 2000 Standard Form and its manual of completion, according to the Natura 2000 Standard Form revised on 14.02.2024*

| No. crt. | Natura 2000 Code | Habitat name | Coverage (ha) | Repres. | Rel. Surf. | Conserv. Status | Global evaluation |
|---|---|---|---|---|---|---|---|
| 1. | 3220 | Herbaceous vegetation on the banks of mountain rivers | 109,0000 | B | C | A | A |

| No. crt. | Natura 2000 Code | Habitat name | Coverage (ha) | Repres. | Rel. Surf. | Conserv. Status | Global evaluation |
|---|---|---|---|---|---|---|---|
| 2. | 3230 | Woody vegetation with *Myricaria germanica* along mountain rivers | 109,0000 | B | C | A | A |
| 3. | 3240 | Woody vegetation with *Salix elaeagnos* along mountain rivers | 109,0000 | B | C | A | A |
| 4. | 4060 | Alpine and boreal forests | 552,0000 | B | C | B | B |
| 5. | 40A0* | Subcontinental peri-pan-Pannonian sub-continental tufts | 3,0000 | B | C | B | B |
| 6. | 6190 | Pannonian cliff meadows | 19,0000 | B | C | B | B |
| 7. | 6230* | Species-rich montane *Nardus* meadows on siliceous substrates | 24,0000 | B | C | C | B |
| 8. | 6410 | *Molinia* meadows on calcareous, peaty or clayey soils | 1,0000 | D | - | - | - |
| 9. | 6430 | Border communities with tall, hygrophilous tall grasses from lowland to upland levels mountain and alpine | 109,0000 | B | C | B | B |
| 10. | 6510 | Low-lying meadows | 231,0000 | B | C | B | B |
| 11. | 7220* | Petrifying springs with travertine formation | 1,0000 | A | B | B | B |
| 12. | 8220 | Rocky slopes with chasmophytic vegetation on siliceous rocks | 110,0000 | C | C | B | B |
| 13. | 9110 | *Luzulo-Fagetum* beech forests | 3584,0000 | B | C | A | B |
| 14. | 9130 | *Asperulo-Fagetum* beech forests | 318,0000 | B | C | A | B |
| 15. | 9150 | Middle-European *Cephalanthero-Fagion* beech forests | 11,0000 | D | - | - | - |
| 16. | 9170 | *Galio-Carpinetum* oak forests with hornbeam | 109,0000 | B | C | A | B |
| 17. | 9180* | *Tilio-Acerion* forests on steep slopes, ravines and gullies | 135,0000 | A | C | B | B |
| 18. | 91E0* | Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* | 58,0000 | A | B | A | A |
| 19. | 91L0 | Oak and hornbeam forests | 109,0000 | B | C | B | B |
| 20. | 91V0 | Dacian beech forests | 4152,0000 | A | C | A | B |
| 21. | 91Y0 | Dacian oak and hornbeam forests | 62,0000 | B | C | B | B |
| 22. | 9410 | Acidophilous *Picea abies* forests of the montane region | 19,0000 | B | C | B | B |

Repres. = Representativity = measure for how typical a habitat is of the site (A - excellent representativity, B - good representativity, C - significant representativity, D - insignificant representativity);

Rel. surf. = Relative area = The area of the site covered by the natural habitat relative to the total area covered by that natural habitat type within the national territory (A: 100≥p>15%, B: 15≥p>2%, C: 2≥p>0%);

Conserv. = State of conservation = The degree of conservation of the structures and functions of the natural habitat type in question, as well as the possibilities for restoration/reconstruction (A = excellent conservation, B = good conservation, C = fair or poor conservation).

In the following table are presented, according to the Natura 2000 Standard Form of the site of Community importance ROSCI0063 Defileul Jiului revised on 14.02.2024, the species of Community interest within the perimeter of the protected natural area.

*Table no. 6 List of species listed in Annex II of Council Directive 92/43/EEC for which the Natura 2000 site ROSCI0063 Defileul Jiului has been designated and assessment of the populations at the Natura 2000 site level, according to the Natura 2000 Standard Natura 2000 Form revised on 14.02.2024*

| **Species** | | | **Population** | | | | **Sit** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Nr crt .** | **Natura 2000 Code** | **Scientific name** | **Tip** | **Size (no. individuals)** | | **Categ.** | **Pop.** | **Conserv.** | **Isolatio n** | **Global** |
| | | | | **Min.** | **Max.** | | | | | |
| 1. | 1308 | *Barbastella barbastellus* | P | 100 | 300 | P | C | C | C | B |
| 2. | 1352* | *Canis lupus* | P | 3 | 3 | R | C | C | C | B |
| 3. | 1355 | *Lutra lutra* | P | 12 | 12 | P | C | C | C | C |
| 4. | 1361 | *Lynx lynx* | P | 2 | 2 | V | C | B | C | B |
| 5. | 1310 | *Miniopterus schreibersii* | R | 50 | 100 | P | C | B | C | B |
| 6. | 1307 | *Myotis blythii* | P | 30 | 100 | P | C | B | C | B |
| 7. | 1324 | *Myotis myotis* | P | 30 | 100 | P | C | B | C | B |
| 8. | 1304 | *Rhinolophus ferrumequinum* | P | 50 | 100 | P | C | B | C | B |
| 9. | 1303 | *Rhinolophus hipposideros* | P | 50 | 100 | P | B | C | A | C |
| 10. | 1354* | *Ursus arctos* | P | 9 | 24 | P | C | B | C | B |
| 11. | 1193 | *Bombina variegata* | P | 2.000 | 5.000 | C | C | B | C | B |
| 12. | 1166 | *Triturus cristatus* | P | 150 | 200 | P | C | C | C | C |
| 13. | 5261 | *Barbus balcanicus* | P | 100 | 200 | P | C | C | C | C |
| 14. | 1163 | *Cottus gobio* | P | - | - | V | D | - | - | - |
| 15. | 6145 | *Romanogobio uranoscopus* | P | 1.000 | 1.500 | P | C | B | C | B |
| 16. | 5197 | *Sabanejewia balcanica* | P | 30 | 100 | V | C | C | C | C |
| 17. | 1093* | *Austropotamobius torrentium* | P | 30 | 30 | P | C | C | B | B |
| 18. | 4014 | *Carabus variolosus* | P | 5.000 | 10.000 | P | C | B | C | B |
| 19. | 1088 | *Cerambyx cerdo* | P | 1.000 | 2.000 | P | C | A | C | A |
| 20. | 4057 | *Chilostoma banaticum* | P | 500 | 4.000 | P | C | B | C | B |
| 21. | 1086 | *Cucujus cinnaberinus* | P | 200 | 400 | P | B | B | C | B |
| 22. | 6199* | *Euplagia quadripunctaria* | P | 5.000 | 10.000 | P | B | A | C | B |
| 23. | 1083 | *Lucanus cervus* | P | 4.000 | 5.000 | P | C | A | C | A |
| 24. | 6908 | *Morimus asper funereus* | P | 4.000 | 5.000 | P | B | B | C | B |
| 25. | 6966* | *Osmoderma eremita* complex | P | 500 | 1.000 | P | C | B | C | B |

| Species | | | Population | | | | Sit | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Nr crt. | Natura 2000 Code | Scientific name | Tip | Size (no. individuals) Min. | Max. | Categ. | Pop. | Conserv. | Isolation | Global |
| 26. | 4054 | *Pholidoptera transsylvanica* | P | 50.000 | 70.000 | P | C | A | C | B |
| 27. | 4026 | *Rhysodes sulcatus* | P | 200 | 200 | P | A | A | C | A |
| 28. | 1087* | *Rosalia alpina* | P | 2.000 | 3.000 | P | C | B | C | B |
| 29. | 4070* | *Campanula serrata* | P | 500 | 1.000 | P | C | C | C | B |
| 30. | 4116 | *Tozzia carpatica* | P | - | - | R | C | B | C | B |

Pop. = population status = the size and density of the population of the species present in the site in relation to the populations present in the national territory (A: 100≥p>15%, B: 15≥p>2%, C: 2≥p>0%);

Conserv. = Conservation = the degree of conservation of the habitat features that are important for the species concerned and the possibilities for recovery (a-excellent conservation, b-good conservation, C-fair or poor conservation);

Isolation = population size and density of the species present in the site in relation to the populations present in the national territory (A- almost isolated population, B- non-isolated population but at the limit of its range, C- non-isolated population with a wide range; Global = overall assessment of the value of the site for the conservation of the species concerned (A-excellent value, B-good value, C-significant value).

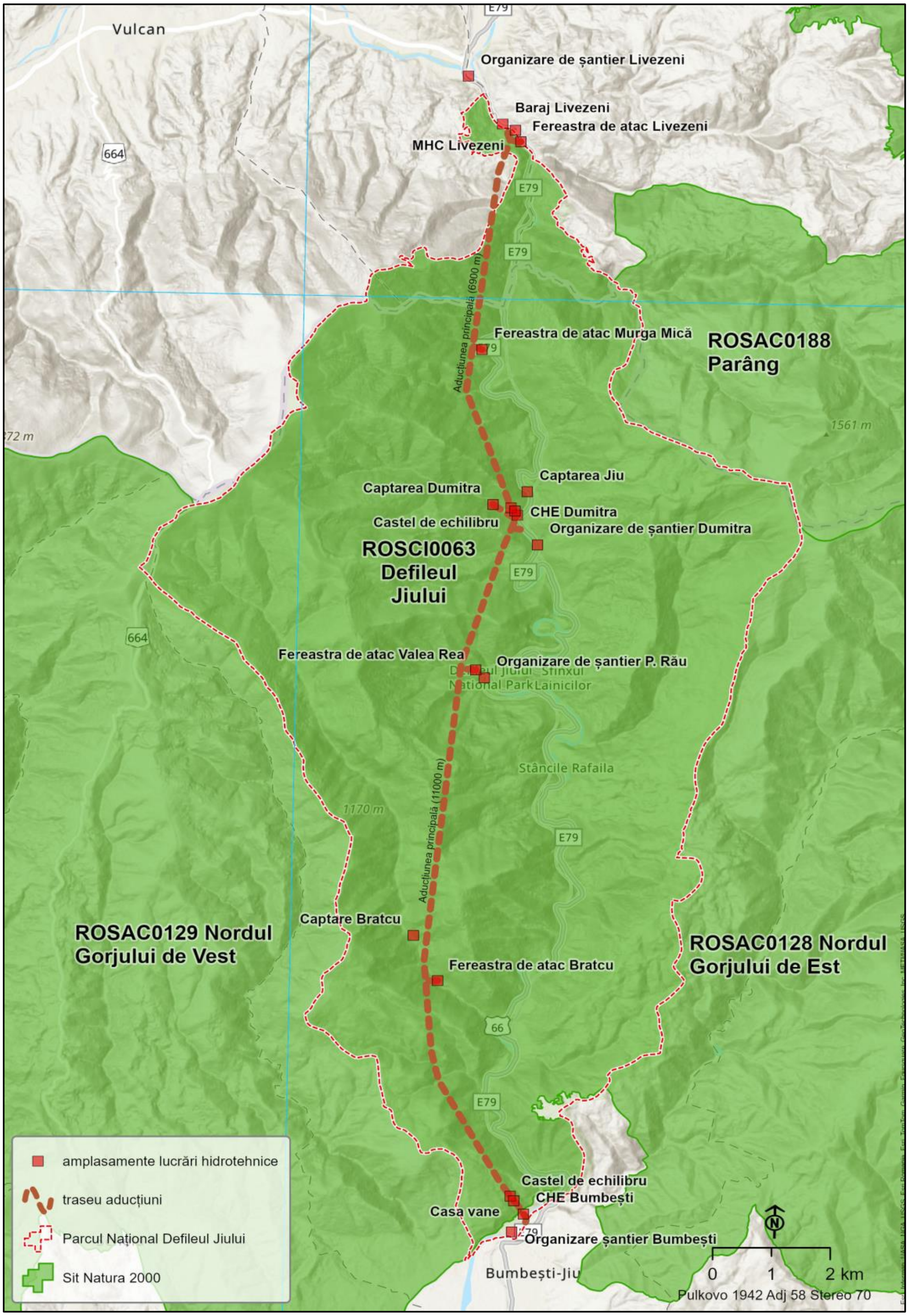



Fig. 2 Location of the analyzed project components in relation to the site of Community importance ROSCI0063 Defileul Jiului

*Table no. 7 Conservation status of the habitats of community interest within the site of community importance ROSCI0063 Defileul Jiului (according to the draft Management Plan currently being endorsed)*

| No. crt. | Natura 2000 Code | Habitat name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Surface occupied | Specific structure and function | Habitat prospects for the future | Overall state of recovery |
| 1. | 3220 | Mountain watercourses and herbaceous vegetation along their banks | Unknown | Untreated | Untreated | Untreated |
| 2. | 3230 | Woody vegetation with *Myricaria germanica* along mountain streams | Unknown | Untreated | Untreated | Untreated |
| 3. | 3240 | 3240 Woody vegetation with *Salix elaeagnos* along mountain rivers | Unknown | Untreated | Untreated | Untreated |
| 4. | 4060 | Alpine and boreal (sub) alpine and boreal tufa forests | Favorable | Favorable | Favorable | Favorable |
| 5. | 40A0* | Peripanonic subcontinental peripanonical tuffies | Favorable | Favorable | Unknown | Favorable |
| 6. | 6190 | Pannonian cliff meadows | Favorable | Favorable | Unknown | Favorable |
| 7. | 6230* | Species-rich montane *Nardus* meadows on siliceous substrates | Favorable | Unfavorable | Unfavorable-inadequate | Unfavorable |
| 8. | 6410 | Meadows with Molinia on calcareous, peaty or clay-loam soils (*Molinion caeruleae*) | Unfavorable-inadequate | Favorable | Unknown | Unfavorable-inadequate |
| 9. | 6430 | Lowland and montane to alpine tall-grass communities | Unknown | Untreated | Untreated | Untreated |
| 10. | 6510 | Low altitude meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) | According to the MP the habitat is not present in the perimeter of the site of Community importance ROSCI0063 Defileul Jiului (it is mentioned that this habitat was wrongly introduced, the areas correspond in reality to habitat 6520 - Mountain meadows) | | | |
| 11. | 6520 | Mountain meadows | Favorable | Favorable | Unknown | Favorable |
| 12. | 7220* | Petrifying springs with travertine deposition (*Cratoneurion*) | Favorable | Favorable | Unknown | Favorable |
| 13. | 8220 | Siliceous rocky slopes with casmophytic vegetation | Favorable | Favorable | Favorable | Favorable |
| 14. | 9110 | *Luzulo* beech forests - *Fagetum* | Favorable | Favorable | Favorable | Favorable |
| 15. | 9130 | Asperulo-Fagetum beech forests | Favorable | Favorable | Favorable | Favorable |
| 16. | 9150 | Middle-European *Cephalanthero-Fagion* beech forests on calcareous substrates | Unfavorable-inadequate | Favorable | Favorable | Unfavorable-inadequate |

| No. crt. | Natura 2000 Code | Habitat name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Surface occupied | Specific structure and function | Habitat prospects for the future | Overall state of recovery |
| 17. | 9170 | *Galio-Carpinetum* oak forests with hornbeam | Unknown | Untreated | Untreated | Untreated |
| 18. | 9180* | *Tilio-Acerion* forests on slopes, gullies and ravines | Favorable | Favorable | Unknown | Favorable |
| 19. | 91E0* | Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) | Favorable | Favorable | Unknown | Favorable |
| 20. | 91L0 | *Eryththronio-Carpinion* forests | Unknown | Untreated | Untreated | Untreated |
| 21. | 91V0 | Dacian forests of *Fagus sylvatica* (*Symphito-Fagion*) | Favorable | Unfavorable-inadequate | Favorable | Unfavorable-inadequate |
| 22. | 91Y0 | Dacian oak and hornbeam forests | Unfavorable-inadequate | Unfavorable-inadequate | Unfavorable-inadequate | Unfavorable-inadequate |
| 23. | 9410 | Acidophilous *Picea abies* forests of the montane region (*Vaccinio-Piceetea)* | Unfavorable-inadequate | Favorable | Unfavorable-inadequate | Unfavorable-inadequate |

*Table no. 8 Conservation status of the species of Community interest within the site of Community importance ROSCI0063 Defileul Jiului (according to the draft Management Plan currently being endorsed)*

| No. crt. | Natura 2000 Code | Species name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Species population | Habitat of the species | Future prospects for the species | Overall conservation status |
| 1. | 1308 | *Barbastella barbastellus* | The species is not assessed for conservation status in the MP. | | | |
| 2. | 1352* | *Canis lupus* | Favorable | Favorable | Favorable | Favorable |
| 3. | 1355 | *Lutra lutra* | Favorable | Favorable | Favorable | Favorable |
| 4. | 1361 | *Lynx lynx* | Favorable | Favorable | Favorable | Favorable |
| 5. | 1310 | *Miniopterus schreibersii* | The species is not assessed for conservation status in the MP. | | | |
| 6. | 1307 | *Myotis blythii* | Unknown | Unknown | Unknown | Unknown |
| 7. | 1324 | *Myotis myotis* | Unknown | Unfavorable-inadequate | Unknown | Unfavorable-inadequate |
| 8. | 1304 | *Rhinolophus ferrumequinum* | The species is not assessed for conservation status in the MP. | | | |
| 9. | 1303 | *Rhinolophus hipposideros* | The species is not assessed for conservation status in the MP. | | | |

| No. crt. | Natura 2000 Code | Species name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Species population | Habitat of the species | Future prospects for the species | Overall conservation status |
| 10. | 1354* | *Ursus arctos* | Favorable | Favorable | Favorable | Favorable |
| 11. | 1193 | *Bombina variegata* | Favorable | Favorable | Favorable | Favorable |
| 12. | 1166 | *Triturus cristatus* | Unfavorable-inadequate | Unfavorable-inadequate | Unknown | Unfavorable-inadequate |
| 13. | 5261 | *Barbus balcanicus* | Unfavorable-inadequate | Favorable | Unfavorable-inadequate | Untreated |
| 14. | 6965 | *Cottus gobio* | Unknown | Favorable | Unknown | Untreated |
| 15. | 6145 | *Romanogobio uranoscopus* | Unfavorable-inadequate | Favorable | Unfavorable-inadequate | Untreated |
| 16. | 5197 | *Sabanejewia balcanica* | Unfavorable-inadequate | Favorable | Unfavorable-inadequate | Untreated |
| 17. | 1093* | *Austropotamobius torrentium* | The species is not assessed for conservation status in the MP. | | | |
| 18. | 4014 | *Carabus variolosus* | The species is not assessed for conservation status in the MP. | | | |
| 19. | 1088 | *Cerambyx cerdo* | Favorable | Favorable | Favorable | Favorable |
| 20. | 4057 | *Chilostoma banaticum* | The species is not assessed for conservation status in the MP. | | | |
| 21. | 1086 | *Cucujus cinnaberinus* | The species is not assessed for conservation status in the MP. | | | |
| 22. | 6199* | *Euplagia quadripuctaria* | The species is not assessed for conservation status in the MP. | | | |
| 23. | 1083 | *Lucanus cervus* | Favorable | Favorable | Favorable | Favorable |
| 24. | 6908 | *Morimus asper funereus* | Favorable | Favorable | Favorable | Favorable |
| 25. | 6966* | *Osmoderma eremita* | Favorable | Favorable | Favorable | Favorable |
| 26. | 4054 | *Pholidoptera transsylvanica* | The species is not assessed for conservation status in the MP. | | | |
| 27. | 4026 | *Rhysodes sulcatus* | The species is not assessed for conservation status in the MP. | | | |
| 28. | 1087* | *Rosalia alpina* | Favorable | Favorable | Favorable | Favorable |
| 29. | 4070* | *Campanula serrata* | Unfavorable-inadequate | Unfavorable-inadequate | Unfavorable-inadequate | Unfavorable-inadequate |
| 30. | 4116 | *Tozzia carpatica* | In the MP the species is not assessed in terms of conservation status. The species has an uncertain presence within the perimeter of the Site of Community Importance ROSCI0063 Defileul Jiului. | | | |

***ROSCI0217 Retezat***

The ROSCI0217 Retezat Site of Community Importance ROSCI0217 Retezat was declared a Site of Community Importance by the Order of the Ministry of Environment and Sustainable Development no. 1.964/2007 on the establishment of the protected natural area regime of the Sites of Community Importance as an integral part of the Natura 2000 European Ecological Network in Romania.

ROSCI0217 Retezat, with a surface area of 43,528 ha, overlaps to a large extent with the Retezat National Park, exceeding its boundaries only in the south-western part. By its position in the Retezat, Godeanu and Țarcu massifs, in the western part of the Southern Carpathians, at altitudes ranging from about 700 m (on the western side, in the Râo Mare valley) to 2509 m (Vf. Peleaga), this SCI is entirely in the alpine region.

The Natura 2000 site ROSCI0217 Retezat is an important area from a conservation point of view, in particular due to the presence of 4 habitats of Community interest - *Pinus mugo* and *Rhododendron hirsutum* (Mugo-Rhododendretum hirsuti) shrublands, *Nardus* species-rich meadows on siliceous substrata of mountainous areas, Alpine pioneer vegetation with Caricion bicoloris-atrofuscae and Slope, scree or ravine forests with Tilio-Acerion.

The mosaic of aquatic and terrestrial habitats on the territory of the site favors the presence of a rich biodiversity. Thus, 10 protected mammal species, 1 protected amphibian species of Community interest, 3 protected fish species of Community interest, 9 protected invertebrate species of Community interest and 7 protected plant species of Community interest are found on the site. The mammal species are represented by 3 species of large carnivores (wolf, bear, lynx), 6 species of bats (mole bat, Mediterranean horseshoe bat, greater horseshoe bat, lesser horseshoe bat, common bat, common little bat) and one species of otter. The aquatic ecosystems and their associated habitats on the site favor the presence of a rich aquatic fauna, including 3 species of fish of community interest: the common reef, wagtail, and the common sculpin. The combination of aquatic and terrestrial ecosystems favors the presence of more than 9 invertebrate species of Community interest, 4 of which are priority species for conservation at European level, namely the striped butterfly (*Callimorpha quadripunctaria*), the Litera L butterfly (*Nymphalis vaualbum*), the beech croaker (*Rosalia alpina*) and the Transylvanian grasshopper (*Pholidoptera transsylvanica*).

The following table shows the list of habitat types of community interest within ROSCI0217 Retezat and the assessment of criteria according to the Order of the Minister of Environment and Water Management no. 207/2006 on the approval of the content of the Natura 2000 Standard Form and its completion manual, according to the ROSCI0217 Retezat Standard Form of 17.02.2024.

*Table no. 9 List of habitat types of community interest within ROSCI0217 Retezat and evaluation of criteria according to the Order of the Minister of Environment and Water Management no. 207/2006 on the approval of the content of the Natura 2000 Standard Form and its completion manual, according to the ROSCI0217 Retezat Standard Form of 17.02.2024*

| No. crt. | Natura 2000 Code | Habitat name | Ha | Represent | Rel. surf. | Conserv | Global |
|---|---|---|---|---|---|---|---|
| 1. | 3230 | Mountain rivers and their woody vegetation with *Myricaria germanica* | 435,28 | B | C | B | B |
| 2. | 3240 | Mountain rivers and their woody vegetation with *Salix elaeagnos* | 435,28 | B | C | B | B |
| 3. | 7240* | Alpine pioneer vegetation with *Caricion bicoloris-atrofuscae* | 4,35 | A | B | A | A |
| 4. | 9170 | Galio-Carpinetum oak forests with hornbeam | 56,5 | B | C | A | A |
| 5. | 91Q0 | *Pinus sylvestris* relict forests on calcareous substrates | 5,01 | B | C | A | A |

The following table shows the list of species of community interest within ROSCI0217 Retezat and the evaluation of criteria according to the Order of the Minister of Environment and Water Management no. 207/2006 on the approval of the content of the Natura 2000 Standard Form and its completion manual, according to the ROSCI0217 Retezat Standard Form of 17.02.2024.

*Table no. 10 List of species of community interest within the ROSCI0217 Retezat and assessment of criteria according to the Order of the Minister of Environment and Water Management no. 207/2006 on the approval of the content of the Natura 2000 Standard Form and its completion manual, according to the ROSCI0217 Retezat Standard Form of 17.02.2024*

| Species | | | Population | | | Sit | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. crt. | Natura 2000 Code | Scientific name | Size (no. individuals) Min. | Max. | Categ. | Pop. | Conserv. | Isolation | Global |
| 1. | 1308 | *Barbastella barbastellus* | 500 | 1.000 | R | C | A | C | A |
| 2. | 1310 | *Miniopterus schreibersii* | 10 | 50 | R | C | B | B | B |
| 3. | 1323 | *Myotis bechsteinii* | 1.000 | 1.500 | P | C | A | C | A |
| 4. | 1307 | *Myotis blythii* | 1.000 | 1.500 | C | A | A | C | A |
| 5. | 1321 | *Myotis emarginatus* | 200 | 250 | R | C | A | B | A |
| 6. | 1324 | *Myotis myotis* | 1.000 | 1.500 | C | C | A | C | A |
| 7. | 1305 | *Rhinolophus euryale* | - | - | P | C | B | B | B |
| 8. | 1304 | *Rhinolophus ferrumequinum* | 150 | 250 | R | C | A | B | A |

| Species | | | Population | | | Sit | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. crt. | Natura 2000 Code | Scientific name | Size (no. individuals) Min. | Max. | Categ. | Pop. | Conserv. | Isolation | Global |
| 9. | 1303 | *Rhinolophus hipposideros* | 250 | 300 | C | C | A | C | A |
| 10. | 1193 | *Bombina variegata* | 1.000 | 5.000 | R | C | A | B | A |
| 11. | 5266 | *Barbus petenyi* | - | - | R | D | - | - | - |
| 12. | 6965 | *Cottus gobio* all others | 1.000 | 5.000 | R | C | B | C | B |
| 13. | 4123 | *Eudontomyzon danfordi* | 5.000 | 10.000 | V | C | B | A | B |
| 14. | 6169 | *Euphydryas maturna* | 100 | 500 | P | C | A | A | A |
| 15. | 6199* | *Euplagia quadripunctaria* | 500 | 1.000 | R | C | A | A | A |
| 16. | 4034 | *Glyphipterix loricatella* | - | - | P | A | A | A | A |
| 17. | 4036 | *Leptidea morsei* | - | - | R | B | B | C | B |
| 18. | 1060 | *Lycaena dispar* | 50 | 100 | P | C | C | B | C |
| 19. | 4093* | *Nymphalis vaualbum* | 50 | 100 | P | C | B | B | B |
| 20. | 4054 | *Pholidoptera transsylvanica* | 5.000 | 10.000 | C | C | A | C | A |
| 21. | 4024* | *Pseudogaurotin excellens* | 100 | 500 | R | C | B | A | B |
| 22. | 1087* | *Rosalia alpina* | 1.000 | 5.000 | C | C | A | C | A |
| 23. | 4070* | *Campanula serrata* | - | - | C | B | A | C | A |
| 24. | 1902 | *Cypripedium calceolus* | - | - | V | C | A | C | A |
| 25. | 2113 | *Draba dorneri* | - | - | V | A | A | A | A |
| 26. | 1758 | *Ligularia sibirica* | - | - | R | C | A | C | A |
| 27. | 1389 | *Meesia longiseta* | - | - | R | C | A | C | A |
| 28. | 4122 | *Poa granitica subsp. Disparilis* | 10 | 300 | V | C | B | B | B |
| 29. | 4116 | *Tozzia carpathica* | - | - | R | B | A | C | A |

*Table no. 11 Conservation status of the habitats of Community interest within the site of Community importance ROSCI0217 Retezat (according to the draft Management Plan currently being approved)*

| No. crt. | Natura 2000 Code | Habitat name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Surface occupied | Specific structure and function | Habitat prospects for the future | Overall state of recovery |
| 1. | 3220 | Alpine rivers and their herbaceous vegetation | Favorable | Unfavorable-inadequate | Unfavorable-inadequate | Unfavorable-inadequate |
| 2. | 3230 | Mountain rivers and their woody vegetation with *Myricaria germanica* | According to the data provided by the PM, the species has not been identified within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |
| 3. | 3240 | Mountain rivers and their woody vegetation with *Salix elaeagnos* | According to the data provided by the PM, the species has not been identified within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |
| 4. | 4060 | Alpine and boreal forests | Unknown | Favorable | Favorable | Favorable |
| 5. | 4070* | Clumps of *Pinus mugo* and *Rhododendron myrtifolium* | Unknown | Favorable | Favorable | Favorable |
| 6. | 4080 | Subarctic stands of *Salix* spp. | Unknown | Favorable | Favorable | Favorable |
| 7. | 6150 | Boreal and alpine meadows on siliceous substrates | Unknown | Unfavorable-inadequate | Unfavorable-inadequate | Unfavorable-inadequate |
| 8. | 6170 | Alpine and subalpine calcareous grasslands | Unknown | Unfavorable-inadequate | Unfavorable-inadequate | Unfavorable-inadequate |
| 9. | 6230* | Species-rich *Nardus* meadows on siliceous substrates in upland areas | Unknown | Unfavorable-inadequate | Unfavorable-inadequate | Unfavorable-inadequate |
| 10. | 6430 | Lowland and montane to alpine tall-grass communities | Unknown | Favorable | Favorable | Favorable |
| 11. | 6520 | Mountain meadows | Unknown | Unfavorable-inadequate | Unfavorable-inadequate | Unfavorable-inadequate |
| 12. | 7110* | Active curved active swimming pool | The species is not assessed for conservation status in the MP. | | | |
| 13. | 7140 | Transitional peat bogs and moving peat bogs | Unfavorable | Unfavorable | Unfavorable | Unfavorable |
| 14. | 7240* | Alpine pioneer vegetation with *Caricion bicoloris-atrofuscae* | According to the data provided by the PM, the habitat has not been identified within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |
| 15. | 8110 | Siliceous scree groocias from the montane to the nival - Androsacetalia *alpinae* and *Galeopsietalia ladani* | Unknown | Favorable | Favorable | Favorable |

| No. crt. | Natura 2000 Code | Habitat name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Surface occupied | Specific structure and function | Habitat prospects for the future | Overall state of recovery |
| 16. | 8120 | Calcareous and calcareous shale scree from montane to alpine -Thalspietea *rotundifolii* | Unknown | Favorable | Favorable | Favorable |
| 17. | 8210 | Rocky limestone slopes with casmophytic vegetation | Unknown | Favorable | Favorable | Favorable |
| 18. | 8220 | Siliceous rocky slopes with casmophytic vegetation | Unknown | Favorable | Favorable | Favorable |
| 19. | 9110 | *Luzulo* beech forests - *Fagetum* | Favorable | Favorable | Favorable | Favorable |
| 20. | 9150 | Middle-European *Cephalanthero-Fagion* forests | Favorable | Favorable | Favorable | Favorable |
| 21. | 9170 | Oak forests with *Galio* hornbeam - *Carpinetum* | Favorable | Favorable | Favorable | Favorable |
| 22. | 9180* | *Tilio-Acerion* forests on steep slopes, ravines and gullies | Favorable | Favorable | Favorable | Favorable |
| 23. | 91E0* | Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior - Alno-Padion, Alnion incanae, Salicion albae* | Favorable | Favorable | Favorable | Favorable |
| 24. | 91Q0 | *Pinus sylvestris* relict forests on calcareous substrates | Favorable | Favorable | Favorable | Favorable |
| 25. | 91V0 | *Symphyto-Fagion* beech forests | Favorable | Favorable | Favorable | Favorable |
| 26. | 9410 | Acidophilous *Picea abies* forests of the montane region -*Vaccinio-Piceetea* | Favorable | Favorable | Favorable | Favorable |
| 27. | 9420 | Forests of *Larix decidua* and/or *Pinus cembra* in the montane region | Favorable | Favorable | Favorable | Favorable |

*Table no. 12 Conservation status of the species of Community interest within the site of Community importance ROSCI0217 Retezat (according to the draft Management Plan currently being approved)*

| No. crt. | Natura 2000 Code | Species name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Species population | Habitat of the species | Future prospects for the species | Overall conservation status |
| 1. | 1308 | *Barbastella barbastellus* | Favorable | Favorable | Favorable | Favorable |
| 2. | 1310 | *Miniopterus schreibersii* | The species is not assessed for conservation status in the MP. | | | |
| 3. | 1323 | *Myotis bechsteinii* | The species is not assessed for conservation status in the MP. | | | |
| 4. | 1307 | *Myotis blythii* | Favorable | Favorable | Favorable | Favorable |
| 5. | 1321 | *Myotis emarginatus* | The species is not assessed for conservation status in the MP. | | | |
| 6. | 1324 | *Myotis myotis* | Favorable | Favorable | Favorable | Favorable |
| 7. | 1305 | *Rhinolophus euryale* | According to the data provided by the PM, the species has not been identified within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |
| 8. | 1304 | *Rhinolophus ferrumequinum* | Favorable | Favorable | Favorable | Favorable |
| 9. | 1303 | *Rhinolophus hipposideros* | Favorable | Favorable | Favorable | Favorable |
| 10. | 1352* | *Canis lupus* | Favorable | Favorable | Favorable | Favorable |
| 11. | 1354 | *Ursus arctos* | Favorable | Favorable | Favorable | Favorable |
| 12. | 1361 | *Lynx lynx* | Favorable | Favorable | Favorable | Favorable |
| 13. | 1355 | *Lutra lutra* | Favorable | Favorable | Favorable | Favorable |
| 14. | 1193 | *Bombina variegata* | Favorable | Favorable | Favorable | Favorable |
| 15. | 5266 | *Barbus petenyi* | According to the data provided by the PM, the species has not been identified within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |
| 16. | 6965 | *Cottus gobio* | Unfavorable-inadequate | Favorable | Unfavorable-inadequate | Unfavorable-inadequate |
| 17. | 4123 | *Eudontomyzon danfordi* | Unfavorable-inadequate | Favorable | Unfavorable-inadequate | Unfavorable-inadequate |
| 18. | 6169 | *Euphydryas maturna* | Favorable | Favorable | Favorable | Favorable |
| 19. | 6199* | *Euplagia quadripunctaria* | Favorable | Favorable | Favorable | Favorable |
| 20. | 4034 | *Glyphipterix loricatella* | In the MP the species is not assessed in terms of conservation status. The species has an uncertain presence within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |
| 21. | 4036 | *Leptidea morsei* | In the MP the species is not assessed in terms of conservation status. The species has an uncertain presence within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |

| No. crt. | Natura 2000 Code | Species name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Species population | Habitat of the species | Future prospects for the species | Overall conservation status |
| 22. | 1060 | *Lycaena dispar* | Unknown | Unfavorable-inadequate | Unfavorable | Unfavorable |
| 23. | 4039* | *Nymphalis vaualbum* | Unknown | Favorable | Unfavorable | Unfavorable |
| 24. | 4054 | *Pholidoptera transsylvanica* | Favorable | Favorable | Favorable | Favorable |
| 25. | 4024* | *Pseudogaurotin excellens* | Unknown | Favorable | Unfavorable-inadequate | Unfavorable-inadequate |
| 26. | 1087* | *Rosalia alpina* | Favorable | Favorable | Favorable | Favorable |
| 27. | 4070* | *Campanula serrata* | Unknown | Unknown | Favorable | Unknown |
| 28. | 1902 | *Cypripedium calceolus* | Unknown | Unknown | Favorable | Unknown |
| 29. | 2113 | *Draba dorneri* | Unknown | Unknown | Unfavorable-inadequate | Unknown |
| 30. | 1758 | *Ligularia sibirica* | In the MP the species is not assessed in terms of conservation status. The species has an uncertain presence within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |
| 31. | 1389 | *Meesia longiseta* | In the MP the species is not assessed in terms of conservation status. The species has an uncertain presence within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |
| 32. | 4122 | *Poa granitica* subsp. *disparilis* | In the MP the species is not assessed in terms of conservation status. The species has an uncertain presence within the perimeter of the Site of Community Importance ROSCI0217 Retezat. | | | |
| 33. | 4116 | *Tozzia carpathica* | Unknown | Unknown | Favorable | Unknown |

***ROSPA0084 Retezat Mountains***

The special avifaunistic protection area ROSPA0084 Retezat Mountains overlaps entirely and exactly over the area of the Retezat National Park, being located mainly in Hunedoara county, extending a little in Gorj and Caras-Severin counties, covering a large part of the Retezat Massif, the entire Godeanu Massif and a small part of the Țarcu Mountains, in the western part of the Southern Carpathians, between the altitudinal limits of approx. 700 m (in its western part, in the Râului Mare valley) and 2509 m (vf. Peleaga).

The avifauna is well represented by species characteristic of the area in which the site is located, with numerous species of day and night birds of prey, as well as insectivores, very important to mention are several species threatened at the European Union level: the heron, the mountain eagle (it is the second most important site in the country for this species), the peregrine falcon, the martin, the little martin, the cherub, the great owl, the mountain woodpecker and the little flycatcher. There are also other important bird species in the area of this site, such as the Lesser Spotted Eagle, the Little Spotted Eagle, the Wasp, the Serpari, the Great Crested Serpari, the Great Loon, the Black Stork, 3 species of woodpeckers, the Field Capercaillie, etc.

The following table presents the list of species of community interest within ROSPA0084 Retezat Mountains and the evaluation of the criteria according to the Order of the Minister of Environment and Water Management no. 207/2006 on the approval of the content of the Natura 2000 Standard Form and its completion manual, according to the Standard Form of ROSPA0084 Retezat Mountains of 17.02.2024.

*Table no. 13 List of species of community interest within ROSPA0084 Retezat Mountains and evaluation of criteria according to the Order of the Minister of Environment and Water Management no. 207/2006 on the approval of the content of the Natura 2000 Standard Form and its completion manual, according to the Standard Form of ROSPA0084 Retezat Mountains of 17.02.2024*

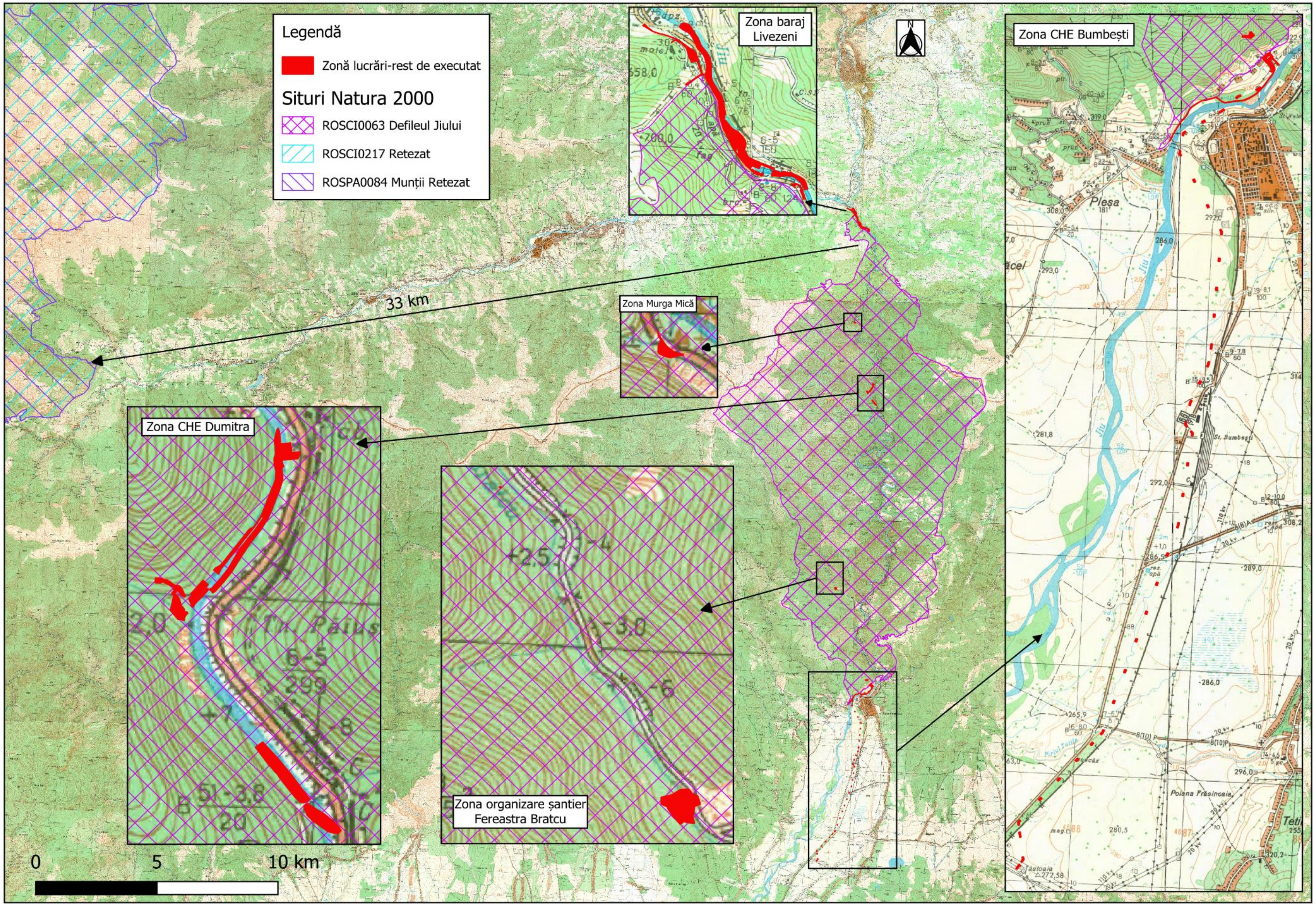
| Species | | | Population | | | Sit | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. crt. | Natura 2000 Code | Scientific name | Size (p-pairs, i-individends) | | Categ. | Pop. | Conserv. | Isolation | Global |
| | | | Min. | Max. | | | | | |
| 1. | A223 | *Aegolius funereus* | 50 p | 70 p | C | C | A | C | A |
| 2. | A229 | *Alcedo atthis* | 1 p | 2 p | V | D | - | - | - |
| 3. | A091 | *Aquila chrysaetos* | 3 p | 4 p | C | B | A | C | A |
| 4. | A089 | *Aquila* | 3 p | 4 p | C | B | A | C | A |
| 5. | A104 | *Bonasa bonasia* | 110 p | 140 p | C | C | A | C | A |
| 6. | A215 | *Bubo bubo* | 8 p | 12 p | - | C | A | C | B |
| 7. | A224 | *Caprimulgus europaeus* | 15 p | 25 p | R | C | B | C | C |
| 8. | A030 | *Ciconia nigra* | 3 p | 5 p | R | C | B | C | B |
| 9. | A080 | *Circaetus gallicus* | 1 p | 2 p | R | C | B | C | B |
| 10. | A122 | *Crex crex* | 5 p | 7 p | R | D | - | - | - |

| Species | | | Population | | | Sit | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. crt. | Natura 2000 Code | Scientific name | Size (p-pairs, i-individends) Min. | Max. | Categ. | Pop. | Conserv. | Isolation | Global |
| 11. | A239 | *Dendrocopos leucotos* | 80 p | 120 p | R | C | A | C | A |
| 12. | A238 | *Dendrocopos medius* | 5 p | 10 p | V | D | - | - | - |
| 13. | A236 | *Dryocopus martius* | 40 p | 60 p | V | C | A | C | A |
| 14. | A103 | *Falco peregrinus* | 2 p | 3 p | R | B | A | C | B |
| 15. | A321 | *Ficedula albicollis* | 2.000 p | 2.500 p | C | C | B | C | B |
| 16. | A320 | *Ficedula parva* | 800 | 1.300 | C | C | A | C | A |
| 17. | A217 | *Glaucidium passerinum* | 15 p | 20 p | R | C | A | C | A |
| 18. | A338 | *Lanius collurio* | 25 p | 35 p | V | D | - | - | - |
| 19. | A072 | *Pernis apivorus* | 35 p | 50 p | V | C | B | C | B |
| 20. | A241 | *Picoides tridactylus* | 75 p | 100 p | C | C | A | C | A |
| 21. | A234 | *Picus canus* | 20 p | 25 p | R | D | - | - | - |
| 22. | A220 | *Strix uralensis* | 30 p | 40 p | R | C | A | C | A |
| 23. | A108 | *Tetrao urogallus* | 50 p | 80 p | P | C | B | C | B |

*Table no. 14 Conservation status of bird species of Community interest within the special avifaunistic protection area ROSPA0084 Retezat Mountains (according to the draft Management Plan currently being approved)*

| No. crt. | Natura 2000 Code | Species name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Species population | Habitat of the species | Future prospects for the species | Overall conservation status |
| 1. | A223 | *Aegolius funereus* | Unknown | Unknown | Favorable | Unknown |
| 2. | A091 | *Aquila chrysaetos* | Favorable | Favorable | Favorable | Favorable |
| 3. | A089 | *Aquila pomarina* | Unknown | Favorable | Favorable | Unfavorable-inadequate |
| 4. | A104 | *Bonasa bonasia* | Favorable | Favorable | Favorable | Favorable |
| 5. | A215 | *Bubo bubo* | Unknown | Favorable | Unknown | Unfavorable-inadequate |
| 6. | A224 | *Caprimulgus europaeus* | Unknown | Unknown | Unknown | Unknown |
| 7. | A030 | *Ciconia nigra* | Unknown | Favorable | Unknown | Unfavorable-inadequate |
| 8. | A080 | *Circaetus gallicus* | Favorable | Favorable | Favorable | Favorable |
| 9. | A122 | *Crex* crex | Unknown | Unknown | Unknown | Unknown |
| 10. | A239 | *Dendrocopos leucotos* | Favorable | Unknown | Favorable | Unknown |
| 11. | A236 | *Dryocopus martius* | Favorable | Unknown | Favorable | Unknown |
| 12. | A103 | *Falco peregrinus* | Favorable | Favorable | Favorable | Favorable |
| 13. | A321 | *Ficedula albicollis* | Favorable | Unknown | Favorable | Unknown |
| 14. | A320 | *Ficedula parva* | Favorable | Unknown | Favorable | Unknown |
| 15. | A217 | *Glaucidium passerinum* | Favorable | Favorable | Favorable | Favorable |

| No. crt. | Natura 2000 Code | Species name | State of preservation according to PM | | | |
|---|---|---|---|---|---|---|
| | | | Species population | Habitat of the species | Future prospects for the species | Overall conservation status |
| 16. | A338 | *Lanius collurio* | Unfavorable-inadequate | Unknown | Unfavorable-inadequate | Unknown |
| 17. | A072 | *Pernis apivorus* | Favorable | Favorable | Favorable | Favorable |
| 18. | A241 | *Picoides tridactylus* | Favorable | Unknown | Favorable | Unknown |
| 19. | A234 | *Picus canus* | Favorable | Unknown | Favorable | Unknown |
| 20. | A220 | *Strix uralensis* | Unknown | Favorable | Favorable | Unknown |
| 21. | A108 | *Tetrao urogallus* | Favorable | Favorable | Favorable | Favorable |


Legendă
Zonă lucrări-rest de executat
Situri Natura 2000
ROSCI0063 Defileul Jiului
ROSCI0217 Retezat
ROSPA0084 Munții Retezat
Zona baraj Livezeni
Zona CHE Bumbești
Zona Murga Mică
Zona CHE Dumitra
Zona organizare șantier Fereastra Bratcu
33 km
0
5
10 km

b.3. Protected natural areas of national interest

The area of influence of the project also includes the Defileul Jiului National Park, and the overlap of the works with this protected natural area is presented in Table no. 4. The Defileul Jiului National Park is a protected natural area of national interest, located mainly in the north of Gorj County and in the south-eastern part of Hunedoara County. It has an area of 11,127 ha, according to the normative act of establishment, namely Government Decision no. 1581/2005 on the establishment of the protected natural area regime for new areas.

According to the Government Decision no. 1581/2005 on the establishment of the protected natural area regime for new areas, the boundaries of the Defileul Jiului National Park are detailed as follows:

The northeastern boundary starts downstream from the confluence of the West and East Jiu, forest boundary 1 production unit (UP) VII, Forestry office (O.S.) Petroşani, follows the Ogrinului Ridge up to forest boundary 5 UP VII, O.S. Petroșani, descends through the forest to the SE into the Polatiștea stream (forest posts 4, 8, 9, 11, 12, 13, 17, 20/UP VII, O.S. Petroșani), climbs Pr. Stolojoaia and the ridge of the same name (forestry markers 300, 312, 313, 309/UP VII, O.S. Petroşani) up to the Polatiștei ridge (forestry marker 299, 298, 296/UP VII, O.S. Petroşani) and follows eastwards the Polatiștei ridge, part of it in the mountain hollow, with the peaks (named and listed on the forestry plan) Pietricica, 1.355 m, Piatra Angelii (Piatra Argelii, on the topographic map), 1.432 m (forestry markers 296, 294, 186, 187, 188/UP IV, O.S. Bumbești) until the watershed between the Chitu and Sadu watersheds (about 2.5 km E of Vf. Piatra Argelelor).

Southeastern boundary. From the Polatiștei ridge, the boundary descends approximately perpendicular to the south on the Alunului ridge between the Chitu and Sadu watersheds and enters the forest (forestry markers 181, 179, 177, 175, 173, 211, 215, 206, 44, 119/UP IV O.S. Bumbești), then crosses alternately forested territories and mountain gaps through Vf. Trântor (991 m), continues with Culmea and Vf. Bâlbea (forestry markers 15, 184, 2/UP IV, O.S. Bumbești, 2 and 1/UP V, O.S. Bumbești) until the confluence of Pr. Sadu with the Jiul. From here it follows the slope of the Jiu up to the bridge over the Jiu of the county road Tg. Jiu - Sâmbotin.

South-western boundary. From the Jiului talvegul (forest post 1/UP III, O.S. Bumbești), it climbs northwards on Culmea Pleșa (forest posts 450, 448, 444, 440, 439/UP II, O.S. Bumbești) to Vf. Runcu Porcenilor (1.030 m) and then on the Runcu Porcenilor Ridge (forest posts 426, 420, 418, 416, 414, 408) to Vf. Pietriceaua (1.202 m) and further on the Pietriceaua Ridge (forestry markers 65, 69, 71, 73, 77/UP III, O.S. Bumbești) up to the point (named on the topographic map) "La Crucea de Piatră" in the "Căpățânii" Ridge (named on the forestry plan) in the Chenia - Dumitra Mountain Gorge.

North-western boundary. The ridge of Căpățânii from the Chenia - Dumitra Mountain Gorge continues to the north-north through the Vulcan Pass, 1,621 m (highlighted and marked on the topographic map), on the alpine ridges (named on the silvicultural plan) "Chenia - Dumitra" with Vf. Drăgoiu, 1.600 m and "Carcanului" at Vf. Cândețu (1,548 m), follows the northern boundary of the mountain hollow called 'Polatiște' on the forestry plan, extended in the forest with the ridge marked by forestry boundary posts 243, 241, 241 bis (UP II, O.S. Petroșani), after which it turns perpendicular to the N (along forestry boundary posts 243 bis, 254 bis, 252, 258, 269, 262, 256, 270, 261, 279/UP II, O.S. Petroșani) and from here it descends into the Ji river slope (forestry boundary 175/UP II, O.S. Petroșani).

Given that the Defileul Jiului National Park does not have a management plan approved by a normative act, the internal zoning taken into account is the one from the above mentioned HG, thus, according to it, the Special Conservation Areas of the Defileul Jiului National Park include forest parcels and sub-parcels is made up of parcels:11-14, 15 a, b, 16 a, b, 17-19 b, 20-21 b, 22-35, 36 a-e, 37 a - 41 a, 41 b, 42 a, b, 43 a, b, 44-75 b, 76, 77 a-d, 78-79 b, 80 a-c, 81 a-d, 82 a, b, 84 a-c, 85-86 c, 87 a, 88, 89-91 d, 92, 93, 94-102 c, 103 a-e, 104 a-i, 105-142 from UP III Bratcu of Ocolului Silvic Bumbești - Jiu, 1-18 b, 19-37 b, 38 a - 42 d, 43 a-c, 44-48 c, 49-59, 60 a, b, 61-79, 79 b - 81 from UP IV Chitu of O.S. Bumbești - Jiu, 1, 3, 4, 6, 7, 11 a, b, c, d %, 12 a %, b % of P.U. II Straja a O.S. Petroșani, 1, 3 a, b, 4 a, b, 5, 119-121, 122 a, 122 b, 123-125 of UP VII Polatiște of Ocolului Silvic Petroșani, as well as the alpine hollows Chenia - Dumitra (31,5 ha) and Piatra Argelelor (38,1 ha).

**It should be mentioned that the draft management plan categorizes the park area (according to the legislation in force) into 4 conservation zones: Sustainable Conservation, Sustainable Development, Strict Protection and Integral Protection. The GIS analysis carried out showed that the remaining works to be carried out overlap with the Sustainable Conservation Zone and the Sustainable Development Zone.**

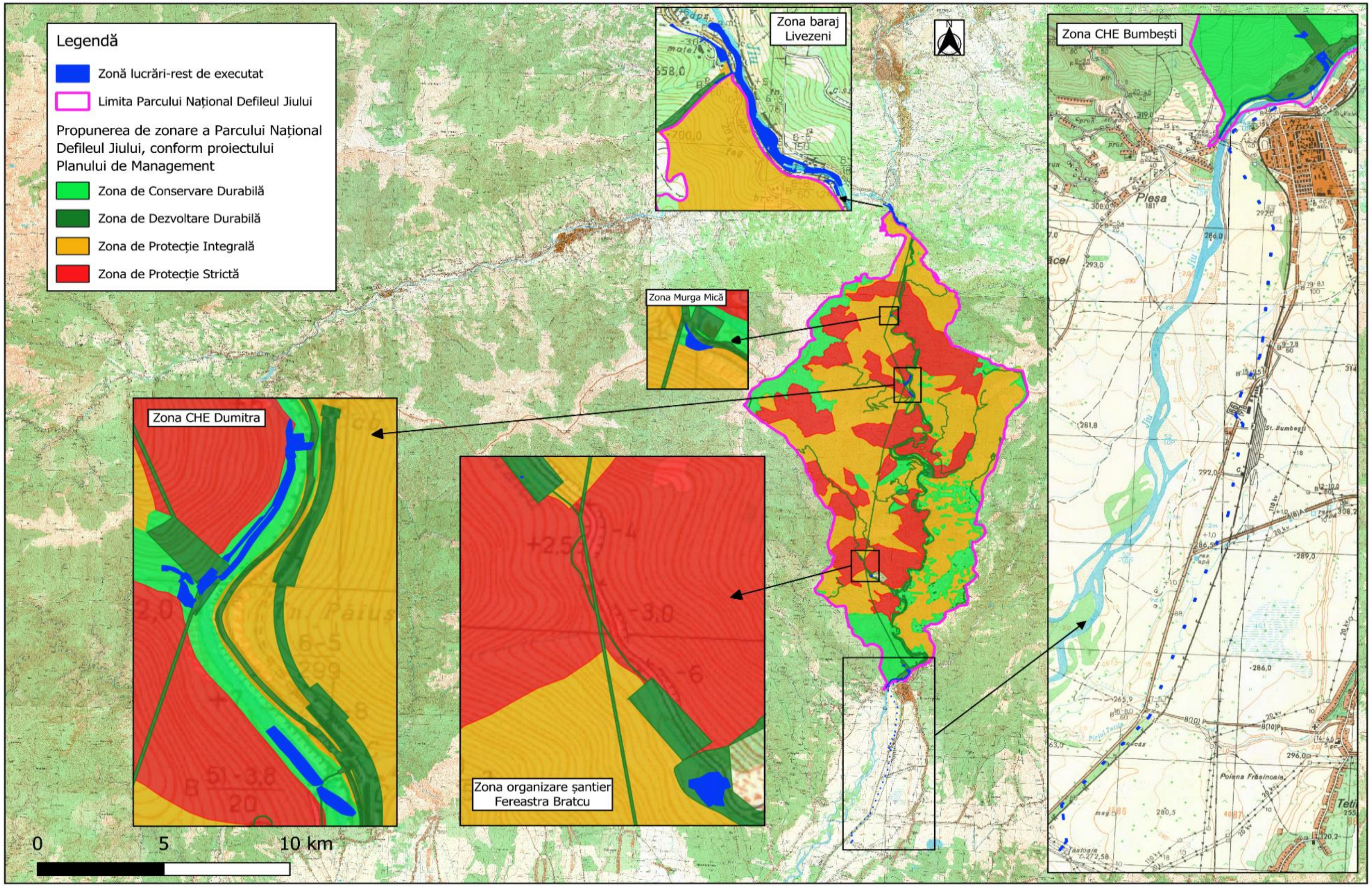



Fig. 3
Proposed internal zoning of the DJNP according to the draft management plan

*c) Land Regime*

The following urban planning certificates were issued for the implementation of the project:
- CU nr. 162/23.08.2024 issued by CJ Hunedoara for works located on the territory of jud. Hunedoara;
- CU nr. 85/19.08.2024 issued by CJ Gorj for works on the territory of jud. Gorj;
- CU nr. 105/30.06.2022 issued by UAT Bumbești for the connection line to SEN of CHE Bumbești;
- CU nr. 37/31.10.2022 issued by UAT Aninoasa for the connection line to SEN of CHE Dumitra.
- CU nr. 81/16.03.2023 issued by CJ Hunedoara for connection to SEN of MHC Livezeni.

The land is located on theadministrative territory of Aninoasa in Hunedoara County and Bumbești-Jiu in Gorj County.

**Ownership**: Romanian State, Hidroelectrica, other properties.

*d) Climatic, geological, geomorphological and hydrological description of the site*

*I. <u>Climate and relief features</u>*

***Climate characteristics of the Defile of Jiului***

From the topoclimatic point of view, in the southern third of the Defile of Jiului area, there is a climate of hills and foothills, characterized by average annual temperatures between 8 and 10˚C, average annual precipitation of 600-850 mm, relative humidity above 75%, respectively a climate of low mountains, characterized by average annual temperatures around 6˚C at the base and towards 0˚C in the upper part, average annual precipitation increases with altitude (from about 850 mm to over 1000 mm) (Geografia României VOL. I).

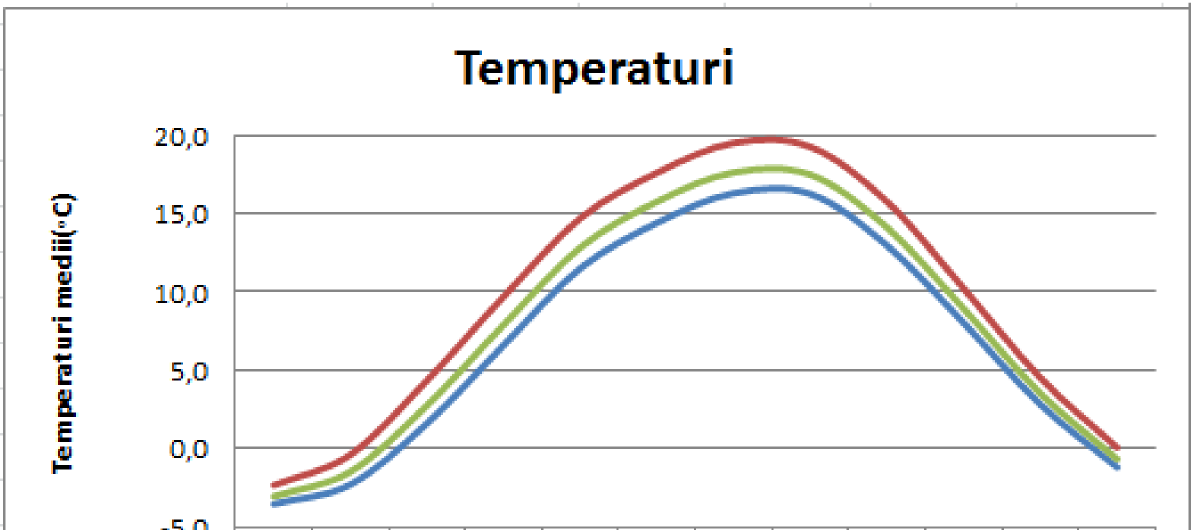
In addition to the complex topoclimates, there are also elementary topoclimates, such as gorge topoclimates, mountain ridge topoclimates, topoclimates of slopes with different exposures. However, being situated in the sheltered interior of the Carpathians, precipitation may be lower and temperature inversions occur frequently in winter.

The sheltered climate of the Ji river valley, which is oriented transversely to the direction of circulation of cold air masses from the east, provides favorable conditions for maintaining higher temperatures especially on the interfluves, which contributes to the preservation of thermophilous vegetation on the slopes. According to the Köppen climate classification, there are two climatic zones within the protected area:

At altitudes below 700 m: temperate rainy climate (C), with year-round precipitation (f), average temperature in the warmest month below 22˚C (b), with maximum rainfall in late spring to early summer.

In the area with altitudes above 700 m: rainy boreal climate with cold winters (D), year-round precipitation (f), average temperature above 10˚C but not more than 18˚C in 1-4 months per year (c), precipitation with a maximum in June totals 700-1200 mm annually.

Minimum, maximum and average temperatures in the Defileul Jiului area are shown in the diagram below.



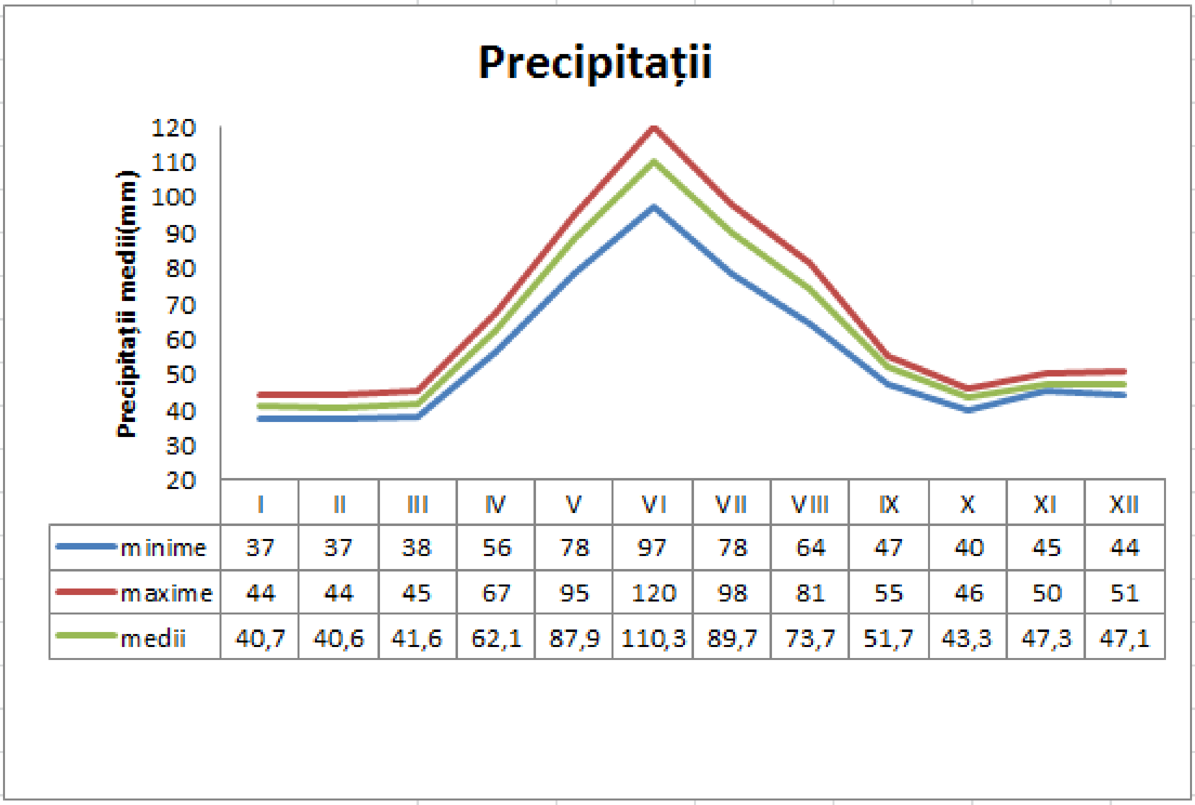

| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| minime | -3,6 | -2,3 | 1,6 | 6,6 | 11,5 | 14,4 | 16,3 | 16,3 | 13,0 | 8,0 | 2,8 | -1,2 |
| maxime | -2,4 | -0,4 | 4,4 | 9,7 | 14,7 | 17,6 | 19,5 | 19,3 | 15,8 | 10,2 | 4,5 | 0,1 |
| medii | -3,1 | -1,5 | 2,8 | 7,9 | 12,8 | 15,8 | 17,6 | 17,5 | 14,1 | 8,9 | 3,5 | -0,7 |

Fig. 4 Average monthly temperatures in the Defileului Jiului area (source: *WORLDCLIM global model)*

We note that the average monthly temperature reaches its maximum in July, with a value of 17.6˚C. The coldest month is January, with an average temperature of -3.1˚C.

The average annual temperature is 7.9˚C, which is the result of the geographical position in the V of the country, where the climate is milder due to the Mediterranean influences in the southern part, but also due to the location of the relief unit, namely in the mountainous area.

***Average monthly precipitation***




| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| minime | 37 | 37 | 38 | 56 | 78 | 97 | 78 | 64 | 47 | 40 | 45 | 44 |
| maxime | 44 | 44 | 45 | 67 | 95 | 120 | 98 | 81 | 55 | 46 | 50 | 51 |
| medii | 40,7 | 40,6 | 41,6 | 62,1 | 87,9 | 110,3 | 89,7 | 73,7 | 51,7 | 43,3 | 47,3 | 47,1 |

Fig. 5 Average monthly precipitation in the Defileului Jiului area (source: *WORLDCLIM global model)*

From the above graph we observe that the maximum precipitation is in June (120 mm) and the minimum in February (40.57 mm). The average annual precipitation is 735.9 mm, which is typical of the montane and premontane meadows.

Also of note is the amplitude between maximum and minimum values, which is much higher in the summer months than in winter.

*II.* *<u>Description of the river network (source PMBHJ)</u>*

The Jiu hydrographic basin is located in the south-western part of the country, delimited by: - to the north, by the high peaks of the Șurian, Parâng, Retezat, Cerna mountains, which separate it from the basins of the tributaries of the Mureș, Sebeș, Streiului and Cerna; - to the west, by the peaks of the mountains and high hills that separate it from that of the Cerna. - to the east, the boundary of the Jiu basin, followed by a narrow ridge separating it from that of the Olt, as far as near Craiova. To the south, the Jiu enters the Romanian Plain, and the boundary of the basin follows a line joining the villages of Leu - Ghizdăvești - Bechet; - to the south, the boundary is formed by the course of the Danube. From the administrative point of view, the Jiu catchment area occupies almost entirely the counties of Mehedinți, Gorj, Dolj and partially the counties of jud. Hunedoara (subcarpathian part). The total population is about

1,341,000 inhabitants, with a population density of 80.02 inhabitants/km$^2$ . The main urban agglomerations are: Craiova, Petroșani, Tg.-Jiu, Drobeta Turnu Severin, Lupeni, Vulcan, Băilești, Petrila, Calafat, Filiași and Rovinari.

The total area of the Jiu river basin is 16758.59 km$^2$ , representing 7.03% of the country's surface. This area also includes the catchment basins of the direct tributaries of the Danube in south-western Oltenia: Bahna, Topolnița, Blahnița, Drincea, Balasan, Desnățui, Jieț, which occupy an area of 6596 km$^2$ . The hydrographic network includes 286 registered watercourses, with a total length of 4954 km and an average density of 0.30 km/km$^2$ .

The total surface water resources in the Jiu river basin amount to approx. 4059 mil.m$^3$ /year, of which usable resources are approx. 2109,5 mil.m$^3$ /year. These represent approx. 51.9% of the total resources and are formed mainly by the Jiu and its tributaries, respectively the direct tributaries of the Danube in the south-western part of the country Bahna, Topolnița, Blahnița, Drincea, Balasan, Desnățui and Jieț. In the Jiu catchment basin there are 8 major reservoirs (larger than 0.5 km$^2$ ), which have a complex use and an active storage volume of 60.8 million m$^3$ .

In relation to the population of the basin, the specific usable resource is 1431 m$^3$ /place/year, without the usable resource of the Danube River in the ABA Jiu area, and the specific resource calculated on the theoretical available stock (multiannual average) is 2753 m$^3$ /place/year. The water resources confined in the Jiu catchment area can be considered small and unevenly distributed in time and space. The multiannual mean flows for the main rivers in the Jiu catchment area are between 2.39 m$^3$ /s (Amaradia at Albești) and 90.6 m$^3$ /s (Jiu at Zăval).

Of the total length of registered watercourses in the Jiu catchment area, non-permanent watercourses account for about 18.5%. In the Jiu catchment area groundwater resources are estimated at 1035 million m$^3$ , of which 568 million m$^3$ come from groundwater sources and 467 million m$^3$ from deepwater sources.

*III.* *Seismic zoning data*

According to the standards, the seismic zonations of the Romanian territory present the following intensities (i) for the Livezeni-Bumbești development area:

- ✓ according to STAS 11.100/1-77I = 6;
- ✓ in accordance with SR 11.100/1-93I = 6, with a return period of 50 years;
- ✓ according to P100-92I = 6 (microseismic zone F).

There is a significant underestimation of the expected maximum intensities, compared to the assessments of the same intensities, under the recent strong seismic activation in the area.

Based on recent analysis of the seismicity of the area, the following parameters of maximum expected earthquakes have resulted:

- ➢ DBEI level = 7. 5$a_{max}$ = 160 cm/s$^2$ ;
- ➢ MCEI level = 8. 5$a_{max}$ = 320 cm/s$^2$ ; Vrâncean regional earthquake
- ➢ DBEI level = 6$a_{max}$ = 50 cm/s$^2$ ;
- ➢ MCEI level = 7$a_{max}$ = 100 cm/s$^2$ .

According to the seismic zoning maps (P100-1/2013), the site is located in seismicity zone 7, which corresponds to a ground acceleration of ag=0.20g, with a corner period of the seismic spectrum Tc=0.7 s, for an earthquake with an average return period of 225 years.

Zonation of the territory of Romania in terms of peak design ground acceleration values, ag for earthquakes with mean recurrence interval IMR=225 years (P100-1/2013).

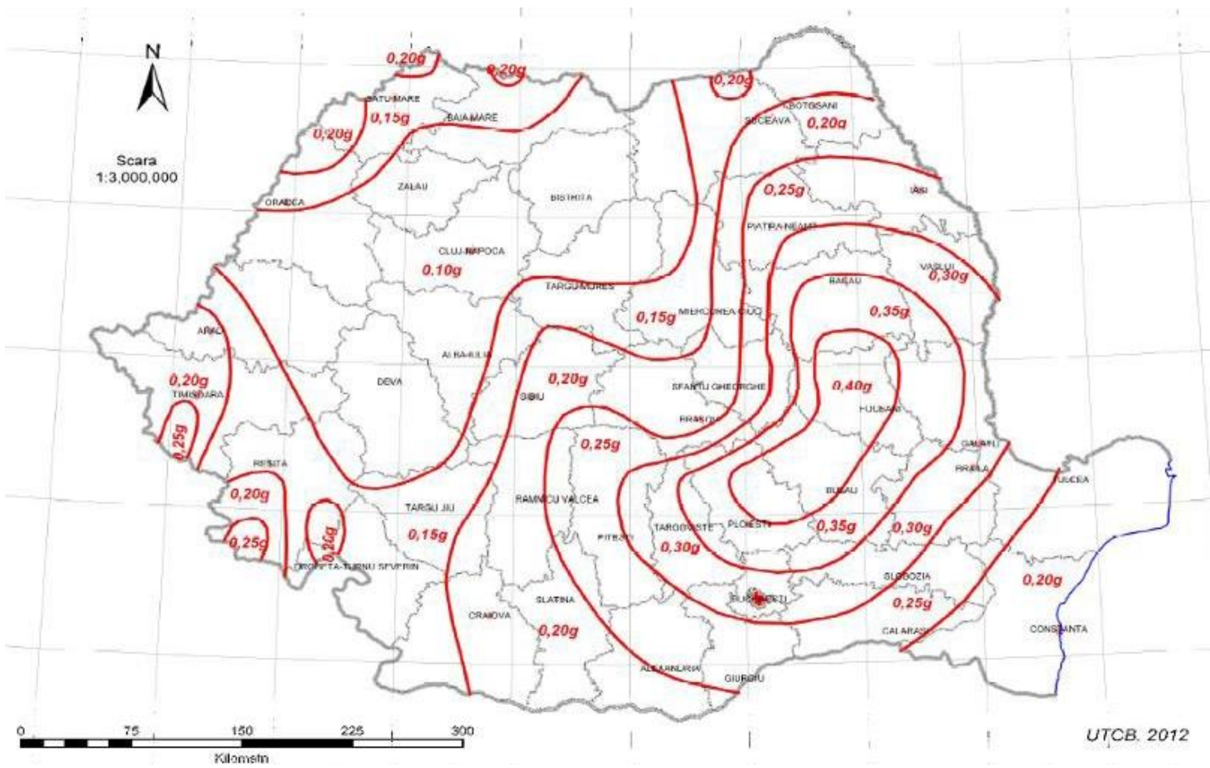


Fig. 6 Seismic zonation of Romania

*e) Objectives located in the vicinity of the BH Jiu site*

Several catchments, lakes or micro-hydropower plants are located in the Jiu catchment, their location being presented in the table below.

*Table no. 15 Objectives from BH Jiu (according to the address of S.H.I. Petroșani no. 2578/CS/07.08.2024)*

| Nr. crt. | Name of the holder of abstraction/water course | Capture type | Qzi max |
|---|---|---|---|
| 1 | Mining Lonea /pr. Voievodu<br>left bank of the East Jiul river | Bank intake structure | Qzi max<br>1385, 19 mc/z |
| 2 | SC Hidro Clear SRL/ pr. Taia afl. de dreapta<br>of the East Jiul river | Reinforced concrete profile intake<br>Summer and winter plug | Qmax cap<br>1.324 mc/s |
| 3 | SC Hidro Clear SRL/ pr. Aușelu afl. de dreapta al pr. Taia | Reinforced concrete profile intake<br>Summer and winter plug | Qmax cap<br>2.102 mc/s |
| 4 | Apa Serv Valea Jiului/ pr. Taia right tributary of the East Jiul river | Spillway dam, side outlet<br>with two openings | Q projected<br>300 l/s |
| 5 | Apa Serv Valea Jiului/ pr. Jieț left tributary of the river Jiul de Est | Spillway dam | Q projected<br>150 l/s |
| 6 | SC Groapa Seacă SRL /2 watercourses<br>Unclassified, right tributaries of the Jieț river | Two intakes with concrete bottom sill | Qzi max<br>49.48mcc/day<br>Qzi max<br>15.55 mc/day |
| 7 | SC General Trans SA Cabana Mija for Energy Production/ pr. Mija afl. de stânga al pr. Jieț | Intake structure with concrete dam | Qzi max<br>6000 mc/day |
| 8 | SC General Trans SA Cabana Mija/ pt. Mija afl. de stânga al pr. Jieț | 5 perforated pipes | Qzi max<br>8, 2 mc/day |
| 9 | Exploatare Minieră Livezeni/pr. Maleia afl. de stânga del râului Jiul de Est | Bottom sill, shore inlet | Qzi max<br>168.58 mc/day |
| 10 | C.L. Mun. Petroșani- Snow cannons Parâng/<br>Maleia on the left bank of the East Jiul river | Perforated pipes with Dn=300mm | Qzi max<br>330.31 mc/day |
| 11 | Ecological Association Rusu/ pr. Gruniu unclassified, tributary of the East Jiul river | Sorb filter placed in the bed<br>Fr. Gruniu | Qzi max<br>85.01 mc/day |

| Nr. crt. | Name of the holder of abstraction/water course | Capture type | Qzi max |
|---|---|---|---|
| 12 | Apa Serv Valea Jiului/ pr. Polatişte, left tributary of the river Jiu | Concrete dam, Streambed intake | Q projected 300 l/s |
| 13 | SC MN trading RO SRL/pr. Negaru, afl. de right of the East Jiul river | Dual Capture Camera compartment | Qzi max 9.97 mc/day |
| 14 | Exploatare Minieră Vulcan/pr. Crevedia, afl. left bank of the West Jiul river | Shore inlet fitted with iron grate | Qzi max 2606,22 mc/day |
| 15 | Exploatare Minieră Lupeni/pr. Sohodol, afl. right bank of the West Jiul river | Lateral streambed intake, left bank, and dam with spillway | Qzi max 128.32 mc/day |
| 16 | SC Termoplast SRL Vila Straja/pr. Sohodol on the right tributary of the West Jiul river | Concrete intake chamber | Qzi max 3.01 mc/day |
| 17 | Apa Serv Valea Jiului/ Braia pr., right tributary of the West Jiul river | Reinforced concrete dam with side overflow, summer and winter outlet | Q projected 120 l/s |
| 18 | SC Energetic Valea Jiului SA-SE Paroşeni/ Western Jiul river | Gravity dam with sluice gate, free-flow intake structure | Qzi max 601,320 mc/day |
| 19 | SC Energetic Valea Jiului SA-SE Paroşeni/pr. Baleia | Streambed intake | Qzi max 6 mc/day |
| 20 | Apa Serv Valea Jiului/ pr. Lazăr, left tributary of the river Jiul de Vest | Reinforced concrete dam with Central overflow, summer and winter outlet | Q projected 700 l/s |
| 21 | A.B.A Jiu- SHI Petroşani/Acumularea Valea de Pești, located on the Valea de Pești (right tributary of the West Jiul river) | Rockfill dam with asphaltic concrete face | Active storage volume 4.2 mil. m3 |
| 22 | SC Hidroelectrica SA Suc. Hidrocentrale Haţeg/ Valea de Pești reservoir | Dam made of rockfill | Qinstatat 0.74 mc/s |
| 23 | SC Hidroelectrica SA Suc. Hidrocentrale Haţeg/ pr. Buta, left tributary of the river Jiul de Vest | Transversal bottom sill on the riverbed, weir spillway | Qinstalat 0.9 mc/s |

*1.2. Physical characteristics of the entire investment objective*

The Livezeni - Bumbești hydropower plant is located on the gorge sector of the Jiu River, between Livezeni (confluence of the East and West Jiu) and Bumbești (confluence with the Curpenului stream), on a length of about 20 km and a drop of 252 m and has a unit potential of over 1700 kW/km.

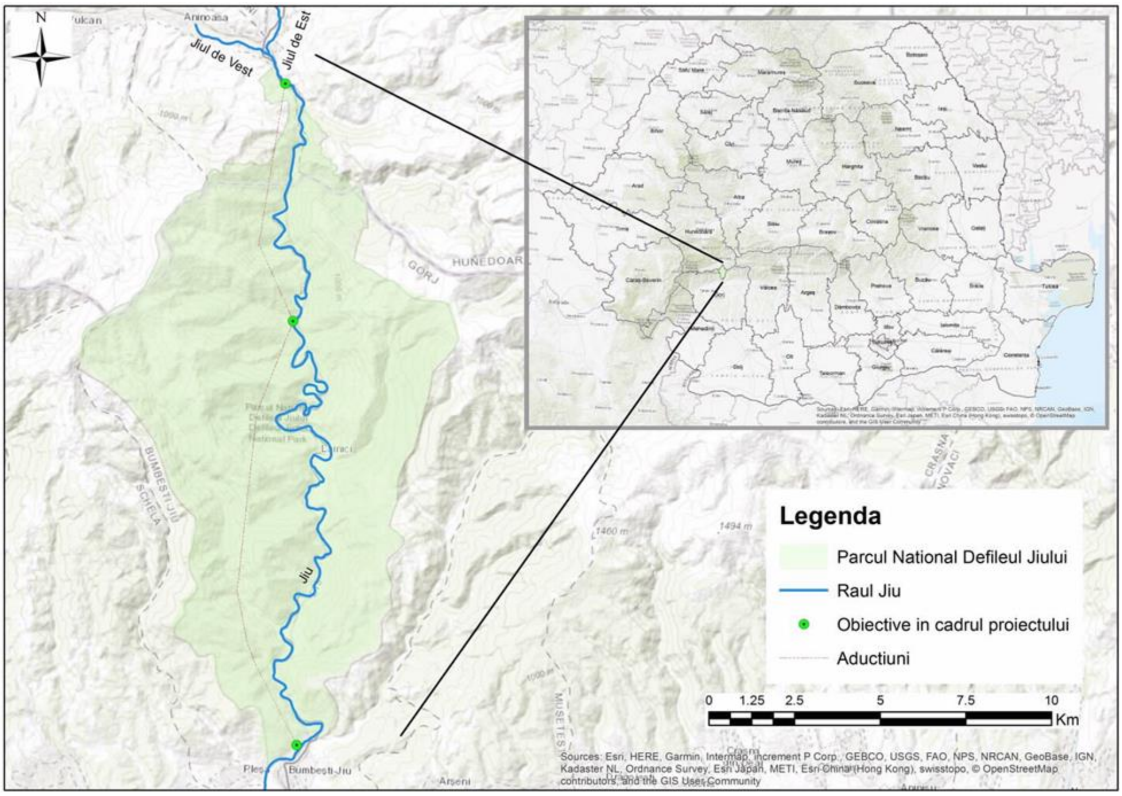



Fig. 7 Location of the hydropower project on the Jiu river in the Livezeni-Bumbești sector

The hydropower development scheme of the Jiu River on the Livezeni - Bumbești sector includes two power plants on diversion and one micro-hydropower plant for the easement flow, namely: the Dumitra CHE, Bumbești CHE and MHC Livezeni.

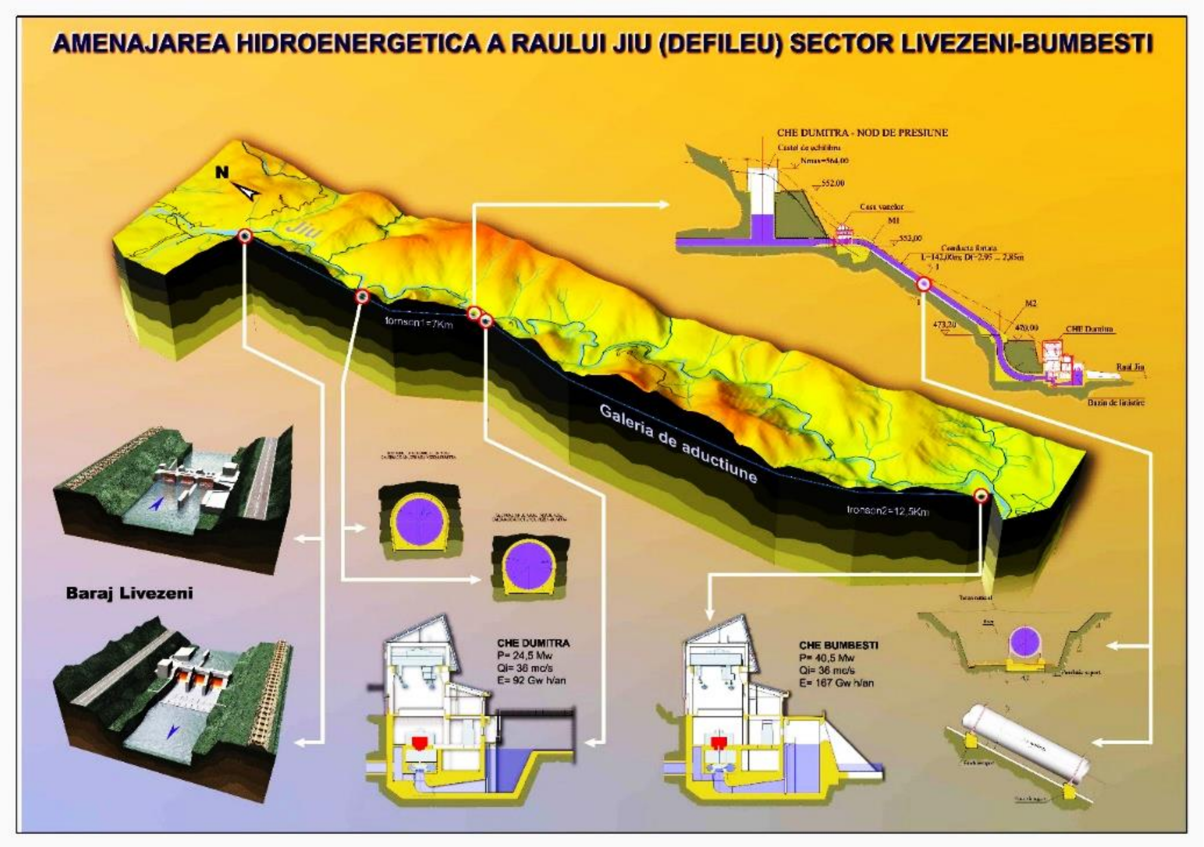



Fig. 8 AHE scheme of the Jiu river on the Livezeni-Bumbești sector

The project falls under Annex 2, point 3, letter (h) of the Law No. 292/2018. The project also falls under the provisions of Art. 48, paragraph (1) - a and Art. 54 of the Water Law No. 107 /1996, as amended.

The project has been designated as being of public interest of overriding importance, using renewable energy, and is considered an exceptional situation within the meaning of Art. 5 para. (2) of Law no. 292/2018 on the assessment of the environmental impact of certain public and private projects, and is a project of national interest/importance/national security according to the provisions of O.U.G. no. 175/2022 for the establishment of measures on investment objectives for the completion of hydropower facilities under implementation, as well as other projects of major public interest using renewable energy, and for amending and supplementing some normative acts.

At present, the project "*Hydropower development of the Jiu river on the Livezeni-Bumbești sector*" represents the works necessary for the completion of the investment, an investment regulated from the environmental protection point of view by the environmental agreement GJ-51/18.04.2003.

The investment objective is approved by the Government Decision no. 10/2003 and declared "*investment objective of public utility of national interest*" by the Government Decision no.1.297/2006. It provides for the realization of a hydropower development scheme on the gorge sector of the Jiu River between Livezeni and the confluence with the Sadu River, over a length of about 20 km and a drop of 263 m, by building two hydropower plants on the diversion, namely: CHE Dumitra and CHE Bumbești, and the micro-hydropower plant (MHC) Livezeni, located on the section that will provide the flow of easement.

The overall objective of the project is to exploit the hydropower potential of the Livezeni-Bumbești sector on the Jiu River in the gorge area by completing the remaining works to be executed at the two hydropower plants and the micro-hydropower plant.

For this reason, the current environmental impact assessment procedure has been launched, with appropriate evaluation, in order to ensure, on the one hand, the assessment of new solutions and, on the other hand, the updating of information on the impact on protected species and habitats in Natura 2000 areas.

The energy produced by the power plants built on the Jiu river provides electricity to over 100,000 households with an average monthly consumption of 200 kWh/month .

The commissioning of the *"Jiu River Hydropower Development on the Livezeni-Bumbești sector"* will contribute to the increase of energy produced by 259 GWh/year and to the security of electricity supply to the national energy system, in the context in which our country has undertaken the phased phase-out of lignite and hard coal power plants. By December 31, 2022, 2,355 MW had been decommissioned (1,695 MW by 31.12.2021 and 660 MW by 31.12.2022 ) and will be phased out by 2025 at the latest - 1425 MW of the total installed lignite and hard coal-fired power capacity .

The hydropower scheme is divided into two stages. The two stages are linked by two underground concrete headrace galleries that do not impact protected natural areas.

**Work is 87% complete.**

**The Project on increasing the share of electricity production from renewable sources by completing the works and ensuring permanent monitoring of the environmental impact of the hydropower development of the Jiu river on the Livezeni - Bumbești sector" - continuation of the remaining works to be executed at the AHE Livezeni – Bumbești sector only concerns the remaining works for the commissioning of the project.**

The hydropower development of the Jiu river on the Livezeni-Bumbești sector is structured in two stages, which, in turn, are composed of investment objects, as follows:

**1. Dumitra fall step which includes the following objects:**

1.1. Livezeni reservoir;
1.2. Livezeni Dam;
1.3. Livezeni power intake;
1.4. MHC Livezeni;
1.5. Settling pond;
1.6. Connection of MHC Livezeni to SEN via LES.
1.7. Livezeni-Dumitra headrace;
1.8. Dumitra power structure;
1.9. CHE Dumitra;
1.10. Connection box with the headrace;
1.11. Small Murga Platform;

1.12. Access road;
1.13. Intervention Block Dumitra;
1.14 Connection to SEN of CHE Dumitra through LES.

**2. The Bumbești fall includes:**

2.1. The main Dumitra-Bumbești main headrace;
2.2. Bumbești power structure;
2.3. CHE Bumbești;
2.4. Bumbești runaway canal;
2.5. Technical block Bumbești;
2.6. Exterior technical block
2.7. Dumitra catchment, Jiu catchment, Bratcu catchment
2.8. TRAFO station;
2.9. Connection to SEN of CHE Bumbești through LEA.

The hydropower scheme is divided into two stages, the two stages being linked by two underground concrete headrace galleries that do not impact protected natural areas. The works are 87% completed.

**1. The Dumitra fall step**

**1.1. Livezeni Reservoir**

The Livezeni reservoir is about 1,000 m upstream from the dam. The right bank is delimited by the national road DN 66 Târgu Jiu - Petroșani, and the left bank by the railroad Bumbești - Livezeni.

The main features of accumulation are:

| | |
|---|---|
| - normal retention level | 552,00 mdM; |
| - minimum operating level | 549,00 mdM; |
| - spillway threshold level | 542,00 mdM; |
| - total volume at NNR | 132.000 $m^3$ ; |
| - active storage volume | 81.000 $m^3$ ; |
| - lake area at NNR | 4,27 ha. |

**Work is now 99% complete.**

**1.2. Livezeni Dam**

Livezeni dam, located at the entrance to the gorge, at km 116 + 300 of DN 66, about. 1.10 km downstream of the confluence of the East and West Jiu. It is a dam equipped with three identical radial gate with a 10 m opening and a height of 10.5 m, with a length of the dam face of 42 m.

The features of the dam are as follows:

| | |
|---|---|
| - canopy elevation | 554,00 mdM; |
| - threshold quota | 542,00 mdM; |
| - maximum structure height | 20.0 m; |
| - length of the barred front | 42,0 m; |
| - length of the heat stilling basin | 24,0 m; |
| - fixed rhizberm length | 20,0 m; |

- mobile rhizberm length 15,0 m.

An easement flow of 2.7 $m^3$ /s will be provided downstream of the dam at all times. This flow is used to produce electricity through a micro-hydropower plant (MHC Livezeni) located adjacent to the right bank of the dam or discharged through a by-pass when the micro-turbine is not operating.

A fish ladder will be placed on the left side of the dam to facilitate fish migration.

**Work is now 99% complete.**

**1.3. Livezeni energy hub**

The Livezeni power intake is a reinforced concrete construction in the form of a funnel, underground, located on the right bank of the river, adjacent to the spillway dam and is equipped with: a fixed metal grate with 3 openings - 28.50 $m^2$ , a grate cleaning machine, automatic, equipped with mobile storage container for floats coming down the river and two 11.2 $m^2$ floodgate gates at the entrance to the headrace.

**Work completed.**

**1.4. MHC Livezeni**

The MHC Livezeni is a completed underground/aboveground concrete construction that is located on the technological platform adjacent to the dam and water intake. In this building is located the micro-hydroaggregate which will operate under the conditions of ensuring at all times the easement flow of 2,7 $m^3$ /s to be ensured in the Jiu riverbed downstream of the Livezeni dam. A bypass is provided on the hydraulic circuit for periods when the dam is not in operation. The micro-hydropower plant has an installed capacity of 0.14 MW and an average annual energy of 1.00 GWh/year.

**Work now 99% complete.**

**1.5. Settling tank**

The settler is an underground construction located about 50 m from the Livezeni intake. It is 130 m long and has a concrete cross-section 8.0 m wide and 12.0 m high. The purpose of the settler is to decant the silt entrained by the water. It is designed in such a way that it is self-cleaning by flushing.

The outlet of the wash is a 170 m long underground concrete tunnel in the Jiu River.

**Work completed.**

**1.6. Connection of MHC Livezeni to SEN via LES**

In order to connect MHC Livezeni to the SEN, as well as to ensure the supply of internal services from CHE Dumitra and Livezeni dam, a 6 kV connection point will be realized, with medium voltage delimitation and measurement. It is necessary to place two poles, one between poles 52 and 53 of the existing 6 kV LEA and one between poles 81 and 82 of the existing 6 kV LEA. The connections are made through LES in lengths of approx. 50 m and approx. 60 m.

The connection point (building) will be equipped with:

- 2 x 24 kV, 400 A, 16 kA modular line cells;

- 1 measuring cell with load separator.

**Execution has not begun.**

**1.7. Livezeni-Dumitra headrace**

The headrace Livezeni - Dumitra is located on the right slope of the Jiu River. The pipeline is an underground tunnel, lined with reinforced concrete, with a length of about 7.0 km, with a circular cross-section with a diameter of 3.80 m. The water access to the headrace gallery is made from the settling basin over a 9.0 m wide sill, which is designed to prevent the ingress of alluvium into the headrace to the CHE Dumitra.

**Work completed.**

**1.8. Dumitra power structure**

The Dumitra power structure consists of:

- the surge chamber, a reinforced concrete construction underground and above ground. It consists of: the chamber shaft with a height of 26.0 m and an inner diameter of 12.0 m; the upper chamber with a height of 13.0 m and an inner diameter of 16.0 m;
- valve chamber, above ground construction - located on a platform at 527.50 mdM, at the point where the headrace gallery emerges, equipped with a butterfly valve of 3.2 m diameter, which closes automatically in emergency situations;
- metal penstock - located on the slope between the valve chamber and the power station distributor, with a length of 140 m and a variable internal diameter of 3.0 m at the top and 2.80 m at the connection to the distributor. The pipeline is anchored on two concrete anchors.

**Work is now 99% complete.**

**1.9. CHE Dumitra**

CHE Dumitra is an underground/surface construction called a hydroelectric power plant, located on the right bank of the Jiu river, at the confluence with the Dumitra stream.

The power plant is equipped with three Francis vertical-shaft hydraulic turbines, FVM 10.3 - 95, for the turbulation of a flow of 3 x 12 $m^3$ /s and three hydro-generators with all the auxiliary installations necessary for optimal operation. In case the plant is not in operation, the downstream flow is channeled through the turbine (idling).

CHE Dumitra has the following energy characteristics:

- average available flow 15.49 $m^3$ /s;
- gross drop 97 ,6 m;
- installed flow 36.0 $m^3$ /s;
- installed power 24.5 MW;
- average annual energy 91.0 GWh/year.

The construction is a monolithic reinforced concrete tub (floor and walls), with external dimensions of $L_{max}$ = 30,70 m, $B_{max}$ = 15,50 m, $H_{max}$ = 12,90 m.

The flow return is made through a stilling basin connected to the spillway to the Jiu River and the downstream headrace box to the Bumbești power plant headrace gallery.

The Dumitra power plant platform is arranged in such a way as to allow access to the power plant and to the 110 kV substation, located upstream of the power plant. At the same time, the Dumitra-Bumbești connection box, the Dumitra stream catchment and the Dumitra stream discharge channel, the intervention block, the cooling water basin, the drinking water treatment basin and the septic tank are located on this platform, in accordance with the situation plan.

**The work is now 98% complete.**

### 1.10. Junction box with the main Dumitra-Bumbești pipeline

The connection box with the main headrace has the role to transit the flow from the stilling basin of the CHE Dumitra to the headrace gallery of the CHE Bumbești.

The construction consists of a concrete box with interior dimensions of 4.0 x 4.0 m and a length of 67.0 m.

Upstream, about 10 m from the junction with the headrace gallery of the CHE Bumbești, there is a shaft for the dry-docking of the downstream section, in case of inspection or repair, without interrupting the operation of the CHE Dumitra. In this case, the turbionized flow from this power plant will be discharged into the Jiu, through a spillway located in front of the power plant's stilling basin at 454.40 mdMN.

**The work is now 98% complete.**

### 1.11. Dumitra catchment and Bratcu catchment

The Dumitra and Bratcu catchments, located on the streams of the same name, introduce into the Dumitra - Bumbești headrace an average flow of 0.135 $m^3$ /s and 0.285 $m^3$ /s, respectively. The catchments are of the Tyrolean type, with concrete spillway dam and automatic flushing spillway dam and have installed flows of 0.6 $m^3$ /s and 1.0 $m^3$ /s, respectively.

### a). Capture Dumitra

The catchment sill is composed of a 8.85 m long ogee spillway and a 1.15 m long summer inlet block. The total length of the spillway is 10.0 m. It allows the maximum design flow (Q5% = 30 mc/sec) to be translated downstream with the height of the spillway blade on the sill of 1.47 m. The height of the spillway blade on the sill for the maximum verification flow (Q1% = 53 mc/sec) is 2.15 m.

The spillway sill elevation is 462.85 mdMN and resulted from the condition to ensure the hydraulic flushing height of the spillway dam (5.84 m).

The inlet block consists of:

a) The summer inlet, with dimensions of 1.25 m in the direction of water flow and 1.15 m transverse to the direction of water flow, equipped with a metal grate mounted at 462.35 mdMN. The installed flow of the catchment is$_Q$ i= 0,64 mc/s.

The overflow sill in front of the grate is protected with 8 mm thick lining.

b) The winter inlet, located on the invert of the wash opening (elevation 461.35 mdM), consists of a grate with a metal cover 60 cm x 50 cm.

The flushing and drying opening has an opening of 0.80 m and is provided at the upstream and downstream ends with a 0.60 m x 0.60 m wall valve. By maneuvering these gates, the alluvium deposited in front of the catchment face is washedaway.

Closing wings in slopes are laterally embedded approx. 1.5 min into the rock, and for foundation the rock embedment will be min. 1.0 m. The closure in the slopes is provided at elevation 465.15 mdM, corresponding to the spillway blade at the verification flow with a 0.15 m guard in order not to endanger the access road to the CHE Dumitra valve chamber. The closure wings are made of plain concrete 1.00 m thick and 8.35 m long for the left bank wing and 14.40 m long for the right bank wing.

The desilter

The dimensions of the desizing are:

- length: 21.60 m;
- width: 2.00 m;
- height: 2.85 - 3.83 m.

The 0.80 m long downstream control section, with overflowing crest at elevation 461.20 mdM, allows the flow of the captured flow, cleaned of suspended alluvium, to pass into the connection head with the headrace.

The segment valve control devices are fitted to the sand trap, which must be opened both when deposits are deposited on the sand trap invert and when the flow rate exceeds the installed flow rate.

At the downstream end of the denisipator is the flush valve for which a 0.80 x 0.60 m void was left in the downstream wall.

A thermal protection layer of 75 cm thick excavated material is laid over the floor of the sand trap, which closes into the road embankment.

At the base of the road embankment, a triangular cross-section storm water drainage channel (b=0.6, h=0.3 m) is provided. Both the surface of the fill and the swale are protected with a boulder wall.

Automation room

Hydromechanical installations are mounted in the valve chamber. In the downstream wall there is a 1.40 x 0.80 m void for the discharge of water from the washer-disinfector flushing.

**The work is now 60% complete.**

## 1.12. Capturing the Jiu

The Jiu secondary intake is located on the Jiu River about 350 m upstream of the Dumitra power plant and brings a flow of about 2.10 $m^3$ /s into the Dumitra - Bumbești intake. The installed flow of the catchment is 6.00 $m^3$ /s. The abstracted flow is transited to the stilling basin of the CHE Dumitra through an headrace.

The components of the Jiu secondary intake are:

- The catchment sill (with sub-assemblies: spillway field, enclosing walls, fish migration ladder);
- Catchment inlet (with sub-assemblies: side inlet, flushing pocket, valve chamber, drain, load chamber, plenum);
- Downstream regularization.

The catchment sill, which is intended to achieve the 456.20 mdM catchment level, consists of the following sub-assemblies: the C16/20 concrete C16/20 concrete spillway or high water discharge, with a hydraulically profiled cross section, continued with a 12.70 m long basin-type energy dissipater and a mobile rhizberm made of anrocemente.

The total length of the spillway face (including the fish migration ladder) is 42 m and ensures the discharge of the calculation flow $O_{5\%}$ = 600 mc/s with a spillway blade of approx. 2.78 m and the verification flow $Q_{1\%}$ = 983 mc/s with a spillway of approx. 4,40 m.
The maximum construction height of the overflow sill is 8.00 m.

The foundation of the threshold shall be made of simple concrete C12/15 up to elevation 450.70 mdM. From this elevation, the threshold will be made of C16/20 plain concrete.

The elevation of the closure wall crest (from the face of the catchment) is 461.00 mdM (1% assigned level).

The stilling basin is of the basin type, with invert elevation 451.20 mdM, l.30 m below the slope elevation, provided with a 1.2 m high end sill and a basin length of 12.7 m. The stilling basin is 1.00 m thick.

The first 70 cm are made of plain concrete C12/15. The dissipative basin is continued with a rhizberm made of 1.50 m thick rock rubble over a length of 15.50 m. The rock chips shall have a minimum diameter of 60 cm and a weight > 1000 kg/piece. The heatstilling basin shall have permanent longitudinal and transverse joints, which shall be non-tight.

**Work started.**

### 1.13. Small Murga Platform

The Murga Mica access tunnel has allowed the opening of two additional work fronts for the Livezeni - Dumitra pipeline. The gallery is located on the right slope of the Jiu River. A small technological platform was set up in the right of the Murga Mica access tunnel.

**Work is now 97% complete.**

### 1.14. Access road

Access from CHE Dumitra to the catchment will be via a road at elevation 459.00 mdM, located on the right bank of the Jiu River. The total length of the road is 333.00 m. The road is 5.00 m wide.

The road system consists of a 12 cm layer of crushed stone, 25 cm of ballast and local fill.

**Work started.**

**1.15. Intervention block**

Work has not started on the intervention block.

**This object will be fully realized.**

**1.16. Connection of CHE Dumitra to SEN via LES**

LES 110 kV will ensure the evacuation of power produced in CHE Dumitra to SEN.

The connection to the SEN of CHE Dumitra consists of two sections of cable:

- the first cable section consists of three single-phase power cables, laid in line, with a symmetrical load distribution on the three phases. The cable is of underwater type, with XLPE (cross-linked polyethylene) main insulation, laid in the headrace gallery, between CHE Dumitra and the line cell of Livezeni dam (encapsulated cell with SF6 insulation - GIS type), on a length of approx. 7,4 km;
- the second cable section will be a LES consisting of three single-phase buried power cables, laid in line, with a symmetrical load distribution on the three phases. This section will be about 900 meters long and will connect the 110 kV GIS cell installed on the downstream platform of the Livezeni Dam with the installation to be executed on the connection tariff, consisting of a 110 kV substation input-output in the 110 kV Vulcan - Livezeni LEA and the input and output circuits through which the connection between this substation and the Pylon 41 where the LEA is sectioned will be made. These circuits will be LES with 2 streams of buried cables on a route as shown in the attached drawing. Each cable run will consist of 3 single-phase 110 kV cables with XLPE insulation, approximately 250 meters in length.

**Only the first section has been completed.**

**2. Bumbești fall step**

**2.1. Dumitra-Bumbești headrace**

The headrace Dumitra - Bumbești, with a length of 12.5 km, ensures the transit of the flow from the CHE Dumitra and the flows from the basin difference on the Jiu River between Livezeni and CHE Dumitra, as well as the flows of the Dumitra and Bratcu streams.

The Dumitra - Bumbești tunnel consists of two distinct sections:

- the upstream free level section with a length of 1.50 km and a cross-section at the upstream end of 4.40 x 4.40 m and at the downstream end of 4.40 x 6.65 m, with a horizontal gallery vault; it provides a volume of water for compensation of approx. 6,750 $m^3$ ;
- the downstream section with a length of 11.0 km and a slope of 2.3%, a pressure tunnel having a circular cross-section with an internal diameter of 4.00 m.

**Work is now 95% complete.**

**2.2. Bumbești power structure**

Bumbești power structure is composed of:

- the surge chamber, reinforced concrete construction underground and above ground. It consists of: the chamber shaft with a height of 30.0 m and an inner diameter of 12.0 m; the upper chamber with a height of 15.4 m and an inner diameter of 17.0 m;
- the valve chamber, an above ground construction - located on a platform at 420.00 mdM, at the point where the headrace gallery comes out at the open, equipped with a butterfly valve of 3.0 m diameter, which closes automatically in emergency situations;
- metal penstock - located on the slope between the valve chamber and the power station distributor, with a length of 260 m and a variable internal diameter of 3.0 m at the top and 2.80 m at the connection to the distributor. The pipeline is anchored on three concrete anchors.

**Work is now 87% complete.**

### 2.3. CHE Bumbești

CHE Bumbești is the second power plant located upstream of Bumbești, located on the right bank of the Jiu river, upstream of the confluence with the Curpenului stream.

In the hydroelectric power station, three hydro-power hydro-aggregates are installed with all the auxiliary installations for the turbulation of a flow of 3 x 12 $m^3$ /s. If the power plant is not in operation, the downstream flow is channeled through the turbine (idling).

CHE Bumbești has the following energy characteristics:

- installed flow 36,0 $m^3$ /s;
- installed capacity 40.5 MW;
- average annual energy 167.0 GWh/year.

Flow is returned to the riverbed via a stilling basin and a short trailrace channel.

The Bumbești power plant platform provides access to the power plant and to the 110 kV substation. On the right side of the power station is located the intervention block, the cooling water tank, the septic tank and the laying of the drinking water supply pipe from the existing network in the area. On the upstream side of the platform, an access road to the properties of local residents is being laid.

**Work is now 77% complete.**

### 2.4. Bumbești trailrace channel

The Bumbești trailrace channel ensures the return to the Jiu of the water turbined in the Bumbești CHE. It is a free level channel with a trapezoidal cross section. The cross-section of the outlet channel has a low base of 2.80 m, a high base of 14.00 m, a total depth of 3.80 m, slope of the embankments of 1:2. At the downstream end, where the channel joins the River Jiu, there are planned connecting works to the riverbed to prevent erosion and degradation.

**Work is now 77% complete.**

### 2.5. Bumbești Intervention Block

The building is composed of 3 apartments of 3 rooms and 2 apartments of 2 rooms, arranged on the ground floor and two upper floors with access via a common staircase in the center of the building.

The structure of the building is made of reinforced concrete frames and beams with infill masonry and monolithic reinforced concrete slabs over the partial basement, ground floor and upper floors.

The basement is composed of a space for "Civil Protection Shelter" according to Law no. 106/1996, with an access SAS and a space where the central heating system for heating and domestic hot water will be installed.

The roof is a wooden roofing of decatized wood, with a resinous plank roofing and a double-laid tile covering.

The water drains through gutters and is channeled through galvanized sheet metal downpipes, draining freely to the surface of the natural terrain.

**Work 80% completed.**

### 2.6. Exterior technical block

The landscaping works concern the realization of:

- access to the road access, respectively to the access platform to the intervention block and implicitly to the power plant;
- parking areas;
- pedestrian access to the intervention block and, by extension, to the power plant.

**No work has started.**

### 2.7. Exterior CHE Bumbești

The landscaping works related to the hydroelectric power plant concern:

- realization of the external concrete platform providing access to the plant;
- realization of the macadam platform;
- storm water drainage channels;
- realization of the guard sidewalk around the building.

The perimeter of the power plant building will have a sidewalk of 1.0 x 1.0 m concrete slabs, bordered by prefabricated curbs. The slabs will be poured over a sand and gravel drainage layer of about 10 cm.

**No work has started.**

### 2.8. 110 kV TRAFO station

**No work has started.**

### 2.9. Connection to SEN of CHE Bumbești through LEA

The evacuation of power from CHE Bumbești will be realized by means of a 110 kV line connected in the 110 kV Tg. Jiu Nord - Parângu circuit 2, existing, at pole 35 bis.

**No work has started.**

**A. Work carried out/components realized**

In order to establish the physical stage of realization for each object of the investment objective "Hydropower development of the Jiu river on the Livezeni-Bumbesti sector", the works executed and the works still to be executed necessary for the completion of each functional object will be presented.

***A.1. The Dumitra step***

**Livezeni dam and power intake**

It is located at the entrance to the gorge, at km 124+300 of DN 66, at approx. 1,10 km downstream of the confluence of the East and West Jiu

It is a gravity spillway dam equipped with 3 identical, electromechanically operated segmented flap gates.

**The** following **work has been carried out** on this landscaping object:

- Left bank slope support with drilled columns;
- coarse and finishing excavations in the area of the dam's ampriza;
- elevation of DN 66 A in the dam area;
- Dam infrastructure and superstructure;
- fixed and mobile rhizberm;
- segment gate;
- wash-out gate;
- sheave drive mechanisms;
- bridge over the dam;
- portal crane;
- electrical and mechanical equipment for dam and MHC.

Fig. 9 Physical status of the Livezeni Dam

Livezeni power intake

It is located on the right bank, adjacent to the dam and is equipped with a large, fixed grill with 3 openings-3x(6x3.50sqm), grill cleaning machine and 2x(2.1x3.50sqm) cofferdam vane.

**MHC Livezeni**

The micro-hydropower plant is located on the technological platform adjacent to the dam and the water intake and will operate continuously, using the easement flow to be ensured in the bed of the river Ji downstream of the intake - 2.7 mc/s and has the following technical characteristics: Pi = 0.14 MW; Em = 1 GWh/year; Hbrut = 12 m.

**Accomplished works:**

- MHC infrastructure;
- MHC superstructure;
- MHC turbine and generator;
- MHC electrical equipment;
- rolling bridge.

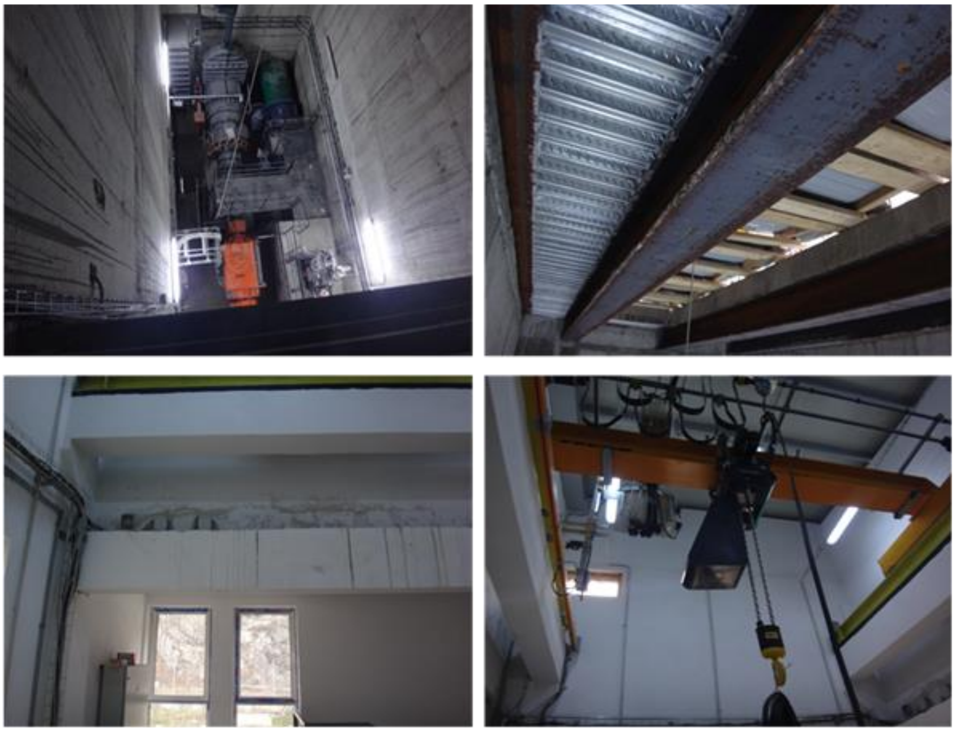


Fig. 10 Physical status MHC Livezeni

**Livezeni-Dumitra headrace**

The pipeline has a length of about 7.0 km and a circular cross-section with an inner diameter of 3.80 m; the gallery was fully excavated and concreted along its entire length. The tunnel was constructed in several excavation faces. In order to develop the fronts, the adits, Livezeni, Murga Mica and the access tunnel of the Dumitra chamber were executed. The concreting was executed in circular section with D=3,80m.

The gallery was fully excavated and concreted along its entire length and **the following works were carried out**:

- bulk and finishing excavations;
- concreting;
- Filling and strengthening injections

Underground sewage treatment and access tunnel Livezeni

- bulk and finishing excavations;
- concreting;
- Filling and strengthening injections;
- gallery and alluvium outlet channel;
- wash valve;
- electrical equipment

Small Murga access tunnel

-excavations;

-portal;

-outdoor platform refurbishment;

-metal lining and watertight gate;

Access tunnel Dumitra

-excavations;

-portal;

-metal lining and watertight gate.

Fig. 11 Concrete intake Murga downstream

Fig. 12 Pictures inside the concrete settling tank

**Dumitra power structure** comprises: The Surge chamber, the Valve chamber and the Penstock and its role is to concentrate the water volume drop at the three turbines with which the CHE Dumitra is equipped, the Surge chamber taking the pressure variations due to the non-permanent movement caused by the closing and opening of the steering unit at the power plant;

Fig. 13 The penstock from the power structure of CHE Dumitra

**The works realized** for this object are:

- Penstock
  - bulk excavations and finishing of the pipeline channel;
  - massive concreting of M1 and M2 anchorage;
  - mounting of ferrules, tensioning saddles and penstock compensator.
  - Gate chamber
  - bulk and finishing excavations;
  - concreting infrastructure;

- superstructure realization;
- butterfly valve mounting;
- assembling electromechanical equipment;
- access road to gate chamber.

- Dumitra Surge chamber
  - Coarse excavations and finishing the upper chamber;
  - concreting the upper chamber;
  - injections.

**CHE Dumitra**

The plant is located on the right bank of the Jiu river and has the following technical characteristics: Pi=24,5 MW; Em=91 GWh/year; Hbrut=97m; Qi=36 mc/s. The power plant is equipped with 3 groups of Francis hydraulic turbines, FVM 10,1-93, with vertical axis.

Fig. 14 CHE Dumitra - exterior

**<u>The realized works are:</u>**

- bulk and finishing excavations;
- distributor fitting;
- concreting infrastructure;
- superstructure concreting;
- mounting overhead crane;
- installation of hydromechanical equipment on the 3 groups;
- fitting electrical generators and electrical equipment;
- realization of transformer station;
- interior and exterior finishing;
- central access road.

Fig. 15 CHE Dumitra - interior

No work has been carried out on the **Dumitra intervention block**. They want to promote the abandonment of this construction.

### ***A.2. Bumbești fall step***

**Dumitra- Bumbești headrace**

The pipeline ensures the transit of the installed flow of 36 mc/s between the CHE Dumitra and the Bumbești power structure, with a length of 12.5 km. The Dumitra-Bumbești pipeline is an underground tunnel with a circular cross-section with a radius of 2.3 m and a height H=4.6 m. The following adits were executed to develop the fronts: Dumitra Aval, Valea Rea, Bratcu, Chamber Bumbești.

The headrace gallery has two distinct sections:

- the upstream section with free level (the pond) has a length of 1.500,00 m, the cross section at the upstream end is 4,40 x 4,40m and at the downstream end etc. of 4,40 x 6,65m, with a horizontal gallery vault;
- the 11.0 km downstream section is a pressure tunnel and has a circular cross-section with an inner diameter of 4.00m.

Fig. 16 Concrete intake Murga downstream

Fig. 17 Pictures inside the concrete settling tank

**Bumbești Power structure** The power structure, as a whole, has the role of concentrating the water volume drop at the three turbines with which CHE Bumbești is equipped, the surge chamber taking the pressure variations due to the non-permanent movement caused by the closing and opening of the steering device at the plant;

**<u>Works executed</u>** at Bumbești power structure:
Surge chamber Bumbești
- bulk excavations and finishing the upper chamber;
- concreting the upper room;
- injections.

Gate chamber
- bulk and finishing excavations;
- concreting infrastructure;
- access road to the gatehouse and the chamber.

Penstock
- bulk excavations and finishing of the pipeline channel;
- Massive M2 and M3 anchorage concreting;
- fitting of ferrules, tensioning saddles and penstock compensators.

Fig. 18 Penstock from CHE Bumbești

Fig. 19 CHE Bumbești power structure

**Bumbesti trailrace channel**

At the downstream end, where the channel joins the River Jiu, works are planned to connect the channel to the riverbed to prevent erosion and degradation.

**Executed works:**

- Excavation of the Bumbesti escape channel;
- Concreting of the Bumbești trailrace channel.


Fig. 20 Flume at the connection to the stilling basin and long view

**By-catches**

The Dumitra and Bratcu catchments, located on the streams of the same name, introduce into the Dumitra-Bumbești headrace an average flow of 1.6 mc/s. The catchments are of the Tyrolean type, with overflow sill and denisipator with automatic flushing.

**Executed works:**

Dumitra catchment

- bulk and finishing excavations;
- concreting of infrastructure and superstructure spillway sill;
- concreting denisipator.

Capture Bratcu:

- bulk and finishing excavations;
- concreting of infrastructure and superstructure spillway sill;
- concreting denisipator;
- well excavations;
- well concreting;
- injections to fill and strengthen the well.

Fig. 21 Images from Dumitra secondary intake

Fig. 22 Images from Bratcu catchment

The Jiu catchment is located on the Jiu river at approx. 400 m upstream of the Dumitra power plant and the **following works** were **carried out**:

- access road access catchment;
- bulk and finishing excavations;
- concreting left bank catchment infrastructure, stage I

-

Fig. 23 Images from Captare Jiu

**CHE Bumbești**

The power plant is located on the right bank of the river Jiu and has the following technical characteristics: Pi=40,5 MW; Em=167 GWh/year; Hbrut=155m; Qi=36 mc/s. The power plant is equipped with 3 groups of Francis hydraulic turbines, FVM 16,3-150, with vertical axis.

**The realized works** are:

- bulk and finishing excavations;
- distributor fitting;
- concreting infrastructure;
- superstructure concreting;
- mounting overhead crane;
- mounting hydromechanical equipment on 2 groups;
- Excavation and concreting of the trailrace channel;
- central access road.

Fig. 24 CHE Bumbești – exterior

Fig. 25 CHE Bumbești - interior

**Intervention Block Bumbești**

The building has a basement, ground floor and two storeys, made of load-bearing masonry reinforced with posts and monolithic concrete slabs over the ground floor and the two storeys. The foundations are continuous plain concrete.

**<u>Executed works:</u>**

- earthworks;
- the resistance structure;

- masonry;
- completion of the tile roofing;
- carpentry

***Connections to the National Energy System***

Connecting CHE Dumitra

**Works that have been executed:**

- Realization of a cable section consisting of three single-phase power cables, laid in line, the cable is laid in the headrace gallery, between CHE Dumitra and the line cell on the Livezeni dam (encapsulated cell with SF6 insulation - GIS), on a length of approx. 7,4 km;
- Realization of 110kV station (GIS 110 kV cells) mounted on the downstream platform of Livezeni Dam.

Connection CHE Bumbești

**Works that have been executed:**

- Realization of connection tariff station.

Connection MHC Livezeni

**Work remaining to be executed:**

- Execution of works on the connection tariff, according to the connection contract;
- Execution of works at user's expense, according to ATR.

**B. Work remaining to be carried out**

*Table no. 16 The completion of the investment objective "AHE of the Jiu river on the Livezeni - Bumbești sector" implies the following remaining works to be executed:*

| | |
|---|---|
| 1. Livezeni dam and power intake | |
| | 1.1. Development of Livezeni dam technological platform |
| | 1.2. Development of the Livezeni reservoir basin |
| | 1.3. Closure of the diversion channel of the Livezeni dam with fish passage |
| | 1.4. Regularization of the riverbed downstream Livezeni dam |
| | 1.5. MHC Livezeni finishes |
| 2. CHE Dumitra | |
| | 2.1. CHE Dumitra landscaping, platforms, fences and gullies and decommissioning Site organization Dumitra |
| | 2.2. Bridge over the stilling pond CHE Dumitra |
| 3. CHE Dumitra Intervention Block | |
| 4. Dumitra catchment | |
| 5. Access roads CHE Dumitra | |
| | 5.1. Access road to the outer platform CHE Dumitra |
| | 5.2. Access road over the Dumitra catchment |

| | |
|---|---|
| 6. Bumbești power structure | |
| | 6.1. Concreting of the superstructure of the Bumbești gate chamber |
| | 6.2. Massive concreting M1 penstock Bumbești |
| 7. CHE Bumbești | |
| | 7.1. CHE Bumbești |
| | 7.2. Outdoor arrangements technical block CHE Bumbești |
| | 7.3. CHE Bumbești landscaping, fencing and swales |
| | 7.4. Concreting of the connection between the stilling basin and the Bumbești tailrace channel |
| | 7.5. 110 kV CHE Bumbești Transformer Station |
| 8. Access road to CHE Bumbești | |
| 9. Access road over the M3 CHE Bumbești massif | |
| 10. Bratcu catchment | |
| 11. Jiu secondary intake | |
| | 11.1. Concreting infrastructure and superstructure of Jiu secondary intake, including fish ladder |
| | 11.2. Jiu secondary intake headrace pipeline and junction box |
| 12. Access road to Jiu secondary intake | |
| 13. Site organization | |
| | 13.1. Decommissioning of temporary bridge upstream Livezeni dam |
| | 13.2. Decommissioning of the technological platform upstream Livezeni dam and final connection of the wastewater pipeline |
| | 13.3. Construction of the technological platform and access road to the Livezeni access tunnel and concreting of the closing plug |
| | 13.4. Development of technological platform at the Murga Mica access tunnel |
| | 13.5. Decommissioning of the site organization at the Bratcu Access tunnel |
| 14. Connecting SEN | |
| | 14.1. Connection of MHC Livezeni to SEN |
| | 14.2. Connecting CHE Dumitra to SEN |
| | 14.3. CHE Bumbești connection to SEN |
| 15. The Dumitra - Bumbești pipeline | |

The remaining works to be executed as a result of the project implementation are described below.

**1. Livezeni dam and power intake**

**1.1. Development of technological platform Livezeni dam**

Technological platform - located outside, adjacent to the national road DN66 (**Figure no. 27**). It is located at the elevation of 554.00 mdMN, on it there are provided 110kV electric cable pulling cables and cable ducts.

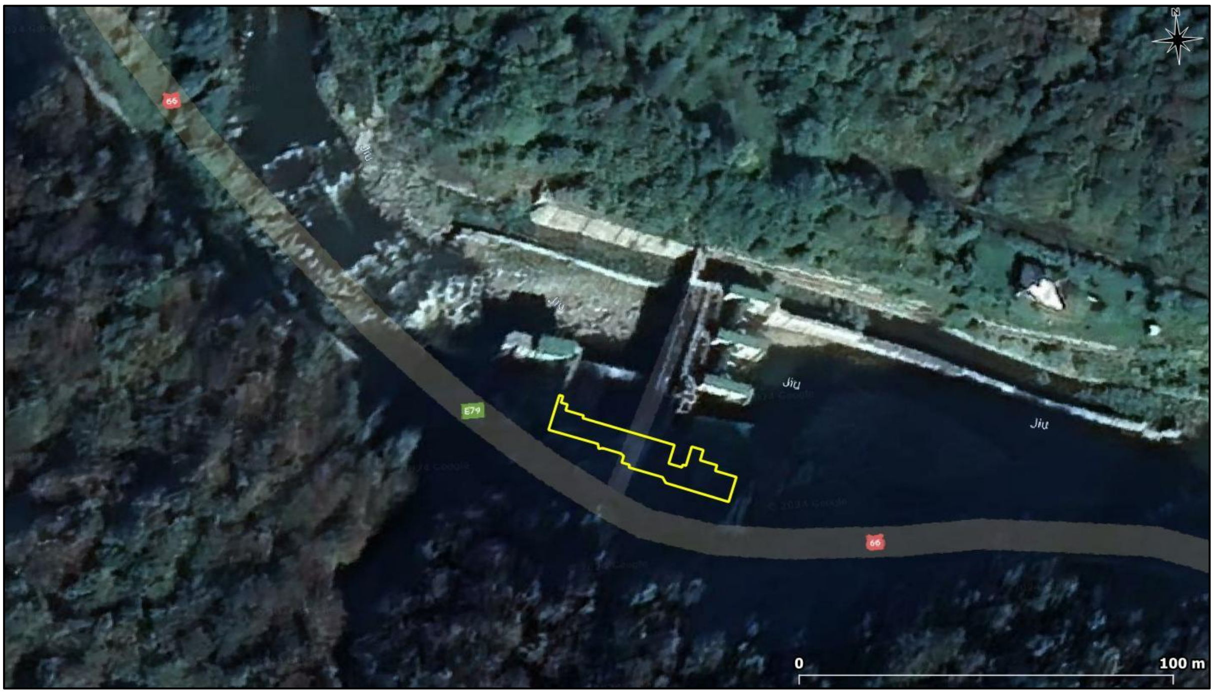



Fig. 26 Location of the site targeted by the development of the Livezeni technological platform

The improvement of the outer platform of the Livezeni dam consists in laying a 30 cm thick layer of ballast, over which a 20 cm thick layer of C25/30 concrete reinforced with Buzău 08 100 x 100 mm Buzău 08 100 x 100 mm mesh will be poured. The surface area of the concreted platform is 330 square meters and the canopy will be completed.

The installation of measuring and control devices (AMC), which aim to monitor the evolution of the main behavior parameters (parameters that give actions on the construction and parameters of response of the construction to external actions), to detect at an early stage of negative phenomena that by their evolution over time could affect the safety of the dam.

Fencing of the platform will be finalized, on a length of 22 m, with:

- metal posts made of rectangular pipe, 50 x 50 x 4 mm in cross-section and 2 m high, embedded in a concrete foundation, 40 x 40 cm in plan and 90 cm deep.
- 2.00 x 2.00 m galvanized metal edged mesh panels.

- Finishing the mechanism rooms and canopy;

**1.2. Development of the Livezeni reservoir basin**

The Livezeni reservoir (**Figure no. 28**) is about 1,000 m upstream of the dam. The right bank is bounded by the national road DN 66 Târgu Jiu - Petroșani, and the left bank by the railroad Bumbești - Livezeni.

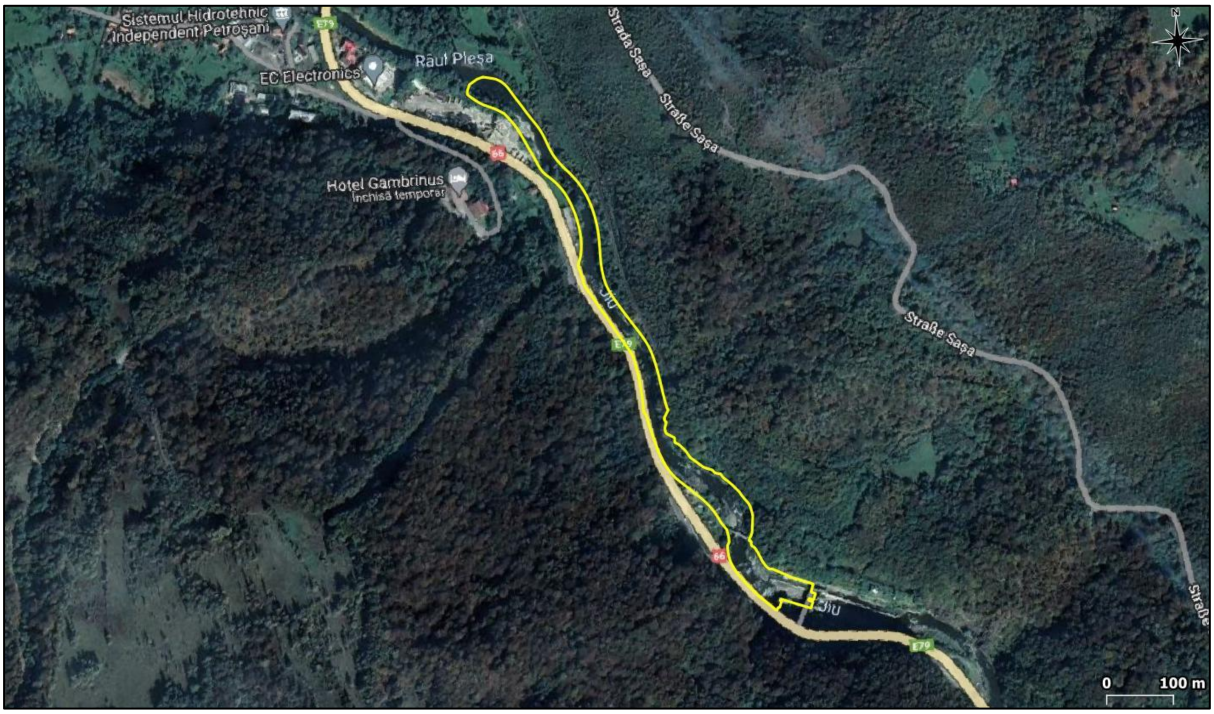



Fig. 27 Localization of the area of the Livezeni reservoir basin

The main features of accumulation are:

- normal retention level 552,00 mdM;
- minimum operating level 549,00 mdM;
- spillway threshold level 542,00 mdM;
- total volume at NNR 132.000 $m^3$ ;
- active storage volume 81.000 $m^3$ ;
- lake area at NNR 4,27 ha.

The work is now 99% complete.

In order to arrange the basin of the reservoir, it is necessary to remove the vegetation on the banks of the Jiu river which delimits the reservoir Livezeni.

**1.3. Closure of the diversion channel of the Livezeni dam with fish passage**

The fish passage through the Livezeni dam will be built through the diversion channel of the Jiu river used for the execution of the works (**Figure 29**). The diversion channel is 10.00 m wide and 75.00 m long.

The fish ladder will be of the vertical slot type. In order to connect the upstream and downstream levels, with the provision of a velocity specific to the ichthyofauna in the area, a fish ladder length of approximately 200 m has resulted. Downstream of the movable rhizberm, a fish-attraction pool will be installed to attract fish to the ladder.


Fig. 28 Location of the site targeted by the closure of the diversion canal of the Livezeni dam with the assurance of the passage of the fish species inhabiting this sector of the river Jiu

**1.4. Regularization of the riverbed downstream Livezeni dam**

Downstream of the mobile rhizberm, up to the outlet of the access and outlet gallery from the underground settling tank, for a length of approximately 228.00 m (**Figure no. 30**), the Jiu riverbed will be channelized, corresponding to the IVth class of importance, according to STAS 4273/83.

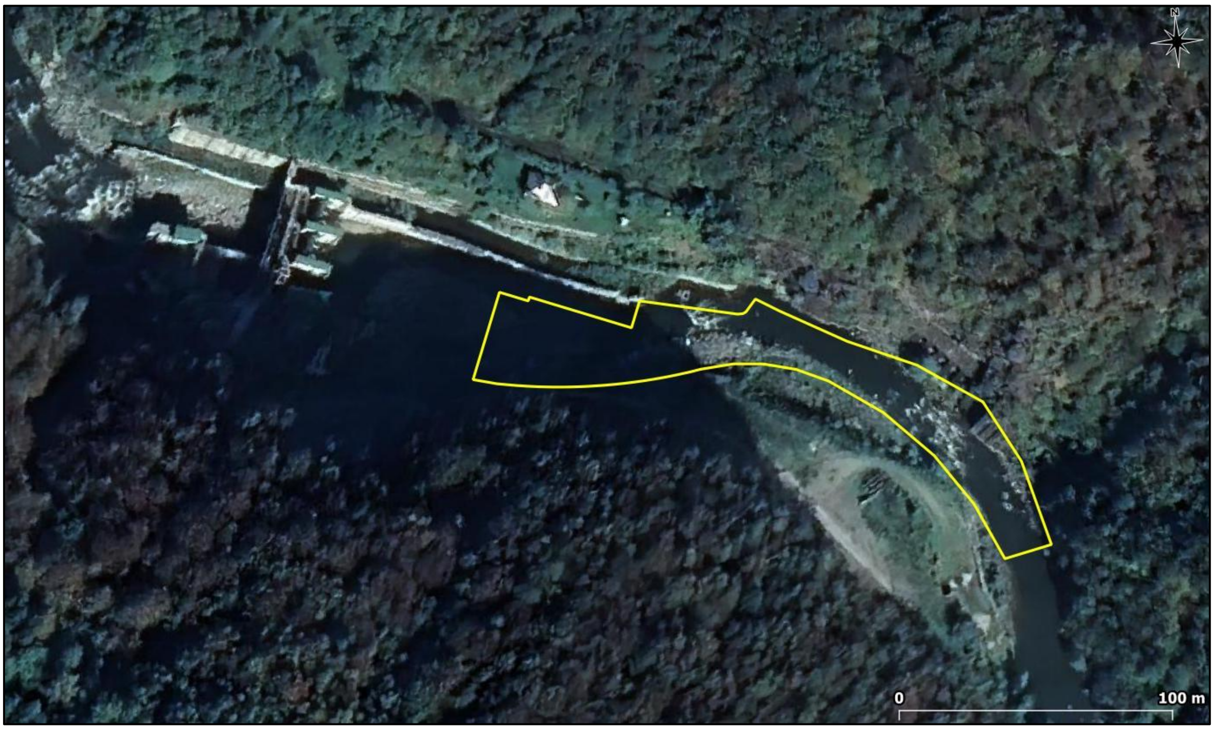



Fig. 29 Location of the section of the Jiu riverbed targeted by regularization works downstream of Livezeni dam

The proposed works to calibrate the riverbed are:

- Excavation works: to rectify and calibrate the river bed;
- bank protections made of gabion boxes;
- clearing dry vegetation in the river bed to reduce the roughness of the river bed.

**1.5. MHC Livezeni finishes**

The Livezeni MHC is a completed underground/aboveground concrete construction that is located on the technological platform adjacent to the Livezeni dam and the related water intake. In this building is located the micro-hydroaggregate which will operate under the conditions of ensuring at all times the easement flow of 2,7 $m^3$ /s to be ensured in the bed of the Jiu river downstream of the Livezeni dam. A bypass is provided on the hydraulic circuit for periods when the dam is not in operation. The micro-hydropower plant has an installed capacity of 0.14 MW and an average annual energy of 1.00 GWh/year.

Work now 99% complete.

For this objective, the works necessary to complete the investment will be carried out. In their category are interior and exterior finishes.

Interior compartments

The partition walls on the first floor, depending on the use of the rooms, will be made of plasterboard, with thicknesses of 12.5 cm and 7.5 cm.

The walls with a thickness of 7,5 cm are intended for subdivision of the sanitary unit, with a metal structure of 5 cm wide profiles, mineral wool insulating core and simple cladding on both sides with moisture-resistant plasterboard. The sanitary fittings are mounted on walls with a thickness of at least 12,5 cm, which have metal elements in their structure that allow them to be fixed.

The 12.5 cm thick walls are intended for partitioning the rest of the rooms, with a metal structure made of 7.5 cm wide profiles, mineral wool insulating core and double-sided plasterboard cladding.

Interior joinery

The interior joinery, i.e. the doors, shall be made of electrostatically painted aluminum interior profiles. The movable part of the doors, i.e. the header, shall be solid, made of aluminum composite panel with heat insulating core, factory electrostatically painted electrostatically, in the same color as the rest of the joinery.

Interior finishes

Over the plaster of the masonry walls or the concrete elements of the structure, two coats of washable varnish and paint shall be applied. Plasterboard walls shall be plastered except in areas to be tiled. Two coats of washable paint shall be applied over the plaster. The walls of the sanitary unit, up to a height of 2,10 m, shall be tiled with ceramic faience.

In the MHC hall, the TRAFO cubicle and the rooms upstairs, the ceilings, including exposed beams, will be plastered over the entire surface with finely stripped cement mortar-based plaster, over which the gleam and washable paint will be applied in two coats.

The panel hall will be fitted with a 60 x 60 cm false ceiling with mineral fiber cassettes, with its own support and suspension system.

The ceiling of the mechanism room will be insulated with 5 cm thick fire-retardant expanded polystyrene. The insulation is to be covered with spackling, fiberglass reinforcing mesh and then primed and painted with two coats of washable paint.

The floor of the machine room, the intermediate platform at 551.26 mdMN, as well as the steps of the access staircase to the microhydroaggregate room will be made of a layer of polished concrete.

In the MHC hall, as well as the first two flights of stairs leading to the intermediate level, the floor will be made of non-slip porcelain tiles for heavy traffic, resistant to staining and mechanical shock. It must be installed with elastic adhesive mortar and flexible, water-repellent grout.

The flooring of the panel hall will be of the raised access floor type, made of 600 x 600mm slabs, class CO combustibility, inert calcium sulphate core and antistatic, wear-resistant, grey PVC finish, mounted on galvanized steel support structure, i.e. adjustable pedestals and cross beams with antistatic gaskets. Connection to the wall will be provided by means of a flexible PVC plinth. In the upstairs rooms (except the living room and the bedroom niche), the floor will be made of non-slip porcelain tiles for interior use, including skirting, which must be installed with elastic adhesive mortar and flexible, water-repellent grout. The flooring of the living room and the bedroom niche will be made of medium traffic laminate flooring, laid over a layer of sound-insulating foil. All around, along the walls, skirting will be fitted to transition from floor finish to wall finish.

Exterior finishes

On top of the layers of fire-retardant extruded polystyrene insulation, the already laid screed and fiberglass reinforcing mesh, the primer coat is applied and finally the decorative stone mosaic plaster.

On the exterior walls, over the already executed layers of fire-retardant expanded polystyrene thermal insulation, the already executed spackling mass and fiberglass reinforcing mesh, the primer and the structured (decorative) acrylic resin-based (decorative) plaster will be applied.

On exterior facade walls finished with 6 cm thick sandwich panels, which have not been installed, their fixing will be continued. First, the metal structure supporting the panels will be executed followed by their installation. Once they have been finished, all the panel closures and connections with the facade walls and joinery openings shall be made. These closures shall be made of cement-bonded plasterboard fixed to a metal supporting structure to which the prefabricated sheet metal subassemblies specific to the panel manufacturer shall be applied.

Exterior staircase: after the concrete structure of the staircase has been built, it will be finished as follows:

a) a structured plaster based on acrylic resins shall be applied on the posts, beams, the sides of the ramps and their soffits, over a coat of primer;

b) the finishing layer of the footbridges, as well as of the steps, will be made of cement based mosaic with marble granules, finished by sanding on site, on the construction site.

The staircase handrail will be made of metal profiles, primed and painted on site with alkyd enamel after installation.

Roof

The roof works are divided into two categories: terrace roofing and sandwich-panel roofing.

Terrace type roof: a circulating thermo-hydroinsulating terrace, applied over the floor covering the trafo box, with the following horizontal layers:

a) waterproofing protection layer of 30 x 30 x 3 cm mosaic slabs for circulation, laid on a 3 cm thick layer of sand, with the joints filled with cement slurry and the contraction joints (20 mm in both directions at 5.00 m) filled with bitumen-horizontal mastic;

(b) waterproofing layer of two membranes based on distilled bitumen modified with plastomeric polymers (APP) or elastomers (SBS), with a composite reinforcement, consisting of polyester (P) or glass fiber (V) reinforced with twisted glass fibers, arranged longitudinally, 4 kg/mp, applied with flame technology;

c) 2-layer bituminous primer;

d) 3 cm thick cement screed reinforced with Ø 6;

e) a separating and protective layer of polyethylene foil thermal insulation;

f) high-density expanded polystyrene insulation, 10 cm thick;

g) vapor barrier CA 400, bonded with bitumen type H80/90;

h) vapor diffusion layer CPB 360 perforated bituminous bitumen board, plus the addition of H80/90 bitumen mastic mastic due to perforations;

i) 2-layer bituminous primer;

j) 2 cm thick mortar layer grinding surface;

k). concrete slope;

l) reinforced concrete floor.

In addition, a 50 cm wide reinforcement layer of waterproofing membrane will be applied at intersections.

Vertical:

a) 2 cm thick M 100-T mortar leveling layer, 2 cm thick over the entire height of the attic;

b) bituminous primer - 2 layers;

c) raising the vapor diffusion layers and vapor barrier (idem horizontal);

d) thermal insulation made of high-density expanded polystyrene 10 cm thick;

e) waterproofing layer - same as horizontal.

The non-circulating thermal-hydroinsulating non-circulating terrace, applied over the interior staircase floor providing access to the lower levels of the infrastructure, has the following horizontal layers:

a) the first layer of waterproofing membrane based on distilled bitumen modified with plastomeric polymers (APP) or elastomers (SBS), having a composite reinforcement, consisting of polyester (P) or glass fiber (V) reinforced with twisted glass fibers, arranged longitudinally, 4 kg/mp and an outer protective layer of slate granules;

b) the second layer of waterproofing membrane based on distilled bitumen modified with plastomeric polymers (APP) or elastomers (SBS), having a composite reinforcement, consisting of polyester (P) or glass fiber (V) batt, reinforced with twisted glass fibers, arranged longitudinally, 4 kg/mp, applied with a flame technology;

c) 2-layer bituminous primer;

d) 3 cm thick cement screed reinforced with Ø 6;

e) a separating and protective layer of polyethylene foil thermal insulation;

f) high-density expanded polystyrene insulation, 10 cm thick;

g) vapor barrier CA 400, bonded with bitumen type H80/90;

h) vapor diffusion layer CPB 360 perforated bituminous bitumen board, plus the addition of H80/90 bitumen mastic mastic due to perforations;

i) 2-layer bituminous primer;

j) 2 cm thick mortar layer grinding surface;

k) sloping concrete;

l) reinforced concrete floor.

In addition, a 50 cm wide reinforcement layer of waterproofing membrane will be applied at intersections.

The polystyrene used to realize the thermal insulating layer of all types of terraces is high-density fire-retardant expanded polystyrene, 10 cm thick, with the following thermo-technical characteristics: thermal conductivity $\lambda$ = 0,044 W/mK and thermal assimilation coefficient s = 0,30 W/mpK. The water-insulating non-circular insulating terrace, applied over the external staircase floor, has the following horizontal layers:

a) the first layer of waterproofing membrane based on distilled bitumen modified with plastomeric polymers (APP) or elastomers (SBS), having a composite reinforcement, consisting of polyester (P) or glass fiber (V) reinforced with twisted glass fibers, arranged longitudinally, 4 kg/mp and an outer protective layer of slate granules;

b) the second layer of waterproofing membrane based on distilled bitumen modified with plastomeric polymers (APP) or elastomers (SBS), having a composite reinforcement, consisting of polyester (P) or glass fiber (V) batt, reinforced with twisted glass fibers, longitudinally arranged, 4 kg/mp, applied with a flame technology;

c) 2-layer bituminous primer;

d) concrete slope;

e) reinforced concrete floor.

In addition, a 50 cm wide reinforcement layer of waterproofing membrane will be applied at intersections.

Vertical:

a) 2 cm thick M 100-T mortar leveling layer, 2 cm thick over the entire height of the attic;

b) bituminous primer - 2 layers;

c) waterproofing layer - same as horizontal.

<u>Runoff from precipitation</u>

For terrace roofs, the water is drained through a gargoyle downspout and from here, through a pouring trough, the water is directed to a downspout which ensures its discharge.

For pitched roofs the drainage is realized by a system of gutters and downpipes that ensure its drainage. The downspout shall be mounted directly on the plane of the sandwich panel of the facade, following the slope of the facade.

<u>Outdoor arrangements</u>

These works include the execution of fall protection elements, i.e. exterior metal handrails primed and painted on site with alkyd enamel.

Once the construction works are completed, interior, exterior and PSI installations will be installed.

## <u>2. CHE Dumitra</u>

CHE Dumitra (**Figure no. 31**) is an underground/surface construction called hydroelectric power plant, located on the right bank of the Jiu river, at the confluence with the Dumitra stream.

The power plant is equipped with three Francis vertical-shaft hydraulic turbines, FVM 10.3 - 95, for the turbulation of a flow of 3 x 12 $m^3$ /s and three hydro-generators with all the auxiliary installations necessary for optimal operation. If the power plant is not in operation, the downstream flow will be channeled through the turbine (idling).

The construction is a monolithic reinforced concrete tub (floor and walls), with external dimensions of $L_{max}$ = 30,70 m, $B_{max}$ = 15,50 m, $H_{max}$ = 12,90 m.

The following types of works will be carried out on this objective:

- Flooring - interior works in the CHE building, as follows: finishing of floors at the vacuum level, turbine level, machine room, assembly platform, crane level circulation;

will be executed in polyurethane hard-elastic system;

- Finishing - outdoor arrangements on the CHE building, as follows: decorative plaster for the plinth, ventilated facade system with HPL plywood, vertical and sloping thermal insulation panels with a thickness of 10 cm, made of a mineral wool insulating core;
- Metalwork - interior works, protective metal balustrades on staircases and around installation gaps;
- Exterior landscaping, platforms, fencing and railings - Exterior landings and steps at pedestrian access and machine access will be finished with a pumpable mortar system with metal aggregate. The perimeter gutters will be waterproofed with a layer of waterproof mortar based on special cements and waterproof resins;
- Bridge over the stilling basin - asphalting and balustrades.

**2.1. CHE Dumitra landscaping, platforms, fences and gullies and decommissioning Site organization Dumitra**

The Dumitra power plant platform (**Figure no. 31**) is arranged in such a way as to allow access to the power plant and to the 110 kV substation, located upstream of the power plant on the right bank of the Jiu River.


Fig. 30 Territorial framing of the CHE Dumitra building (purple polygon), the Dumitra power plant platform (yellow polygon) and the bridge over the stilling basin (blue polygon)

The platform is to be concreted on the entire surface, fenced with a fence made of edged mesh panels and metal posts in individual concrete foundations.

The power plant platform is equipped with a concrete rainwater tailrace channel and rainwater is collected in a stormwater collector. The Site Organization related to the CHE Dumitra will be dismantled.

### 2.2. Bridge over the stilling pond CHE Dumitra

The surface of the bridge over the stilling basin will be concrete, with the same structure as the rest of the plant platform. The bridge will be fitted with handrailing on the side with the power station building. On the side facing the river the railing is already installed.

## 3. Dumitra Intervention Block

Work has not started on the intervention block. This object will be fully realized.


Fig. 31 The territorial setting of the CHE Dumitra building (purple polygon) and the site of the Dumitra intervention block (yellow polygon)

The building has the function of dwellings composed of: basement, ground floor, first floor, being category of importance "C" - building of normal importance and class of importance III, having a rectangular shape in plan with sides of 20.5 m x 11.00 m.

The structure of the building is made of load-bearing masonry with columns and monolithic reinforced concrete slabs over the basement, ground floor and first floor.

In the basement was created a space for local defense with a structure of walls of 40 cm thick reinforced concrete walls and slab over the basement with 20 cm thick. The building is composed of 2 apartments of 3 rooms and 2 apartments of 2 rooms, arranged on the ground floor and first floor, with access via a common staircase in the center of the building.

The roof is a timber frame roof with a wooden eaves made of resinous planks and a double-laid tile covering.

The water drains through gutters and is channeled through galvanized sheet metal downpipes, draining freely to the surface of the natural terrain.

The basement has a built area of 63.6 square meters composed of: civil protection shelter (11 square meters), common use space (24 square meters).

The ground floor has a built area of 212.8 sq.m and consists of two apartments: 3-room apartment composed of: - living room 18.30 sq.m/bedroom 15.90 sq.m/bedroom 11.7 sq.m / Living area = 45.90 sq.m /hol 12.30 sq.m / kitchen 8.17 sq.m / bathroom 3.85 sq.m / useful area = 70.22 sq.m and 2-room apartment composed of:- living room - 23,00 sq.m./ bedroom 15,00 sq.m./ living area = 38,00 sq.m./ living room - 11,75 sq.m./ kitchen 7,17 sq.m./ bathroom 3,86 sq.m./ useful area = 60,78 sq.m./ living room - 11,75 sq.m./ kitchen 7,17 sq.m./ bathroom 3,86 sq./ useful area = 60,78 sq.m.

The first floor is the same as the ground floor, the surfaces and the use of the rooms are the same as on the ground floor.

All masonry and ceilings will be plastered with lime-cement mortar, plastered and plastered with plaster in rooms that will be finished with washable paints.

The walls of the bathrooms will be tiled with tiles with grooved joints (simple installation) up to h = 2.10 m as well as the kitchen work front with h = 1.50 m. The rest of the walls and ceiling will be finished with washable paint. The floors in the living room and bedrooms will be warm parquet flooring mounted on the blind floor glued to the concrete slab.

The exterior walls, after being thermally insulated by fixing the mineral wool thermal insulation and protecting it with iron concrete netting and rape netting, will be plastered with a discussed plaster to be finished by painting with paint.

The construction plinth will be finished with a stone dust plaster which will be finished by plastering.

Taking stock of areas:

- Basement area: 63,60 sq.m;
- Ground floor: 212, 80 square meters;
- Floor area: 212, 80 square meters;
- Built area: 212,8 square meters;
- Developed area: 489,20 square meters.

Given that there is no public water supply network in the area, the water will be supplied from its own source, which serves both the intervention block and the hydroelectric power plant.

The water coming from the emptying of the heating installation and from the hot and cold water installations will be directed to a collector, from where, with a discharge pump, with a maximum flow rate of 1001/min, Hmax=6,5 mCA, through a discharge pipe, made of polypropylene pipe for sewage, it is led to the outside.

The indoor sewage system will be connected to the outdoor network through a manhole located at approx. 5 m from the building.

The external sewage network will be made of simple concrete pipes, with a socket and socket, Dn200 mm, installed buried below the frost depth on a sand bed.

The sewer network will be connected to a compact sewage treatment plant. These plants will be drainable at certain intervals with authorized economic operators.

## 4. Dumitra catchment

The Dumitra catchment, located on the creek of the same name, introduces into the Dumitra - Bumbești headrace an average flow of 0.135 $m^3$ /s. The catchment is of the Tyrolean type, with a concrete spillway dam sill and automatic flushing spillway dam and has an installed flow of 0.6 $m^3$ /s.

Dumitra catchment (**Figure no. 33**) is about 80% completed.

This component of the project requires the completion of the concrete pouring of the spillway dam guardrail (towards the river) and the headrace loading house.

Following the desilter is the automation (sluice) chamber, measuring 2.60 x 3.90 m, which has not been executed. The connection of the sewer to this valve is also not executed.

The catchment spillway field requires the construction of a concrete plug to close the water diversion and the dismantling of the remaining PREMO pipes in the bed.


Fig. 32 Land boundary of the CHE Dumitra building (purple polygon), the Dumitra catchment and the access road over the Dumitra catchment (yellow polygon)

The continuation works at Dumitra catchment consist of:

- mounting mechanical equipment mechanical equipment overflow threshold and winter outlet;
- Mounting of the mechanical equipment of the sand trap and automation chamber.

To connect the Dumitra catchment sill with the concrete channel area is required:

- downstream regularization by excavation works;
- concreting the connecting wall on the left bank between the sluice chamber and the concreted channel.

## 5. Access roads CHE Dumitra

### 5.1. Access road to the CHE Dumitra outer platform

The access road to the CHE Dumitra (**Figure no. 34**) connects the existing forest road, at the end of the right bank of the bridge over the Jiu that connects with DN 66 in the area of Livezeni and Bumbești, with the end of the bridge over the Dumitra stream. Longitudinally, the road connects elevation 451,18 mdM (Dumitra forest road) with elevation 458,00 mdM (bridge over the Dumitra river) over a length of 583 m.


Fig. 33 Territorial framing of the access road to the CHE Dumitra outer platform (yellow polygon)

Along the route of the access road there are 2 typical cross profiles:

- Type 1 profile on the earth with the road system consisting of 20 cm concrete cover and 20 cm thick crushed stone foundation;
- Type 2 profile on rocky areas, with the road system consisting of 20 cm concrete cover and 10 cm thick crushed stone foundation.

For the collection and discharge of rainwater and seepage water, longitudinal ditches will be built towards the slope, which will be discharged into the Jiu riverbed through 3 culverts under the road.

### 5.2. Access road over the Dumitra catchment

The access road over the Dumitra catchment (Figure 34) represents a section of the access road to the butterfly valve chamber and the upper chamber of the Dumitra surge chamber.

The road route is adjacent to the spillway dam and is located downslope with crossing over the closure wing on the left slope. Upstream, the route connects to the existing forest road and downstream to the existing road. The connection between the existing road and the planned road is made on the platform at elevation 459.00 mdMN and continues with a 12% gradient up to elevation 466.61 mdMN for a length of 79.72 m.

The width of the roadway, including two 0.375 m shoulders, is 3.50 m. The road system consists of a 15 cm thick ballast foundation layer and an 8 cm thick layer of crushed stone as a wearing course. The slope of the road surface is 3%. Rainwater, both from the road and from the slope, is collected in triangular ditches with a 15 cm dry-walled wall and discharged through the existing culverts into the Dumitra stream.

The protection of the embankments after the crossing area of the enclosure wall from the right bank will be done with a reinforced concrete retaining wall. The wall has a total length of 10.00 m. The height of the wall elevation is 3.40 m and the foundation is 1.00 m. The foot of the foundation is 1.70 m. At the back of the wall is planned to be executed a drain of rough stone discharging through barbacane.

## 6. Bumbești power structure

The Bumbești power structure is composed of: underground and above-ground gate chamber, valve chamber, metal penstock.

The work is now 87% complete.

Work needed to be completed:

- concreting of the superstructure of the Bumbești gate chamber;
- massive concreting M1 penstock Bumbești.

### 6.1. Concreting of the superstructure of the Bumbești valve chamber

The valve chamber (Figure 35), with a surface area of about 125 square meters, is located on the platform at elevation 420.00 mdM, at the point where the Dumitra-Bumbești headrace gallery comes out at the outlet. It is equipped with a butterfly valve with a diameter of 3.0 m, which closes automatically in emergency situations.

The location of the construction and its dimensions were determined according to the gauge of the 3 m butterfly valve, as well as the metal pieces connecting to the diameter of the headrace. The position was set about 3.50 m from the portal. The interior space provides the location of the other hydraulic and electrical installations for the valve. The structure is made entirely of monolithic reinforced concrete. The infrastructure consists of a massive tank with two diaphragms upstream and downstream of the valve, diaphragms in which there are openings for the metal connecting pieces between the headrace and the valve. It is founded on bedrock.

The remaining to be executed on this item consists of:

- concreting of the superstructure - consists of a concrete frame placed between the two diaphragms stiffened longitudinally by beams. The roof slab is supported by a network of beams and diaphragms;
- external works - execution of the perimeter protection pavement, with a surface area of 23.45 square meters, made of concrete slabs measuring 1.00 x 0.50 m, bordered by prefabricated kerbs. The slabs will be poured over a drainage layer of sand and gravel about 10 cm thick;
- repairing the embankments of the access road to the ramp and the technological platform of the valve chamber, with an area of 1.571,27 square meters by laying a 10 cm thick layer of ballast.


Fig. 34 Territorial framing of the CHE Bumbești building (purple polygon) and the valve chamber (yellow polygon)

The positioning of the equipment (valve, hydraulic actuating cylinders) will be done on concrete foundations by means of embedded metal plates (for position see mechanical part), also the electrical panels. A recessed pipe, Dn 200, is foreseen through the invert, necessary to discharge the water retained by the difference in diameter between the adduct and the valve. The superstructure consists of a concrete frame placed between the two diaphragms longitudinally stiffened by beams. The roof slab is supported by a network of beams and diaphragms.

From the point of view of the architectural specialty in the category of works remaining to be carried out at the gatehouse are: perimeter enclosures, exterior carpentry, interior finishes, exterior finishes, roof, rainwater drainage, outdoor arrangements.

The perimeter enclosures, those relating to the external walls, will be made of brick masonry and M50-Z mortar, 30 cm thick.

The exterior carpentry is made of aluminum profiles with thermal bridge break barrier and thermal insulating glass.

The entire surface of the walls will be plastered with cement mortar, followed by a coat of plaster and washable paint.

Cement mortar plaster will be applied on the soffit of concrete surfaces, followed by a coat of plaster and washable paint.

The floor will be finished in polished cement.

At the plinth, the finish is decorative plaster applied over the previously fixed fire-retardant extruded polystyrene insulation, over the fiberglass reinforcing mesh and primer. The walls are finished with decorative mineral plaster.

Rainwater drainage: The rainwater drainage system is made of gutters and downpipes.

External works: this category includes the execution of a 1 m wide concrete sidewalk. It will run around the building.

Electrical installations: indoor and lightning protection.

The manifold drain assembly consists of the drain pipe leading from the headrace manifold and a concrete sump where the concrete sump drain valve is located. This assembly is on the left bank of the powerhouse.

The discharge pipe runs from elevation -1.40 (294.60 mdM), the outlet of the distributor, to elevation -1.55 (294.45 mdM), the outlet into the stilling basin.

The drain pipe is 219 mm in diameter, 8 mm thick, 45.15 m long, with a slope of 0.3% and will be embedded in concrete.

The access manhole to the distributor outlet has a reinforced concrete structure with a depth of 11,12 m between +8,20 (304,20 mdM) elevation of the landscaped area and -2,92 (293,02 mdM) elevation.

The footprint of the well is 4.40 x 3.30 m, narrowing to 2.40 x 3.10 m at the crown. Access to the well is via a metal ladder that runs the full depth through the 1.00 m x l.70 m gap at the crown. The well cover is made of 3 precast concrete slabs.

### 6.2. Massive concreting M1 penstock Bumbești

The penstock that equips the Bumbești power structure is a welded metal construction, assembled up to date, on supports equipped with roller bearings.

The elbow in the vertical plane at point M1 and the elbow at point M2 shall be fixed in reinforced concrete anchorage piles, founded on sound rock and connected to the ground by Ø 20 mm anchors made of PC 52 steel concrete, 3.50 m long (2.50 m in rock and 1.00 m in concrete).

The work on the M2 and M3 penstocks of the penstock is completed.

In longitudinal profile, the penstock has two sections:

- Section I: from the butterfly valve chamber to the M2 anchorage with a length of 110.98 m;
- Section II: between anchorages M2 and M3, 137.85 m long.

The section of pipeline between M1 and M2 has lining installed along its entire length, including the elbow elements, but the massive M1 is not concreted.

## 7. CHE Bumbești

### 7.1. CHE Bumbești

CHE Bumbești is the second power plant located upstream of Bumbești, located on the right bank of the Jiu river, upstream of the confluence with the Curpenului stream.

In the hydroelectric power station, three hydro-power hydro-aggregates are installed with all the auxiliary installations for the turbulation of a flow of 3 x 12 $m^3$ /s. If the power plant is not in operation, the downstream flow is channeled through the turbine (idling).

CHE Bumbești has the following energy characteristics:

- installed flow 36,0 $m^3$ /s;
- installed capacity 40.5 MW;
- average annual energy 167.0 GWh/year.

The completion works consist of both infrastructure and superstructure works on the power plant building.


Fig. 35 Territorial framing of the CHE Bumbești building (yellow perimeter)

The following types of infrastructure works are required: interior compartmentalization, interior carpentry, interior finishing.

Interior compartments

The partition walls, which separate the compressed air plant from the turbine level room, are made of 25 cm thick solid brick masonry with M50-Z mortar.

Interior joinery

The interior carpentry will be of two types: solid metal doors and a fire resistant door.

Single or double-leaf solid metal doors, having a structure of specific metal profiles, block frame for fitting in the hollow space, 45 mm thick solid door leaf and accessories such as hinges, locks, locks and contour seals. The joinery shall be purchased with all additional sealing elements, including accessories for closing-opening. The 90 minute fire resistant door in a cantilever, made in sandwich system with steel sheet faces and heat insulated core.

Interior finishes

*Walls.* The concrete walls of the suction level and turbine level shall be cleaned of segregated concrete and any remaining burrs after pouring and repaired by local application of cement-based mortar. The same procedure shall be used for repairing or restoring damaged straight edges.

After repair, cement mortar plaster will be applied, followed by two coats of two-component water-based epoxy resin (MasterTop TC 485 W), white, which provides both open vapor diffusion protection and waterproofing of the surfaces.

In the stairwell the walls will be plastered on the entire surface and 1.40 m high will be tiled with cream-colored faience. The areas not covered with tiles will be coated with white, two coats of two-component water-based epoxy resin (MasterTop TC 485 W), which provides both open vapor diffusion protection and surface waterproofing.

*Ceilings.* The concrete ceiling of the turbine hall as well as the ceiling of the stairwell and the intrados of the ramps will be cleaned of segregated concrete parts as well as any remaining burrs after pouring, after which they will be repaired by applying cement-based mortar locally. After repair, cement mortar plaster will be applied, followed by two coats of two-component water-based epoxy resin (MasterTop TC 485 W), white in color, which provides both open vapor diffusion protection and waterproofing of the surfaces.

*Flooring.* As a finish, the floor at the level of the aspirators and the sluice platforms will be made of rolled cement. Slope concrete will be poured under the finishing layer to ensure that water accidentally drained from the installations located here is discharged into the channels. The finish of the floor at turbine level and of the concrete steps and risers connecting the - 2.55 and - 0.40 elevations will be of the polyurethane hard-elastic type. The perimeter grooves will be waterproofed with a single-component waterproofing mortar based on special cements and waterproof resins. The floor finish to be applied to the stairwell, steps, risers and intermediate floors will be anti-slip interior sandstone.

In the superstructure, the following types of works are required: interior partitioning, interior joinery, interior finishing, exterior finishing, insulation works, rainwater drainage, outdoor arrangements.

Interior compartments

Partition walls, with the exception of those in the cloakroom and office areas, will be made of brick masonry filled with M50-Z mortar. Their thickness will vary depending on location, from 15 to 25 or 30 cm. The walls dividing the toilet, changing room and office areas will be made of plasterboard, 10 cm and 12,5 cm thick.

Interior joinery

The interior carpentry will be of two types: metal carpentry, i.e. doors; aluminum profile carpentry, i.e. doors and showcases.

Interior finishes

*Walls.* The concrete walls or structure shall be cleaned of segregated concrete parts as well as any burrs remaining after pouring. After repair, cement-based mortar shall be applied locally. Cement mortar plaster will then be applied to the entire surface of the concrete walls or structure as well as the masonry walls, followed by a coat of plaster and epoxy system painting (one coat of primer and two coats of water-based two-component epoxy resin paint), which provides both open vapor diffusion protection and surface waterproofing. In the stairwell, the walls will be plastered over the entire surface and tiled to a height of 1.40 m. The plasterboard walls, with the exception of the unglazed surfaces, will be plastered and finished with epoxy paint (one coat of primer and two coats of water-based two-component epoxy resin).

*Ceilings.* At most infrastructure and superstructure rooms the ceiling will be cleaned of segregated concrete as well as any remaining burrs after pouring. The parts thus cleaned will be straightened by applying cement-based mortar locally. The same procedure will also be used to repair or restore the straight, damaged edges. Once this operation has been completed, cement mortar plaster will be applied, followed by a coat of plaster followed by epoxy painting (one coat of primer and two coats of water-based two-component epoxy resin paint).

*Flooring.* As finishing the floor of the suction level, respectively of the sluice platform, will be made of rolled cement. Under the finishing layer, slope concrete was poured to ensure the evacuation of water accidentally drained from the installations located here into the channels. In most of the rooms at elevation -0.40 turbine level, elevation +3.70 machine room, elevation +8.50 assembly platform the floor will be of the polyurethane hard-elastic system type, with the following composition: a solvent-free, low viscosity, two-component epoxy epoxy primer coat, which seals the pores and corrects the flatness of the mineral substrates; a self-leveling, solvent-free, hard-elastic polyurethane, self-leveling base coat; a transparent, two-component, water-based, wear-resistant, matt satin-finish, two-component, transparent polyurethane top coat.

in the rest of the rooms we will have: in the medium-voltage station and the operating room, raised technological floor with its own supporting structure and floor tiles AIFL(CO) fire reaction class, 600 x 600 mm format, 40 mm thick, with inert core, resistant to the project loads, with antistatic and anti-conductive finish on the upper part and the edge protected with non-conductive electrical strips; in the changing room, the restroom, the stairwell, the finish is anti-slip tiles for the interior.

Exterior finishes

*Walls.* The exterior wall finish, regardless of type (thermosystem or sandwich panel plywood), shall be applied over the plaster applied as part of the rendering work. At the plinth, the finish will be of the type of decorative plaster based on acrylic resins and stone mosaic applied over the previously fixed 5 cm thick fire-retardant extruded polystyrene insulation, over fiberglass reinforcing mesh and primer. Part of the exterior walls of the hydropower plant will be finished with a thermosystem. This consists of the following layers: fire-retardant expanded polystyrene thermal insulation, mechanically and adhesively fixed in advance, shimming compound, fiberglass reinforcing mesh, primer and decorative mineral plaster based on acrylic resins.

The rest of the walls will be finished with a layer of 5 cm thick mineral wool sandwich panels, fire reaction class A2 - sldO, protected against corrosion for environmental aggressiveness class III.

*Flooring.* The finishing of the external access ramps to the engine room, the Diesel group, as well as the personnel access steps or the trafo boxes, consists in the realization of a cement floor with metallic aggregates of approx. 5 mm thick, consisting of: a bonding layer; a base layer of concrete with metallic aggregates subjected to a helicopter process 4-5 hours after pouring, only on horizontal or shallow sloping surfaces; sealing of the surface with a varnish with a dual function of regulating water evaporation and aesthetics.

Insulation works

The insulation works will be carried out on both vertical and horizontal surfaces.

The thermal insulation applied to vertical surfaces, i.e. the thermal insulation of exterior walls, is in fact concerned with the realization of the thermosystem. Those applied to horizontal surfaces concern the thermal insulation of the floor of the rooms in the downstream area. Thus, a layer of mineral wool mats, covered with aluminum foil, 10 cm thick, was laid over the floor in the attic.

Runoff from precipitation

On the façade of row A (rear façade), the waters from the slope of the roofing are collected in a so-called wider gutter, a type of sewer, located at the lower part of the roof. From here they are discharged to the outside by means of downspouts concealed in the upper third of the wall. On the façade of row C (main façade) the gutter at the lower part of the roofing collects the rainwater and then drains it out through the downpipes.

Outdoor arrangements

These works include the execution of fall protection elements, i.e. exterior metal handrails primed and painted on site with alkyd enamel.

Indoor and outdoor installations

*Plumbing.* The power plant building has been equipped with a restroom at elevation + 8,50. The sanitary unit is equipped with shower, stilling basin and WC. The cold drinking water is supplied from the outside network via a high-density polyethylene connection - PE 40 mm. Drinking water enters the building through a recessed piece provided in the resistance part.
Hot water will be supplied to the consumers by an electric boiler V = 80 I, located in the sanitary group. The hot and cold water pipes will be made of polypropylene pipes.

The domestic sewage from the sanitary group will be drained externally into a sewage pipe, then through PVC pipes to a modern treatment plant. The outlet of the sewage pipe from the building will be through a recessed pipe in the resistance part.

Drainage of water from the plant floor resulting from leaks in the installations, accidental seepage or water resulting from extinguishing a fire shall be carried out by means of specially designed channels and embedded pipes provided by the construction and apparent side of the building, which lead the water into the plant's drainage basin.

*PSI installations.* The building requires two simultaneous 2.5 l/s jets to extinguish interior fires.

The water supply of the fire extinguishing installation with internal and external hydrants will be realized by means of a fire pumping group (one working and one standby pump) located at elevation -0,40 in the PSI station, with Q, = 40 mc/h; H=55 m AC. Access to the station will be from inside the plant and from the outside through a dedicated shaft.

The source of water for the PSI installation (internal and external hydrants) is the plant's stilling basin, which also constitutes the intangible fire reserve. Internal fire hydrants have been provided at all service levels of the plant, type 'C' 0 2', equipped with type 'C' 0 50 mm hose, 20 m long, and with single hand-pipe discharge pipes.

The discharge pipe of each hydrant is equipped with a 0 14 mm nozzle for water spraying. A list of technical equipment and initial products has been drawn up in accordance with PE 009/93 for extinguishing fire starts.

*Outdoor installations*

The project addresses the following categories of installations:

- Drinking water connection;
- External fire extinguishing network;
- Outside domestic sewage network.

<u>Drinking water connection</u>

The supply of drinking water to the sanitary group in the plant is made from the external city network in the area supplying the intervention block, through a polyethylene PE pipe, Pn 6 bar, D = 50 mm, from the existing AC (plumbing with meter).

The water supply pipe shall be installed below freezing depth - h = 1,30 m. The polyethylene pipes shall be kept under test pressure for 2 hours (test pressure is 1,5 Pn).

<u>External fire extinguishing network</u>

The fire extinguishing system has been designed according to the legislation in force. The building requires a flow rate of 10 l/s for external extinguishing, provided by external hydrants (3 pcs) located on the plant platform, 2 hydrants in operation, with a flow rate of 5 l/s each. In order to ensure the necessary flow and pressure, a pump station for fire extinguishing is provided at level - 0.47. It supplies the internal and external hydrants. The supply pipe for the external hydrants exits the building at + 6.90 elevation and is made of high density polyethylene PE 110 mm.

<u>Outside domestic sewerage network (network and compact treatment plant)</u>

The domestic wastewater from the sanitary group in the plant is discharged outside into a sewage pipe complying with STAS 2448. From here, through PVC pipes with D = 200 mm and sewage pipes, it is led to a compact, modern sewage treatment plant adjacent to the intervention block.

### 7.2. Outdoor arrangements technical block CHE Bumbești

The landscaping works concern the realization of:

- access to the road access, respectively to the access platform to the intervention block and implicitly to the power plant;
- parking areas;
- pedestrian access to the intervention block and therefore to the power plant.

The access to the intervention block is realized through a concrete road with a width of 7 m, which starts from the concrete platform serving the Bumbești power plant and ends at the beneficiary's property boundary, laterally, the road is framed by the property boundary (right side) and the escape channel (left side).

This is an interior technological roadway with a concrete swale on the right side and sidewalk on the left side. In front of the intervention block building there are 2 parking areas of 5 and 4 parking spaces respectively.

The roadway and parking areas are made of BcR 3.5 low traffic road concrete with the following characteristics:

- PI road platform: 7,00 m;
- roadway Pc: 7,00 m;
- 1 lane per direction: 3.50 m;
- 2% cross slope for rainwater drainage;
- elevation at the beginning of the road: 304,20 mdMN;
- road end elevation: 302.50 mdMN;
- design speed: 10 km/h;
- turning radii: 20.50 m (in the centerline of the road);
- road platform area: 633.70 square meters;
- parking area: 240,00 square meters.

On the right side, the road is equipped with a 50 x 40 cm rainwater channel, and on the left side (towards the storm drain and the intervention block) there is a 1.00 m wide paved sidewalk.

At the entrance to the CHE Bumbești, the road has a roundabout with a radius of 20.51 m (in the axis) and a widening on the left side (towards the tailrace channel) allowing easier maneuvering of the machines that serve the plant. The width of the carriageway (Pc) at the end of the road is 8.45 m and 9.95 m respectively (including the gutter and the pavement).

The infrastructure of the road consists of: 20 cm BcR 3.5 road concrete layer of 20 cm; 10 cm insulating layer of sand; 30 cm compacted ballast layer of 30 cm thickness (medium thickness).

For greater strength over time, it is recommended that a 6 cm layer of asphalt concrete (wearing course) is poured over the concrete slabs (resistance layer).

On the right-hand side of the concrete access platform to the central access to the intervention block building, a sidewalk will be made of precast concrete paving stones laid on a sand bed and bordered by a row of precast kerbs laid on a concrete foundation.

Adjacent to the parking lot, 2 (two) parking areas will also be provided. The first of these, for a group of 4 (four) cars, has a cell perpendicular to the platform. The second parking lot, connected to the platform, forms a separate area of approx. 163 square meters, an area for 5 cars.

In total, the road platform together with parking areas have an area of approx. 873,70 square meters.

Perimetrically, the technical block building will have a sidewalk of concrete slabs of 1.00 m x 1.00 m bordered by prefabricated curbs. The slabs will be poured over a sand and gravel drainage layer of about 10 cm.

The pedestrian access from the technological road (the related pedestrian sidewalk) to the external stair platform is made of precast concrete pavers laid on a sand bed. It is bordered on either side by a row of prefabricated kerbstones laid on their own concrete foundation. The pedestrian area including the sidewalk together with the pedestrian access and the perimeter sidewalk totals 135.20 square meters.

### 7.3. CHE Bumbești landscaping, platforms, fencing and swales

The surface area of the CHE Bumbești outer platform (**Figure no. 37**), including the assembly platform, is 1,020 square meters. The platform will be concreted with 20 cm thick reinforced concrete.


Fig. 36 The territorial setting of the CHE Bumbești building (purple polygon) and of the areas concerned by the landscaping, platforms, fences and gullies (yellow polygons)

The landscaping works related to the hydroelectric power plant concern:

- realization of the external concrete platform providing access to the power plant;
- realization of the macadam platform;
- storm water drainage channels;
- realization of the guard sidewalk around the building.

The perimeter of the plant building will have a sidewalk of 1.00 m x 1.00 m concrete slabs bordered by prefabricated curbs. The slabs will be poured over a sand and gravel drainage layer of about 10 cm.

These platforms are provided with concrete drainage swales, which collect the rainwater into a stormwater collection sump. The downspouts are also located perimeter along the perimeter fencing, fencing the property lines will be wire mesh fencing and metal posts in individual concrete foundations.

### 7.4. Concreting of the connection of the stilling basin with the Bumbești trailrace channel

The connection area between the stilling basin of CHE Bumbești and the tailrace channel (**Figure no. 38**) is 70% completed. About. 10 m of the outlet channel and, partially, the left and right bank connecting walls between the stilling basin and the outlet channel.


Fig. 37 The territorial framing of the CHE Bumbești building (purple polygon) and of the connection area between the CHE Bumbești stilling basin and the escape channel (yellow polygon)

### 7.5. 110 kV transformer station CHE Bumbești

The 110 kV transformer station at CHE Bumbești has not started works. The part of construction related to this object involves stripping, excavation and backfilling as well as concrete for the transformer tank, raceway for transformer positioning, collection (hydrocarbon), cable ducts and channels and other independent foundations (lightning arrester, metal stela, zero arrester, etc.). For safety reasons, the substation will be fenced with mesh fencing with metal posts in individual concrete foundations.

The work is carried out to ensure the operation of the power plant and the discharge of the electricity produced into the system.

The 110 kV Bumbești transformer substation (**Figure no. 39**) has plan dimensions of 14.00 m x 22.80 m.


Fig. 38 Territorial framing of the CHE Bumbești building (purple polygon) and the 110 kV CHE Bumbești transformer station (yellow polygon)

The 110 kV TRAFO station, which is the subject of this project, is an outdoor, single-cell station.

The construction works for the realization of the transformer station consist of:

- foundations for voltage transformers, arrester, earthing knife, hybrid module, metal pole with lightning arrester;
- foundation for the 63MVA transformer tank and the transformer runway;
- cable pulling fireplaces;
- cable ducts with roadway covers (within the transformer station).

The foundation for the 63 MVA transformer raceway has plan dimensions of:

- the foundation for the type 1- 2.30 x 23.60 running track with a depth of 1.60 m.
- foundation for the type 2 roadway - 2.88 x 18.34 and depth of 1.60 m.

A 110 KV electrical cable pulling house and electrical cable ducts are foreseen on the station premises. The cross-section of the cable pulling shaft is 1.30 m x 1.30 m and the clear height is 1.00 m. 110 kV cable protection pipes will be placed in the shaft walls.

For the discharge of rainwater from the pulling shafts and cable ducts, 2" diameter PVC downpipes were provided at 1 m spacing.

A 2.40 x 2.40 m x 2.40 m deep 2.70 m deep shaft was provided in the 63 MVA transformer tank collector bay for the positioning of the hydrocarbon separator.

Fencing of the station is also foreseen, which will be made of panels of edged wire mesh, mounted on galvanized posts of 40x60mm and separate accesses for the trailer 6,00 x 2,20 $m^2$ and pedestrian access 1,00 x 2,20 $m^2$ .

## 8. Access road to CHE Bumbești

The access road to CHE Bumbești, with a length of 1.37 km, branches off from DC 149 and continues on the right bank of the Jiu River up to the power plant (**Figure no. 40**).

The width of the roadbed varies between 4.50 m and 7.00 m, with the roadway side between 3.50 m and 5.50 m. In the 7 crossing areas the roadway width is 5.50 m.

The natural relief conditions and the geologic structure of the terrain encountered on the route imposed three typical cross-sectional profiles, applicable in the earth, earth and rock and rock and rock areas: mixed, in debble and in embankment.

The road system consists of a 20 cm thick concrete wearing course laid on a 20 cm thick layer of ballast, to be used both during the works and after the commissioning of the plant.

The access road is equipped with heavy metal guardrails and stone masonry guardrails of h = 70cm for traffic safety.

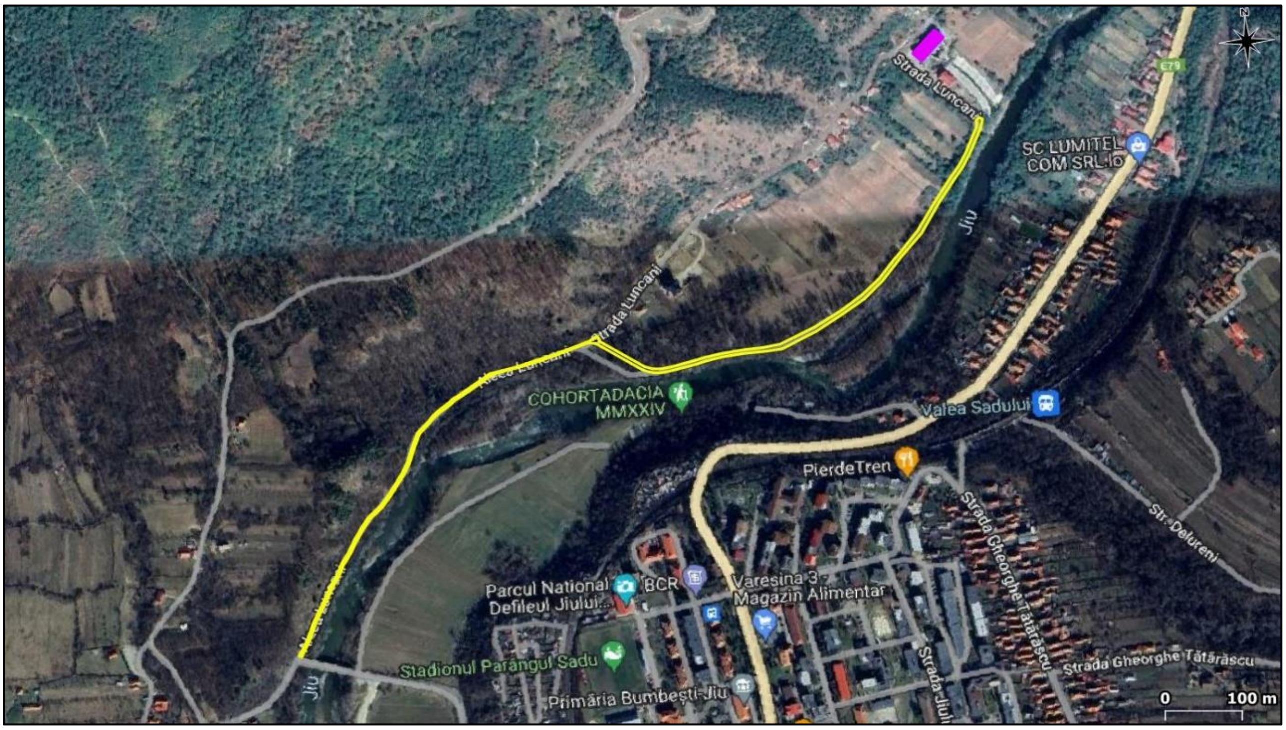



Fig. 39 The territorial framing of the CHE Bumbești access road (yellow polygon); CHE Bumbești building (purple polygon)

On the road route, the geological profile has imposed the need to carry out works to support and defend the road:

- Stone masonry retaining walls L = 250 m, h = 2,50 -e- 3,00 m, with drainage channels;
- Gabion defense walls L = 410 m, mattress or box type.

For the collection and discharge of rainwater and seepage water, longitudinal ditches will be built towards the slope, which will be discharged through culverts under the road to the Jiu riverbed. The culverts will be made of PREMO Dn 800 and BUCOV Dn 1400 pipes. A backfill at least 50 cm thick will be built above the outer generator of the tubes.

**9. Access road over the M3 CHE Bumbești massif**

The access road over the M3 CHE Bumbești Bumbești massif restores the continuity of access to the households in the immediate vicinity (**Figure no. 41**), interrupted by the execution of works at the power structure.


Fig. 40 Territorial framing of the access road over the M3 CHE Bumbești massif (yellow polygon); CHE Bumbești building (purple polygon)

The road is 101.76 m long. The road has a single carriageway with a width of 3.50 m: carriageway 2.75 m and two shoulders of 0.375 m each. The longitudinal profile of the road has gradients of max. 6.7%.

In order to collect rainwater, the cross-section of the road has a 4% slope (inclination) towards the slope, where the concrete swale is laid along the entire length of the resurfaced road section. The ruler is made of C12/15 concrete with a cross-section varying between 50 and 100 cm. The swale will be connected to the existing channels.

The infrastructure of the road is made of local material (fill material, ballast) over which the road system (superstructure) is applied. The road system of the road consists of: 12 cm crushed stone (wearing course), 25 cm ballast ballast foundation layer and 10 cm sand insulating layer.

Between km 0+008 and km 0+045, in the area of the power plant, between the elevation of the road and the elevation of the external platform of the 110 KV CHE Bumbești station, there is a difference in level varying between 3.10 + 4.60 m. In this area it was necessary to protect with retaining walls on a length of 37.25 m. These walls are closed in the natural terrain by 2 closing wings:

- L = 12,90 m, which delimits the CHE Bumbești enclosure on the right side and protects the existing households;
- L = 7.60 m, which delimits the CHE Bumbești enclosure behind the power plant and separates the 110 kV station area from the sloped portion of the road.

The walls vary in height between 2.80 and 5.50 m, depending on the gradients of the road. In order to reduce the hydrostatic pressure behind the walls, PVC pipe Dn 100 mm is used to reduce the hydrostatic pressure. The walls are of the corbelled type, made of reinforced concrete C16/20.

Further, from km 0+045,000 to km 0+101,761, the road connects with the CHE Bumbești platform through a slope, with a gradient between 1:1.15 and 1:2.

**10. Bratcu catchment**

The Bratcu catchment (**Figure no. 42**), located on the stream of the same name, introduces into the Dumitra - Bumbești headrace an average flow of 0.285 $m^3$ /s. The catchment is of the Tyrolean type, with a concrete spillway dam sill and automatic flushing spillway dam and has an installed flow of 1.0 $m^3$ /s.

Fig. 41 Aspect of the built constructions related to the Bratcu catchment (yellow colored polygon, relative spatial framing by the environmental study developers)

In the area of the closure of the catch sill on the right bank, washing of the downstream wall fills was observed. To strengthen and protect the area, excavation and rock fill works are required to protect the closure in the right slope. The catchment platform is covered with ballast layer and leveled.

**11. Jiu secondary intake**

The location of the Jiu secondary intake is located on the Jiu River at approx. 400 m upstream of the Dumitra power plant (**Figure no. 43**) and introduces into the Dumitra - Bumbești headrace an average flow of approx. 3 mc/s.

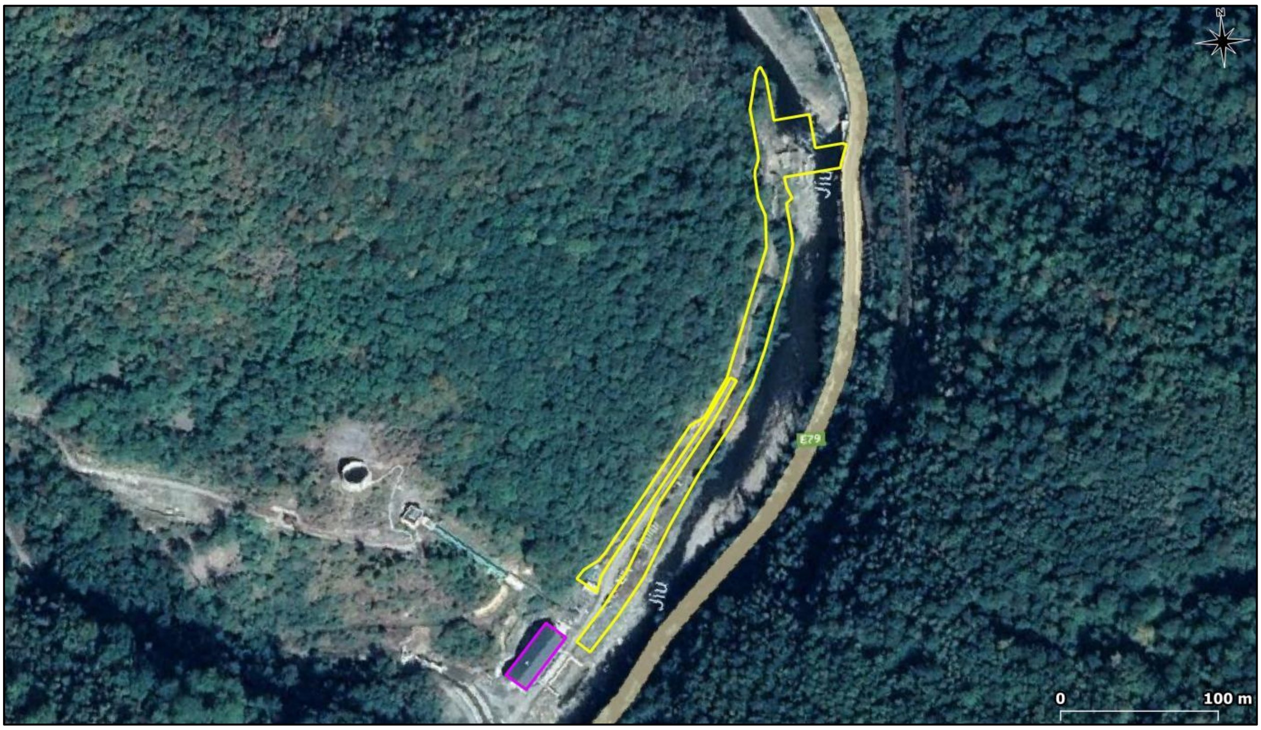



Fig. 42 Land setting of the Jiu secondary intake area - including pipeline route and operation road (yellow polygon); CHE Dumitra building (purple polygon)

**11.1. Concreting of catchment infrastructure and superstructure, including fish ladder**

The works have been started and abandoned, with approx. 20% for the first stage of concreting the infrastructure. The slope closure (left embankment) has been completed and shows no degradation, but only 75% of the infrastructure concrete was considered reusable. The resumption of the works implies the execution of the water diversion works with the related excavations and backfilling.

The concreting of the superstructure will also be carried out in stages in the infrastructure diversion phase (Stage I or Stage II diversion). In addition to the spillway, the power inlet, the spillway dam with associated pipework and the fish ladder are included. These works were never addressed. When the concreting of the superstructure is completed, the water diversion will also be decommissioned.

The water is collected via a 12,55 m long side inlet with a vertical grate L = 10,00 m, h = 1,00 m, located at the side of a 45,00 m long wash pocket.

The remaining works to be executed at the Jiu catchment consist of:

- completion of the spillway threshold (from elevation 452.50 mdM to final elevation);
- the construction of the ladder to ensure the passage of ichthyofauna;
- finalizing the power dissipator;
- execution of the intake;
- downstream regularization.

Capture intake

The water is collected via a 12,55 m long side inlet with a vertical grate L = 10,00 m, h = l,00 m, located at the side of a 45,00 m long wash pocket.

Downstream of this is the valve chamber, which houses two manually operated slide gates l.80 m x l.80 m. In the current operation of the catchment, the slide gate, with which the flush pocket is equipped, is closed. It will only open when flushing is to be carried out.

The slide gate with which the spillway dam is equipped shall remain in the open position. It shall be closed at the inlet to prevent silt from entering the drain. The hydraulic circuit continues with a 32.45 m long spillway dam. The purpose of the spillway dam is to retain and discharge the entrained solid flow from the upstream reach. The spillway dam is continued by the valve chamber, which houses two manually operated, flat, l.80 m x l.80 m, manually operated valves. The first will be in the closed position and will be opened to flush the deposits. The second valve will be in the open position and will only close when it is necessary to close the hydraulic circuit to repair the pipeline.

In the downstream area, a lateral spillway is provided in the spillway dam wall, with the crest elevation at 455.15 mdM. The loading chamber is positioned to the right of the denisipator and is 7.35 m long. Downstream of this is the connecting chimney, from which the PAFSIN pipe with Dn 2000, with a pipe axis elevation of 453.52 mdMN, departs.

The catchment inlet, with a length of 50.00 m, is composed, for construction and structural reasons, of 6 sections and a downstream retaining wall, as follows:

- section 1 intake - length 12,55 m;
- section 2 - upstream valve chamber - length 6,30 m;
- section 3 - wash pocket, drain - length 8.65 m;
- section 4 - wash pocket, drain - length 8.00 m;
- section 5 - wash pocket, de-strainer, downstream valve chamber, loading chamber - length 9.50 m;
- section 6 - connection - length 5.00 m;
- downstream retaining wall - length 17.50 m.

Downstream regularization

Downstream of the catchment, a regularization of the Jiu River is necessary to better transit the flood flow, without affecting the stability of the national road DN 66, as well as to ensure a level to be able to carry out the flushing of the spillway dam.

Therefore, a fairway width of 45.5 m is required immediately downstream of the sill, with a required talveg elevation of 452.5 mdM.

At approx. 20 m, the channel will be reduced from 45.5 m to 30 m.

No embankments will be carried out on the left bank, in order not to affect the stability of the road, the width of the path will be realized only with excavation works on the right bank.

The downstream regularization will be made on a length of 100 m.

### 11.2. Jiu secondary intake headrace pipe and junction box

The connection pipe between the catchment desilter and the stilling basin of the CHE Dumitra is installed in the proportion of approx. 50% (**Figure no. 43**), but the backfilling is only partially executed. Excavation and backfilling works are required for 50% of the length of the headrace in order to install the DN2000 GRP DN2000 pipes, while the remaining 50% of the headrace needs to be filled in.

The total length of the pipeline is 332.00 m. The pipeline route is divided into four sections.

The pipeline is made of pipes PAFSIN SN 10000, PN 6, of which 158,00 m - DN 2000 and 174,00 m - DN 1800.

The pipe is laid in the excavation, on a bed of 8-16 mm granular sort with a thickness of 15 cm and then covered with a backfill of compacted granular material, in this case, the distance between the pipe and the trench wall is 60 cm. depending on the compaction equipment this distance can be modified. By the time the work was stopped, 205 ml of pipe had been installed.

The execution works for the completion of the connection box object with the main headrace consist of:

- rock excavations on the remaining length of 127,00 m;
- laying 127.00m of DN 2000 diameter pipeline;
- backfilling from useful excavations above the pipeline.

## 12. Access road to Jiu secondary intake

The access from CHE Dumitra to the catchment will be via an existing road (**Figure no. 43**), located at 459.00 mdM, on the right bank of the Jiu River.

The total length of the road will be 333.00 m. The road will be 5.00 m wide. The road system will be composed of 12 cm crushed stone, 25 cm ballast and local fill.

For stormwater runoff, the roadway superstructure will have a 4° cross-slope to the slope. The gully will be located at the base of the slope and will convey the rainwater to a catch basin. From the catch basin, the waters are directed to the Jiu river through a reinforced concrete pipe type PREMO, Dn 600 mm.

Protection of the slope of the road to the river will be done as follows:

- up to the water level ensuring $Q_{5\%}$ , anrocrocks with a minimum thickness of 1.50, d > 60cm, > 1000 kg/piece;
- between the water level with $Q_{5\%}$ and the road surface of the road, stone with a minimum thickness of 0.50, > 400 kg/piece shall be laid.

## 13. Site organization

### 13.1. Decommissioning of temporary bridge upstream Livezeni dam

The provisional bridge realized for the execution of the works at the Livezeni dam has L = 37,00 m, it consists of 2 spans of 18,40 m length. The superstructure consists of 2 metal planks on each span. The roadway on the bridge was provided with a 3.76 m wide roadway and two sidewalks of 0.75 m each. A 4 cm layer of asphalt concrete was laid on the bridge road. The infrastructure of the bridge consists of 2 concrete piers and a concrete pier, with direct plain concrete foundations.

The ramp on the right bank, providing access to the temporary bridge, is protected by gabions filled with river boulders.

The decommissioning of the bridge involves the removal from the site of the bridge girders and the gabions that make up the embankment on the right bank.


Fig. 43 Spatial delineation of the temporary bridge upstream of the Livezeni dam (yellow polygon)

**13.2. Decommissioning of the technological platform upstream Livezeni dam and final connection of the wastewater pipeline**

Upstream of the Livezeni dam, a platform adjacent to the DN 66 has been arranged, from which the temporary bridge described in the previous section starts, on which the site organization was set up (Figure no. 45).

The site organization set up on this platform serves both the works on the Livezeni dam and the works on the Livezeni access tunnel, realized for the execution works of the Livezeni-Dumitra headrace tunnel.

The platform for the technological organization has a total area of 312 sqm and is located on the right bank of the Jiu river, about 300 m upstream from the Livezeni dam.

On this platform were installed: 2 metal containers for the foreman's office and a shack, 2 ecological toilets, trafo station 20/0,4-630 KVA, compressor station, ventilation and water collection station for wet drilling and network.

The metal containers measure 5.76 x 2.86 x 2.48 m and were placed on 10 cm thick reinforced concrete platforms. Movement between the containers will be on concrete slab sleepers 50 x 50 x 8 cm, laid on a layer of sand.

The water requirement for wet drilling at the Livezeni access tunnel is provided by a cribbing catchment located in the Jiu River, protected upstream by a gabion wall. The water supply will be stored in a 3,000-liter water reservoir, placed on a 15 cm thick concrete foundation. The site of the platform will be connected to the diverted wastewater pipe coming from the wastewater treatment plant on Danutoni Street.


Fig. 44 Spatial delineation of the technological platform located upstream of the Livezeni dam (yellow polygon), targeted by decommissioning works

**13.3. Layout of the technological platform and access road to the Livezeni access tunnel and concreting of the closing plug**

Development of the Livezeni platform and access road (**Figure no. 46**): provides access from DN 66 to the Livezeni underground settler of the Livezeni - Dumitra headrace.

The works on this object consist of stripping the topsoil, backfilling around the undercrossing box and concreting the platform and access ramp (access road to the platform). Concrete will be poured on the closing plug of the Livezeni access tunnel.


Fig. 45 Spatial setting of the technological platform and the access road to the Livezeni access tunnel (yellow polygon), objectives targeted by the development works

**13.4. Development of technological platform at the Murga Mica access tunnel**

A small technological platform was set up in front of the Murga Mica access tunnel (**Figure no. 47**).

Of the works planned for the final installation of this technological platform, there are still some to be carried out:

- platform protection barricade located at the top of the embankments bordering the platform. The barricade is made of steel profiles anchored in concrete foundations;
- protection of the rock slope, located upstream of the portal of the Murga Mică attack gallery, with a shotcrete applied on a metal mesh, anchored to the rock;
- surface water (meteoric and exfiltration) collecting swales at the top and base of the slopes bordering the platform;
- the final canalization of the Murga Mica river under the platform, through a canal of prefabricated frames type C2, located between the valley of this stream and the existing connection and from which the captured waters drain further towards the Jiu, through the bridge under the DN66;
- Final landscaping of the platform surface by cleaning and leveling it and then laying a 10 cm layer of ballast.


Fig. 46 Territorial framing of the technological platform at the Murga Mica access tunnel (yellow polygon), which is the target of the development works

**13.5. Decommissioning of the construction site organization at the Bratcu Access tunnel**

The platform for technological organization, set up at the Bratcu access tunnel, has a total area of 3,360 square meters and is located on the right bank of the Bratcu stream (**Figure no. 48**).

On this platform were installed: the asphalt plant, 10 metal containers (batch headquarters, foreman's office, sampling laboratory, showers and changing room, dining room, lamp room) and an aggregate store for the asphalt plant.

The metal containers, sized according to their intended use, were placed on 10 cm thick reinforced concrete platforms. The containers are equipped with furniture and water and electricity installations as required. Movement between the containers will be on concrete sleepers of 50 x 50 x 8 cm, laid on a layer of sand.

The concrete plant is composed of the following: control cabin, loading space for trucks for concrete transportation, aggregate hopper with 4 aprons for feeding the plant and 2 cement silos.

The aggregate storage for asphalt aggregates is provided with storage spaces for 4 aggregate sorts, separated by reinforced concrete walls with an average thickness of 20 cm and a height of 2.50 m. The area of the aggregate store is 17.75 x 12.00 m.


Fig. 47 Territorial framing of the site organization at the Bratcu Tunnel (yellow polygon), target of decommissioning works

For the water supply of the site organization, a well made of prefabricated concrete rings of Dn 1000 mm and H = 1000 mm, with barbed holes for inward intake structure, was provided. The water network was installed below the freezing depth and made of galvanized steel pipes. To provide a water supply, a 3000 1 tank was mounted on a metal scaffolding at a height of 9.00 m. The metal scaffolding is made of 4 metal pillars, founded on reinforced concrete foundations of 40 x 40 x 60cm

The water loaded with cement slurry from the concrete factory is led through concrete channels into the settling tank, from where the treated water is discharged into the Bratcu stream through the channels.

The settler is an open reinforced concrete basin with flared side walls. Water enters and leaves the settling tank through trapezoidal concrete channels.

The grease separator, located next to the dining hall container, is a reinforced concrete trough 2.30 x 1.10 m in plan and 2.20 m deep. The separator will be covered with a concrete slab with a 50 x 50 cm cavity, covered with a corrugated sheet metal cover.

## 14. Connecting SEN

### 14.1. Connection of MHC Livezeni to SEN


Fig. 48 Land areas concerned by the implementation of the project component aiming to connect MHC Livezeni to SEN (yellow polyline)

The discharge of power from the MHC Livezeni will be realized in the 6 kV zonal distribution network by means of a utilization installation for connection to the SEN consisting of:

- A prefabricated connection point with three compartments, located on a precast concrete foundation laid on a ballast cushion, with access from the public road;
- LES 20 KV of copper between the metering cell in the connection compartment and the arrival cell in the user compartment, shown through the connection point;
- Identification and insertion of the existing 20 kV LES 3x (1x150) mmp A1, from MHC Livezeni (approx. 1 km) into the newly designed Connection Point in the line cell.

The evacuation of the power from the MHC Livezeni will be realized by means of a SEN connection installation consisting of:

- Realization of MV connection between the existing 6 kV PA 3 Petroșani Sud LEA and the projected connection point, by planting 1 pc. 14G31 type pole between poles no. 52 and 53 of the existing 6 kV LEA, equipped with switchgear and grounding, and MV LES of approx. 50 m with three-core AL cable laid underground in a polyethylene protection tube;
- Realization of MV connection between the existing 6 kV L2-PA 1 Vulcan and the planned connection point, by planting 1 pc. Type 14G31 pole between poles no. 81 and 82 of the existing 6 kV LEA, equipped with switchgear and grounding, and MV LES of approx. 60 m with three-core AL cable laid underground in a polyethylene protection tube.

**14.2. Connecting CHE Dumitra to SEN**

The discharge of the power from the Dumitra CHE will be realized in the 110 kV zonal distribution network through a newly designed substation in input-output system (**Figure no. 50**).

The remaining works to be executed: the second cable section will be a LES consisting of three single-phase buried power cables, laid in line, with a symmetrical load distribution on the three phases. This section will be about 900 meters long and will connect the 110 kV GIS cubicle mounted on the downstream platform of the Livezeni Dam with the installation to be executed on the connection tariff, consisting of a 110 kV substation input - output in the 110 kV Vulcan - Livezeni LEA and the input and output circuits through which the connection between this substation and the Pylon 41 where the LEA is sectioned will be made. These circuits will be LES with 2 streams of buried cables on a route as shown in the attached drawing. Each cable run will consist of 3 single-phase 110 kV XLPE insulated 110 kV cables, approximately 250 feet in length.

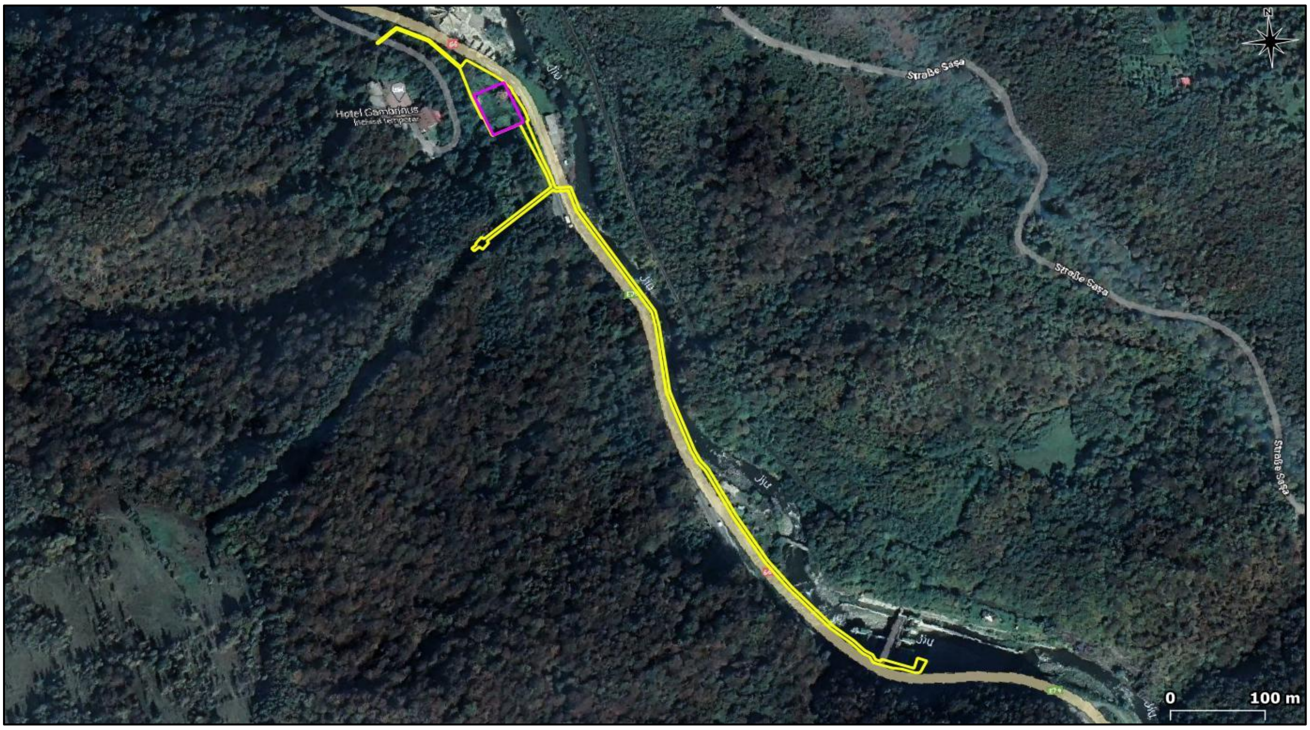



Fig. 49 Territorial framing of the areas concerned by the implementation of the project component aimed at connecting CHE Dumitra to the SEN (yellow polygons - power line routes, purple polygon - 110 kV transformer station)

The discharge of power from CHE Dumitra will be realized through a utilization installation for connection to SEN consisting of:

- LES 110 kV s.c. designed, in a concrete conduit, in compliance with the standards in force, between the existing 110 kV GIS cell on the Livezeni dam platform and the 110 kV in - out 110 kV connection station (designed), total length of approx. 0.8 km in length, equipped with fiber optic cable installed in the same concrete conduit as the

110 kV LES. The route of the new 110 kV LES will follow the DN 66, on its right side in the direction towards Petroșani, starting from the Livezeni dam platform, for about 0.8 km, where it will subtraverse the DN 66 through an existing subtraversión to the 110 kV connection station designed for the connection.

- Connection to the existing distribution network in the area for the supply of internal 0.4kV services of the 110 kV input - output connection station (projected), from the existing PTZ 57 Petroșani, S=400 kVA, located near the Gambrinus hotel, by 0.4kV cable, over a distance of approx. 200 m up to the new 110 kV connection station.

If the power reserve of the internal service transformer in PTZ 57 does not cover the required power needs, but not more than 100 kW for the new substation, then a new substation will be provided, within the premises of the planned substation, in accordance with the standards in force, supplied by MV LES of approx. 600 m from the existing 20 (6) kV distribution network in the area.

The discharge of power from CHE Dumitra will be realized through a SEN connection installation, in the 110 kV d.c. Vulcan - Livezeni LEA, consisting of:

- LES 110 kV d.c. from pole no. 41 of the existing 110kV Vulcan - Livezeni 110kV LVL to the new inlet-outlet connection station, in concrete conduit, according to the standards in force, in length of approx. 200 m. Fiber optic cables (OPUG) will also be installed on these sections, in the same cable duct, to connect the new connection station to the existing 110 kV LEA;
- The connection to the 110 kV LEA is made by mounting the connection cables on the existing pole under each bracket. The cables and connecting materials shall be mounted directly on the pole elements or on metal brackets attached to the pole structure;
- New outdoor 110 kV 110 kV input-output connection station, equipped with:
  - two 110 kV line cells;
  - single rigid 110 kV busbar;
  - three-pole 110 kV separator outgoing to the user, connected to the 110 kV busbar. The equipment in the outdoor substation enclosure, including the 110 kV LES terminal boxes and related arresters, will be mounted on metal supports and concrete foundations, container for automation, metering, protection and remote control equipment, internal AC and DC services, made in concrete envelope, with separate compartmentalization for the generator set;
  - generator set mounted in the separate compartment in the internal control and service container;
  - earthing installation;
  - lightning protection installation with vertical lightning rods on metal posts with concrete foundations;
  - access road, fencing, landscaping and consolidation of the station platform, storm water drainage;
  - burglar and fire surveillance systems;
  - realization of the transmission support and the related works for the remote control of the 110 kV incoming-outgoing connection substation and for the

realization of the longitudinal differential protection of the power line, by installing fiber optic on the 110 kV LEA sections: 110 kV Vulcan - pole no. 41 - connection station CHE Dumitra (8.6 km+0.2 km) and connection station CHE Dumitra - pole no. 41 - 110kV Livezeni (4.2 km+0.2 km) and the provision of line differential protection in the two end stations.

The installation of the equipment in the new connection station will be realized by the following construction elements:

- between pole 41 and pole 42 a metal double-circuit metallic pole No 41A type ItnTr 110244-5,3BR and a double-circuit pole No 41B type ICN 110-263 shall be installed;
- 16 F3 foundations and metallic confections necessary for the support of the 110 kV OLAL conductor at the crossing of the access roads;
- 6 F4 foundations and metallic confections necessary to support the 110 kV surge arresters;
- 6 F5 foundations and metallic confections necessary for the support of 110 kV transformers;
- 6 F6 foundations and metallic confections necessary to support the 110 kV line separators;
- 6 F7 foundations and metallic confections necessary to support 110 kV current transformers;
- 2 F8 foundations and metallic confections necessary to support the 110 kV circuit breakers;
- 9 F6 foundations and metal fabrications required to support the 110 kV busbar separators;
- 6 F9 foundations and 3 metal frames required for the support of the insulators supporting the rigid aluminum bar fields;
- 4 F10 foundations to support the metal container;
- 2 PI and P2 foundations to support the lightning rods;
- 7 foundations and metal fabrications required for lighting columns;
- 18 cable ducts for secondary circuits, covered with roadway cover;
- 2 foundations for local clamp boxes DQ1907.

The foundations will be made of C16/20 reinforced concrete and will be poured over a C8/10 equalizing concrete. Foundations will be of the footing and socket type.

The 110 kV CHE substation will be built on a purpose-built platform following the slope of the natural terrain. The station platform will be built in general fill.

The inner platform will be concreted and will consist of:

- Support layer of 95% compacted soil;
- 10 cm thick ballast foundation after compaction;
- 10 cm thick C16/20 reinforced concrete layer.

The road access will be on a section of road with 2 branches, one to the control building and the second along the station. The road is 160 m long and 3.50 m wide. The road superstructure consists of: crushed stone 20 cm thick, ballast foundation 10 cm, reinforced concrete layer C16/20 14 cm and road concrete wearing course 6 cm.

### 14.3. Connection of CHE Bumbești to SEN

The power evacuation from CHE Bumbești will be realized through a 110 kV line (**Figure no. 51**) connected in the LEA110 KV Tg. Jiu Nord-Parângu circuit 2 (pole nr. 35 bis).

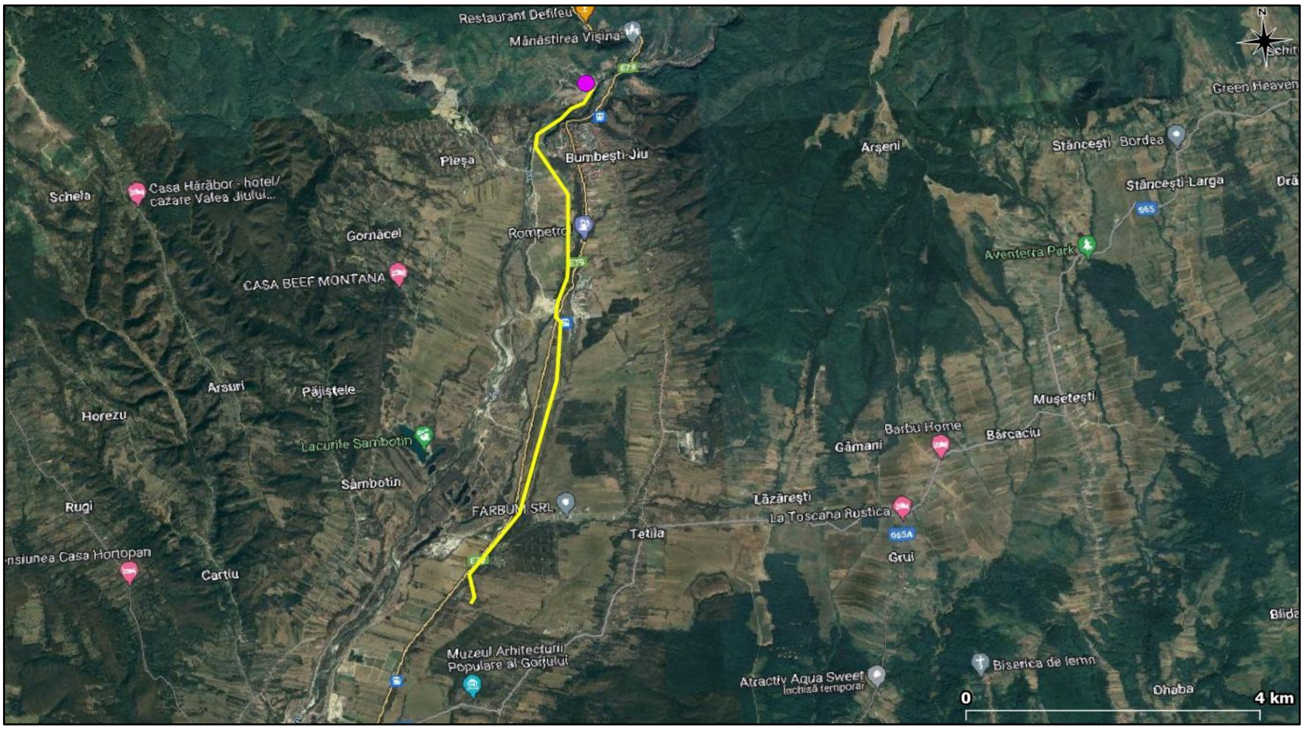



Fig. 50 Territorial framing of the route of the 110kV LEA (yellow colored polyline) connecting CHE Bumbești (transformer station - purple colored dot) and the 110kV Tg. Jiu Nord-Parângu existing circuit 2 (pole nr. 35 bis)

Utilization installation for connection to SEN:

The line will be realized on metal poles, double circuit, with one equipped circuit. The line will be approx. 8.4 km long and will consist of 17 extension poles and 19 support poles. Four types of poles will be used:

- For supporting columns: type Sn 110252-5,3R (1994 version);
- For the extension poles: type Icn 110262-5,3R (1994 version), Icn 110263-5,3R (1994 version), Icn 110264-5,3R (1994 version).

The standard height of the poles to the conductor attachment point is 15 m. The foundations of the poles shall be normal poured quadriblock foundations and special drilled foundations, taking into account the geological and hydrological conditions of the pole locations.

The areas of land to be definitively occupied for the pillar foundations are:

- For the poles: 27 4- 40 square meters/pole;
- For the supporting pillars: 15 * 21 sq.m/post.

The exit from the 110 KV CHE Bumbești station will be made through a 150 m long underground power line located in the CHE Bumbești enclosure. The 110 KV cable will be laid in a 1.00 m deep trench.

SEN connection installation:

- New pole nr. 35 bis type Itn 110244, inserted in the alignment of the 110 kV Parângu -Tg. Jiu Nord (circ. 2) to which the 110 kV CHE Bumbești CHE;
- Replacement of existing guard wire on 110 kV s.c. Parângu-Tg. Jiu Nord (circ. 1) with OPGW fiber optic fence conductor;
- Replacement of existing guard wire on 110 kV Tg. Jiu Nord-Barsești 2-CHE Vădeni, between Tg. Jiu Nord and CHE Vădeni on 8.5 km, with OPGW.

The main stages carried out for the execution of the 110 kV d.c. CHE Bumbești - terminal 35 bis include:

- Temporary re-design of temporary access paths to access the proposed overhead power line sections;
- picketing the pole sites;
- stripping the topsoil from the foundations and temporary storage of the cover in the work area until the completion of the foundation pouring and pillar erection works, after which the land is restored to its original state;
- platform leveling;
- realization of the line route;
- clearing the LEA safety lane of spontaneous vegetation.

## 15. The Dumitra - Bumbești pipeline

The Dumitra-Bumbești pipeline is an underground construction.

The **Dumitra - Bumbești headrace**, with a length of 12.5 km, ensures the transit of the flow from the CHE Dumitra and the flows from the basin difference on the Jiu River between Livezeni and CHE Dumitra as well as the flows of the Dumitra and Bratcu streams. The Dumitra - Bumbești headrace gallery is composed of two distinct sections:

- the upstream section with free level (which also serves as compensation) with a length of 1.50 km and a longitudinal slope of 1.5‰, the cross section at the upstream end is 4.40 x 4.40 m and at the downstream end is 4.40 x 6.65 m, with a horizontal gallery vault; it provides a volume of water for compensation of about 6,750 m3;
- the downstream section with a length of 11.0 km and a slope of 2.3‰ is a pressure tunnel and has a circular cross-section with an inner diameter of 4.00 m.

The execution of the Dumitra - Bumbești headrace gallery was realized on 6 working fronts by providing the Dumitra, p. Rău, Bratcu and Nod pressure attack galleries:

1. Front Dumitra;
2. Front p. Rău upstream;
3. Front p. Rău downstream;
4. Front Bratcu upstream;
5. Front Bratcu downstream;
6. Front Power structure.

The execution works for the completion of the headrace are markings, lining installation works, watertight gates, etc., as follows:

- Downstream Valea Rea markings and finishing - deburring and installation of hectometric plates;
- Markings and finishing Bratcu upstream - deburring and installation of hectometric plates;
- Injections Bratcu upstream 2+400 - 3+000, intersection of Valea Rea access tunnel, intersection at Bratcu access tunnel - the following will be carried out: filling injections in order to fill any voids between the concrete liner and the rock; consolidation injections to ensure the homogeneity of the concrete lining; control injections to check the capacity of the lining to withstand the pressure of the water flowing through the tunnel;
- Concreting of the intersection plug Valea Rea - upon completion of the works, the access will be definitively closed by a concrete plug, thus ensuring the continuity of the supply; the land related to the Valea Rea technological platform will be brought to its initial state;
- Concreting of the Bumbești chamber intersection - concreting ensures the stability of the watertight gate to the pressure of the water from the headrace;
- Bratcu well injections - filling injections, consolidation injections, control injections;
- Bratcu watertight gate concreting - concreting ensures the stability of the watertight gate at the pressure of the water in the headrace.

For the realization of the two headrace were made excavations, and the resulting material was deposited on two ponds, respectively Bumbești Pond with a capacity of 100,000 cubic meters and Bratcu Pond. The excavated material from the Bratcu pit was used for access roads, etc.

***Duration of investment***

The total estimated duration of the investment is 36 months. The actual execution of the works planned to be carried out for the objects included in the investment is estimated to be completed in 24 months. Depending on the period within which they will be achieved, a number of constraints will also have to be complied with in relation to the periods allowed for construction. In this regard, given that the project overlaps with protected areas of national (Defileul Jiului National Park) and community (ROSCI0063 Defileul Jiului) interest, from March 1 to June 30, no surface works will be carried out in the minor bed of the Jiu River, as well as in the working fronts that are on the water, except for those related to the exterior design of buildings, which are allowed during the entire period, given the low impact on biodiversity components. Moreover, the interior works (interior fittings, finishing, carpentry, installation of mechanical, hydraulic or electrical equipment) do not produce negative effects on biodiversity and protected natural areas with which some of the works overlap, so they are also permitted throughout the project period.

*1.3. Main characteristics of the operational phase of the investment objective*

**1.3.1 Technology flow**

The energy intake of the Livezeni dam (a pond with a total volume of 132,000 m3) diverts a quantity of water, an average flow of 36 m3, to the first stage of the hydropower plant - CHE Dumitra, equipped with 3 synchronous hydro-generating groups, equipped with Francis type hydraulic turbines, FVM 10.1 - 93, with vertical axis.

The easement flow corresponding to the Livezeni Dam, according to the water management permit no.410/2005, of 2.7 mc/s, was planned to be used by a micro-hydropower plant, located in the body of the dam and then discharged downstream.

At the level of the three aggregates, the quantity of water transported through the underground Livezeni Dumitra headrace gallery, with a length of about 7 km and an inner diameter of 3.80 m, is processed.

After the water is used in CHE Dumitra, the water is returned, through an underground pond, to the Dumitra Bumbești headrace gallery with a length of about 12.5m and an inner diameter of 4 m, and then it is processed in the second stage of the fall - CHE Bumbești equipped with 3 synchronous hydro-generating groups, equipped with Francis type hydraulic turbines with vertical axis, FVM 16.3 - 150, with vertical axis.

At the level of the second stage, additional water is brought from the Jiu, Dumitra and Bratcu secondary catchments through the Dumitra Bumbești headrace gallery.
The water resulting from the turbining in the Bumbești CHE is returned through a channel to the Jiu riverbed.

The technological principle of electricity generation is a typical one of hydropower plants, based on the potential difference between two basins and the flow of water transported. Thus, the potential energy accumulated in the head of the cascade - Livezeni dam, is transformed at the level of the turbines of CHE Dumitra and CHE Bumbești into kinetic energy and mechanical work. The turbines transfer this mechanical work to the vertical synchronous hydro-generators, at their level the electric energy is realized (transformation of mechanical work into electric energy).

The electricity produced is evacuated through the 110 kV power lines by transforming the energy from the generator terminals to the parameters required by the SEN through the step-up transformers - from 10.5kV to 110kV.

**1.3.2 Information on the production to be realized, the resources used for energy production and technological sources with potential environmental impact**

The execution of the projected works involves the use of materials which by their composition or their potential effects on the health of employees are classified as toxic and dangerous substances. These substances and materials are:

- paints; primers (restoring corrosion protection);
- fuels / lubricants (running machinery / means of transport);
- oils (hydraulic; turbine; transformer) (mounted equipment operation).

The management of these substances will be carried out in compliance with the legislation in force and with the indications on the packaging of these products and the safety data sheets accompanying the products.

On delivery, all these categories of substances will be accompanied by safety data sheets, which specify the strict conditions to be imposed on their transportation, handling, storage, use.

The supplier of all these substances shall provide evidence of pre-registration/registration of substances according to the requirements of REACH 1907 /2006 (Regulation concerning the Registration, Evaluation, Authorization and Restriction of Chemicals) as amended.

All equipment/sub-assemblies to be fitted must have, where applicable: * Certificate of conformity and CE marking - use in permanent contact with water.

Once the works are finalized and this fall stage is put into operation, the management of this category of substances (oils (hydraulic; turbine; transformer)) will be done in accordance with SPEEH Hidroelectrica's internal procedures.

A number of raw and auxiliary materials, energy and fuels will be used to complete this investment, both in the operation and implementation phases of the project. In the following, the raw and auxiliary materials used, their origin and their management will be presented.

**1. The Dumitra fall step**

**1.1. Livezeni Dam and MHC Livezeni**

The raw materials that will be used for the realization of the remaining works to be executed (as presented above) at the Livezeni Dam and MHC Livezeni (comprising the following objects: the Livezeni dam, the Livezeni reservoir, the MHC Livezeni, the Livezeni energy intake, the settler) are presented in the following table.

*Table no. 17 List of raw materials used and quantities of each - Livezeni dam and MHC Livezeni*

| No. crt. | Raw materials | Quantity/volume | Unit of measurement |
|---|---|---|---|
| 1. | cement | 37,50 | tone |
| 2. | aggregates sorted | 140 | mc |
| 3. | welded mesh | 40 | buc |
| 4. | timber | 5 | mc |
| 5. | compressed oxygen | 60 | mc |
| 6. | acetylene | 20 | kg |

*Table no. 18 List of fuels and lubricants used and quantities - Livezeni dam and MHC Livezeni*

| No. crt. | Raw materials | Quantity | Unit of measurement |
|---|---|---|---|
| 1. | diesel | 2.300 | l/month |
| 2. | gasoline | 200 | l/month |
| 3. | lubricants | 60 | l/month |

### 1.2. CHE Dumitra

The raw materials that will be used for the realization of the remaining works to be carried out (as presented above) at CHE Dumitra (including the following objects: power structure Dumitra composed of: underground/aboveground surge chamber, valve chamber, metal penstock; CHE Dumitra, connection box with the main headrace, Dumitra, Bratcu and Jiu catchments, Murga Mică platform, Jiu catchment access road, intervention block) are presented in the following table.

*Table no. 19 List of raw materials used and quantities of each - CHE Dumitra*

| No. crt. | Raw materials | Quantity | Unit of measurement |
|---|---|---|---|
| 1. | cement | 41,25 | tone |
| 2. | aggregates sorted | 160 | mc |
| 3. | welded mesh | 20 | buc |
| 4. | timber | 5 | mc |
| 5. | compressed oxygen | 60 | mc |

*Table no. 20 List of fuels and lubricants used and related quantities - CHE Dumitra*

| No. crt. | Raw materials | Quantity | Unit of measurement |
|---|---|---|---|
| 1. | diesel | 2.500 | l/month |
| 2. | gasoline | 200 | l/month |
| 3. | lubricants | 30 | l/month |

## 2. Bumbești fall step

The raw materials that will be used for the realization of the remaining works to be carried out (as presented above) at the Bumbești drop stage (including the following investment objects: main Dumitra-Bumbești headrace; Bumbești power structure composed of: underground/aboveground surge chamber, valve chamber, metal penstock; Bumbești CHE; Bumbești escape channel; Bumbești leakage channel; external technical block; external CHE Bumbești, TRAFO station) are presented in the following table.

*Table no. 21 List of raw materials used and quantities of each - fall Bumbești*

| No. crt. | Raw materials | Quantity | Unit of measurement |
|---|---|---|---|
| 1. | cement | 375 | tone |
| 2. | aggregates sorted | 1400 | mc |
| 3. | steel concrete | 150 | Tone |
| 4. | welded mesh | 100 | buc |
| 5. | timber | 20 | mc |
| 6. | compressed oxygen | 90 | mc |
| 7. | acetylene | 30 | kg |

*Table no. 22 List of fuels and lubricants used and corresponding quantities - Bumbești fall stage*

| No. crt. | Raw materials | Quantity | Unit of measurement |
|---|---|---|---|
| 1. | diesel | 2.500 | l/month |

| | | | |
|---|---|---|---|
| 2. | gasoline | 200 | l/month |
| 3. | lubricants | 50 | l/month |

*Table no. 23 List of raw materials used and quantities of each - connection to SEN*

| No. crt. | Raw materials | Quantity | Unit of measurement |
|---|---|---|---|
| 1. | cement | 882 | mc |
| 2. | metal poles | 187 | tone |
| 3. | electrical conductors | 20 | tone |
| 4. | electrodes | 1.000 | buc. |
| 5. | paint for flagging | 100 | kg |

***Electricity generation***

In order to assess the average annual electricity production to be obtained in the Livezeni-Bumbești hydropower development, on the two stages of fall, hydrological studies were prepared on the determination of flows, respectively Hydrological study on the Jiu River in 8 sections of calculation in the area of the Livezeni Dam, conducted by INHGA, the resulting data are presented below:

***Determination of morphometric elements***

The calculation sections have been indicated by the beneficiary in the order and have been identified on topographic maps at a scale of 1:25/000, based on the coordinates in 1970 stereographic projection ,,Stereo 70", provided by the beneficiary. Their sections and coordinates are located and indicated on the elevation map shown below.

They are located in the upper catchment area of the Jiu river (cadastral code: VII-1), in the Bumbești-Livezeni gorge sector.

In order to calculate the required hydrological parameters, it was necessary to previously determine the main morphometric elements of the requested section, namely the surface area (F-kmp) and the mean basin elevation ($H_{med}$ - m). The values of these elements were determined on the basis of topographic maps in GIS format, at appropriate scales, and were agreed with those existing in the National Institute of Hydrology and Water Management (INHGA).

***Calculation of multi-annual average flows and annual average monthly flows***

In order to obtain the monthly and multiannual mean flow values for the period 1967-2017 in the requested sections, an analysis of the existing hydrometric materials related to the mean runoff over the Jiu River and its tributaries in the Bumbești-Livezeni gorge area was performed.

On the basis of the obtained data, the multiannual mean flows were calculated and a zonal synthesis relation of the form $q_{med} = f(H_m)$ was then realized for the Jiu river catchment in the area of interest for the period 1967-2017. From this relation the values corresponding to the calculation sections, which correspond to the natural flow regime, were extracted. Given that sections 3 and 4, respectively 5-7, are very close to each other and therefore very similar in terms of morphometric characteristics (surface area and average altitude), the values of the multiannual mean flows in these sections are practically identical.

The values of the multiannual mean flows are thus obtained are shown in the table below.

The existing data from the hydrometric stations in the area were used to compile the monthly mean flow sheets for the period 1967-2017. By composing the average monthly flows from the hydrometric stations: Iscroni, located on the West Jiul river and Livezeni, located on the East Jiul river, the monthly mean flow sheet for section no. 1, ,,Livezeni dam" on the Jiu river was obtained. On this basis, the corresponding sheets were obtained for the other downstream sections. As in the case of the multiannual mean flows, taking into account the morphometric particularities mentioned above, for sections 3-4 and 5-7 the tables below are presented.

***Graph of the temporal variation of mean annual flows (1967-2017)***

The representation of the temporal variation of the mean annual flows in the 8 calculation sections was based on the mean annual flows presented in the mean annual flow sheets corresponding to the sections.

The same remark made above for Sections 3-4 and 5-7 (for which only one graph is presented each) holds true for the graphical representations of mean annual flows, which are presented in the figure below.

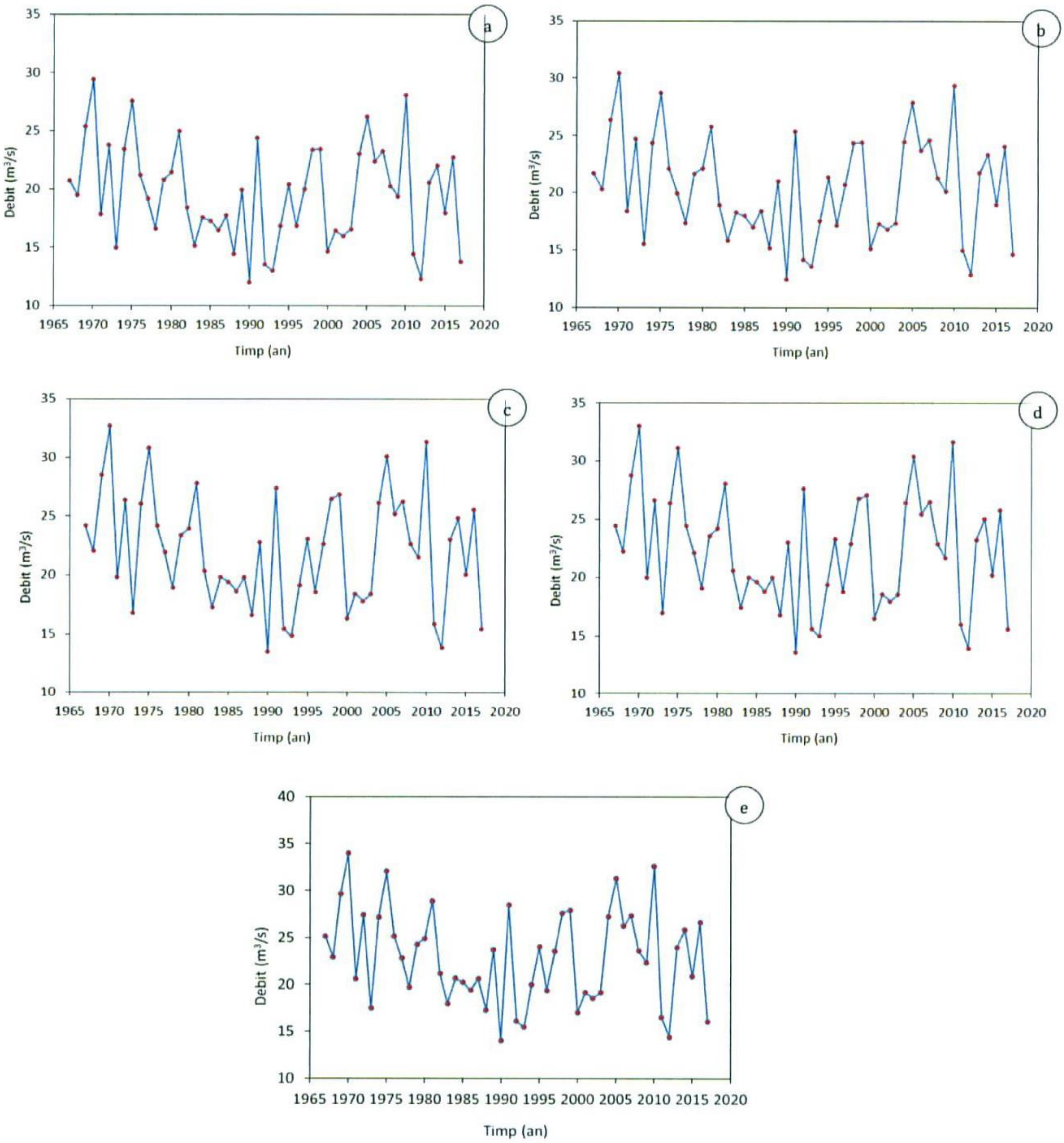



Fig. 51 Plots of temporal variation (1967-2020) of mean annual flows on the Jiu river in the sections: (a) downstream Livezeni dam - Jiu river; (b) am. R. Polatiște - R. Jiu; (c) am. Conf. R. Murga Mica and R. Murga Mare - R. Jiu; (d) catchment - R. Jiu, am. R. Dumitra and am. Valea Rea; (e) am. R. Brtacu-r. Jiu (source: INHGA-Study 8 sections)

***Calculation of maximum flows with different probabilities of exceedance***

The required values refer to maximum flows with a probability of exceedance of 1%, 2% and 5%.

It should be noted at the outset that the maximum flows with the probability specified above have been calculated for the natural flow regime under the current land use situation and do not include the safety factor.

In order to calculate the maximum flows, a detailed analysis of the existing materials on the characteristics of the maximum runoff on the Jiu River and its tributaries in the Bumbești-Livezeni gorge was carried out.

Considering the fact that the calculation sections have large areas, the maximum flows were determined using graphical relations of the form $Q_{max}\ p\% = f(F)$, valid for the Jiu river gorge sector.

*Table no. 24 Morphometric and hydrologic data on the Jiu river for the period 1967-2017*

| Râu | Cod cadastral | Coordonate topografice secțiune | Secțiune | F (km²) | $H_{med}$ (m) | $Q_{med.}$ multianual (m³/s) | $Q_{max\ p\%}$ (m³/s) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1% | 2% | 5% |
| Jiu | VII-1 | X: 372700<br>Y: 430350 | „baraj Livezeni" - r. Jiu | 966 | 1069 | 19.5 | 945 | 780 | 535 |
| | | X: 372952<br>Y: 427803 | am. conf. r. Polatiștea - r. Jiu | 1014 | 1072 | 20.5 | 970 | 805 | 545 |
| | | X: 372459<br>Y: 426368 | am. conf. r. Murga Mică - r. Jiu | 1066 | 1086 | 22,0 | 992 | 825 | 560 |
| | | X: 372530<br>Y: 425544 | am. r. Murga Mare - r. Jiu | 1067 | 1085 | 22.0 | 992 | 825 | 560 |
| | | X: 373187<br>Y: 423795 | „captare" - r. Jiu | 1077 | 1084 | 22.2 | 995 | 830 | 665 |
| | | X: 373003<br>Y: 423344 | am. r. Dumitra - r. Jiu | 1078 | 1084 | 22.2 | 995 | 830 | 665 |
| | | X: 372472<br>Y: 420498 | am. Valea Rea - r. Jiu | 1079 | 1083 | 22.2 | 995 | 830 | 666 |
| | | X: 372647<br>Y: 414381 | am. r. Bratcu - r. Jiu | 1133 | 1074 | 22,9 | 1020 | 850 | 575 |

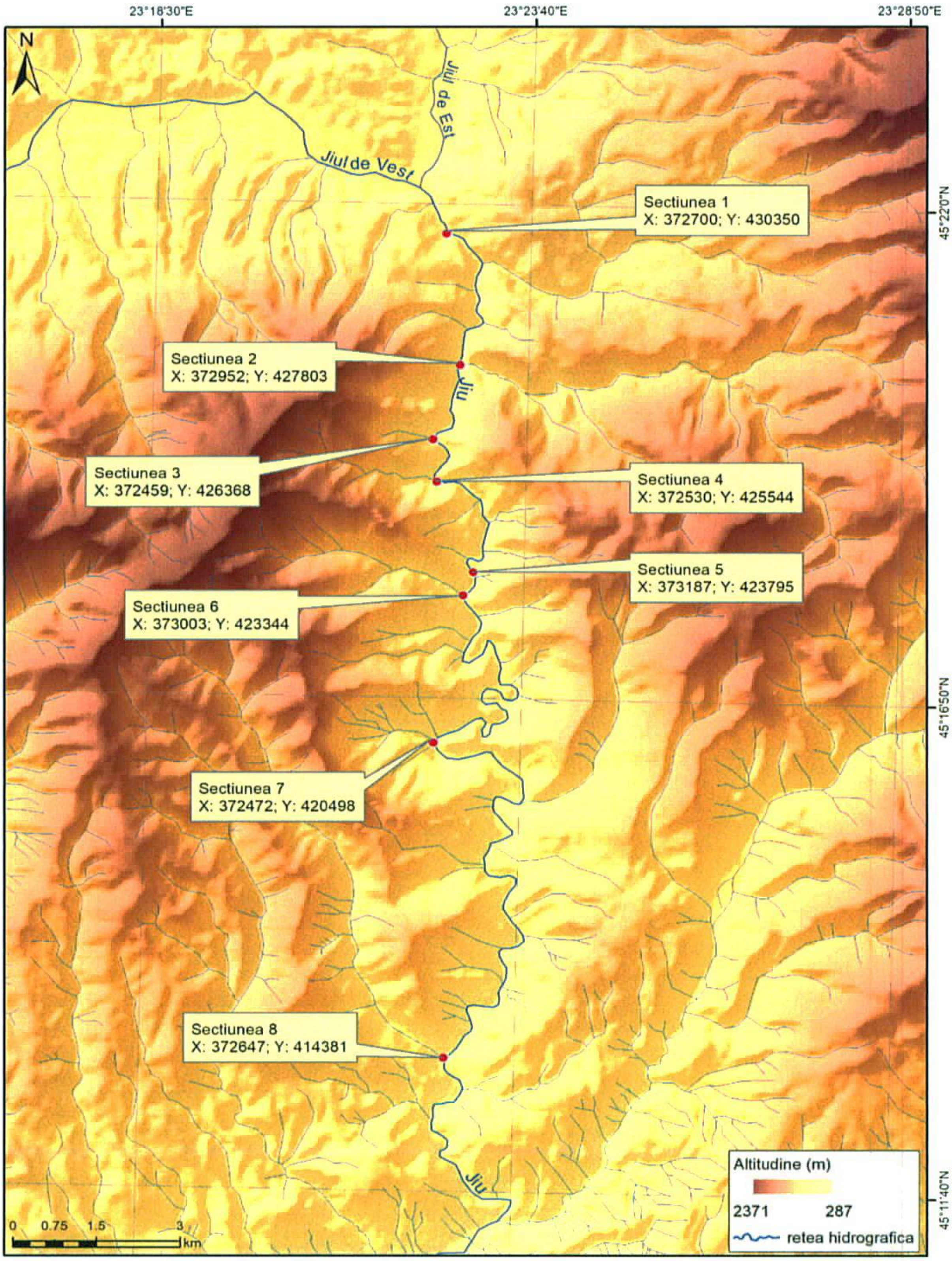



Fig. 52 Location of calculation sections

*Table no. 25 Average monthly flows on the R. Jiu in section 1: Livezeni dam*

| AN | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | MEDIA ANUALA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1967 | 9.04 | 11.5 | 26.9 | 50.8 | 60.6 | 30.9 | 17.3 | 6.89 | 9.00 | 8.71 | 6.23 | 11.0 | 20.7 |
| 1968 | 13.0 | 18.4 | 19.2 | 41.7 | 27.8 | 10.2 | 8.34 | 17.5 | 29.5 | 13.7 | 22.4 | 12.3 | 19.5 |
| 1969 | 10.7 | 14.9 | 17.2 | 39.1 | 45.5 | 57.3 | 38.1 | 13.8 | 17.1 | 7.64 | 9.96 | 33.7 | 25.4 |
| 1970 | 19.2 | 17.3 | 27.6 | 74.6 | 69.7 | 54.5 | 41.6 | 14.9 | 7.41 | 8.26 | 9.12 | 8.99 | 29.4 |
| 1971 | 20.2 | 12.1 | 21.7 | 36.0 | 34.4 | 26.2 | 14.5 | 9.66 | 13.5 | 8.25 | 7.84 | 9.84 | 17.9 |
| 1972 | 8.66 | 9.85 | 13.6 | 33.0 | 25.3 | 16.1 | 39.1 | 17.7 | 25.9 | 64.2 | 19.8 | 12.5 | 23.8 |
| 1973 | 6.63 | 7.55 | 13.5 | 31.9 | 47.1 | 19.4 | 17.1 | 9.67 | 6.59 | 7.71 | 6.34 | 5.97 | 14.9 |
| 1974 | 4.72 | 7.33 | 11.5 | 13.4 | 52.1 | 47.3 | 23.3 | 15.0 | 9.39 | 53.8 | 27.1 | 16.8 | 23.5 |
| 1975 | 14.0 | 8.51 | 16.8 | 49.1 | 40.9 | 63.3 | 48.1 | 24.0 | 25.7 | 19.7 | 12.5 | 8.83 | 27.6 |
| 1976 | 10.1 | 10.0 | 15.0 | 47.7 | 41.5 | 28.3 | 11.5 | 15.5 | 16.8 | 14.0 | 27.1 | 17.0 | 21.2 |
| 1977 | 10.4 | 23.7 | 29.3 | 50.1 | 31.9 | 16.0 | 17.4 | 11.5 | 12.9 | 8.58 | 9.95 | 8.46 | 19.2 |
| 1978 | 6.72 | 13.8 | 20.2 | 22.5 | 40.3 | 19.0 | 22.7 | 7.34 | 20.4 | 13.3 | 6.45 | 6.81 | 16.6 |
| 1979 | 17.4 | 16.0 | 16.2 | 28.0 | 48.2 | 37.9 | 19.6 | 20.6 | 10.4 | 8.20 | 15.5 | 11.5 | 20.8 |
| 1980 | 8.29 | 11.3 | 12.5 | 30.6 | 47.5 | 31.4 | 26.4 | 22.7 | 9.57 | 20.5 | 19.0 | 17.6 | 21.4 |
| 1981 | 10.3 | 11.5 | 43.3 | 31.5 | 49.1 | 34.7 | 14.2 | 11.1 | 17.4 | 30.5 | 20.5 | 25.7 | 25.0 |
| 1982 | 18.6 | 10.3 | 16.3 | 36.1 | 45.1 | 23.8 | 17.3 | 16.3 | 11.9 | 9.16 | 7.29 | 9.02 | 18.4 |
| 1983 | 9.44 | 13.5 | 17.9 | 38.5 | 19.4 | 20.4 | 20.3 | 13.7 | 9.09 | 6.90 | 5.82 | 6.91 | 15.1 |
| 1984 | 7.07 | 7.73 | 13.7 | 31.0 | 61.9 | 24.3 | 14.0 | 9.35 | 10.9 | 12.4 | 9.85 | 8.13 | 17.5 |
| 1985 | 7.63 | 9.24 | 19.3 | 45.7 | 38.8 | 25.2 | 14.9 | 10.1 | 8.71 | 5.99 | 7.66 | 14.1 | 17.3 |
| 1986 | 11.8 | 9.72 | 18.4 | 52.7 | 24.9 | 25.6 | 18.2 | 12.0 | 6.92 | 6.85 | 5.50 | 5.09 | 16.5 |
| 1987 | 6.11 | 11.4 | 12.7 | 47.6 | 62.5 | 28.0 | 11.1 | 6.79 | 4.89 | 5.65 | 7.27 | 8.68 | 17.7 |
| 1988 | 7.40 | 11.0 | 18.0 | 31.8 | 36.5 | 31.5 | 9.87 | 5.12 | 6.67 | 5.34 | 4.68 | 5.26 | 14.4 |
| 1989 | 4.92 | 8.57 | 17.3 | 31.4 | 35.0 | 43.9 | 14.2 | 14.0 | 19.7 | 20.7 | 18.0 | 11.6 | 19.9 |
| 1990 | 9.41 | 12.0 | 17.3 | 22.5 | 16.4 | 13.1 | 13.1 | 7.38 | 7.46 | 7.43 | 7.10 | 11.2 | 12.0 |
| 1991 | 9.11 | 7.51 | 19.9 | 32.1 | 56.1 | 51.5 | 43.3 | 16.3 | 11.4 | 12.3 | 20.1 | 13.1 | 24.4 |
| 1992 | 5.95 | 7.02 | 12.4 | 24.7 | 18.1 | 32.5 | 13.6 | 7.30 | 7.28 | 8.53 | 14.3 | 10.7 | 13.5 |
| 1993 | 7.00 | 6.94 | 17.8 | 29.6 | 24.6 | 11.4 | 8.36 | 7.37 | 11.3 | 10.7 | 7.07 | 13.7 | 13.0 |
| 1994 | 15.5 | 9.75 | 14.6 | 36.8 | 25.4 | 22.0 | 14.1 | 9.10 | 14.1 | 18.9 | 12.0 | 10.0 | 16.8 |
| 1995 | 9.54 | 15.3 | 17.4 | 16.9 | 53.7 | 36.2 | 15.6 | 12.4 | 19.0 | 13.1 | 13.4 | 21.8 | 20.4 |
| 1996 | 16.0 | 10.9 | 10.3 | 28.0 | 38.6 | 11.1 | 7.51 | 9.13 | 29.7 | 12.9 | 9.85 | 18.1 | 16.8 |
| 1997 | 12.5 | 11.5 | 12.7 | 28.2 | 44.7 | 25.1 | 17.8 | 27.7 | 16.4 | 15.5 | 11.8 | 15.9 | 20.0 |
| 1998 | 16.7 | 21.7 | 18.9 | 37.1 | 42.8 | 44.6 | 27.1 | 11.6 | 17.8 | 19.0 | 12.8 | 10.6 | 23.4 |
| 1999 | 10.5 | 11.7 | 25.5 | 45.1 | 33.4 | 30.2 | 36.7 | 26.8 | 21.3 | 11.0 | 13.4 | 16.3 | 23.5 |
| 2000 | 13.5 | 14.0 | 27.1 | 57.5 | 21.8 | 9.21 | 8.29 | 5.85 | 5.50 | 4.18 | 3.97 | 4.99 | 14.7 |
| 2001 | 5.37 | 5.27 | 16.7 | 31.7 | 22.1 | 18.7 | 22.0 | 13.7 | 26.3 | 13.8 | 11.3 | 10.0 | 16.4 |
| 2002 | 10.0 | 14.7 | 11.8 | 11.2 | 10.9 | 12.2 | 11.2 | 29.7 | 18.1 | 22.7 | 16.7 | 22.2 | 16.0 |
| 2003 | 14.5 | 10.7 | 13.2 | 30.5 | 28.2 | 12.1 | 10.2 | 8.66 | 13.0 | 28.4 | 17.7 | 11.7 | 16.6 |
| 2004 | 10.6 | 20.5 | 26.4 | 36.4 | 24.6 | 27.2 | 26.1 | 18.2 | 13.6 | 13.4 | 39.6 | 20.3 | 23.1 |
| 2005 | 13.3 | 17.6 | 34.9 | 52.0 | 40.6 | 21.6 | 40.0 | 32.4 | 18.6 | 12.6 | 10.7 | 20.5 | 26.2 |
| 2006 | 15.5 | 10.1 | 21.8 | 60.1 | 29.5 | 32.4 | 24.7 | 27.8 | 17.3 | 9.74 | 10.5 | 9.65 | 22.4 |
| 2007 | 15.8 | 21.8 | 34.9 | 24.2 | 35.3 | 25.9 | 9.19 | 14.9 | 23.5 | 27.6 | 27.2 | 19.2 | 23.3 |
| 2008 | 12.0 | 13.3 | 26.5 | 43.3 | 38.2 | 21.4 | 17.4 | 9.05 | 9.48 | 14.6 | 8.54 | 29.6 | 20.3 |
| 2009 | 16.1 | 15.6 | 22.9 | 39.4 | 23.2 | 21.2 | 20.3 | 12.4 | 6.61 | 10.3 | 33.2 | 11.5 | 19.4 |
| 2010 | 25.0 | 16.3 | 22.5 | 33.6 | 36.1 | 48.8 | 28.6 | 24.7 | 18.5 | 19.7 | 27.1 | 36.1 | 28.1 |
| 2011 | 17.1 | 12.7 | 19.6 | 20.1 | 17.2 | 21.5 | 22.5 | 14.9 | 7.80 | 6.89 | 6.24 | 6.49 | 14.4 |
| 2012 | 5.06 | 4.88 | 11.2 | 35.5 | 36.2 | 18.2 | 7.71 | 6.44 | 5.09 | 5.57 | 6.04 | 5.84 | 12.3 |
| 2013 | 7.80 | 12.3 | 30.2 | 61.8 | 31.2 | 18.7 | 11.2 | 8.35 | 9.70 | 23.8 | 18.1 | 13.9 | 20.6 |
| 2014 | 12.1 | 15.4 | 18.3 | 31.5 | 38.7 | 22.6 | 33.1 | 20.9 | 16.2 | 24.3 | 14.5 | 17.1 | 22.0 |
| 2015 | 26.6 | 19.1 | 20.5 | 19.1 | 34.3 | 15.0 | 9.49 | 9.78 | 12.5 | 20.4 | 14.1 | 15.0 | 18.0 |
| 2016 | 10.2 | 23.6 | 27.7 | 34.7 | 34.4 | 40.4 | 32.4 | 15.6 | 10.4 | 11.4 | 20.4 | 12.2 | 22.8 |
| 2017 | 7.93 | 11.3 | 19.3 | 20.1 | 30.6 | 12.6 | 9.72 | 9.47 | 8.37 | 8.19 | 12.5 | 15.0 | 13.8 |
| MEDIA MULTIANUALA | 11.6 | 12.7 | 19.8 | 36.0 | 36.7 | 27.3 | 20.0 | 14.2 | 13.9 | 15.0 | 13.8 | 13.7 | 19.5 |

*Table no. 26 Average monthly flows on the R. Jiu in section 2: upstream confluence of R. Polatiște*

| AN | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | MEDIA ANUALA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1967** | 9.53 | 12.1 | 28.2 | 52.7 | 63.2 | 32.5 | 18.3 | 7.16 | 9.45 | 9.08 | 6.56 | 11.8 | **21.7** |
| **1968** | 14.0 | 19.7 | 20.2 | 43.0 | 28.8 | 10.6 | 8.73 | 18.4 | 30.9 | 14.2 | 22.9 | 12.6 | **20.3** |
| **1969** | 11.0 | 15.3 | 17.8 | 40.6 | 46.9 | 60.0 | 39.8 | 14.5 | 17.5 | 7.86 | 10.3 | 34.8 | **26.4** |
| **1970** | 20.1 | 18.1 | 28.6 | 76.4 | 71.8 | 56.7 | 43.1 | 15.3 | 7.62 | 8.56 | 9.51 | 9.46 | **30.4** |
| **1971** | 21.2 | 12.6 | 22.7 | 36.9 | 35.2 | 27.1 | 14.9 | 9.80 | 14.1 | 8.40 | 8.07 | 10.2 | **18.4** |
| **1972** | 8.96 | 10.3 | 14.0 | 33.8 | 26.4 | 16.6 | 41.6 | 18.4 | 26.6 | 66.6 | 20.3 | 12.7 | **24.7** |
| **1973** | 6.69 | 7.72 | 14.1 | 33.2 | 49.8 | 20.2 | 17.9 | 10.0 | 6.70 | 7.78 | 6.42 | 6.10 | **15.5** |
| **1974** | 4.78 | 7.81 | 11.8 | 13.7 | 53.8 | 49.4 | 24.1 | 15.5 | 9.71 | 55.9 | 28.4 | 17.6 | **24.4** |
| **1975** | 14.6 | 8.70 | 17.3 | 51.0 | 42.2 | 66.5 | 50.1 | 25.3 | 26.4 | 20.2 | 12.8 | 9.11 | **28.7** |
| **1976** | 10.5 | 10.5 | 16.2 | 50.0 | 43.1 | 29.6 | 11.9 | 16.3 | 17.7 | 14.4 | 27.8 | 17.6 | **22.1** |
| **1977** | 10.7 | 24.7 | 30.3 | 51.6 | 33.0 | 16.9 | 18.3 | 12.3 | 13.5 | 8.93 | 10.2 | 8.71 | **19.9** |
| **1978** | 6.93 | 14.7 | 20.9 | 23.2 | 42.1 | 19.7 | 23.8 | 7.58 | 21.8 | 14.0 | 6.66 | 7.09 | **17.4** |
| **1979** | 18.2 | 16.9 | 16.6 | 29.0 | 49.9 | 39.9 | 20.8 | 21.7 | 10.7 | 8.42 | 15.8 | 11.7 | **21.7** |
| **1980** | 8.51 | 11.7 | 13.2 | 31.7 | 49.2 | 32.6 | 27.2 | 23.1 | 9.79 | 21.0 | 19.5 | 18.2 | **22.1** |
| **1981** | 10.6 | 11.8 | 44.4 | 32.2 | 50.8 | 35.9 | 14.7 | 11.5 | 18.0 | 31.4 | 21.3 | 26.7 | **25.8** |
| **1982** | 19.2 | 10.5 | 16.8 | 36.9 | 46.2 | 24.6 | 17.9 | 16.8 | 12.4 | 9.40 | 7.52 | 9.31 | **19.0** |
| **1983** | 9.86 | 14.3 | 18.7 | 40.1 | 20.2 | 21.6 | 21.0 | 14.1 | 9.37 | 7.10 | 6.01 | 7.15 | **15.8** |
| **1984** | 7.35 | 8.05 | 14.5 | 32.4 | 64.2 | 25.7 | 14.4 | 9.7 | 11.5 | 12.9 | 10.2 | 8.43 | **18.3** |
| **1985** | 7.89 | 9.59 | 20.7 | 47.4 | 40.4 | 26.4 | 15.4 | 10.5 | 9.00 | 6.16 | 7.88 | 14.6 | **18.0** |
| **1986** | 12.2 | 10.0 | 19.0 | 53.6 | 25.5 | 26.9 | 19.4 | 12.7 | 7.12 | 7.01 | 5.59 | 5.16 | **17.0** |
| **1987** | 6.35 | 12.2 | 13.4 | 49.4 | 65.3 | 29.2 | 11.4 | 6.95 | 4.98 | 5.72 | 7.40 | 8.92 | **18.4** |
| **1988** | 7.57 | 11.6 | 19.2 | 33.4 | 38.2 | 33.7 | 10.4 | 5.28 | 6.85 | 5.46 | 4.81 | 5.59 | **15.2** |
| **1989** | 5.11 | 9.3 | 18.6 | 33.1 | 37.4 | 46.5 | 14.7 | 14.5 | 20.6 | 21.6 | 18.8 | 12.0 | **21.0** |
| **1990** | 9.77 | 12.5 | 18.0 | 23.1 | 16.9 | 13.8 | 13.9 | 7.59 | 7.60 | 7.57 | 7.22 | 11.7 | **12.5** |
| **1991** | 9.44 | 7.82 | 20.8 | 32.9 | 57.9 | 54.2 | 45.5 | 17.3 | 11.7 | 12.6 | 20.7 | 13.5 | **25.4** |
| **1992** | 6.28 | 7.38 | 13.4 | 26.0 | 18.8 | 34.3 | 14.2 | 7.58 | 7.55 | 8.82 | 14.8 | 11.1 | **14.2** |
| **1993** | 7.17 | 7.10 | 18.7 | 31.0 | 25.6 | 11.8 | 8.59 | 7.59 | 12.1 | 11.2 | 7.38 | 14.5 | **13.6** |
| **1994** | 16.1 | 10.1 | 15.2 | 38.3 | 26.6 | 23.2 | 14.6 | 9.40 | 14.6 | 19.8 | 12.2 | 10.3 | **17.5** |
| **1995** | 9.94 | 16.0 | 17.9 | 18.1 | 56.2 | 39.2 | 16.3 | 12.8 | 19.9 | 13.5 | 14.0 | 22.4 | **21.3** |
| **1996** | 16.4 | 11.1 | 10.5 | 29.0 | 39.5 | 11.3 | 7.56 | 9.22 | 30.4 | 13.1 | 10.0 | 18.4 | **17.2** |
| **1997** | 12.7 | 11.7 | 13.0 | 29.8 | 46.3 | 26.0 | 18.3 | 29.1 | 17.0 | 16.0 | 11.9 | 16.4 | **20.7** |
| **1998** | 17.1 | 22.5 | 19.3 | 38.7 | 44.4 | 47.2 | 28.9 | 11.9 | 18.3 | 19.9 | 13.2 | 10.8 | **24.3** |
| **1999** | 10.7 | 12.3 | 27.2 | 47.0 | 35.0 | 32.3 | 38.3 | 27.9 | 21.6 | 11.1 | 13.6 | 16.6 | **24.4** |
| **2000** | 13.6 | 14.3 | 28.6 | 59.7 | 22.6 | 9.30 | 8.35 | 5.86 | 5.54 | 4.19 | 3.98 | 5.06 | **15.1** |
| **2001** | 5.42 | 5.34 | 17.7 | 33.4 | 23.0 | 20.0 | 23.3 | 14.4 | 28.3 | 14.6 | 11.8 | 10.4 | **17.3** |
| **2002** | 10.5 | 15.8 | 12.6 | 12.2 | 11.6 | 12.9 | 11.7 | 31.4 | 19.0 | 23.8 | 17.5 | 22.8 | **16.8** |
| **2003** | 15.1 | 11.0 | 13.8 | 32.1 | 29.1 | 12.6 | 10.6 | 8.86 | 13.5 | 30.1 | 18.8 | 12.3 | **17.3** |
| **2004** | 11.2 | 22.0 | 28.5 | 38.4 | 26.9 | 28.9 | 27.0 | 19.1 | 14.0 | 13.9 | 42.1 | 22.2 | **24.5** |
| **2005** | 14.1 | 18.6 | 37.3 | 54.6 | 43.4 | 23.6 | 42.5 | 34.8 | 19.7 | 13.5 | 11.1 | 21.7 | **27.9** |
| **2006** | 16.4 | 10.6 | 23.3 | 62.5 | 31.2 | 34.3 | 25.7 | 30.0 | 18.8 | 10.3 | 11.1 | 10.2 | **23.7** |
| **2007** | 16.9 | 23.2 | 36.9 | 25.3 | 37.2 | 27.0 | 9.48 | 15.4 | 24.6 | 29.7 | 29.4 | 20.3 | **24.6** |
| **2008** | 12.5 | 14.1 | 27.9 | 45.5 | 40.6 | 22.5 | 18.3 | 9.40 | 9.70 | 15.4 | 8.81 | 31.0 | **21.3** |
| **2009** | 16.8 | 16.3 | 24.3 | 40.7 | 24.0 | 22.1 | 21.3 | 12.7 | 6.66 | 10.6 | 34.1 | 11.9 | **20.1** |
| **2010** | 26.0 | 17.2 | 23.5 | 34.9 | 37.8 | 51.1 | 30.4 | 25.8 | 19.3 | 20.3 | 28.3 | 38.0 | **29.4** |
| **2011** | 17.8 | 13.2 | 20.4 | 20.8 | 18.1 | 22.8 | 23.5 | 15.6 | 7.92 | 6.95 | 6.27 | 6.58 | **15.0** |
| **2012** | 5.13 | 4.96 | 11.9 | 37.5 | 38.2 | 19.1 | 7.96 | 6.64 | 5.17 | 5.71 | 6.30 | 6.04 | **12.9** |
| **2013** | 8.24 | 12.9 | 31.7 | 64.1 | 32.5 | 20.7 | 11.9 | 8.84 | 10.4 | 25.5 | 19.5 | 15.0 | **21.8** |
| **2014** | 13.2 | 16.5 | 19.2 | 33.3 | 41.0 | 24.1 | 35.6 | 22.2 | 16.8 | 25.5 | 15.2 | 17.9 | **23.4** |
| **2015** | 28.5 | 20.3 | 21.6 | 20.4 | 36.1 | 16.1 | 10.1 | 10.2 | 13.1 | 21.2 | 14.7 | 15.7 | **19.0** |
| **2016** | 10.6 | 24.6 | 28.9 | 36.5 | 36.4 | 42.9 | 34.4 | 16.4 | 10.9 | 12.1 | 21.8 | 13.0 | **24.0** |
| **2017** | 8.31 | 11.9 | 20.8 | 21.4 | 32.8 | 13.5 | 10.2 | 9.83 | 8.77 | 8.65 | 13.2 | 16.1 | **14.6** |
| **MEDIA MULTIANUALA** | **12.1** | **13.3** | **20.8** | **37.5** | **38.3** | **28.7** | **20.9** | **14.8** | **14.4** | **15.6** | **14.4** | **14.3** | **20.2** |

*Table no. 27 Mean monthly flows on the R. Jiu in sections 3 and 4: upstream confluence of R. Murga Mică and upstream conf. R. Murga Mare*

| AN | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | MEDIA ANUALA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1967 | 11.1 | 13.0 | 31.3 | 57.4 | 68.0 | 36.1 | 20.6 | 8.46 | 11.0 | 10.8 | 8.32 | 14.1 | 24.2 |
| 1968 | 15.2 | 20.7 | 21.7 | 46.9 | 31.2 | 11.6 | 9.51 | 20.1 | 33.3 | 15.7 | 24.8 | 13.9 | 22.0 |
| 1969 | 12.1 | 16.3 | 19.1 | 43.7 | 50.8 | 65.5 | 43.2 | 16.3 | 18.7 | 8.35 | 10.8 | 37.2 | 28.5 |
| 1970 | 22.0 | 19.1 | 30.4 | 82.2 | 76.7 | 62.1 | 46.3 | 16.2 | 8.08 | 9.06 | 10.1 | 10.1 | 32.7 |
| 1971 | 22.4 | 13.3 | 24.2 | 39.5 | 38.0 | 29.8 | 16.2 | 10.4 | 15.4 | 9.05 | 8.56 | 10.8 | 19.8 |
| 1972 | 9.57 | 11.2 | 15.1 | 36.3 | 28.6 | 18.4 | 44.0 | 19.8 | 28.2 | 70.1 | 21.4 | 13.7 | 26.4 |
| 1973 | 7.46 | 8.14 | 14.8 | 35.6 | 54.2 | 22.4 | 19.3 | 11.0 | 7.32 | 8.37 | 6.91 | 6.51 | 16.8 |
| 1974 | 5.10 | 8.22 | 12.8 | 14.8 | 57.7 | 53.4 | 26.0 | 16.6 | 10.3 | 59.5 | 30.5 | 18.6 | 26.1 |
| 1975 | 15.5 | 9.29 | 18.6 | 54.2 | 45.7 | 72.2 | 54.0 | 28.0 | 28.0 | 21.1 | 13.5 | 9.66 | 30.8 |
| 1976 | 11.1 | 11.0 | 16.8 | 55.5 | 47.6 | 32.2 | 13.2 | 17.9 | 19.7 | 15.9 | 30.1 | 19.1 | 24.2 |
| 1977 | 11.6 | 26.3 | 33.0 | 57.1 | 36.9 | 19.4 | 20.1 | 13.7 | 14.8 | 9.80 | 11.0 | 9.40 | 21.9 |
| 1978 | 7.28 | 15.7 | 22.8 | 25.0 | 46.9 | 21.8 | 25.7 | 8.27 | 23.8 | 15.1 | 7.25 | 7.67 | 18.9 |
| 1979 | 19.1 | 18.1 | 17.9 | 31.2 | 53.5 | 43.5 | 22.8 | 23.5 | 11.8 | 9.3 | 16.8 | 12.6 | 23.3 |
| 1980 | 9.19 | 12.5 | 14.3 | 34.6 | 52.9 | 35.6 | 29.3 | 24.6 | 10.7 | 22.6 | 21.0 | 19.9 | 23.9 |
| 1981 | 11.5 | 12.6 | 48.3 | 34.7 | 55.0 | 39.1 | 15.9 | 12.3 | 19.1 | 33.5 | 22.7 | 28.7 | 27.8 |
| 1982 | 20.4 | 11.2 | 17.6 | 39.6 | 49.0 | 26.5 | 19.4 | 18.4 | 14.0 | 10.2 | 8.14 | 10.1 | 20.4 |
| 1983 | 10.7 | 15.6 | 20.5 | 43.9 | 22.4 | 24.2 | 22.7 | 15.3 | 10.2 | 7.70 | 6.52 | 7.60 | 17.3 |
| 1984 | 7.79 | 8.49 | 15.1 | 35.9 | 70.0 | 28.3 | 15.4 | 10.3 | 12.5 | 14.1 | 11.0 | 9.13 | 19.8 |
| 1985 | 8.47 | 10.1 | 21.7 | 52.0 | 44.0 | 28.8 | 16.6 | 11.3 | 9.76 | 6.66 | 8.43 | 15.5 | 19.4 |
| 1986 | 13.1 | 10.6 | 20.1 | 57.9 | 27.6 | 30.0 | 22.3 | 15.1 | 7.92 | 7.69 | 6.04 | 5.55 | 18.7 |
| 1987 | 6.87 | 12.9 | 14.2 | 53.3 | 70.2 | 31.6 | 12.4 | 7.50 | 5.35 | 6.07 | 7.84 | 9.42 | 19.8 |
| 1988 | 8.05 | 12.4 | 20.4 | 36.8 | 41.6 | 37.3 | 11.7 | 5.97 | 7.63 | 6.07 | 5.36 | 6.19 | 16.6 |
| 1989 | 5.62 | 10.4 | 19.8 | 36.0 | 40.8 | 50.3 | 15.8 | 15.4 | 22.1 | 23.7 | 20.4 | 13.0 | 22.8 |
| 1990 | 10.5 | 13.3 | 19.4 | 24.8 | 18.7 | 15.4 | 15.2 | 8.20 | 8.05 | 7.98 | 7.58 | 12.7 | 13.5 |
| 1991 | 10.2 | 8.45 | 22.1 | 35.4 | 62.2 | 59.3 | 49.6 | 19.0 | 12.5 | 13.3 | 22.0 | 14.4 | 27.4 |
| 1992 | 6.93 | 7.96 | 14.5 | 28.7 | 20.6 | 36.9 | 15.7 | 8.37 | 8.26 | 9.68 | 16.1 | 12.1 | 15.5 |
| 1993 | 7.77 | 7.60 | 20.3 | 33.9 | 28.3 | 12.9 | 9.44 | 8.39 | 13.9 | 12.2 | 8.12 | 15.5 | 14.9 |
| 1994 | 17.2 | 11.0 | 16.4 | 41.7 | 30.0 | 25.4 | 15.9 | 10.4 | 15.8 | 21.8 | 13.3 | 11.4 | 19.2 |
| 1995 | 10.8 | 17.2 | 19.4 | 20.8 | 61.5 | 43.3 | 17.6 | 13.3 | 21.1 | 14.0 | 14.4 | 23.4 | 23.1 |
| 1996 | 17.7 | 11.7 | 11.1 | 31.8 | 43.3 | 12.4 | 8.31 | 10.0 | 32.4 | 14.1 | 10.7 | 19.8 | 18.6 |
| 1997 | 13.4 | 12.4 | 13.8 | 32.2 | 51.6 | 28.4 | 19.8 | 32.3 | 19.1 | 17.7 | 13.0 | 18.0 | 22.7 |
| 1998 | 18.3 | 24.1 | 20.6 | 42.5 | 48.4 | 51.7 | 32.5 | 12.8 | 19.5 | 21.8 | 14.4 | 11.6 | 26.5 |
| 1999 | 11.3 | 13.1 | 29.3 | 52.6 | 38.6 | 37.0 | 42.0 | 30.7 | 23.0 | 12.0 | 14.5 | 17.9 | 26.8 |
| 2000 | 14.5 | 15.2 | 30.6 | 65.1 | 24.8 | 10.2 | 9.03 | 6.37 | 6.07 | 4.59 | 4.34 | 5.38 | 16.4 |
| 2001 | 5.68 | 5.6 | 18.5 | 35.6 | 25.2 | 21.4 | 24.7 | 14.9 | 30.6 | 15.7 | 12.4 | 10.8 | 18.4 |
| 2002 | 10.9 | 16.5 | 13.2 | 12.9 | 12.3 | 13.7 | 12.6 | 33.9 | 20.1 | 25.2 | 18.5 | 24.2 | 17.8 |
| 2003 | 15.6 | 11.4 | 14.2 | 34.6 | 32.0 | 13.5 | 11.1 | 9.2 | 14.0 | 32.3 | 20.2 | 12.9 | 18.4 |
| 2004 | 11.6 | 22.9 | 30.6 | 41.3 | 29.2 | 31.1 | 28.1 | 19.9 | 14.6 | 14.6 | 46.4 | 23.8 | 26.2 |
| 2005 | 14.7 | 19.4 | 39.1 | 59.4 | 47.9 | 27.2 | 47.4 | 37.0 | 20.6 | 14.2 | 11.8 | 22.7 | 30.1 |
| 2006 | 17.6 | 10.9 | 24.4 | 66.9 | 33.7 | 36.6 | 26.6 | 32.2 | 20.2 | 11.0 | 11.8 | 10.6 | 25.2 |
| 2007 | 17.7 | 24.2 | 39.3 | 26.8 | 40.6 | 28.1 | 9.94 | 16.4 | 26.5 | 31.9 | 32.5 | 21.4 | 26.3 |
| 2008 | 12.9 | 14.6 | 29.2 | 48.9 | 44.0 | 24.0 | 19.6 | 9.94 | 10.0 | 16.3 | 9.32 | 33.3 | 22.7 |
| 2009 | 17.9 | 17.4 | 25.7 | 43.4 | 26.0 | 24.3 | 23.4 | 13.4 | 7.03 | 11.1 | 36.0 | 12.6 | 21.5 |
| 2010 | 27.3 | 17.9 | 25.0 | 37.6 | 41.1 | 54.4 | 32.4 | 27.8 | 20.6 | 21.3 | 30.0 | 40.6 | 31.3 |
| 2011 | 18.7 | 13.7 | 21.2 | 21.8 | 19.6 | 25.0 | 24.9 | 16.6 | 8.26 | 7.26 | 6.55 | 6.89 | 15.9 |
| 2012 | 5.38 | 5.17 | 12.5 | 40.8 | 42.0 | 20.7 | 8.33 | 6.95 | 5.42 | 6.04 | 6.66 | 6.34 | 13.9 |
| 2013 | 8.68 | 13.5 | 33.8 | 68.0 | 34.6 | 21.8 | 12.7 | 9.24 | 10.8 | 27.2 | 20.6 | 15.6 | 23.0 |
| 2014 | 13.9 | 17.4 | 20.2 | 35.6 | 43.9 | 25.7 | 39.3 | 24.0 | 17.3 | 26.6 | 15.7 | 18.4 | 24.8 |
| 2015 | 29.8 | 21.1 | 22.6 | 22.4 | 38.7 | 17.1 | 10.5 | 10.6 | 13.8 | 22.1 | 15.3 | 16.7 | 20.0 |
| 2016 | 11.2 | 26.0 | 30.9 | 39.4 | 39.6 | 45.9 | 36.2 | 17.0 | 11.2 | 12.6 | 23.3 | 13.5 | 25.6 |
| 2017 | 8.78 | 12.3 | 22.0 | 22.7 | 36.0 | 14.3 | 10.5 | 10.1 | 9.09 | 8.98 | 13.7 | 16.9 | 15.4 |
| MEDIA MULTIANUALA | 12.9 | 14.1 | 22.2 | 40.6 | 41.6 | 31.3 | 22.7 | 16.0 | 15.5 | 16.7 | 15.4 | 15.2 | 22.0 |

*Table no. 28 Average monthly flows on the R. Jiu in sections 5, 6 and 7: R. Jiu -Captare; R. Jiu am. R Dumitra; R. Jiu am Valea Rea*

| AN | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | MEDIA ANUALA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1967 | 11.2 | 13.2 | 31.6 | 58.0 | 68.7 | 36.5 | 20.8 | 8.55 | 11.1 | 10.9 | 8.40 | 14.2 | 24.4 |
| 1968 | 15.4 | 20.9 | 21.9 | 47.4 | 31.5 | 11.7 | 9.61 | 20.3 | 33.6 | 15.9 | 25.0 | 14.0 | 22.3 |
| 1969 | 12.2 | 16.5 | 19.3 | 44.2 | 51.3 | 66.1 | 43.6 | 16.4 | 18.9 | 8.44 | 10.9 | 37.6 | 28.8 |
| 1970 | 22.2 | 19.3 | 30.7 | 83.0 | 77.4 | 62.7 | 46.7 | 16.4 | 8.16 | 9.15 | 10.2 | 10.2 | 33.0 |
| 1971 | 22.7 | 13.5 | 24.4 | 39.8 | 38.3 | 30.1 | 16.4 | 10.5 | 15.5 | 9.14 | 8.65 | 10.9 | 20.0 |
| 1972 | 9.66 | 11.3 | 15.3 | 36.7 | 28.8 | 18.6 | 44.5 | 20.0 | 28.5 | 70.8 | 21.7 | 13.8 | 26.6 |
| 1973 | 7.54 | 8.22 | 15.0 | 36.0 | 54.8 | 22.7 | 19.5 | 11.1 | 7.39 | 8.45 | 6.98 | 6.57 | 17.0 |
| 1974 | 5.15 | 8.30 | 12.9 | 14.9 | 58.2 | 53.9 | 26.3 | 16.7 | 10.4 | 60.1 | 30.8 | 18.7 | 26.4 |
| 1975 | 15.7 | 9.38 | 18.8 | 54.7 | 46.2 | 72.9 | 54.5 | 28.3 | 28.3 | 21.3 | 13.7 | 9.75 | 31.1 |
| 1976 | 11.2 | 11.1 | 17.0 | 56.0 | 48.1 | 32.5 | 13.4 | 18.1 | 19.9 | 16.1 | 30.4 | 19.3 | 24.4 |
| 1977 | 11.7 | 26.6 | 33.3 | 57.7 | 37.3 | 19.6 | 20.3 | 13.8 | 14.9 | 9.90 | 11.1 | 9.49 | 22.1 |
| 1978 | 7.36 | 15.9 | 23.0 | 25.3 | 47.3 | 22.0 | 26.0 | 8.35 | 24.0 | 15.3 | 7.32 | 7.74 | 19.1 |
| 1979 | 19.3 | 18.3 | 18.1 | 31.5 | 54.1 | 43.9 | 23.0 | 23.8 | 11.9 | 9.42 | 17.0 | 12.7 | 23.6 |
| 1980 | 9.28 | 12.6 | 14.4 | 35.0 | 53.5 | 36.0 | 29.6 | 24.9 | 10.8 | 22.8 | 21.3 | 20.0 | 24.2 |
| 1981 | 11.6 | 12.8 | 48.8 | 35.0 | 55.6 | 39.4 | 16.0 | 12.4 | 19.3 | 33.9 | 22.9 | 29.0 | 28.1 |
| 1982 | 20.6 | 11.3 | 17.7 | 40.0 | 49.4 | 26.8 | 19.6 | 18.6 | 14.1 | 10.3 | 8.22 | 10.2 | 20.6 |
| 1983 | 10.8 | 15.7 | 20.7 | 44.3 | 22.6 | 24.4 | 22.9 | 15.4 | 10.3 | 7.78 | 6.58 | 7.67 | 17.5 |
| 1984 | 7.86 | 8.6 | 15.3 | 36.3 | 70.6 | 28.5 | 15.6 | 10.4 | 12.6 | 14.2 | 11.1 | 9.22 | 20.0 |
| 1985 | 8.56 | 10.2 | 21.9 | 52.5 | 44.4 | 29.1 | 16.8 | 11.4 | 9.85 | 6.72 | 8.52 | 15.7 | 19.6 |
| 1986 | 13.2 | 10.7 | 20.3 | 58.4 | 27.9 | 30.2 | 22.5 | 15.3 | 8.00 | 7.76 | 6.10 | 5.61 | 18.8 |
| 1987 | 6.93 | 13.0 | 14.4 | 53.8 | 70.9 | 31.9 | 12.6 | 7.57 | 5.41 | 6.13 | 7.92 | 9.51 | 20.0 |
| 1988 | 8.13 | 12.5 | 20.6 | 37.2 | 42.0 | 37.7 | 11.8 | 6.03 | 7.71 | 6.13 | 5.41 | 6.25 | 16.8 |
| 1989 | 5.68 | 10.5 | 20.0 | 36.4 | 41.2 | 50.8 | 15.9 | 15.5 | 22.3 | 23.9 | 20.7 | 13.2 | 23.0 |
| 1990 | 10.6 | 13.4 | 19.5 | 25.1 | 18.9 | 15.6 | 15.3 | 8.29 | 8.13 | 8.06 | 7.66 | 12.8 | 13.6 |
| 1991 | 10.3 | 8.54 | 22.4 | 35.8 | 62.8 | 59.9 | 50.1 | 19.2 | 12.6 | 13.4 | 22.2 | 14.6 | 27.6 |
| 1992 | 7.00 | 8.04 | 14.7 | 29.0 | 20.8 | 37.2 | 15.8 | 8.45 | 8.35 | 9.77 | 16.2 | 12.2 | 15.6 |
| 1993 | 7.85 | 7.68 | 20.5 | 34.2 | 28.6 | 13.0 | 9.53 | 8.47 | 14.1 | 12.3 | 8.2 | 15.7 | 15.0 |
| 1994 | 17.4 | 11.1 | 16.6 | 42.1 | 30.3 | 25.6 | 16.0 | 10.5 | 16.0 | 22.1 | 13.5 | 11.5 | 19.4 |
| 1995 | 10.9 | 17.3 | 19.6 | 21.0 | 62.2 | 43.7 | 17.7 | 13.4 | 21.3 | 14.1 | 14.6 | 23.7 | 23.3 |
| 1996 | 17.8 | 11.9 | 11.3 | 32.1 | 43.7 | 12.6 | 8.40 | 10.1 | 32.8 | 14.2 | 10.8 | 20.0 | 18.8 |
| 1997 | 13.5 | 12.5 | 13.9 | 32.5 | 52.1 | 28.7 | 20.0 | 32.7 | 19.3 | 17.9 | 13.1 | 18.2 | 22.9 |
| 1998 | 18.5 | 24.3 | 20.8 | 42.9 | 48.9 | 52.3 | 32.8 | 13.0 | 19.7 | 22.0 | 14.5 | 11.7 | 26.8 |
| 1999 | 11.4 | 13.2 | 29.6 | 53.1 | 38.9 | 37.3 | 42.5 | 31.0 | 23.3 | 12.2 | 14.7 | 18.1 | 27.1 |
| 2000 | 14.7 | 15.4 | 30.9 | 65.8 | 25.0 | 10.3 | 9.12 | 6.43 | 6.13 | 4.63 | 4.38 | 5.44 | 16.5 |
| 2001 | 5.74 | 5.6 | 18.7 | 36.0 | 25.5 | 21.6 | 24.9 | 15.0 | 30.9 | 15.8 | 12.5 | 10.9 | 18.6 |
| 2002 | 11.0 | 16.7 | 13.4 | 13.0 | 12.4 | 13.8 | 12.7 | 34.3 | 20.3 | 25.5 | 18.7 | 24.5 | 18.0 |
| 2003 | 15.7 | 11.5 | 14.4 | 34.9 | 32.3 | 13.6 | 11.2 | 9.30 | 14.1 | 32.6 | 20.4 | 13.0 | 18.6 |
| 2004 | 11.7 | 23.1 | 30.9 | 41.7 | 29.5 | 31.4 | 28.4 | 20.1 | 14.8 | 14.7 | 46.8 | 24.0 | 26.4 |
| 2005 | 14.8 | 19.6 | 39.5 | 60.0 | 48.4 | 27.4 | 47.8 | 37.4 | 20.8 | 14.4 | 11.9 | 22.9 | 30.4 |
| 2006 | 17.8 | 11.0 | 24.7 | 67.6 | 34.0 | 36.9 | 26.8 | 32.5 | 20.4 | 11.1 | 11.9 | 10.7 | 25.5 |
| 2007 | 17.9 | 24.4 | 39.7 | 27.1 | 41.0 | 28.4 | 10.0 | 16.5 | 26.7 | 32.2 | 32.8 | 21.6 | 26.5 |
| 2008 | 13.1 | 14.7 | 29.5 | 49.4 | 44.4 | 24.3 | 19.8 | 10.0 | 10.1 | 16.5 | 9.41 | 33.7 | 22.9 |
| 2009 | 18.1 | 17.5 | 25.9 | 43.8 | 26.3 | 24.5 | 23.7 | 13.5 | 7.10 | 11.2 | 36.4 | 12.7 | 21.7 |
| 2010 | 27.6 | 18.1 | 25.3 | 38.0 | 41.5 | 55.0 | 32.8 | 28.1 | 20.8 | 21.5 | 30.3 | 41.0 | 31.7 |
| 2011 | 18.9 | 13.8 | 21.4 | 22.1 | 19.8 | 25.3 | 25.2 | 16.7 | 8.34 | 7.34 | 6.61 | 6.96 | 16.0 |
| 2012 | 5.44 | 5.22 | 12.6 | 41.2 | 42.4 | 20.9 | 8.42 | 7.02 | 5.48 | 6.10 | 6.72 | 6.40 | 14.0 |
| 2013 | 8.76 | 13.6 | 34.1 | 68.7 | 34.9 | 22.1 | 12.8 | 9.33 | 10.9 | 27.5 | 20.8 | 15.7 | 23.3 |
| 2014 | 14.0 | 17.5 | 20.4 | 35.9 | 44.3 | 26.0 | 39.7 | 24.2 | 17.4 | 26.8 | 15.8 | 18.6 | 25.1 |
| 2015 | 30.1 | 21.3 | 22.8 | 22.6 | 39.1 | 17.3 | 10.6 | 10.7 | 13.9 | 22.3 | 15.5 | 16.8 | 20.2 |
| 2016 | 11.3 | 26.3 | 31.2 | 39.8 | 40.0 | 46.3 | 36.5 | 17.1 | 11.3 | 12.7 | 23.6 | 13.7 | 25.8 |
| 2017 | 8.86 | 12.4 | 22.2 | 22.9 | 36.3 | 14.5 | 10.6 | 10.2 | 9.18 | 9.07 | 13.9 | 17.1 | 15.6 |
| MEDIA MULTIANUALA | 13.0 | 14.2 | 22.4 | 41.0 | 42.1 | 31.6 | 22.9 | 16.1 | 15.6 | 16.9 | 15.6 | 15.4 | 22.2 |

*Table nr. 29 Average monthly flows on R. Jiu in section 8 R. Jiu am. R Bratcu*

| AN | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | MEDIA ANUALA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1967 | 11.5 | 13.6 | 32.5 | 59.7 | 70.7 | 37.6 | 21.4 | 8.8 | 11.4 | 11.2 | 8.65 | 14.6 | **25.1** |
| 1968 | 15.8 | 21.5 | 22.5 | 48.8 | 32.4 | 12.0 | 9.9 | 20.9 | 34.6 | 16.4 | 25.8 | 14.4 | **22.9** |
| 1969 | 12.5 | 16.9 | 19.8 | 45.5 | 52.9 | 68.1 | 44.9 | 16.9 | 19.5 | 8.69 | 11.2 | 38.7 | **29.6** |
| 1970 | 22.8 | 19.9 | 31.6 | 85.5 | 79.7 | 64.6 | 48.1 | 16.9 | 8.40 | 9.42 | 10.5 | 10.5 | **34.0** |
| 1971 | 23.3 | 13.9 | 25.1 | 41.0 | 39.5 | 31.0 | 16.9 | 10.8 | 16.0 | 9.41 | 8.90 | 11.3 | **20.6** |
| 1972 | 9.95 | 11.6 | 15.7 | 37.8 | 29.7 | 19.1 | 45.8 | 20.6 | 29.3 | 72.9 | 22.3 | 14.2 | **27.4** |
| 1973 | 7.76 | 8.47 | 15.4 | 37.0 | 56.4 | 23.3 | 20.1 | 11.4 | 7.61 | 8.70 | 7.19 | 6.77 | **17.5** |
| 1974 | 5.30 | 8.55 | 13.3 | 15.4 | 60.0 | 55.5 | 27.1 | 17.2 | 10.7 | 61.8 | 31.7 | 19.3 | **27.2** |
| 1975 | 16.2 | 9.66 | 19.4 | 56.3 | 47.5 | 75.1 | 56.1 | 29.1 | 29.2 | 21.9 | 14.1 | 10.0 | **32.1** |
| 1976 | 11.5 | 11.4 | 17.5 | 57.7 | 49.5 | 33.5 | 13.8 | 18.7 | 20.5 | 16.6 | 31.3 | 19.9 | **25.1** |
| 1977 | 12.0 | 27.4 | 34.3 | 59.4 | 38.4 | 20.2 | 20.9 | 14.3 | 15.4 | 10.2 | 11.4 | 9.77 | **22.8** |
| 1978 | 7.57 | 16.3 | 23.7 | 26.0 | 48.7 | 22.7 | 26.7 | 8.60 | 24.7 | 15.7 | 7.54 | 7.97 | **19.7** |
| 1979 | 19.8 | 18.8 | 18.6 | 32.4 | 55.7 | 45.3 | 23.7 | 24.5 | 12.2 | 9.69 | 17.5 | 13.1 | **24.3** |
| 1980 | 9.56 | 13.0 | 14.9 | 36.0 | 55.1 | 37.1 | 30.5 | 25.6 | 11.2 | 23.5 | 21.9 | 20.6 | **24.9** |
| 1981 | 12.0 | 13.1 | 50.3 | 36.0 | 57.2 | 40.6 | 16.5 | 12.8 | 19.8 | 34.9 | 23.6 | 29.8 | **28.9** |
| 1982 | 21.2 | 11.7 | 18.3 | 41.2 | 50.9 | 27.6 | 20.2 | 19.2 | 14.6 | 10.6 | 8.46 | 10.5 | **21.2** |
| 1983 | 11.1 | 16.2 | 21.3 | 45.7 | 23.3 | 25.1 | 23.6 | 15.9 | 10.6 | 8.01 | 6.78 | 7.90 | **18.0** |
| 1984 | 8.10 | 8.8 | 15.7 | 37.4 | 72.7 | 29.4 | 16.1 | 10.7 | 13.0 | 14.6 | 11.4 | 9.50 | **20.6** |
| 1985 | 8.81 | 10.5 | 22.5 | 54.1 | 45.7 | 29.9 | 17.3 | 11.7 | 10.1 | 6.92 | 8.77 | 16.1 | **20.2** |
| 1986 | 13.6 | 11.0 | 20.9 | 60.2 | 28.7 | 31.1 | 23.2 | 15.7 | 8.24 | 7.99 | 6.28 | 5.77 | **19.4** |
| 1987 | 7.14 | 13.4 | 14.8 | 55.4 | 73.0 | 32.8 | 12.9 | 7.80 | 5.57 | 6.31 | 8.15 | 9.79 | **20.6** |
| 1988 | 8.37 | 12.9 | 21.2 | 38.3 | 43.3 | 38.8 | 12.2 | 6.21 | 7.93 | 6.32 | 5.57 | 6.43 | **17.3** |
| 1989 | 5.85 | 10.8 | 20.6 | 37.4 | 42.5 | 52.3 | 16.4 | 16.0 | 23.0 | 24.6 | 21.3 | 13.6 | **23.7** |
| 1990 | 11.0 | 13.8 | 20.1 | 25.8 | 19.5 | 16.0 | 15.8 | 8.53 | 8.37 | 8.30 | 7.89 | 13.2 | **14.0** |
| 1991 | 10.6 | 8.79 | 23.0 | 36.8 | 64.7 | 61.7 | 51.6 | 19.8 | 13.0 | 13.8 | 22.9 | 15.0 | **28.5** |
| 1992 | 7.21 | 8.28 | 15.1 | 29.9 | 21.4 | 38.3 | 16.3 | 8.70 | 8.6 | 10.1 | 16.7 | 12.6 | **16.1** |
| 1993 | 8.08 | 7.91 | 21.1 | 35.2 | 29.4 | 13.4 | 9.81 | 8.72 | 14.5 | 12.7 | 8.45 | 16.2 | **15.5** |
| 1994 | 17.9 | 11.5 | 17.1 | 43.3 | 31.2 | 26.4 | 16.5 | 10.8 | 16.5 | 22.7 | 13.9 | 11.9 | **20.0** |
| 1995 | 11.3 | 17.8 | 20.2 | 21.6 | 64.0 | 45.0 | 18.3 | 13.8 | 22.0 | 14.5 | 15.0 | 24.4 | **24.0** |
| 1996 | 18.4 | 12.2 | 11.6 | 33.1 | 45.0 | 12.9 | 8.6 | 10.4 | 33.7 | 14.7 | 11.1 | 20.6 | **19.4** |
| 1997 | 13.9 | 12.9 | 14.3 | 33.5 | 53.7 | 29.6 | 20.6 | 33.6 | 19.9 | 18.5 | 13.5 | 18.7 | **23.6** |
| 1998 | 19.0 | 25.1 | 21.4 | 44.2 | 50.3 | 53.8 | 33.8 | 13.4 | 20.3 | 22.6 | 15.0 | 12.1 | **27.6** |
| 1999 | 11.7 | 13.6 | 30.5 | 54.7 | 40.1 | 38.4 | 43.7 | 31.9 | 24.0 | 12.5 | 15.1 | 18.6 | **27.9** |
| 2000 | 15.1 | 15.8 | 31.8 | 67.7 | 25.8 | 10.6 | 9.39 | 6.62 | 6.31 | 4.77 | 4.51 | 5.60 | **17.0** |
| 2001 | 5.91 | 5.81 | 19.3 | 37.0 | 26.2 | 22.2 | 25.7 | 15.5 | 31.8 | 16.3 | 12.9 | 11.2 | **19.2** |
| 2002 | 11.3 | 17.2 | 13.8 | 13.4 | 12.8 | 14.2 | 13.1 | 35.3 | 20.9 | 26.2 | 19.2 | 25.2 | **18.5** |
| 2003 | 16.2 | 11.8 | 14.8 | 35.9 | 33.3 | 14.0 | 11.5 | 9.58 | 14.6 | 33.6 | 21.0 | 13.4 | **19.1** |
| 2004 | 12.1 | 23.8 | 31.8 | 42.9 | 30.4 | 32.4 | 29.2 | 20.7 | 15.2 | 15.1 | 48.2 | 24.8 | **27.2** |
| 2005 | 15.3 | 20.2 | 40.6 | 61.8 | 49.8 | 28.2 | 49.3 | 38.5 | 21.4 | 14.8 | 12.2 | 23.6 | **31.3** |
| 2006 | 18.3 | 11.3 | 25.4 | 69.6 | 35.0 | 38.0 | 27.6 | 33.5 | 21.0 | 11.5 | 12.2 | 11.0 | **26.2** |
| 2007 | 18.4 | 25.1 | 40.8 | 27.9 | 42.2 | 29.3 | 10.3 | 17.0 | 27.5 | 33.2 | 33.8 | 22.3 | **27.3** |
| 2008 | 13.4 | 15.2 | 30.4 | 50.9 | 45.7 | 25.0 | 20.4 | 10.3 | 10.4 | 17.0 | 9.69 | 34.7 | **23.6** |
| 2009 | 18.6 | 18.1 | 26.7 | 45.1 | 27.1 | 25.2 | 24.4 | 13.9 | 7.31 | 11.6 | 37.5 | 13.1 | **22.4** |
| 2010 | 28.4 | 18.7 | 26.0 | 39.1 | 42.8 | 56.6 | 33.7 | 28.9 | 21.4 | 22.2 | 31.2 | 42.2 | **32.6** |
| 2011 | 19.5 | 14.2 | 22.1 | 22.7 | 20.3 | 26.0 | 25.9 | 17.2 | 8.59 | 7.55 | 6.81 | 7.17 | **16.5** |
| 2012 | 5.60 | 5.38 | 13.0 | 42.4 | 43.7 | 21.5 | 8.67 | 7.23 | 5.64 | 6.28 | 6.92 | 6.59 | **14.4** |
| 2013 | 9.02 | 14.0 | 35.1 | 70.8 | 36.0 | 22.7 | 13.2 | 9.60 | 11.3 | 28.3 | 21.4 | 16.2 | **24.0** |
| 2014 | 14.4 | 18.1 | 21.0 | 37.0 | 45.6 | 26.8 | 40.9 | 24.9 | 18.0 | 27.6 | 16.3 | 19.1 | **25.8** |
| 2015 | 31.0 | 21.9 | 23.5 | 23.3 | 40.2 | 17.8 | 11.0 | 11.0 | 14.3 | 23.0 | 15.9 | 17.3 | **20.8** |
| 2016 | 11.6 | 27.1 | 32.1 | 41.0 | 41.2 | 47.7 | 37.6 | 17.6 | 11.6 | 13.1 | 24.3 | 14.1 | **26.6** |
| 2017 | 9.13 | 12.7 | 22.9 | 23.6 | 37.4 | 14.9 | 10.9 | 10.5 | 9.45 | 9.34 | 14.3 | 17.6 | **16.1** |
| MEDIA MULTIANUALA | 13.4 | 14.7 | 23.1 | 42.2 | 43.3 | 32.6 | 23.6 | 16.6 | 16.1 | 17.4 | 16.0 | 15.9 | 22.9 |

**1.3.3 Estimates of the workforce employed by the realization of the investment: in the realization phase, in the operation phase including the utilities provision**

***a) Workforce***

*a.1. ) work to complete the investment*

The table below gives an estimate of the workforce required to complete the investment, by professional qualification, i.e. trades specific to this type of construction work; it should be noted that not all of these posts may be filled simultaneously during the period of the investment.

*Table no. 30 Labor required during the investment period*

| Specific professional qualification/specialization | No. persons |
|---|---|
| Site Manager | 1 |
| Construction Engineer | 2 |
| Electro-Mechanical Engineer | 1 |
| TESA Staff | 3 |
| Foreman | 2 |
| Surveyor | 1 |
| Concrete Plant Operator | 4 |
| Concrete Laboratory Operator | 2 |
| General Transportation Driver | 3 |
| Dumper Truck Driver (on-site) | 5 |
| Construction Equipment Operator | 5 |
| Blaster | 2 |
| Carpenter | 2 |
| Concrete Worker | 3 |
| Concrete Mixer Operator | 4 |
| Injection Operator | 2 |
| Unskilled Worker | 14 |
| **TOTAL** | **56** |

*a.2.) in service*

- foreman - 1 person;
- dam installation electrician - 3 persons;
- hydrotechnical installation machinist - 3 persons;
- hydrotechnical engineer: 5 persons;

***b) How utilities are provided***

The realization of the project implies a consumption of natural resources both during the execution of the works and during the operation of the activity. during the construction period by using construction materials (wood, gravel, sand, stone, etc.). Water can also be specified as a natural source used for concrete production.

Given the nature of the proposed investment, it is assessed that there are no negative environmental effects in terms of the use of natural resources.

During the exploitation period, the water will be used as a natural source for the operation of the hydropower facilities, while also ensuring the easement flow for the Jiu River, which will ensure the viability of wildlife species and the proper functioning of riparian habitats. It is important to note that the water used in exploitation is fully returned to the watercourse downstream of CHE Bumbești.

The transportation of aggregates from the quarries and/or ballast pits to the project site area will be carried out by specific means of transport on national and/or local roads, as appropriate. Front loaders will also be used for transportation as part of the site/works organization.
Procurement of materials will be done gradually, in stages of construction, so that they can be put into operation and to avoid long-term stockpiling of raw materials.

In addition, the supply of the necessary natural resources will be made only from authorized companies located as close as possible to the project site.
As regards the source of supply of material resources to be used for the realization of the planned works, they will be purchased from authorized firms specialized in this respect, which will provide the materials ready to be put into operation on the project site, taking into account its specificity.

*Table 31 Quantities of works*

| Subject | areas/volumes |
|---|---|
| **1. Livezeni dam and power intake** | |
| 1.1. Technological platform development | |
| - platform embankments | V = 99 mc |
| - concreting of platform and foundations of fence posts | V = 69 mc |
| 1.2. Lake basin development | |
| - dry vegetation removal | S = 900 sqm |
| - upstream riverbed regularization | V= 11.165 mc |
| 1.3. closing the diversion channel with fish migration | |
| - concreting fish ladder | V = 640 mc |
| - breaking of asphalt and transportation to authorized landfill | V = 100 mc |
| - fillings with local materials | V = 3000 mc |
| 1.4. Downstream regularization | |
| -removal of dry vegetation | S= 1.372 sqm |
| - calibration excavations | V = 20.800 mc |
| **2. CHE Dumitra** | |
| 2.1. Exterior landscaping: platforms, fencing and swales | |
| - excavations | V = 25.1 mc |
| - concreting including fencing foundations | V = 176.67 mc |

| Subject | areas/volumes |
|---|---|
| - OS Dumitra platform | S=6400 mp |
| 2.2. Bridge over the stilling pond | |
| - concreting | V = 3 mc |
| **3. Dumitra Intervention Block** | |
| - excavations | V = 1.029 mc |
| - local material fillings | V= 1.351 mc |
| - concreting | V = 460 mc |
| - macadam | V = 75 mc |
| **4. Capture Dumitra** | |
| - concreting of the catchment drain including connection to the overflow channel | V= 1.512 mc |
| - right bank anrocity fillings right bank catchment | V = 50 mc |
| - concreting water diversion water catchment Dumitra | V = 1.8 mc |
| - excavations regularization downstream Dumitra catchment | V = 120 mc |
| **5. Access roads CHE Dumitra** | |
| 5.1. Access road to the CHE Dumitra outer platform (L = 580 m) | |
| - earth embankments | V = 5 414 mc |
| - rock embankments | V = 14.962 mc |
| - rough stone retaining walls | V = 2.590 mc |
| - Crushed stone foundation | V = 844 mc |
| --concrete concrete 50 cm thick | V = 568 mc |
| 5.2. Access road over the Dumitra catchment (L = 80 m) | |
| - excavations | V = 1.511 mc |
| - road superstructure (rolled ballast) | V = 51 mc |
| - retaining walls (concrete) | V = 63 mc |
| **6. Bumbești power structure** | |
| 6.1. Concreting of the superstructure of the Bumbești chamber; | |
| - local material fillings | V = 159 mc |
| - concreting | V = 269 mc |
| 6.2. Massive concreting M1 penstock Bumbești | |
| - concreting | V = 304 mc |
| **7. CHE Bumbești** | |
| 7.1. Landscaping, platforms, fences and swales | |
| - excavations | V = 217 mc |

| Subject | areas/volumes |
|---|---|
| - local material fillings | V = 173 mc |
| - concreting | V = 273 mc |
| 7.2. Concreting of the connection between the stilling basin and the | |
| - excavations | V = 23 mc |
| - local material fillings | V = 93 mc |
| - concreting | V = 135 mc |
| 7.3. 110 kV station | |
| - excavations | V = 614 mc |
| - local material fillings | V = 114 mc |
| - concreting | V = 319 mc |
| **8. Access road to CHE Bumbești (L = 1370 m)** | |
| - 50 cm thick concrete clothing | V = 3.345 mc |
| **9. Access road over the M3 CHE Bumbești massif (L = 102 m)** | |
| - excavations | V = 81 mc |
| - local material fillings | V = 2310 mc |
| - concrete wall + foundations deformable guardrails | V = 305 mc |
| - 50 cm thick crushed stone + ballast + sand | V = 178.5 mc |
| **10. Bratcu catchment** | |
| - excavations | V = 30 mc |
| - local material fillings | V = 6 mc |
| - concreting | V = 2 mc |
| **11. Jiu secondary intake** | |
| 11.1. Concrete infrastructure + superstructure Jiu catchment, including fish ladder | |
| - excavations | V = 6 555 mc |
| - concreting | V = 3.543 mc |
| - water diversion (stage I + stage II); | |
| - excavations | V = 1.327 mc |
| - local material fillings | V = 3.007 mc |
| - concreting | V = 388 mc |
| - decommissioning of C2 boxes + temporary bridge | V = 1.121 mc |
| 11.2 Jiu catchment pipeline; | |
| - excavations | V = 7 875 mc |
| - fillings | V = 12.250 mc |

| Subject | areas/volumes |
|---|---|
| **12. Jiu catchment access road (L = 400 m)** | |
| --crushed stone superstructure + ballast | V = 2.720 mc |
| - slope protection | V = 6.912 mc |
| - concreting road gully, road underpass | V = 51 mc |
| **13. Site organization** | |
| 13.1. Decommissioning of temporary bridge upstream Livezeni dam | |
| - decommissioning gabions | V = 768 mc |
| - breaking of asphalt and transportation to authorized landfill | V = 226 mc |
| 13.2. Decommissioning platform upstream Livezeni dam and realization of connection | |
| - Excavation and breaking of asphalt and transportation to authorized | V = 47 mc |
| 13.3. Construction of platform and access road to the Livezeni access | |
| - peeling | V= 29 mc |
| - sticks | V = 43 mc |
| - local material fillings | V = 53 mc |
| 13.4. Platform development at the Murga Mica access tunnel | |
| - platform arrangement: | |
| - platform ballasting: | V = 75 mc |
| - Concrete perimeter concrete perimeter rail: | V = 13 mc |
| - slope protection: shotcreteed net | |
| - safety net | S = 657 sqm |
| - protective shotcrete | V = 33 mc |
| - installation of a torrent: sub-crossing box + loading chamber + connection pipe | |
| - Excavation (transported to the excavator) | V = 286 mc |
| - concreting | V = 78 mc |
| 13.5. Decommissioning of the Bratcu access tunnel site organization | |
| - breaking of asphalt and transportation to authorized dump (Platform + asphalt station) | V = 281 mc |
| **14. Connecting SEN** | |
| 14.1. MHC Livezeni | |
| - excavation of LES pillar and ditch foundations | V =1.088 mc |
| - concreting of pillar and culvert foundations | V = 62 mc |

| Subject | areas/volumes |
|---|---|
| - bentonite canivou bentonite | V = 13 mc |
| 14.2. CHE Dumitra | |
| - excavation of pillar, road, platform foundations | V = 1.313 mc |
| - concreting of pillar foundations, road, platform | V = 527 mc |
| 14.3. CHE Bumbești | |
| - excavations | V = 754 mc |
| - concreting foundations | V = 754 mc |
| **15. The Dumitra - Bumbești pipeline** | |
| - Valea Rea platform | S=3446 mp |
| - concreting the closure plug of the Rea Valley | V = 840 mc |

**<u>How utilities are provided:</u>**

**1. Water supply**

The proposed project involves the continuation of the work already carried out for the hydro-power development of the Jiu River on the Livezeni-Bumbești section. Bottled water will be used to supply water to the workers during the works for all the above-mentioned objectives.

Workers will also be provided with drinking water from bottled water for the period of operation of the objectives.

The raw water supply for the work points will be provided as follows:

- **MHC Livezeni:**

For the construction phase: transportation of raw water by tanker from the Livezeni concrete factory (raw water taken from the Jiu and metered);

For the operational phase: public mains, via a connection box with meter;

- **CHE Dumitra:**

For the construction phase: left bank creek catchment with installed water meter;

For the operation phase: water for the sanitary facilities will be drawn from a borehole on the right bank of the Dumitra river.

- **CHE Bumbești:**

For the construction phase: drinking water network in Bumbești Jiu town with installed water meter;

For the operation phase: the external network to the water meter chimney located on the plant premises, through a high density polyethylene connection. The water pipes will be made of polypropylene.

- **Valea Rea:**

For the construction phase: abstraction from the stream Valea Rea with SADU pumps Q=12 mc/h, H=70 mCA, P=7,5 kW, N=3000 rotations/min, Q day max = 3,93 l/s;

For operation phase: not applicable.

- **Bratcu:**

For the construction phase: abstraction from the Bratcu stream with SADU pumps Q.=12 mc/h, H=70 mCA, P=7,5 kW, N=3000 rotations/min, Q day max = 3,93 l/s;

For operation phase: not applicable.

- **Connection to SEN of the 3 power plants:**

For the construction phase: not applicable.

For operation phase: not applicable.

**2. Waste water disposal**

Sewage disposal for work points will be as follows:

- **MHC Livezeni:**

For the construction phase: domestic wastewater is discharged into a drainable watertight tank with V=4.32 m3; technological wastewater is discharged into the Jiu river, after preliminary treatment through a settler with V=31.25 m3.

For the operation phase: The domestic wastewater will be discharged outside into a sewage sump. From here via PVC pipes, installed buried below the frost depth, it will be led to a compact type treatment plant in accordance with the current requirements of the relevant legislation. The wastewater will comply with the requirements of NTPA 001-2002 and the European standard EC 91/271, concerning the establishment of pollutant load limits for wastewater discharging into natural receptors. Emptying will be carried out at very long intervals (10-12 months) in order to remove deactivated sludge from the treatment plant.

- **CHE Dumitra:**

For the construction phase: ecological toilets will be installed, the technological wastewater will be discharged into the Jiu river, after a preliminary treatment by means of a settler;

For the operation phase: the domestic wastewater from the sanitary group of the plant is discharged externally into a standardized sewage pipe, then through PVC pipes the wastewater will be led to a compact wastewater treatment plant in accordance with the current requirements of the legislation in the field.

- **CHE Bumbești:**

For the construction phase: ecological toilets will be installed, the technological wastewater will be discharged into the Jiu river, after a preliminary treatment by means of a settler;

For the operation phase: the domestic wastewater from the sanitary group of the plant is discharged externally into a standardized sewage pipe, then through PVC pipes the wastewater will be led to a compact wastewater treatment plant in accordance with the current requirements of the legislation in the field.

- **Valea Rea:**

For the construction phase: discharge into the Valea Rea stream, pre-purified in a one-piece settling tank;

For operation phase: not applicable.

- **Bratcu:**

For the construction phase: discharge into the Bratcu stream, after treatment in concrete settling basins;

For operation phase: not applicable.

- **Connection to SEN of the 3 power plants:**

For the construction phase: not applicable;

For operation phase: not applicable.

**3. Power supply**

The electricity supply for the work points will be provided as follows:

- **MHC Livezeni:**

For the construction phase: 400 kV network, through a 6/04 kV TRAFO substation;

For the operation phase: own transformer substation MHC Livezeni.

- **CHE Dumitra:**

For the construction phase: 3 transformer substations fed from the Gerom International Petroșani distribution network, through 3 underground and surface cables at 20 kV;

For the operation phase: own transformer substation CHE Dumitra.

- **CHE Bumbești:**

For the construction phase: 210 kVA diesel generator and distribution network;

For the operation phase: own transformer substation CHE Bumbești.

- **Connection to SEN of the 3 power plants:**

For the construction phase: not applicable.

For operation phase: for operation only.

**4. Technological water supply - cooling water**

Technological water for the period of operation of the investment will not be available, there will be only used water, which will come out of the two CHE - and MHC Livezeni, conventionally clean water.

For connection of the 3 power plants to the SEN: not applicable.

**5. Natural gas supply**

For the proposed project, the continuation of works on the hydropower development of the Jiu river on the Livezeni-Bumbești sector, natural gas supply will not be necessary.

**6. Heating installations**

- **MHC Livezeni:**

For the construction phase: radiators/electric convector heaters, if necessary;

For the operation phase: the following technical solutions will be adopted:

- the heating of the generator set will be done with electric unit heaters;
- heating in the remaining rooms will be done with electric convector heaters.
- **CHE Dumitra:**

For the construction phase: radiators/electric convector heaters, if necessary;

For the operation phase: depending on the specifics of each room and the parameters required for the operation of the machines, the following heating installations have been provided:

- electric heaters have been installed in the engine room;

- in the rooms of the diesel group, sanitary group, control room, panel room, panel room, head office, electromechanical workshop, accumulator batteries, medium voltage stations, electric oil radiators with thermostat have been provided.
- **CHE Bumbești:**

For the construction phase: radiators/electric convector heaters, if necessary;

For the operation phase: depending on the specifics of each room and the parameters required for the operation of the machines, the following heating installations have been provided:

- electric heaters have been installed in the engine room;
- in the rooms of the diesel group, sanitary group, control room, panel room, panel room, head office, electromechanical workshop, accumulator batteries, medium voltage stations, electric oil radiators with thermostat have been provided.

*1.4. Estimation by type and quantity of expected waste and emissions*

***a) Waste generated***

Directive 2014/955/EU on the establishment of a waste list makes it obligatory for economic operators and any other waste generators, whether natural or legal persons, to keep records on waste management.

a) For the execution period we present below the list of potentially generated waste.

- ✓ 20 03 01 Mixed municipal waste
- ✓ 15 01 01 Paper and cardboard packaging
- ✓ 15 01 02 Plastic packaging
- ✓ 15 01 03 Wooden packaging
- ✓ 15 01 10* Packaging containing residues of or contaminated with dangerous substances
- ✓ 15 02 02* Absorbents, filter materials (including oil filters not otherwise specified), polishing materials and protective clothing contaminated with dangerous substances
- ✓ 13 02 07* Readily biodegradable engine, transmission and lubricating oils
- ✓ 17 01 01 Concrete
- ✓ 17 02 01 Wood
- ✓ 17 02 03 Plastics
- ✓ 17 04 07 Metallic mixtures
- ✓ 17 04 11 Cables other than those mentioned in 17 04 10* 17 04 10
- ✓ 17 05 04 Soil and stones other other than those mentioned in 17 05 03* 17 05 03*
- ✓ 17 06 04 Insulating materials other than those mentioned in 17 06 01 and 17 06 03

<u>Storage, transportation and recovery/disposal of the waste presented above:</u>

Ferrous and non-ferrous metal waste will be collected and temporarily stored on the site organization's premises on a waterproofed and covered surface and will be recovered by authorized economic operators.

Waste from construction materials (concrete waste) will be temporarily stored on site in the area set aside specifically for each work point and will be used for backfilling the foundation pits.

The inert waste (surplus soil) resulting from the excavation/drilling of the foundation pits will be transported and deposited by the constructor on the areas indicated by the town halls of the administrative-territorial units on whose territory this waste arises. It will not be deposited on the territory of ROSCI0063 Defileul Jiului or in the vicinity within 500 m of the site boundary.

Cable, conductor and insulator scrap will be collected on the site organization's premises and handed over to an authorized economic operator.

*<u>Packaging waste</u>* will include:

- Reusable packaging will be returned to the supplier (wooden slat pallets (15 01 03) from the packaging of the pole components);
- wooden drums (15 01 03) from conductors;
- wooden crates (15 01 03) from rebar packaging) and recoverable packaging waste:
- waste cardboard (15 01 01) from the packaging of component parts of insulating chains, clamps and earthing plugs; and
- PETs (15 01 02).

Reusable packaging (pallets, drums and wooden crates) will be temporarily stored on the site organization's premises and then returned to the economic operator from whom they were purchased.

Waste cardboard and plastic (PET) containers will be collected separately and handed over to an authorized economic operator.

*<u>Household waste</u>* results from staff involved in carrying out the works.

Household waste resulting from the personnel involved in the implementation of the project, from the work points, will be collected in polyethylene bags and transferred daily in Eurocontainer or Eurobins, placed on a waterproofed surface and without leakage on the ground, on the site organization premises, from where they will be handed over to an authorized economic operator.

For the temporary storage of various wastes, specific operating procedures should be considered in accordance with the guidelines, on:

- waste transportation,
- waste reception,
- waste handling,
- waste delivery.

Special areas will be set up for temporary storage of waste, by category, in accordance with the provisions of existing specialized guidelines, with management carried out through practical activities and planning in the short (current) or medium and long term. Temporary storage will be carried out at the level of site organizations and will not be deposited on undeveloped land on the ROSCI0063 Defileul Jiului area.

If hazardous waste is still generated during and as a result of the works, it will be removed from the site by an authorized company.

b) For the operating period of the objective, the waste potentially generated are:
- 20 03 01 Mixed municipal waste
- 13 02 05* Non-chlorinated mineral engine, transmission and lubricating oils
- 13 01 10* Unchlorinated mineral hydraulic oils
- 20 01 21* Fluorescent tubes and other waste containing mercury
- 16 06 05 Other batteries and accumulators
- 13 03 07* Non-chlorinated mineral insulating and heat transmission oils
- 17 04 07 Scrap metal from maintenance activities
- 17 04 11 Cables other than those mentioned in 17 04 10*

Group 20 waste originating from the upstream river.

This waste will be generated in insignificant quantities, sporadically, the generated quantity will be handed over to authorized economic operators.

Group 20 wastes that are brought in during flooding situations will be collected by a cleaning machine, which is mounted on the dam, next to the power outlet. It will be removed on site and handed over to an authorized economic operator for recovery/disposal.

***Waste management plan:***

The management of waste during the execution period is the responsibility of the constructor, which is collected in special containers in specially designated areas and handed over for recovery/final disposal to an authorized economic operator.

Waste management during the operational period is the responsibility of the Beneficiary of the investment, which is collected in special containers in specially designated areas and handed over for recovery/final disposal to an authorized economic operator.

During the period of realization of the investment works included in the proposed project, hazardous, non-hazardous and inert waste will be generated, which must be recovered and/or disposed of in accordance with the provisions of *O.U.G. no. 92/2021 on waste regime*, with subsequent amendments and additions.

The monitoring of waste management is done in accordance with *H.G. no. 856/2002 on waste management records* and for the approval of the list of waste, including hazardous waste, with subsequent amendments and additions, and reporting is made to the competent environmental protection authority.

***Hazardous chemical substances and preparations used and/or produced:***

There is only one type of hazardous substance or preparation during both the construction and the operational period, namely mineral oil for turbines, hydraulic and electrically insulating oil. Turbine oil for electricity generation is used for greasing, regulating and sealing.

This type of oil is delivered in different containers and quantities from authorized economic agents and temporarily stored in the oil management households, located in the buildings of the two CHEs, respectively Dumitra and Bumbești.

How to manage hazardous chemical substances and preparations and ensure conditions for the protection of the environment and the health of the population:

The mineral oil for the turbines is temporarily stored in the oil house, which is an underground concrete facility within the CHE buildings. The drums are handled by means of overhead cranes, which are provided in the buildings of the two CHEs.

The risk of accidental water pollution is minimal because the barrels are stored in concrete enclosures that have no contact with water.

Please note that the above mentioned types of oil are used permanently for plant and equipment (turbines, compressors and circuits, power station), and oil changes will be carried out during maintenance periods, at long intervals.

Environmental monitoring measures will be implemented for the realization of the works proposed within the project "*Hydropower development of the Jiu River on the Livezeni-Bumbești sector - Continuation of works*". The investment involves carrying out the construction works for which the following measures to control emissions of pollutants are planned:

- Erect effective barriers (in the form of netting) around the area of dust activities or as a site boundary;
- There will be no open fires;
- When drawing up the Site Plan, particular attention will be paid to the location of dust-generating machinery and activities;
- Special solutions will be used to increase the effectiveness of water in binding dust (this solution will be used to spray the access routes to the site, the area of the site where construction materials are unloaded and the volumes being demolished);
- Storing stocks of building materials on site for as little time as possible;
- All loads being transported to or from the site shall be covered to limit the dispersion of dusts;
- Vehicles and machinery will have their engines stopped when stationary;
- Vehicles will be effectively cleaned and their wheels washed when leaving the site organization;
- The vehicles and equipment will be properly maintained and will have up-to-date technical overhauls;
- The works will take into account the breeding and rearing periods for all categories of fauna identified on the site.

During operation there are no emissions of pollutants into the environment, so it is not necessary to provide facilities and measures to control them.

The elimination/reduction of dust emissions on the construction site and on the access road shall be achieved by applying the following measures:

- water sprinkling of dust sources and dirt roads in dry periods;
- Transportation means will travel at reduced speed to reduce the amount of fine dust particles in the atmosphere;
- the load of bulk material (dry concrete) will be covered during transportation, which means that tipper trucks must be equipped with tarpaulins
- organizing work by work points, thus grouping fewer mobile sources.

Due to the natural terrain characteristics of the site, the propagation of dust into the atmosphere is also limited by natural obstacles formed by trees and uneven landforms.

***b) Emissions***

The main sources of pollution in the project area are air emissions from:

- Excavation, excavation and landscaping activities;
- Moving activities in the site organization of the materials used;
- Transportation activities.
-

*Emissions from non-road mobile sources*

Execution stage

In the execution phase, non-road mobile sources will be represented by the machinery and equipment involved in the construction works (bulldozer; excavator; crane; compactor; front-end loader). The emissions from the operation of these sources have been estimated using the calculation methodology *EMEP/EEA - 1.A.4 Non road mobile machinery, Tier1*, which takes into account the type and consumption of fuel used and the corresponding emission factors for the characteristic pollutants.

Operating stage

At this stage, the non-road mobile sources will be electric generators. It should be noted that these sources will operate occasionally, only in the event of power grid failures. The pollutant emissions from these sources have been estimated using the calculation methodology EMEP/EEA - 1.A.4 Non road mobile machinery, TIER1, which takes into account the type and consumption of fuel used and the corresponding emission factors for the characteristic pollutants.

The results of the emission calculations are shown in the following table.

*Table 32 Emissions from non-road mobile sources in the implementation phase*

| Source name | Pollutant | Mass flow | | | Emission concentration ($mg/m^3$ )* |
|---|---|---|---|---|---|
| | | kg/h | g/h | g/s | |
| Mobile crane | Pulberi | 0,015 | 14,09 | 0,004 | 132,19 |
| | $SO_2$ | 0,002 | 1,66 | 0,0005 | 15,7 |
| | $NO_x$ | 0,22 | 217,18 | 0,06 | 2048,9 |
| | CO | 0,07 | 71,71 | 0,02 | 676,5 |
| Excavator/Front Loader | Pulberi | 0,02 | 24,51 | 0,01 | 132,5 |
| | $SO_2$ | 0,003 | 2,91 | 0,001 | 15,7 |
| | $NO_x$ | 0,38 | 380,06 | 0,11 | 2054,4 |
| | CO | 0,13 | 125,50 | 0,03 | 678,4 |
| Bulldozer | Pulberi | 0,02 | 21,01 | 0,01 | 133,0 |
| | $SO_2$ | 0,002 | 2,50 | 0,001 | 15,8 |
| | $NO_x$ | 0,33 | 325,77 | 0,09 | 2061,8 |
| | CO | 0,11 | 107,57 | 0,03 | 680,8 |
| Compactor | Pulberi | 0,01 | 14,00 | 0,004 | 132,1 |
| | $SO_2$ | 0,002 | 1,66 | 0,0005 | 15,7 |
| | $NO_x$ | 0,22 | 217,18 | 0,06 | 2048,9 |
| | CO | 0,07 | 71,71 | 0,02 | 676,5 |

* Due to the estimated mass flow rates for the calculated pollutants being below the limit value of Order no. 462/1993 - Annex 1, the maximum permissible values of pollutant concentrations of the above mentioned Order do not apply to the analyzed sources.

*Emissions from unabated stationary sources*

*Execution stage*

The uncontrolled stationary sources of air pollution during the execution period of the works proposed for the realization of the objective are represented by the earth moving activities (stripping, digging, filling, levelling, loading - unloading, transport) for the site development. These operations will mainly be sources of dust emissions into the atmosphere.

An additional source of dust is wind erosion, which accompanies construction works. This phenomenon occurs when, for a certain period of time, uncovered areas of land are exposed to wind action. Wind erosion can, however, be controlled by appropriate measures to reduce the spatial and temporal extent of unvegetated land areas.

Dust generated by material handling and wind erosion is mainly of natural origin (soil particles, mineral dust).

The cutting and welding operations of the metal elements that will make up the buildings will generate emissions of: fine particles containing mainly metal oxides (iron oxide, manganese oxide, nickel oxide, etc.), carbon monoxide resulting from the decomposition of atmospheric carbon dioxide in the electric arc zone, nitrogen dioxide resulting from the oxidation of atmospheric nitrogen due to the high temperature in the electric arc zone, ozone.

These sources, however, will not generate significant amounts of pollutants in the atmosphere and have not been included in the calculation of atmospheric emissions.

Emission concentrations cannot be associated with the sources characteristic of the activities during the execution phase of the works, as they are free, open, undirected sources. For the same reason, they cannot be evaluated in relation to the provisions of Order 462/1993 and other emission regulations.

*Operating stage*

There will be no uncontrolled stationary emission sources during operation.

<u>*Emissions from mobile sources*</u>

*Execution stage*

During the execution of the works, the mobile sources will be the heavy goods vehicles for the transportation of construction materials and the vehicles of the employees involved in the construction works. All these sources will not operate simultaneously on the site, and their actual operating time will be short, sufficient for moving around the site and parking them in specially designated areas.

The estimation of pollutant emissions from mobile sources was carried out using the EMEP/EEA calculation methodology - 1.A.3.b.b.i-iv Road transport 2016, Tier 1, which takes into account the type of vehicle, fuel type, fuel consumption used and emission factors corresponding to the characteristic pollutants. For this purpose we have considered an average number of 10 heavy-duty vehicles per day running on diesel, 10 light-duty vehicles per day running on diesel and 5 light-duty vehicles per day running on gasoline.

*Operating stage*

During the operation phase of the objective, the mobile sources will be the employees' vehicles, i.e. 5 vehicles per day (estimated).

We specify that the sources of emissions from employee vehicles will not operate simultaneously on the site, with the busiest period of a day being at the start of the shift. In addition, the duration of a vehicle's operation on the site will be as short as necessary for the time needed to drive to the parking place and to perform parking maneuvers.

*Table 33 Mobile source emissions*

| Types of mobile sources | Fuel type | Pollutants | Emissions (g/h) | Run-time emissions (g/h) | Emissions during operation (g/h) |
|---|---|---|---|---|---|
| Employee vehicles | Diesel | CO | 4,23 | 33,28 | 339,60 |
| | | $NO_x$ | 16,68 | 129,57 | 1320,79 |
| | | Pulberi | 1,47 | 11,04 | 112,55 |
| | | $SO_2$ | 0,04 | 0,20 | 1,67 |
| Employee vehicles | Petrol | CO | 105,68 | 210,48 | 2146,89 |
| | | $NO_x$ | 11,10 | 21,99 | 221,83 |
| | | Pulberi | 0,04 | 0,09 | 0,84 |
| | | $SO_2$ | 0,15 | 0,27 | 2,10 |

Order No 462/1993 does not set limits for mobile sources. The Order indicates that the pollutant emissions of road motor vehicles are limited as a preventive measure by the technical conditions laid down in the technical inspections carried out periodically throughout the period of use of road motor vehicles registered in the country.

Preventive limitation of emissions from motor vehicles is achieved through the technical conditions imposed at type-approval for registration for entry into service and throughout their service life through mandatory periodic roadworthiness tests.

***c) Noise***

At present, the site area is characterized by low noise and vibration due to the absence of industry and other major sources of auditory discomfort in the main localities adjacent to the project. The main source of noise and vibration is road and rail traffic as well as mineral aggregate mining (quarrying) as follows:

- Livezeni dam area - traffic on the DN66, Simeria-Petroșani-Târgu Jiu-Filiași railway and mineral aggregates exploitation (including crushing and sorting plant) at Iscroni
- Platform Murga Mica - traffic on DN66
- CHE Dumitra area - traffic on the DN66, Simeria-Petroșani-Târgu Jiu-Filiași railroad
- Site Organization Bratcu - exploitation of mineral aggregates - Meri quarry
- CHE Bumbești area - - traffic on DN66, Simeria-Petroșani-Târgu Jiu-Filiași railroad, the quarry (including the ballast and sorting plant) Pleșa and the Dacorex ballast plant

The generated noise levels indicate values within the limit values for the protection of the population.

In order to determine the background noise in the project area, specific determinations were carried out in November 2023 with Integrating Sound Level Meter on A, C type 2250 Light BRUEL & KJAER A, C type 2250 Light weighting networks.

- **Principle of the method**

For ambient noise measurements there are two main strategies:

- a single measurement is made under favorable weather conditions, while closely monitoring the source operating conditions;
- a long-term measurement or several point measurements, dispersed over time, with monitoring of meteorological conditions.

Both types of measurement require further processing of the measured data. Each result will have some uncertainty, which needs to be determined.

The principle of the method is the determination of the A-weighted equivalent continuous sound pressure level (LAeqT) using a class 1 integrating-averaging sound level meter.

Determination of LAeqT can be performed:

- by continuous measurement over the time interval T;
- by measuring the A-weighted equivalent continuous sound pressure levels over time subintervals of T during which the noise is stationary, LAeqT being obtained by calculation from the results of these measurements;
- by measuring the sound exposure levels of the individual events occurring over the time interval T, LAeqT being calculated from the results of these measurements;

– by combining the above methods.

The acoustic sources contributing to the total field exposure may or may not be distinct. Measurements shall be performed in the field, the determinations may be supplemented by computational steps, including the use of specific validated software.

➢ **Equipment**

– Integrating sound level meter on A,C weighting networks, class 1- Bruel&Kjaer 2250 Light, series 3011282

Technical specifications

- Class 1 precision integrating sound level meter;
- measuring range 16.4 dB - 140 dB(A);
- Frequency range 5 Hz - 18 kHz;
- frequency analysis module, provides real-time 1/1 and 1/3 octave analysis;
- frequency weightings A, B, C, Z;
- automatic/manual measurement mode;
- touchscreen;
- illuminated keyboard;
- USB interface, PC software.

– Class 1 acoustic calibrator type 4231 - Bruel&Kjaer

Technical specifications

- In accordance with SR ISO 6926:2003;
- Sound pressure level 94± 0,2 dB or 114± 0,2 dB;
- Frequency 1000 Hz.

– Tripod sound level meter - Bruel&Kjaer

Determinations were carried out in the 4 project areas as follows:

- Zone 1 - Livezeni dam;
- Zone 2 - Small Murga Platform;
- Zone 3 - CHE Dumitra;
- Zone 4 - Site organization Bratcu
- Zone 5 - CHE Bumbești

The values obtained are compared with:

➢ The A-weighted equivalent continuous A-weighted sound pressure level, $L_{AeqT}$ provided in SR 10009/2017 "Acoustics. Permissible limits of environmental noise level", item 4.1 "Permissible limits of noise level at the boundary of functional spaces", Table 1, item 4, which states:

*Table 34 Sound pressure level limits*

| No. crt. | Functional spaces | A-weighted equivalent continuous A-weighted sound pressure level, $L_{AeqT}$ (dB) |
|---|---|---|
| 1 | Spaces for recreation and relaxation, medical treatment and balneotherapy | 45 |
| 2 | School, nursery or kindergarten premises and children's playgrounds | 75 |
| 3 | Open-air stadiums, open-air cinemas and theaters, open-air cultural, sporting and entertainment events1) | 902) |
| **4** | **Industrial premises and premises assimilated to industrial activities3)** | **65** |
| 5 | Markets, shopping areas, outdoor restaurants4) | 65 |
| 6 | Parking5) | 70 |

Note 1 - The boundary of such premises shall be deemed to be the space exclusively arranged for the specific activity and not the boundary of the property to which the premises belong, which may be wider
Note 2 - The period of time taken into account for the application of the permissible limit is the actual period corresponding to the length of service
Note 3 - Any space that has commercial production or maintenance activities (such as car service, car washes, etc.) and is not located in an industrial zone established by the PUG. The boundary of the functional space is the property boundary of this space according to the cadastral plan (including land)
Note 4 - The boundary of such premises shall be deemed to be the boundary of the space for the specific activity and not the boundary of the property to which the premises belong, which may be wider
Note 5 - The boundary of this space shall be deemed to be the boundary of the space exclusively designated as a parking space and not the boundary of the property to which the space belongs, which may be wider, and the permissible limit shall apply only to parking spaces serving large economic objectives (shopping complexes, office buildings, etc.) or which are similar to parking spaces serving such objectives and shall not apply to parking spaces along arterial roads.

*Table 35 Measured values of the A-weighted equivalent continuous A-weighted sound pressure level, LAeqT*

| Sample code | Test method | UM | Value obtained | Permissible limit values |
|---|---|---|---|---|
| Zone 1 | SR 6161-1/2022; SR ISO 1996-1:2016; SR ISO 1996-2:2018; PSL 28 | dB(A) | **50,6** | **65** |
| Zone 2 | | | **39,6** | |
| Zone 3 | | | **40,1** | |
| Zone 4 | | | **32,7** | |
| Zone 5 | | | **51,3** | |

As can be seen from the table above, the noise values in the monitored area are currently below the maximum permissible thresholds.

***Sources of vibration and noise during construction***

During the construction works, noise sources will be temporary in nature, generating local effects for a limited time. The physical pollution associated with the project at this stage is caused by noise and vibration generated by construction activities (vehicle and machinery engines, material handling, operation of earthmoving equipment used for site development, etc.).

The noise level regulated by STAS 10009/2017, "Urban acoustics, permissible noise level limits" is 65 dB(A) at the site boundary. According to the Order of the Ministry of Health No. 119/2014 for the approval of the Hygiene and Public Health Norms on the living environment of the population, the continuous equivalent weighted sound pressure level (AeqT), measured outside the dwelling according to the SR ISO 1996/2-08 standard, at 1.5 m height from the ground, shall not exceed 55 dB and the noise curve Cz 50. During the night (23:00 - 7:00), the continuous equivalent weighted sound pressure level shall not exceed 45 dB and the noise curve Cz 40.

In order to assess the level of impact generated by the proposed project, a noise source modeling was performed using the Sound Plan Essential 2.0 software application. A very likely scenario was taken into account, i.e. a scenario in which several noise sources operate simultaneously during the execution of the works, considering the following noise levels:

- 1 bulldozer 110 dB(A);
- 1 truck 105 dB(A);
- 1 compactor 100 dB(A);
- 1 crane 104 dB(A);

The sources of noise will be of temporary character, being represented by:

- ✓ construction operations loading/unloading/loading materials and equipment;
- ✓ operation of equipment and vehicles involved in construction/erection works;
- ✓ vehicular traffic necessary for carrying out the works.

Normally construction work will take place during the day between 08:00 - 18:00. However, there are also operations that need to be carried out continuously, such as pouring concrete for foundations, which may also require night work.

The results of the modeling carried out with the SoundPLAN software show that, during the construction phase, the noise level generated by the project will not have a significant impact on the quality of living in the neighboring villages at the level of the nearest receptors, the operation of the equipment used in the modeling generating a maximum noise level of about 48 dB. The noise generated by the construction activities is not able to change the current noise level induced mainly by the motor traffic in the area.

At the level of protected natural areas, the noise generated by construction activities may lead to an increase in the equivalent noise level of up to 100 dB(A) over a distance of maximum 50 m, which could lead to a disturbance of species (especially birds) during the works, but given the site area in a forested area this increase will be significantly reduced in the immediate vicinity of the project.

At the same time, taking into account the location of the works in relation to inhabited areas (Bumbești-Jiu town), the noise value falls within the limits set by Order No. 119/2014.

Taking into account that the works carried out in the analyzed project will have a low contribution to the noise level generated in inhabited areas, we consider that no measures are necessary to reduce the noise level in relation to the settlements.

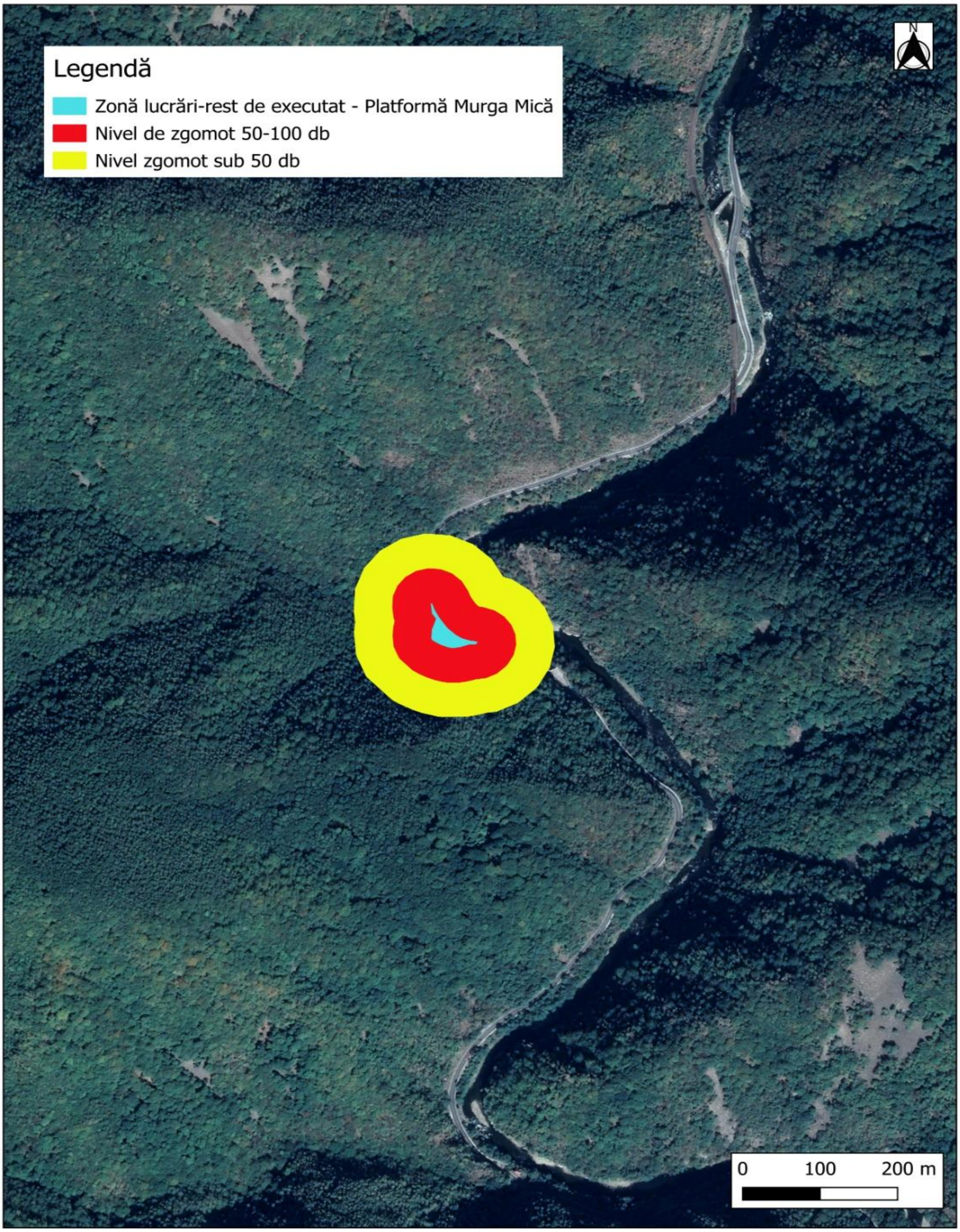



Fig. 53 Noise dispersion from areas with works - Murga Mica Platform

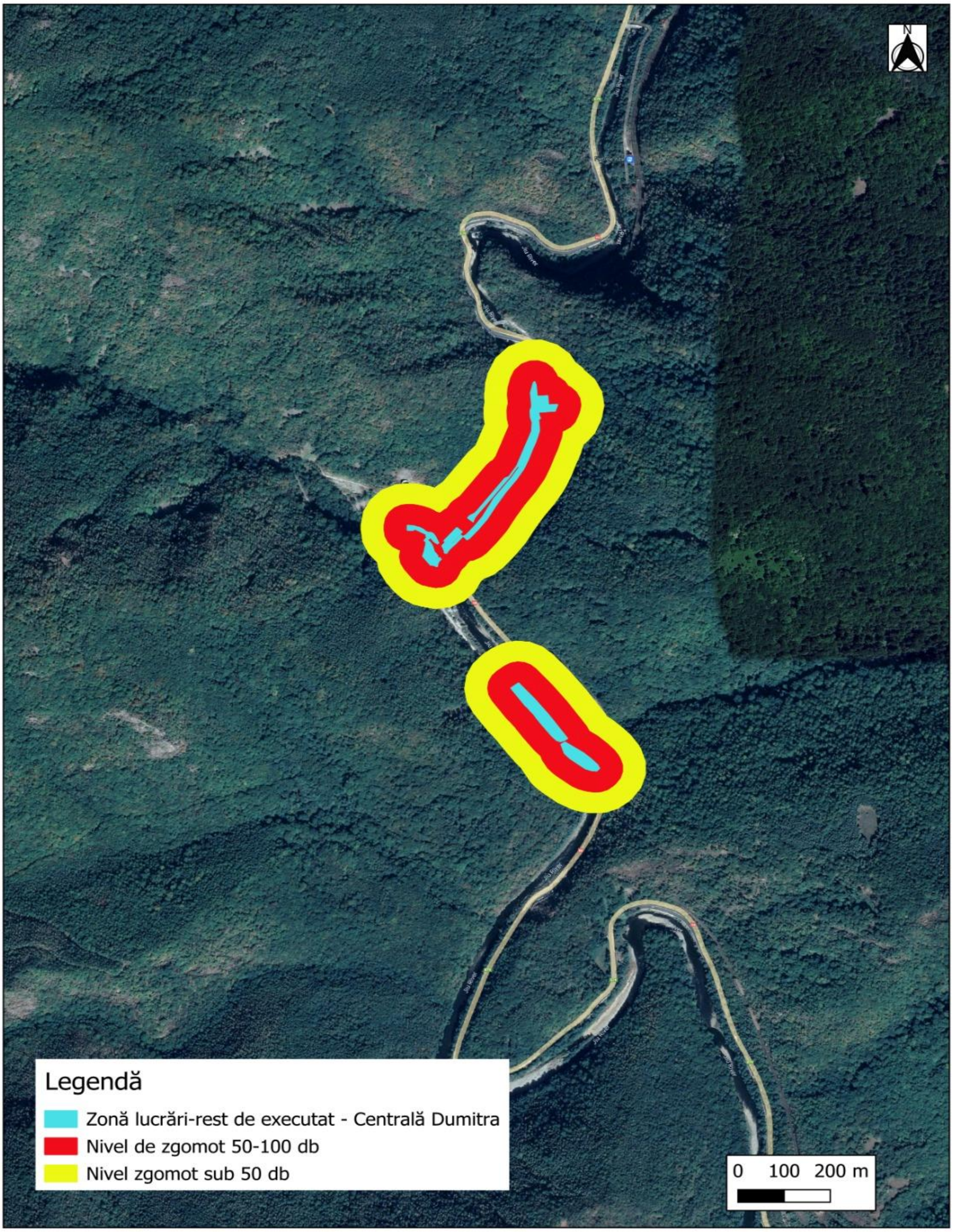



Fig. 54 Noise dispersion in areas with works - CHE Dumitra

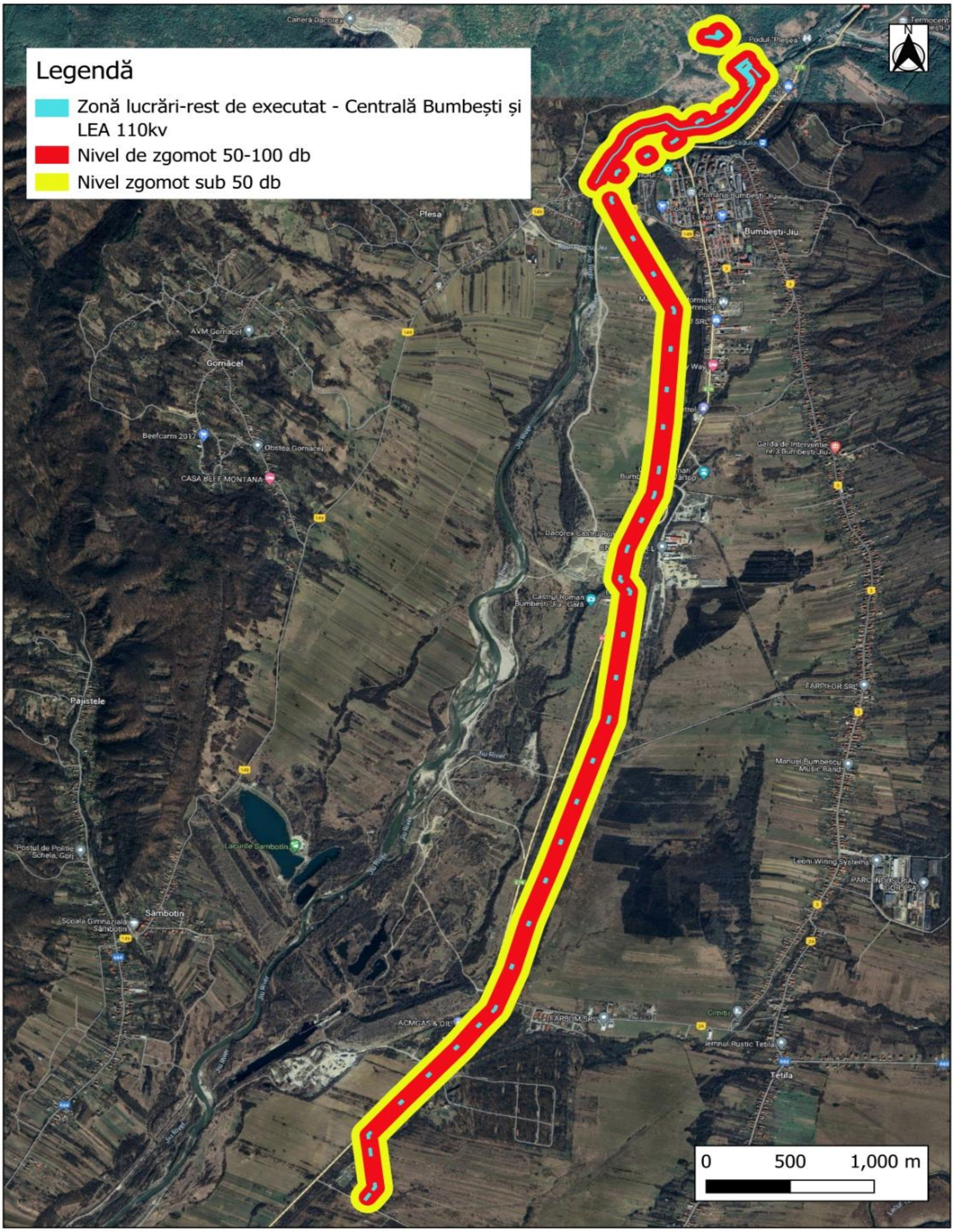



Fig. 55 Noise dispersion from areas with works - CHE Bumbești and LEA

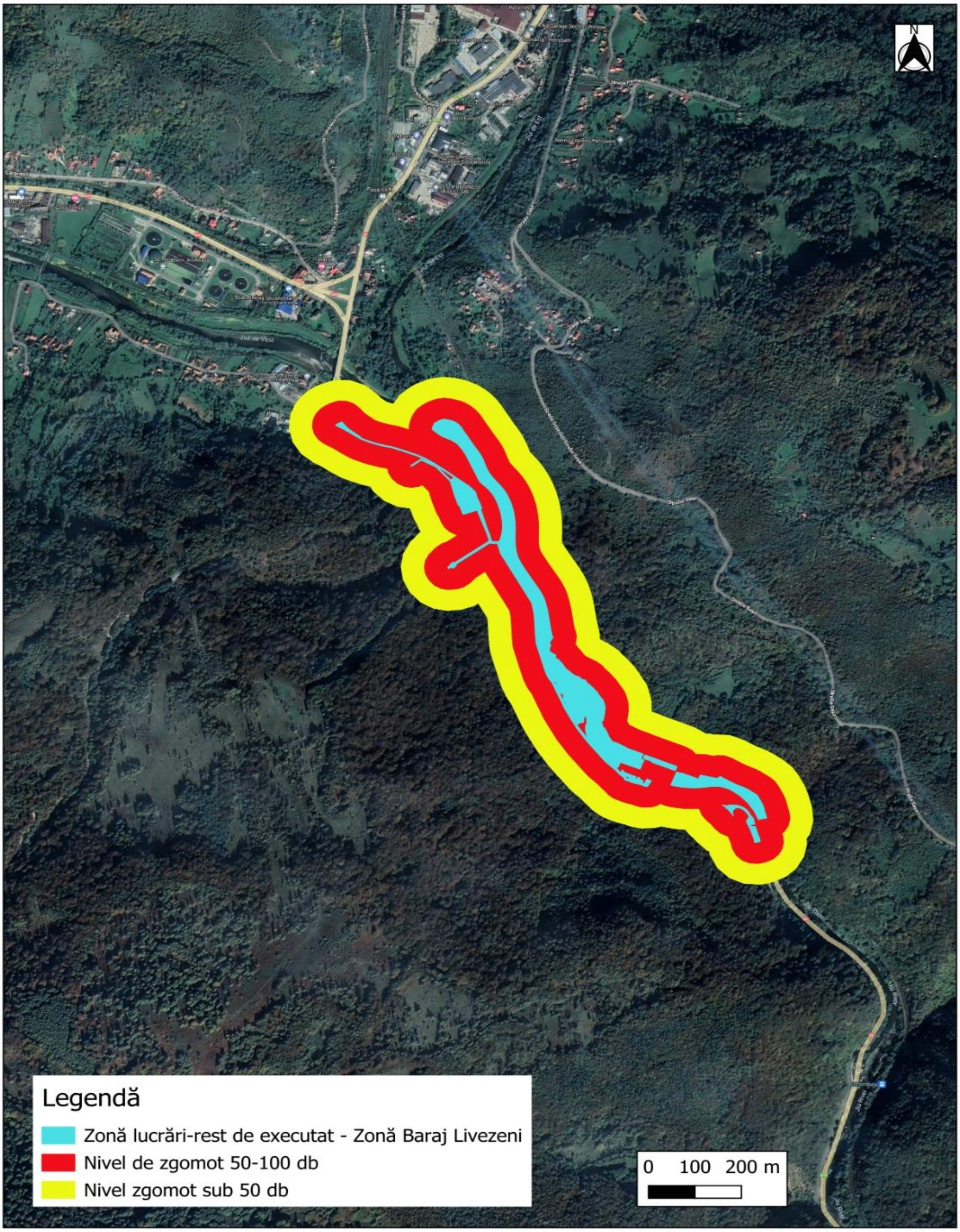



Fig. 56 Noise dispersion from work areas - Livezeni Dam

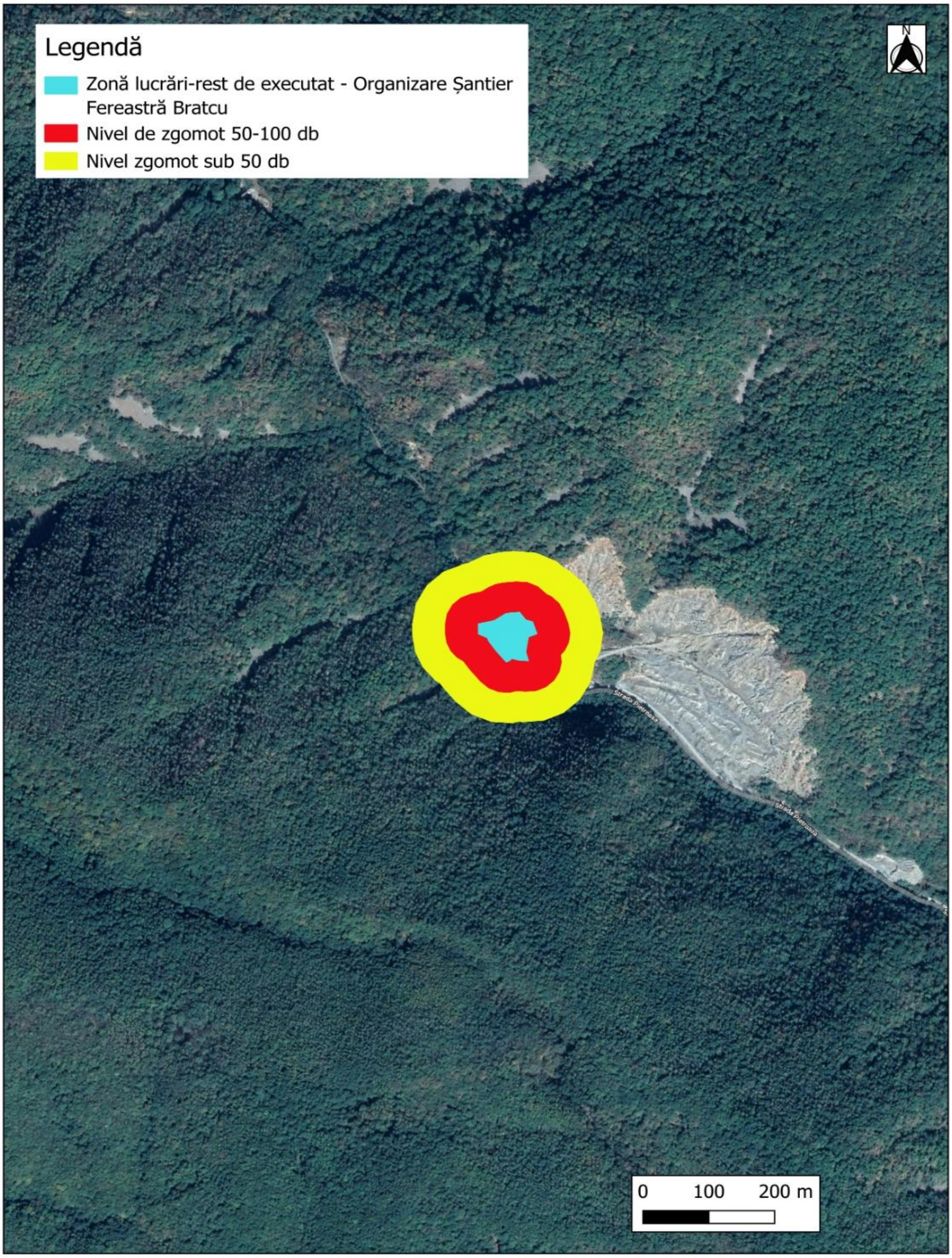



Fig. 57 Noise dispersion from work areas - Bratcu site organization

***Sources of vibration and noise during operation***

There will be no additional sources of noise and vibration during the operation of the project compared to the current road traffic.

## 2. DESCRIPTION OF FEASIBLE ALTERNATIVES

***Alternative "zero" - the project is not finalized and the works will be dismantled***

Under this alternative it is envisaged to halt the completion of the project and to dismantle the works already completed and restore the land to its original state.

Taking into account the very long period of time during which the investments have been realized up to the current stage (more than 10 years), as well as the elements and volumes of works already completed, their dismantling would generate a negative-significant impact on the conservation objectives of the protected natural areas in the area of influence, as follows:

a) A huge amount of waste, construction waste, ferrous waste, etc., will be generated during the decommissioning period, thus:

*Table no. 36 Quantities of materials/excavation already realized within the project*

| NR. CRT. | TITLE OBJECTIVE/description | UM | CANT |
|---|---|---|---|
| **1** | **LEA 20 kV CHE DUMITRA** | | |
| | 20 kV power line LEA, LES, LEC on the route Livezeni - Dumitra - Valea Rea | km | 20 |
| **2** | **LEA 20kV CHE Bumbesti** | | |
| | 20 kV power line LEA, LES | km | 1.735 |
| **3** | **ACCESS ROAD TO CHE BUMBEȘTI** | | |
| | Site preparation | mp | 13100 |
| | Excavation | mc | 11696 |
| | Rock excavations | mc | 1238 |
| | Road resurfacing | ml | 1300 |
| | Stone foundation | mc | 1923 |
| | Embankment retaining walls | mc | 615 |
| | Gabions | mc | 1650 |
| | Pipe culverts D = 0.8m | buc | 5 |
| | Guardrail | m | 448 |
| **4** | **ACCESS ROAD TO CHE DUMITRA** | | |
| | Site preparation | mp | 4170 |
| | Excavations | mc | 5414 |
| | Rock excavations | mc | 14962 |
| | Stone masonry walls | mc | 2590 |
| | Crushed stone foundation | mc | 844 |
| | Box culverts with prefabricated elements | buc | 4 |
| **5** | **ACCESS ROAD GATE CHAMBER BUMBEȘTI** | | |
| | Site preparation | mp | 16084 |
| | Excavation | mc | 25000 |
| | Rock excavations | mc | 8088 |
| | Stone walls with mortar | mc | 1239 |

| NR. CRT. | TITLE OBJECTIVE/description | UM | CANT |
|---|---|---|---|
| | Wall trenches | mp | 846 |
| | Concrete channels | mc | 93 |
| | Macadam pavement | mp | 8140 |
| | Reprofiling of the road surface | ml | 1681 |
| | Crushed stone foundation | mp | 3130 |
| | Pipe culverts 0.8 m | buc | 5 |
| | Concrete box culvert | mc | 68,7 |
| **6** | **ACCESS ROAD GATE CHAMBER DUMITRA** | | |
| | Site preparation | mp | 10500 |
| | Earth embankments | mc | 6266 |
| | Rock removal | mc | 11713 |
| | Stone masonry walls | mc | 3602,6 |
| | Concrete walls | mc | 407 |
| | Macadam road foundation | mp | 5860 |
| | Broken foundation stone | mc | 514 |
| | Pipe culvert Ø 800 mm | ml | 20 |
| **7** | **ACCESS ROAD VALEA REA** | | |
| | Site preparation | mp | 1200 |
| | Excavation | mc | 6500 |
| | Retaining walls | mc | 86,6 |
| | Rough stone filling | mc | 102 |
| | Aggregate mat. cylindrical | mc | 240 |
| | Tub canal IPREROM D=1.5m; L=6m, | buc | 15 |
| **8** | **DUMITRA BRIDGE CONSOLIDATION** | | |
| | Pouring 3 cm of asphalt pavement | mp | 57 |
| | Asphaltic concrete roadway | t | 4,1 |
| | Concrete bridge crown | mc | 0,5 |
| **9** | **OVER WIDENING DN 66** | | |
| | Rock excavations | mc | 29900 |
| | Slope protection | mp | 3673 |
| | Concrete retaining wall | mc | 420 |
| | Slope consolidation embankments | mc | 7200 |
| | *Stream diversion* | | |
| | Excavations | mc | 2263 |
| | Concrete | mc | 2064 |
| | Raw stone wall | mp | 70 |
| | Concrete bridge | mc | 101 |
| | Roadway lanes | m | 593 |
| | Guardrails | m | 400 |
| | Right slope consolidation | ml | 120 |
| **10** | **VALEA REA POD** | | |
| | Embankments | mc | 892 |
| | Concrete | mc | 97 |
| | Retaining walls | mc | 86 |
| | Metal beams | t | 36 |
| | Prefabricated reinforced concrete chambers | buc | 11 |
| | Metal guardrail | kg | 3115 |
| **11** | **POD LIVEZENI Km 124+440** | | |

| NR. CRT. | TITLE OBJECTIVE/description | UM | CANT |
|---|---|---|---|
| | Site preparation | mp | 6000 |
| | Excavation | mc | 1600 |
| | Rock excavations | mc | 1962 |
| | Retaining walls | mc | 22 |
| | Gabions | mc | 1598 |
| | Concrete cupolas, wings and walls | mc | 127 |
| | Concrete foundations | mc | 185 |
| | Bridge infrastructure concrete, piles, boxes | mc | 41 |
| **12** | **LIVEZENI DAM** | | |
| | Drilled column wall | | |
| | Drilled column excavations | mc | 7674 |
| | Drilled columns | ml | 2936 |
| | Column concrete | mc | 3147 |
| | Coronation beam concrete | mc | 200 |
| | Stage I diversion | | |
| | Diversion channel excavations | mc | 64138 |
| | Diversion channel concrete | mc | 4196,86 |
| | Upstream cofferdam excavations | mc | 500 |
| | Dam infrastructure + superstructure | | |
| | Excavations | mc | 118344 |
| | Concreting | mc | 12914,28 |
| | Filling | mc | 17500 |
| | Bridge over the dam | | |
| | Beam installation | ml | 50 |
| | Concreting + asphalting | ml | 50 |
| | Energy dissipator L=24 m | | |
| | Concreting | mc | 3630,74 |
| | Fixed rhizberm L=20 m | | |
| | Excavations | mc | 550 |
| | Concreting | mc | 800 |
| | Mobile rhizberm L=20 m | | |
| | Excavations | mc | 2133,82 |
| | Filling with riprap | mc | 1000 |
| | Stream diversion, right bank | | |
| | Torrent correction and connection chamber | | |
| | Excavations | mc | 288 |
| | Filling | mc | 32 |
| | Concreting | mc | 230 |
| | Riprap wall | mp | 82 |
| | Upstream channel | | |
| | Excavations | mc | 324 |
| | Filling | mc | 413 |
| | Concreting | mc | 195 |
| | Anchors | mc | 1260 |
| | Slope protection | mp | 629 |
| | Bridge D+5.00 m and upstream chamber | | |
| | Excavations | mc | 169 |
| | Filling | mc | 19 |

| NR. CRT. | TITLE OBJECTIVE/description | UM | CANT |
|---|---|---|---|
| | Concreting | mc | 213 |
| | Riprap wall | mp | 18 |
| | Prefabricates | buc | 27 |
| | Asphalt layer | mp | 57 |
| | Dam equipment | | |
| | Segmented flap gate | buc | 3 |
| | Wash-out gate | buc | 1 |
| | Intake grate | buc | 1 |
| | Grate cleaning machine | buc | 1 |
| | Slide gate | buc | 1 |
| | Cofferdams | buc | 8 |
| | Gantry crane | buc | 1 |
| **13** | ENERGY INTAKE | | |
| | Energy intake | | |
| | Excavations | mc | 2100 |
| | Concrete | mc | 1645 |
| | Wash pocket | | |
| | Infrastructure concreting | mc | 3225,85 |
| | Connection gallery between settler and intake 26.8 ml | | |
| | Excavations | mc | 370 |
| | Concrete | mc | 400 |
| | DN66 underpass | | |
| | DN66 underpass – intake area | ml | 21,4 |
| **14** | LIVEZENI-DUMITRA HEADRACE | | |
| | Livezeni underground settler | | |
| | Excavations | ml | 130,7 |
| | Concreting | ml | 130,7 |
| | Installation of tight gate | buc | 1 |
| | Installation of wash-out gate | buc | 1 |
| | Connection gallery between settler and headrace | | |
| | Excavations | ml | 21,36 |
| | Concreting | ml | 21,36 |
| | Connection gallery between settler and wash gallery | | |
| | Excavations | ml | 9 |
| | Concreting | ml | 9 |
| | Connection between settler and Jiu river | | |
| | Excavations | mc | 260 |
| | Concreting | mc | 220 |
| | Gabions | mc | 283 |
| | Downstream Livezeni front – 366.60 ml | | |
| | Excavations | ml | 366,6 |
| | Concreting | ml | 366,6 |
| | Injections | ml | 366,6 |
| | Upstream Murga front – 3468.70 ml | | |
| | Excavations | ml | 3468,7 |
| | Concreting | ml | 3468,7 |
| | Injections | ml | 3468,7 |
| | Murga intersection – 38.60 ml | | |

| NR. CRT. | TITLE OBJECTIVE/description | UM | CANT |
|---|---|---|---|
| | Excavations | ml | 38,6 |
| | Concrete | ml | 23,6 |
| | Installation of tight gate + Lining | buc | 1 |
| | *Front Murga downstream-2522 ml* | | |
| | Excavations | ml | 2522 |
| | Concrete | ml | 2522 |
| | Injections | ml | 2422 |
| | *Front chamber upstream-409ml* | | |
| | Excavations | ml | 409 |
| | Concrete | ml | 409 |
| | Injections | ml | 409 |
| | Lining | ml | 90 |
| | *Intersection Dumitra-12,41ml* | | |
| | Excavations | ml | 12,41 |
| | Concrete | ml | 12,41 |
| | Installation of tight gate + Lining | buc | 1 |
| | *Wash Gallery-146ml* | | |
| | Excavations | mc | 747 |
| | Concrete | mc | 451 |
| | *Livezeni attack firebreak* | | |
| | Excavations | ml | 126,36 |
| | Concrete | ml | 10 |
| | Portal gallery Betonare | mc | 60 |
| | *Murga Mica adits* | | |
| | Excavations | ml | 139,5 |
| | Concrete | ml | 10 |
| | Beton gallery portal | mc | 60 |
| | *Dumitra chamber access tunnel* | | |
| | Excavations | ml | 52 |
| | Concrete | ml | 10 |
| | Portal gallery chamber Dumitra Beton | mc | 10 |
| | Portal gallery Betonare | mc | 10 |
| **15** | **DUMITRA POWER STRUCTURE** | | |
| | *Gate chamber* | | |
| | Protection of chamber embankments | mp | 180 |
| | Concrete | mc | 250 |
| | Masonry | mc | 36 |
| | Carpentry | mp | 80 |
| | *Dumitra surge chamber* | | |
| | Chamber platform excavations | mc | 17000 |
| | Chamber platform slope protection | mp | 1610 |
| | Chamber well excavations | ml | 25,6 |
| | Concrete chamber collar | mc | 96,4 |
| | Concrete lower room | mc | 964 |
| | Upper chamber excavation | mc | 120 |
| | Concrete upper chamber | mc | 521,8 |
| | *Penstock* | | |
| | Penstock clearing | mp | 950 |

| NR. CRT. | TITLE OBJECTIVE/description | UM | CANT |
|---|---|---|---|
| | Excavation of penstock trenches | mc | 2940 |
| | Penstock - concrete + equalization | mc | 592 |
| | Concrete penstock horizontal gal. | mc | 1290 |
| | CF portal horizontal gallery | mc | 12,23 |
| | Solid concrete M1 | mc | 320 |
| | Solid concrete M2 | mc | 803 |
| | Concrete penstock (shotcrete) | mc | 16 |
| **16** | **CHE DUMITRA** | | |
| | Deforestation | ha | 0,8 |
| | Barricade protection | mp | 730 |
| | Gross exaggerations | mc | 22500 |
| | Excavation finishing in silt | mc | 3746 |
| | Excavation rock finishing | mc | 3407 |
| | Concrete protective barricade | mc | 34,88 |
| | Central concreting | mc | 1133,75 |
| | Infrastructure concreting + platform erection | mc | 601 |
| | Concrete infrastructure generator level | mc | 627,25 |
| | slope protection | mc | 52,8 |
| | Concrete mounting | mc | 147 |
| | Excavation stilling basin | mc | 1400 |
| | Concrete stilling basin | mc | 988,01 |
| | Quieting pool execution enclosure | mc | 41 |
| | Distributor drain well | mc | 130,8 |
| | Concrete central distributor concrete | mc | 774 |
| | Platform assembly - concreting | mc | 497,5 |
| | Pardoseli | mc | 25,3 |
| | Mount HG1, HG2 and HG3 | buc | 3 |
| | Hydraulic installation | buc | 3 |
| | Exhausting installation | buc | 1 |
| | Cooling water installation | buc | 1 |
| **17** | **MHC LIVEZENI** | | |
| | Concreting enclosure | mc | 1500 |
| | Install Kaplan turbine + Generator | buc | 1 |
| | Fit slide gate | buc | 2 |
| **18** | **DUMITRA-BUMBEȘTI HEADRACE** | | |
| | *Front Dumitra Downstream* | | |
| | Front loading camera - excavations | ml | 41,6 |
| | Front-loading-bonking camera | ml | 41,6 |
| | Gal. niv. Free-excavations | ml | 1448,2 |
| | Gal. niv. Liber-betonare | ml | 1448,2 |
| | *Front V. Rea Amonte-1.464,20ml* | | |
| | Excavations | ml | 1474,2 |
| | Concrete | ml | 1474,2 |
| | Injections | ml | 1474,2 |
| | *Front Valea Rea Aval-257272.30ml* | | |
| | Excavations | ml | 2572,3 |
| | Concrete | ml | 2520 |
| | Injections | ml | 2572,3 |

| NR. CRT. | TITLE OBJECTIVE/description | UM | CANT |
|---|---|---|---|
| | *Rea Valley junction-38,60ml* | | |
| | Excavations | ml | 38,6 |
| | *Front Bratcu Amonte-2.980,70ml* | | |
| | Excavations | ml | 2980,7 |
| | Concrete | ml | 2980,7 |
| | *Intersection Bratcu-38,60ml* | | |
| | Excavations | ml | 38,6 |
| | *Front Bratcu aval-2780,70ml* | | |
| | Excavations | ml | 2780,7 |
| | Concrete | ml | 2780,7 |
| | Injections | ml | 2780,7 |
| | *Fr. Chamber Bum.Am.-1336,50ml* | | |
| | Excavations | ml | 1336,5 |
| | Concrete | ml | 1336,5 |
| | Injections | ml | 1336,5 |
| | *Bumbești Chamber intersection-21.0ml* | | |
| | Excavations | ml | 21 |
| | Lining | ml | 21 |
| | *Front Chamber Bumbești Aval-41ml* | | |
| | Excavations | ml | 41 |
| | Concrete | ml | 41 |
| | Injections | ml | 41 |
| | Lining | ml | 41 |
| | *Access tunnel Dumitra=126ml* | | |
| | Excavations | ml | 126 |
| | Concrete | ml | 30 |
| | Portal gallery Betonare | mc | 60 |
| | Concrete raft | ml | 126 |
| | *Access tunnel Val.Rea=340ml* | | |
| | Excavations | ml | 340 |
| | Concrete | ml | 10 |
| | Portal gallery Betonare | mc | 60 |
| | *Access tunnel Bratcu=216ml* | | |
| | Excavations | ml | 216 |
| | Concrete | ml | 10 |
| | Portal gallery Betonare | mc | 60 |
| | *Bratcu access tunnel* | | |
| | Excavations | ml | 216 |
| | Concrete | ml | 10 |
| | Portal gallery Betonare | mc | 60 |
| | *Bumbești access tunnel* | | |
| | Excavations | ml | 122,6 |
| | Concrete | ml | 10 |
| | Portal gallery Betonare | ml | 60 |
| **19** | **POWER STRUCTURE BUMBEȘTI** | | |
| | *Bumbești penstock* | | |
| | Slope protection | mp | 996 |
| | Excavations | mc | 41750 |

| NR. CRT. | TITLE OBJECTIVE/description | UM | CANT |
|---|---|---|---|
| | *Massive concrete M1* | mc | 140,4 |
| | *Massive concrete M2* | mc | 811,16 |
| | *M3 massive concreting* | mc | 1241 |
| | *Concrete stairs + gutters* | mc | 512,4 |
| | Concrete raft + supports between massive | mc | 639,2 |
| | *Surge chamber Bumbești* | | |
| | Excavation of chamber well | mc | 4493 |
| | Concrete leveling | mc | 680,31 |
| | Body concreting | mc | 1252 |
| | *Gate chamber* | | |
| | Concrete | mc | 50 |
| **20** | **CHE BUMBEȘTI** | | |
| | Site preparation | mp | 6300 |
| | Excavations | mc | 29300 |
| | Concrete infrastructure | mc | 3110,7 |
| | Basin site preparation | mp | 271 |
| | Coarse excavation stilling basin | mc | 3430 |
| | Coarse excavation alu.stilling basin | mc | 1843 |
| | Concrete superstructure | mc | 300 |
| | Concreting stilling pool | mc | 430 |
| | Metal roof structure | to | 46 |
| | Sandwich panel cladding | mp | 1900 |
| | Mounting spiral chambers | buc | 3 |
| | Assembling traveling crane | buc | 1 |
| **21** | **INTERVENTION BLOCK BUMBEȘTI** | | |
| | Excavations | mc | 473 |
| | Fillings | mc | 161 |
| | Concrete | mc | 387 |
| | *Architecture* | | |
| | Masonry and compartmentalization | mc | 240 |
| | roofs and roofing | mp | 293 |
| | Interior plastering | mp | 1150 |
| | Pardoseli | mp | 511 |
| | Stairs | ml | 65 |
| | Carpentry | mp | 198 |
| **22** | **BUMBEȘTI ESCAPE CHANNEL** | | |
| | Excavations | mc | 2600 |
| | Concrete | mc | 900 |
| **23** | **JIU CATCHMENT ACCESS ROAD** | | |
| | Site preparation | mp | 1500 |
| | Excavations | mc | 2486 |
| **24** | **DUMITRA CATCHMENT** | | |
| | Excavations | mc | 900 |
| | Concrete | mc | 700 |
| | *Intake - stilling reservoir pipeline* | | |
| | Concrete | mc | 1605 |
| | Pipe installation | ml | 154 |
| **25** | **ACCESS ROAD BUMBEȘTI CHAMBER** | | |

| NR. CRT. | TITLE OBJECTIVE/description | UM | CANT |
|---|---|---|---|
| | Site preparation | mp | 6570 |
| | Excavation | mc | 2900 |
| | Rock excavations | mc | 6900 |
| | Retaining walls | mc | 100 |
| | Pipe culvert Ø 800 L = 5 m | buc | 1 |
| **26** | **LEA 110 KV DUMITRA** | | |
| | Underwater electrical cable installation (three phases) | ml | 21000 |
| **27** | **BRATCU CATCHMENT** | | |
| | Site preparation | mp | 650 |
| | Excavations | mc | 753 |
| | Concrete catch | mc | 972 |
| | Stone filling | mc | 660 |
| **28** | **CAPTARE JIU** | | |
| | Fillings | mc | 30000 |
| | Excavations | mc | 30000 |
| | Concrete | mc | 700 |
| | Upstream downstream gabion protection | ml | 20 |
| **29** | **LEA 110 KV BUMBEȚTI** | | |
| | *Poles* | buc | 36 |
| **30** | **TRAFO station 110 kV** | | |
| | Concrete | mc | 188 |
| | Transformer | buc | 1 |
| **31** | **Downstream bridge CHE Dumitra** | | |
| | Concrete | mc | 442 |

Centralized, the volumes look like this:

- Over 77,000 cubic meters of concrete to be demolished and removed from the project area;
- Over 500,000 cubic meters of excavation, land that should be restored to its original state;
- Over 89 tons of plastic and ferrous materials (cables, reducers, metal lining, etc)
- More than 45,000 square meters of landscaped roads that should be brought to their original state (more than 90,000 cubic meters of material were excavated to build these roads).

b) The decommissioning works will be carried out over a minimum period of 5 years, during which time noise will be generated on the surface of the protected natural areas creating a continuous disturbance of the species, which may lead to substantial changes in their distribution patterns within the protected natural areas, and decreases in the population sizes of species of Community interest (e.g. breeding disturbance for bird species, noise and vibration disturbance during hibernation for chiropteran species of Community interest);

c) The handling of large volumes of earth and concrete has the potential to lead to increased air pollution (especially dust particles) and given the long period of time over which these works are expected to be carried out, dust deposition on the foliage of tree/shrub/plant species in the immediate vicinity of the site may occur, affecting their photosynthetic capacity, leading to drying and degradation of habitats of conservation interest;

d) Given that the decommissioning work on the already completed targets will take place over a long period of time and that they will have to pass through inhabited areas, there is the potential to affect the human population by creating nuisance and noise from the heavy goods vehicles transporting the waste generated;
e) The work to restore the land to its original condition will require over 600,000 cubic meters of borrow soil, most of which is topsoil, and can only be sourced from borrow pits, which will have an additional negative impact on the soil. Furthermore, borrow soil may be contaminated with roots, bulbs, rhizomes, etc. of invasive plant species, which is a potential pathway for these species to enter the surface of the protected natural areas, with the risk of their further spreading into the surface of habitats of Community interest, leading to a subsequent degradation of the conservation status of these habitats.

***Alternative "one" - completing the investment***

"Romania's Energy Strategy 2022 - 2030, with the perspective of 2050" has as its vision the growth of the energy sector in conditions of sustainability, economic growth and accessibility, in the context of the implementation of the 2030 climate and energy policy framework of the legislative package Clean Energy for All Europeans, with the setting of targets for the reduction of greenhouse gas emissions, non-renewable energy sources and energy efficiency and with the perspective of Romania's implementation of the European Ecological Pact 2050. The development of the energy sector is part of Romania's development process. Growth means: using innovative clean technologies in all sub-sectors of the energy system and maintaining Romania as an energy supplier, a factor of energy stability in the South-European area; building new production capacities based on advanced clean technologies; transition from solid fossil fuels (coal, lignite, etc.) to natural gas and renewable energy sources; retrofitting and modernization of existing production capacities and their compliance with environmental standards, strengthening of energy transmission and distribution networks; encouragement of decentralized energy production; encouragement of increased domestic consumption in energy-efficient conditions; export. The national energy system will thus be stronger, safer and more stable, and Romania will maintain its role as an energy security provider in the region.

The implementation of the "Romanian Energy Strategy 2022 - 2030, with a 2050 perspective" also contributes to the completion of the works related to the Livezeni-Bumbești hydropower project.

The feasibility study studied three options for hydropower development on the Jiu River:

## 1. *3-step design option*

The scheme consists of 3 power stations per branch:

- ✓ CHE Dumitra comprising the following main objects (presented in order of technological flow):
  - ➢ accumulation of water in Livezeni lake, with NNR at 551 mdM, with an initial gross volume of 90,000 m3, of which 40,000 m3 active storage volume, which ensures an hourly regularization of tributary flows.
  - ➢ Water catchment, accompanied by coarse settling to retain large particles of water in the settling tank in front of the inlet. Periodic scouring of sediment is accomplished by partially raising the stavill near the intake when the lake is at minimum operating level;
  - ➢ underground pipeline of 4 m inside diameter and 7 km long;
  - ➢ the power structure consisting of: the balancing tower, the valve chamber and the metal penstock on the slope;
  - ➢ Dumitra power plant, located on the present day, equipped with 4 identical vertical axis Francis groups, with a total hydraulic capacity of 40 mc/s, gross head 101 m, installed capacity of 29.3 MW and energy production of 107.00 GWh/year;
  - ➢ restitution in the riverbed through a stilling basin, which in the final phase will be drowned below the level of the stage II lake.

The scheme also includes a number of ancillary or ancillary works, including:

- ▪ the stormwater drainage system in the perimeter between the right bank slope and the retention embankment of Lake Livezeni:
- - overhead power line for the power plant;
- - the headrace access tunnel, on the Murga Mica valley.

- ✓ CHE Ponorița, consisting of the following main objects:
  - ➢ Dumitra reservoir, with NNR 450 mdM, with a gross volume of approx. 150,000 m3, of which 50,000 m3 active storage volume on the first 2 m of the upper part, a volume that ensures an independent operation of 30-60 minutes;
  - ➢ water abstraction accompanied by coarse settling to the retention of the river mud particles in the settling tank in front of the intake. Periodic scouring of the deposits is done by partially raising the rake next to the inlet when the lake is at minimum operating level;
  - ➢ underground pipeline of 4 m internal diameter and 5.6 km length;
  - ➢ the power structure consisting of: the balancing tower, the valve chamber and the metal penstock on the slope;
  - ➢ Ponorița power plant, located on the present day, equipped with 4 identical vertical axis Francis groups, with a total hydraulic capacity of 40 mc/s, gross head of 80 m, installed capacity of 23.3 MW and energy production of 96.00 GWh/year;
  - ➢ restitution in the riverbed through a stilling basin, which in the final phase will be drowned below the level of the stage III lake.

The scheme also includes a number of related works, including:

- ▪ overhead power line for the power plant's power evacuation; the headrace access tunnel in the Lainici valley.

- ✓ CHE Bumbești, consisting of the following main objects: the Ponorița reservoir, with NNR 370 mdM, with a gross volume of approx. 150,000 m3, of which 50,000 m3 active storage volume on the first 2 m of the upper part, a volume that ensures an independent operation of 30-60 minutes:
  - ➢ water catchment, accompanied by coarse settling to retain large particles from the river in the settling tank in front of the inlet. Periodic scouring of the deposits is done by partially raising the sluice gate next to the inlet when the lake is at minimum operating level.
  - ➢ underground pipeline of 4 m inside diameter and 4.8 km long;
  - ➢ the power structure consisting of: the balancing tower, the valve chamber and the metal penstock on the slope;
  - ➢ Sadu- Jiu power plant, located up to date, equipped with 4 identical Francis groups with vertical axis, with a total hydraulic capacity of 40 mc/s, gross head 65 m, an installed capacity of 18.60 MW and an energy production of 79.00 GWh/year;
  - ➢ return to the riverbed via a stilling pond.

The scheme also includes a number of related works, including: overhead power line to evacuate power from the power plant, road elevation in the dam area, river regulation downstream of the dam.

The electro-mechanical equipment for the dams and water intakes of the development are identical.

Each spillway dam is equipped with 3 identical radial gate with an opening of 12 m and a height of (5+2) m. The level of the sill is at the level of the slope in order to minimize upstream levels during floods. The design flow is 800 mc/s and the verification flow is 1730 mc/s, corresponding to class III of importance (cf. STAS 4273/1987).

Each outlet is equipped with a large, fixed grate, inclined at 70 degrees, with a gross area of 60 square meters and 35 mm spacing between the bars, and a grate cleaning facility.

The valve chambers at the power structures are each equipped with a 3.20 m diameter butterfly valve, a rolling girder and a 5 tf winch.

Each power plant is equipped with: 4 Francis type hydraulic turbines with vertical axis, 4 butterfly type turbine intake structure valves, 4 suction closing barriers operated by an electro-lever, overhead crane with 32 tf rated load, cooling water, compressed air and oil house systems.

The electrical part includes for each substation: 4 vertical axis synchronous generators, 2 transformers of 16 MVA - 6,3/110 kV, own service transformers 6,3/0,4 kV and 20/0,4 kV, 6,3 kV cables for the connection between the terminals and the generator cells, as well as between the busbars and the low voltage terminals of the 16 MVA transformer. Secondary switching includes: general and own 0.4 kV alternating current services, general 220 V and 24 V direct current services, measuring, signaling, protection, control and automation installations for all hydro-aggregate installations, 110, 20 and 6.3 kV substations, remote control installations, telephone and radio communication installations.

2. ***2-step layout***

The proposed scheme for the hydropower development of the Jiu river, gorge sector, includes in this variant 2 power plants on diversion:

a) The CHE Dumitra, identical to the 3-step version, consists of the following main objects:
   - The dam that provides water storage in the lake Livezeni, with NNR at 551 mdM. The reservoir has an initial gross volume of 90,000 m3, of which 40,000 m3 active storage volume, which allows an hourly regularization of the tributary flows;
   - Energy intake to capture water, accompanied by coarse settling to retain large particles of water in the settling tank in front of the intake. Periodic scouring of the deposits is done by partially raising the rake next to the inlet when the lake is at minimum operating level;
   - Underground pipeline of 4 m inside diameter and 7 km long;
   - The power structure consisting of: balancing tower, valve chamber and metal penstock on the slope;
   - The Dumitra power plant, located on the present day, equipped with 4 identical vertical axis Francis groups, with a total hydraulic capacity of 40 mc/s and an installed capacity of 29.3 MW. From the stilling basin of the power plant the turbined flow discharges into the stage II pond.

The scheme also includes a number of related works:
   - the stormwater drainage system in the perimeter between the right bank slope and the retention embankment of Lake Livezeni;
   - overhead power line for the power plant;
   - the headrace access tunnel, on the Murga Mica valley.

b) CHE Bumbești, consisting of the following main objects:
   - Dumitra Pond, located underground, with NNR 450 mdM, with an active storage volume of approx. 36000 m3, a volume that ensures the plant an operating independence of 30-60 min;
   - Energy intake for water abstraction from the pond;
   - Underground pipeline of 4.20 m inside diameter and 12.5 km long;
   - The power structure consisting of: balancing tower, valve chamber and metal penstock on the slope;
   - Bumbești power plant, located up to date, equipped with 4 identical vertical axis Francis groups, with a total hydraulic capacity of 40 mc/s and an installed capacity of 43.0 MW;
   - The tailrace channel, following the stilling basin, through which the flow used by the power plant turbines is returned to the Sadului Valley reservoir.

The scheme also includes a number of related works, including: overhead power line to evacuate power from the power plant, road elevation in the dam area, river regularization downstream of the dam.

*Electro-mechanical equipment*

The Livezeni dam is equipped with 3 identical radial gates with an opening of 12 m and a height of (5+2) m. The level of the sill is at the level of the slope in order to influence the upstream levels as little as possible during floods. The design flow is 1188 mc/s and the verification flow is 1730 mc/s, corresponding to class II of importance (cf. STAS 4273/1987).

Each outlet is equipped with a large, fixed grill, inclined at 70 degrees, with a gross area of 60 square meters and 35 mm bar spacing and a grill cleaning facility.

The valve chambers at the power structures are each equipped with a 3.20 m diameter butterfly valve, a rolling beam and a 5 tf winch.

Each power plant is equipped with: 4 Francis type hydraulic turbines with vertical axis, 4 butterfly type turbine intake structure valves, 4 suction closing barriers operated by an electro-lever, overhead crane with 32 tf rated load, cooling water, compressed air and oil house systems.

The electrical part includes for each substation: 4 vertical axis synchronous generators, 2 40 MVA - 6.3/110 kV transformers, 6.3/0.4 kV and 20/0.4 kV own service transformers, 6.3 kV cables for the connection between the generator terminals and cells, as well as between the block busbars and the low voltage terminals of the 16 MVA transformer. Secondary switching comprises: general and own 0.4 kV alternating current services, general 220 V and 24 V direct current services, measuring, signaling, protection, control and automation installations for all hydro-aggregate installations, 110, 20 and 6.3 kV substations, remote control installations, telephone and radio communication installations.

### 3. Single-step layout

The proposed scheme for the hydropower development of the Jiu river, gorge sector, includes in this variant a power plant on diversion, CHE Bumbești, consisting of:

- The dam that ensures the storage of water in the lake Livezeni, with NNR at 551 mdM. The reservoir has an initial gross volume of 90,000 m3, of which 40,000 m3 active storage volume, which allows an hourly regulation of tributary flows;
- Energy intake to capture water, accompanied by coarse settling to retain large particles of water in the settling tank in front of the intake. Periodic scouring of the deposits is done by partially raising the rake next to the inlet when the lake is at minimum operating level;
- Underground pipeline of 4.20 m inside diameter and 19.70 km long;
- The power structure consisting of: balancing tower, valve chamber and metal penstock on the slope;
- The Bumbești power plant, located on the present day, equipped with 4 identical vertical axis Francis groups, with a total hydraulic capacity of 40 mc/s and an installed capacity of 29.3 MW. From the power plant's stilling basin, the turbined flow discharges into the Jiu River.

The scheme also includes a number of related works:

- the stormwater drainage system in the perimeter between the right bank slope and the retention embankment of Lake Livezeni;
- overhead power line for the power plant;
- 5 adits for the headrace gallery.

***Choice of layout variant***

The energy-economic calculations revealed the following:

- The single-stage variant has the minimum investment, the investment in the 2-stage variant is 451 thousand USD higher;
- maximum energy production is obtained in the 2-step variant: 283 million kWh/year;
- The single-stage development option occupies the smallest area of land, 4 ha less than the 2-stage option;
- the two-stage development variant has the best indicators (lowest specific investment, highest B/C ratio, lowest discounted unit cost and highest internal rate of return).

The single-stage design variant, due to the very long length of the headrace gallery and the small difference between the normal retention level and the minimum operating level (about 2 m), presents operating difficulties caused by non-permanent movements on the headrace when stopping and starting the hydroaggregates (the oscillations in the ecilliberate chamber at maximum jump are hardly damped, the minimum jump when starting the groups may cause aeration of the headrace gallery). In order to mitigate these phenomena, special constructive measures have to be taken and certain operating restrictions imposed. The constructive measures refer to the selection of a very large balancing tower, which is difficult to construct, the provision of a lower chamber with water circulation, and/or a hydraulic bypass system at the power plant that ensures continuous water circulation in the headrace with a minimum flow of 6 $m^3/s$, even when the units are not in operation. The operating restrictions concern the imposition of very long times for stopping and starting the units, which is difficult to achieve in practice.

Taking all these considerations into account, the pre-feasibility study and subsequently the feasibility study proposed the two-stage development variant for further development in the next design phases.

Given the very advanced stage of the works, the specific environmental studies have analyzed the environmental impact of the 2-stage development variant, which is also what was actually carried out in the field.

## 3. DESCRIPTION OF RELEVANT ASPECTS OF THE CURRENT STATE OF THE ENVIRONMENT

### a) *Environmental factor: water*

***Surface waters***

As a result of the spatial GIS analysis in relation to the works related to the Livezeni-Bumbești E.H.W.A., the surface water bodies potentially affected by the completion and commissioning of the Livezeni-Bumbești E.H.W.A. were identified, being represented both by the water bodies on which the works related to the Livezeni-Bumbești E.H.W.A. are located and by the water bodies upstream of the Livezeni dam. Therefore, 4 surface water bodies were identified and are presented in *Table 37*.

*Table no. 37 - Surface water bodies potentially affected by the completion and commissioning of the Livezeni Bumbești H.H.E.*

| No. crt. | Water body code | Name of water body |
|---|---|---|
| 1 | RORW7-1_B4 | Jiul de Vest - loc. Paroșeni-confl. Jiul de Est |
| 2 | RORW7-1-15_B10 | Jiul de Est - loc. Petrila - cf. Jiu |
| 3 | RORW7-1-19_B18 | Bratcu - spring - cf. Jiu |
| 4 | RORW7-1_B14 | Jiu confl. Jiul de Est -Acum. Vădeni |

Regarding groundwater bodies, 2 groundwater bodies were identified (ROJI01 - Neag-Petrila Field, ROJI05 - Lunca and terraces of the Jiu and its tributaries) which are located outside the project development area (upstream and downstream of the project works) and were not considered potentially affected.

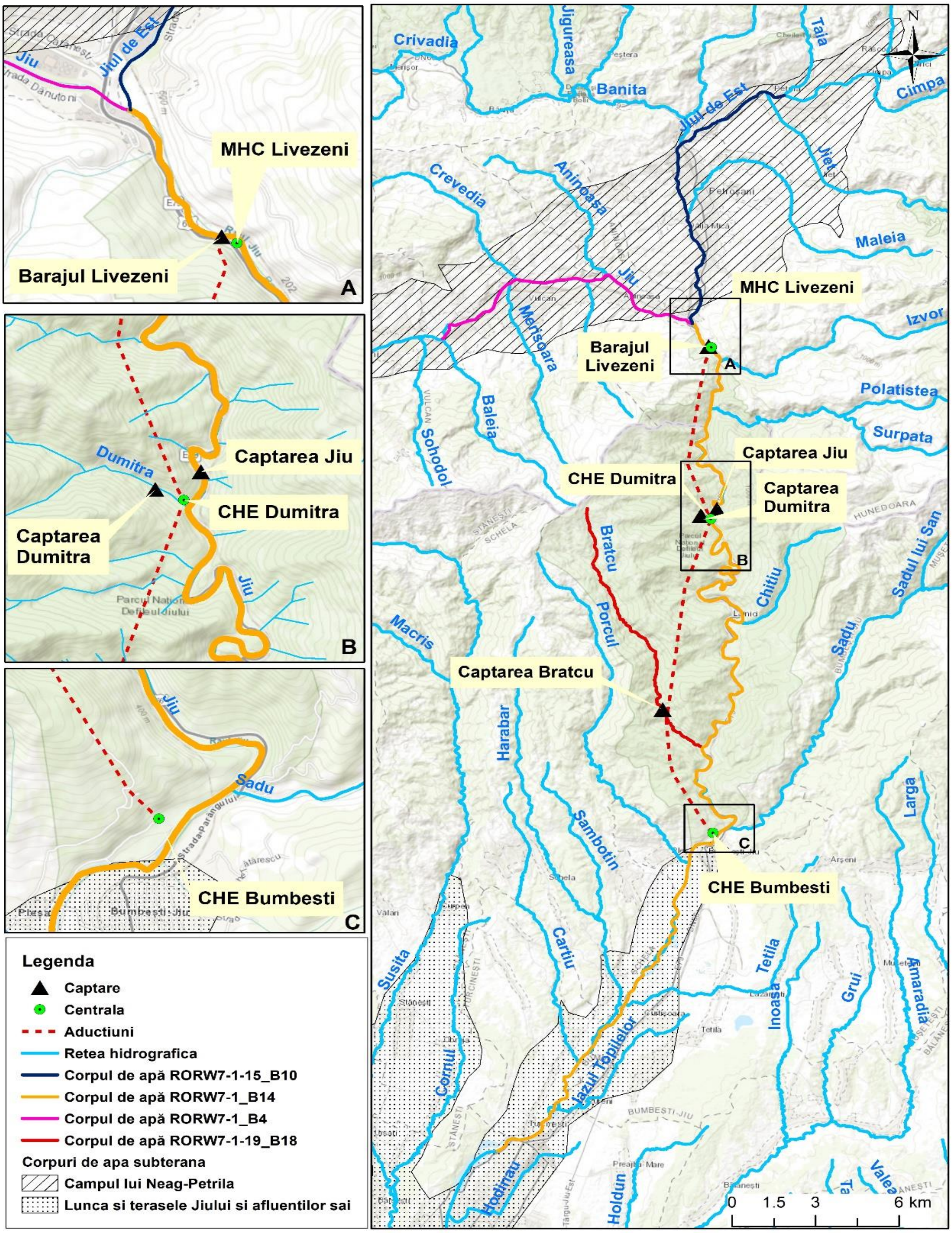



Fig. 58 Representation of groundwater bodies

The following are some images *(figures below)*, taken as a result of the field visit, with the intersection areas of the water bodies with the works related to the H.H.E. Livezeni Bumbești.

*Upstream area* *Downstream area - with silt deposited over time*

Fig. 59 Water body Jiu confl. Jiu de Est-Acum. Vădeni (view from Livezeni dam)

Downstream view of the dam *Downstream of the dam*

Fig. 60 Water body Jiu confl. Jiu de Est-Acum. Vădeni (downstream Livezeni dam)


Fig. 61 Water body Jiu confl. Jiu de Est-Acum. Vădeni (area of the Jiu catchment to be built on the Jiu river upstream of the confluence with the Dumitra river) - view from the right bank


*Upstream catchment area* *Downstream catchment area*


*Spillway dam area* *Bratcu catchment*

Fig. 62 Bratcu - spring - cf. Jiu (Bratcu catchment area)

The longest water body potentially affected by the project is the water body *Jiu - confluence East Jiu - Vădeni Accumulation* (50.25 km long), and the other water bodies are about 11-12 km long. The length of the above mentioned surface water bodies are specified in *Table 38*.

*Table 38 - Length of potentially affected water bodies*

| No. crt. | Water body code | Name of water body | Length (km) |
|---|---|---|---|
| 1 | RORW7-1_B4 | West Jiu - loc. Paroşeni-confl. East Jiul | 11,24 |
| 2 | RORW7-1-15_B10 | Jiul de Est - loc. Petrila - cf. Jiu | 12,40 |
| 3 | RORW7-1-19_B18 | Bratcu - spring - cf. Jiu | 11,68 |
| 4 | RORW7-1_B14 | Jiu confl. East Jiu-Acum. Vadeni | 50,25 |

*b)* *Environmental factor: air*

**Bumbești-Jiu area**

The main sources of air pollution are road traffic and industrial activities developed in the area. The road traffic is on the arteries E79 (DN66) - from Oradea (N-V) to Bulgaria (S); DN 66 - connecting Târgu Jiu-Petroșani; DJ665 - connecting Novaci and the northern part of the county; DC 149 - connecting Schela; DC 2, DC2A, DC3, DC3A - connecting the neighboring localities.

The following pollutants are emitted into the atmosphere from the combustion of fuels: carbon monoxide, hydrocarbons, sulphur dioxide, nitrogen oxides, volatile organic compounds.

The main industrial activities in the area of Bumbești-Jiu are represented by the extraction of granite minerals and the production of ammunition at the Sadu Mechanical Plant.

According to information provided by the Agency for Environmental Protection Gorj, the National Company ROMARM, SC UZINA MECANICĂ SADU S.A., located in Bumbești-Jiu is part of the Seveso sites.

At present, the plant's object of activity consists in the realization of products and provision of services, as follows:

- research, design, manufacture and commercialization of NATO caliber infantry ammunition (5.56 x 45 mm, 7.62 x 51 mm, 9 mm Parabellum, in different constructive variants) as well as "Eastern" calibers, from 5.45 mm to 9 mm Makarov and various pyrotechnic initiating elements.

The plant can also provide a wide range of services through its facilities, namely:

- R&D activities on various projects;
- tool design, production and repair.

Granite quarrying activities generate negative effects on the air, in particular by entraining sedimentable dust. This activity has been carried out in the urban area of Bumbești-Jiu since before 1990.

**Aninoasa-Petroșani area**

In the municipality of Petroşani, the main sources of air pollution with gaseous and solid chemical substances in suspension are: thermal power plants; car transportation; fan stations of mining units; technological processes (painting, foundries, welding, etc.).

The burning of fossil fuels in stationary and mobile sources is the main human activity - in terms of prevalence and intensity - responsible for loading the atmosphere with a complex of gaseous and solid pollutants, inorganic and organic in nature. Within this complex, the most important are acid gases: sulphur dioxide and trioxide, nitrogen oxides, carbon monoxide and carbon dioxide.

Alongside these are dust (ash and/or soot) and some volatile organic compounds (hydrocarbons - mainly methane, aldehydes, organic acids).

It should be noted that the ashes resulting from coal combustion contain a number of toxic metals: Cd; Pb; Mn; Hg; Ni; V as well as traces of radioactive elements. Pollutants resulting from the combustion of solid fuels lead not only to deterioration of the quality of the atmosphere, but also to deterioration of other environmental factors, thus directly or indirectly affecting man. The effects on human and animal organisms occur either through the direct action of NOx entering the respiratory system, or indirectly through food and water as a result of changes in the natural parameters of soil, water and vegetation, and acid rain.

The air quality monitoring network in Gorj county has no automatic monitoring station in Bumbești-Jiu nor in the vicinity (the nearest station is in Tg. Jiu, more than 15 km from the site). At the same time, in Hunedoara county the nearest air quality monitoring station is in Călan, more than 75 km from the site.

Due to the lack of monitoring stations in the area, modeled data made available by different applications were used to analyze the air quality, the source of the data presented below is the Meteoblue application.

In detail each diagram shows the following information:

a) The top panel shows the forecast for the Common Air Quality Index (CAQI) used in Europe since 2006. It is a number on a scale from 1 to 100, where a low value (green color) represents good air quality and a high value (red color) represents poor air quality. The CAQI color code is used in all air pollution display panels of the meteograms to indicate the pollution level.
b) The second panel shows the forecast of particulate matter (PM and desert dust) for Aninoasa, for example. Atmospheric particulate matter (PM) is microscopic matter in solid or liquid form that is suspended in the air. The sources of particles can be natural or anthropogenic. Of most concern for public health are particles small enough to be inhaled in the deepest parts of the lung. These particles are less than 10 microns in diameter (about 1/7 the thickness of a human hair) and are defined as PM10. They are a mixture of materials including smoke, soot, dust, salt, acids and metals. The particles are also formed when gases emitted by motor vehicles and industry undergo chemical reactions in the atmosphere. PM10 is visible to the eye as smog. PM10 is among the most harmful air pollutants.

c) PM 2.5 pollutants can come directly from natural sources such as dust, soot, bacteria, windblown salt, pollen, smoke from fires or from man-made (anthropogenic) sources such as industrial processes, some power plants, vehicle emissions, stoves, fireplaces and smoking. PM 2.5 fine particles are also formed when different chemicals combine in the air. For example, chemicals from coal-fired power stations or car emissions react with water vapor in the atmosphere to form new particles smaller than 2.5 microns.

d) Forecasts for concentrations of air polluting gases are shown in the third panel.

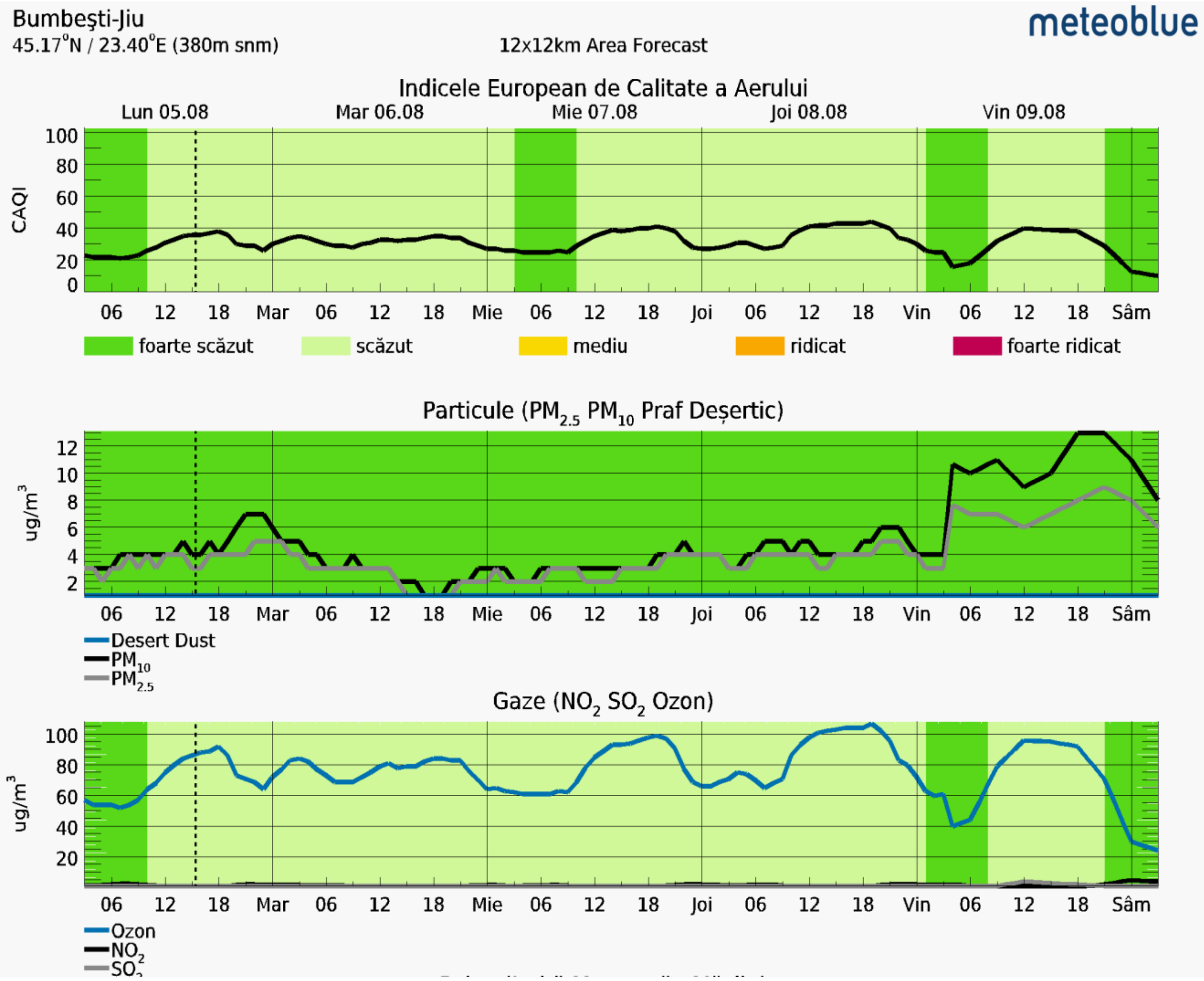



Fig. 63 Modeled air quality elements in the Bumbești-Jiu area (source: Meteoblue)

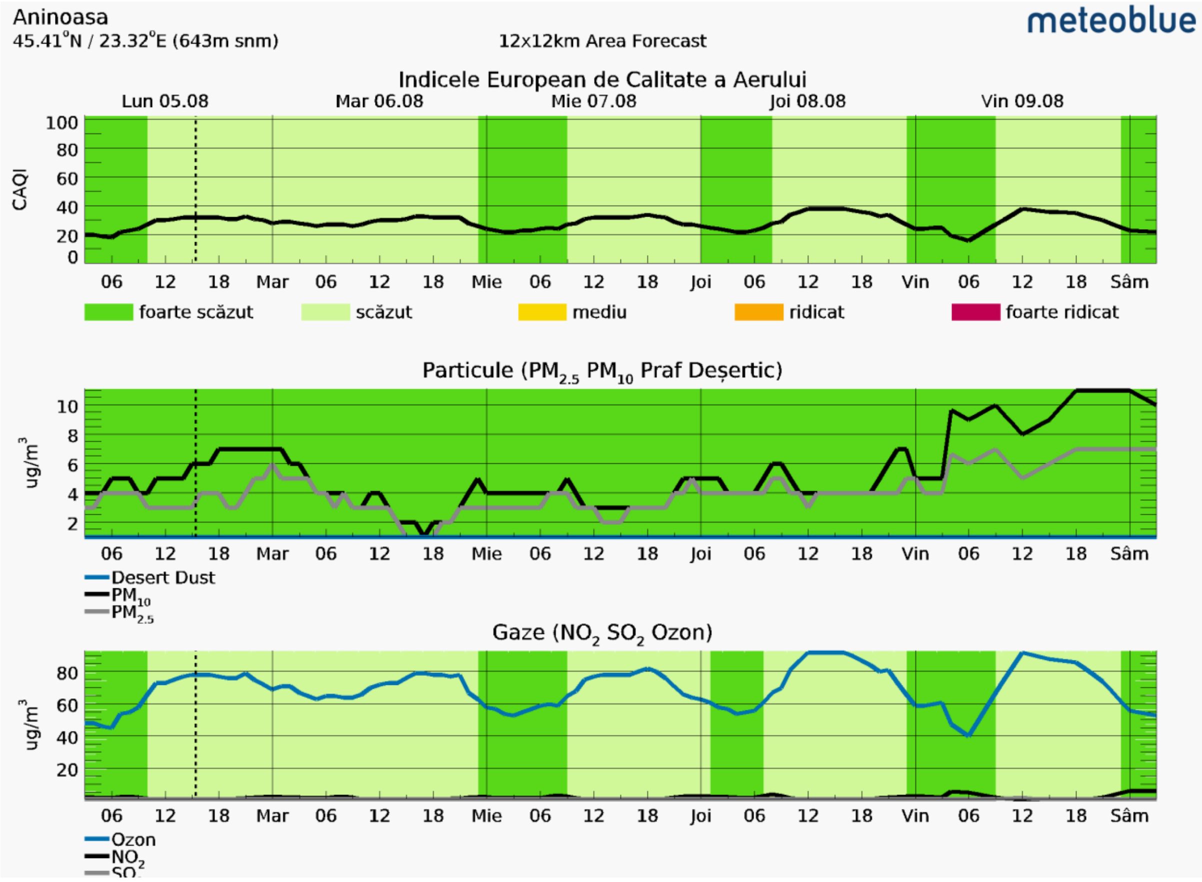


Fig. 64 Modeled air quality elements in the Aninoasa area (source: Meteoblue)

*c) Environmental factor: soil/subsoil*

The following soil types, grouped by classes, occur in the Defile of the Jiu:

- Class Protisols: Lithosols (distric, eutric), Alluviosols;
- Class Cambisols: Districambosols (typical and lithic), Eutricambosols (lithic);
- Class Luvisols: Luvisols;
- Class Spodisols: Cryptopodsols (lithics);
- Class Antrisols: Erodisolides.

The predominant soils in the Defile of Jiului area are distric lithosols (36%), i.e. superficial soils with a high proportion of skeleton, which correlates with the dominance of the area of land with high slopes, which favors erosion by removing the humus layer.

In the area of the project site dominate soils of the Protisols class, respectively Distric and Eutric Lithosols.

In this class were included young, unevolved soils, generally formed along valleys, being subject to the permanent action of water, which by continuous washing does not allow the processes of solification to start. Within this class, there are 2 types of soils within the area: lithosols (with the subtypes distric and eutric) and alluvisols (subtype distric).

*The lithosols*, formerly also called Rankere, are specific to mountainous regions with rugged relief. They form on hard eruptive or metamorphic rocks resistant to alteration. In general they may evolve into zonal soils, districambosols or podzols.

The soil profile is O-Ao-R or Ao-R, where Ao is 5-10 cm thick and often consists of a mixture of humus, decomposing organic matter, rock fragments. The Ao horizon is light in color. The texture of the more evolved ones can be coarse to fine-grained, and the structure gravelly or poorly developed polyhedral. The short profile makes permeability, aeration porosity and water capacity values low.

Most of the excavation works in the project area have already been completed, so soil degradation will be localized and extremely limited.

d) *Biodiversity*

***d.1.) General information***

Based on the provisions of the Methodological Guide on the appropriate assessment of the potential effects of plans or projects on protected natural areas of Community interest, approved by Order of the Minister of Environment, Water and Forests no. 1.682/2023, the following table presents data on protected natural areas of Community interest potentially affected by the implementation of the project analyzed.

Below are presented **data on protected natural areas of community interest potentially affected by the implementation of the analyzed project**, according to the structure of Table no. 39 (*Data on PNAIC affected by the implementation of the PP*) in Annex no. 5A to the Annex to the Order MMAP no. 1.682/2023 for the approval of the Methodological Guide on the adequate assessment of the potential effects of plans or projects on protected natural areas of community interest.

*Table no. 39 Data on ANPIC affected by PP implementation*

| Name and code protected natural area | Area (ha) | Importance / Role | Management plan and the normative act by which it was approved | Decision / Note approving the conservation objectives of the protected natural area | Biogeographical region(s) where the protected natural area is located | Types of ecosystems | Overlap with other protected natural areas | Relations of the protected natural area of Community interest with other protected natural areas |
|---|---|---|---|---|---|---|---|---|
| ROSCI0063 Defileul Jiului | 10.914,42 ha | The Site of Community Importance ROSCI0063 Defile of the Jiu was declared for the conservation of 22 habitats of Community interest and 30 species of Community interest. | The integrated management plan of the Defileul Jiului National Park and Natura 2000 site ROSCI0063 Defileul Jiului is in the environmental assessment procedure, and will be submitted for approval, under | MMAP Note no. 13.421/CA /11.09.2020 on the approval of the minimum set of special measures for the protection and conservation of biological diversity, as well as the conservation of natural habitats, wild flora and fauna, population | Alpine | Natural grasslands, pastures, arable land, scrublands, aquatic habitats, coniferous forests, mixed forests, deciduous forests | ROSCI0063 Defileul Jiului entirely overlaps the Defileul Jiului National Park and includes the nature reserves Sfinxul Lainicilor (INSPIRE code RONPA0444) and Stâncile Rafailă (RONPA0472) | To the east ROSAC0188 Parâng and ROSAC0128 Nordul Gorjului de Est, to the west ROSAC0129 Nordul Gorjului de Vest. It has a coridorecologic role for large carnivore species in the upper basin of the R. Jiu (together with the |

| Name and code protected natural area | Area (ha) | Importance / Role | Management plan and the normative act by which it was approved | Decision / Note approving the conservation objectives of the protected natural area | Biogeographical region(s) where the protected natural area is located | Types of ecosystems | Overlap with other protected natural areas | Relations of the protected natural area of Community interest with other protected natural areas |
|---|---|---|---|---|---|---|---|---|
| | | | the conditions of the law. | safety and investments in ROSCI0063 Defileul Jiului | | | | previously mentioned sites) |
| ROSCI0217 Retezat | 43.528,5 ha | The Site of Community Importance ROSCI0217 Retezat has been designated for the conservation of 5 habitats of Community interest and 29 species of Community interest, according to the standard form of the protected natural area. According to the Integrated Management Plan of the protected natural area, 24 types of | Management plan of the Retezat National Park, including the reserves 2.494 Gemenele, 2.496 Peștera Zeicului, together with the partially overlapping Natura 2000 sites - ROSCI0217 Retezat and ROSPA0084 Munții Retezat, currently under environmental assessment procedure | Note MMAP no. 11140/BT / 21.04.2021 on the approval of the minimum set of special measures for the protection and conservation of biological diversity, as well as the conservation of natural habitats, wild flora and fauna, population safety and investments in ROSCI0217 Retezat | Alpine | Rivers, lakes, natural meadows, deciduous forests, coniferous forests, mixed forests and cliffs. | The Site of Community Importance ROSCI0217 overlaps with the Retezat National Park (INSPIRE Code RONPA0002) and the Special Protection Area for Birds ROSPA0084 Retezat Mountains. Also, within the perimeter of the protected natural area there are the following Reserves of national interest: Gemenele (INSPIRE Code RONPA0511) and Zeicului Cave (INSPIRE Code RONPA0513) | North: Țara Hațegului Dinosaur Geopark (INSPIRE Code RONPA0292) and the sites of Community importance ROSCI0292 Rusca Montană - Țarcu - Retezat Corridor and ROSCI0236 Strei - Hațeg, to the south the special area of conservation ROSAC0129 Nordul Gorjului de Vest, Domogled - Valea Cernei National Park (INSPIRE Code 0001), the site of Community |

| Name and code protected natural area | Area (ha) | Importance / Role | Management plan and the normative act by which it was approved | Decision / Note approving the conservation objectives of the protected natural area | Biogeographical region(s) where the protected natural area is located | Types of ecosystems | Overlap with other protected natural areas | Relations of the protected natural area of Community interest with other protected natural areas |
|---|---|---|---|---|---|---|---|---|
| | | habitats of Community interest and 26 species of fauna and flora of Community interest have been identified at the level of ROSCI0217 Retezat | | | | | | importance ROSAC0069 Domogled - Valea Cernei and the special protection area for bird species ROSPA0035 Domogled - Valea Cernei and to the west the site of Community importance ROSCI0126 Munții Țarcu |
| ROSPA0084 Retezat Mountains | 38 316 ha | The Special Protection Area ROSPA0084 Retezat Mountains has been designated for the conservation of 23 bird species of Community interest | | Note MMAP no. 253925/MF/ 253925/MF/ 18.12.2020 on the approval of the minimum set of special measures for the protection and conservation of biological diversity, as well as the conservation of natural habitats, wild flora and fauna, population safety and investments in ROSPA0084 | Alpine | Rivers, lakes, natural meadows, deciduous forests, coniferous forests, mixed forests and cliffs | The special avifauna protection area ROSPA0084 Retezat Mountains overlaps with the Retezat National Park (INSPIRE Code RONPA0002) and the site of community importance ROSCI0217 Retezat. Also, within the perimeter of the protected natural area there are the following Reserves of national interest: Gemenele (INSPIRE Code RONPA0511) and Zeiciului Cave | |

| Name and code protected natural area | Area (ha) | Importance / Role | Management plan and the normative act by which it was approved | Decision / Note approving the conservation objectives of the protected natural area | Biogeographical region(s) where the protected natural area is located | Types of ecosystems | Overlap with other protected natural areas | Relations of the protected natural area of Community interest with other protected natural areas |
|---|---|---|---|---|---|---|---|---|
| | | | | Retezat Mountains | | | (INSPIRE Code RONPA0513) | |

***d.2.) Biodiversity in the project site area***

In order to clarify all aspects related to the presence and distribution of species and habitats in the project's area of influence, between October 2023 and June 2024, experts on different taxonomic groups carried out field trips in the project site area, the results of the field activities are summarized as follows:

***A. <u>Habitats and plants</u>***

**Methodology**.

As the areas with N2000 non-forest habitats are very small in the whole study area, their entire surface was surveyed, including the steep areas, where small inaccessible areas were scanned with binoculars, telephoto and drone. Transects were made through the much larger areas of forest habitats adjacent to them, following their species composition and typology to track ecotonal interference with non-forest habitats. From all the non-forest habitats, surveys were made for each plant association identified.

**General framework**

The studied area within the Defile of Jiului consists of 6 insular perimeters with altitudes between 300-580 m, with a very rugged relief, characterized by steep slopes and high energy. The rocks are predominantly acidic, here there is a succession from north to south of epizone schists (Livezeni dam), paraamphibolites with crystalline limestone lenses (Murga Mica access tunnel and Dumitra CHE), epizone schists (Dumitra and Valea Rea adits), granites and granodiorites (Bratcu access tunnel, Bumbești CHE). As such, the soil cover is predominantly acidic and shallow, dominated by dystric cambisols (eutric on para-amphibolites) and leptosols.

Vegetation is predominantly forested mont montane/submediterranean forest with very few non-forest habitats, lacking the extensive meadows of most Carpathian mountainous areas, due to the fact that the energy of relief and inaccessibility of the gorge prevented human access until late in the indistrict period.

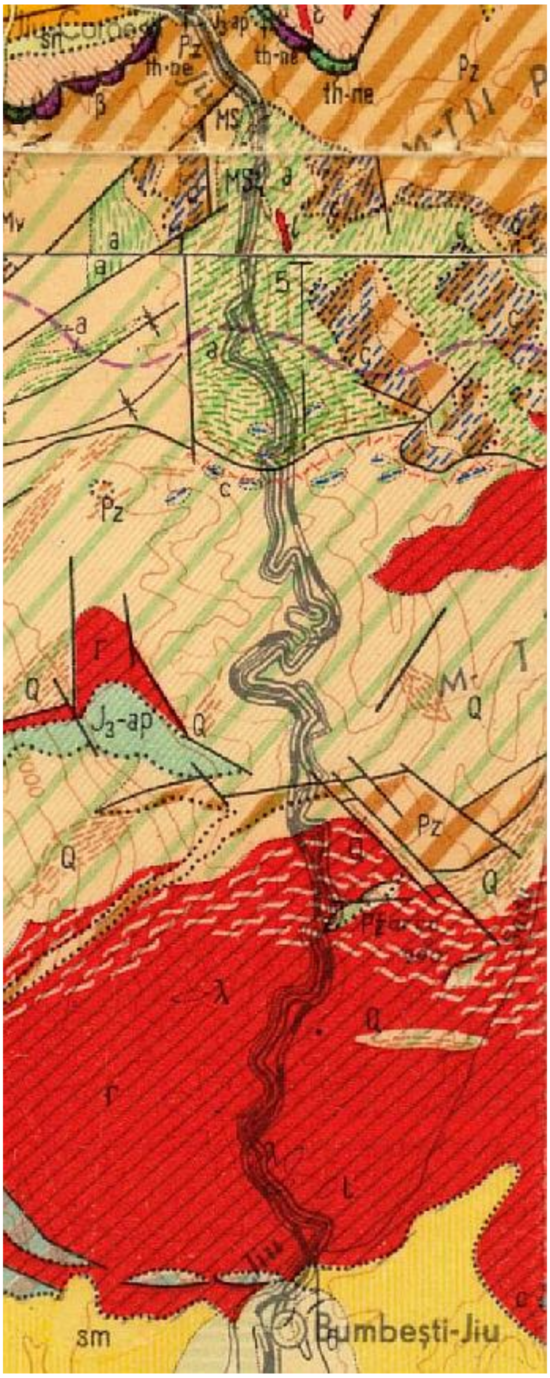



Fig. 65 Geologic map of Defileul Jiului NP (after the Geologic Map of RSR 1:200.000 sheets Petroșani and Târgu Jiu)

There is a petrographic succession from north to south - the acidic crystalline epizone crystalline schists of the Tulișa Series, followed by the Drăgășan ortho-amphibolite series (basic volcanic rocks of the metamorphosed gabbro type), the acidic crystalline epizone schists of the Lainici-Păiuș Series and to the south (red) the granitoid Tismana massifs. However, the geological succession does not fundamentally influence the vegetation and habitat typology, as the north-south displacement of the Dacian oak (91Y0) and Dacian facies (91V0) by the

Illyrian oak (91L0) and Illyrian facies (91K0) is due to the existence of a climatic gradient and a phytogeographic cline.

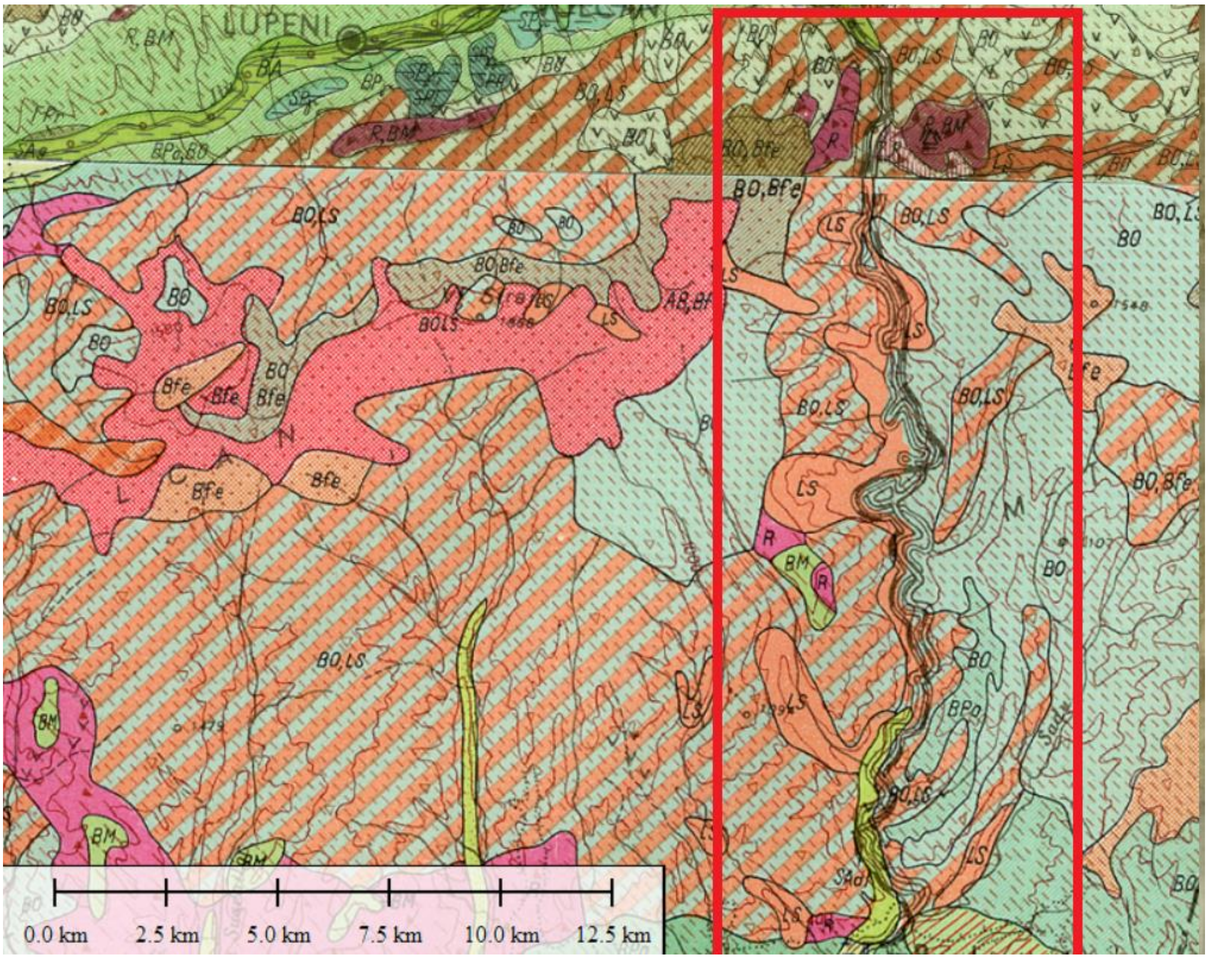



Fig. 66 Geology of the area


Fig. 67 Typical distribution of dominant habitats within the narrow sections of the Defile of the Jiu River

On slopes with a dominant western and eastern exposure, there are Dacian oak forests, habitat N2000 91V0 intimately mixed, on the higher and more rocky slopes with forests of oaks - priority N2000 habitat 9180* and the cliff variant of Dacians meadows with *Aspleniium scolopendrium*. Non-forested habitats of scrublands, meadows or saxicolous, conditioned by siliceous or less frequently basal or calcareous cliffs occur on some local sections and/or at the top of slopes.

**Natura 2000 habitats identified**

*3.1. Livezeni Dam.*

Within the perimeter of the Livezeni dam there are no N2000 non-forest habitats, the area being dominated by forest habitats, namely the Central European mesotrophic-neutrophic beech forests, 9130, some of which are regenerating and interrupted riparian corridors, namely priority habitat 91E0*. The remaining vegetation encountered is ruderal. The structure of this mosaic of habitats is explained in the maps below.


Fig. 68 The distribution of habitats in the Livezeni dam area shows that there are no non-forest N2000 habitats here, only ruderal vegetation. The remaining N2000 habitats are exclusively forested, such as Central European neutrophilous beech forests, 9130 (many in regeneration), black alder forests 91E0*, and ravine forests, 9180*


Fig. 69 The distribution of N2000 forest habitats in the perimeter of the Livezeni dam is compact, leaving no room for non-forest habitats


Fig. 70 Local distribution of N2000 forest habitats around the Livezeni dam. There are no non-forest N2000 habitats in the perimeter

*3.2. Murga Mica access tunnel*

40A0* Subcontinental peri-Pannonian scrub. CLAS. PAL.: 31.8B12p, 31.8B13, 31.8B14, 31.8B3p and
8220 Siliceous rocky slopes with chasmophytic vegetation CLAS. PAL.: 62.2.

Despite its apparently simple topography, the habitat mosaic within the Murga Mica access tunnel is quite complex, dominated mainly by Dacian oak forests 91V0 mixed on the steeper, stony slopes with Cork oak forests 9180*. The natural cliffs above the access tunnel are largely colonized by *Populus tremula and Betula pendula*, together with other softwood species, phytocenoses of the Populeto - Betuletum pendulae association Coldea Coldea 1972. Although they are pioneers, their presence status is permanent, due to the rocky and relatively arid substratum. Interestingly, thus largely eliminated from the landscape here are the non-forested shrubland habitats 40A0* (Spiraea ulmifolia bull thickets) and 8220 (siliceous rocky casmophytic vegetation) just above the access tunnel. Dense patches of *Spiraea ulmifolia* still vegetate between the birch and aspen trees, as does the habitat-specific flora 8220.

These habitats, 40A0* and 8220 occur only on the cliffs immediately north of the mouth of the valley and, in restricted areas (only 8220) on very steep cliffs above the Murga Mica access tunnel. It is interesting that the flora has some basiphilic characters, due to the massive presence of para-amphibolites and limestone lenses in the substratum.
7220* Petrifying springs with tufa formation (Cratoneurion) CLAS. PAL.: 54.12.

Habitat 7220* is a surprising occurrence in the areal, but the presence of paraamphibolites and crystalline limestone lenses in the slope explains its presence in the succession of cascades on the very steep and rocky bed of the Murga Mica valley. The porous travertine deposits are small, but here there are characteristic species of this habitat, primarily bryophytes of the genus Cratoneuron. .

The phytocenoses of the habitat 8220 of low altitudes are not yet described in a coherent manner in the Romanian and European phytosociological literature. The identified phytocenoses can be tentatively placed in the associations Hypno-Polypodietum Jurko et Peciar 1963 and Asplenietum septentrionalis Schwick 1944. Those with more compact vegetation and more species of cormophytes belong to the associations Potentillo arenariae - Festucetum pseudodalmaticae (Domin 1933) Majovsky 1954, Minuartio frutescentis - Festucetum pseudodalmaticae (Mikyska 1933) Klika 1938 on sunny slopes, respectively Asplenio trichomanis-Poëtum nemoralis Boșcaiu 1971 subass. veronicetosum bachofenii (Borza 1959) stat. nov. The phytocenoses of the Murga Mica access tunnel are poor, and the emblematic species, the regional endemics Veronica bachofenii and Dianthus henteri are very rare here, due to the very small extent of the habitats. We only note the local abundance of the biogeographically interesting species Saxifraga rotundifolia here.

Habitat 40A0* is represented by restricted areas, some included in young forests of Populus tremula and Betula pendula through much impoverished phytocenoses of the Calamagrostio-Spiraeetum ulmifoliae Resmeriță et Csűrös 1966.

Habitat 7220* also has poor phytocenoses of the typical association Cratoneuretum filicino-commutati (Kuhn 1937) Oberd. 1977.

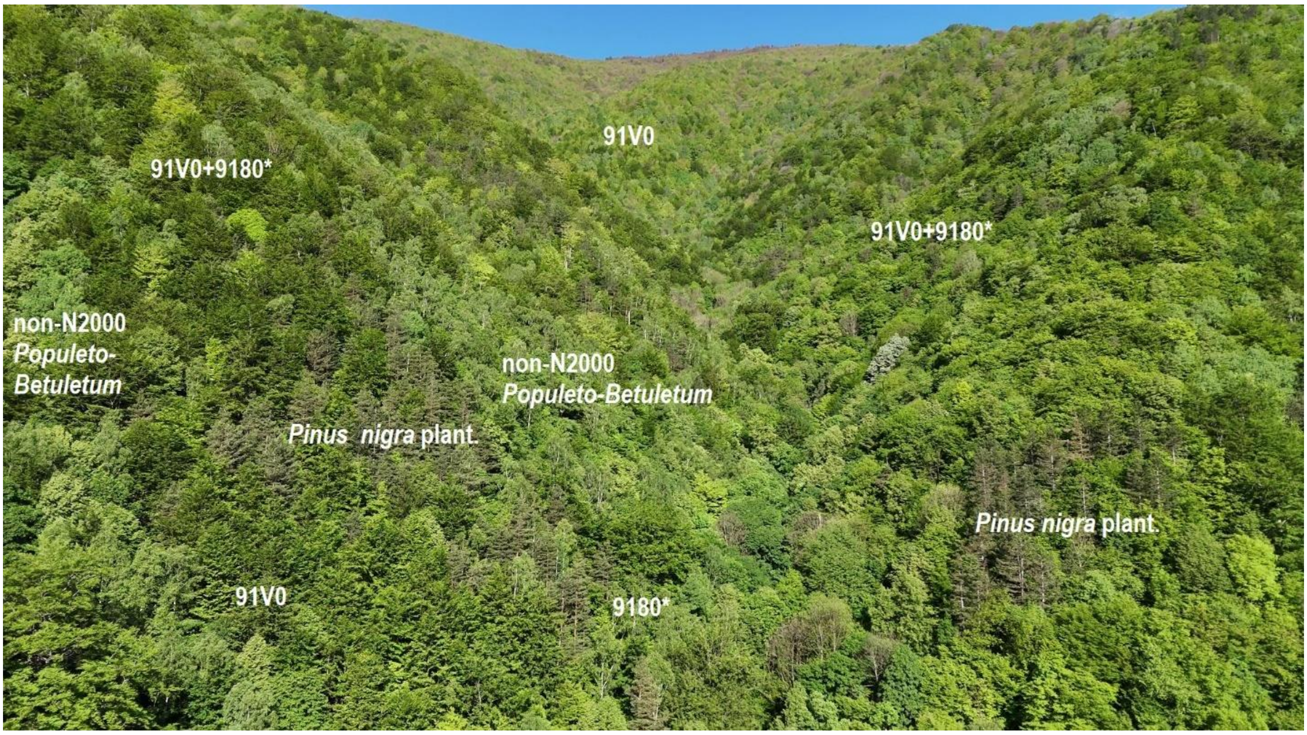



Fig. 71 Structure of N2000 habitats in the Murga Mica valley perimeter, above the homonymous access tunnel

They are exclusively forested according to aerial images, with Dacian oak forests, 91V0, patchy in places on steep rocky slopes with 9180* Cork oak woodland. There are frequent plantations of Pinus nigra, an allochthonous, non-native species in the region, and pioneer forests of aspen and Populus tremula - Betuletum pendulae Coldea 1972. In reality, not visible from the air, there are along the very steep-bedded Murga Mica valley segments of N2000 priority non-forest habitat 7220*.

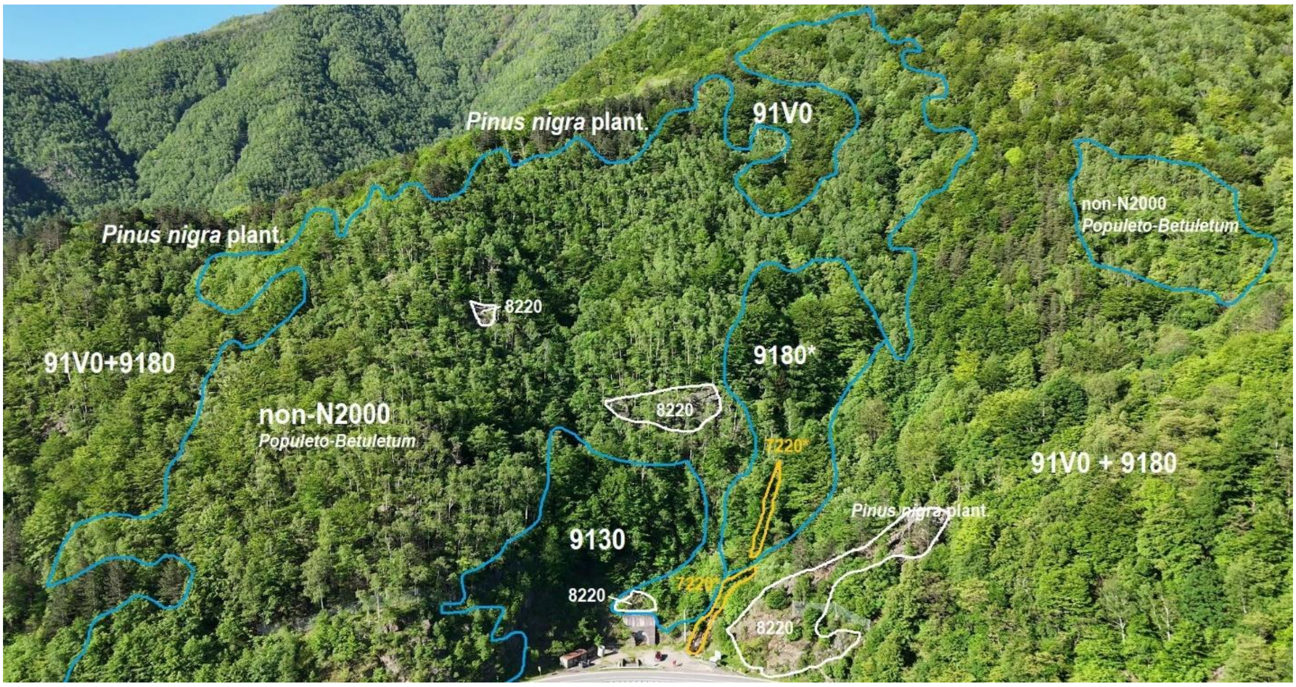



Fig. 72 Habitat structure of the Murga Mica access tunnel (visible at the base of the slope).

Most of the N2000 and non-N2000 habitats are forested, i.e. Dacian oak forests 91V0 mosaicized with 9180* cork oak woodland 9180* forests, Pinus nigra plantations and pioneer forests of Populus tremula and Betula pendula, Populeto - Betuletum pendulae Coldea 1972. The latter are grown over cliffs covered in places by Spiraea ulmifolia, which would make them suitable for the N2000 priority habitat 40A0*.

The siliceous cliffs scattered in small patches belong to habitat 8220 and are sometimes covered by *Fraxinus ornus*, but on very small areas, which cannot lead to the delimitation of segments of priority N2000 habitat 40A0*.

In the steep and stony bed of the Murga Mica valley there are segments of waterfalls with small travertine deposits and massive presence of species of the bryophyte genus Cratoneuron. The presence of this habitat in an area with predominantly siliceous rocks (crystalline epizon crystalline schists) is due to the fact that there are many lenses of paraamphibolites (basic rocks) and even crystalline limestones that form the bed of the valley. .


Fig. 73 Siliceous cliff habitat islands 8220 within the non-N2000 forest habitat of pioneer Populus tremula and Betula pendula forests, Populeto - Betuletum pendulae Coldea 1972

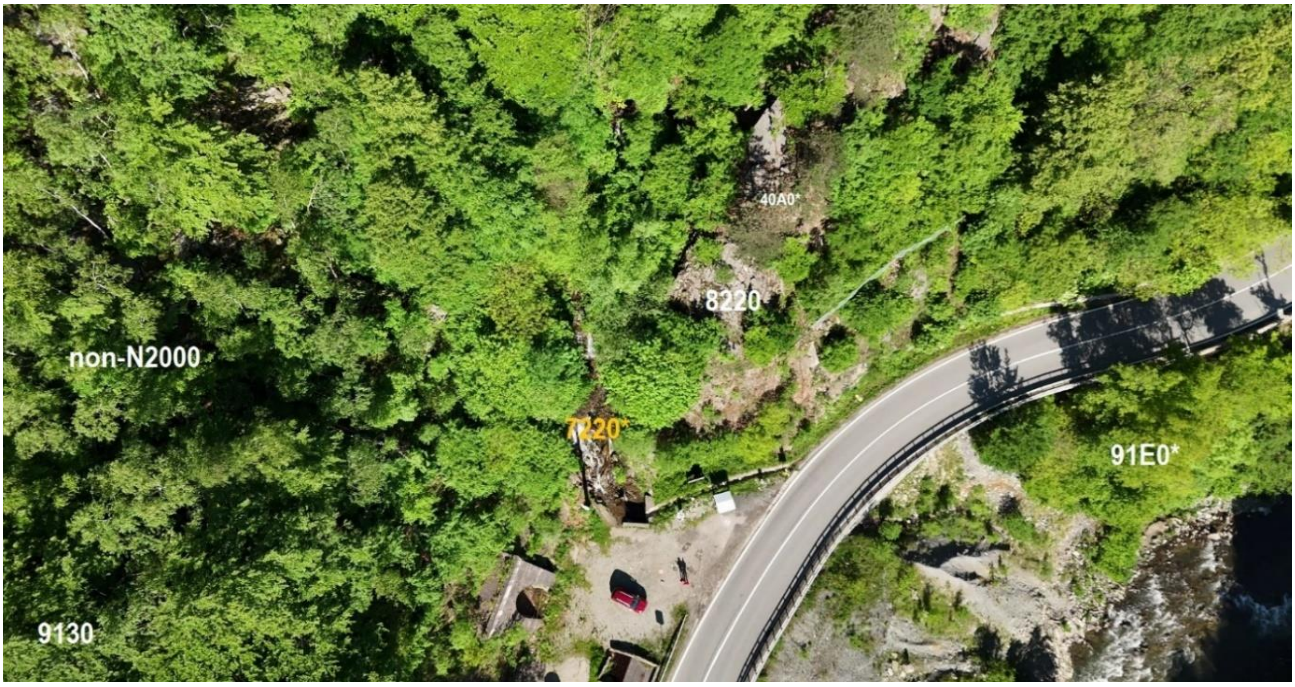



Fig. 74 Relationship between non-forest habitats N2000 8220 and 7220*, and forest habitats N2000 and non-N2000 in the perimeter of the Murga Mica access tunnel

A small segment of N2000 Priority 40A0* N2000 habitat can be seen in the image with the bullfrog, Spiraea ulmifolia on the cliffs in the top-center of the image. These scrublands are in the rest of the perimeter covered by fairly dense pioneer forests of Populus tremula and Betula pendula, non-N2000 forest habitat.

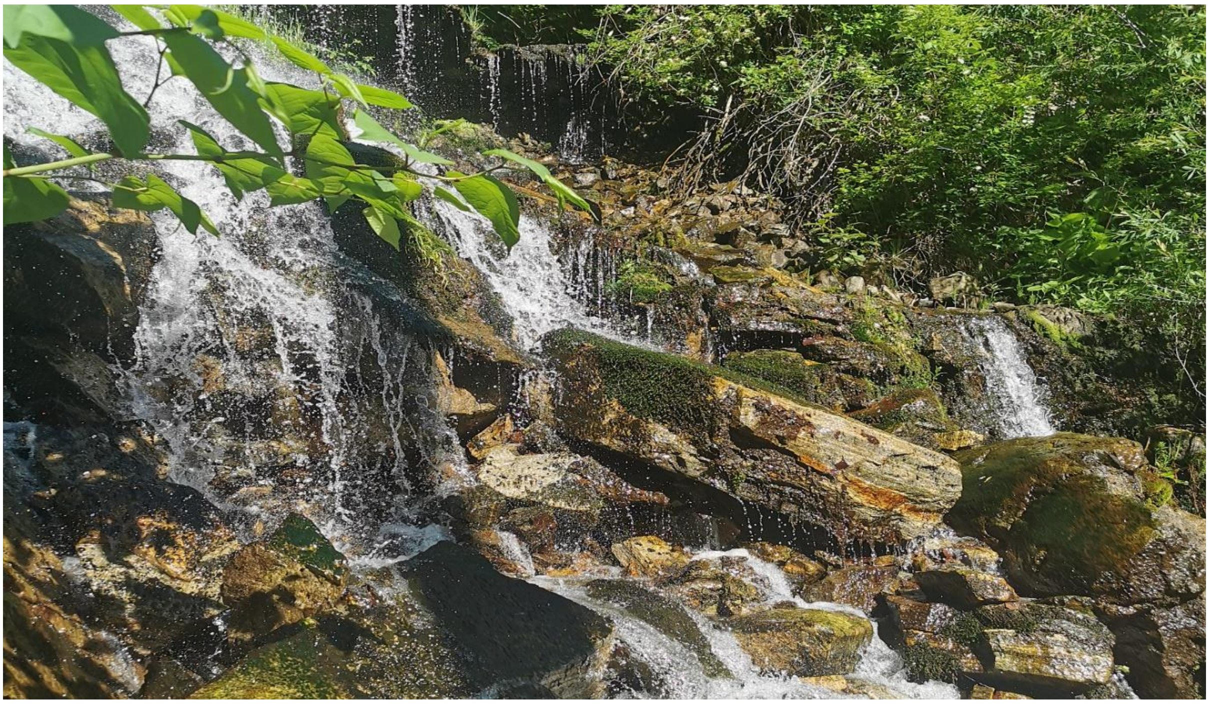


Fig. 75 Cascades with (weak) travertine deposition and Cratoneuron bryophytes on the Murga Mica valley, close to the homonymous access tunnel. The massive presence of para-amphibolites and lenses of crystalline limestone in the valley bed lead to the occurrence of priority habitat N2000 7220* here

Fig. 76 Pioneer forests in the perimeter of the Murga Mica access tunnel, non-N2000 habitat of Populus tremula and Betula pendula, Populeto - Betuletum pendulae grow on stony/ rocky surfaces often over Spiraea ulmifolia stands forming N2000 priority 40A0* priority 40A0* non-forested shrubland shrubland habitats

*3.3. CHE Dumitra*

Forest habitats definitely dominate the landscape here, around the most complex hydro-engineering complex of the hydropower complex, being represented mainly by illyrian gorun forests with much oaks Fraxinus ornus and Quercus petraea ssp. polycarpa on the sunny slope (where most of the hydro-engineering complex is located). It could be seen that the Fraxinus ornus is represented in isolated specimens or patches on the cliffs around CHE Dumitra, but in the natural and semi-natural vegetation of the slope it is totally embedded in the Quercus petraea ssp. polycarpa forests here and never forms extensive shrublands.

On the opposite, shaded slope, Dacian meadow habitats predominate, 91V0, in places with inclusions of 9180* oak woodland. In the stony bed of the Dumitra brook, there is a succession of habitats of oak woodland, 9180* with all the characteristic species present, followed towards the spillway by black alder, habitat 91E0* unfortunately with a lot of planted acacia.

8220 Siliceous rocky slopes with chasmophytic vegetation CLAS. PAL.: 62.2.

In these conditions, the non-forest habitats are very restricted, represented here exclusively by islands of sericito-chloritous and para-amphibolite schist cliffs. Especially the latter rock types, abundantly represented in the CHE Dumitra area, preserve the richest phytocenoses of the studied area, belonging to the Hypno-Polypodietum Jurko et Peciar 1963 and Asplenietum septentrionalis Schwick 1944 associations, on the preserved natural surfaces. Those with more compact vegetation and more cormophyte species belong to the associations Potentillo arenariae - Festucetum pseudodalmaticae (Domin 1933) Majovsky 1954, Minuartio frutescentis - Festucetum pseudodalmaticae (Mikyska 1933) Klika 1938 on sunny slopes, respectively Asplenio trichomanis-Poëtum nemoralis Boşcaiu 1971 subass. veronicetosum bachofenii (Borza 1959) stat. nov.

Note that the regionally endemic flagship species Veronica bachofenii and Dianthus henteri are very common here.

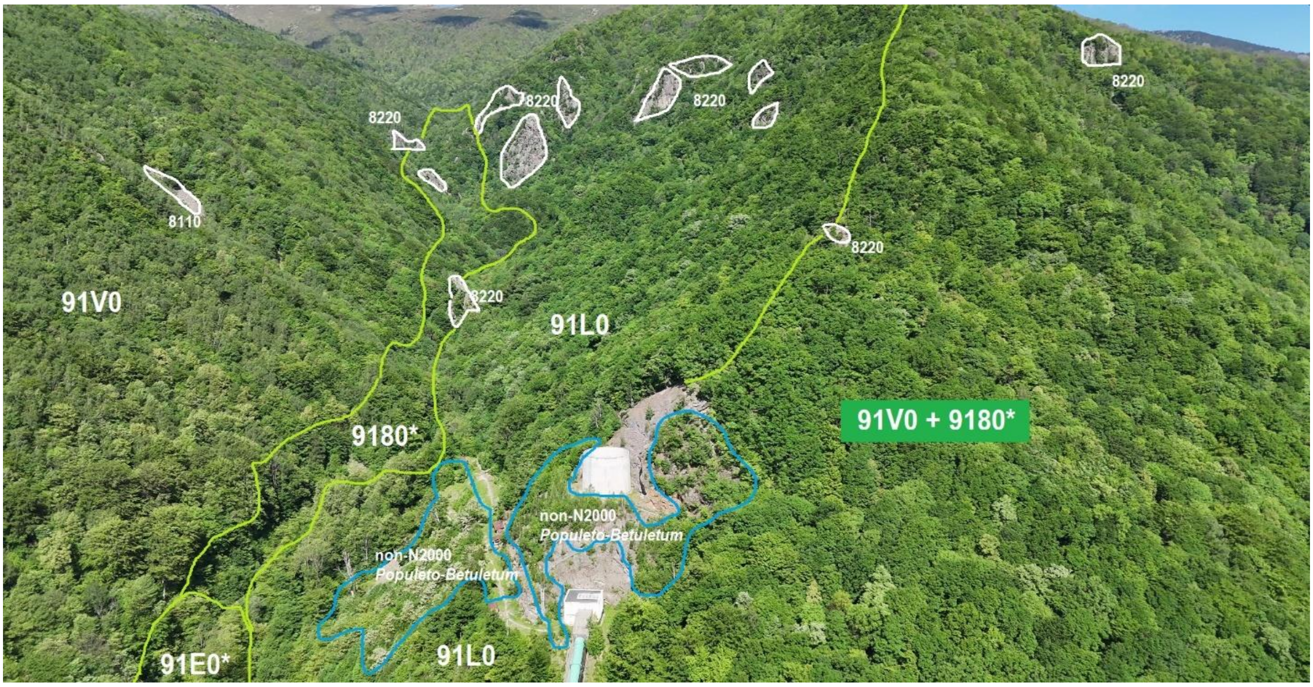



Fig. 77 Structure of N2000 and non-N2000 habitats within the perimeter of CHE Dumitra, view from the east

Forest habitats predominate, on sunny slopes being present the illyrian oak 91L0 with Quercus petraea ssp. polycarpa (exclusively) and on the shady slopes the Dacian oak forests, 91V0, both mosaic on the steep rocky slopes with the forests of the hornbeam 9180* (the latter contain all their characteristic species and extend also in the Dumitra valley bed over a very long length only in the area near the spillway, where the habitat of the black alder, 91E0*, is also present).

Siliceous natural cliffs, non-forest N2000 habitats of type 8220 occur as small islands in forest perimeters. Non-N2000 pioneer forest habitats dominated by Populus tremula, Betula pendula, with the presence of *Populus alba, Salix capraea, Salix purpurea, Salix alba, Salix triandra, Salix alba,* and from the adjacent illyrian oak, specimens of the Fraxinus ornus migrate to the cliffs. They are exclusively integrated into these oak and do not occur in large, consistent areas around natural and artificial cliffs to form habitat segments 40A0*.


Fig. 78 The structure of N2000 and non-N2000 habitats, forest and non-forest, in the CHE Dumitra area, view from the south-south-east. Explanations are the same as in the previous figure

Fig. 79 Habitat 91L0, illyrian oak forests with *Quercus petraea ssp. polycarpa* and *Fraxinus ornus* sectioned by the rocky artificial shoulder front in which the CHE Dumitra CHE stand-still chamber is embedded. The massive rock formed of sericito-chlorite shales of the Lainici-Paiuos Series and the thin profi soils of leptosol and lithic eutric cambisols are observed

Fig. 80 Rare pioneer forests (non-N2000 forest habitat) installed on the steep sericito-chloritic shale cliffs of the CHE Dumitra equilibrium chamber, Populeto - Betuletum pendulae Coldea 1972. They also contain isolated *Fraxinus ornus* oaks and *Quercus petraea* ssp. polycarpa, as well as *Populus alba*, *Acer pseudoplatanus, Salix capraea*, *S. aurita*, *S. purpurea*, *S. fragilis*, etc.

Fig. 81 CHE Dumitra and the adjacent sector of the Jiu river, dominated by N2000 forest habitats of the Dacian oak forests 91V0 only at the mouth of the Dumitra valley by black alder 91E0* with much planted *Robinia pseudacaccia*. Around the surge chamber and the penstock the rocky slopes were occupied by pioneer forests (non-N2000 habitat) with Populus tremula and Betula pendula

Fig. 82 *Fraxinus ornus* and *Quercus petraea ssp. polycarpa*, remaining isolated from the former habitat 91L0 once extended over the area currently occupied by the CHE Dumitra chamber

Fig. 83 *Quercus petraea ssp. polycarpa* dominating the habitat N2000 91L0 of the Illyrian gorune on the sunny left slope of the Dumitra valley

Fig. 84 Pioneer forests (non-N2000 forest habitat) on the artificial cliffs resulting from the installation of the CHE Dumitra surge chamber, with *Populus tremula* and *Betula pendula* codominant. Isolated specimens of *Quercus petraea ssp. polycarpa and Fraxinus ornus* can also be observed, *together with Populus alba, Salix capraea, S. alba, S. purpurea,* etc.

Fig. 85 Habitat of siliceous cliffs (sericito-chloritic shales of the epimetamorphic Lainici-Păiuș Series) with *Genista ovata, Cytisus nigricans*, *Cardaminopsis arenosai* and the rare species of conservation interest *Dianthus henteri and Veronica bachofenii*, within poorly structured phytocenoses of the association Asplenio trichomanis - Poetum nemoralisi Boșcaiu 1971

Fig. 86 Siliceous cliff habitat (sericito-chloritic shales of the epimetamorphic Lainici-Păiuș series) with *Genista ovata, Cytisus nigricans, Cardaminopsis arenosai* and the rare species of conservation interest *Dianthus henteri and Veronica bachofenii*, within poorly structured phytocenoses of the association Asplenio trichomanis - Poetum nemoralisi Boșcaiu 1971.

Fig. 87 *Dianthus henteri*, a regional endemic species for the Olt and Jiu oak forests, is common on the siliceous natural cliffs (habitat N2000 8220) in the whole study area; specimen near the CHE Dumitra chamber

Fig. 88 *Veronica bachofenii*, a regional endemic species for the Southern Carpathians, from the Făgăraș Mountains to the Timiș-Cerna Corridor. Although erroneously mentioned by Flora Europaea and Flora Eur+Med. as occurring in Serbia and Bulgaria, the species does not occur here (Albach et al. 2017)

*3.4. CHE Bumbești*.

Within the CHE Bumbești perimeter there are no N2000 non-forest habitats. The whole area was once occupied by illyrian oak forests 91L0 with typical *Quercus petraea* and very much Fraxinus ornus Nowhere here does the latter form extensive shibblestone-like stands that could be attributed to habitat 40A0*. Very large areas of these original scrublands have been cleared and replaced by large compact plantations of *Pinus sylvestris* (dominant in the area of the CHE Bumbești penstock) and *Robinia pseudacacia* (dominant in the contact region between the Valcan Mountains and the Gorj Subcarpathians). Gorun forests remained dominant on the upper, less steep slopes.

Also having rare sectors in the past, there are many thermophilious/sub-Mediterranean grassland plants here, such as *Achillea crithmifolia*, *Potentilla aurea*, *Veronica teucrium, Verbascum banaticum*, etc but these do not make up coherent grassland habitats and it is evident that everywhere else the illyrian gorgonians 91L0 are here regenerating.

The structure of these N2000 and non-N2000 habitats is explained in more detail in the following maps.


Fig. 89 The mosaic of N2000 and non-N2000 habitats in the CHE Bumbești area does not include non-forest types, apart from some small ruderal areas and artificial cliff areas, devoid of characteristic species

Most extensive on the montane branch are the *Pinus sylvestris* plantations (less Robinia pseudacaccia) which have replaced the illyrian oak here - habitat 91L0.

On the much less steep upper slopes, they predominate, but are heavily affected by chaotic cutting.

The illyrian oak forests here contain much *Fraxinus ornus* and are entirely dominated by the typical *Quercus petraea*.

Very many sub-Mediterranean herbaceous thermophilious grassland species occur here, including meadows, but they are contained within rarer portions of the forest ecosystem.

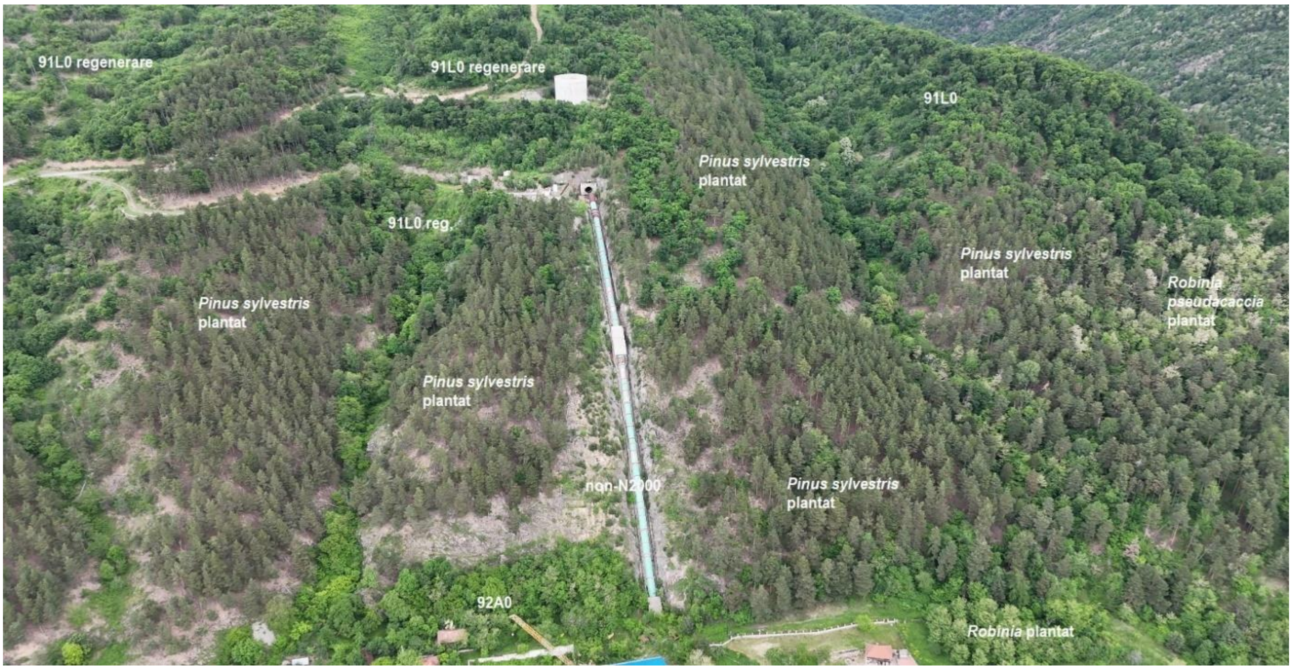



Fig. 90 Detail of the N2000 and non-N2000 habitats of the southern mountain range in which CHE Bumbești is embedded


Fig. 91 Detail of the N2000 and non-N2000 habitats of the southern mountain range, in which the CHE Bumbești is embedded, the area of the penstock

Fig. 92 Above the CHE Bumbești equilibrium chamber the 91L0 illyrian oak forest habitat with *Quercus petraea and Fraxinus ornus* 91L0 91L0 is regenerating. The forest had numerous thinner sections, where there are species of thermophilious/submediterranean grassland, but these did not and still do not form coherent non-forested grassland or shrubland habitats

Fig. 93 Habitat 91L0 in regeneration on the less sloping slopes above the CHE Bumbești surge chamber

Fig. 94 Regenerating habitat 91L0 on the slopes above the CHE Bumbești surge chamber, with numerous species of thermophilious/submediterranean grassland in areas with rarer stands or older clearcuts. These species do not form substantial non-forest habitats

Fig. 95 The CHE Bumbești area is located at the contact between the Valcan Mountains and the Gorjului Subcarpathians where *Robinia pseudacaccia and Pinus sylvestris* plantations have been established on hundreds of hectares, completely occupying entire slopes and destroying the natural forest ecosystems of the area, represented by the illyrian oak forest with Fraxinus ornus

**Identified Natura 2000 plant species and other plant taxa of conservation importance.**

*PLANT ASSOCIATION: Minuartio frutescentis - Festucetum pseudodalmaticae* (Mikyska 1933) Klika 1938

Reliefs 1-3: CHE Dumitra, 4-5: Murga Mica access tunnel, on the left of the stream of the same name

| Relay no. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Altitude (m) | 540 | 573 | 555 | 561 | 572 |
| Vegetation cover % | 30 | 40 | 30 | 35 | 30 |
| Exhibition | SE | S | SE | S | SE |
| Slope | 35 | 30 | 30 | 45 | 30 |
| Sample area ($m^2$) | 25 | 25 | 25 | 25 | 25 |
| *Festuca pseudodalmatica* | 2 | 1 | 3 | -3 | 2 |
| *Festuca valesiaca* | 1 | 1 | 1 | 1 | 1 |
| *Festuca rupicola* | + | + | + | + | + |
| *Poa angustifolia* | + | + | + | + | + |
| *Minuartia frutescens* | + | + | + | + | + |
| *Veronica bachofenii* | + | + | + | - | + |
| *Dianthus henteri* | + | + | + | + | - |
| *Genista ovata* | + | - | - | - | - |
| *Saxifraga rotundifolia* | + | + | - | + | - |
| *Campanula sibirica* | + | + | + | + | + |
| *Stachys recta* | + | - | + | + | + |
| *Veronica teucrium* | + | + | + | - | - |
| *Salvia verticillata* | + | + | + | + | + |
| *Peucedanum oreoselinum* | + | + | + | - | + |
| *Carex humilis* | + | - | - | + | - |
| *Polygala comosa* | + | - | - | + | - |
| *Sedum hispanicum* | + | + | - | + | + |
| *Anthemis tinctoria* | + | + | + | - | + |
| *Sedum maximum* | + | + | + | + | - |
| *Teucrium chamaedrys* | + | - | + | + | + |
| *Solidago virgaurea* | + | - | + | - | + |
| *Veronica spicata* | + | + | - | + | - |
| *Scabiosa ochroleuca* | + | - | - | + | - |
| *Hypericum perforatum* | + | + | + | - | - |
| *Linaria genistifolia* | + | + | - | + | - |
| *Cytisus albus* | + | - | + | + | + |
| *Fraxinus ornus* | + | + | - | + | + |
| *Sedum acre* | + | - | + | + | + |
| *Centaurea micranthos* | + | + | + | - | - |
| *Thymus comosus* | + | + | + | + | + |

| | | | | | |
|---|---|---|---|---|---|
| *Alyssum murale* | + | - | - | + | + |
| *Mycelis muralis* | + | - | - | - | + |
| *Trifolium medium* | - | + | - | + | - |
| *Primula columnae* | - | + | + | + | - |
| *Allium flavum* | - | + | + | - | + |
| *Fragaria viridis* | - | + | + | + | + |
| *Campanula sibirica* | - | + | - | + | + |
| *Saxifraga cuneifolia* | - | + | + | + | - |
| *Potentilla cgrysantha* | - | + | + | + | + |
| *Andropogon ischaemum* | - | + | + | - | - |
| *Medicago minima* | - | + | + | + | + |
| *Draba verna* | - | + | - | - | - |
| *Trifolium arvense* | - | + | + | + | + |
| *Asperula glauca* | - | + | + | - | + |
| *Carex digitata* | - | + | + | + | - |
| *Dorycnium herbaceum* | - | + | + | - | + |
| *Melica ciliata* | - | + | - | + | - |
| *Hieracium pavichii* | - | + | - | + | - |
| *Silene viscaria* | - | + | + | + | + |
| *Galium erectum* | - | + | - | + | + |
| *Rosa canina* | - | + | - | + | - |
| *Euphorbia cyparissias* | - | - | + | + | + |
| *Cytisus nigricans* | - | - | + | - | + |
| *Digitalis grandiflora* | - | - | + | + | + |
| *Cerastium brachypetalum* | - | - | + | + | - |
| *Scleranthus perennis* | - | - | + | + | - |
| *Geranium columbinum* | - | - | + | + | + |
| *Astwer amellus* | - | - | + | - | - |
| *Galium pedemontanum* | - | - | + | + | + |
| *Coronilla varia* | - | - | + | - | + |
| *Carduus candicans* | - | - | + | + | - |
| *Verbascum phoeniceum* | - | - | + | + | + |
| *Quercus polycarpa* | - | - | + | - | + |
| *Sanguisorba minor* | - | - | - | + | - |
| *Allium montanum* | - | - | - | + | + |
| *Achillea crithmifolia* | - | - | - | + | + |
| *Viola tricolor* | - | - | - | + | + |
| *Stachys recta* | - | - | - | + | - |
| *Veronica teucrium* | - | - | - | + | + |
| *Salvia verticillata* | - | - | - | + | - |
| *Peucedanum oreoselinum* | - | - | - | - | + |

| | | | | | |
|---|---|---|---|---|---|
| *Carex humilis* | - | - | - | - | + |
| *Polygala comosa* | - | - | - | - | + |

*PLANT ASSOCIATION: Potentillo arenariae - Festucetum pseudodalmaticae* (Domin 1933) Majovsky 1954

Reliefs 1-4: CHE Dumitra, 5-6: Murga Mica access tunnel, on the left/right of the stream of the same name

| Relay no. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Altitude (m) | 540 | 510 | 490 | 568 | 590 | 560 |
| Vegetation cover (%) | 60 | 60 | 55 | 55 | 60 | 60 |
| Exhibition | SE | SE | SE | SE | SE | SE |
| Slope | 25 | 25 | 20 | 20 | 25 | 25 |
| Sample area ($m^2$) | 25 | 25 | 25 | 25 | 25 | 25 |
| *Festuca pseudodalmatica* | 4 | 4 | 3 | 3 | 4 | 3 |
| *Festuca valesiaca* | + | + | + | + | + | + |
| *Verbascum banaticum* | + | + | + | + | - | - |
| *Veronica bachofenii* | + | + | + | + | - | + |
| *Dianthus henteri* | + | + | + | + | - | + |
| *Potentilla arenaria* | + | + | + | + | + | + |
| *Silene viscaria* | + | + | - | - | - | - |
| *Cardaminopsis arenosa* | + | + | + | + | + | + |
| *Cytisus nigricans* | + | - | - | + | + | + |
| *Centaurea micranthos* | + | + | - | + | + | + |
| *Dorycnium herbaceum* | + | + | + | - | - | + |
| *Hieracium pavichii* | + | + | + | + | + | + |
| *Sedum hispanicum* | + | - | + | - | + | - |
| *Carex digitata* | + | + | + | + | + | + |
| *Veronica teucrium* | + | + | + | - | - | + |
| *Asperula glauca* | + | + | - | + | + | + |
| *Fraxinus ornus* | + | - | - | + | + | - |
| *Saxifraga cuneifolia* | + | + | + | + | + | + |
| *Trifolium arvense* | + | - | + | - | - | + |
| *Hypericum perforatum* | + | + | - | + | - | + |
| *Sedum maximum* | + | + | - | + | + | - |
| *Solidago virgaurea* | + | + | + | + | + | - |
| *Peucedanum oreoselinum* | + | - | + | - | + | + |
| *Rosa canina* | + | - | + | + | + | + |
| *Trifolium medium* | + | + | - | + | + | + |
| *Fragaria viridis* | + | + | + | - | + | - |
| *Astwer amellus* | + | + | + | + | + | - |
| *Medicago minima* | + | + | + | + | + | + |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Allium flavum* | + | + | - | - | - | - |
| *Veronica spicata* | + | - | - | - | - | + |
| *Carduus candicans* | + | + | + | + | + | + |
| *Polygala comosa* | + | + | - | + | - | - |
| *Anthemis tinctoria* | + | - | + | - | + | - |
| *Salvia verticillata* | + | + | - | + | - | - |
| *Viola tricolor* | + | + | + | + | - | + |
| *Potentilla cgrysantha* | + | - | + | - | - | - |
| *Verbasscum phoeniceum* | + | + | + | + | - | - |
| *Achillea crithmifolia* | + | + | - | - | - | + |
| *Primula columnae* | + | - | + | + | + | + |
| *Cytisus albus* | + | + | + | - | - | - |
| *Draba verna* | + | - | - | + | + | - |
| *Andropogon ischaemum* | + | + | + | + | + | + |
| *Digitalis grandiflora* | - | + | + | + | + | + |
| *Linaria genistifolia* | - | + | + | - | + | + |
| *Teucrium chamaedrys* | - | + | - | - | - | - |
| *Galium pedemontanum* | - | + | - | + | - | + |
| *Campanula sibirica* | - | + | + | - | + | - |
| *Sanguisorba minor* | - | + | - | + | - | + |
| *Scleranthus perennis* | - | + | + | + | + | - |
| *Quercus polycarpa* | - | + | + | + | - | - |
| *Carex humilis* | - | + | - | + | + | + |
| *Cerastium brachypetalum* | - | + | - | - | - | - |
| *Geranium columbinum* | - | - | + | + | + | + |
| *Scabiosa ochroleuca* | - | - | + | + | + | - |
| *Thymus comosus* | - | - | + | + | - | + |
| *Allium montanum* | - | - | + | - | + | - |
| *Melica ciliata* | - | - | + | + | - | - |
| *Mycelis muralis* | - | - | + | - | + | + |
| *Silene dubia* | - | - | + | - | - | - |
| *Alyssum murale* | - | - | - | + | - | - |
| *Galium erectum* | - | - | - | + | + | + |
| *Coronilla varia* | - | - | - | + | - | + |
| *Euphorbia cyparissias* | - | - | - | + | + | - |
| *Stachys recta* | - | - | - | + | + | + |
| *Sedum acre* | - | - | - | + | - | + |
| *Cytisus nigricans* | - | - | - | - | + | - |
| *Centaurea micranthos* | - | - | - | - | + | - |
| *Dorycnium herbaceum* | - | - | - | - | - | + |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Hieracium pavichii* | - | - | - | - | - | + |
| *Sedum hispanicum* | - | - | - | - | - | + |

*PLANT ASSOCIATION: Asplenio trichomanis-Poëtum nemoralis* Boşcaiu 1971 subass. veronicetosum bachofenii (Borza 1959) stat. nov.

Relays 1-3 CHE Dumitra, 4-5 Murga Mica access tunnel

| Relay no. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Altitude (m) | 450 | 471 | 460 | 455 | 462 |
| Vegetation cover (%) | 20 | 30 | 30 | 40 | 55 |
| Exhibition | SE | SE | SE | SSV | ESE |
| Slope | 70 | 60 | 85 | 90 | 65 |
| Sample area (m²) | 25 | 25 | 25 | 25 | 25 |
| *Asplenium trichomanes* | + | + | + | + | 1 |
| *Poa nemoralis* | 1 | 2 | 2 | 2 | 2 |
| *Veronica bachofenii* | + | + | + | + | + |
| *Betula pendula juv.* | + | + | + | + | + |
| *Spiraea ulmifolia* | + | + | + | + | + |
| *Polypodium vulgare* | + | + | + | + | + |
| *Asplenium ruta-muraria* | + | + | + | + | + |
| *Campanula grossekii* | + | + | + | + | + |
| *Centaurea micranthos* | + | + | + | + | - |
| *Hypericum perforatum* | + | - | + | + | + |
| *Mycelis muralis* | + | + | - | - | - |
| *Cytisus nigricans* | + | - | + | - | - |
| *Saxifraga cuneifolia* | + | + | - | + | + |
| *Arabis turrita* | + | - | - | + | + |
| *Equisetum arvense* | + | - | + | + | + |
| *Cardaminopsis arenosa* | + | + | + | - | + |
| *Rubus hirtus s.l.* | + | + | - | + | + |
| *Cynanchum vicentoxicum* | + | + | + | + | + |
| *Solidago virgaurea* | - | + | - | - | + |
| *Coronilla varia* | - | + | - | + | + |
| *Epilobium montanum* | - | - | + | + | - |
| *Potentilla chrysantha* | - | - | + | + | + |
| *Calamagrostis arundiacea* | - | - | + | + | + |
| *Scabiosa ochroleuca* | - | - | - | + | - |
| *Calamintha hungarica* | - | - | - | + | - |
| *Veronica chamaedrys* | - | - | - | - | + |
| *Moehringia muscosa* | - | - | - | - | - |
| *Linaria genistifolia* | - | - | - | - | - |
| *Geranium robertianum* | - | - | - | - | - |

*PLANT ASSOCIATION: Hypno-Polypodietum* Jurko et Peciar 1963

Relays 1-3 CHE Dumitra, 3-4 Murga Mica access tunnel

| Relay no. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Altitude (m) | 550 | 538 | 561 | 493 |
| Vegetation cover (%) | 30 | 30 | 30 | 40 |
| Exhibition | SE | SE | SE | SE |
| Slope | 90 | 80 | 80 | 70 |
| Sample area ($m^2$) | 25 | 25 | 25 | 25 |
| *Hypnum cupressiforme* | 2 | 2 | 2 | 1 |
| *Polypodium vulgare* | + | 1 | + | 1 |
| *Geranium robertianum* | + | + | + | + |
| *Poa nemoralis* | + | + | + | + |
| *Saxifraga cuneifolia* | + | + | + | + |
| *Veronica urticifolia* | + | - | - | + |
| *Saxifraga rotundifolia* | + | + | + | + |
| *Spiraea ulmifolia* | + | - | - | + |
| *Asplenium trichomanes* | + | + | + | + |
| *Asplenium ruta-muraria* | + | - | + | + |
| *Cystopteris fragilis* | + | + | - | - |
| *Mycelis muralis* | + | + | + | + |
| *Asplenium scolopendrium* | + | + | + | + |
| *Cirsium erisithales* | - | + | + | + |
| *Epilobium montanum* | - | + | + | - |
| *Campanula trachelium* | - | + | - | - |
| *Polytrichum juniperinum* | - | + | + | + |
| *Selaginella helvetica* | - | - | + | - |
| *Calamagrostis arundinacea* | - | - | - | + |

**Proposed conservation measures.**

The issue of the impact of the hydropower project in Defileul Jiului on biodiversity must also be assessed from the perspective of the affected Natura 2000 habitats within ROSCI0063 Defileul Jiului. The nomenclature of national habitats, recommended by ANANP to be used for national parks, is not applied here, as it is unfortunately in great need of radical revision after the first edition (in 2005) proved to have many shortcomings - natural for a first attempt in this respect.

The impact on Natura 2000 habitats is related to simple solutions linked to avoiding unnecessary interference with them and, in the case of CHE Dumitra, to integrating it into the landscape of the gorge, in order to avoid an undesirable visual impact on it (landscape impact). Here there is a unique possibility, the first of its kind in Romania, to integrate such a massive industrial construction into the landscape of a mountain valley, by covering all the artificial rock surfaces around it with three priority Natura 2000 habitats. .

However, the major biodiversity impacts of the hydropower system in the Defile of the Jiu are not related to the Natura 2000 habitats on the slopes or in the meadows, which are dealt with in this chapter, but to the aquatic ecosystems of the Jiu river - the ichthyofauna in the first place. All efforts to find conservation solutions must be focused on them, because the truly far-reaching effects will, of course, be felt here.

The corner of the cliff where the MHC Dumitra constructions have been installed affects, according to our assessments, 800 sq.m of habitat 8220 and 91L0 out of the approximately 2100 sq.m originally estimated in the area of the cliff and approximately 750 sq.m of habitat 9180* out of the approximately 2300 sq.m originally estimated to exist on the eastern flank of the cliff. The areas affected are very small on the left slope of the Dumitra valley (about 5% of habitat 8220, 1% of habitat 91L0 and 3% of habitat 9180* on the slope) and negligible, less than 1%, on the NP Defileul Jiului. .

In terms of non-aquatic habitats, the proportions of affected habitats are negligible at the scale of the protected area. It is the landscape impact that needs to be carefully assessed as this is the really major one, with any building developed in the middle of a cliff corner with the 91L0, 8220 and 9180* habitat mosaic being seen from very long distances and despoiling the wildness of the landscape here. There are solutions that can be implemented effectively and relatively cheaply for:

1. To mask with natural vegetation this building with all its annexes, restoring the integrity of the landscape ;

2. Encourage the repopulation of anthropogenically shaped rock faces with species characteristic of habitats 8220, 91L0 on sunny clines and 9180* (mountain elm, common ash and the two maple species) on shaded clines. There is no need to design expensive programs or special investments. Only under the simple supervision and guidance of specialists can the natural ecological succession be encouraged and left undisturbed, and the natural succession will take care of itself. To this end, however, it is imperative that the artificial rock faces resulting from the construction work be left undisturbed and not cleared or reshaped for the implementation of new access roads or auxiliary structures.

The natural succession started on these, with the natural colonization of the artificial rocky escarpments by birch *Betula verrucosa*, but due to the periodic clearing of the vegetation this succession always remains in its incipient stage. If birch grows very fast, tall trees and shrubs characteristic for habitat 91L0, such as Balkan strawthorn and Fraxinus ornus, grow more slowly and must be left to develop freely, unaffected by enclosure operations.

This is easily achieved by fencing off perimeters accessible by foot and stopping vegetation clearing on man-made escarpments.

The integration of the massive industrial structure of CHE Dumitra into the natural landscape is perfectly possible within a maximum of 15 years on such a route, if the natural succession of vegetation is allowed to run its normal course. This fact is amply demonstrated by the unexpected installation of a segment of another priority N2000 habitat, previously non-existent in this perimeter: in the middle (altitudinally) part of the perimeter, to the east, where there is a water conduit that has generated a permanent runoff on the steep, about 15 meters high, which has the appearance of a small stepped waterfall. A calcareous lens of crystalline shale at the top of the waterfall has supplied calcium carbonate to the stream, forming small travertine terraces populated by the most characteristic species of Priority Habitat 7220* - encrusting springs and waterfalls with calcareous tuff formation - bryophytes of the genus Cratoneuron. This habitat has local/point development, it is a priority and wherever it occurs, it must be strictly protected according to Art.1 of the Habitats Directive even if it is semi-natural, as in the present case.

The natural population of the cliff faces with gorun, Fraxinus ornus bushes and other species of habitat 91L0, of the shady sides of the cliff with forests of habitat 9180* and the leaving of small waterfalls with tufa terraces - habitat 7220* from place to place would not impact the smooth functioning of CHE Dumitra and would be the first industrial objective in Romania, possibly in the whole EU, integrated by natural ecological successions in a mosaic of three Natura 2000 habitats, two of which are priority habitats. It is a perfectly feasible project, with an impact on public opinion and specialists and unexpectedly cheap, almost free of charge.

## B. ***Invertebrates***

### B.1 MONITORING METHODS

The deployment area for the inventory and assessment of invertebrate species is within or close to the Natura 2000 site ROSCI0063 Defileul Jiului, in the standard form of which 12 invertebrate species of Community importance are mentioned: *Austropotamotamobius torrentium, Carabus variolosus, Cerambyx cerdo, Chilostoma banaticum, Cucujus cinnaberinus, Callimorpha quadripunctaria, Lucanus cervus, Morimus funereus, Osmoderma eremita, Pholidoptera transsylvanica, Rhysodes sulcatus and Rosalia alpina.*

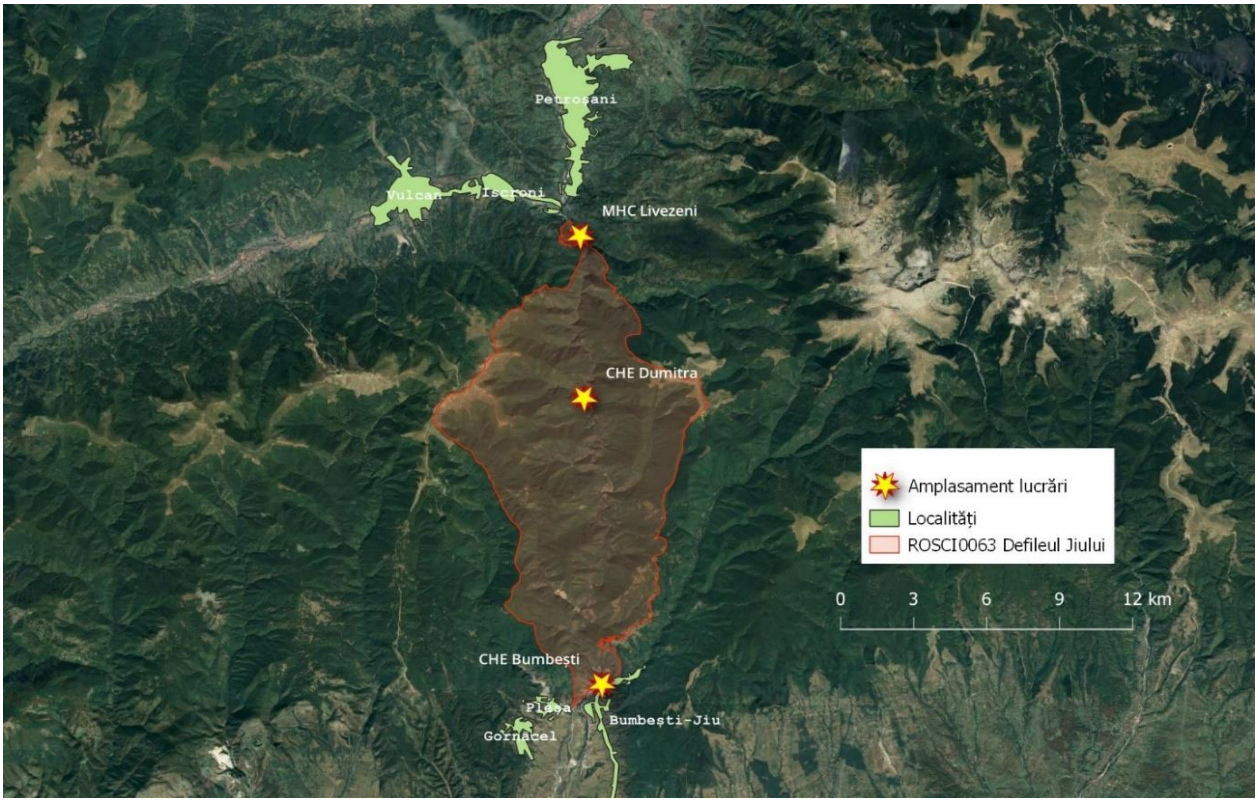



Fig. 96 Location of hydro-engineering developments in the Jordan basin

*Diurnal line transect monitoring method*

Given the specific inventory methodology of the species concerned and the fact that most of them are suitable for the diurnal visual line transect method (Figure 98), this was the method used in the field work.

The method involves walking through areas of about 500 m in length (the length may vary, depending on local habitat conditions) along which individuals of the species under investigation are observed in flight or activity, over a width of 10 m on either side of the direction of travel.

As these species have different habitat preferences (mesophilic grasslands, forest road and forest edge areas, beech or oak forests, river bank areas with organic sediments or with emergent vegetation), transect areas were traversed crossing as many habitat types as possible, along which the target species were observed.


Fig. 97 Line transect model for assessing diurnally active invertebrates (source: van Swaay et al., 2015)

By applying the methodology, the route was traveled at a constant speed (about 1-1.5 km/h) during the period of activity of the target species, in optimal or suboptimal weather conditions (air temperature as high as possible, given the unsuitable period, wind speed below 6 km/h, wind speed below 6 km/h, cloud cover no more than 50%), during the day between 9:00-19:00, the individuals of the target species were counted in an imaginary cube with sides of 5 m, which moves in front of the assessor as he moves.

The placement of the monitoring transects was made according to the specific conditions in each of the 3 locations.

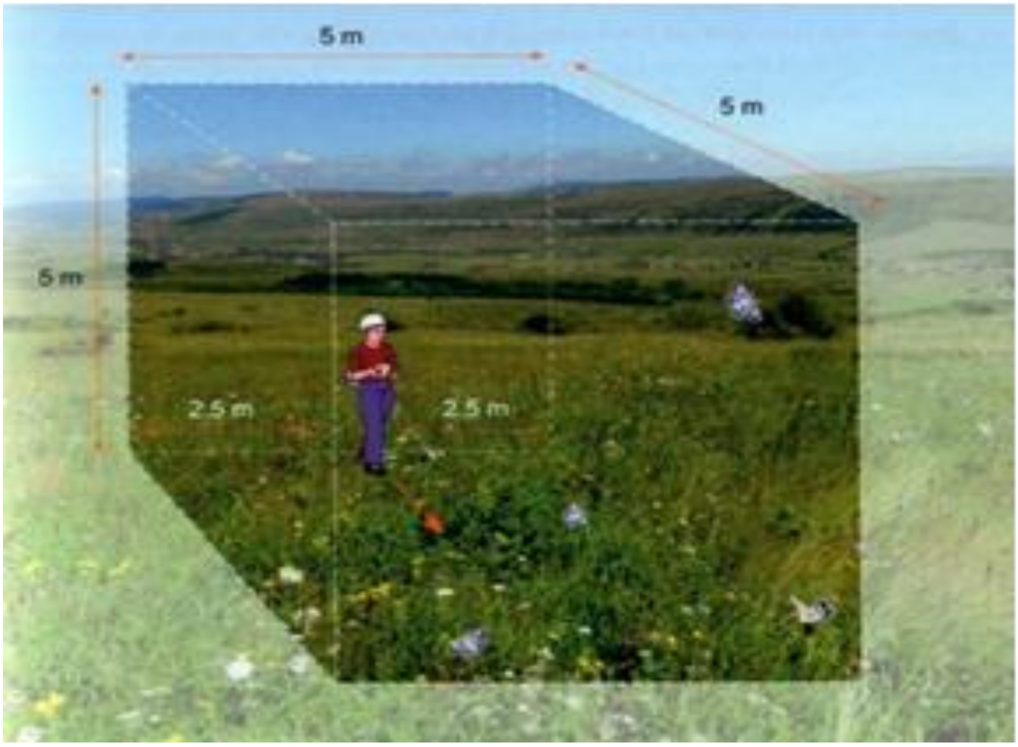



Fig. 98 Imaginary cube with 5 m sides counting individuals of target species of diurnal invertebrates (source: Rákosy 2013)

Fig. 99 Location of monitoring transects within the MHC Livezeni

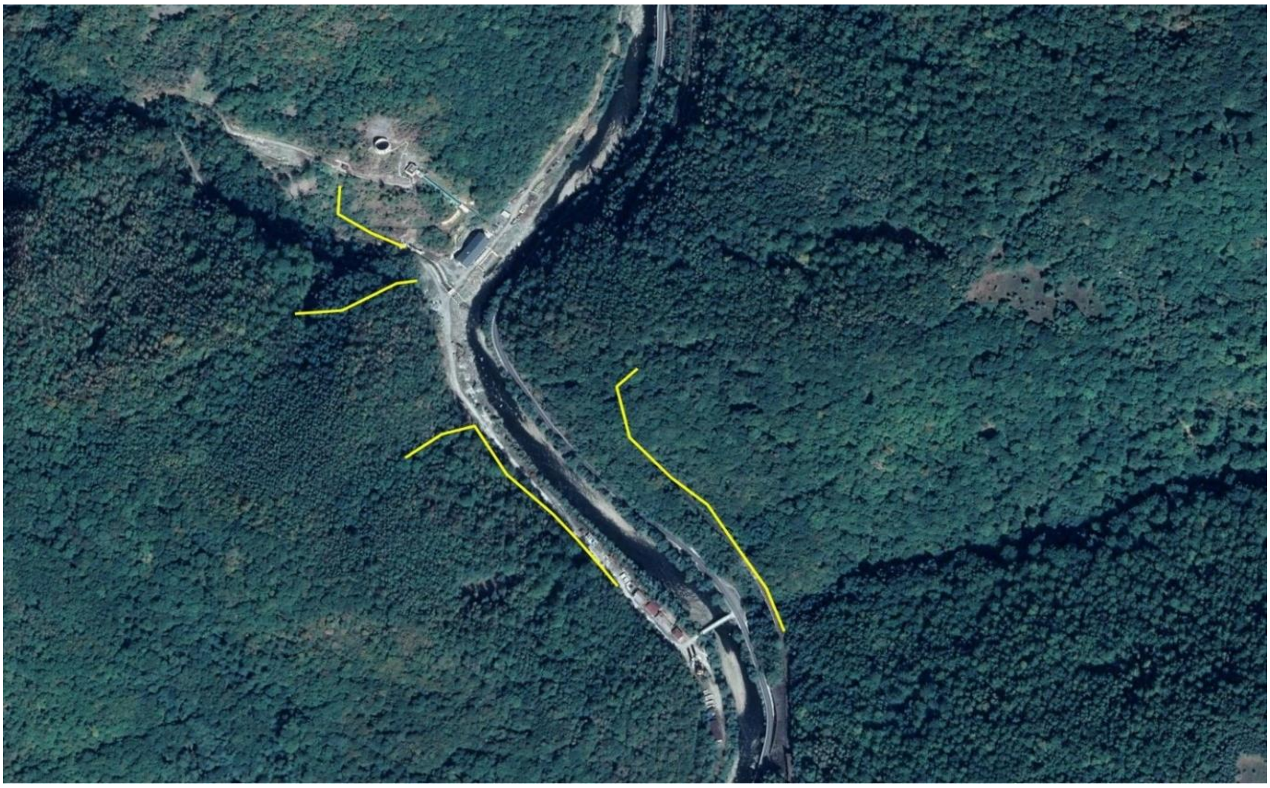


Fig. 100 Location of monitoring transects within the CHE Dumitra

Fig. 101 Location of monitoring transects within the CHE Bumbești

## B.2. MONITORING RESULTS

During the monitoring period, the presence in the area of the sites of the species listed on the standard forms of the sites in the vicinity of the sites, as well as the presence of habitats favorable to host the species in question were investigated.

The situation of the potential presence of favorable species and habitats is presented in the following table:

*Table 40 Potential presence of protected species and their favorable habitats in the project area*

| Site name Natura 2000 | Natura 2000 Code | Scientific name species | Source of information | Conservation status | Potential species presence | Presence of favorable habitat |
|---|---|---|---|---|---|---|
| ROSCI0063 Defileul Jiului | 1093 | *Austropotamobius torrentium* | Standard Form, Management Plan | favorable | No | Yes, in the Dumitra area |
| | 4014 | *Carabus variolosus* | Standard Form, Management Plan | favorable | No | No |
| | 1088 | *Cerambyx cerdo* | Standard Form, Management Plan | favorable | No | No |
| | 4057 | *Chilostoma banaticum* | Standard Form, Management Plan | favorable | From | Yes, at all sites |
| | 1086 | *Cucujus cinnaberinus* | Standard Form, Management Plan | favorable | No | No |
| | 6199 | *Callimorpha quadripunctaria* | Standard Form, Management Plan | favorable | From | Yes, at all sites |
| | 1083 | *Lucanus cervus* | Standard Form, Management Plan | favorable | From | Yes, at all sites |
| | 6908 | *Morimus funereus* | Standard Form, Management Plan | unknown | From | Yes, at all sites |
| | 6966 | *Osmoderma eremita* | Standard Form, Management Plan | favorable | No | No |
| | 4054 | *Pholidoptera transsylvanica* | Standard Form, Management Plan | favorable | From | Yes, at CHE Bumbești |
| | 4026 | *Rhysodes sulcatus* | Standard Form, Management Plan | unfavorable - inadequate | No | No |
| | 1087 | *Rosalia alpina* | Standard Form, Management Plan | favorable | From | Yes, at all sites |

During the reporting period no invertebrate species of community interest were identified in the area of the investigated sites. The invertebrate communities are, however, well edified, with 25 invertebrate species identified in the vicinity of the targets during the reference period surveys.

All species are relatively common nationally in habitats similar to those investigated and are classified as Least Concern or Data Deficient by IUCN.

In terms of the invertebrate community, they are relatively typical for the type of habitats investigated, either from beech or mixed woodland habitats or from shrubland shrubland habitats at the other sites.

*Table no. 41 Species of invertebrates identified during field surveys (L: MHC Livezeni; D: CHE Dumitra; B: CHE Bumbești)*

| No. crt. | Species | L | D | B | IUCN assessment | O.U.G. no. 57/2007 | Habitats Directive |
|---|---|---|---|---|---|---|---|
| 1 | *Araschnia levana.* | x | x | | - | - | - |
| 2 | *Bombus terrestris* | | | x | DD | No | No |
| 3 | *Cantharis rustica* | x | x | x | LC | No | No |
| 4 | *Cerambyx scopolii* | x | | | LC | No | No |
| 5 | *Cercopis sanguinolenta* | | | x | - | - | - |
| 6 | *Cetonia aurata* | x | | x | LC | No | No |
| 7 | *Coccinella septempunctata* | | x | x | DD | No | No |
| 8 | *Coenonympha pamphilus* | | | x | LC | No | No |
| 9 | *Decticus verrucivorus* | | | x | LC | No | No |
| 10 | *Dorcadion pedestre* | x | x | x | DD | No | No |
| 11 | *Gryllus campestris* | | | x | LC | No | No |
| 12 | *Harmonia axyridis* | x | x | x | LC | No | No |
| 13 | *Lamia textor* | x | x | | LC | No | No |
| 14 | *Lumbricus terrestris* | x | x | x | LC | No | No |
| 15 | *Maniola jurtina* | | | x | DD | No | No |
| 16 | *Neptis sappho* | | x | x | | | |
| 17 | *Oxythrea funesta* | | | x | DD | No | No |
| 18 | *Panorpa sp.* | x | x | | - | - | - |
| 19 | *Pararge aegeria* | x | x | x | DD | No | No |
| 20 | *Pieris rapae* | x | x | x | LC | No | No |
| 21 | *Polygonia c-album* | x | x | x | LC | No | No |
| 22 | *Polyommatus icarus* | | | x | LC | No | No |
| 23 | *Pyrhocorris apterus* | x | x | x | LC | No | No |
| 24 | *Tipula sp.* | x | x | x | - | - | - |
| 25 | *Xylocopa violacea* | x | x | x | DD | No | No |

Fig. 102 *Pararge aegeria*

Fig. 103 *Neptis sappho*

Fig. 104 *Cetonia aurata*

Fig. 105 *Araschnia levana*

The area contains favorable habitats for some species of Community interest present on the standard forms of nearby sites, but whose presence in the area has not been confirmed.

***Callimorpha quadripunctaria*** is a medium-sized species (wingspan 40-60 mm), lacking obvious sexual dimorphism, with an extremely characteristic appearance that is virtually impossible to mistake. Unlike other related species of the tribe Arctiini, the adults of this species have a well-developed proboscis, which allows them to suck nectar from flowers. The thorax is black with two cream-colored longitudinal bands. The triangular tegulae are black with white margins. At rest, the adults are triangular in shape, with the forewings swept back, completely covering the hindwings. The forewings are black, with a faint bluish or greenish tinge in newly hatched individuals. On the surface of the forewings there are a series of white or yellowish-white oblique bands. Two of these bands create a characteristic 'V' pattern in the subterminal region of the forewing. The hindwings are red with 3-4 irregularly outlined black spots: one marginal, two submarginal and one median. Both pairs of wings are fringed. The abdomen is orange with a row of black spots on the dorsal midline.

It is a nocturnal butterfly with diurnal activity. It is a thermo-hygrophilous species, found in meadows and wet meadows with shrubs, in glades and at the edge of wet deciduous forests, on the banks of streams with rich vegetation, in shrubby thickets and on wet scrubby slopes with abundant vegetation. It has been reported in Romania up to about 1,000 m altitude.

Only one generation per year. Flight period begins in late June and lasts until September. The adult is especially active at dusk. Periodically migrates distances of about 300 m. Overwinters as larvae. In April-May, the larvae, which are polyphagous, can be seen on the leaves of *Plantago* sp., *Trifolium sp.*, *Qercus sp*., *Fagus sylvatica*, *Urtica sp.* and other plant species. Larvae pupate on the soil surface.

Adults of this species are frequently found during the day on *Eupatorium cannabinum* bushes, especially on the edges of watercourses and in wet meadows (plant association Eupatorium cannabini R. Tüxen), where they feed on nectar from inflorescences and camouflage well during the day, but may also adopt *Mentha longifolia* or *Telekia speciosa* as host plants. If they feel threatened, individuals on inflorescences adopt various defensive strategies: they hide under inflorescences (a posture they also adopt as a protective measure during rain or in the morning when there is still abundant moisture on the vegetation), they open their forewings to expose their hind wings which have a warning coloration, they fly on the higher branches of nearby shrubs (*Alnus sp*., *Rubus sp*., *Corylus sp*., etc.) or on other herbaceous plants on which they can camouflage well. However, the adults of this species are relatively sedentary and after a while return to the inflorescences of the host plants on which they were on before being disturbed.

*The species was not identified during field surveys.*

***Pholidoptera transsylvanica*** is a brown or grayish-brown-bodied species, often with a light-colored transverse band on the frons. Body length is about 18-25 mm in males and 21-30 mm in females. The male tegmina are about the same length as the pronotum. The male's cerci are thin, with the inner tooth located near the base. The tibellaris have a weakly curved basal part and a strongly toothed tip. The shrill carina contains 100 to 130 teeth. The ovipositor is almost straight, 20 - 30 mm long. The stridulation consists of isolated, tri- or tretrasyllabic strophes. Oscillographic analysis shows that each syllable is composed of 2 semi-syllables, according to the opening and closing movements of the wings.

The species prefers mesophlous and hygro-meciduous meadows with shrubs, especially in glades and forest edges in mountainous regions (extremely rare in hilly areas). Adults are present from early July to late August. It is an omnivorous species.

*The species was not identified during field surveys.*

***Rosalia alpina*** is a relatively large croaker, 15-38 mm long. The body has a short, fine, short, dense, recumbent background pubescence, bluish-gray or greenish-gray, sometimes almost blue. The pronotum and elytra have a variable pattern of black transverse spots and bands. Usually the pronotum has a median spot at the anterior margin, and the elytra have a spot anteriorly, a median transverse spot or band, and a small spot posteriorly. The pronotum has a strong, upward pointing lateral tooth. The antennae are long, with articles 1 and 2 black and articles 3-6 blue with apical tufts of black hairs. Both legs and antennae are body-like in color. It is an unmistakable species because of its characteristic coloration and antennae. It is very rare to find specimens with much reduced black spots on the elytra or with almost completely black elytra.

It is a stenotopic, sylvicicolous, xylodetrichicolous, lignicolous, xylophagous, saproxylic species. It lives predominantly in cool, moist beech forests in the uplands, where the species may be locally common. It also occurs less frequently in mixed forests or in querceline and beech forests. Larvae develop in dead wood or old live trees, most often on Fagus, but sometimes also on Acer or other deciduous species. Adults are found on these trees or on piles of freshly cut logs, as well as on inflorescences, especially of umbellifers, where they feed on pollen. Adults can be seen from June to September.

*The species was not identified during field surveys.*

***Chilostoma banaticum*** is a gastropod with a large (15-20 mm high, 25-35 mm wide), flattened-lentiform, solid, tough, irregularly striate, reddish-brown to yellowish-brown, rarely with greenish tinges, with a reddish-brown band at the periphery, with a median carina, more evident in the juvenile stage. It has 5-5.5 regularly growing, slightly convex amphracts, separated by a faintly evident suture, the last amphract descending slightly towards the aperture. The peristome is twisted, hardened, whitish, umbilicus open, partly covered by columellar twisting. The species is grayish or brown.

In Romania, it has quite wide ecological values, being present in particular along the valleys from the mountainous area to the plains, preferring medium altitudes. It is a microphagous, mesophagous, hygrophilous species, preferring wooded areas or at least abundant vegetation. It is found under stones, among rotting wood, logs, on rocks, on plants, in foliage on the ground, in forests, bushes, various plant formations, including parks and gardens, on roadsides, in shady and damp places, often near water. It is a species quite resistant to anthropic changes, being able to populate fragments of habitats maintained by chance, either along streams, ditch margins, roads or railway embankments, the latter representing refuges with conditions frequently at the limit of survival of gastropod populations.

*The species was not identified during field surveys.*

***Lucanus cervus*** is a large species, with males reaching up to 80-90 mm. Females are smaller, sometimes as small as 20 mm. The body is elongate, massive, black or dark brown in color, with a dull gloss especially in females, and brownish-brown mandibles and elytra in males. The species shows marked sexual dimorphism. In males the head is massive, broader than the pronotum, and the mandibles are very well developed, long and branched with the appearance of deer antlers. They are bifid at the extremities and have a median or postmedian tooth on the inner side, and in very large specimens can reach half the body length. Females, smaller than males, have a pronotum much broader than the head, mandibles shorter than the head and forelegs adapted for digging.

It is considered to be a polyphagous species, thriving in the rotting wood (below ground level) of many deciduous species, but prefers quercus. It can be found in deciduous forests as well as in open areas with isolated trees or hedgerows, in urban and suburban gardens, parks, wooded pastures, wherever there is a sufficient source of dead wood.

*The species was not identified during field surveys.*

***Morimus funereus*** is a large croaker, 16-38 mm long. Although the background color of the body is black, it is covered with a very dense silvery-gray pubescence that almost completely covers the black background. The anterior part of the head, starting from the forehead, is directed steeply downwards forming an almost right angle with the vertex. Antennomeres with unringed articles. Pronotum with numerous irregular rugulations, and laterally with a strong sharp tooth apically. The elytra grayish, with fine, glossy granules, stronger at the base, and on each elytra two black, velvety, well-demarcated, velvety spots may be noticed. Of these, one is located in the anterior third and the other is postmedian. In males, the antennae are 1.5 times longer than the elytra, and in females about the same length as the elytra.

It is considered to be a polyphagous species, thriving predominantly in dead wood of beech and oak. Adults can be found in forests on fallen trunks, recent stumps or freshly cut logs of beech, oak, chestnut, chestnut, poplar, poplar, lime, maple, hornbeam, willow, etc.

*The species was not identified during field surveys.*

Fig. 106 Favorable habitat *Calimorpha quadripunctaria* and *Chilostoma banaticum*

Fig. 107 Favorable habitat *Calimorpha quadripunctaria* and *Chilostoma banaticum*

Fig. 108 Favorable habitat for *Pholidoptera transsylvanica*

Fig. 109 Beech trunk attacked by xylophagous beetles

Fig. 110 Favorable habitat for *Rosalia alpina, Lucanus cervus and Morimus funereus*

Fig. 111 Favorable habitat for *Rosalia alpina, Lucanus cervus and Morimus funereus*

**POTENTIAL IMPACTS AND MANAGEMENT MEASURES**

As far as invertebrate species are concerned, the works to be carried out on the **investigated sites will have no impact on the majority of species or, in rare cases, will have a minimal impact on a small number of species, namely those that find favorable habitat in the bank areas of the water impoundments, areas that will be affected by the shifting of the water level and the reshaping of the bank line.** In these situations, the impact will be minimal, consisting of the displacement of species populations in the new bank area formed, without affecting species populations, their conservation status or species viability.

As regards Natura 2000 species likely to occur in the area, the situation is as follows:

- in the case of *Chilostoma banaticum*, the broad ecological values of the species and the extremely widespread habitat in the area do not require specific management measures when the species is investigated at the sites;

- in the case of *Lucanus cervus*, the broad ecological values of the species and the extremely widespread habitat in the area do not require specific management measures when the species is investigated on sites;

- in the case of *Morimus funereus*, the broad ecological values of the species and the extremely extensive habitat in the area do not require specific management measures when the species is investigated at the sites;

- in the case of *Rosalia alpina*, the broad ecological values of the species and the extremely widespread habitat in the area do not require specific management measures when the species is investigated at the sites;

- in the case of *Callimorpha quadripunctaria*, the large area of the species' habitat does not require complex management measures if the species is investigated in the area, the only applicable measure is to avoid affecting this habitat, usually present along forest roads;

- in the case of *Pholidoptera transsylvanica*, the large area of habitat of the species does not require complex management measures if the species is investigated in the area, the preservation of areas of wet meadow with rich vegetation is sufficient to ensure the continued presence of the species populations.

## *C. Herpetofauna*

### C.1 Materials and methods

*Project location*

The deployment area for the inventory and assessment of amphibian and reptile species of Community interest is within or close to the Natura 2000 protected natural area ROSCI0063 Defileul Jiului (Figure no. 113).

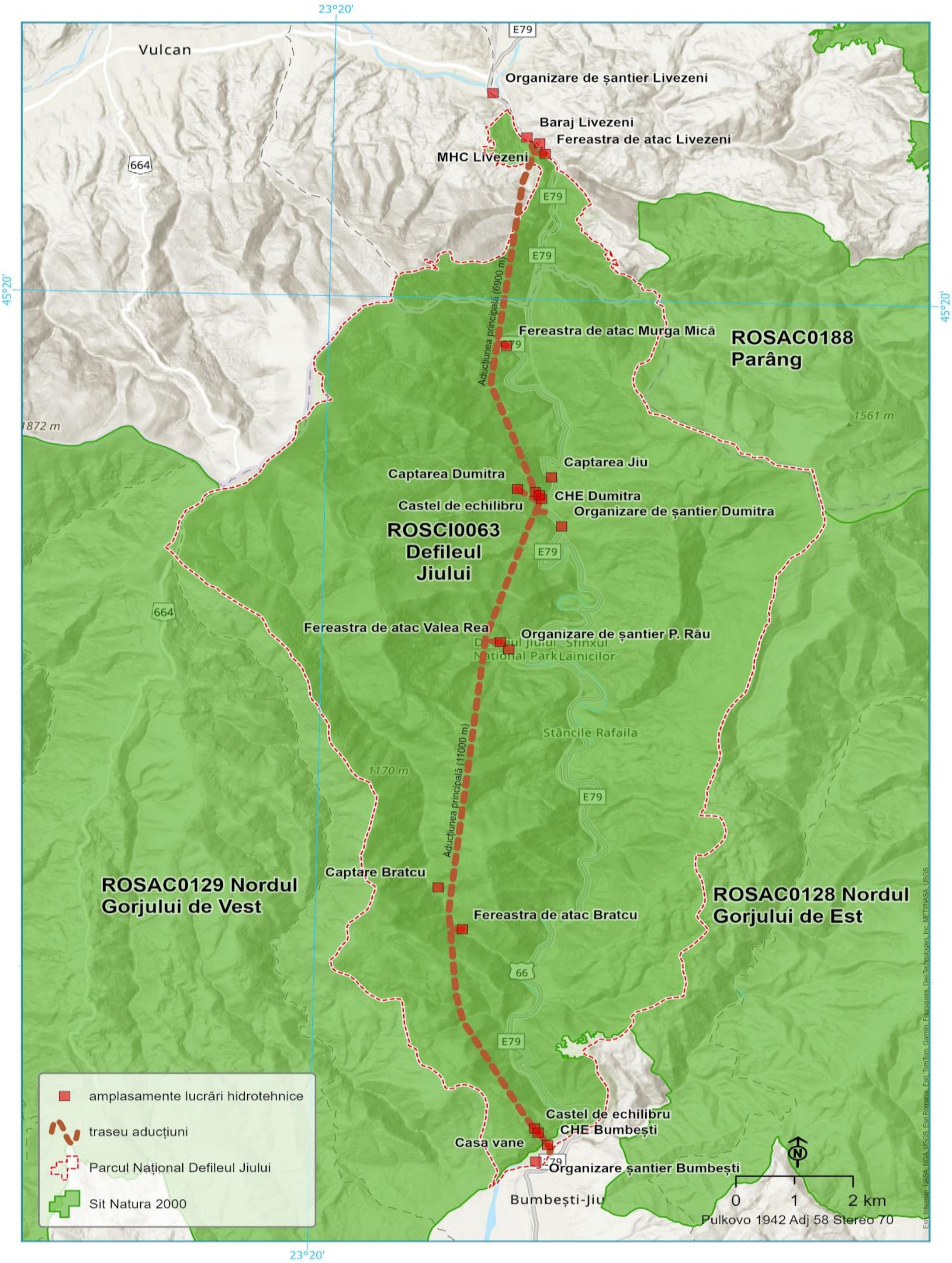



Fig. 112 Location of the hydro-engineering works in the Bumbești-Livezeni sector on the territory of the Natura 2000 site ROSCI0063 Defileul Jiului.

The study was conducted from December 2023 through May 2024 within the project perimeter and vicinity, primarily using the diurnal line transect monitoring method.

*Brief description of species of conservation concern*

In the Natura 2000 standard form ROSCI0063 Defileul Jiului the species *Bombina variegata, Triturus cristatus* are mentioned in category 3.2. Species referred to in Article 4 of Directive 2009/147/EC, species listed in Annex II to Directive 92/43/EEC and the site assessment for them.

| EUNIS code - Scientific name (vernacular name) | Legal conservation status* |
|---|---|
| *638 - Bombina variegata* (yellow-bellied puddle spring) | Annex 3, 4A |
| *814 - Triturus cristatus* (crested newt) | Annex 3, 4A |

*Law no. 49/2011 for the approval of the Government Emergency Ordinance no. 57/2007 *on the regime of protected natural areas, conservation of natural habitats, wild flora and fauna*; Annex 3. Species (...) of animals whose conservation requires the designation of special areas of conservation (...); Annex 4A. Species of Community interest. Species of animals (...) requiring strict protection

***Bombina variegata*** (code 1193) - Yellow-bellied Pond-mallow

The Yellow-bellied Oystercatcher is widespread in Romania between altitudes of 150 m and alpine hollows (up to 2000 m), usually not exceeding the upper limits of forests. On the dorsal side it has irregularly arranged warts, ending with a black horny spine at the tip, surrounded by many small horny spines, unlike Bombina bombina (the vicariant species for the lowland area), which has warts without horny spines. Dorsal coloration is light grayish-brown, grayish-brown, uniformly olive or mottled with black; usually with a pair of black spots between the shoulders and a spot in the middle of the back (Fuhn, 1960). Ventrally, *Bombina variegata* has gray or black spots on a light yellow background, with yellow predominating; white spots sometimes occur, especially within the dark marbling on the breast. *The Bombina variegata* secretes a toxic substance when threatened and displays a warning behavior (aposematic behavior, referred to in the literature as "Unken-reflex"): it arches dorsally to expose the light-colored ventral area of the gill, forelimbs and hindlimbs and to warn of toxicity of the integument.

*Bombina variegata* is an eurytopic, predominantly aquatic, social amphibian species, active both day and night. The species has a very good dispersal, being able to colonize any newly formed aquatic habitat or water body, and can tolerate polluted waters relatively well (Cogălniceanu et al., 2000). It is much less demanding in terms of spawning habitat than the vicariant *Bombina bombina*, the latter preferring larger pools in lowland areas, large river valleys or floodplains. The breeding strategy of *Bombina variegata* is to use as many water holes as possible, formed in road ruts or cattle tracks, temporary pools, small muddy springs, etc., to lay a few eggs, thus ensuring the continuity of the species and preventing some of the sites where it has laid eggs from drying up.

The species *Bombina variegata* is associated with small, temporary, sometimes even polluted pools and ponds, without vegetation, soil unevenness containing less than 1 liter of water, and is undemanding in terms of habitat requirements (Fuhn, 1960; Cogălniceanu et al., 2000).
The species' trophic spectrum consists of araneids, isopods, heteroptera, coleoptera (larvae and adults), heteroptera, hymenoptera (formicids, cynipids, ichneumonids) and diptera (culicids, brachyceans), colembola, lepidoptera, dermaptera and homoptera.
Breeding begins in late April - early May and lasts throughout the summer, with the female laying several eggs during this period. They hibernate between October and April.

***Triturus cristatus*** (code 1166) - great crested newt

It is the second largest newt species in Romania, up to 16 cm long. The body is robust and oval in cross-section, the head is broad, with a rounded snout, lacking longitudinal grooves. Well pronounced gular crest. Limbs long and strong, when stretched across the body - hind to fore - toes touching. Tail length less than or equal to the body and ending pointed. The integument is rough both dorsally and ventrally. Males are smaller than females, have longer limbs, and in the breeding season have a high, toothed dorsal crest that starts between the eyes, disappears at the cloaca and is continued by the caudal crest, which is equally well developed but less toothed; this is also developed on the ventral side of the tail. The male cloaca is swollen and dark. Females have a medio-dorsal groove in place of the crest, and the caudal crests are very poorly developed (Fuhn, 1960; Cogălniceanu et al., 2000).

Breeding males have a background coloration, dorsally and laterally, dark brown with black to olive-brown spots, sometimes with reddish-brown shades; white dots appear laterally and laterally ventrally, which agglutinate on the head and on the goiter, and may form white vermicules. The gape is yellow to black, often with white spots; the ventral part is yellow or yellow-orange with irregular black spots; the cloaca is black. On the sides of the tail there is a broad, shiny, white stripe. The color pattern of the female is similar to that of the male, with slight differences: the cloaca and ventral edge of the tail are yellow or yellow-orange, and the sidephyle stripe on the tail is missing (Fuhn, 1960; Cogălniceanu et al., 2000).

It is a predominantly aquatic and nocturnal newt, but can also be diurnal; when environmental conditions become unsuitable, it retreats to land near the pool, being nocturnal only.

It is generally found in the water from March to June, and then on land near the water, hiding under stones, foliage, fallen logs, holes in the ground. Isolated individuals may remain in the water throughout the year. The migratory and colonization power covers distances up to 1 km. Despite their large size, they move quickly in both aquatic and terrestrial environments (Cogălniceanu et al., 2000).

Due to their large size they do not breed in small temporary pools, only in permanent ones. Reproduction takes place in March-April; nuptial games are carried out in the same way as in other newt species. Fertilization is internal, without amplexus, and is achieved by means of a spermatophore. Spermatophore transfer takes place following a complex sexual parade during which the partners do not touch each other, stimulating the female and synchronizing their movements for successful spermatophore transfer by a series of visual, olfactory and mechanical signals. Females lay a single egg or groups of 2 to 3, which they attach to submerged vegetation, more precisely they are wrapped in plant leaves; in total 60 to 200 eggs are laid, they are large, 2-4 mm in size and white in color, but some of them do not develop due to chromosomal mutations. Larvae are large (8 - 10 mm at hatching) with a high dorsal ridge that is continued by a caudal filament up to 6 mm long and vary in color from dark brown to light gray with large black spots. Embryogenesis takes 12-20 days and lar larval development takes around 2.5-3 months; many larvae hibernate at this stage. After hatching, the larvae have a benthic mode of life (found on aquatic plants or substrate), and become pelagic after the development of the caudal filament and toes. There are also cases of neoteny, sexual maturity being reached after the first 2-3 years of life in males, when body length reaches 12-13 cm; females take longer (Cogălniceanu et al., 2000).

If captured, they may make a high-pitched squeaking sound; the skin secretes a white toxic substance with a specific odor. Sometimes they may assume a specific defensive posture: they expose the aposematic colors of their abdomen by twisting their body and rolling their tail; the position is maintained with eyes closed and without breathing for several seconds.

It is widespread in wooded areas, meadows, parks, gardens; it prefers large and deep stagnant waters with submerged and marshy vegetation, in our country it is found from the plains up to 1000 - 1400 m altitude (Cogălniceanu et al., 2013). It is common in ponds and lakes, ditches, pools, artificial pools, even irrigation channels or smooth-flowing waters, especially if there is aquatic vegetation in which it can hide and fish are absent. It is not very fussy about water quality, but the larvae have higher water quality requirements; they have difficulty adapting to urban or suburban habitats.

*Methodology for inventory, mapping and assessment of herpetofauna species of conservation interest*

The inventory and mapping of target species was carried out on the basis of the following complementary sub-activities:

*Table no. 42. Description of the steps in the methodology, expected results, logistics and material resources used and venue*

| Species | Description of the steps in the methodology | Results - interim and final | Logistics and material resources used | Venue |
|---|---|---|---|---|
| *Bombina variegata, Triturus cristatus* | Inventorying, mapping and assessing the conservation status of aquatic habitats in use | Distribution, suitability of aquatic habitats (availability of standing water bodies, depth, water quality, presence of predators), availability of terrestrial habitats, pressures and threats, their intensity, conservation status | sock, GPS receiver, map, field sheet, camera, vehicle. | ROSCI0063 Defileul Jiului |
| *Bombina variegata, Triturus cristatus* | Inventorying, mapping and assessing the conservation status of occupied terrestrial habitats | Distribution, habitat suitability (presence of specific structures and features), pressures and threats, their intensity, conservation status | GPS receiver, map, field sheet, camera, vehicle. | ROSCI0063 Defileul Jiului |
| *Bombina variegata, Triturus cristatus* | Inventorying, mapping and assessing the conservation status of the species during the breeding season | Species distribution, estimated population size, pressures and threats, their intensity, conservation status. If possible: age and sex ratios, population viability, etc. | sock, GPS receiver, map, field sheet, camera, vehicle. | ROSCI0063 Defileul Jiului |

Amphibians are a group of animals with a complex lifestyle. Their reproduction is closely linked to the presence and quality of water bodies. Some species, such as species of the genus Bombina, are closely linked to the presence of water bodies, such as small, temporary pools. These species spend their entire annual activity period in these aquatic habitats, where they breed and feed. Newts and most species of native frogs, such as the crested newts Triturus sp. and brown frogs - Rana sp. have an annual aquatic and terrestrial cycle. They enter an aquatic phase in spring, which is also a morphological change, and breed only in aquatic habitats. The time spent in the aquatic habitat depends on the species, the weather, the physical characteristics of the water and the vegetation. After reproduction they leave the water and become terrestrial and generally nocturnal.

The larval development of all amphibian species takes place only in water, so the lack of aquatic habitats for reproduction leads to local extinction of amphibians. The preference and resistance of larvae to the physical, chemical and structural characteristics of aquatic habitats and threat factors differ, thus these characteristics and factors determine species composition structure and abundance.

In order to inventory and map the species of amphibians or reptiles with semi-aquatic lifestyles, as a first step, the aquatic habitats used were identified and inventoried. The localization was carried out by field transects broken down by the different habitat types existing on the site and mainly in the area of the hydro-engineering sites targeted by the project and in their vicinity. The transect method is a widely known and used method for inventorying species and their habitats. With this method we use well-defined units, e.g. the area covered by the transects, which are usually randomly arranged in the target area. Data obtained by observation along the transects result in datasets on the diversity, distribution and relative abundance of the target species, and the structure and quality of the habitats they occupy. These data can be used to compare the diversity, distribution and relative abundance of species in different habitat types, along an altitudinal gradient, or a distance from a negative factor. From the distributions obtained we can infer the relationship between the habitats occupied and the ecology of the target species. The repeatability of the inventory is a strength of the method. Inventory data taken at different times of the year or on an annual basis can reveal changes in the presence and structure of communities, so it is a method often used to monitor changes in community structure over time.

Field observations were supplemented with information from the literature for a more accurate assessment of the distribution of species of conservation interest in the project area. The data were georeferenced in GIS system where species distribution maps were made.

**C.2 Results**

Following the analysis of the existing information for the protected natural areas in the project area, an amphibian species of community interest potentially affected by the project was identified, namely *Bombina variegata*, according to the Natura 2000 standard form for the site of community importance ROSCI0063 Defileul Jiului (Table 33, Table 34, Table 35).

*Table no. 43 Critical analysis of the representative bibliographical references concerning the herpetofauna species of community interest in ROSCI0063 Defile of Jiului and its overlapping protected natural areas*

| No. crt. | Details bibliographical reference | Comments |
|---|---|---|
| 1. | Fuhn I.E. (1960): Fauna of the Romanian People's Republic, Vol. XIV Amphibia, Editura Academiei Republicii Populare Române, Bucharest | The most extensive work on amphibian chorology for the second half of the second century. XX mentions the presence of the species *Bombina variegata* in the Vulcan Pass. |

| No. crt. | Details bibliographical reference | Comments |
|---|---|---|
| 2. 2. | I.C.A.S. (2004): Tema nr. 11.RA.2004: Study on the constitution of the National Park "Defileul Jiului". Regia Națională a Pădurilor - Romsilva. Bucharest | The scientific baseline study contains an inventory of herpetofauna species mentioning the presence of the species:<br>Bombina variegata - in the study areas:<br>U.P. B III, u.a. 54b, 55a - "Little Domogled";<br>U.P. B IV, u.a. 49a - the left bank of the Ji river 1 km upstream from Lainici Monastery;<br>U.P. B III, w.u. 66 - Scots pine gorunet;<br>U.P. B III, u.a. 108 - border at the confluence of Pr. Cerbănașul with Jiul;<br>U.P. B III - the meadow of Locurele hermitage;<br>U.P. B III, u.a. 127 - the cliff at km 117;<br>U.P. B III - Lainici Monastery, next to u.a. 84a;<br>Triturus cristatus - in the study areas:<br>U.P. B IV, u.a. 49 (enclave 37) - Vama veche;<br>U.P. B IV - Gara Meri, aval u.a. 11;<br>U.P. B III - Lainici railway station, next to u.a. 84a;<br>U.P. B IV - Pietrile Albe railway station, surroundings. |
| 3. | Tudor M., Crăciun N. and Burlacu L. (2004): Preliminary report on the herpetofauna in the area of the future National Park "Defileul Jiului". Muzeul Olteniei Craiova. Oltenia. Studies and Communications, Natural Sciences 20: 269-272 | The article contains a summary distribution of the collecting stations for amphibian and reptile species in the Defileul Jiului National Park from which we mention the species distribution:<br>Bombina variegata - Meri, White Stones;<br>Triturus cristatus - Lainici, Bumbești, Meri. |
| 4. | Petrescu A., Petrescu I., Răduleț N., Iftime Al., Ban C. (2004): Preliminary faunistic data from the area of the future Defileul Jiului National Park. Oltenia, Studies and Communications, Natural Sciences 21: 229-240 | The article contains a list of amphibian and reptile species in the Defileul Jiului National Park, in which the species Bombina variegata and Triturus cristatus are mentioned with certainty. |
| 5. | Dobre F., Bucur D.-M., Mihuț R., Birceanu M., Gale O. (2007): Data on the food composition of a population of *Triturus cristatus* (Laur. 1768) from the National | In this paper a population of *Triturus cristatus* was studied in a system of large puddles on station lines 4 and 5 and a ditch separating line 5 from the neighboring lands of the CFR Meri station. |

| No. crt. | Details bibliographical reference | Comments |
|---|---|---|
| | Park "Defileul Jiului". Biharean Biologist 1: 23 - 28. | |
| 6. | Covaciu-Marcov S.-D., Cicort-Lucaciu A.Ș., Dobre F., Ferenți S., Birceanu M., Mihuț R., Strugariu A. (2009): The herpetofauna of the Defileul Jiului National Park, Romania. North-Western Journal of Zoology 5(Supplement 1): S01-S78 | It is the first paper that has dealt in detail with the distribution of herpetofauna in the Defileul Jiului National Park, identifying 23 species of amphibians and reptiles in the period 2007-2008, of which 11 amphibian species (*Salamandra salamandra*, *Mesotriton alpestris*, *Triturus cristatus*, *Lissotriton vulgaris*, *Bombina variegata*, *Bufo bufo*, *Bufo viridis*, *Hyla arborea*, *Pelophylax ridibundus*, *Rana dalmatina* and *Rana temporaria*) and 12 reptile species (*Lacerta agilis*, *Lacerta viridis*, *Podarcis muralis*, *Darevskia praticola*, *Zootoca vivipara*, *Anguis fragilis*, *Natrix natrix*, *Natrix tessellata*, *Coronella austriaca*, *Zamenis longissimus*, *Vipera ammodytes* and *Vipera berus*.<br>The two amphibian species of community interest have been reported in the following areas:<br>*Triturus cristatus*: Comandă pond, Bumbești tunnel entrance, Meri CFR station;<br>*Bombina variegata*: Meri quarry, Chitu valley, Tăul Porcului, at the entrance to the park from Bumbești and about 60 other temporary aquatic habitats in the altitudinal range 300 - 1300 m presented on a distribution map at the end of the article without mentioning any place names or exact geographical coordinates. |
| 7. | Dobre F., Cicort-Lucaciu A-Ș., Dimancea N., Boroș A., Bogdan H-V. (2009): Research on the biology and ecology of some newt species (Amphibia) from the Jiu River Gorge National Park. Analele Universității din Craiova, Seria Biologie, Horticultura, Tehnologia Prelucrării Produselor | The habitats of the species *Triturus cristatus* and *Lissotriton vulgaris* were studied in the following aquatic habitats in 2009: the Comandă pond, a permanent aquatic habitat about 7 m long and 0.4 - 1 m deep, at an altitude of 900 m. The aquatic habitat is affected by human activities, in particular cow grazing. There, 89 individuals of *Triturus cristatus* and 486 individuals of *Lissotriton vulgaris* were inventoried. |

| No. crt. | Details bibliographical reference | Comments |
|---|---|---|
| | Agricoleelor, Ingineria Mediului 14: 475-480 | |
| 8. | Covaciu-Marcov S.-D., Ferenți S., Dobre F., Condure N. (2010): Research on some *Bombina variegata* populations (Amphibia) from Jiu Gorge National Park, Romania. Museu Olteniei Craiova. Studies and Communications. Natural Sciences 26 (1):171-176 | Within the article, 5 aquatic habitats with the species *Bombina variegata* were studied in the following areas: tunnel entrance Bumbești, Meri CFR station, Meri quarry, other temporary aquatic habitats located on a forest road in the Comandă area, respectively the Comandă pond. |
| 9. | Cogălniceanu D., Rozylowicz L., Székely P., Samoilă C., Stănescu F., Tudor M., Székely D., Iosif R., 2013a, Diversity and distribution of amphibians in Romania. ZooKeys, 296: 35. | The article includes most of the bibliographical citations from pre-2013 articles plus personal communications or field data of the team of herpetologists led by Prof. Dr. Cogălniceanu Dan Cogălniceanu in the period 1986-2012.<br>Thus, the spatial references regarding the presence of the species *Bombina variegata* in the Defileul Jiului area are: Bumbești-Jiu, the area between Schitul Locurele and Tancuri, Dragalina Valley, Sălătruc Valley, Lainici Pass, Vulcan Pass, Chitu, Meri Station, Bratcu Valley, Baltă Comandă, Culmea cu Conace, Culmea Dumitra, Trântorul, Cerbănașul, Cheile Strâmbuței.<br>The spatial references on the presence of the species *Triturus cristatus* are: Bumbești-Jiu, Gara Meri, Balta la Comandă, Lainici.<br>These references do not contain data on habitat type or other biotope or population data, but only the presence of the species within the range of the localities mentioned. |
| 10. | Sucea F., Cicort-Lucaciu A.-Ș., Covaci R.F., Dimancea N. (2014): Note on the diet of two newt species in Jiu Gorge National Park, Romania. Herpetologica Romanica 8: 11-27 | The results of the diet of the two newt species of the Defileul Jiului National Park, *Lissotriton vulgaris* and *Triturus cristatus*, from the permanent aquatic habitat of Comandă at an altitude of about 900 m are presented in the article. |
| 11. | Ile G.-A., Sucea F.-N. (2018): Artificial habitats serving as | The article reports the presence of two species of newts, Lissotriton vulgaris and Triturus |

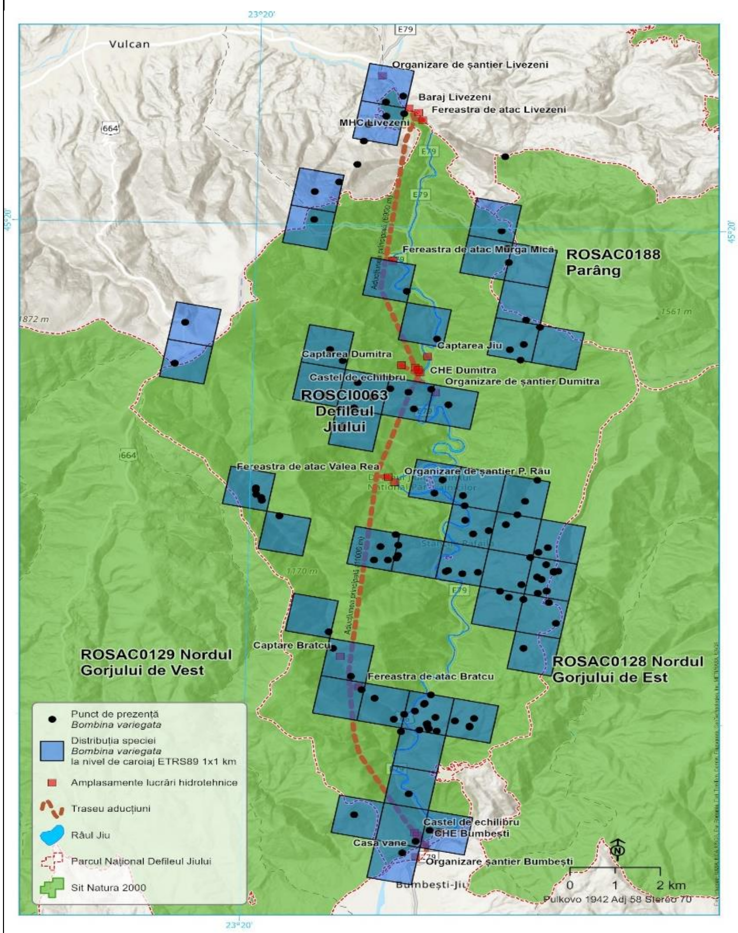
| No. crt. | Details bibliographical reference | Comments |
|---|---|---|
| | shelters for amphibians in rich biodiversity areas: a case in the Jiu Gorge National Park, Romania. South-Western Journal of Horticulture, Biology and Environment 9(2): 91-96. | cristatus in two aquatic habitats of about 50 square meters each in the abandoned technological area of the Meri quarry, a few tens of meters from the Jiu River. The presence of other amphibian species is also reported: *Bombina variegata*, *Hyla arborea*, *Rana dalmatina*, *Pelophylax ridibundus* and *Bufotes viridis*. |
| 12. | Sucea F.-N. (2019). The second record of a rare lizard species, Darevskia praticola (Eversmann, 1834), in the Jiu Gorge National Park, Romania. Ecologia Balkanica 11(1):239-241 | This paper presents the second record of the reptile species *Darevskia praticola* in a beech forest at 562 m altitude inside the Defileul Jiului National Park. The first record was published by Covaciu-Marcov et al. (2009) in the area of Gării Meri. |
| 13. | Covaciu-Marcov S.-D. and Sucea F.-N. (2021) Altered breeding behavior in some amphibians from an artificial habitat in the Jiu Gorge National Park, Romania. Herpetology Notes, 14: 1353-1356 | The article mentions the presence of the following amphibian species in the area of the abandoned quarry at Meri: *Triturus cristatus*, *Lissotriton vulgaris*, *Bombina variegata*, *Bufo bufo*, *Bufo viridis*, *Hyla arborea*, *Pelophylax ridibundus*, *Rana dalmatina*. |
| 14. | Covaciu-Marcov S.-D, Pop D.-M, Sucea F.-N, Ile G.-A, Cicord-Lucaciu A.-Ș, and Ferenți S. (2023) Good news from newts: distribution, population size, and dynamics of two protected newt species in the Jiu Gorge National Park, Romania. Studia Universits Babeș-Bolyai Biologia, 68 (2):219-234 | The article aimed to assess the population size of the newt species *Lissotriton vulgaris* and *Triturus cristatus* as well as the presence of other amphibian species in the following areas of the Defileul Jiului National Park:<br>pond Command: *Lissotriton vulgaris*, *Triturus cristatus*, *Bombina variegata*, *Bufo bufo*, *Rana dalmatina*, *Rana temporaria*;<br>Vulcan pass: *Triturus cristatus*;<br>Meri race: *Salamandra salamandra*, *Lissotriton vulgaris*, *Triturus cristatus*, *Bombina variegata*, *Rana dalmatina*, *Rana temporaria*;<br>Meri quarry: *Salamandra salamandra*, *Lissotriton vulgaris*, *Triturus cristatus*, *Bombina variegata*, *Hyla arborea*, *Bufo bufo*, *Bufo viridis*, *Rana dalmatina*, *Rana temporaria*, *Pelophylax ridibundus*.<br>The population size of *Triturus cristatus* ranged from 89 individuals in 2009 to 161 individuals in 2019. |

| No. crt. | Details bibliographical reference | Comments |
|---|---|---|
| 15. | Sucea F.-N., Popovici P.-V., Ile G.-A., Iacobescu I.D. and Mihuț R. (2023): Wildlife road mortality in a National Park in the Romanian Carpathians (Jiu Gorge National Park). Biharean Biologist 17 (2):71-84 | The article includes mentions of species mortality on two road sections, DN66 and the road linking the town of Vulcan to the Vulcan Pass, with mentions of herpetofauna species:<br>DN66 Defileul Jiului:<br>amphibians: *Salamandra salamandra*, *Bufo bufo*, *Rana dalmatina*;<br>reptile: *Lacerta viridis*, *Podarcis muralis*, *Natrix natrix*, *Natrix tessellata*, *Coronella austriaca*, *Zamenis longissimus;*<br>DJ664 TransVâlcan:<br>amphibians: *Salamandra salamandra*, *Lissotriton vulgaris*, *Triturus cristatus*, *Bombina variegata*, *Bufo bufo*, *Rana dalmatina*, *Rana temporaria;*<br>*reptile: Zootoca vivipara*, *Anguis colchica*, *Natrix natrix*, *Vipera berus*. |
| 16. | Natura 2000 standard form ROSCI0063 Defileul Jiului | The standard form includes the following amphibian and reptile species in the sections:<br>3.2. Species referred to in Article 4 of Directive 2009/147/EC, species listed in Annex II to Directive 92/43/EEC and site assessment for them: *Bombina variegata*, *Triturus cristatus;*<br>3.3. Other important flora and fauna species:<br>Amphibians: *Bufo bufo*, *Hyla arborea*, *Rana dalmatina*, *Rana temporaria*, *Salamandra salamandra*, *Triturus alpestris*, *Triturus vulgaris;*<br>Reptile: *Anguis fragilis*, *Coronella austriaca*, *Elaphe longissima*, *Lacerta agilis*, *Lacerta viridis*, *Natrix tessellata*, *Podarcis muralis*, *Vipera ammodytes.* |
| 17. | Ministry of Environment, Waters and Forests (2020): Note on the approval of the minimum set of special measures for the protection and conservation of biological diversity, as well as the conservation of natural habitats, wild flora and fauna, population | The specific conservation objectives at the site ROSCI0063 Defileul Jiului are presented for the following herpetofauna species:<br>*Bombina variegata*<br>Population size: 2000 - 5000 (target value: 3500 individuals);<br>Area of potential habitat: unknown;<br>Species distribution in ETRS89: unknown; |

| No. crt. | Details bibliographical reference | Comments |
|---|---|---|
| | safety and investments in ROSCI0063 Defileul Jiului. | Density and total number of breeding habitats: at least 2 breeding habitats/km or 4/kmp;<br>Presence of terrestrial habitats with natural vegetation around the breeding habitats within a radius of 500 m from the breeding habitats: at least 75% of the surface cover.<br>*Triturus cristatus*<br>Population size: 150 - 200 individuals (target value: 175 individuals);<br>Area of potential habitat: unknown;<br>Species distribution in ETRS89: unknown;<br>Density and total number of breeding habitats: unknown;<br>Presence of terrestrial habitats with natural vegetation around the breeding habitats within a radius of 500 m from the breeding habitats: at least 75% of the surface cover. |

*Table no. 44 Species specific data of Bombina variegata at the level of the protected natural area*

| No. crt. | Information/Attribute | Description |
|---|---|---|
| 1 | Species | 638 |
| 2 | Species-specific information | It is less fussy in its choice of aquatic habitat, being found in temporary or permanent pools and puddles, with or without vegetation, swamps, marshes, smoother streams, streams, including in water collected in machine tracks. The population size is estimated in the range 2000-5000 individuals and is distributed in more than 100 different aquatic habitats in the altitudinal range 350 - 1550 m. |
| 3 | Presence status [temporary] | Resident |
| 4 | Presence status [spatial] | Widespread |
| 5 | Attendance status [management] | Native |
| 6 | Abundance | Common |
| 7 | Field data collection period | December 2023 - May 2024 |
| 8 | Species distribution [interpretation] | Bumbești-Jiu tunnel entrance, Comandă pool, Trântorului plateau, Meri quarry, Meri, Lainici and |

| | | |
|---|---|---|
| | | Pietrele Albe CFR stations, Vulcan Pass, Vama Veche, Meri CFR station - lines 4 and 5, Meri quarry, between Schitul Locurele and Tancuri, Valea Dragalina, Valea Sălătruc, Pasul Lainici, Chitu, Valea Bratcu, Culmea cu Conace, Culmea Dumitra, Trântorul, Cerbănașul, Cheile Strâmbuței, U.P.P. B III, w.u. 54b, 55a - "Micul Domogled", U.P. B IV, w.u. 49a - left bank of the Ji river 1 km upstream of Lainici Monastery, U.P. B III, w.u. 66 - gorunet with Scots pine, UP B III, w.u. 108 - border at the confluence of Pr. Cerbănașul with the Jiul, U.P. B III - the meadow of Locurele hermitage, U.P. B III, u.a. 127 - the cliff at km 117, U.P. B III - Lainici Monastery, near u.a. 84a and dozens of other habitats. |
| 9 | Species distribution [distribution map] | <br><br>Fig. 113 Distribution of *Bombina variegata* in ROSCI0063 |
| 10 | Other information on sources of information | Fuhn I.E. (1960): Fauna of the Romanian People's Republic, Vol. XIV Amphibia, Editura Academiei Republicii Populare Române, Bucharest |

| | | |
|---|---|---|
| | | I.C.A.S. (2004): Tema nr. 11.RA.2004: Study on the constitution of the National Park "Defileul Jiului". Regia Națională a Pădurilor - Romsilva. Bucharest<br>Tudor M., Crăciun N. and Burlacu L. (2004): Preliminary report on the herpetofauna in the area of the future National Park "Defileul Jiului". Muzeul Olteniei Craiova. Oltenia. Studies and Communications, Natural Sciences 20: 269-272<br>Petrescu A., Petrescu I., Răduleț N., Iftime Al., Ban C. (2004): Preliminary faunistic data from the area of the future Defileul Jiului National Park. Oltenia, Studies and Communications, Natural Sciences 21: 229-240<br>Covaciu-Marcov S.-D., Cicort-Lucaciu A.Ș., Dobre F., Ferenți S., Birceanu M., Mihuț R., Strugariu A. (2009): The herpetofauna of the Defileul Jiului National Park, Romania. North-Western Journal of Zoology 5(Supplement 1): S01-S78<br>Covaciu-Marcov S.-D., Ferenți S., Dobre F., Condure N. (2010): Research on some *Bombina variegata* populations (Amphibia) from Jiu Gorge National Park, Romania. Museu Olteniei Craiova. Studies and Communications. Natural Sciences 26 (1):171-176<br>Cogălniceanu D., Rozylowicz L., Székely P., Samoilă C., Stănescu F., Tudor M., Székely D., Iosif R., 2013, Diversity and distribution of amphibians in Romania. ZooKeys, 296: 35.<br>Ile G.-A., Sucea F.-N. (2018): Artificial habitats serving as shelters for amphibians in rich biodiversity areas: a case in the Jiu Gorge National Park, Romania. South-Western Journal of Horticulture, Biology and Environment 9(2): 91-96.<br>Covaciu-Marcov S.-D. and Sucea F.-N. (2021) Altered breeding behavior in some amphibians from an artificial habitat in the Jiu Gorge National Park, Romania. Herpetology Notes, 14: 1353-1356<br>Sucea F.-N., Popovici P.-V., Ile G.-A., Iacobescu I.D. and Mihuț R. (2023): Wildlife road mortality in a National Park in the Romanian Carpathians (Jiu Gorge National Park). Biharean Biologist 17 (2):71-84<br>Natura 2000 standard form ROSCI0063 Defileul Jiului<br>Ministry of Environment, Waters and Forests (2020): Note on the approval of the minimum set of special measures for the protection and conservation of biological diversity, as well as the conservation of natural habitats, wild flora and fauna, population safety and investments in ROSCI0063 Defileul Jiului. |

*Triturus cristatus* has not been identified at the project site.

Fig. 114 Aquatic habitat in anthropogenic structure (CHE Bumbești)

Fig. 115 Aquatic habitat in anthropogenic structure (Livezeni dam)

Fig. 116 *Bombina variegata* (CHE Bumbești)

***D. Birds***

**D.1 Location of study areas**

The sites targeted by the implementation of the project are located on the administrative radius of Aninoasa (Livezeni Dam), respectively on the administrative radius of Bumbești - Jiu (CHE Dumitra and CHE Bumbești).

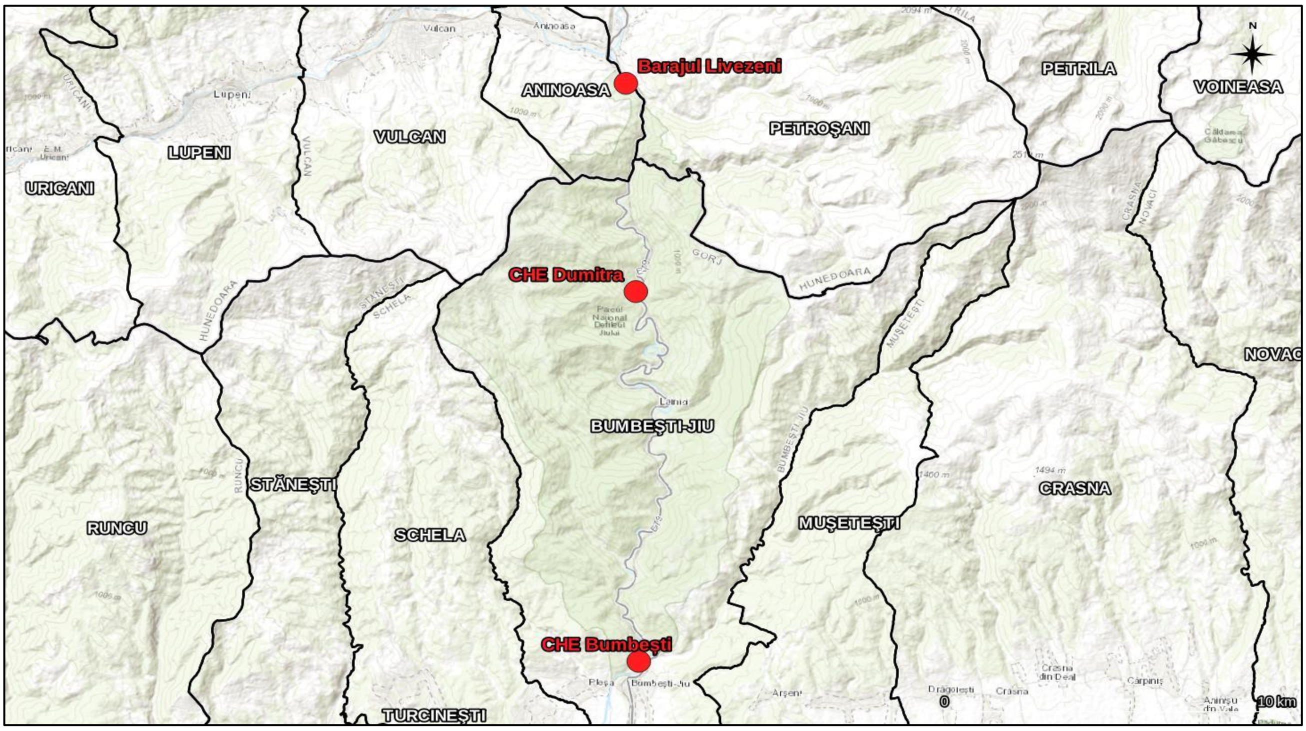



Fig. 117 - Aspects regarding the territorial location of the sites concerned by the implementation of the project (red colored dots) in relation to the administrative territorial boundaries of the analyzed area (black colored polygons)

The analyzed sites are not located within or in the immediate vicinity of Natura 2000 sites designated for the conservation of bird species. The nearest SPAs are the following:

- ROSPA0084 Munții Retezat , located at least 33 km north - west from Livezeni Dam.

The sites targeted by the implementation of the project are located within the Defileul Jiului National Park.

According to the draft Management Plan of the Defileul Jiului National Park, the inventory list of bird species of conservation interest identified in the perimeter of the protected natural area of national interest is as follows:

**Ord.Ciconiiformes**

- *Egreta (Chasmerodius) albus*; Annex 3 to Law 49/2011

**Ord. Accipitriformes**

- *Aquila chrysaetos*; Annex 3 to Act 49/2011; Annex 4A to Act 49/2011
- *Aquila pomarina*; Annex 3 to Law 49/2011; Annex 4A to Law 49/2011
- *Aquila clanga*; Annex 3 to Law 49/2011; Annex 4A to Law 49/2011
- *Buteo buteo*; Annex 4A to Law 49/2011
- *Falco peregrinus*; Annex 3 of Law 49/2011;
- *Falco tinnunculus*; Annex 4B to Law 49/2011

**Ord. Strigiformes**

- *Strix uralensis*; Annex 4A to Law 49/2011
- *Bubo bubo*; Annex 3 of Law 49/2011;

**Ord. Apodiformes**

- *Sunset*; Annex 4A of Law 49/2011

**Ord. Caprimulgiformes**

- *Caprimulgus europaeus*; Annex 3 to Law 49/2011

**Ord. Piciformes**

- *Dendrocopos major*; Annex 4A to Law 49/2011
- *Dendrocopos medius*; Annex 4A to Law 49/2011
- *Dryocopus martius*; Annex 3 to Law 49/2011
- *Picus canus*; Annex 3 to Law 49/2011
- *Motacilla alba*; Annex 4B to Law 49/2011
- *Motacilla cinerea*; Annex 4B to Law 49/2011
- *Lanius collurio*; Annex 3 to Law 49/2011; Annex 4A to Law 49/2011Corvus *corax*; Annex 4B to Law 49/2011
- *Garrulus glandarius*; Annex 4A to Law 49/2011
- *Cinclus cinclus*; Annex 4B to Law 49/2011
- *Troglodytes troglodytes*; Annex 4A to Law 49/2011
- *Regulus regulus*; Annex 4B of Law 49/2011
- *Luscinia luscinia*; Annex 4A to Law 49/2011
- *Parus ater*; Annex 4A of Law 49/2011
- *Parus caeruleus*; Annex 4A to Law 49/2011Parus *major*, Annex 4A to Law 49/2011
- *Parus montanus*; Annex 4A to Law 49/2011
- *Parus palustris*; Annex 4A to Law 49/2011
- *Certhia familiaris*; Annex 4A to Law 49/2011
- *Sitta europaea*; Annex 4B to Law 49/2011
- *Pyrrhula pyrrhula*; Annex 4A to Law 49/2011
- *Fringilla coelebs*; Annex 4A to Law 49/2011
- *Carduelis chloris*; Annex 4B to Law 49/2011
- *Carduelis spinus*; Annex 4B to Law 49/2011

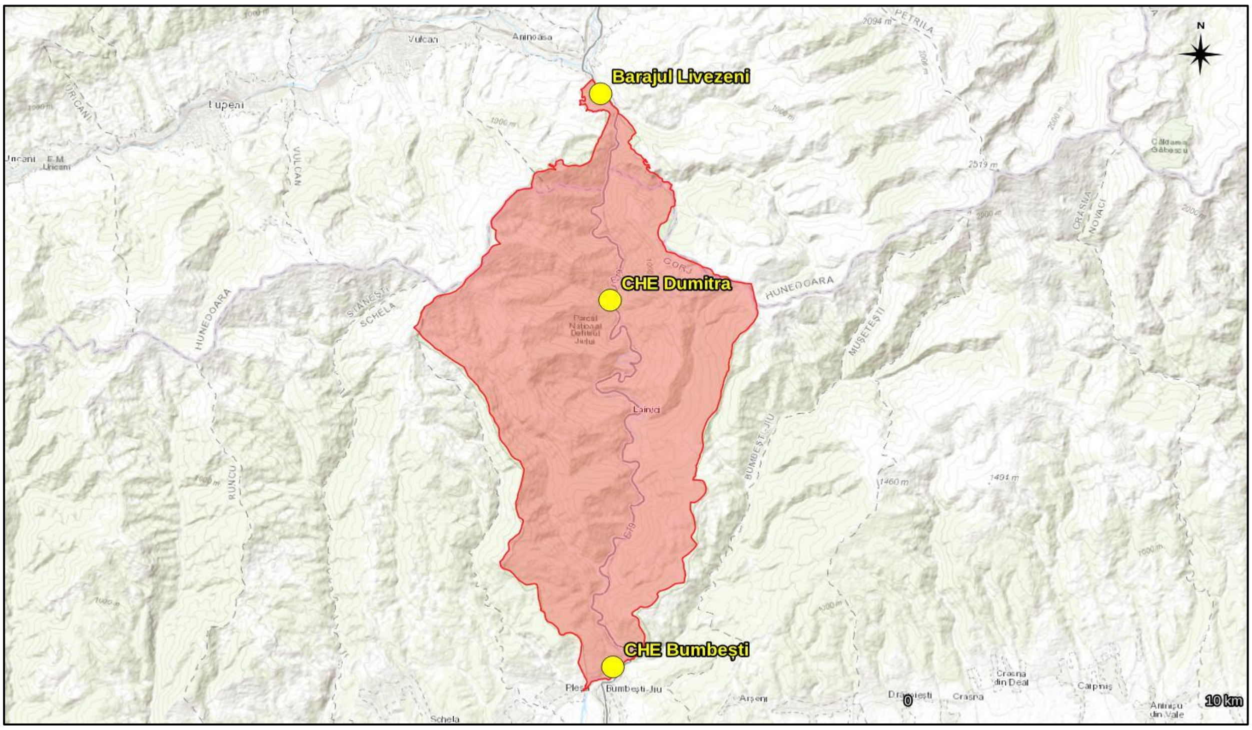



Fig. 118 Aspects regarding the relationship of the sites targeted by the project (yellow colored dots) with the Defileul Jiului National Park (red colored polygon)

**Monitoring methodology used**

In order to identify the presence of bird species in the area of influence of the project, the information provided by the draft Management Plan of the Defileul Jiului National Park, currently in the process of endorsement, was analyzed.

Following the analysis, the monitoring planning stage was carried out. A planning of the actions carried out, both in the field (data collection phase) and in the office (processing, analysis and final decision phase), was realized. The geographic coordinates of the project were entered into a sub-metric GPS device in order to accurately identify the areas concerned by the project implementation and of interest for this report.

The field data collection stage was one of the most important stages because the nature and accuracy of the data collected in the field depend on the results of the report and therefore on the achievement of the proposed objectives. In order to collect field data, all the areas concerned by the implementation of the project, as well as their neighboring area (Livezeni Dam, CHE Dumitra and CHE Bumbești) were fully covered. The observations were carried out using the **transect method**, these samples being located within and in the vicinity of the sites concerned by the implementation of the project, as well as the **fixed-point observation** method.

The data obtained from the application of the methodologies were centralized in a CSV database and subsequently added to QGIS and saved in a SHP file in order to have a clear view on the distribution of bird species in relation to the sites targeted by the project implementation.

Baza de date livezeni — Features Total: 133, Filtered: 133, Selected: 0

| | Num spec | nr ind | sex | activit | x | y |
|---|---|---|---|---|---|---|
| 1 | Cinclus cinclus | 2 | M+F | pereche in habitat optim | 372675.245 | 430372.038 |
| 2 | Phoenicurus ochruros | 2 | M+F | Cuibăritor pe perete de stâncă | 373029.432 | 430185.532 |
| 3 | Turdus merula | 2 | M+F | Pereche | 372502.796 | 430527.920 |
| 4 | Motacilla cinerea | 2 | M+F | Pereche în habitat corespunzător | 372704.363 | 430344.677 |
| 5 | Motacilla cinerea | 2 | M+F | Pereche în habitat corespunzător | 373035.456 | 430104.202 |
| 6 | Motacilla cinerea | 2 | M+F | Pereche in habitat corespunzător | 373075.368 | 423402.777 |
| 7 | Cecrophis daurica | 2 | M+F | Cuibăritor | 372881.582 | 411292.919 |
| 8 | Anas platyrhynchos | 2 | M+F | Pereche | 373112.519 | 410753.983 |
| 9 | Dendrocopos major | 1 | M | Darabană | 372595.673 | 430353.965 |
| 10 | Erithacus rubecula | 1 | M | Individ cântător | 372625.293 | 430479.976 |
| 11 | Erithacus rubecula | 2 | M | Indivizi cântător | 372537.939 | 430388.103 |
| 12 | Erithacus rubecula | 1 | M | Individ cântător | 373037.966 | 430228.958 |
| 13 | Erithacus rubecula | 1 | M | Individ cântător | 373093.190 | 430315.308 |
| 14 | Turdus merula | 1 | M | Indivizi cântători | 372949.608 | 430148.381 |
| 15 | Accipiter nisus | 1 | M | NULL | 373016.881 | 429943.551 |
| 16 | Dryobates minor | 1 | M | Individ cântător | 373231.752 | 429764.826 |
| 17 | Dryocopus martius | 1 | M | Darabană | 372602.199 | 430089.141 |
| 18 | Motacilla cinerea | 1 | M | NULL | 372535.930 | 430626.821 |
| 19 | Phoenicurus ochruros | 1 | M | NULL | 372697.084 | 430372.289 |
| 20 | Regulus regulus | 1 | M | Indivizi cântători | 372782.681 | 430202.601 |
| 21 | Motacilla cinerea | 1 | M | NULL | 373207.403 | 423723.075 |
| 22 | Dendrocopos major | 1 | M | darabană | 373275.178 | 423717.302 |

Fig. 119 Aspect of the structure of the database resulting from the field application of the methodology for data collection at the sites targeted by the project implementation

### D.3. Aspects of the presence of bird species in the areas of influence of the project

A total of **42 bird species** were observed following the field application of the monitoring methodology.

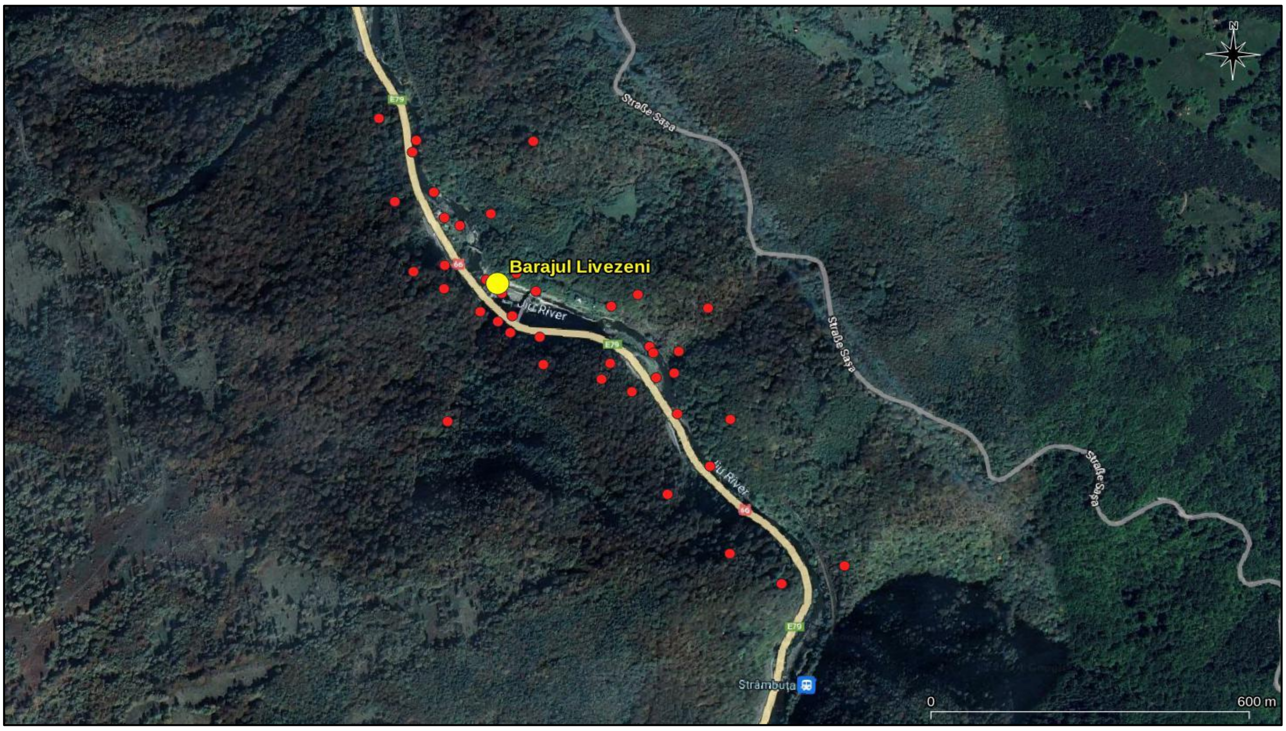



Fig. 120 Aspect of the distribution of bird species in the area of influence of the project - Livezeni Dam

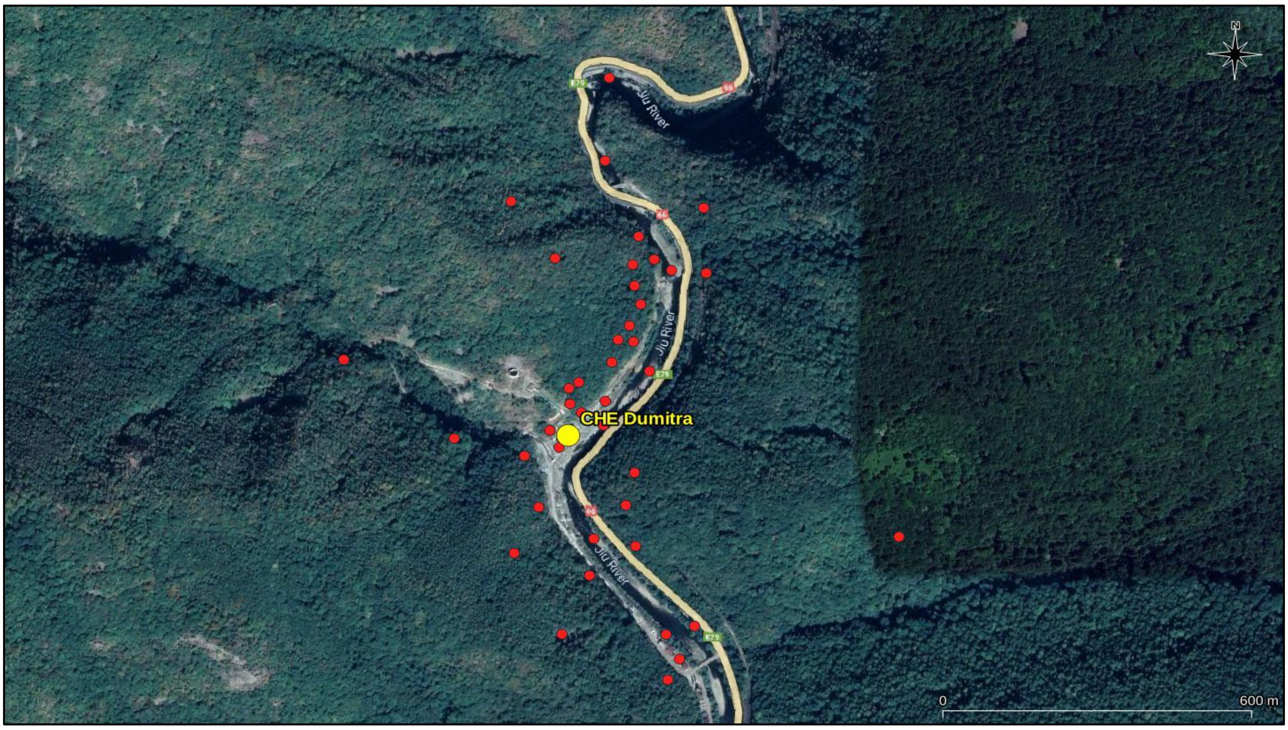



Fig. 121 Distribution of bird species sightings in the project area of influence - CHE Dumitra


Fig. 122 Aspect of the distribution of bird species in the area of influence of the project - CHE Bumbești

The following table presents the bird species identified in the project's areas of influence (Livezeni Dam, Dumitra and Bumbești reservoirs), their habitat requirements and other relevant observations.

*Table no. 45 Presentation of the bird species identified in the areas of influence of the project (Livezeni Dam, Dumitra and Bumbești reservoirs), their habitat requirements and other relevant observations*

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| 1. | *Accipiter nisus* | 1 individual | - | 1 individual | It nests mainly in higher, hilly areas, especially in Transylvania, but also in dense lowland forests (where it nests in smaller numbers). It prefers coniferous and mixed forests, pine plantations, parks with large trees or isolated groups of trees. Reaches altitudes up to 2,100m in areas where woodland alternates with open areas. It avoids dark, pure deciduous forests that are dense or very thinned. May also inhabit the suburbs of forested areas. | Taking into account the habitat preferences of the species, correlated with the characteristics of the sites targeted by the implementation of the project, it can be stated without reservations that the common buzzard may occasionally use the analyzed areas only as suboptimal foraging habitat.<br>Given that the species is an aerial feeder, the realization of the investment objectives will in no way lead to a loss of foraging habitat for the species. |
| 2. | *Alauda arvensis* | No specific habitat | No specific habitat | 2 individuals | The species colonizes open areas with level, moist soil covered with herbaceous vegetation (including cereals), and is absent from arid and muddy regions. | Only 2 individuals were observed in the CHE Bumbești area.<br>Through the implementation of the project, works are foreseen only in built or partially built |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | | areas that do not represent in any way specific habitats of the field lark.<br>The implementation of the project does not lead to species-specific habitat loss. |
| 3. | *Anas platyrhynchos* | 4 individuals in flight. No specific habitat in the analyzed areas | No specific habitat | 2 pairs downstream of the backflow area of the CHE Bumbești | The common duck is a species that adapts readily to a wide range of habitats, from tundra to subtropical, habitats that include slow-flowing or still, relatively sheltered waters, estuaries and deltas, lagoons, shallow water sea coasts, lakes, rivers, ponds and pools. They prefer shallow water with adjacent vegetation, submerged or floating. Generally avoids deep or exposed water. | The sections of the Jiu River in the area of the Livezeni dam and the CHE Dumitra dam do not fulfill in any way the minimum requirements of breeding or feeding habitat of the species. In these areas the common duck can only occasionally be observed in transition.<br>In the CHE Bumbești area, the species may occur in small numbers (especially in those meanders where the water has a smooth flow). Taking into account the fact that the upstream water will be discharged in this area and that no works are foreseen in the |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | | minor riverbed, it can be stated without reservations that the implementation of the project will not lead to loss of specific habitats of the species. |
| 4. | *Anthus trivialis* | No specific habitat | No specific habitat | 1 individual at least 300 m south - west from CHE Bumbești | Habitats include the edges of deciduous and coniferous forests, clearings, clearings with tall, isolated trees, tree-line edges and hilly or mountainous areas. It also occurs in meadows with shrubs and trees, from sea level to just above the tree line, reaching up to 2,300 m in the Alps. | The species is present only in the southern part of the analyzed area, in the vicinity of CHE Bumbești.<br>With the implementation of the project, works are foreseen only in built or partially built areas that do not represent in any way specific forest habitats.<br>The implementation of the project does not lead to species-specific habitat loss. |
| 5. | *Ardea alba* | No specific habitat | No specific habitat | 1 individual at least 700 m south - west from CHE Bumbești | It prefers puddles and wetlands over large areas, with reedbeds, flooded meadows, canals, ponds, etc. It feeds in shallow water, flooded areas with rich vegetation, marshes, on the banks of streams, canals. | White Egret was not observed in the area of Livezeni dam and CHE Dumitra. In these stretches of the Jiu River, the species can occasionally be observed only in transition, without using the river banks in any way (they are |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | | totally suboptimal for the species). In the CHE Bumbești area, the species occurs isolated on the muddy or sandy banks of the Jiu River, which are far enough away from the analyzed site so that the implementation of the project does not lead in any way to the species' damage. |
| 6. | *Ardea cinerea* | No specific habitat | No specific habitat | 1 individual at minimum 720 m south - west from CHE Bumbești | It is a species characteristic of a wide variety of habitats, including freshwaters (large lakes, ponds, rivers and other watercourses, etc.) and trees, using trees more frequently than other species of lizards. It feeds on the banks of lakes, ponds, canals, flooded meadows, etc. and nests most frequently in tree canopies. | The gray heron was not observed in the area of Livezeni dam and CHE Dumitra. In these stretches of the Jiu River, the species can occasionally be observed only in transition, without using the river banks in any way (they are totally suboptimal for the species). In the CHE Bumbești area, the species occurs isolated on the muddy or sandy banks of the Jiu River, which are far enough away from the analyzed site so |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | | that the implementation of the project does not lead in any way to the species' damage. |
| 7. | *Buteo buteo* | 1 individual | 1 individual | 1 individual | The common dormouse is the bird of prey most commonly seen in much of Europe, living mainly in wooded areas near open farmland, farmland or wetlands. It is characteristic of hilly regions with many habitat types, but also occurs in lowlands and mountains, where it can be seen perching on poles or other high supports used as observation posts. | The species is present in the vicinity of all sites targeted by the project. Taking into account the fact that the works targeted by the investment objectives will be carried out in built-up or partially built-up areas and that they are not foreseen to be carried out in forest habitats, it can be stated without any reservations that the implementation of the project will not lead to any loss of species-specific habitats. |
| 8. | *Cecrophis daurica* | No specific habitat | No specific habitat | 1 pair nesting on the walls of the Surge chamber, located about 340 m north- | It nests in open, preferably rocky, mountainous regions or along steep coastlines. In Romania it nests in Dobrogea, in the Retezat, Parâng, Apuseni, Danube belt and Cernei mountains. | The pair identified in the CHE Bumbești area nests on the concrete walls of the surge chamber. The implementation of the project in no way leads to |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | west of CHE Bumbești. | | the loss of areas of habitat specific to the red swallow. |
| 9. | *Chloris chloris* | - | 3 individuals | - | It is a fairly common bird in open areas with trees and shrubs, in gardens and parks, forest edges, tree-lines, and in the interior of settlements. It prefers low-lying areas, generally up to an altitude of 1,400 m, in boreal, temperate or Mediterranean climates. | Three individuals were observed in the area of Che Dumitra. This species may also occur in the area of the other analyzed sites (Livezeni Dam and CHE Bumbești). Taking into account the habitat preferences of the species and the fact that the implementation of the project does not foresee any interventions in forest habitats, it can be stated without reservations that the execution of the specific works targeted by the project does not lead to the loss of specific habitats of the field lark. |
| 10. | *Cinclus cinclus* | 2 pairs | 1 pair | 1 individual | The white-throated dipper is widespread along mountain streams in coniferous and mixed forests. Occasionally it can be seen | The species has a wide distribution on the Jiu river, being observed in all 3 analyzed areas. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | on the banks of lakes in rocky areas. | Taking into account the fact that the remaining works to be carried out only concern the completion of almost completely built objectives, it can be concluded that at the present time there is no longer any question of loss of habitat specific to the species. The implementation of the project may only lead to local disturbance, resulting in only a slight spatial retreat of the species during the execution of the works in the Jiu riverbed. |
| 11. | *Columba palumbus* | 4 individuals in flight at a significant distance from the Livezeni dam | 2 individuals in flight at significant distance from the proposed catchment in the Che | - | Widespread in all forested regions. It is common in sparse forests, preferring oak; it can also be found in man-made areas such as large city parks. It is found from the lowlands to the lower limits of forests, preferring areas at altitudes between 900 and 1,600 m, where there are isolated trees, | Taking into account that the implementation of the proposed works will not intervene in forest habitats, it can be stated without reservations that the implementation of the project does not lead to loss of habitat specific to the collared dove. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | Dumitra area | | forest patches or thinned forests bordering open areas or agricultural crops. It has no preference for a particular forest formation, but does not go too deep into closed or extensive forest stands. In Romania, this species has not yet undergone the urbanization that is common in Western and Central Europe. | |
| 12. | *Corvus corax* | 5 individuals in flight | 2 individuals in flight | - | Most ravens prefer wooded areas with large tracts of open land nearby, or coastal regions for nesting and feeding. In some areas with high human population densities, the species can even be seen nesting in human settlements, taking advantage of an abundant food source. | <u>The implementation of the project will not intervene in specific raven habitats (forest habitats with cliffs).</u> |
| 13. | *Cyanistes caeruleus* | 1 individual | - | 2 individuals | As in other parts of its range, in Romania it is present in different types of habitats, being one of the least demanding species of woodpecker. It prefers lowland | The species is common and may occur in all areas surveyed.<br>No blue tit nesting activity was observed at the sites analyzed. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | areas with deciduous forests, mainly oak (*Qurcus sp.*), but it also avoids mixed forests, orchards, gardens and parks in the interior of towns. If it finds suitable hollows or cavities for nesting, it also occurs in bushes, gardens or roadside tree lines. In winter it can also be found in reed-covered fields. | <u>Project implementation may result in a loss of habitat over a short period of time, particularly during the decommissioning of previous site organizations. These land areas will be subject to renaturalization.</u><br><u>The implementation of the project does not affect the population of the species.</u> |
| 14. | *Delichon urbicum* | 3 individuals | 11 individuals | 10 individuals | They flock together in flocks, populating stone-built towns; they can often be seen on power lines.<br>In the wild, the house martin usually nests in bright caves or in cracks in sedimentary rocks, most often on the banks of mountain rivers. It rarely nests in bank sedges (*Riparia riparia*). With the advent of towns and cities, sedges began to build their nests under eaves and ledges, preferring stone or brick walls; for this reason they are found more in towns than in | The species is present in all 3 analyzed areas, using the buildings for breeding.<br><u>The implementation of the project does not in any way lead to damage to the house grass.</u> |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | villages. Gradually, these birds have become anthropophagous, and are rarely seen outside human settlements. The maximum altitude at which the grasshoppers live is 2,200m. | |
| 15. | *Dendrocopos leucotos* | - | 1 individual at a significant distance from Che Dumitra | - | In Romania it can be considered a species specialized on deciduous forests in hilly and mountainous regions. It prefers forests composed of beech (*Fagus sp.*), birch (*Betula sp.*), maple (*Acer sp.*), ash (*Fraxinus sp.*), elm (*Ulmus sp.*), poplar (*Populus sp.*). Often found in mixed forests, sometimes also in coniferous forests. It often nests on the southern slopes of hills and mountains, but also in gallery forests along streams dominated by softwood tree species. Thus, the species can be found from low altitudes, from 400 m, where it nests in deciduous forests, to the | Taking into account the strict habitat preferences of the species (deciduous, old-growth forest habitats) and the fact that the implementation of the project will not interfere in any way with these types of habitats, it can be stated that <u>the execution of the proposed works will not lead to any loss of species-specific habitats.</u> |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | montane areas at 1800 m, where it nests in old beech or mixed forests. | |
| 16. | *Dendrocopos major* | 1 individual | 1 individual | 1 individual | It is present in all types of forest habitats and even in most habitats with a low number of accessible trees (parks, grasslands with scattered trees, etc.). Although it was primarily a forest species, it now occupies other secondary habitats such as old orchards, large parks, gardens and other anthropized habitats such as tree-lined strips in the streets of quieter cities. | Taking into account the habitat preferences of the species (old forest habitats) and the fact that the implementation of the project will not interfere in any way with these types of habitats, it can be stated that <u>the execution of the proposed works will not lead to any loss of habitats specific to the species.</u> |
| 17. | *Dendrocopos syriacus* | No specific habitat | No specific habitat | 1 individual observed in the orchards near CHE Bumbești | It is not a fussy species, occurring in forests, parks, farms, wood pastures or gardens. It is the most anthropized species of woodpecker, with the majority of the population nesting in gardens or near settlements, or in secondary habitats with high anthropogenic impact (e.g. in | <u>The sites analyzed do not meet the minimum habitat requirements of the species in any way.</u> A single individual was observed in an orchard in the neighborhood of CHE Bumbești. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | poplar strips along roadsides). It avoids large, closed forests, favoring rather groups of trees, forest edges, old, isolated trees, etc. It also occurs in deciduous and coniferous forests where tree trunks are larger than 25 cm in diameter. Known longevity is 10 years and nine months in the wild. | The implementation of the project does not lead to the species' habitat being affected. |
| 18. | *Dryobates minor* | 1 individual observed 800 m south of the Livezeni dam | - | - | In Romania it nests in both lowland, hilly and mountainous areas, where it finds its preferred habitats in old deciduous or mixed forests with a low percentage of conifers, which have a lot of deadwood and deadwood. It prefers natural forests with very low silvicultural impact, intensive silvicultural management leading to local extinction of the species. The species can also be found nesting in gallery forests with many softwoods, and is also common in forests or plantations | The sites analyzed do not meet the minimum habitat requirements of the species in any way.<br>The species may only occur in forest habitats in the vicinity of the analyzed sites.<br>Taking into account that the implementation of the project will not interfere in any way with forest habitats, it can be stated that the execution of the proposed works will not lead to any loss of species-specific habitats. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | in the Danube Delta. Although primarily a forest species, in recent decades it has occupied many other secondary habitats, such as old orchards, large parks and gardens and other lightly anthropized habitats. | |
| 19. | *Dryocopus martius* | 1 individual at a significant distance from the Livezeni dam | 1 individual at a significant distance from Che Dumitra | 1 individual at a significant distance from Che Bumbești | It forages in montane forests, sometimes up to the tree line, and in the Alps it can reach heights of over 2,000 m. In the northern taiga it is mainly a lowland species. It prefers the tall, old trunks of forests at the climax of plant succession. Although it prefers sparser patches of woodland, it can also be found in isolated forest patches relatively far from intact forest. Unlike the other woodpecker species, whose flight is undulatory, the black woodpecker's flight is continuous, similar to that of the hazel grouse or jay. | Taking into account the habitat preferences of the species (old forest habitats) and the fact that the implementation of the project will not interfere in any way with these types of habitats, it can be stated that <u>the execution of the proposed works will not lead to any loss of habitats specific to the species.</u> |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| 20. | *Erithacus rubecula* | 5 singing individuals | 4 singing individuals | 4 singing individuals | The species prefers wooded areas, gardens, parks or hedgerows, generally areas alternating between open and open land. In northern Europe it prefers scrublands and mixed woodlands. | The species is common and may occur in all areas surveyed.<br>No robin nesting activity was observed at the analyzed sites.<br>Project implementation may result in habitat loss over a short period of time, particularly during the decommissioning of previous site organizations. These areas will be subject to renaturalization.<br>The implementation of the project does not affect the population of the species. |
| 21. | *Fringilla coelebs* | 9 singing individuals in nearby forest habitats | 7 singing individuals in nearby forest habitats | 2 singing individuals in nearby forest habitats | The species is partly migratory in Romania. Females and juveniles migrate in the cold season to south-west Asia and north-eastern parts of Africa, followed by some of the males. They are generally sedentary and can be found in lowland areas even in winter. The individuals seen in winter may also come from populations that | The species inhabits forest habitats only.<br>The analyzed sites do not meet the minimum habitat conditions of the finch.<br>The implementation of the project will in no way lead to loss of species-specific habitats. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | have nested in northern regions. This is due to the male's sedentary advantage near nesting sites. Our birds retreat to winter most likely in the Balkans or Italy. They have a melodious song, repeated in series; the species has regional "dialects" even in Romania. | |
| 22. | *Garrulus glandarius* | - | 2 individuals in nearby forest habitats | 3 individuals in nearby forest habitats | It lives in areas of dense forest, especially oak, but also in forests with other deciduous or coniferous trees. It can also be found in parks with trees or even gardens, and tolerates a moderate degree of anthropization of the habitat quite well. | The species may occur in forest habitats adjacent to the analyzed sites.<br>The sites targeted for project implementation do not meet the minimum habitat requirements of the finch.<br>The implementation of the project will in no way lead to loss of species-specific habitats. |
| 23. | *Hirundo rustica* | No specific habitat | No specific habitat | 2 individuals | The swallow is one of the most common local nesting species. Its occurrence depends largely on domestic livestock. They usually avoid extensive forests and very dry areas. Probably long ago it | Migratory species that may use the CHE Bumbești area only for feeding.<br>The implementation of the project will in no way affect the species. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | nested in mountainous areas, coastal areas with hollows, oak forests and barren trees; over time, however, it has adapted to the man-made environment. Thus, the swallow can be found on farmland, in villages, along roadsides, wherever it finds suitable places to nest and gather food, often preferring areas near water. | |
| 24. | *Jynx torquila* | No specific habitat | No specific habitat | 1 individual observed in the orchards near CHE Bumbești | The species is found in deciduous forest edges and clearings, in small stands, on sparse trees in open areas, in clearings and meadow forests, groves, plantations and old orchards. It can also be seen close to humans, in trees in gardens or large local parks. It prefers lowland and hilly areas, occasionally penetrating mountainous areas, valleys and depressions, up to the molidihs (the maximum nesting altitude in | The sites analyzed do not meet the minimum habitat requirements of the species in any way. A single individual was observed in an orchard in the neighborhood of CHE Bumbești. The implementation of the project does not lead to the species' habitat being affected. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | Romania is 1,300 m, in the Păltiniș pass in the Bistrița Mountains). | |
| 25. | *Lanius collurio* | No specific habitat | No specific habitat | 1 individual observed in the orchards near CHE Bumbești | The reddish-brown spruce is characteristic of open grassland agricultural areas with many shrubs and scrubs. It occurs up to a maximum altitude of 1,700 m. | The project sites do not meet minimum habitat conditions for the species.<br>A single individual was observed in the vicinity of CHE Bumbești, at a distance of at least 130 m to the south.<br>Implementation of the project does not lead to loss of optimal habitat for the species. |
| 26. | *Leiopicus medius* | No specific habitat | No specific habitat | 1 individual in the neighborhood of CHE Bumbești | It is a species found in forests with mature Querceline trees, but can also be seen in larger parks or wooded pastures, where old oak or gorun trees are present. The altitudinal limits at which the species nests are determined by the presence of oak or gorun habitats and are mainly located between 200 and 600 m; in Dobrogea and the Western Plain it can also be found at lower | Taking into account the habitat preferences of the species (old *Querqus sp.* forest habitats) and the fact that the implementation of the project will not interfere in any way with this type of habitat, it can be stated that <u>the execution of the proposed works will not lead to any loss of species-specific habitats.</u> |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | altitudes. The presence of the species is independent of the slope of the terrain, humidity or the proximity of watercourses. It also lives in mixed forests with oak, hornbeam, ash, ash, beech, even spruce. The spread of the species generally corresponds to the spread of the hornbeam (*Carpinus betulus*). It consumes almost exclusively animal food throughout the year. They forage on bark, twigs and leaf surfaces or burrow in rotten, soft wood. Ecologically, it is intermediate between other woodpecker species, foraging on the surface of tree trunks as well as foliage. | |
| 27. | *Motacilla alba* | 2 individuals | 3 individuals | 1 individual | It is a highly adaptable species, occupying territories in a variety of near-water habitats such as lakes, rivers, streams, canals, estuaries and seashores. It can also be found further away from the | The species can be found in all 3 analyzed areas.<br>No nesting activity of white-browed dourados was observed at the sites surveyed. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | water, in settlements, on livestock farms, roads, airfields, parks, gardens and other places where it finds bare ground and short grass. In contrast to the yellow dobro, this species generally avoids dense, tall vegetation during the day, using these areas only for wintering, during which time it may be seen in reedbeds, bushes or horticultural glasshouses. | Project implementation may result in habitat loss over a short period of time, particularly during the decommissioning of previous site organizations. These land areas will be subject to renaturalization.<br>The implementation of the project does not affect the population of the species. |
| 28. | *Motacilla cinerea* | 3 pairs | 3 pairs | 1 pair | It nests along mountain streams and rivers with exposed rocks or banks, often in wooded areas. It also occurs beside streams at lower altitudes, even near canals, where it finds artificial waterfalls, spillway dams, mill scocks or sluice gates. Outside the breeding season they visit many different habitats, such as farms, sewage treatment plants, forest roads, and even occur in the interior of settlements. The altitudinal limit | The species has a wide distribution on the Jiu River, being observed in all 3 analyzed areas.<br>Taking into account the fact that the remaining works to be carried out are only aimed at finalizing some of the objectives that have been almost completely built, it can be concluded that at the present time there is no longer any question of loss of habitat |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | for nesting is 4,100 m in the Himalayas. | specific to the species. The implementation of the project may only lead to local disturbance, resulting in only a slight spatial retreat of the species during the execution of the works in the Jiu riverbed. |
| 29. | *Parus major* | 2 singing individuals | 1 pair | 6 singing individuals | It is the largest of the woodpeckers. It prefers lowland and hilly areas, but also occurs in mountainous areas, in some regions reaching altitudes of 1,850-1,900 m. In Romania, the Greater Spotted Woodpecker is present in different habitat types, being the least demanding of the species of the family. It can be seen in different types of forests (deciduous, mixed or coniferous), but it also frequents gardens, orchards or parks in the interior of towns, where it finds suitable hollows or cavities for nesting. It is a sedentary species, but outside | The species is common and may occur in all areas surveyed. Project implementation may result in habitat loss over a short period of time, particularly during the decommissioning of previous site organizations. These land areas will be subject to renaturalization. The implementation of the project does not affect the population of the species. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | the nesting period it moves to areas with abundant trophic resources and wanders in search of food with other species of woodpeckers. | |
| 30. | *Pernis apivorus* | - | 1 individual at a distance of at least 670 m from CHE Dumitra | - | Honey buzzard are a characteristic species of deciduous forests with glades on light, dry soils where they can easily dig for food. | The sites surveyed do not meet the species' minimum foraging or breeding habitat requirements in any way.<br>The implementation of the project does not lead to the species being affected. |
| 31. | *Phalacrocorax carbo* | 6 individuals in flight | 4 individuals in flight | 2 individuals in flight | The species frequents both coastal and inland wetland habitats. In the marine environment it is found in protected coastal areas such as estuaries, brackish lakes, lagoons, floodplain forests, deltas and bays. Freshwater habitats are represented by lakes, rivers, flooded areas, marshes with water meshes, fish ponds, etc. | Following the field methodology, only transients were observed. Cormorants generally avoid swift water courses.<br>The implementation of the project will in no way lead to the species being harmed. |
| 32. | *Phoenicurus ochruros* | 1 pair | - | 1 singing individual | Although this species once nested in open and rocky habitats, today | The species is present in the analyzed areas. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | it can be seen very frequently in villages and towns, where it can only be found near buildings, avoiding parks and large gardens. It can also be found in ruined areas. In forested regions, it prefers deciduous or mixed woodland, where it is found only at the edge of woodland. However, its preferred habitats remain open land and slopes where cliffs are present. In Romania it is found wherever there are preferred nesting habitats, from plains to alpine hollows. | Project implementation may lead to insignificant habitat loss over a short period of time, only during the specific works. |
| 33. | *Phoenicurus phoenicurus* | No specific habitat | No specific habitat | 1 singing individual in forest habitats in the vicinity of CHE Bumbești | The species prefers deciduous forests, but is also found in the taiga at various altitudes. In our country it is a common bird in deciduous forests, meadows, willows, parks and orchards or places with old walls. In the summer it is a common species in water holes, in the willow forests | Taking into account the habitat preferences of the species (forest habitats) and the fact that the implementation of the project will not interfere in any way with these habitats, it can be stated that <u>the execution of the proposed works will not lead</u> |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | of the Danube Delta and in light, damp forests. | to any loss of habitats specific to the species. |
| 34. | *Phylloscopus collybita* | 1 singing individual | 2 singing individuals | - | It nests in deciduous, mixed or coniferous forests, as well as in anthropogenic habitats such as parks, orchards, old cemeteries and gardens. In the Carpathian Mountains it nests from the foothills to altitudes of 1,500-1,600m. It prefers deciduous forests with beech, oak, hazel, hazel or willow, but in the central and eastern parts of its range it can also be found in pine, spruce or fir forests. Wet habitats are preferred by southern rather than northern populations. | The species may occur in all 3 analyzed areas in forest habitats. Taking into account the fact that no works in forest habitats are foreseen by the implementation of the project, it can be stated without reservations that the execution of specific works will not lead to loss of specific habitats of the small woodpecker. |
| 35. | *Poecile palustris* | 1 singing individual | 2 singing individuals | - | The southern stonechat lives in lowland areas, but in some regions it can be found up to altitudes of 1,300 meters. In Romania, the characteristic habitats are the non-fragmented deciduous oak (*Quercus sp.*) or beech (*Fagus* | The species may occur in all 3 analyzed areas in forest habitats. Taking into account the fact that no works in forest habitats are foreseen by the implementation of the project, it can be stated without reservations that the |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | *sylvatica*) forests, but the species also occurs in orchards, gardens or local parks. | execution of specific works will not lead to loss of specific habitats of the southern red-legged woodpecker. |
| 36. | *Ptyonoprogne rupestris* | 6 individuals | No specific habitat | No specific habitat | The species' habitat is rocky cliffs in dry, warm, sheltered, upland areas with peaks, oak forests and oak forests. | The species was observed nesting on rocks near the Livezeni dam. <u>No works in species-specific habitats are proposed through project implementation.</u> |
| 37. | *Regulus regulus* | 1 singing individual at significant distance from the Livezeni dam | No specific habitat | No specific habitat | It forages in coniferous and deciduous forests, mostly found up to altitudes of 3,000 m, occasionally climbing to 4,800 m. In these forests it particularly prefers areas where it finds pines, but in winter it also finds its way into local parks and gardens. | Taking into account the habitat preferences of the species (coniferous forest habitats) and the fact that the implementation of the project will not interfere in any way with these habitats, it can be stated that <u>the execution of the proposed works will not lead to any loss of habitats specific to the species.</u> |
| 38. | *Sylvia atricapilla* | 4 singing individuals in forest habitats | 5 singing individuals in forest habitats | 6 singing individuals in forest habitats | While nesting, black-headed blackthroats can be found in forest habitats, and are characteristic of deciduous forests. | All observations of the species come from forest habitats in the vicinity of the analyzed sites. |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | | Taking into account the habitat preferences of the species (forest habitats) and the fact that the implementation of the project will not interfere in any way with these habitats, it can be stated that <u>the execution of the proposed works will not lead to any loss of habitats specific to the species.</u> |
| 39. | *Sylvia curruca* | - | 1 singing individual | 3 singing individuals | The little Silvia is a bird found in a wide range of habitats, from steppe to boreal, from low plains to altitudes of 2,000 meters. It prefers intermediate habitats between broad woodland and open fields, often found in meadows, glades and scrubby clearings. | The species may occur in all 3 analyzed areas in forest habitats. Taking into account the fact that no works in forest habitats are foreseen by the implementation of the project, it can be stated without reservations that <u>the execution of specific works will not lead to loss of small forest habitats.</u> |
| 40. | *Troglodytes troglodytes* | 1 singing individual | 2 singing individuals | 1 singing individual | It nests at medium altitudes, but occasionally, in some regions, brooding pairs can be seen at higher altitudes. The nesting range | The species may occur in all 3 analyzed areas in forest habitats. Taking into account the fact that no works in forest habitats are |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | extends from the Mediterranean through temperate to boreal, with a more oceanic than continental trend, where temperatures are between 10 and 20°C in July, avoiding extremes of cold and heat. It also occasionally occurs above the forest line, even at altitudes above 2,000m, but usually prefers lowland and hilly areas where the vegetation provides ideal nesting and foraging sites. It is a species of moist coniferous forests with a rich canopy, although it also occurs in other types of deciduous or mixed forests where it finds dense vegetation. | foreseen by the implementation of the project, it can be stated without reservations that the execution of specific works will not lead to loss of specific habitats of the spruce. |
| 41. | *Turdus merula* | 2 pairs in nearby forest habitats | 1 pair in nearby forest habitats | 3 pairs in forest habitats or nearby orchards | The blackbird is the best-known thrush species, found in both urban parks and mountain forests. The habitats in which it is found are very diverse, ranging from dense woodland to grassland, various | The species is present in forest habitats located in the vicinity of the analyzed areas.<br>Taking into account that no works in forest habitats are proposed with the |

| No. crt. | Species | Location of observations | | | Habitat requirements | Other comments |
|---|---|---|---|---|---|---|
| | | Livezeni Dam | CHE Dumitra | CHE Bumbești | | |
| | | | | | crops, some wetlands, most urban areas. It tolerates low temperature, windy and humid areas better than high temperature or/and dry. It is wary of areas that do not provide shelter more than 100-200 m away. | implementation of the project, it can be stated without reservations that the implementation of the project does not lead to loss of specific blackbird habitats. |
| 42. | *Turdus philomelos* | - | 2 singing individuals in nearby forest habitats | 2 singing individuals in nearby forest habitats | The favorite habitat of the song thrush is deciduous and coniferous forests with well-developed undergrowth, in which the preferred food, which is invertebrates, is abundant. It has recently adapted to urbanized habitats, plains converted to arable land, gardens and even parks; the presence of high densities of snails and earthworms, the preferred food of the song thrush, favours the occurrence of this species in such places. | The species is present in forest habitats located in the vicinity of the analyzed areas. Taking into account that no works in forest habitats are proposed by the implementation of the project, it can be stated without reservations that the implementation of the project does not lead to loss of song thrush habitats. |

The species marked green in the above table are species of birds of Community interest listed in Annex I to Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

The bird species *Aquila chrysaetos*, *Aquila pomarina*, *Aquila clanga*, *Aquila clanga*, *Apus apus*, *Apus apus*, *Strix uralensis*, *Bubo bubo*, *Bubo bubo*, *Caprimulgus europaeus*, *Luscinia luscinia*, *Parus ater*, *Parus montanus*, *Sitta europaea*, *Pyrrhula pyrrhula*, *Carduelis spinus* reported in the inventory list of the Defileul Jiului National Park and which were not identified in the study areas during the field inventory, use other habitat structures (old coniferous forest habitats, meadows, rocky areas), generally avoiding built-up areas. **<u>The implementation of the project does not in any way lead to the impairment of these species.</u>**

The species of community interest *Falco peregrinus* may only occasionally occur in the study areas for foraging. Taking into account that the peregrine falcon forages in flight, it can be stated that the **<u>implementation of the project does not induce any impact on the species.</u>**

**D.4. Aspects of the impact of the project implementation on the bird species identified in the study areas**

Taking into account that the project area does not overlap with bird protection areas, as well as the fact that these sites are more than 30 km away, the following table presents the impact of the project implementation on bird species from the perspective of habitat loss and disturbance.

*Table no. 46 The impact assessment of project implementation on the bird species identified in the area of the analyzed sites*

| **Crt. No.** | **Species** | **Location of observations** | | | **Population loss** | **Loss of habitat** | **Disruption** |
|---|---|---|---|---|---|---|---|
| | | **Livezeni Dam** | **Dumitra HPP** | **Bumbești HPP** | | | |
| 1. | *Accipiter nisus* | 1 individual | - | 1 individual | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species may occasionally use the analyzed areas only as suboptimal feeding habitat.<br>Given that the species forages in the air, achieving the investment objectives will not result in any loss of feeding habitats for the species. | YES<br>The implementation of the project can only cause a local, totally insignificant disturbance, having only the effect of a slight spatial withdrawal of the species, without leading to population losses. |
| 2. | *Alauda arvensis* | No specific habitat | No specific habitat | 2 indiduals | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>Through the implementation of the project, works are foreseen only in built-up or partially built-up areas that do not in any way represent habitats specific to the *Alauda arvensis (skylark)*.<br>The implementation of the project does not lead to loss of habitats specific to the species. | NO<br>The species has been identified at a sufficient distance from the sites provided with specific works, so that the implementation of the project cannot lead to damage to the species in any way. |
| 3. | *Anas platyrhynchos* | 4 individuals in flight.<br>No specific habitat in the analyzed areas | No specific habitat | 2 pairs downstream of the water discharge area from | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The sectors of the Jiu River in the area of the Livezeni Dam and the Dumitra HPP do not in any way meet the minimum breeding or feeding habitat requirements of the species. In the area of CHE | YES<br>The implementation of the project can only cause a local, **totally insignificant** disturbance, having |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | Bumbești HPP | | Bumbești, the species can appear in a reduced population (especially in those meanders where the water has a smooth flow). Taking into account the fact that in this area the water captured upstream will be discharged and the fact that no works are planned in the minor riverbed, it can be affirmed without reservation that the implementation of the project will not lead to the loss of habitats specific to the species. | only the effect of a slight spatial withdrawal of the species, without leading to population losses. |
| 4. | *Anthus trivialis* | No specific habitat | No specific habitat | 1 individual at least 300 m in the south-west direction from the Bumbești HPP | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species is present only in the southern area of the analyzed site, in the vicinity of the Bumbești HPP.<br>By implementing the project, works are foreseen only in built-up or partially built-up areas that do not in any way represent habitats specific to the forest strip.<br>The implementation of the project does not lead to loss of habitats specific to the species. | NO<br>The species has been identified at a sufficient distance from the sites provided with specific works, so that the implementation of the project cannot lead to damage to the species in any way. |
| 5. | *Ardea alba* | No specific habitat | No specific habitat | 1 individual at least 700 m in the south-west direction from the Bumbești HPP | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The white egret was not observed in the area of Livezeni dam and Dumitra HPP. In these sectors of the Jiu River, the species can only occasionally be observed in transition, without using the banks of | YES<br>The implementation of the project can in the worst case generate only a local disturbance, **totally** |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | | the water in any way (these being totally suboptimal for the species).<br>In the Bumbești HPP area, the species appears isolated on the muddy or sandy banks of the Jiu River, located at a sufficient distance from the location analyzed so that the implementation of the project does not lead to the species being affected in any way. | **insignificant**, having only a slight spatial withdrawal as an effect, only if the species is present in the analyzed area at the time the targeted works are carried out. |
| 6. | *Ardea cinerea* | No specific habitat | No specific habitat | 1 individual at least 720 m in the south-west direction from the Bumbești HPP | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The white egret was not observed in the area of Livezeni dam and Dumitra HPP. In these sectors of the Jiu River, the species can only occasionally be observed in transition, without using the banks of the water in any way (these being totally suboptimal for the species).<br>In the Bumbești HPP area, the species appears isolated on the muddy or sandy banks of the Jiu River, located at a sufficient distance from the location analyzed so that the implementation of the project does not lead to the species being affected in any way. | YES<br>The implementation of the project can in the worst case generate only a local disturbance, **totally insignificant**, having only a slight spatial withdrawal as an effect, only if the species is present in the analyzed area at the time the targeted works are carried out. |
| 7. | *Buteo buteo* | 1 individual | 1 individual | 1 individual | NO<br>The implementation of the project does not in any way lead | NO<br>The species is present in the vicinity of all the locations targeted by the implementation of the project. | NO<br>The implementation of the project does not lead to the disturbance |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | to population losses of the species | Taking into account the fact that the works targeted by the investment objectives will be carried out in built-up or partially built-up areas and the fact that they are not intended to be carried out in forest habitats, it can be stated without reservation that the implementation of the project does not lead to any loss of species-specific habitats. | of the species in any way. |
| 8. | *Cecrophis daurica* | No specific habitat | No specific habitat | 1 pair nesting on the walls of the Balance Castle, located about 340 m north-west from the Bumbești HPP. | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The pair identified in the area of Bumbești HPP nests on the concrete walls of the balance castle. The implementation of the project does not in any way lead to the loss of areas of habitats specific to the red-rumped swallow. | NO<br>The implementation of the project does not lead to the disturbance of the species in any way. |
| 9. | *Chloris chloris* | - | 3 individuals | - | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>3 individuals were observed in the Dumitra HPP area. This species can also occur in the area of the other sites analyzed (Livezeni Dam and Bumbești HPP). Taking into account the habitat preferences of the species and the fact that the implementation of the project does not foresee interventions in forest habitats, it can be stated without reservation that the execution of the | YES<br>The implementation of the project can in the worst case generate only a local disturbance, **totally insignificant**, having only a slight spatial withdrawal as an effect. |

| **Crt. No.** | **Species** | **Location of observations** | | | **Population loss** | **Loss of habitat** | **Disruption** |
|---|---|---|---|---|---|---|---|
| | | **Livezeni Dam** | **Dumitra HPP** | **Bumbești HPP** | | | |
| | | | | | | specific works targeted by the project do not lead to the loss of habitats specific to the greenfinch. | |
| 10. | *Cinclus cinclus* | 2 pairs | 1 pair | 1 individ | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species has a wide distribution on the Jiu River, being observed in all 3 analyzed areas.<br>Taking into account the fact that the works left to be executed are only aimed at the completion of almost completely built objectives, it can be seen that, at the moment, the problem of habitat loss specific to the species cannot be raised. | YES<br>The implementation of the project can only lead to a local, **insignificant** disturbance, resulting only in a slight spatial withdrawal of the species, during the execution of the works in the Jiu River bed. |
| 11. | *Columba palumbus* | 4 individuals in flight, at a significant distance from the Livezeni dam | 2 individuals in flight, at a significant distance from the proposed intake in the Dumitra HPP area | - | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>Taking into account that the implementation of the proposed works will not interfere with forest habitats, it can be stated without reservation that the implementation of the project does not lead to loss of habitats specific to the common wood pigeon. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 12. | *Corvus corax* | 5 individuals in flight | 2 individuals in flight | - | NO<br>The implementation of the project does | NO<br>Through the implementation of the project, there will be no intervention in | NO<br>The species does not use the analyzed area. |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | not in any way lead to population losses of the species | habitats specific to the crow (forest habitats with cliffs). | |
| 13. | *Cyanistes caeruleus* | 1 individual | - | 2 individuals | NO<br>The implementation of the project does not in any way lead to population losses of the species | YES<br>The species is common and can occur in all analyzed areas.<br>No eurasian blue tit nesting activity was observed at the sites analyzed.<br>Project implementation may lead to short-term habitat loss, particularly during the decommissioning of previous preparatory site works. These land surfaces will be subject to renaturation. | YES<br>The implementation of the project can in the worst case generate only a local, **insignificant** disturbance, having only a slight spatial withdrawal of the species as an effect. |
| 14. | *Delichon urbicum* | 3 individuals | 11 individuals | 10 indivduals | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species is present in all analyzed areas, using the buildings for reproduction.<br>The implementation of the project does not in any way lead to damage to the western house martin. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 15. | *Dendrocopos leucotos* | - | 1 individual at a significant distance from Dumitra HPP | - | NO<br>The implementation of the project does not in any way lead | NO<br>Taking into account the strict habitat preferences of the species (deciduous, old forest habitats) and the fact that the | YES<br>The implementation of the project can, in the worst case, generate |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | to population losses of the species | implementation of the project will not interfere in any way in this type of habitats, it can be stated that the execution of the proposed works will not lead to losses of species-specific habitats. | only a local disturbance, **totally insignificant,** having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 16. | *Dendrocopos major* | 1 individual | 1 individual | 1 individual | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>Taking into account the strict habitat preferences of the species (deciduous, old forest habitats) and the fact that the implementation of the project will not interfere in any way in this type of habitats, it can be stated that the execution of the proposed works will not lead to losses of species-specific habitats. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 17. | *Dendrocopos syriacus* | No specific habitat | No specific habitat | 1 individual observed in the orchards in the vicinity of Bumbești HPP | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The locations analyzed do not in any way meet the minimum habitat requirements of the species.<br>A single individual was observed in an orchard in the vicinity of the Bumbești HPP. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | | The implementation of the project does not lead to damage to the habitat of the species. | withdrawal of the species, without effects on its population. |
| 18. | *Dryobates minor* | 1 individual observed 800 m south of the Livezeni dam | - | - | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The locations analyzed do not in any way meet the minimum habitat requirements of the species.<br>The species can only occur in the forest habitats in the vicinity of the sites analyzed.<br>Taking into account that the implementation of the project will not interfere in any way in forest habitats, it can be stated that the execution of the proposed works will not lead to loss of habitats specific to the species. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 19. | *Dryocopus martius* | 1 individual at a significant distance from the Livezeni dam | 1 individual at a significant distance from Dumitra HPP | 1 individual at a significant distance from Bumbesti HPP | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>Taking into account the strict habitat preferences of the species (deciduous, old forest habitats) and the fact that the implementation of the project will not interfere in any way in this type of habitats, it can be stated that the execution of the proposed works will not lead to losses of species-specific habitats. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| 20. | *Erithacus rubecula* | 5 singing individuals | 4 singing individuals | 4 singing individuals | NO<br>The implementation of the project does not in any way lead to population losses of the species | YES<br>The species is common and can occur in all analyzed areas.<br>No nesting activity of the european robin was observed on the sites analyzed.<br>Project implementation may lead to short-term habitat loss, particularly during the decommissioning of previous preparatory site works. These land surfaces will be subject to renaturation. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 21. | *Fringilla coelebs* | 9 singing individuals in nearby forest habitats | 7 singing individuals in nearby forest habitats | 2 singing individuals in nearby forest habitats | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species lives only in forest habitats. The locations analyzed do not meet the minimum habitat conditions of the eurasian chaffinch.<br>The implementation of the project does not in any way lead to the loss of habitats specific to the species. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, totally insignificant, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 22. | *Garrulus glandarius* | - | 2 individuals in nearby forest habitats | 3 individuals in nearby forest habitats | NO<br>The implementation of the project does not in any way lead | NO<br>The species can occur in forest habitats adjacent to the sites analyzed.<br>The sites targeted by the implementation of the project do not meet the eurasian | YES<br>The implementation of the project can, in the worst case, generate only a local |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | to population losses of the species | jay's minimum habitat conditions. The implementation of the project does not in any way lead to the loss of habitats specific to the species. | disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 23. | *Hirundo rustica* | No specific habitat | No specific habitat | 2 individuals | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>Migratory species that can use the Bumbești HPP area only for feeding. The implementation of the project does not contribute in any way to damage the species. | NO<br>The implementation of the project does not lead to the disturbance of the species in any way. |
| 24. | *Jynx torquila* | No specific habitat | No specific habitat | 1 individual observed in the orchards in the vicinity of Bumbești HPP | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The locations analyzed do not in any way meet the minimum habitat requirements of the species.<br>A single individual was observed in an orchard in the vicinity of the Bumbești HPP.<br>The implementation of the project does not lead to damage to the habitat of the species. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 25. | *Lanius collurio* | No specific habitat | No specific habitat | 1 individual observed in the orchards in the vicinity | NO<br>The implementation of the project does not in any way lead | NO<br>The locations analyzed do not in any way meet the minimum habitat requirements of the species. | YES<br>The implementation of the project can, in the worst case, generate |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | of Bumbești HPP | to population losses of the species | A single individual was observed in the vicinity of Bumbești HPP, at a distance of at least 130 m in the south direction. The implementation of the project does not lead to damage to the habitat of the species. | only a local disturbance**, totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 26. | *Leiopicus medius* | No specific habitat | No specific habitat | 1 individual in the oak trees in the vicinity of Bumbești HPP | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>Taking into account the habitat preferences of the species (old Querqus sp. forest habitats) and the fact that the implementation of the project will not interfere in any way in this type of habitat, it can be stated that the execution of the proposed works will not lead to losses of species-specific habitats. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 27. | *Motacilla alba* | 2 individuals | 3 individuals | 1 individual | NO<br>The implementation of the project does not in any way lead to population losses of the species | YES<br>The species can be found in all 3 analyzed areas.<br>No nesting activity of the white-wagtail was observed on the sites analyzed.<br>Project implementation may lead to short-term habitat loss, especially during the decommissioning of previous preparatory site works. These land surfaces will be | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | | subject to renaturation. The implementation of the project does not lead to damage to the habitat of the species. | withdrawal of the species, without effects on its population. |
| 28. | *Motacilla cinerea* | 3 pairs | 3 pairs | 1 pair | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species has a wide distribution on the Jiu River, being observed in all 3 analyzed areas.<br>Taking into account the fact that the works remaining to be executed only aim at the completion of almost completely built objectives, it can be seen that, at the moment, the problem of habitat loss specific to the species can no longer be raised. The implementation of the project can only lead to a local disturbance, resulting only in a slight spatial withdrawal of the species, during the execution of the works in the Jiu River bed. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 29. | *Parus major* | 2 singing individuals | 1 pair | 6 singing individuals | NO<br>The implementation of the project does not in any way lead to population losses of the species | YES<br>The species is common and can occur in all analyzed areas.<br>Project implementation may lead to short-term habitat loss, especially during the decommissioning of previous preparatory site works. These land surfaces will be subject to renaturation. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | | The implementation of the project does not lead to affecting the population of the species. | withdrawal of the species, without effects on its population. |
| 30. | *Pernis apivorus* | - | 1 individual at a distance of at least 670 m from Dumitra HPP | - | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The sites analyzed do not in any way meet the minimum feeding or breeding habitat requirements of the species.<br>The implementation of the project does not lead to damage to the species. | NO<br>The implementation of the project does not lead to the disturbance of the species in any way. |
| 31. | *Phalacrocorax carbo* | 6 individuals in flight | 4 individuals in flight | 2 individuals in flight | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>Following the application of the methodology in the field, only passing specimens were observed. The great cormorant generally avoids fast watercourses.<br>The implementation of the project does not lead to any harm to the species. | NO<br>The implementation of the project does not lead to the disturbance of the species in any way. |
| 32. | *Phoenicurus ochruros* | 1 pair | - | 1 singing individual | NO<br>The implementation of the project does not in any way lead to population losses of the species | YES<br>The species is present in the analyzed areas.<br>The implementation of the project may lead to insignificant loss of habitat, for a short period, only during the implementation of the specific works. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| 33. | *Phoenicurus phoenicurus* | No specific habitat | No specific habitat | 1 singing individual in forest habitats in the vicinity of Bumbești HPP | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>Taking into account the habitat preferences of the species (forest habitats) and the fact that the implementation of the project will not interfere in any way in this kind of habitats, it can be stated that the execution of the proposed works will not lead to the loss of habitats specific to the species. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 34. | *Phylloscopus collybita* | 1 singing individual | 2 singing individuals | - | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species can occur in all 3 analyzed areas, in forest habitats.<br>Taking into account the fact that through the implementation of the project no works in forest habitats are foreseen, it can be affirmed without reservation that the execution of specific works will not lead to loss of habitats specific to the common chiffchaff. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, **totally insignificant**, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 35. | *Poecile palustris* | 1 singing individual | 2 singing individuals | - | NO<br>The implementation of the project does not in any way lead | NO<br>The species can occur in all 3 analyzed areas, in forest habitats.<br>Taking into account the fact that through the implementation of the project no | YES<br>The implementation of the project can, in the worst case, generate only a local |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | to population losses of the species | works in forest habitats are foreseen, it can be affirmed without reservation that the execution of specific works will not lead to loss of habitats specific to the marsh tit. | disturbance, totally insignificant, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 36. | *Ptyonoprogne rupestris* | 6 individuals | No specific habitat | No specific habitat | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species was observed nesting in the vicinity of the Livezeni dam, on the rocks.<br>By implementing the project, no works are proposed in species-specific habitats. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, totally insignificant, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 37. | *Regulus regulus* | 1 singing individual at a significant distance from the Livezeni dam | No specific habitat | No specific habitat | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>Taking into account the habitat preferences of the species (conifer forest habitats) and the fact that the implementation of the project will not interfere in any way in this type of habitats, it can be stated that the execution of the proposed works will not lead to the loss of habitats specific to the species . | NO<br>The implementation of the project does not lead to the disturbance of the species in any way. |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| 38. | *Sylvia atricapilla* | 4 singing individuals in forest habitats | 5 singing individuals in forest habitats | 6 singing individuals in forest habitats | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>All observations of the species come from forest habitats in the vicinity of the sites analyzed.<br>Taking into account the habitat preferences of the species (forest habitats) and the fact that the implementation of the project will not interfere in any way in this kind of habitats, it can be stated that the execution of the proposed works will not lead to the loss of habitats specific to the species. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, totally insignificant, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 39. | *Sylvia curruca* | - | 1 singing individual | 3 singing individuals | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species can occur in all 3 analyzed areas, in forest habitats.<br>Taking into account the fact that the implementation of the project does not foresee works in forest habitats, it can be stated without reservation that the execution of specific works will not lead to loss of habitats specific to the lesser whitethroat. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, totally insignificant, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 40. | *Troglodytes troglodytes* | 1 singing individual | 2 singing individuals | 1 singing individual | NO<br>The implementation of the project does not in any way lead | NO<br>The species can occur in all 3 analyzed areas, in forest habitats.<br>Taking into account the fact that the implementation of the project does not | YES<br>The implementation of the project can, in the worst case, generate only a local |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | to population losses of the species | foresee works in forest habitats, it can be stated without reservation that the execution of specific works will not lead to loss of habitats specific to the eurasian wren. | disturbance, totally insignificant, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 41. | *Turdus merula* | 2 pairs in nearby forest habitats | 1 pair in nearby forest habitats | 3 pairs in forest habitats or nearby orchards | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species is present in the forest habitats located in the vicinity of the analyzed areas.<br>Taking into account that the implementation of the project does not propose works in forest habitats, it can be stated without reservation that the implementation of the project does not lead to losses of the common blackbird-specific habitats. | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, totally insignificant, having as an effect only a slight spatial withdrawal of the species, without effects on its population. |
| 42. | *Turdus philomelos* | - | 2 singing individuals in nearby forest habitats | 2 singing individuals in nearby forest habitats | NO<br>The implementation of the project does not in any way lead to population losses of the species | NO<br>The species is present in the forest habitats located in the vicinity of the analyzed areas.<br>Taking into account that the implementation of the project does not propose works in forest habitats, it can be stated without reservation that the implementation of the project does not | YES<br>The implementation of the project can, in the worst case, generate only a local disturbance, totally insignificant, having as an effect only a slight spatial withdrawal of the species, without |

| Crt. No. | Species | Location of observations | | | Population loss | Loss of habitat | Disruption |
|---|---|---|---|---|---|---|---|
| | | Livezeni Dam | Dumitra HPP | Bumbești HPP | | | |
| | | | | | | lead to losses of the song thrush specific habitats. | effects on its population. |

The species marked in green in the previous table are bird species of community interest listed in Annex I of Directive 2009/147/EC of the European Parliament and of the Council of November 30, 2009 on the conservation of wild birds.

Bird species Aquila chrysaetos, Aquila pomarina, Aquila clanga, Apus apus, Strix uralensis, Bubo bubo, Caprimulgus europaeus, Luscinia luscinia, Parus ater, Parus montanus, Sitta europaea, Pyrrhula pyrrhula, Carduelis spinus reported in the inventory list of the National Park Defileul Jiului and which during the field inventory were not identified in the study areas, use other habitat structures (old conifer forest habitats, meadows, rocky areas), generally avoiding built-up areas. The implementation of the project does not lead to the damage of these species in any way.

The species of community interest Falco peregrinus may only occasionally appear in the study areas, for feeding. Taking into account the fact that the peregrine falcon procures its food in flight, it can be stated that the implementation of the project does not induce any kind of impact on the species.

**D.5. Conclusions**

According to the information provided in sections 3. - Aspects regarding the presence of bird species in the areas of influence of the project and 4. - Aspects regarding the impact generated by the implementation of the project on the bird species identified in the study areas, the following can be concluded:

- The implementation of the project does not in any way lead to significant damage from the perspective of population loss, loss of specific habitats or disturbance of any bird species identified on the sites analyzed or present on the inventory list of the Jiului Gorge National Park;
- The implementation of the project does not lead to the damage in any way to the species of birds of community interest targeted by the conservative management of the avifaunistic special protection area ROSPA0084 Retezat Mountains, located at least 29 km in the north-west direction from the Livezeni Dam.

**Under these conditions, there are no identifiable measures to avoid or reduce the impact caused by the implementation of the analyzed project.**

### *E. Eurasian Otter (Lutra lutra)*

Following the analysis of existing information for the protected natural areas in the project area, only one semi-aquatic mammal species of conservation interest, potentially affected by the project, was identified, respectively: Lutra lutra (otter).

The activities consist of:

- Analysis of the existing information for the protected natural areas of interest, regarding the mammal species, covered by this contract;
- Carrying out observations in the field to identify the relevant elements of the mammal species, the conservation objectives established for the protected natural areas of interest;

- Analysis of the data collected from the field in order to assess the conservation status of the targeted mammal species;
- Preparation of activity reports, which support the data that will be presented in the Appropriate Assessment Study. The reports will include the information necessary to complete the structure of the appropriate assessment study with the information related to the targeted mammal species;
- If necessary, identifying measures to reduce or eliminate the impact on the targeted mammal species;

**E.1. Materials and methods**

**1.1 Transects on the banks of water courses (Standard Method) for mapping the distribution area of the species: Lutra lutra**

The survey technique used will follow the standard method guidelines for studying otters recommended by the IUCN/SSC Otter Specialist Group (Reuther et al. 2000). Thus, important watercourses will be divided into approximately 5 km segments representing observation sites.

The first 600 m of each observation site will be investigated in search of signs of presence, if signs of otter presence are identified they will be recorded in the field form, continuing the search, the site being declared positive and otherwise it will be negative. The points where the presence of the species is certain will be divided into two categories (permanent or occasional) depending on the age of the presence signs (Reuther et al. 2000).

A standard form was completed in the field to help assess habitat quality, disturbance factors, conservation status assessment, anthropogenic impact assessment and observation outcome.

**Planning**

In order to measure the relative abundance and map the distribution of the otter in the area of the project: Hydropower development of the Jiu River on the Livezeni - Bumbești sector, 7 transects were established along the course of the Jiu River, so that the locations of the transects cover as much as possible of the study area.

Transects of 600 m length were walked and the identified presence marks were entered into the field form. Access to the transect was achieved with a motorized means of transport if the regulation of the protected natural area and the transport network allowed it. The total length of the 600 m transects that were traveled inside the observation sites is 4.2 km, but the access to the beginning of the transect must also be taken into account.

At least one week before the start of the activities, the area to be covered was established, so that all transects could be covered within a maximum of 2 days, to avoid double measurement. Also, the field equipment was prepared and the already existing information was analyzed (already collected by the managers of the hunting funds, the administrator of the protected areas, literature, public reports, etc.), in order to concentrate the effort in the areas of interest.

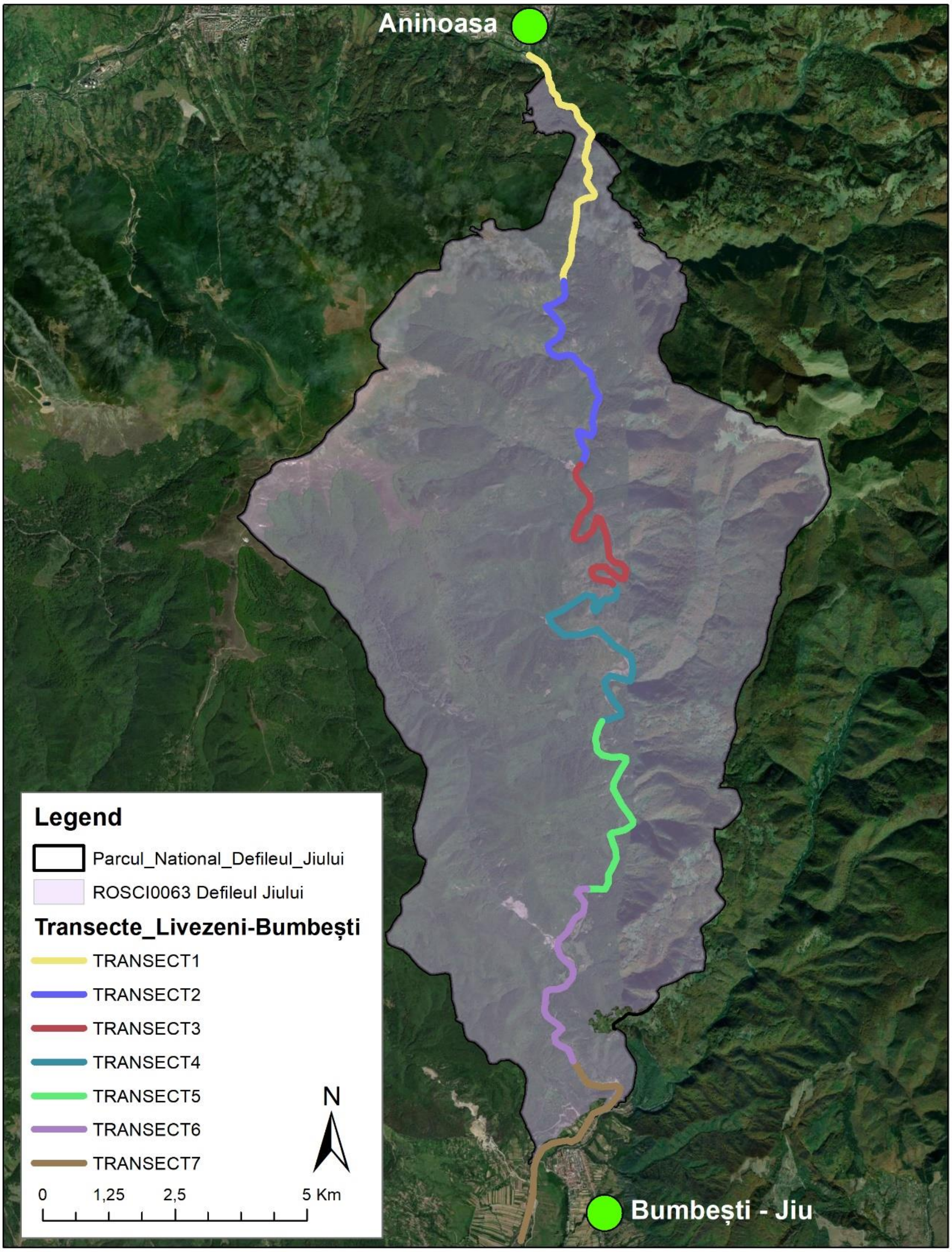



Fig. 123 Map of the distribution of 5 km observation sites in the project area: Hydropower development of the Jiu River on the Livezeni - Bumbești sector

**Perioada de implementare**

| Jan. | Febr. | Mar. | Apr. | Mai | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

**Working method/data collection**

The results of the method depend on the following factors:

• standardization working method.

• recording and centralizing data.

• data analysis.

Stages within each session:

**Step 1.** Preparing the equipment and accessories, determining the means of transport that will be used;

**Step 2.** Scheduling the travel periods of each transect, carrying out the training on working method.

**Step 3**. The actual activity of traversing the transects, by the assigned teams. Taking into account the ethology of the species, it is recommended that field activities begin at dawn and end at sunset, thus creating the premise of the possibility of visual identification of individuals.

In the field, the following were identified:

- Otter tracks;
- each identified trace was measured and the coordinates recorded;
- otter droppings were counted and their age noted;
- any other traces identified in the field were recorded in the field form: burrows, slides, anal jelly, carcasses of amphibians and fish, tracks in the snow, foothills, paths in the grass, drying and resting places, etc.. These signs are also recorded with coordinates or landmarks are recorded (distance, orientation, etc.) depending on the first observation of traces or signs.

**Data storage and processing**

At the end of the transect session, the data is stored in a GIS database, with the purpose of developing an attribute table for the Lutra lutra species. The same operator will ensure the mapping of the distribution of the recorded tracks, by using an IT system for processing geographic data. The centralization of the data will help to identify possible gaps in filling out the forms or any ambiguities regarding the distribution of individuals.

## Observation Sheet Transect 600 m

**Otter *(Lutra lutra)***

Data_______________ Cynegetic Fund_________________________ transect cod______________

Snow____cm / Mud Operator________________Hydronym_______________ GPS ___________

| Tracks on or near the transect | | | | | | | |
|---|---|---|---|---|---|---|---|
| Coordinates | | Track size | | Track age | Substrate | Habitat | Observations |
| X | Y | width | length | | | | |
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| Other signs of otter presence | | | | |
|---|---|---|---|---|
| Coordinates | | On the transect | Type of sign (droppings, prey carcasses, burrows, etc.) | Observations |
| X | Y | da/nu | | |
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Obs. The dimensions will be measured from 0.5 to 0.5 cm

The age will be estimated in the intervals: 0-6 hours, 6-12 hours, 12-18 hours, 18-24 hours, over 24 hours.

Habitat (at maximum distance of 100 m): Deciduous/Mixed/Coniferous Regeneration – RF/A/R, Young/Mature/Old Deciduous Forest – PFT/M/B, Young/Mature/Old Deciduous Forest – PRT/M/B , Mixed Young/Mature/Old Forest – PAT/M/B, Pasture – P, Hay – F, Shrub Areas – ZA, Rockies – S,

Meteorological-hydrological conditions: water level____cm, Temperature_____°C

rainfall _________________

Transect start time ___________________, Transect end time ______________________

Problems with transect traversal and data recording ____________________________________________

_______________________________________________________________________________

**Data interpretation and analysis**

In the case of this method, the data analysis will be carried out statistically. Each 600 m transect of a watercourse corresponds to approximately 5 km of the watercourse. Thus, if no sign of presence could be identified in the 600 meters of transect traveled, the site will be declared negative, as well as the entire sector of approximately 5 km. Field data will be mapped along with the attributes of each record at the end of the data collection season. Using spatial data analysis software, the distribution of the otter species will be identified in the first phase in the project area:

At the end of the interpretation action, the obtained data will be differentiated as follows:

- ✓ Distribution of the species Lutra lutra (otter) within the studied area;
- ✓ Spatial distribution of the otter population (Lutra lutra) within the hydrographic network, on positive (presence) or negative (absence) on river or stream sectors;
- ✓ Relative abundance of Lutra lutra (otter) species.

**Estimated human resources required:**

During the implementation period of the activities, each established transect will be covered. The calculation of the required number of people is done as follows:

- 7 observation sites (transect equivalent);
- 1 session x 1 runs: 7 transects;
- Transect lenght: 600 m;
- 4,2 km total distance to cover;
- 4 - 5 transects/day/team;
- 2 days/team.

## 1.2. General notions regarding the assessed species

- ***Eurasian otter – general notions***

***Taxonomy of the species.*** The Eurasian otter belongs to the Lutrinae subfamily within the Mustelidae family, being one of the largest families belonging to the Carnivora order, with 67 species, dominating the small carnivores. Other subfamilies belonging to mustelids are: Mustelinae (martens, ermines, weasels, ferrets and minks), Melinae (badgers), Mellivorinae (mellivores) and Mephitinae (skunks), the last two are not represented in Europe. Of these, the Mustelinae are most closely related and represent their ancestral branch from which they diverged (Koepfli and Wayne 1998). The elongated body shape of Mustelinae was an important starting point to adapt to an aquatic lifestyle.

***Biometric features.*** The body of the otter is elongated and thin, and the head + trunk length is between 550 – 800 mm, only the tail measures between 300 and 500 mm. The tarsal length is 12 mm, the ear length is between 22 – 30 mm and the height at the withers is 250 – 350 mm (Murariu and Munteanu, 2005).

The body length of the otter (including the tail) varies by sex, between 100 cm (♀) and 120 cm (♂), and the weight varies between 4-5 kg (♀) and 6-8 kg (♂) (Jedrzejewski, 2010 et . al.).

***The head.*** It is flattened, wide and the snout is short and truncated, externally it is not clearly demarcated from the muscular, short and thick neck. The rhinarium is black and the nostrils have valves, so they close when the otter dives. The rhinarium, forehead and upper lip are larger in males than in females (Lemarchand, 2007).

The ears are small, rounded, covered with thick and short hairs on both surfaces. The short ears protrude only slightly above the level of the fur, with the antitragal lobe having a valve-like shape, having a second lobe (above the auditory meatus) and a third lobe (behind the auditory meatus) also valve-shaped (Miller, 1912).

The vibrissae are very long and bushy, located on both sides of the rhinarium, above the eyes, having a yellowish color, the genal (lower) group reaching 80 mm in length, being therefore longer than the supralabial ones (Murariu and Munteanu, 2005). The vibrissae increase the efficiency of hunting and tracking prey. Especially in murky, marshy waters with a high degree of turbidity, where the sense of touch is the otter's main way of landmarking (Lemarchand, 2007).

***The teeth.*** They are typical of a carnivore, organized into incisors, canines, premolars and molars. The carnivores are very well developed. The dentition appears strongly developed, but the coronal surfaces of the molars are relatively small. The upper incisors are single-cuspid, arranged in a straight line, the lateral ones being separated from the canines by a space almost equal to the width of a canine.

***The limbs.*** Otters have four relatively short legs, with broad soles and developed interdigital membranes that join the 5 toes of each limb, which aid in swimming. Non-retractable claws, short (8 mm long), yellowish-white. The forelimbs have larger claws and the interdigital membrane covers a smaller area than the hindlimbs. This is an adaptation to the functions that the limbs perform, so the front legs also serve for digging, movement, grasping not only for swimming, and the hind legs only for swimming and movement.

***Fur.*** The fur color of the Eurasian otter varies from dark chestnut on the back, head and sides of the body and lighter (beige) on the ventral side, neck and chest (Cotta and Bodea, 1969).

The coat is very thick and silky, with a density of around 35,000 – 50,000 hairs per cm² (Lemarchand, 2007). The coat has two types of hair: hard protective hair and short undercoat, having the consistency of a soft down. The first type consists of long (25 mm), thick, shiny and very wear-resistant threads that allow water to slide easily over them. The strong threads are covered with a secretion of the skin glands, improving the hydrodynamics of the otter, at the same time giving the fur properties of waterproofing and thermal insulation. The hairs in the second layer appear in the form of a shorter and denser fluff, having a length of 10 – 15 mm and its role is to maintain a thin layer of air around the skin, thus providing good thermal insulation. In the absence of the protective layer of fat, this fluff provides the otter with thermal protection provided by the air it contains and which isolates the skin from the aquatic environment, playing an important role in the body's thermoregulation (Lemarchand, 2007).

***Locomotion.*** Eurasian otters are adapted to life in the aquatic environment, but they can also travel large distances on land, when they are in search of food or when they move from one watershed to another, over the interfluves of watercourses. Given their elongated anatomical shape and short limbs, it is expected that locomotion in the terrestrial environment is not an asset of otters. Otters move relatively slowly, and the specific thing is not walking but jumping or galloping when they run, this type of locomotion being specific to mustelids in general (Cotta and Bodea, 1969).

***Swimming.*** Surface swimming is done with all four limbs, but there is no particular preference for swimming style, sometimes it swims like a dog, moving the limbs alternately, sometimes it moves all limbs simultaneously, or the two left limbs simultaneously then the right simultaneous. During swimming, otters undulate their body and tail laterally, thus gaining greater propulsion. Similar swimming movements are also observed when the otter swims submerged. When swimming at the surface otters leave the shape of the letter "V" on the surface of the water. (Kruuk, 2006, Chanin, 2013).

The otter generally dives once it is already in the water, but may dive directly from the shore when threatened by some danger. When diving from the surface of the water, it forms an arc, with its hind limbs and tail visible as it dives. When it comes back to the surface it comes straight out with its front end, sticking out its head.

When undisturbed, the otter dives almost noiselessly, only when alarmed does it strike the water with its hind paws and tail, thus making more noise.

Although the otter appears to be a born swimmer and has many adaptations for life in water, otter pups cannot swim immediately after hatching, the female teaches them the secrets of swimming and they practice until they become as good swimmers as the female.

Otters have a swimming speed of 1.5 – 2 km/hour and can swim for up to 8 hours without stopping. Otters are able to stay underwater for 7.5 minutes, but most of their dives, even when hunting, last 16 seconds (Macdonald et. al. 1998).

***Communication.*** Eurasian otters are not very sociable animals, they are solitary and territorial, and in cases where families of otters are observed, it is a female with her young, which accompany her for a period of up to a year.
The main communication element of otters is marking their entire territory with excrement or anal jelly with a strong smell, which can contain information about the otter's sex, age, the fact that this is the limit of its territory, that the marked place is an important feeding place, that it is looking for a mate or many other messages that we can only imagine because we still cannot decipher the message sent by otters by marking the territory (Kruuk, 2006).

***The Diet.*** The otter is an opportunistic species in terms of food preferences, although it has been described in numerous studies as a fish specialist. But in most of Europe the otter's diet is dominated by fish. Amphibians and crustaceans (crabs) also make an important contribution to the otter's diet in certain areas and in different seasons.  Crayfish are eaten especially in summer and frogs especially in spring but also in winter. Regarding fish, the otter does not avoid eating certain species of fish, but consumes them in a certain percentage depending on their availability (Chanin, 2003).

Otters feed on fish of various species and sizes, from fish under 50 mm in length and 1 g in weight (Kruuk et al, 1993), to fish over 900 mm in length and weighing 6.3 kg (Carss, Kruuk & Conroy, 1990).

The otter fishes by spotting fish while swimming on the surface, and when hunting it quickly dives with its tail and searches for fish on the bottom of the water, emerging from the water especially with bottom-dwelling fish species. In general, small fish are eaten directly at the surface of the water, and large ones are brought to the shore, and eaten safely (Kruuk, 2006).

Otters consume approximately 1-1.5 kg of food per day in captivity, but in the wild it is difficult to approximate how much an otter eats. The main activity of otters is searching for food and they consume a large amount of energy to find it, sometimes they travel distances over 40 km river length/day to feed, so the otter may need a larger amount of food in the wild (Chanin, 2013).

***Breeding.*** The Eurasian otter can breed throughout the year, given that traces of otter pups have been found on the ground in all seasons, mostly in spring. This type of behavior is probably correlated with the availability of food resources, which can be found in relatively similar amounts throughout the year (Chanin, 2013).

***Behavior and social organization.*** The otter is a predominantly nocturnal animal, very shy and difficult to observe, usually active about an hour before dusk and up to an hour after dawn. During the day they rest in burrows or burrows dug among the roots of trees on the water's edge, or in the dense vegetation on the banks.

Otters are territorial and solitary animals, they do not live in families, except for the period of about a year when the female otter raises her young and the period of about a week when mating takes place.

***Teritory.*** Otter individuals have a fairly well-defined territory in which they carry out their daily activities, which they know well, they know their travel routes, the best feeding places, resting places and burrows. Otters by their behavior try to exclude other otter individuals that enter their territory, or exclude only individuals belonging to the same sex.

Otters have a territory that varies in size depending on certain factors such as: the type of habitat, the richness of food resources, the availability of resting areas, anthropic disturbance and can have dimensions from 6 to 40 km of water course, but in certain situations it can reach 80 km of water course (Chanin, 2013). In general, males have much larger territories than females, and a male's territory may contain several female territories. In certain regions the otters' territories are smaller, in Sweden the female otters studied had territories of 6-7 km of watercourse, and the males between 10-20 km long (Erlinge, 1967).

But in Scotland the territories of the otters monitored here are much larger, the females had territories of 16-22 km long, while the males around 40 km long of the river, and in the case of a male his territory was variable, between 12 and 80 km (Green et al. 1984).

***The biotope of the Eurasian otter (Lutra lutra).*** The otter (Lutra lutra) lives in varied aquatic and semi-aquatic environments, it can be found from the seashore to high altitudes on mountain streams, even in the center of large cities, as is the case of the Văcărești Natural Park in Bucharest. The presence of otter in a certain environment is strongly correlated with the existence of food resources. It can live both in stagnant fresh water (lakes, ponds, ponds, reservoirs, swamps) and in flowing water (rivers, streams, rivers, man-made canals, sometimes even in trenches with only a few centimeters of water) and in salty water: seas and oceans, but in the case of the latter, there must be sources of fresh water nearby, where the otter can wash its fur, to maintain the waterproofing and thermal insulating role of the fur by removing salt deposits. (Macdonald et al. 1998, Kruuk 2006). However, there are different aquatic habitats preferred by the otter over others, being directly correlated with the availability of food resources, shelter and potential partners.

In Romania, the otter inhabits the aquatic habitats of inland flowing and stagnant waters, having a very wide distribution area, from the shores of the Black Sea and the Danube Delta to altitudes of over 1500 m in the Carpathians. Regions located at higher altitudes are less productive than those located at lower altitudes, and the biomass of fish resources is directly correlated with altitude, therefore the otter population density in most of Europe is lower in higher regions and more high in low ones (Ruiz-Olmo, 1997, Prenda and Granado-Lorencio, 1996, Kruuk, 1993).

Practically otters can be found in most aquatic habitats as long as there are sufficient food resources.

One factor influencing otter habitat use is river width and flow, so the larger the river, the more intensive its use (Durbin 1998, Kruuk et al. 1993). But there is also a differentiation of habitat use according to sex in otters, males prefer to use the main rivers and females use lower habitats such as: tributaries of the main rivers (Kruuk 2006).

The size of the territory is strongly influenced by the abundance of prey species and the type of habitat, so the otter's territory can be between 1 – 57 km² (Reuther 2000). In general, the territories in the mountain area occupy lengths of 4-6 km from the water course (Erlinge 1967). Studies using radio telemetry have shown that otter territory sizes are much larger: 38.8 ± 23.4 km for the adult male and 18.7 ± 3.5 km for the adult female (Durbin 1998; Green et al. 1984; Kruuk et al. 1993). But some males have moved about 84 km upriver in Scotland (Durbin 1998). Although they are semi-aquatic animals, otters are capable of traveling long distances over land to move from one watershed to another, over 2 km (Jefferies 1988).

## E.2 Results

### 2.1. Transects on the banks of water courses (Standard Method) for mapping the distribution area of the species: Lutra lutra

During the observations, the water course of the Jiu river was crossed on foot, between the bridge over the Jiu, from the DC149 to Bumbești – Jiu and the bridge over the West Jiul, from the DN66 to Aninoasa.

The use of the non-invasive method (transects) provided us with important information regarding the distribution of the otter population, but a sustained effort is required to be able to evaluate and monitor the targeted species, which is characterized by high mobility and a predominantly nocturnal activity. The proposed method, calibrated and applied repeatedly, provides credible estimates regarding the distribution of the otter population in the Jiu River sector located in the area of the Bumbești - Livezeni hydropower development.

Following the application of the standard method, signs of the presence of the Lutra lutra species were identified: traces, droppings and anal jelly.

A high density of signs of habitat use by the otter species was recorded throughout the studied Jiu River bed.

On **transect no. 1**, numerous signs of the presence of the Lutra lutra species were identified, starting from the confluence area of the West Jiu and the East Jiu in Aninoasa, but also downstream to the confluence with the Polatiștea stream.
Otter tracks and excrement were identified on the banks of the Jiu river in the area of the CFR Strâmbuța halt but also in the area of the Livezeni dam.

Fig. 124 Otter excrement (Lutra lutra) in the Livezeni dam area

Fig. 125 Otter excrement (Lutra lutra) at the confluence of Jiu and Fr. Polatiste

On **transect no. 2** signs of the Lutra lutra species were identified, in the area of the CFR Pietrele Albe station but also downstream.

Fig. 126 Otter tracks at Cârligu Caprei and Otter excrement in the Pietrele Albe area

**Transect no. 3** begins with the first signs of presence in the confluence area of Dumitra stream with the Jiu River and continues downstream to the CF Zăcele tunnel area. Fewer signs of presence were recorded on this transect, in contrast to the rest of the sectors.

Fig. 127 Otter excrement on a prominent boulder in the CF Zăcele tunnel area

**Transect no. 4** 4 showed a high density of otter presence signs (Lutra lutra) between the CF Lainici village and downstream from the Lainici Monastery and the Răfăilă rocks.

Fig. 128 Otter excrement downstream of Lainici Monastery

Fig. 129 Otter track in the area of the former Lainici cabin

The area that showed a higher density of signs of the presence of the Lutra lutra species on **transect no. 5** was, on the banks of the Jiu in the CF Lespezi tunnel area.

Fig. 130 Otter droppings in the CF Lespezi tunnel area

**Transect no. 6** showed signs of the presence of the otter (Lutra lutra) in the area of the confluence of the Jiu River with the Bratcu stream, both downstream and upstream. Tracks and droppings were identified.

Fig. 131 Otter latrine upstream of the confluence with the Bratcu stream.

On transect no. 7, a high density of otter presence signs (tracks and droppings) were identified, in the sector between the confluence of the Jiu with the Sadu stream and the bridge that crosses the Jiu to the Vișina Hermitage.

Fig. 132 Otter tracks and droppings at the bridge over the Jiu River on DC149, Bumbești – Jiu

Fig. 133 Otter excrement in the Vișina hermitage area

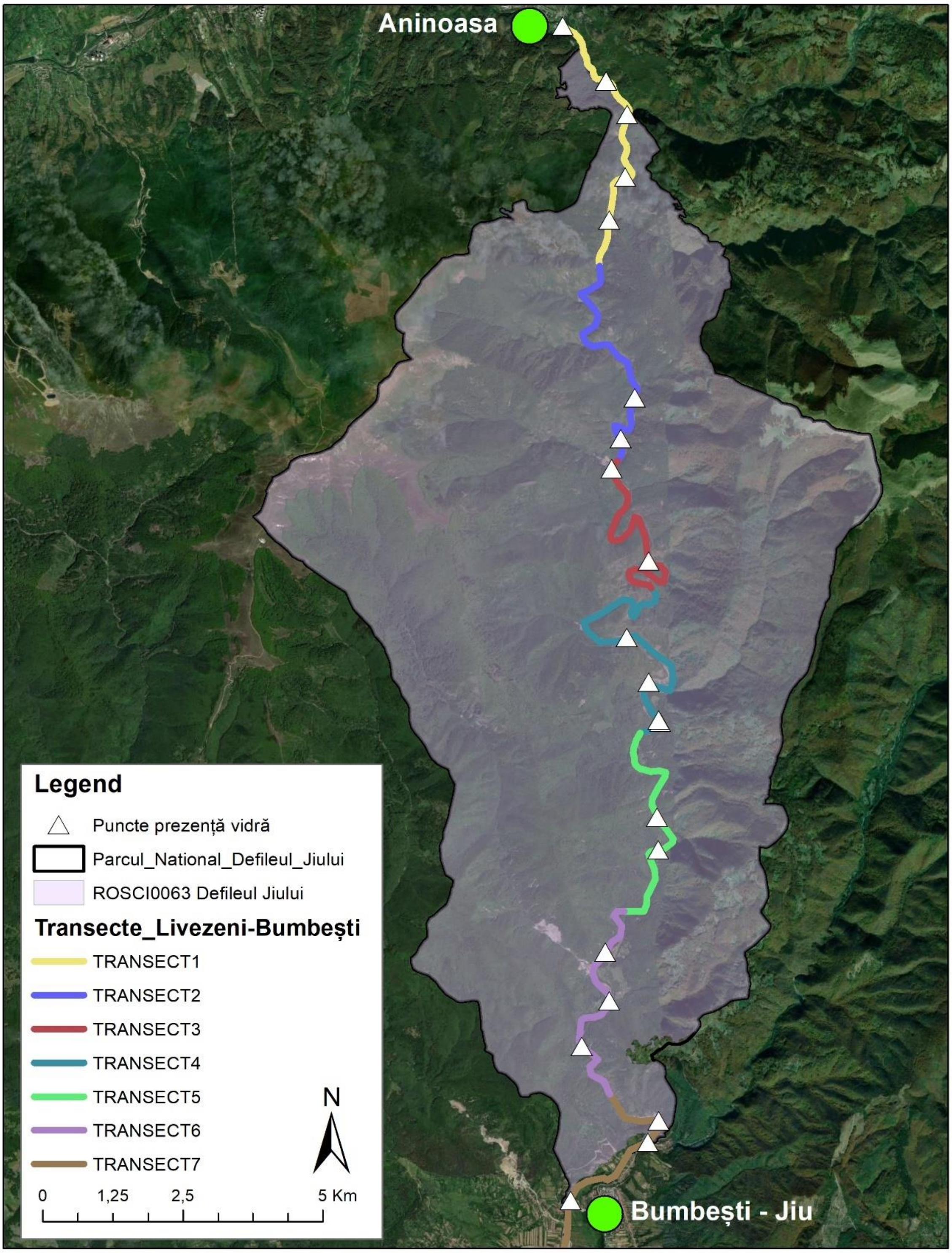


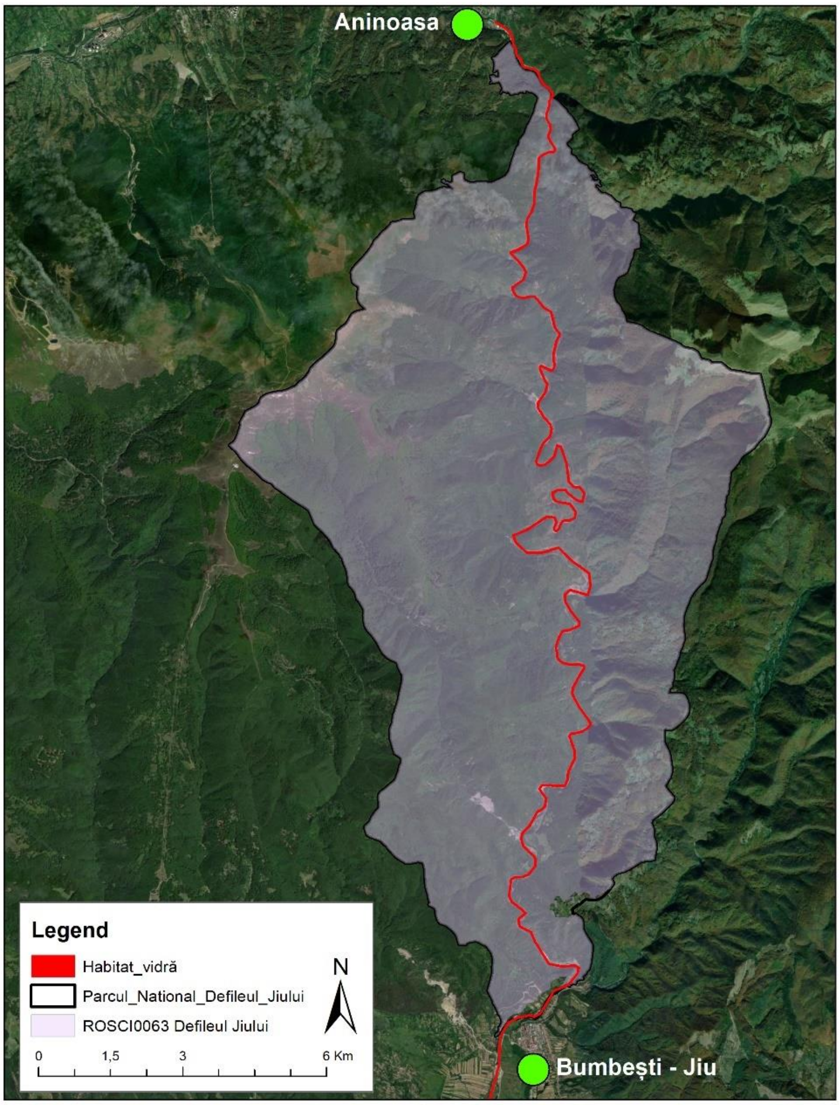

Fig. 134 Distribution map of the species Lutra lutra (otter) – Standard Method

### 2.2 Use of habitats

The otter (Lutra lutra) lives in varied aquatic and semi-aquatic environments, it can be found from the sea shore to high altitudes on mountain streams, even in the center of large cities, as is the case of the Dâmbovița river in Bucharest. The presence of otter in a certain environment is strongly correlated with the existence of food resources. It can live both in stagnant fresh water (lakes, ponds, ponds, reservoirs, marshes) and in flowing water (rivers, streams, rivers, anthropogenic canals, sometimes even in trenches with only a few centimeters of water) and in water salty: seas and oceans; but in the case of the latter, there must be sources of fresh water nearby, where the otter can wash its fur, in order to maintain the waterproofing and heat-insulating role of the fur by removing salt deposits. (Macdonald et al., 1998; Kruuk, 2006). However, there are different aquatic habitats preferred by the otter over others, being directly correlated with the availability of food resources, shelter and potential partners.

In Romania, the otter inhabits the aquatic habitats of inland flowing and stagnant waters, having a very wide distribution area, from the shores of the Black Sea and the Danube Delta to altitudes of over 1500 m in the Carpathians. Regions located at higher altitudes are less productive than those located at lower altitudes, and the biomass of fish resources is directly correlated with altitude, therefore the otter population density in most of Europe is lower in higher regions and more high in low ones (Ruiz-Olmo, 1997; Prenda and Granado-Lorencio, 1996; Kruuk, 1993). Practically otters can be found in most aquatic habitats as long as there are sufficient food resources.

*Table no. 47 Information about the Lutra lutra species in the project area*

| Cod | Parameter | Description |
|---|---|---|
| A.1. | Species | 1355 – *Lutra lutra* |
| A.2. | The type of population of the species in the protected natural area | Permanent population (sedentary/resident) |
| A.3. | Species location [geometry] |   Fig. 135 Lutra lutra species distribution map, Aninoasa – Bumbești – Jiu sector, of the Jiu river |
| A.4. | The area of the habitat of the group of individuals | 68 ha |

| | | |
|---|---|---|
| A.5. | Species location [description] | The habitats used by the otter were identified on all sectors of the Jiu River, in the study area, between Aninoasa and Bumbești - Jiu. |
| A.6. | The size of the population of the species in the area | 7 – 10 adult individuals |
| A.7. | The quality of the data regarding the population of the species in the area | average - estimated data based on extrapolation and/or modeling of data obtained through partial measurements; |
| A.8. | Species density class | High; |

### 1.3. Conservation status assessment

*Table no. 48 Parameters for evaluating the conservation status of the Lutra lutra species from the population point of view*

| No | Parameter | Description |
|---|---|---|
| A.1. | Species | **1355 Lutra lutra** - Otter<br>Habitats Directive: annexes II and IV<br>It is listed in Appendix I of CITES.<br>Annex II of the Berne Convention<br>Annex I of the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals (CMS), which recommends the highest degree of its protection.<br>GEO 57/2007 – Annex 3 and 4A (Law 49/2011) – Plant and animal species whose conservation requires the designation of special conservation areas and areas of special avifaunistic protection<br>IUCN category: NT<br>Carpathian List of Endangered Species: VU |
| A.2 | Temporal presence status of the species | Permanent (sedentary) population |
| A.3 | The size of the population of the species in the natural protected area | 7 - 10 adult individuals |
| A.4 | The quality of the data related to the population of the species in the protected natural area | average - estimated data based on extrapolation and/or modeling of data obtained through partial measurements; |
| A.5 | The size of the reference population for the favorable condition of the study area | 10 individuals |
| A.6 | The methodology for assessing the size of the reference population for the favorable condition | The estimate of the population size was based both on the size of the tracks identified in the field and on a simple formula in which the habitat occupied by the otter will be divided by the average size of the territory occupied by a female otter. The size of female territories is chosen because it is known from the literature that they maintain territories much more stable |

| | | |
|---|---|---|
| | | than males (Kruuk, 1995, 2006).<br>Based on the studied works, for the Jiu River area, it is estimated that the average size of the otter territory is as follows: juveniles 4-5 linear km, females 5 - 6 linear km and males 10 – 15 linear km. The territories of males and females may overlap. Male juveniles older than two years that become independent will seek their own territory, initially small in size (3 – 4 Km²). |
| A.7 | The ratio between the size of the reference population for the favorable condition and the size of the current population | ”≈” – approximately equal |
| A.8 | The quality of the data regarding the current trend of the population size of the species | average - estimated data based on extrapolation and/or modeling of data obtained through partial measurements; |
| A.9 | The population structure of the species | 6 – 7 adult females, 3 – 4 adult males, 3 juveniles<br><br>the age structure of the population does not deviate from normal; |
| A.10 | Conservation status from the point of view of the species population | ”FV” – favorable |

**E.3. Conclusions**

Studies for the inventory and mapping of mammal populations are crucial, because they provide important information regarding the distribution of species, their abundance and habitat, while their presence/absence can serve as potential indicators of the impact of hydroelectric development on the aquatic environment. In general, hydropower projects can produce irreversible habitat loss that can lead to the disappearance of some protected species, such as the otter (Lutra lutra), if they are not planned correctly, taking into account the needs of aquatic and semi-aquatic creatures.

Among the mammal species in the Jiu river sector, between Livezeni and Bumbești, the species most affected by the changes generated by the hydrotechnical infrastructure built here are the semi-aquatic species such as the otter (Lutra lutra), the other species of carnivores, herbivores or bats are to a small extent affected or not at all.

The construction and operation of hydropower plants can generate significant impacts on biodiversity when their location and design do not respect the ecological requirements of habitats and species. Unfortunately, this is the case with the vast majority of hydropower plants built or proposed to be built in Romania. The significant impacts can be felt not only at the local level but also at the level of aquatic ecological corridors, the effects can be felt tens of kilometers away.

The species of mammals potentially affected by the hydro-energy infrastructure built on the Jiu River sector are the semi-aquatic species whose habitat is practically the course of the Jiu River and its tributaries. Among the species most affected by the construction, is the Eurasian otter (Lutra lutra), both through the degradation of the habitat but especially through the reduction of food resources, mostly made up of various fish species.

***F. Mammals other than the otter***

For mammal species, the basic method was the presence/track inventory method. The methods used for mammal species were in accordance with the specialized guidelines, being adapted according to the recommendations of the Guide regarding monitoring protocols and unitary methodologies for monitoring the state of conservation of species of community interest in Romania, within the project "Completing the level of knowledge of biodiversity by implementing the system for monitoring the state of conservation of species and habitats of community interest in Romania and reporting based on Article 17 of the Habitats Directive 92/43/EEC"

The track inventory method is based on the identification of tracks left by individuals in the snow or in the soft substrate near water. Examples of the traces investigated within the project are presented in the figure below. The method involves making transects in areas considered favorable habitat for terrestrial or aquatic mammal species. The transects were made mainly on the existing forest roads in the project area and had variable lengths. The identified tracks were measured, and their geographic position was recorded by GPS.

The presence of chiropteran species in the study area was reported both through field research and literature. Information was extraxted from the literature (Murariu et al. 2016; Valenciuc 1992; Valenciuc and Chachula 2002; Valenciuc, Ion, and Harea 1966), including the data available from the Natura 2000 networks in the site area.

To collect data from the field, a non-invasive observation method was used: ultrasound detection by means of a chiropteran detector (Anabat Walkabout – built-in GPS). Two monitoring campaigns were carried out, 07-10.05.2024 and 27-30.05.2024, totaling 10 nights of work in the field. Data were collected after sunset until the next day at 02:00 AM. The collected data were analyzed by means of the Anabat Insight software and with the help of some guides for the determination of species (Pocora and Pocora 2012; Russ 2012). Some records could not be determined to species level due to the limitations of the methodology and the strong similarity between certain groups of species, such as Pipistrellus nathusii with Pipistrellus kuhlii or the species of the genus Myotis sp. if they are recorded more than 7 m away from the microphone (Chaturvedi, Singh, and Tiwari 2018).

Following the evaluations carried out on the ground, in the area of influence of the works (remaining to be executed), the following species of chiroptera were identified: Miniopterus schreibersii, Myotis myotis, Myotis blythii, Barbastella barbastellus, Rhinolophus ferrumequinum and Rhinolophus hipposideros, their distribution being presented in the figures below.

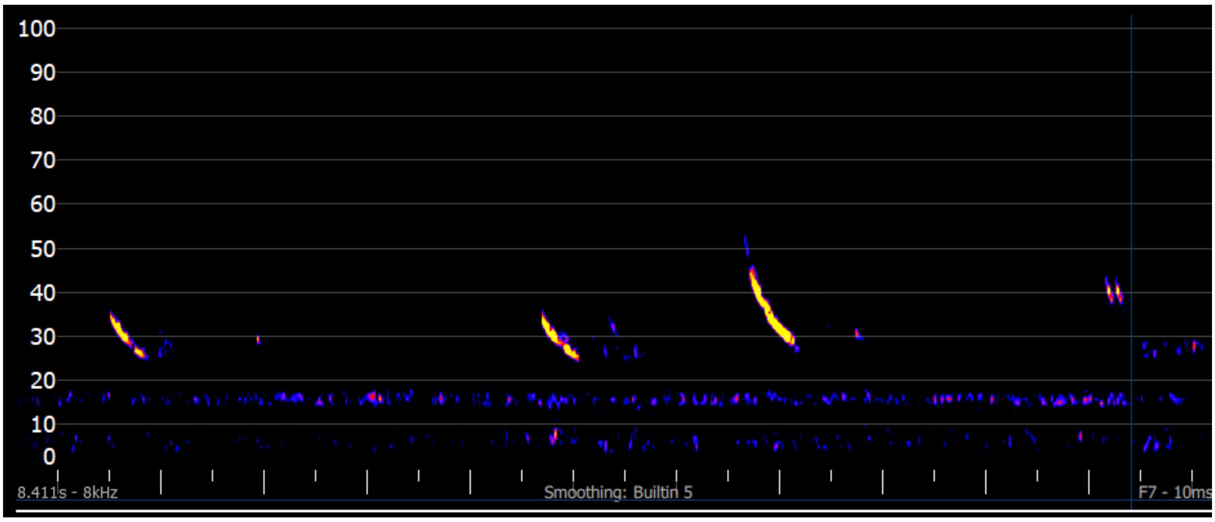



Fig. 136 Example of ultrasound recording of chiropteran species

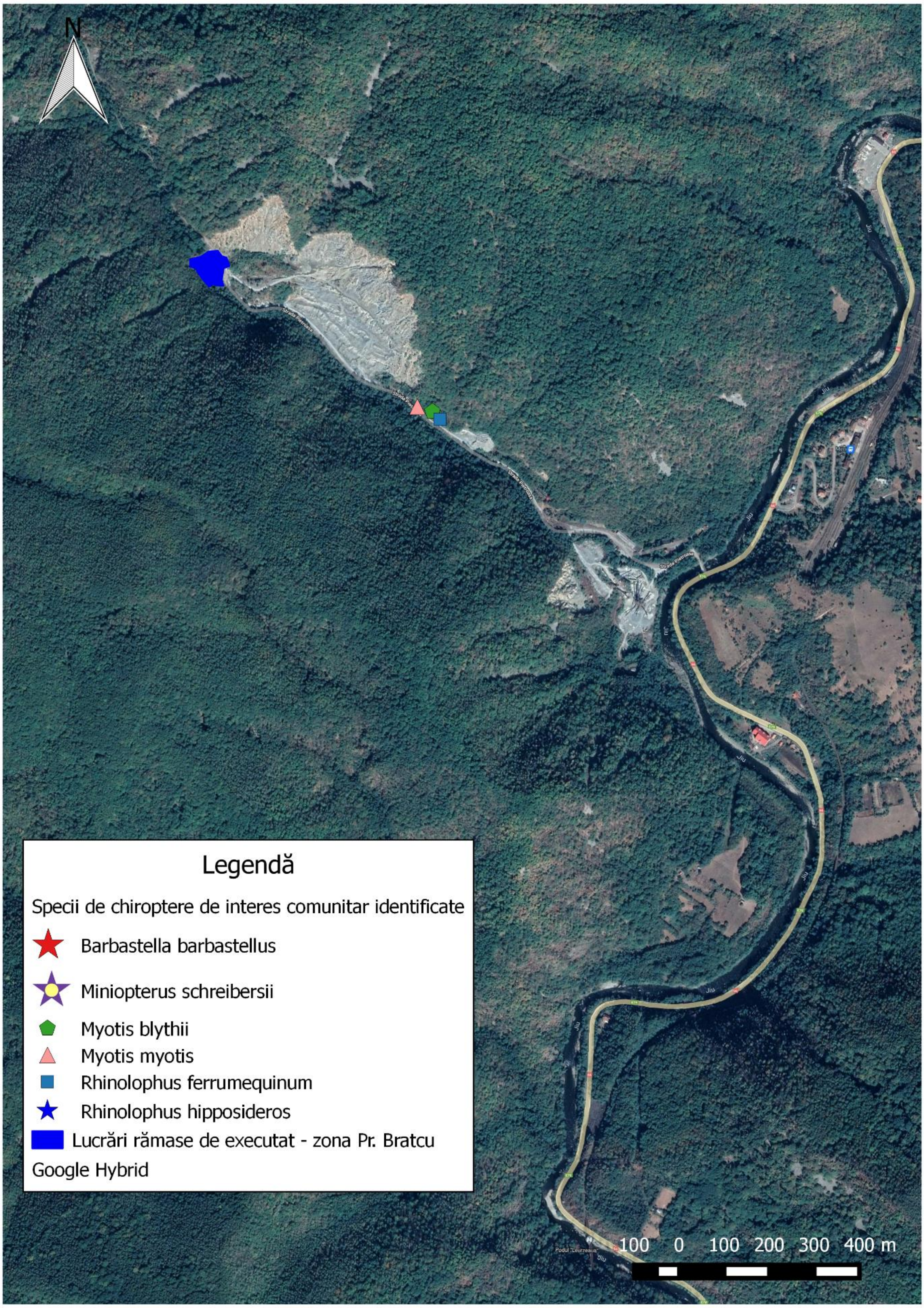



Fig. 137 The distribution of chiropteran species in the area of the site – Bratcu stream area

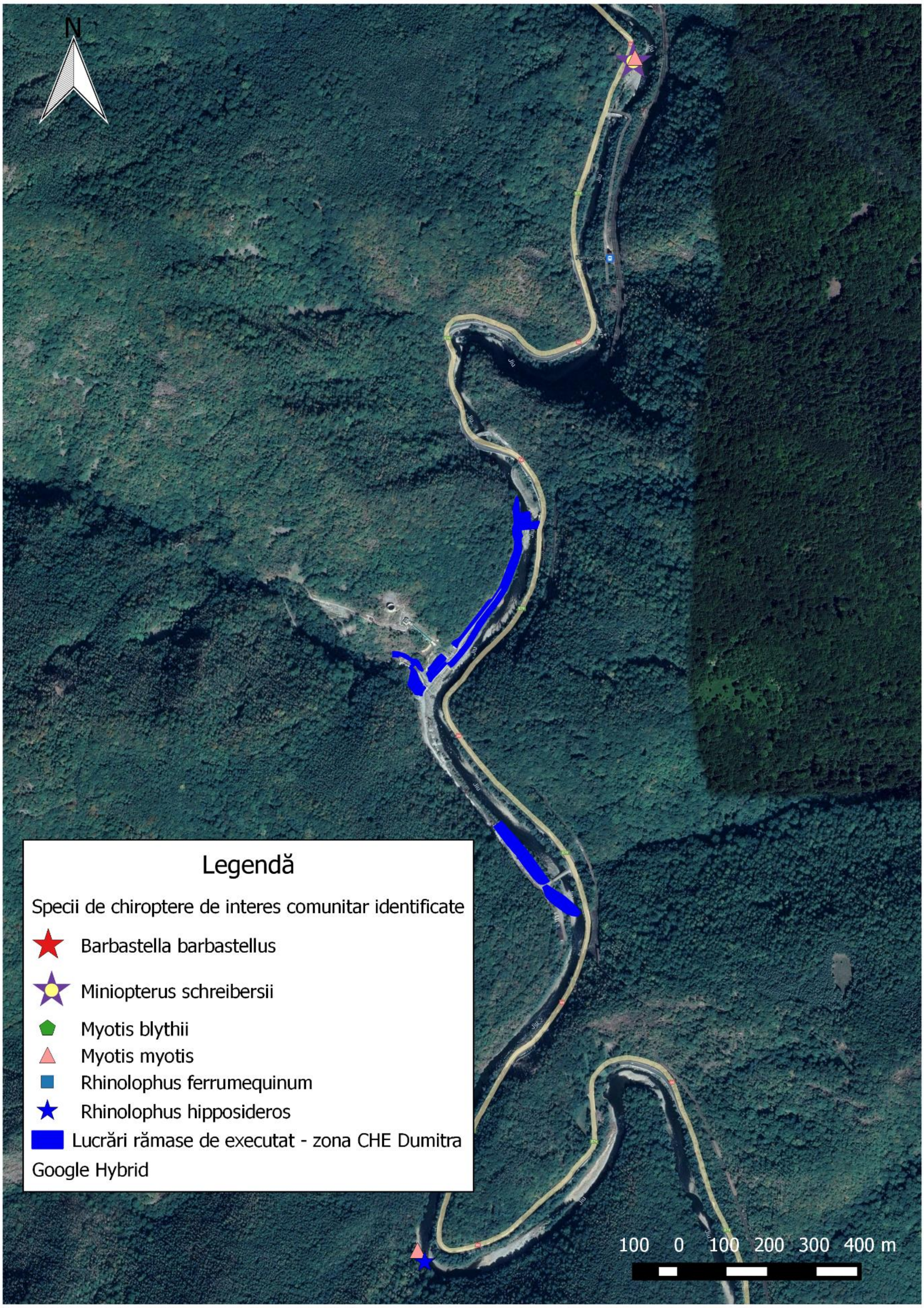



Fig. 138 The distribution of chiropteran species in the site area – Dumitra HPP area

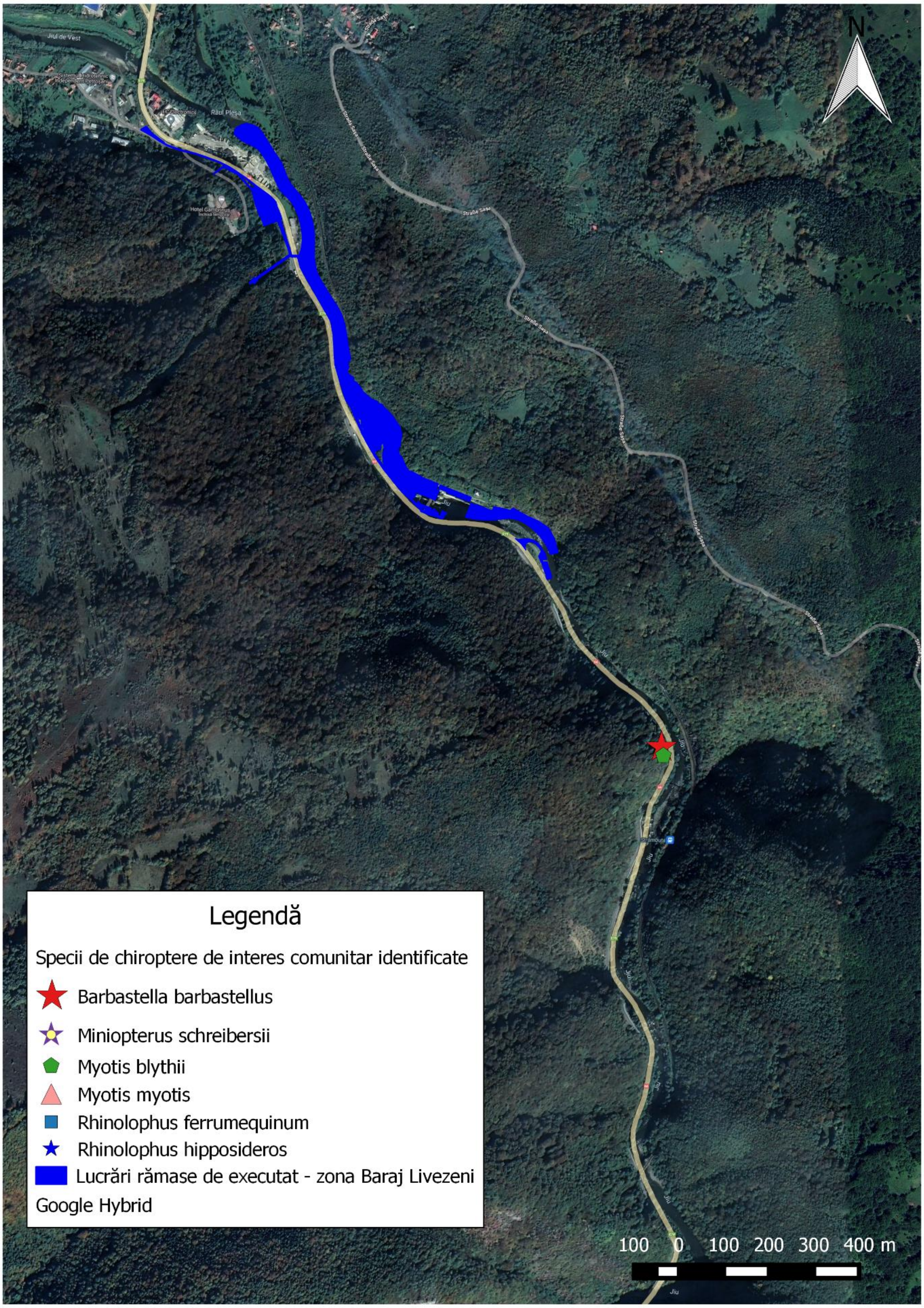



Fig. 139 Distribution of chiropteran species in the site area – Livezeni Dam area

Fig. 140 Stag specimens in the arboretum in the Dumitra area

Fig. 141 Deer specimens in the arboretum in the Dumitra area

## *G. Ichtyofauna*

### G.1. Introduction

The objective of the ichthyofauna monitoring report is to assess the impact of the realization of the Jiu River hydropower development in the Livezeni-Bumbești sector on the fish species in the protected natural areas within and in the vicinity of which elements of the proposed investment are located (ROSCI0063 Jiului Gorge, ROSCI0217 Retezat and ROSPA0084 Munții Retezat), representing at the same time, contributions to the development of the appropriate assessment study for the "Project regarding the increase in the share of electricity production from renewable sources by completing the works and ensuring the permanent monitoring of the environmental impact of the hydropower development of the Jiu River on the Livezeni-Bumbești sector".

### G.2. Description of the methodology used to collect data on ichthyofauna

The fishing procedures and the equipment used depend on the depth of the water in the place of sample collection, on the targeted species, etc. In streams, small and medium rivers, sample collection can be done by electronarcosis fishing from the bed. In large rivers, the collection of ichthyofauna samples is carried out from a boat.

*"Traditional" fishing with electronarcosis:*

The justification for choosing electronarcosis:

Fish have a nervous system similar to other vertebrates. In the dorsal part, the nerves, coming out of the spinal cord, follow the myomeres and enter the muscles. A negative charge appears in the front of the head, which would explain why fish are attracted to the anodes. Once inside the electric field, the behavior of the fish will depend on the spatial positioning of the fish at the initial moment. The expected reaction is to involuntarily swim in a predictable direction (toward the anode).

Electrofishing is size selective. Larger fish tend to be more vulnerable, due to the electrical gradient, the head-to-tail voltage. A large fish crosses more field lines than a small one. There is a difference between size selectivity, capture efficiency and mortality. While the catch efficiency increases with the length of the fish, the mortality depends mostly on the response to the length and frequency of the pulses. If the electronarcosis apparatus is well set, the mortality is almost or even 0. In the case of running waters, the use of electronarcosis brings the best results, because no other accepted method results in almost total detection of the fish fauna in a collection station.

Taking fish samples using electricity is done according to the European standard SR EN 14011.

Electric fishing or electronarcosis is a fishing method that is based on the interaction between the electric current and the nervous system of the fish. In the case of fish, the nervous system works on the basis of electrical impulses. Electrical impulses are transmitted from the brain through the nerves that exit the dorsal part of the spinal cord and enter the muscles. As a result of the physiology of the nervous system in fish, a negative charge appears in the front part of the head, a fact that could explain why fish are attracted to anodes. Electrofishing aims to interfere with the neural transmission pathway between the central nervous system and the fish's musculature.

By blocking the internal signal and overriding it with the artificial signal, electrofishing redirects the neural signal and muscle response. The effect is of involuntary swimming, in the direction of the anode. The orientation of the fish in the electric field determines how it is affected, the strongest effect being when the fish is placed perpendicular to the field lines and with its head facing the anode. The fish inside a continuous electric field move towards the anode and once near it, they go into a state of electronarcosis, lying on their side and thus being very easy to capture/identify. This state is reversible and ceases one to two minutes after removing the fish from the electric field, in some cases much faster.

The European standard CEN/TC 230 Water analysis establishes the way to evaluate the specific composition, abundance and diversity of fish communities in rivers, lakes and coastal waters, in order to qualify their ecological status. These rules standardize the methods of collecting fish, so that the results obtained by different researchers are comparable.

This document presents an electrofishing method that can be used in the capture/identification of fish, in order to characterize the species richness, composition, abundance and age structure of fish communities.

The main components of an electronarcosis machine are the power supply, control panel,

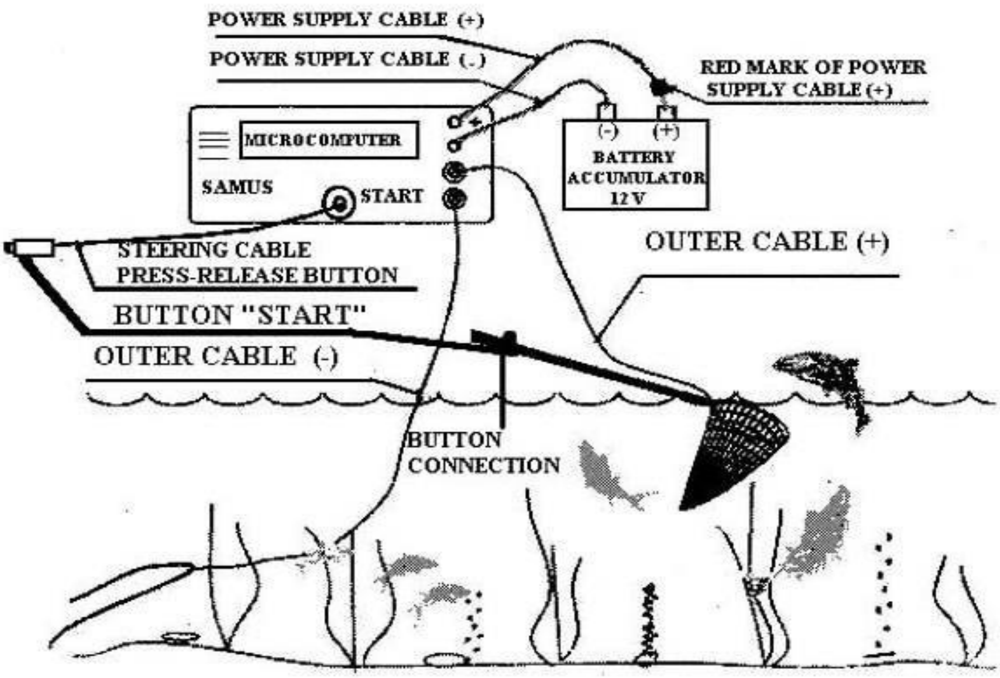



Fig. 142 Funcţionarea aparatului de electronarcoză

cables, safety switches and electrodes. Direct direct current (CCD) or pulsating direct current (CCP) can be used for electrofishing.

Alternating current is very harmful to fish, so it is not used.

All fishing equipment that generates electricity must comply with CENELEC and IEC standards and comply with current European legislation. These devices must be able to output the desired voltage and amperage for the entire duration of operation.

Portable devices, which are carried on the back during operation, must meet the following conditions:

- ✓ have automatic systems for cutting off the electric current when the switch button is not pressed;
- ✓ to be light, to be transported without much effort by the wearer;
- ✓ have batteries that do not spill;

Taking into account the characteristics of the natural aquatic habitats in the studied area, the collection of ichthyofauna data from the area of interest was carried out with the electronarcosis apparatus, from the river bed (by "wading") as an appropriate methodology for the evaluation and monitoring of fish species in the studied area . All identified fish were released immediately after identification.

*Sample collection procedures and place:*

The sample collection place is chosen depending on the width and depth of the river, as follows:

- in small rivers, samples are fished in the bed;
- in larger rivers, samples are collected from near the banks and in the river bed, where possible, and if necessary, the boat is used to collect ichthyofauna data.

In each case, the sample size must be large enough to include the dominant species and to include the complete set of species characteristic of the respective river, to ensure representativeness of the respective fish community (Pricope et al., 2004).

The collection of fish samples is done by at least 2-3 people. The collection of ichthyofauna samples is standardized, so samples taken from similar collection points can be compared. In addition to the above, checking catches from anglers can provide valuable information about the presence of species that are more difficult to identify with the method described above, so where possible, catch from anglers was also checked.

Fig. 143 Fishing areas

Fig. 144 Evaluation of the ichthyofauna on the Bratcu stream

*Constraints on the above method:*

One of the most important limitations of this method is the fact that the range of action of the electronarcosis device is quite small (1-1.5 m). If the range of action of the electronarcosis device is increased, some of the shocked fish will not survive. For this reason this radius of action cannot be increased. This problem occurs with any electronarcosis device, so it cannot be avoided.

Another limitation of this method is its use in turbid and/or elevated waters. In this case the shocked fish cannot be observed and collected by the evaluators. For this reason, the collection of ichthyofauna samples should be carried out, as much as possible, at a time when the water transparency is good enough to be able to observe as many of the shocked individuals as possible. In the same way, the high water level makes the evaluations difficult, so the results obtained in the case of evaluations carried out at a high water level must be treated with caution, especially those related to the lack of some species in the studied area.

*Number and size of fishing areas:*

We consider that in the area of interest of the project, if the assessment is carried out from the river bed, the length of the station should be 150 m, if the conditions on the ground allow it.

Below we present the map with the distribution of the stations at which the evaluations were carried out.

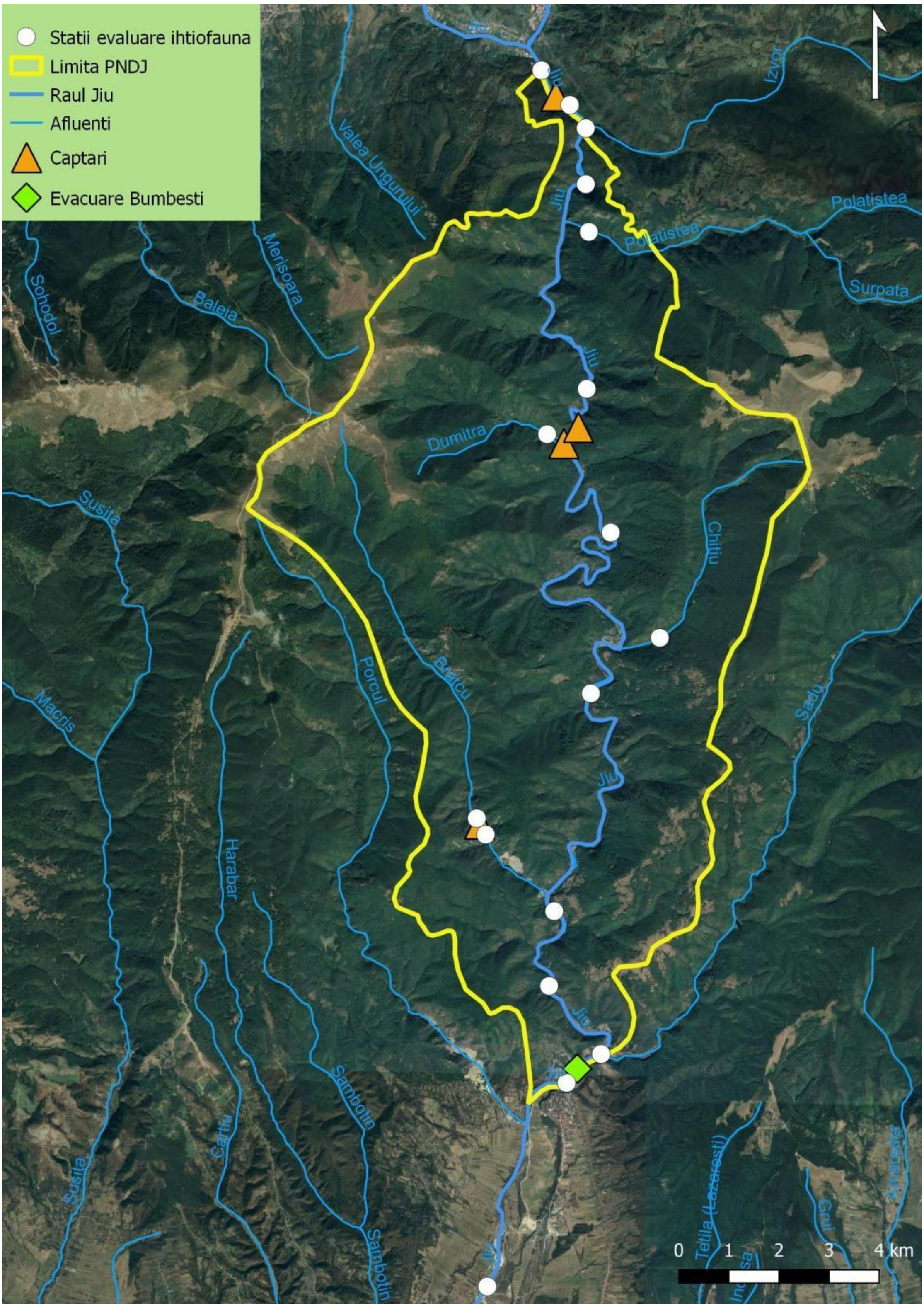



Fig. 145 The stations at which the ichthyofauna assessments were carried out

*Collection period:*

The period of sample collection should be chosen according to the biology of the target species. In most cases, sample collection can be carried out from spring (after the flood recedes) until the end of the growing season (summer - autumn), when the juveniles are large enough to be identified by electronarchosis. The ideal period for data collection is usually between July and October, this largely depends on weather conditions (for example in July spring floods can still persist or in October there can be quite cold spells, each of which reduces the efficiency evaluations).

The current assessments were carried out between April and June 2024 when the water level was quite high, for this reason, the number of species and the number of specimens identified is, most likely, slightly reduced, so when interpreting the results this fact should be taken into account.

*Catch identification and release:*

The fish were identified based on the specialized literature (Bănărescu 1964, Gyurkó 1973, Pintér 1989, Kottelat & Freyhof 2007). All identified fish were released in the area from which they were caught.

*Field form:*

In the field form important information, on the basis of which the inventory reports can be drawn up, are recorded.

*Storage of collected data:*

The data collected in the field are entered into the OpenFishMaps database (https://openfishmaps.ro/).

### G.3. Summary description of the fish species identified in the assessed areas:

#### a) *Alburnoides bipunctatus – spirlin*

It is still a common species in most of the country, present in rivers and streams in the mountain area (downstream sectors of rivers, mountain streams) and hilly. Telcean & Bănărescu (2002) categorize it among the species that have reduced their distribution area and abundance in the last decades.

Fig. 146 Specimens of Alburnoides bipunctatus, identified during assessments in the Jiu River

*Description and identification:* Ventral and dorsal profiles are almost always equally convex. Head compressed laterally, eyes located more in the front half of the head, looking sideways. Interorbital space convex.

Mouth terminal, oblique: its opening reaches below the nostrils. Dorsal margin right, its corners slightly rounded, dorsal insertion slightly behind posterior margin of base of ventrals. Pectorals rounded, their apex generally not touching the insertion of the ventrals. Tip of ventrals rounded, most often touching or almost touching the insertion of the anus. The deeply hollowed tail, its lobes pointed. The scales cover the isthmus entirely, but they are missing on the carapace between the insertion of the ventrals and the anus. Lateral line slightly bent, situated closer to the ventral than to the dorsal side of the body, on the caudal peduncle, equidistant on both sides.

Coloration: Dorsal part light gray, beating in greenish and bluish, flanks silver. On the medio-dorsal line a dark olive line, narrow, very obvious. On 3 rows of scales above the lateral line and usually also on a row below the lateral line, one black spot on each scale, their assembly forming longitudinal stripes. Ventrals and anus yellowish or orange during breeding.

Ecology, behavior and reproduction: Lives exclusively in flowing waters, starting in the grayling area. It lives in small flocks, in the relatively deeper parts of rivers, close to the surface, it is frequent especially under willows. Reproduction takes place in May-June.

Sexual dimorphism is manifested by the slightly more vivid colors of the male during the breeding season and by the longer paired fins of the males. It feeds mainly on aquatic insect larvae (Bănărescu, 1964).

***Barbatula barbatula* – grindel**

It is a common species, generally present on the upper sector of the rivers, downstream of the trout zone. Telcean & Bănărescu (2002) categorize it among species that have been favored by human activities so that they have increased their distribution area or abundance in recent decades.

Fig. 147 Specimen of Barbatula barbatula identified during assessments in the Jiu River

*Description and identification:* Head depressed dorsoventrally, wider than high. The interorbital space is slightly convex, almost flat. Lower mouth small. Both lips fleshy, the upper slightly lobed, the lower interrupted in the middle, with the inner ends pointing back. The third pair of whiskers is the longest. Nostrils nearer to the eye than to the tip of the snout, the anterior nostril tubular, the posterior simple. Caudal peduncle laterally compressed. Towards the base of the caudal, the caudal peduncle rises, and its dorsal and ventral edges narrow, becoming sharp hulls. Caudal truncate or slightly hollow, rarely slightly convex. Pectorals, ventrals and anal rounded. The spine has a straight edge and a rounded tip. Full lateral line, rectilinear, arranged in the middle of the body. Scales very small, not imbricate.

Coloration: The general background is yellowish, sometimes beating greenish, on the back a series of dark spots, wide, in variable number, and on the sides a network of spots, sometimes clear and well defined, sometimes vague and very irregularly anastomosed. Ventral face yellowish. The fins are yellowish; the ventrals and anal without spots, the other fins with brown spots, which on the pectorals are pale and small, on the dorsal and caudal intense, larger and more frequent (Bănărescu 1964).

Ecology, behavior and reproduction: Lives in mountain and hill rivers and streams, isolated specimens are also found on the ground. It is absent in the rivers that spring in the plains, but lives in the upper course of some rivers that spring in the hilly area. It is very undemanding, living both in the main course of the river and in side arms and muddy mountain streams with slow flowing water. Males are generally more numerous than females. Sexual dimorphism is manifested by the shape of the pectorals and the greater length of the fins in males; during the reproductive period, males have a dorsal and a ventral keel on the caudal peduncle. Breeding takes place from April to June. Spawns are laid in portions. Sexual maturity is reached at the age of 1 year, longevity does not exceed 4-5 years. Food consists of small benthic invertebrates, periphyton algae, organic detritus. In search of food, the animal uses whiskers almost exclusively (Bănărescu, 1964).

Breeding takes place from April to June. Spawns are laid in portions. Sexual maturity is reached at the age of 1 year, longevity does not exceed 4-5 years (Bănărescu, 1964).

***b) Barbus - Barbel***

It is a characteristic species of rivers and streams in the submontane area of the country. Telcean & Bănărescu (2002) categorize it among the species that have maintained their distribution area and abundance in the last decades.

Fig. 148 Specimen of Barbus sp. identified during assessments in the Jiu River.

Considering the fact that the blue barbel has been separated into four species in the last decades mainly based on genetic characteristics (Kotlik et al. 2002, Antal et al. 2016), and the fact that these species cannot be clearly distinguished on based on morphological characters, we will treat this species as Barbus sp. Most of the data in the literature refer to these species together, thus, and this description will refer to the same. The species is widespread in most of the country in the rivers of the mountain area and the upper part of the hilly region. Telcean and Bănărescu (2002) categorize it among the species that have maintained their distribution area and abundance in recent years.

*Description and identification:* Medium sizes; elongated and round body; rounded abdomen; big head; small eyes; snout long and prominent; elongated preorbits; semilunar lower mouth; fleshy lips, especially the lower one which is split; two pairs of whiskers, one shorter at the tip of the muzzle, the other longer at the corners of the mouth; caudal peduncle laterally compressed; caudal deeply hollow; scales with divergent striations on the visible side; complete lateral line weakly arched and arranged on the middle of the caudal peduncle; pharyngeal teeth in 3 rows, sharp, bent at the tip, with an excavation at the base of the crown; short intestines; colorless or brown peritoneum. The last simple ray of the dorsal is thin and flexible; the insertion of the ventrals located behind the anterior end of the dorsal insertion; long, recumbent anal reaches or almost reaches (sometimes exceeds) the base of the tail; it has dark spots on its back. At maturity, it grows to a length of 15 - 20 cm.

Ecology and reproduction: Reproduction takes place in the spring, sometimes extending until the end of summer. Bentopelagic. It feeds primarily on benthic aquatic invertebrates (ephemeroptera, trichoptera, gammarids, oligochaetes, etc.) less often on plants or detritus (Bănărescu, 1964).

Habitat: Lives exclusively in the rivers and streams of the mountain region and the upper part of the hilly region; in most rivers that spring from plateau or hill areas, it is missing even from their upper course which is fast. It lives both in stony, rapid and cold rivers, as well as some muddier streams, which heat up strongly in the summer, but only in the mountains. It shows preference especially for the portions with strong current and stony bottom.

### c) *Barbus barbus – the common barbel*

It is a common species, present in the larger rivers in Romania. Telcean & Bănărescu (2002) categorize it among the species that have maintained their distribution area and abundance in the last decades.

Fig. 149 Specimen of *Barbus barbus*

*Description and identification.* Body elongated, slightly compressed, back and abdomen rounded. The upper body profile is an almost straight upward line from the tip of the snout to the nape of the neck. There is a sudden rise near the nape of the neck, and from here to the insertion of the dorsal it rises very smoothly. The forehead is almost flat. Long, pointed snout. The lower mouth, semilunar, its corners reach below the nostrils. Lips fleshy, papillose. The anterior whisker reaches no more than below the posterior nostril. Rear whisker longer, reaching below the eye, rarely exceeding the eye. Dorsal insertion usually slightly closer to base of caudal than tip of snout. The last simple dorsal ray is ossified and strongly serrated on its posterior face. Dorsal margin concave. Scales well fixed, unequal in size, those in the lateral line larger than the neighboring ones, so that the number of scales in the lateral line is less than the number of transverse series of scales, isthmus bare. Lateral line arranged on the middle of the body and the caudal peduncle.

Color. Spine olive-gray, flanks yellow, ventral face white. The coloring is generally uniform, rarely with darker spots. Dorsal and caudal are the body color, the other fins beat red. The shaft of the whiskers is red.

Ecology, behavior, reproduction. Lives exclusively in flowing, sandy and stony waters, from mountain to lowland, it is more common in lowland rivers. It is absent in the small rivers that rise in the hills or on the plateau. In the spring they migrate up the rivers, and in late autumn in the opposite direction. It prefers deep places with a sandy bottom and moderate current. Spawning occurs in May to July in the current in deep water sites. Sexual maturity is reached at 3-5 years. It feeds mainly on aquatic insect larvae, worms, crustaceans, less often on plants or fish eggs
(Bănărescu, 1964).

***d) Cottus gobio – european bullhead***

The species is widespread in most of the country in the mountain area. Telcean & Bănărescu (2002) categorize it among the species that have maintained their distribution area and abundance in recent years.

Fig. 150 Specimen of Cottus gobio identified during assessments at the confluence of the Strâmbuța stream with the Jiu river

*Description and identification:* External morphology: The body is elongated and thick, the maximum height represents 15.1 - 22.6% of the body length, and the thickness is slightly less than or equal to the height. The profile is slightly convex between the tip of the snout and the eye, then almost horizontal, the head being only slightly shorter than the body. Head large, dorsoventrally flattened and thicker than the body. The thickness of the head in some specimens almost equals the length of the head, in others it is considerably smaller. Juvenile specimens usually have a narrower head. The eyes located in the front half of the head, bulbous, look up. The upper half of the eye often covered by a pigmented eyelid, easily confused with the skin. Two pairs of small, simple, distant nostrils. Interorbital space slightly hollow. Snout rounded, its length represents 7.3 - 10% of that of the body. The terminal mouth, large, its corners reach, in adult specimens, to below the middle of the eye or close to it; in juveniles just below the anterior part of the eye. Small teeth, in the form of a brush, arranged in several rows on the premaxilla, prevomer and dentary. Small teeth also on the gill arches (except the first) and on the pharyngeal bones.

Preopercular with a strong spine, directed upwards and slightly curved; the other parts of the opercular apparatus and of the head smooth. The gill openings are wide, the gill membrane attaches to the isthmus. Usually 80 - 100, rarely 120 - 130 mm total length (Bănărescu 1964).

Coloration: The dorsal part of the body is brown-brown, with marbled spots, sometimes turning reddish; less often it is dark gray. The ventral face is light yellow or white, in the back half of the body, 3 - 4 dark transverse stripes, sometimes almost black; these stripes are very obvious in light-colored specimens; in the dark ones these stripes are barely distinguishable. Dorsal, caudal and pectorals with brown spots arranged in longitudinal stripes.

From a morphological point of view, the european bullhead can be confused with the alpine bullhead (Cottus poecilopus). It differs by two morphological characteristics: in the alpine bullhead, the lateral line is incomplete (it does not reach the insertion of the caudal) and the internal radius of the ventral is much shorter than half of the neighboring radius (Bănărescu 1964).

Ecology, behavior, reproduction: Lives exclusively in fresh, cold mountain waters, generally in rivers and streams, rarely in mountain lakes. It stays under rocks, in places with shallower and relatively slower water, often towards the shore or in the side arms. It is a little mobile, if disturbed it moves a short distance. It reproduces in spring, in March-April. Fertilization is internal. Prolificity is low, the female laying 100 - 300 large eggs (2.5 mm diameter). Males guard the brood until hatching, which occurs 4-5 weeks after spawning.

The fry are semi-pelagic at first. Sexual maturity is reached at the age of 2 years. Food consists of insect larvae, amphipods, fish eggs and fry, occasionally frog eggs. It reaches sexual maturity at two years. It reproduces in spring, in March - April. Males "dig" a cavity under stones, where they guard the spawn (Harka & Sallai 2004, Bănărescu 1964).

***e) Eudontomyzon sp. – lamprey***

*Description and identification:* The three species of lamprey from Romania are very similar morphologically. The body is relatively laterally compressed in the anterior region in all three species.

Adulţii de obicei au o mărime sub 300 mm, rareori mai mari.

Fig. 151 Larvae of lamprey, identified during assessments in the Jiu River.

Colour: Adults are dark grey, turning olive or dark brown with a metallic sheen, the ventral part is yellowish-whitish. The larvae are lighter in color than the adults and without metallic luster (Bănărescu 1964).

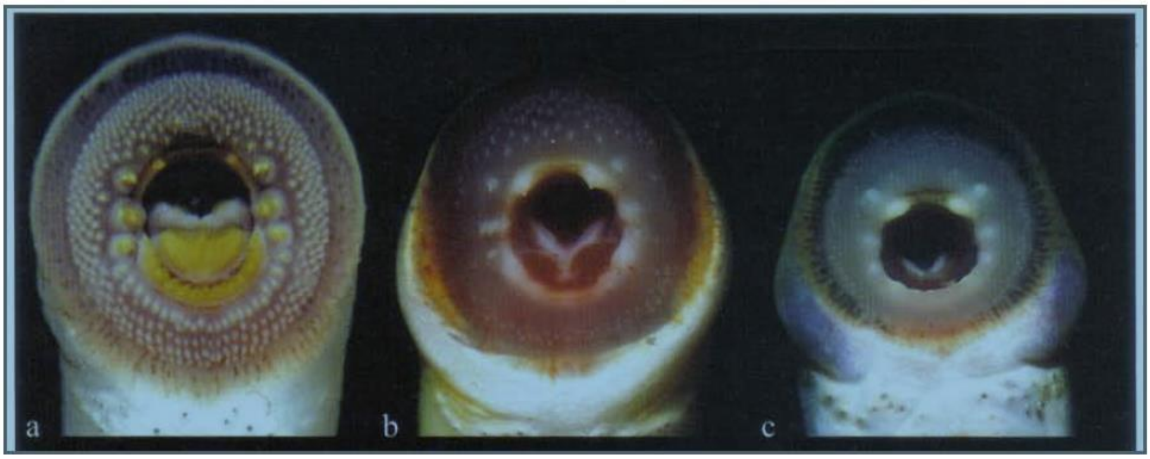



Fig. 152 Oral suction cups of Eudontomyzon species from Romania (adult specimens): a) E. danfordi, b) E. mariae and c) E. vladykovi (Kottelat & Freyhof 2007)

The three species can be distinguished on the basis of the morphological characters in the adult stage, on the basis of the oral suction cups, but in the case of the species E. Mariae and E. Vladykovi the differences are minor, so the determination is often uncertain.

Ecology, behavior and reproduction: The species lives in mountain rivers, in the zone of trout, barbus petenyi and grayling, less often in the upper part of the area of the common nase. Its frequency in different rivers and even in different portions of the same river is unequal. The larvae live buried in mud, especially in mud mixed with sand.

The food of the larvae consists mainly of microflora (diatoms), microfauna and detritus. The adult diet consists of fish (live or recently dead), birds and killed mammals, and probably some invertebrates. The lamprey can attack good swimming fish (trout), but mostly they attack bottom fish, less mobile (bullhead, barbel) or slightly injured ones. They fix themselves with the suction cup on the skin of the prey, which they pierce with the help of the oral and lingual plates, after which they attack the muscles. They orient themselves mainly with the help of smell. Usually on the same fish, after it was attacked by a lamprey, others also fixate on it. When they are not fixed on the prey, the lamprey usually sit quietly on the bottom of the river, under the stones or fixed with the oral suction cup on the stones (Bănărescu 1964).

Reproduction: it reproduces in the months of May-June, during this period the adults climb up the streams.

***f) Gobio gobio sensu lato – common gudgeon***

It is a common species, present in rivers and streams in the hilly area. Telcean & Bănărescu (2002) categorize it among species that have been favored by human activities so that they have increased their distribution area or abundance in recent decades.

Fig. 153 Specimen of Gobio gobio sensu lato, identified during assessments in the Jiu River

*Description and identification:* Body moderately elongated and laterally compressed. Dorsal profile varies with height; in specimens with a tall body, this profile is strongly convex, and in those with an elongated body, the convexity is much weaker. Lower mouth, semilunar; its opening reaches below the nostrils, and the insertion of the mandible below the beginning or first half of the eye. The eyes are small, far apart and look sideways. Caudal peduncle laterally compressed, its minimum height always greater than its thickness. Dorsal edge slightly concave. Caudal moderately hollow, the two lobes equal or nearly equal, their tips pointed (in rheophilic populations) or rounded (in limnophilic ones). The tips of the pectorals in most specimens do not touch the insertion of the ventrals. Insertion of the ventrals located a little behind the insertion of the dorsal, about below its first divided ray. The anus is always located closer to the insertion of the anal than to that of the ventrals. The variability is very pronounced.

Coloration: The upper face is dark gray-green, the head is even darker; on the back 7-10 small, weakly distinct spots. On the flanks, 7-10 (rarely 6 or 11) dark spots, of very variable sizes, generally short and round. Above the lateral line 5 longitudinal blackish-brown stripes, arranged superiorly and inferiorly. Ventral side yellowish white. Colorless fins, on the dorsal rays 3 rows of blackish spots, on the caudal ones 4, on the rays of the other fins rarely spotted and very pale. The coloring is darker in rheophilic populations (Bănărescu, 1964).

Ecology, behavior and reproduction: Lives in various categories of slowly or moderately flowing rivers; it prefers small streams, more or less muddy, in the submontane and hilly region, as well as the upper course of small rivers that spring from the plains. In large rivers, they are more frequent in the upper part of their middle course (scobar zone). In the lower reaches of large rivers (barrel and especially carp area) it becomes increasingly rare. It also lives in stagnant waters. Sexual dimorphism is weakly marked. Food consists primarily of rheophilic insect larvae, then amphipods, worms and molluscs. Breeding lasts from May to the end of July. Spawns are deposited in the current, on a hard bottom (preferably on stones), but they also reproduce in stagnant water (Bănărescu, 1964).

### g) *Phoxinus phoxinus – boiștean*

This is a common species, generally present in the upper sections of rivers and streams, downstream from the trout zone. Telcean & Bănărescu (2002) categorize it among the species that have maintained their distribution range and abundance in recent years.

Fig. 154 European minnow specimens in breeding colors, identified during evaluations in the Jiu River

Description and identification: The body is elongated, thick, almost cylindrical. The dorsal profile is only slightly more convex than the ventral one. The mouth is moderate, subterminal, its opening does not reach below the anterior margin of the eye. The caudal peduncle is long, laterally compressed. The rounded pectorals do not reach the insertion of the ventrals, and the ventrals do not reach the anus; there are no axillary scales at the base of the ventrals. The dorsal fin is situated behind the posterior margin of the ventral fin base, and the anal fin is behind the posterior margin of the dorsal fin. The margins of the dorsal and anal fins are convex. The lateral line is incomplete and has several interruptions. The abdomen and middle of the back are without scales.

Coloration: The back and most of the flanks are dark gray or greenish, sometimes almost black; the sides have a golden sheen. The ventral part is white or yellowish. On the sides, there are a large number of dark spots, sometimes intensely black, which in many cases completely merge into a single longitudinal black stripe. During the breeding season, males become very dark; the ventral part becomes orange or reddish, and the back becomes iridescent emerald green. The fins are colorless; the base of the fins has an orange tinge. During the breeding season, an eruption of nuptial tubercles appears on the head in both sexes, but these are more pronounced in males (Bănărescu, 1964).

Ecology, behavior, and reproduction: It lives in mountain and hill rivers and streams, from the trout zone to the chub zone, as well as in dam lakes and small mountain ponds in these areas. It is also found in the main course of rivers, in fast water, but prefers side branches with slow-flowing water and overgrown with vegetation, as well as slower streams with a substrate mixture of stones, sand, and mud. It almost always groups in large schools. Sexual maturity is reached by some specimens at 1 year and by most specimens at 2 years. Longevity is 5 years. The diet consists of insect larvae and aquatic crustaceans, aerial insects, and more rarely vegetation or detritus. Reproduction takes place from April to June, sometimes even in July or August.

Sexual dimorphism is very marked during this period. The eggs are deposited on stones (Bănărescu, 1964).

***h) Pseudorasbora parva – Stone moroko***

An invasive species, native to East Asia. It was accidentally introduced to Romania in 1960 as fry alongside the fry of some economically valuable species (Bănărescu, 1964).

Fig. 155 Specimen of Pseudorasbora parva identified during evaluations in the Jiu River

Description and identification: Small mouth, oblique upwards, superior and transverse. The caudal fin is deeply forked, with equal and rounded lobes. The chest and isthmus are entirely covered with scales. The lateral line is complete and straight. Mature specimens are 70-89 mm without the caudal fin and 84-106 mm in total length (Bănărescu, 1964).

Coloration: The dorsal part is light gray, the flanks are silvery, and the ventral face is white. On each scale on the sides of the body, there is a gray-silver stripe in the posterior half. On the scales located above the lateral line, this stripe covers almost half of the scale; below the lateral line, the stripe is smaller, and on the ventral scales, it is absent. The dorsal, caudal, and anal fins are light gray, while the pectoral and ventral fins are colorless (Bănărescu, 1964).

Ecology and behavior: It lives in ponds, fish farms, and slow-flowing portions of rivers. Adults are benthophagous, feeding on chironomid larvae, benthic cladocerans, etc. The fry are planktivorous, feeding on rotifers, cladocerans, etc. (Bănărescu, 1964). Adults also consume mucus from the bodies of other fish species, thus exposing them to various diseases.

Reproduction: Sexual maturity is reached at one year of age. Reproduction takes place in spring. In males, large and pointed horny nuptial tubercles appear before the breeding period on the ventral part of the lower jaw, on the sides of the mouth, and under the eyes (Bănărescu 1964).

### *i) Romanogobio uranoscopus – Danubian longbarbel gudgeon*

This is an endemic species to the Danube Basin. Telcean and Bănărescu (2002) mention the species among those that have experienced a numerical decline or a reduction in distribution in recent decades.

Fig. 156 Juvenile and adult specimens of Romanogobio uranoscopus, identified during evaluations in the downstream sector of the Jiu River

Description and identification: The body is elongated, thick, cylindrical, not laterally compressed. The thickness is slightly less than the height. The dorsal profile is weakly convex, the ventral profile is horizontal. The snout is pointed, almost always longer than the postorbital space. The eyes look more upwards. The barbels are much more developed than in other species of the genus. The ventral fins are inserted exactly under the insertion of the dorsal fin or slightly behind. The tip of the pectorals sometimes exceeds the insertion of the ventrals, other times it doesn't reach it. The caudal fin is deeply forked, its lobes rounded, equal, or the lower one slightly longer. The margin of the dorsal fin is slightly concave. The anus is closer to the anal fin than to the ventral fins. The chest and isthmus are completely covered with scales.

Coloration: The dorsal side is grayish-green or reddish-brown; the back scales have a black edge. Behind the dorsal fin are 2-3 large, very evident blackish spots, which give a furrowed appearance. On the sides of the body are 7-10 large round spots, rarely elongated. The ventral side is yellowish-white. At the base of the caudal fin are two very evident white spots. On the scales of the lateral line are two small black dots, weakly pronounced. On the rays of the dorsal and caudal fins (rarely on other fins as well) are two rows of black spots, weaker than in Gobio gobio.

Dimensions: Up to 10.5 cm without the caudal fin, 12.3 cm total length.

Variability: The coloration varies greatly, even within the same population.

Ecology, behavior, and reproduction: It lives in mountain and hill rivers, localized at fords and rapids, where the water has a speed of 70-115 cm/s, and the bottom is rocky. Sometimes it reaches the plains, but only in rapids. The fry stay in slower water, sometimes on sandy bottoms. Although many individuals are found in certain rapids, they never form true schools. The food consists of biofilm and small rheophilic invertebrates. Reproduction takes place in May-June; the eggs are deposited on stones. Sexual dimorphism is manifested only by the greater thickness of the female's body and by the greater length of the paired fins in males.

### j) *Sabanejewia balcanica – Balkan golden loach*

This is a fairly widespread species in the flowing waters of Romania. Telcean & Bănărescu (2002) categorize it among the species that have maintained their distribution range and abundance in recent years.

Fig. 157 Specimen of Sabanejewia balcanica, identified during evaluations in the Jiu River

Description and identification: The body is of variable height, moderately laterally compressed. The suborbital spine is strong, with two divergent branches, the large branch strongly curved. The eyes are close; the interorbital space is flat, equal to, slightly larger, or smaller than the eye. The anterior nostril is prolonged in the form of a tube. The caudal peduncle has an adipose crest, more developed during the breeding period; the anterior limit of this crest coincides with the tip of the dorsal fin (when this fin is folded). No ventral adipose crest. The insertion of the ventral fins is located a short distance behind the anterior margin of the dorsal fin base. The caudal fin is slightly truncated. The pectoral and ventral fins are rounded, the margin of the dorsal and anal fins is straight.

Coloration: The background is yellowish-white, sometimes with a golden tinge. Dorsally, there are 10-14 (rarely 8, 9 or 15, 16) spots; these are longer than wide, their length is greater than or equal to the distance between them. The lateral spots number 10-13 (rarely 8, 9 or 14); their shape is varied. Between the dorsal and lateral spots, there is abundant pigmentation, consisting of small and irregular spots, more or less anastomosed into a network. This pigmentation extends to the caudal fin. At the base of the caudal fin, there is a dorsal and a ventral gray spot, which are generally small and distanced. The variability is very pronounced.

Ecology, behavior, and reproduction: It lives in rivers from the mountains to the plains; it prefers gravel bottoms mixed with sand but is also frequently found in exclusively sandy portions of rivers. It is quite frequently found on clay bottoms, under vertical banks, at the roots of willows. In sandy rivers, it spends most of its time buried in the sand. It is absent in muddy rivers. Reproduction takes place in spring, often until mid-summer. The diet consists of diatoms and small invertebrates.

***k) Sabanejewia romanica – Romanian loach***

This is an endemic species in Romania, present in rivers and streams in the southern part of the country, but also in some places in the Mureș and Olt basins in Transylvania. It is listed in the Red Book of Vertebrates from Romania as a vulnerable species (Bănărescu, 2005).

Fig. 158 Specimen of Sabanejewia romanica, identified during evaluations in the Jiu River

Description and identification: The body is elongated, low, and thick. The body height is almost uniform from the insertion of the pectoral fin to that of the dorsal fin. The two lobes of the lower lip are deeply serrated and pointed. The first pair of barbels is the shortest, the third the longest. The suborbital spine is thinner than in S. balcanica. The pectoral, ventral, and anal fins have rounded margins, the margin of the dorsal fin is very slightly convex, the caudal fin is truncated or slightly concave. The scales are very small, with a smooth and large focal (central) zone, the peripheral zone is narrow, with numerous radial striations. The coloration is lighter than in other species of the genus. The fundamental color is white, with a yellowish tinge. The spots are brown, gray. On the dorsal median line, there are 9-14 spots, the edges of these spots are straight or rounded. On the middle of the flanks, from the operculum to the base of the caudal fin, there is a very thin, bluish or black streak, continuous or interrupted.

Females reach up to 12 cm, males up to 10.5 cm total length.

Ecology, behavior, and reproduction: It lives in mountain and hill rivers, in the grayling and Eurasian minnow zone and in the nase zone, rarely to the barbel zone, as well as in the upper part of the chub zone in small rivers that originate in the hill area. It stays in the sandy areas of rivers, but where there are also boulders. In the exclusively sandy portion of rivers (i.e., in the barbel zone), it is generally absent. A good part of the time they stay buried in the sand, from which only the tip of the snout emerges.

The fry stay in slow-flowing water, with a bottom of fine sand, more or less mixed with mud and covered by a biofilm of diatoms.

Reproduction takes place from May to July, perhaps even in August.

They feed on diatoms, other algae, and small animals from the surface of stones and sand. (Bănărescu, 1964)

***l) Salmo trutta – brown trout***

The species is widespread in most of the country, in the mountain area. Telcean & Bănărescu (2002) categorize it among the species that have maintained their distribution area and abundance in recent years.

Fig. 159 Specimens of Salmo trutta identified in the Bratcu stream, during the evaluations

Description and identification: It is usually 20-30 cm long and 200-600 g; it reaches 40 cm and over 800 g, rarely over 1 kg, exceptionally 8-10 kg. It lives up to 10-12 years. The body is elongated, slightly laterally compressed and covered with small scales. Head and opercular parts without scales. Dorsal profile slightly more convex than ventral. The head is large, with a wide terminal or subterminal mouth, and provided with sharp teeth on the premaxilla, maxilla, palatine, dentary, tongue, plate, and manubrium of the prevomer. All teeth are strong and directed backwards. The snout is short and obtuse, the upper jaw slightly exceeds the lower. Dorsal fin short with straight edge and anal fin slightly concave. Pectoral and ventral fins short and rounded. The ventral fins insert behind the middle of the dorsal fin. Caudal fin weakly excavated in adult, more excavated in juveniles. The adipose fin inserts above the posterior part of the anal fin. Lateral line complete, rectilinear, arranged on middle of body and caudal peduncle.

The color of the body varies according to age, sex, sexual activity, nature and temperature of the water, etc. In shaded and vegetated waters, mountain trout are darker. In adults the back is greenish-brown or olive-green with rounded black or sometimes red spots; the flanks of the body are yellowish, the abdomen yellowish-white. The flanks have in the dorsal part some black spots arranged in irregular longitudinal rows. On the middle of the flanks, near the lateral line, red spots surrounded by a narrow white border. Dorsal and caudal fins gray. Dorsal fin with rounded black and red spots. Pectoral, ventral and anal fins grey-yellowish, often with white anterior margin. (Bănărescu, 1964)

Ecology, habitat and reproduction: It is a cryophilic (optimum temperature 14°-16°) and oxyphilous species and lives only in mountain waters (up to the spring), especially in the upper reaches of rivers and streams, occasionally in lakes. In the north of Europe it also lives in the plains, in the center of Europe only in the mountains. It has been introduced to North America, Africa and New Zealand. It especially likes the holes, where it spends the day hiding at the bottom, under stones, at night it goes out hunting. The brown trout is the best swimmer in our waters. It cuts through the water with the ease of an arrow, overcoming obstacles that no other fish can get over. If necessary, jump waterfalls up to 4 m high.

The main food of trout is worms and various insects, both aquatic (larvae of ephemeroptera, plecoptera, tricoptera) and aerial (to catch which the fish often jumps out of the water). It also feeds on frogs, small fish (Cottus, Phoxinus, Barbatula etc.), eggs and even the young of its own offspring. They also like gammarus crustaceans.

Sexual maturity is reached at 3-4 years. The breeding season lasts from October to the end of December, at a temperature below 6-8°C. To breed, mountain trout migrate up streams to springs, and lake trout move up tributaries. During the spawning season, trout do not feed.

In the breeding season, both sexes are more brightly colored. The males bully each other and the victors accompany the females to the mating site. The female digs on the bottom of the streams with the help of her fins some pits in which she lays her eggs, which the male sprinkles with milk. The pits are then covered with gravel, thus protecting them from enemies. Females lay 1000-1500 eggs per 1 kg of fish. Spawns are yellow or orange in color and 4.5-5 mm in diameter. The fry hatch in spring. After spawning, the adults descend to the bottom of the water.

***m) Squalius cephalus – the european chub***

It is a common species, present in rivers and streams in the hilly area. Telcean & Bănărescu (2002) categorize it among species that have been favored by human activities such that they have increased their distribution area or abundance in recent decades.

Fig. 160 Specimen of Squalius cephalus identified outside the project implementation area

Description and identification: Head elongated, thick, weakly compressed laterally. Dorsal profile weakly convex. Large head, eyes located in the front half of the head, look to the side. Interorbital space very slightly convex, almost flat. The snout is rounded, the mouth large, terminal, the two jaws perfectly equal. The corners of the mouth reach below the anterior margin or below the middle of the eye. The insertion of the dorsal is slightly closer to the base of the caudal than to the tip of the snout. The pectorals do not touch the base of the ventrals, the ventrals do not touch the base of the anal. Insertion of ventrals located slightly in front of the dorsal. Scales thick, well set, chest and isthmus completely covered with scales. A scaly appendage at the base of the ventral. Lateral line slightly curved, located on the middle of the caudal peduncle.

Coloration: The back is grey-green, the flanks are silvery, without metallic luster, the ventral part is white. Dorsal and caudal gray, other fins yellowish, sometimes striking red, iris yellow.

Ecology, behavior and reproduction: Lives almost exclusively in running water: in rivers in the trout area and up to or very close to their discharge into the Danube, then in streams and small flat rivers. It usually breeds in April-July. It lays its eggs in a moderate current, sticking them to stones, less often to plants. During the reproductive period nuptial tubers appear in both sexes.

The longevity of the species is typically 8-9 years. Food consists of aquatic invertebrates and fish, rarely eats plants. Old specimens primarily consume fish (Bănărescu, 1964).

**G.4. Presentation of the results of field evaluations**

During the evaluations carried out between April and June 2024, a total of 17 sectors were inventoried, their length being 150 m each. When choosing the evaluation stations, the location of the proposed intakes and the location of the proposed evacuation were taken into account. Both the ichthyofauna of the Jiu River and the ichthyofauna of its major tributaries in the project implementation area were inventoried, so that in addition to the placement of evaluation stations on the Bratcu and Dumitra streams, one station was also placed on the Strâmbuța, Polatiștea, Chitu streams and Sadu.

In addition to these, an evaluation station was also placed on the Jiu River, downstream of the Bumbești-Jiu locality, in order to identify those species that are present downstream of the PNDJ, but can occasionally climb inside it as well as to evaluate the impact of the water evacuation from the Bumbești HPP level, on the downstream ichthyofauna.

The electronarcosis machine was used during data collection. The methodology is described in the chapter "Description of the methodologies used to collect data on ichthyofauna".

A total of 14 species of fish and cyclostomes were identified (Alburnoides bipunctatus, Barbatula barbatula, Barbus barbus, Barbus sp., Cottus gobio, Eudontomyzon sp., Gobio gobio, Phoxinus phoxinus, Pseudorasbora parva, Romanogobio uranoscopus, Sabanejevia balcanica, Sabanejewia romanica, Salmo trutta and Squalius cephalus), of which five species are of community interest (Barbus sp., Cottus gobio, Eudontomyzon sp., Romanogobio uranoscopus, Sabanejevia balcanica) and one is invasive (Pseudorasbora parva).

Considering the fact that in the last decades the species Barbus sp. have been divided into several species (Kotlik et al. 2002, Antal et al. 2016), and these cannot be identified only on the basis of external morphology, as well as the fact that from the Jiu river basin we have no genetic data on this species, for this we used the name Barbus sp.

Likewise, in the case of the species Eudontomyzon sp. we identified only larvae, and the larvae cannot be determined only on the basis of some morphological characters, thus we used the name Eudntomyzon sp. Moreover, some ongoing genetic research seems to reconsider the situation and distribution of the species of the genus Eudontomyzon (Antal L., personal communication), including those from Romania, so we consider it appropriate to use the name Eudontomyzon sp.

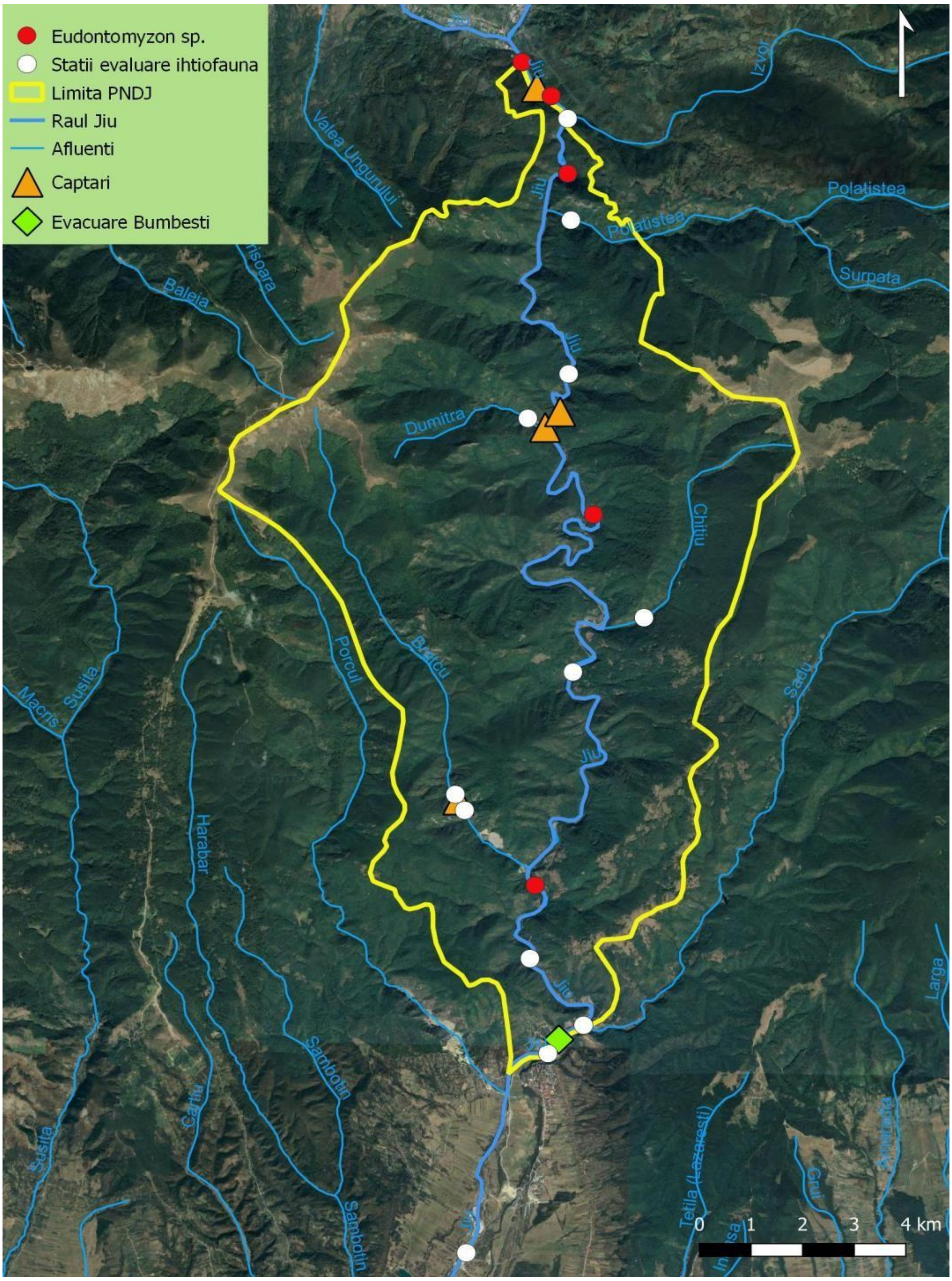



Fig. 161 The presence of Eudontomyzon sp. (red dots) at the level of evaluation stations

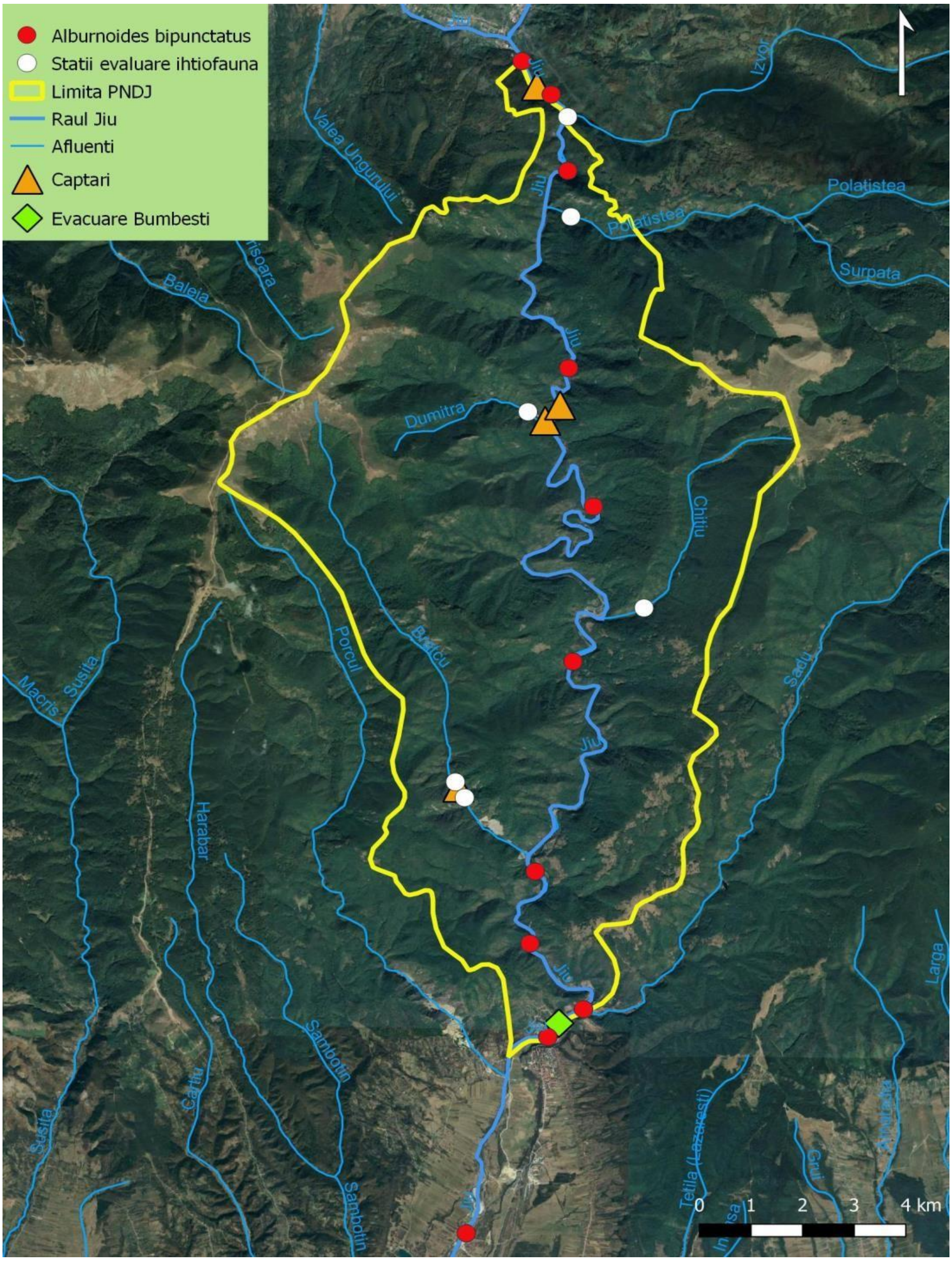



Fig. 162 The presence of the species Alburnoides bipunctatus (red dots) at the evaluation stations

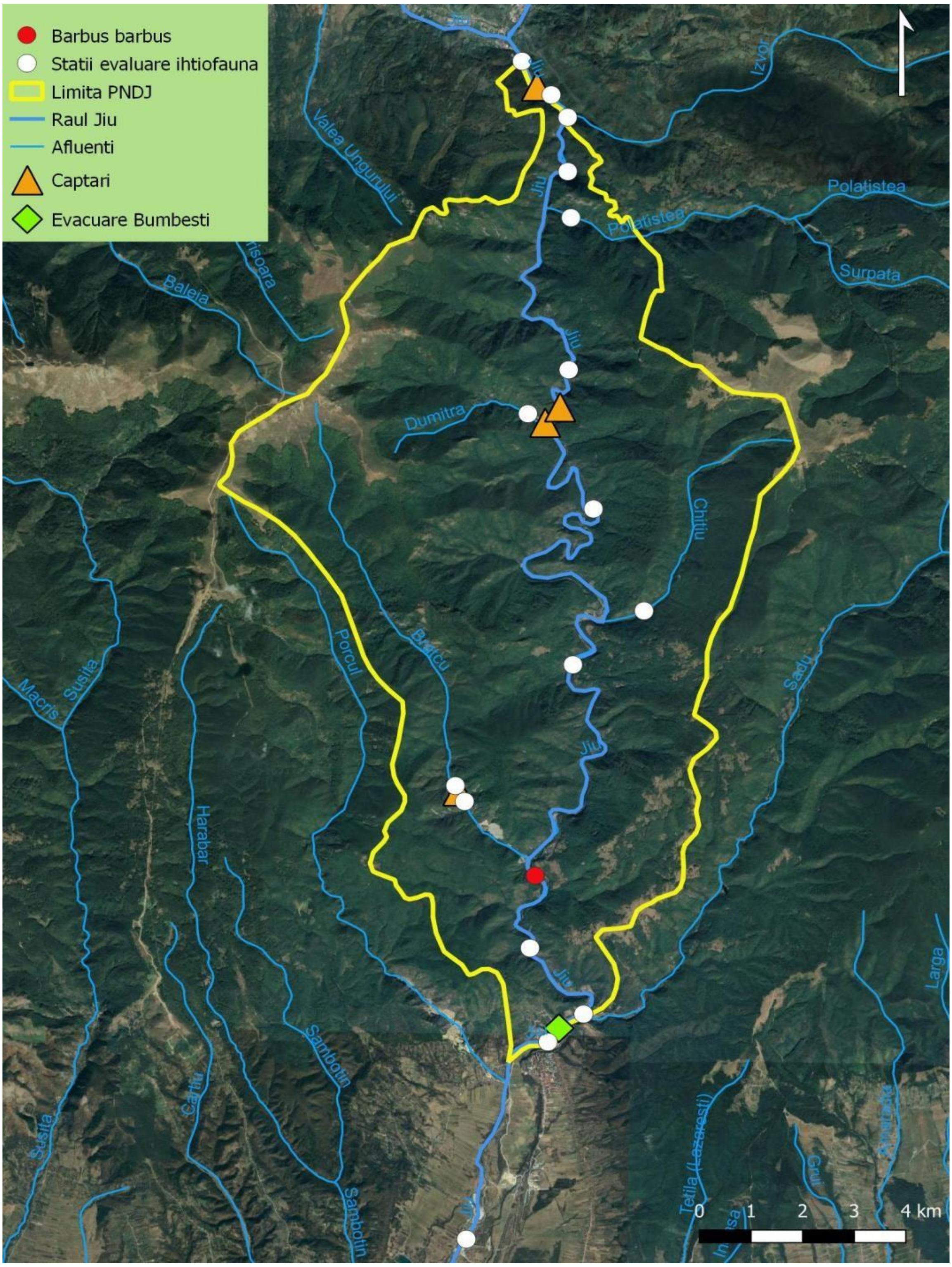



Fig. 163 The presence of the species Barbus barbus (red dots) at the evaluation stations (according to a specimen identified in a fisherman's catch)

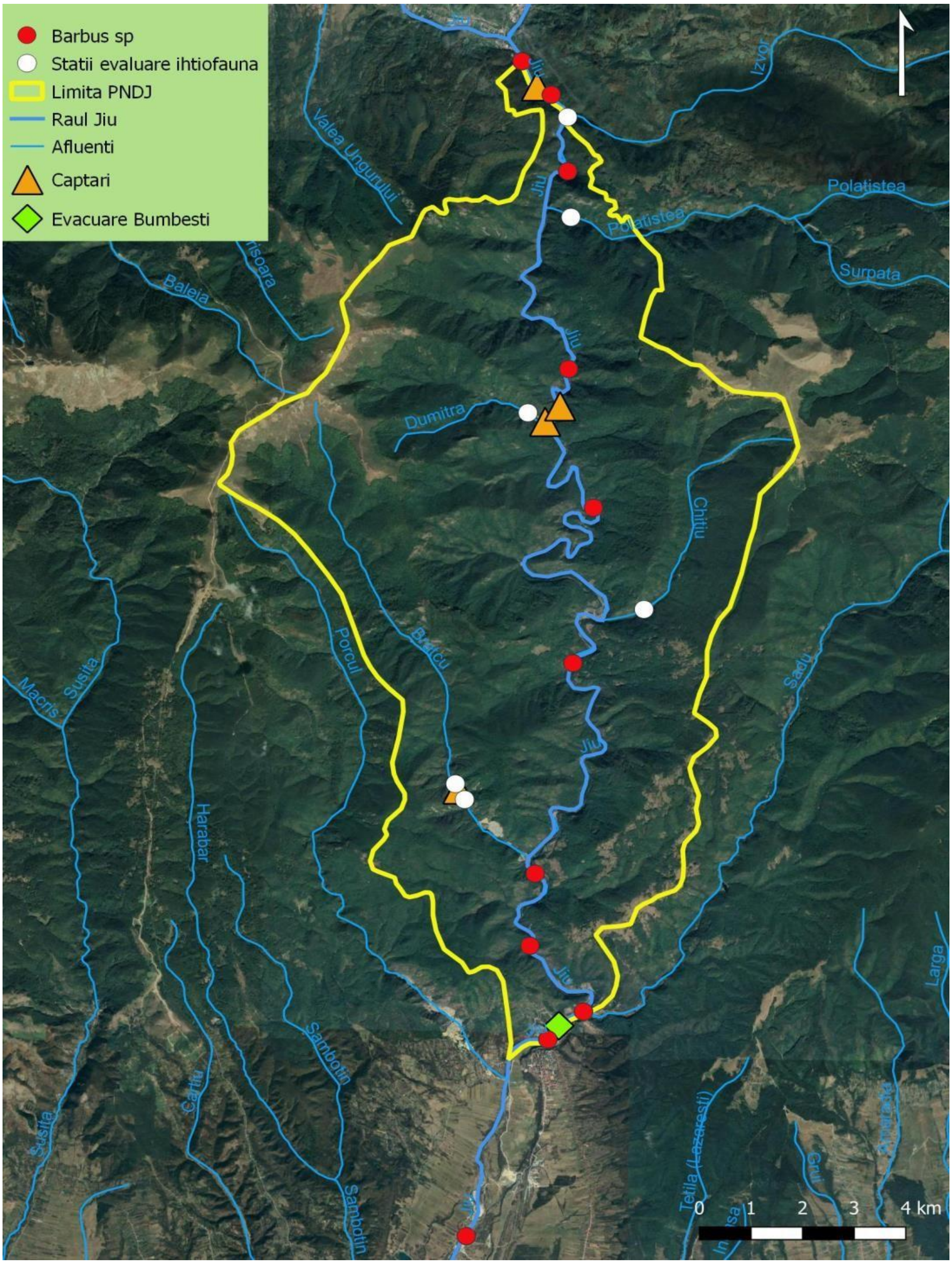



Fig. 164 The presence of the species Barbus sp. (red dots) at the level of evaluation stations

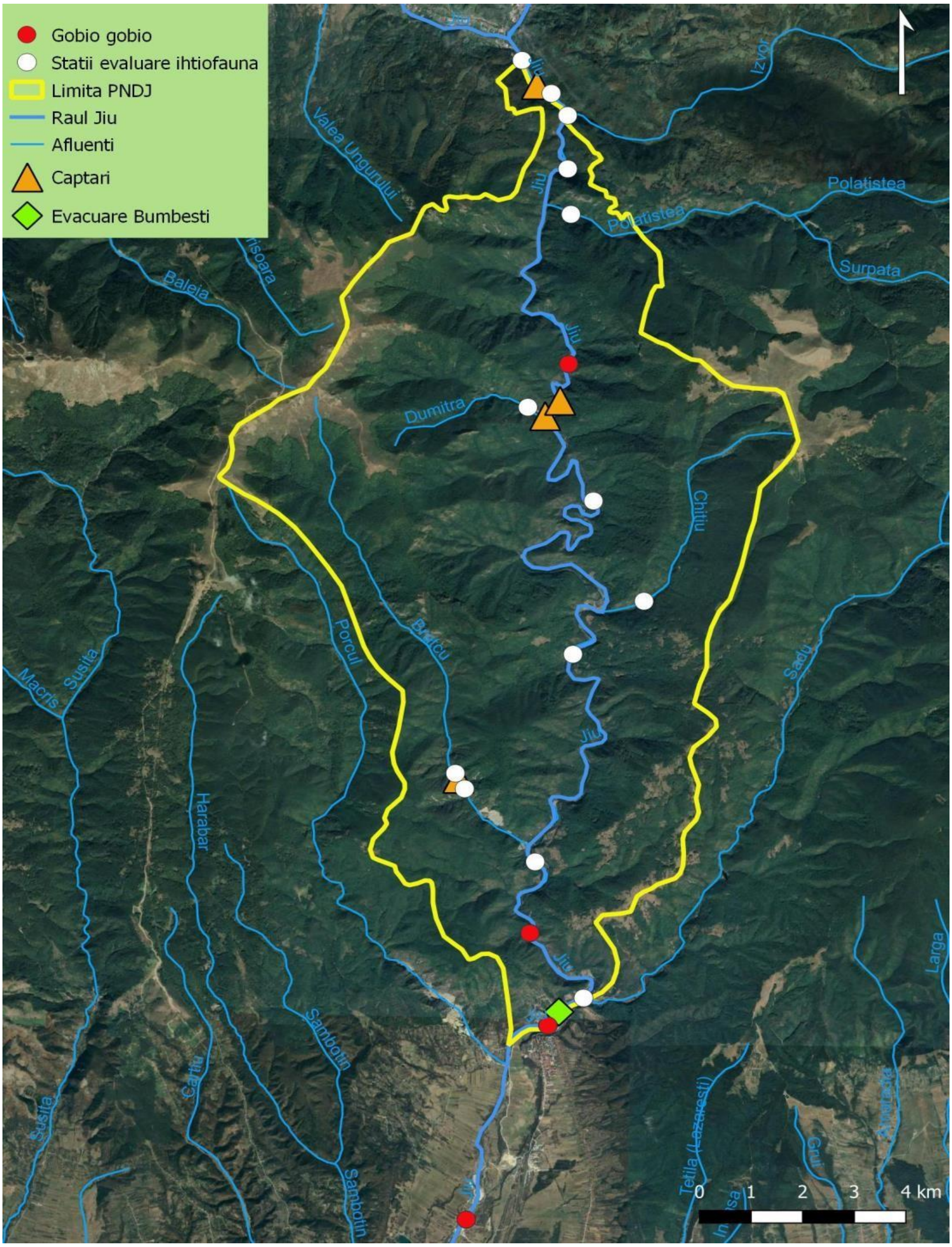



Fig. 165 The presence of the species Gobio gobio sensu lato (red dots) at the evaluation stations

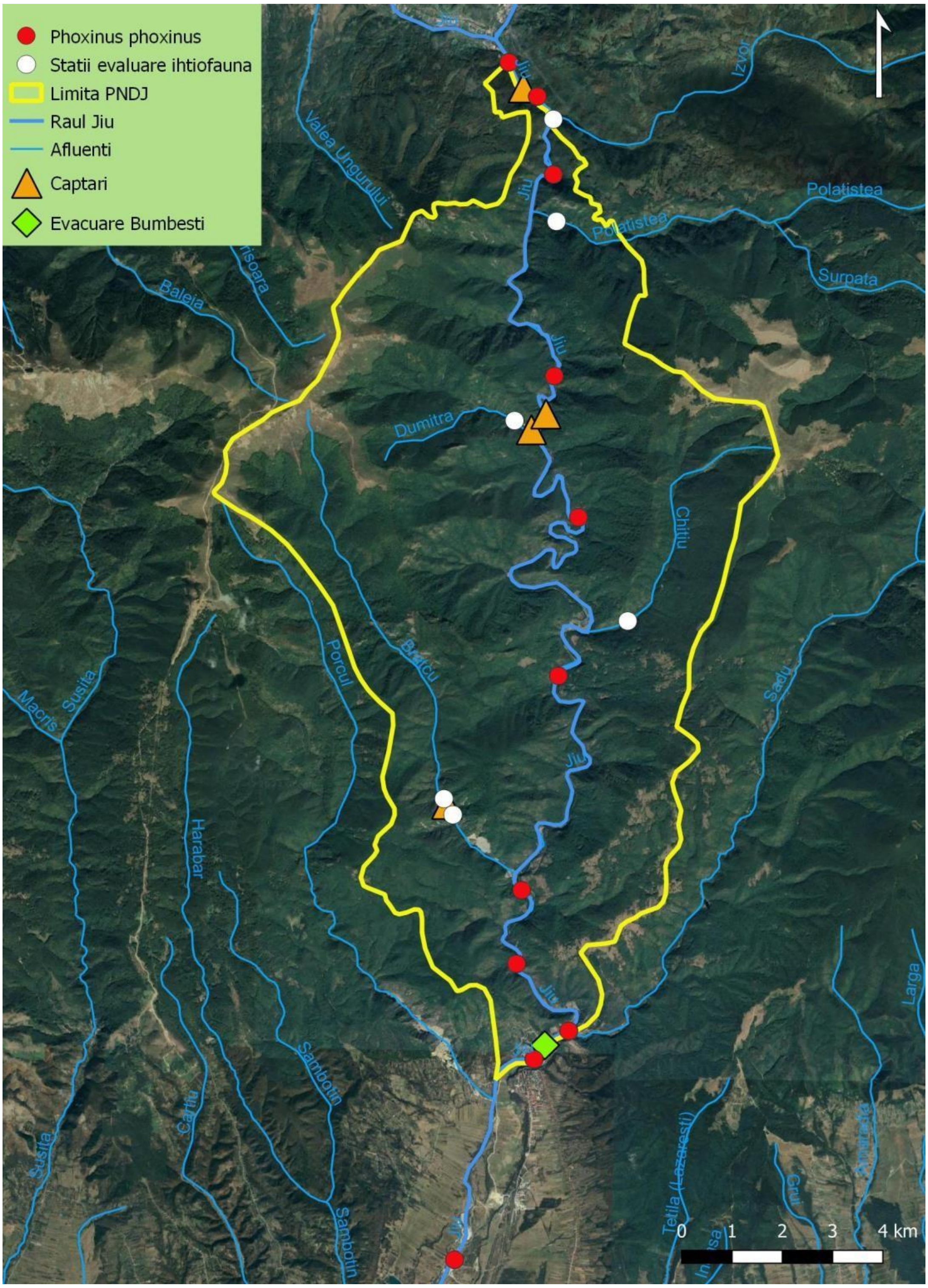



Fig. 166 Prezența speciei Phoxinus phoxinus (puncte roșii) la nivelul stațiilor de evaluare

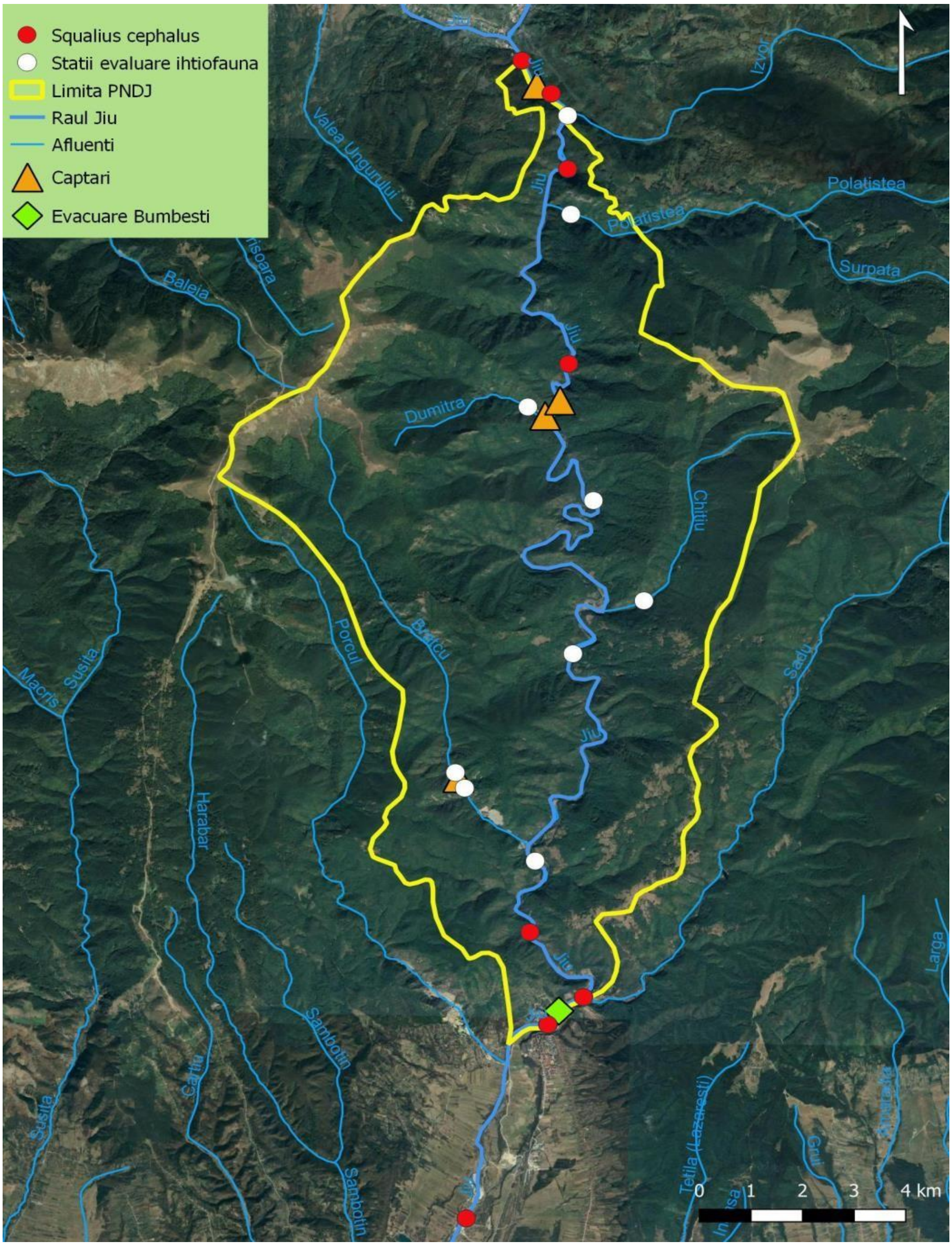



Fig. 167 The presence of the species Squalius cephalus (red dots) at the evaluation stations

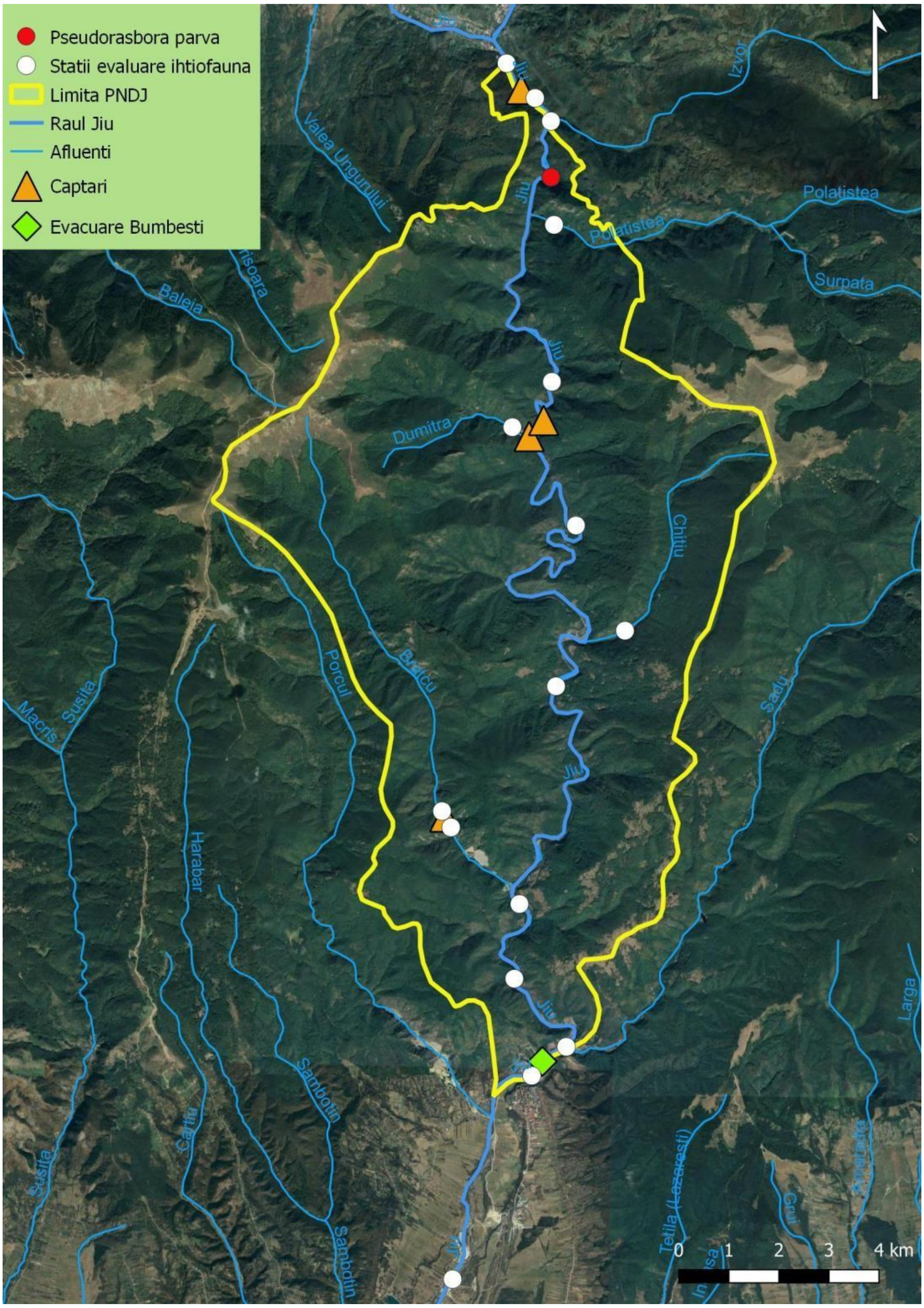



Fig. 168 The presence of the species Pseudorasbora parva (red dots) at the evaluation stations

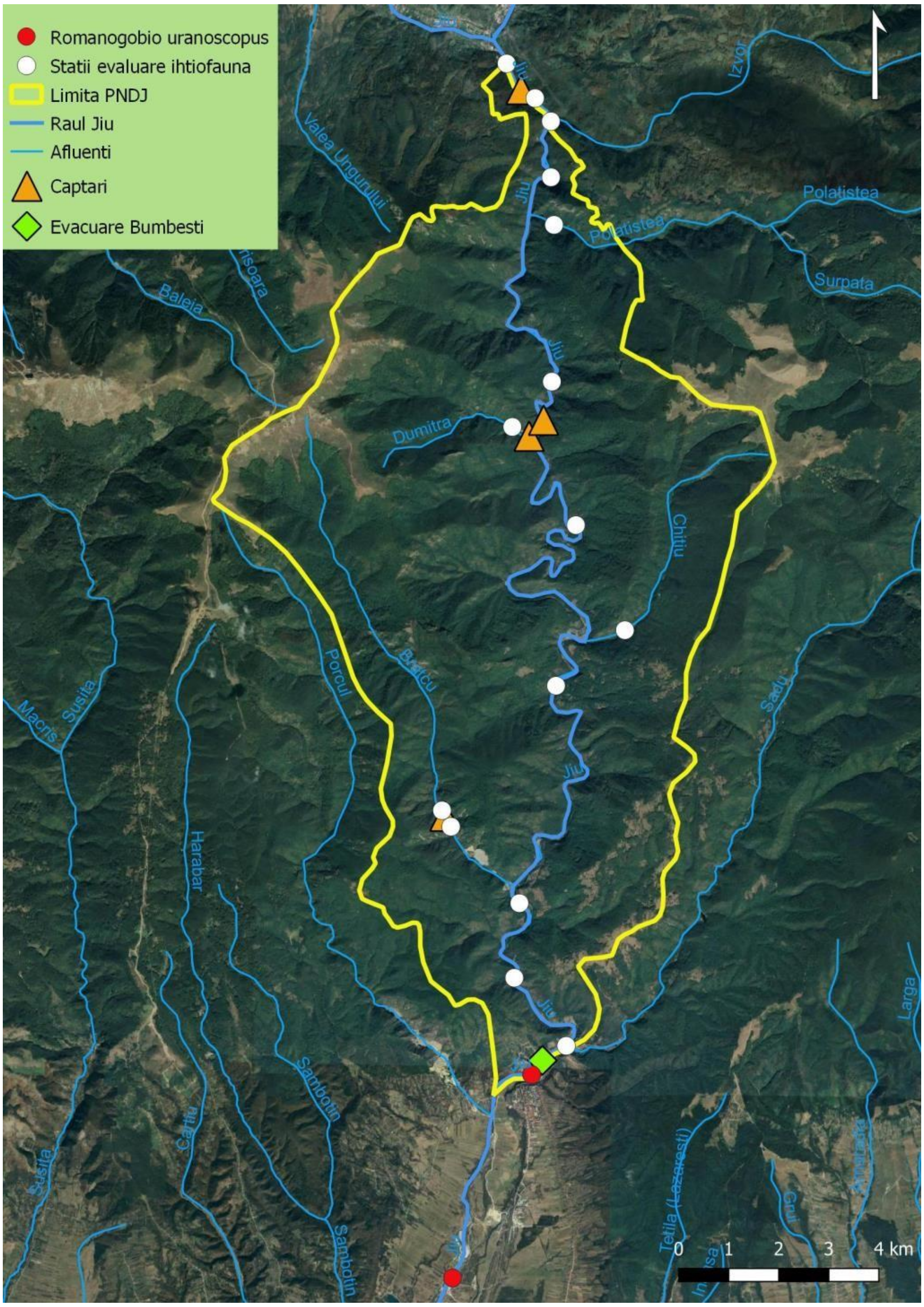



Fig. 169 The presence of the species Romanogobio uranoscopus (red dots) at the evaluation stations

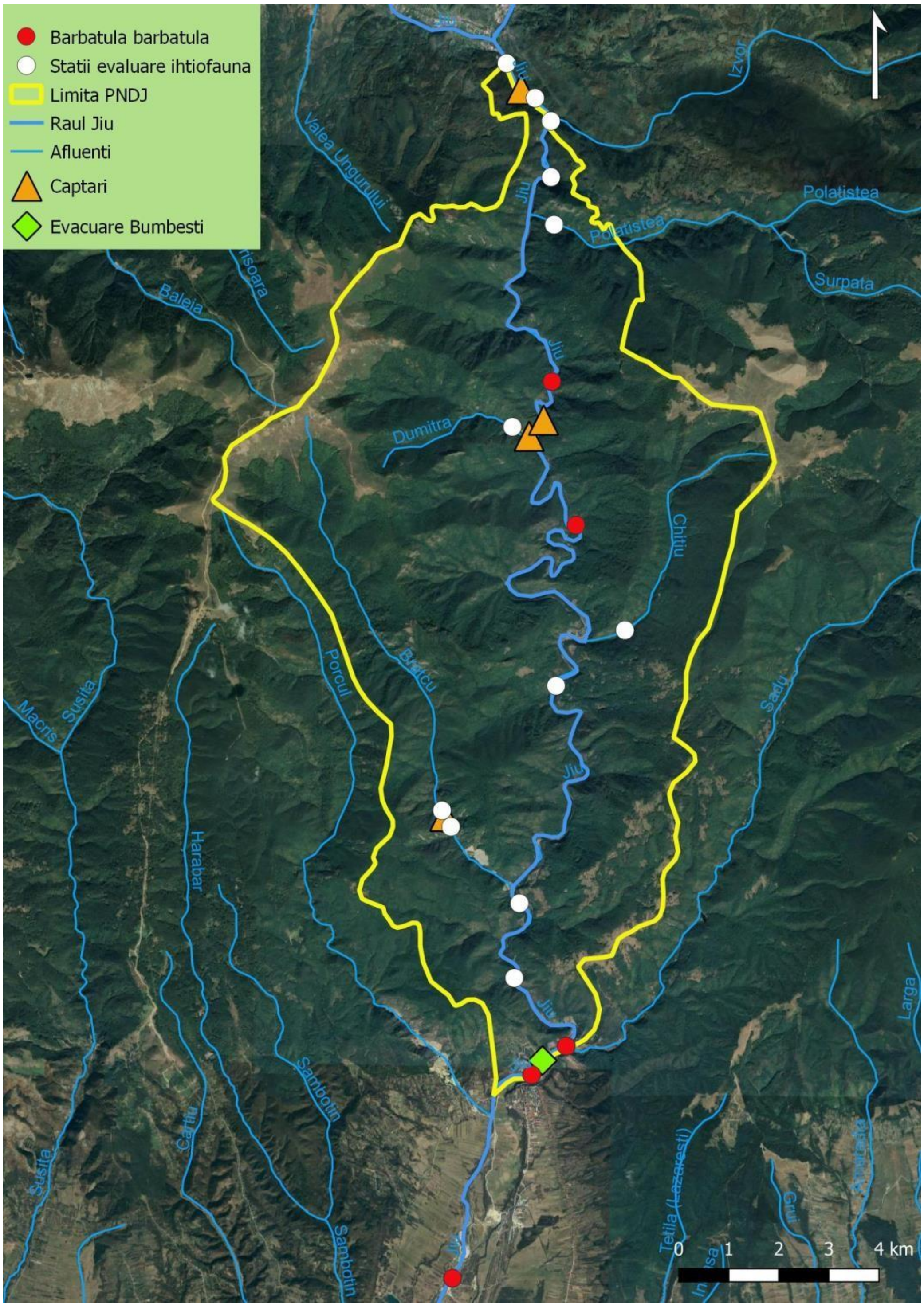



Fig. 170 The presence of the species Barbatula barbatula (red dots) at the evaluation stations

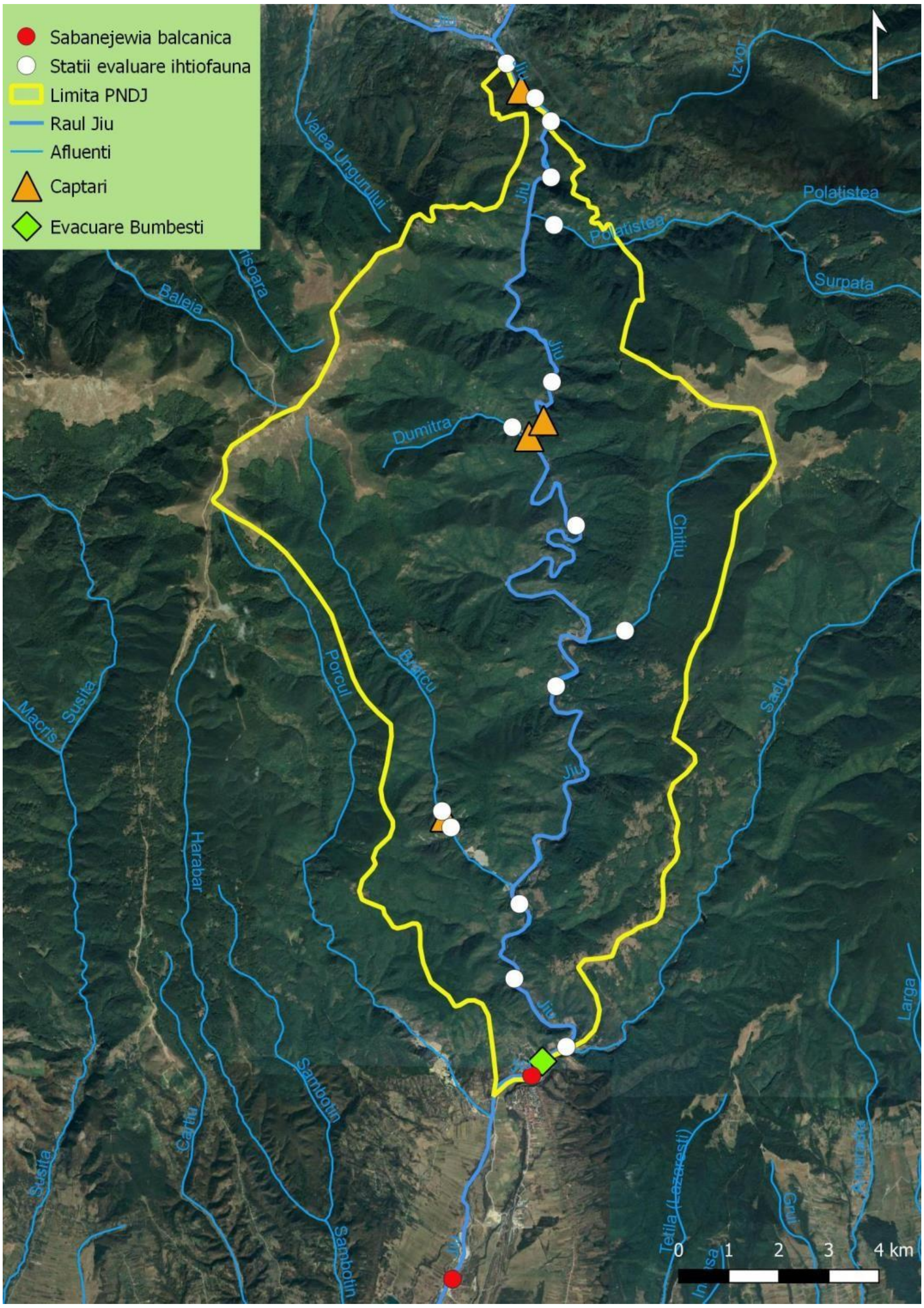



Fig. 171 The presence of the Sabanejewia balcanica species (red dots) at the evaluation stations

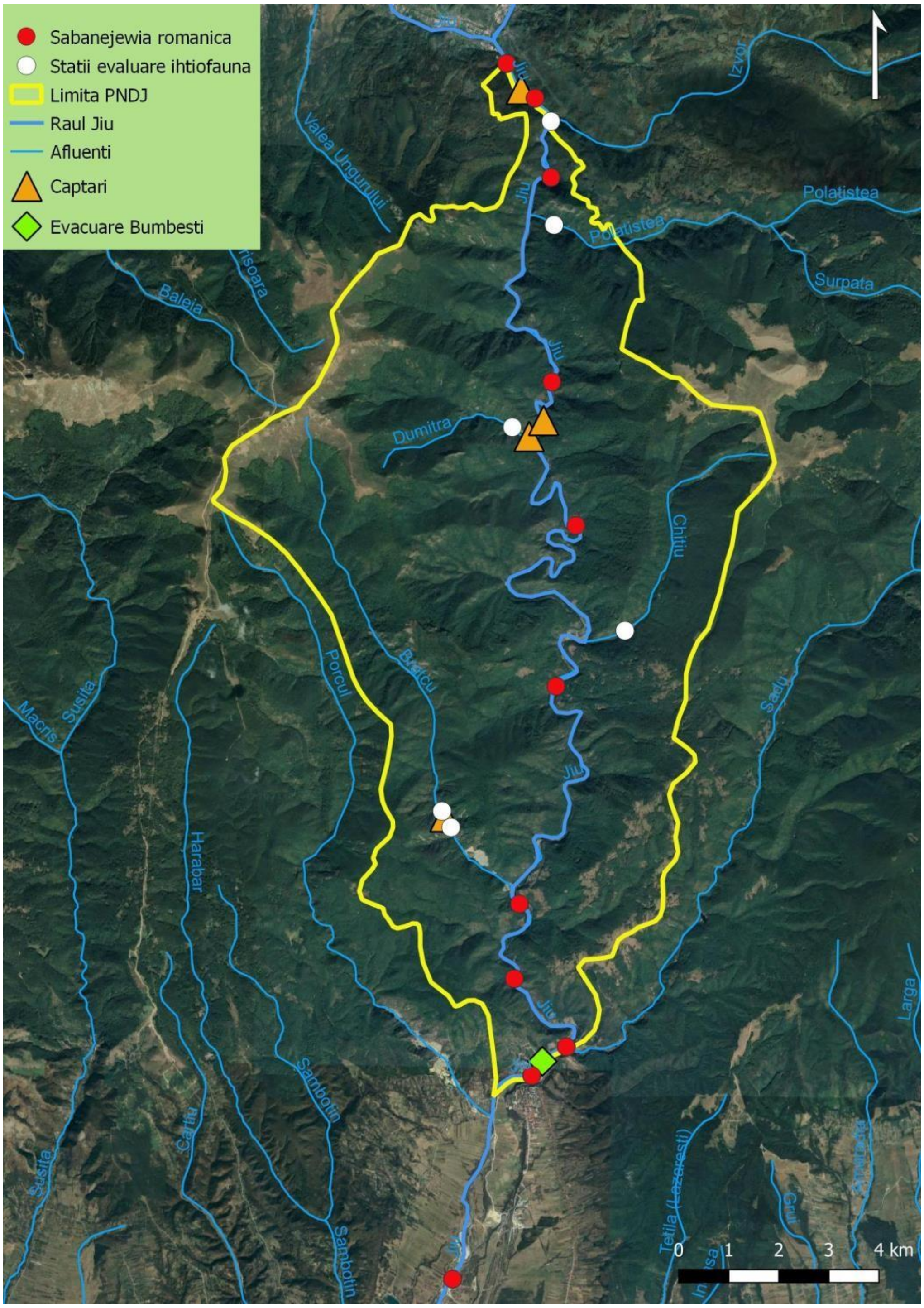



Fig. 172 The presence of the species Sabanejewia romanica (red dots) at the evaluation stations

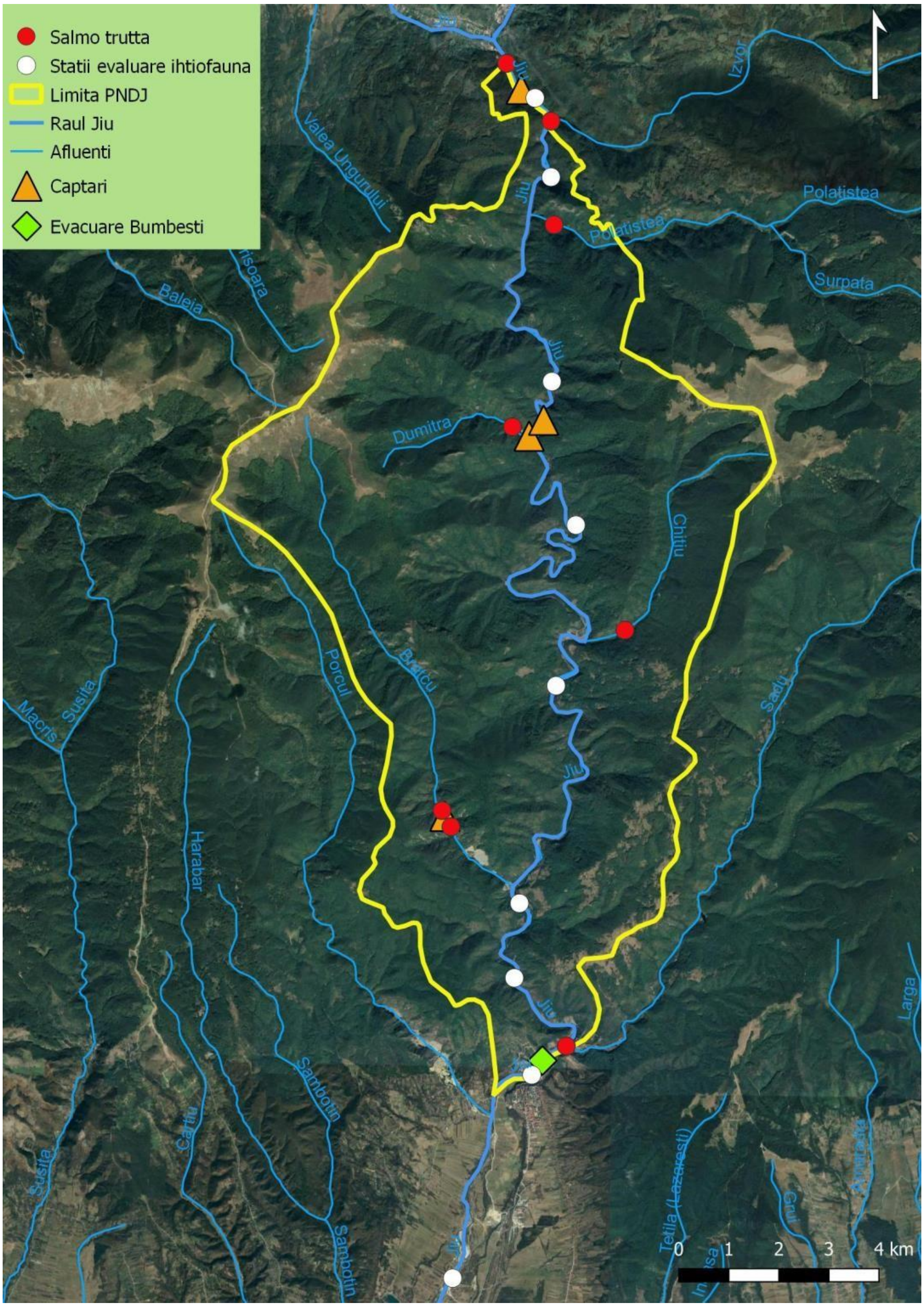



Fig. 173 The presence of the species Salmo trutta (red dots) at the evaluation stations

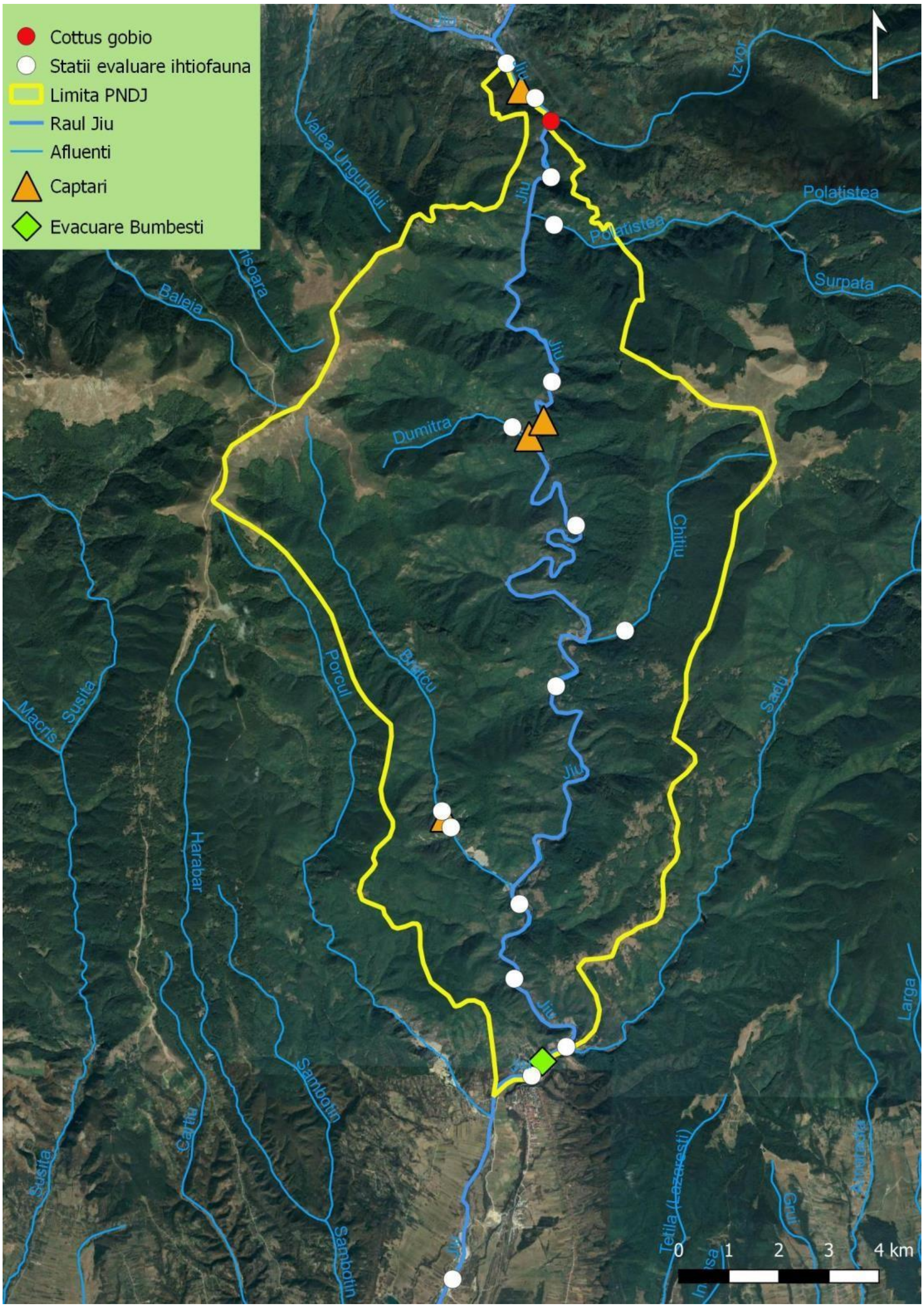



Fig. 174 The presence of the species Cottus gobio (red dots) at the evaluation stations

**G.5. Conservation status for species of community interest:**

The conservation status of species of community interest must be assessed according to the provisions of Order 304/02.04.2018 regarding the approval of the Guidelines for elaborating Management Plans for protected natural areas..

According to Article 2.2. of the Habitats Directive 92/43 EEC, conservation measures must lead to maintaining or improving the conservation status to ensure favorable conservation status for natural habitat types and species of wild flora and fauna of community importance.

Thus, favorable conservation status can be described as the situation in which a habitat type or species thrives (both in terms of area and population size, as well as in terms of population quality, including reproductive capacity, age structure, mortality) and there are prospects for it to thrive also in the future without significant changes in existing policies and management. The fact that a habitat type or species is not threatened (e.g., there is no direct risk of becoming extinct) does not mean that it is in a favorable conservation status. The objective of the directive is defined in positive terms, oriented towards a favorable situation that must be defined, achieved and/or maintained. Therefore, the objective of the Habitats Directive aims for more than avoiding the disappearance of habitat types or species.

Unfavorable conservation status is divided into two classes:

- "Unfavorable-inadequate" for situations where a change in policies or management is necessary to bring the habitat type or species into favorable conservation status, but there is no danger of disappearance in the foreseeable future (e.g., 50-100 years);
- "Unfavorable-bad" for situations where the habitat type or species is in danger of disappearing in the foreseeable future (e.g., 50-100 years).

For all situations where there is insufficient information to make an appropriate assessment, the conservation status is considered "unknown".

According to the draft Integrated Management Plan of Jiu Gorge National Park, currently pending approval, the conservation status of fish species of community interest is:

- Barbus balcanicus (formerly Barbus meridionalis): unfavorable-inadequate;
- Romanogobio uranoscopus (formerly Gobio uranoscopus): unfavorable-inadequate;
- Sabanejewia balcanica (formerly Sabanejewia aurata): unfavorable-inadequate.

**G.6. Project impact on ichthyofauna:**

According to the impact assessment study on water bodies (p. 133), all analyzed water bodies for which possible effects (impact/cumulative impact) have been identified, currently meet the environmental objectives (good ecological status and good chemical status) and, therefore, may present the risk of deterioration at the level of some quality elements.

Similarly, in the impact assessment study on water bodies, on page 137 it is mentioned that "in the case of water bodies: Jiu - confluence of East Jiu - Vădeni Reservoir and Bratcu - source - confluence Jiu, through the previous analysis, a significant impact was highlighted due to existing works, the change in physical characteristics of the water body being clearly translated into a significant effect."

"The possibility of building a system for reintroducing sediments downstream of the water catchment works was analyzed, a measure aimed at mitigating the impact on the Substrate element (hydromorphology), but this is not feasible to be implemented due to the disproportionate costs of this measure" (p. 139).

On the other hand, to have a picture of the effect of this project on ichthyofauna, we must review the conclusions of some studies from the specialized literature that have analyzed the effects of interrupting longitudinal connectivity, blocking/slowing sediment transport, and the effects of flow reduction.

Globally, freshwater aquatic habitats are among the most endangered habitats, as they are exploited in terms of water use, are dried up or polluted by human settlements or other economic activities, thus reducing both the space and the quality of habitat for water-dependent species (Nilsson et al. 2005; He et al. 2011; Wen et al. 2017; Duarte et al. 2021; Wilkinson et al. 2022). Worldwide, natural river courses are seriously modified by hydropower and hydrotechnical development projects (Grill et al. 2019; Barbarossa et al. 2020). These changes can have cascade effects on the ecosystem, leading to alterations in the food web, nutrient cycle, and other ecological processes (Freedman et al. 2013; Harvey & Altermatt, 2019; Maavara et al., 2020).

Dams and migration barriers (e.g., water intakes) modify the natural flow of a river, leading to changes in the physical characteristics of the river, such as depth and width of the riverbed, and can also affect the distribution and circulation of sediments and nutrients (Jumani et al. 2020, Xu & Milliman, 2009). Sediment transport plays an important role in shaping the riverbed, and changes to this process can have consequences for the physical structure of the river and the species living in it. Changes in these physical characteristics of the river and alterations in species abundance and distribution can lead to changes in the entire food web (Freedman et al. 2013; Oliveira et al. 2018). Transverse barrier works (dams, spillways, and bottom sills) can obstruct the migration of fish and other aquatic species (Branco et al. 2017).

Fig. 175 (European bullhead) trapped after a sudden decrease in water level downstream of a micro-hydropower plant. (Foto: Gothárd Ferenc Alpár)

Branco et al. (2017) hypothesized that small transverse barrier works promote residency in potamodromous cyprinids, and fish transition from a potamodromous to a resident lifestyle, even if they are capable of passing over small thresholds. For these reasons, assessing the impact of small obstacles on rivers is also necessary, as their number far exceeds that of large barriers and dams (Belletti et al. 2020).

Nearly half (41.2%) of freshwater fish species in Europe, assessed by the IUCN Red List, are considered threatened (Costa et al. 2021). According to the IUCN threat classification, the most important threats to freshwater fish species in Europe are "Dams and water management/use" (Costa et al. 2021), affecting over half of all native fish species in Europe (Schinegger et al. 2016; Duarte et al. 2021).

Studies by Fischer and Kummer (2000) and Uzunova et al. (2017) show that sections where water is extracted/with significant oscillations/or have extremely low water levels and have transverse barrier works (the habitat is fragmented), are only moderately suitable habitats for adult specimens of some species from mountain streams and are totally unsuitable habitats for the much less mobile juvenile stages.

Dewson et al. (2007) reviewed several scientific articles on the effect of flow reduction and found that flow reduction affects both the density and diversity of macroinvertebrates, the main food base for fish species.

Fig. 176 Image of mayfly larvae stranded after a sudden decrease in water level downstream of a micro-hydropower plant. (Foto: Gothárd Ferenc Alpár)

Fig. 177 Image of deposited eggs left dry after a sudden decrease in water level downstream of a micro-hydropower plant. (Foto: Gothárd Ferenc Alpár)

Ovidio et al. (2004) studied the effect of micro-hydropower plants on brown trout and grayling and found that brown trout biomass decreased by 23% and grayling biomass by 61% in the first year in the area affected by the micro-hydropower plant operation. Additionally, the operation of the micro-hydropower plant affected (reduced) the migration distance of these species during the breeding period. Similarly, level fluctuations caused by the micro-hydropower plant operation affected the egg-laying activities of the two species mentioned above.
Česonienė et al. (2021) studied the effect of micro-hydropower plants in Lithuania (10 micro-hydropower plants studied) and found that they had a negative effect on the abundance and biomass of fish species in the sectors downstream of micro-hydropower plants.

Friedrichs-Manthey et al. (2024) studied the effect of historical flow modifications versus future climate changes in the upper Danube basin for 48 fish species (of which 8 species are also present in the Jiu Gorge) and found an increase in the vulnerability of fish species, being affected especially by temperature increase (but not only). Similarly, they found that species living in fast, well-oxygenated, and cold-water rivers (such as the Mediterranean barbel, brown trout, Danube whitefin gudgeon, or European bullhead, from the area affected by the Livezeni-Bumbești Hydropower Development) were predicted to face high vulnerabilities in the future in those areas where flow is diminished.

Studying the effect of transverse barrier works in Transylvania, Nagy (2023) found that the total number of fish species decreased as the number of downstream barriers increased, and this effect was mainly determined by changes in the number of native species. Transverse barrier works lead to the loss of rheophilic (lotic) habitat, as the habitat above the dam becomes lentic (Birnie-Gauvin et al. 2017). At the same time, barriers impede the migration of potamodromous species and disrupt the reproductive, feeding, and wintering movements of sedentary species (De Leeuw & Winter, 2008; Branco et al., 2017), limiting the ability of fish to adapt to climate change (Comte et al., 2014). Telcean and Cupșa (2015) studied the effect of fragmentation on the Crișul Repede River and found that out of the 29 fish species identified along the affected channel of the Crișul Repede River, 9 species are strongly affected by the isolation process and population fragmentation due to hydropower developments. A similar effect was also found in the case of the Crișul Negru River (Telcean et al., 2017).

Costea et al. (2021) studied the effect of micro-hydropower plants on the ichthyofauna of rivers and streams in the mountainous area of Romania and found that their commissioning affected the ichthyofauna of the studied rivers. Populations of brown trout (Salmo trutta) and European bullhead (Cottus gobio) have been reduced or have disappeared from many streams in the Carpathians that have been affected by these micro-hydropower plants. Thus, from 34% of the sections upstream of the micro-hydropower plants area, and 40.6% located downstream, fish species that were present before the construction and operation of micro-hydropower plants have disappeared.

In the study area, for example, the species Romanogobio uranoscopus will be affected by the reduction of flow and the reduction of water velocity, thus reducing the ideal habitats for this species, which requires a water velocity of 0.7-1.15 m/s (Bănărescu, 1964). Similarly, the species will also be affected by "hydropeaking" activities. The two species of the genus Sabanejewia (S. balcanica, S. romanica), will also be affected by the blocking/slowing of sand transport (a significant amount of sand will be deposited upstream of the Livezeni dam), reducing the preferred habitats of these species, which spend a significant part of their time buried in sand (Bănărescu, 1964).

**G.6. Cumulative impact:**

*Existing fragmentations:*

At present, the Jiu River flows unfragmented within the Jiu Gorge National Park. There is no fragmentation on the Jiu River on the section from the confluence of the East Jiu with the West Jiu to the level of Târgu Jiu (on a sector of 48 km), where there are several important fragmentations: the Vădeni dam and two more drop thresholds, located just upstream of it.

The two proposed fragmentations on the Jiu River (the Livezeni dam and the secondary catchment on the Jiu River, upstream of its confluence with the Dumitra stream) will constitute two important fragmentations, one being inside the Jiu Gorge National Park, and the other being located at its upper limit. In order to reduce the negative impact caused by the two fragmentations, reduction measures have been proposed in the chapter Recommended measures to reduce negative impact. In order to analyze this impact, the monitoring measures described in the chapter "Proposed monitoring" are necessary and if it is demonstrated that the passages/fish ramp arranged are not functional for most fish species in this area, interventions on them will be necessary, in order to ensure longitudinal connectivity at their level.

Apart from these, there are several fragmentations in the upper basin of the Jiu, which block or diminish the transport of sediments that is transported in the Jiu Gorge. The placement of two new fragmentations that will block/slow down sediment transport will have a negative effect on the ichthyofauna.

*Mining activities:*

Even if the scale of these activities has decreased considerably in recent decades, the impact of these activities is still felt on the Jiu Valley. The huchen (Hucho hucho), a critically endangered species according to the Red Book of Vertebrates in Romania and endangered globally (according to the IUCN Red List), was reported in the past in the project implementation area (Antipa 1909, Bănărescu 1964). The species most likely disappeared from the Jiu River due to mining activities, and today it is no longer present in it. Given the needs of the species (deep water, areas with deeper rapids, areas with gravel and sand for reproduction -- Antipa 1909, Bănărescu 1964, Kottelat & Freyhof, 2007), by implementing this project and putting the hydropower plants into operation, any attempt to reintroduce the species is minimized, the chance of survival and formation of a sustainable population, in case of a repopulation action with this species in the future, will be very low.

*Pollution:*

At present, there are several sources of pollution (especially diffuse pollution), which affect the ichthyofauna of the Jiu River. In case of extracting a part of the river flow, dilution will decrease, thus the effect of these pollutions will be felt more accentuated, for a period of eight months of the year being induced an anthropic hydrological drought (Ilinca & Anghel, 2023). In addition, during summer periods, the temperature of the Jiu River (due to the extraction of a significant part of the flow) will rise considerably, the effect of pollution being aggravated by this factor as well.

Fig. 178 Image of a pollution source located a few meters upstream of the Livezeni catchment

Fig. 179 Image of turbid water entering the Bratcu stream from the Meri quarry (in case of rain), near the confluence of the Bratcu stream with the Jiu River

Fig. 180 Image of insufficiently decanted water being discharged into the Jiu River from the Meri quarry

*Invasive and/or tolerant species:*
For the reasons listed above, there are real chances that some invasive species (for example, the species Pseudorasbora parva, an invasive species that has been identified in a very small number in the Jiu River, during current evaluations) or native tolerant species such as the chub, will adapt to the new conditions much better than the indigenous rheophilic species characteristic of this river sector.

***G.7. Recommended measures to reduce impact:***

*Longitudinal connectivity:*
The European Union's Biodiversity Strategy provides for the restoration of natural river functions. Thus, the strategy sets the goal of restoring, by 2030, connectivity on at least 25,000 km of rivers, by removing barriers and restoring floodplains (Kampa 2022).

*Upstream migration:*
To ensure the migration of aquatic fauna upstream at artificial barriers, the specialized literature recommends as a first option the removal of the barrier. Given that in this project, this is not economically justified (practically, this would mean not carrying out water catchments in the form in which they were designed), measures are proposed to restore longitudinal connectivity at the level of barriers.

The proposed project involves the arrangement of 4 water catchments, which will interrupt the longitudinal connectivity of the rivers. Measures are proposed to facilitate longitudinal connectivity at the level of the Livezeni dam (fish ladder/passage), at the secondary catchment on the Jiu, upstream of the confluence with the Dumitra stream (fish ladder or fish ramp across the entire width of the river) and at the catchment on the Bratcu stream (fish ladder).

In the case of the Dumitra stream, currently, the longitudinal connectivity is interrupted (in addition to the catchment) also at its confluence with the Jiu River, so that to restore connectivity at the level of this stream, migration of fauna must be ensured at both locations, which exceeds the framework of the analyzed project.

Fig. 181 Image of the interruption of longitudinal connectivity at the level of the confluence of the Dumitra stream with the Jiu River

*Restoring longitudinal connectivity at the level of the Livezeni dam:*
For this type of barrier and for this river typology, the most suitable solution is that of slot passages, where the slot is provided over the entire height of the partition walls between basins. This type of passage can be more easily adapted to upstream level fluctuations.
The proposed fish ladder through this project requires modifications, as it was designed at a constant water level, although the level variation in the lake upstream of the catchment is 3 m

The main requirements for the passage are given by the dimensions of the european chub and the level difference, they must be ensured for a minimum period of 300 days per year (DWA 2014, Schmutz & Mielach 2013). The chub is the largest species present in this sector, in terms of size, after the indigenous trout (Telcean et al. 2017, Nagy 2021, Nagy et al. 2023, present study). In addition to the fact that native trout were present in very low numbers, they are also the best swimmers of the species present, so the fish ladder cannot be designed for the requirements of the trout (as they generally have been designed for all type of microhydropower plants from Romania), because in this case the fish ladder would not satisfy the needs of weaker swimming species, so it is proposed that the fish pass be designed for the dimensions of the chub. Thus, the main characteristics of the fish ladder must be the following (DWA 2014, Schmutz & Mielach 2013):

- Slot width: minimum 0.3 m;
- Useful length of the pool: minimum 2.45 m;

- Useful width of the pool minimum 1.85 m;
- Thickness of the quasi-natural substrate: 0.3 m;
- Water depth: minimum 0.7 m above the substrate;
- Water speed Jiu Livezeni passage: maximum 1.55 m/s;
- Specific power: maximum 200 W/$m^3$.

The entrance to the passage must be oriented as parallel as possible to the flow axis, as close as possible to the movable ridge.

The attraction current must be released in the immediate vicinity of the entrance to the passage, parallel to it. Any competing flow on the opposite bank (eg. from MHC for ecological flow) will detract from the attractiveness of the passage, resulting in low efficiency. For this reason, the discharge of water from the MHC located at the level of the Livezeni dam must be carried out in the immediate vicinity of the fish ladder (so on the bank opposite the microhydropower plant), in the vicinity of the entrance to the fish ladder, parallel to it.

*Restoration of longitudinal connectivity at the secondary catchment on the Jiu River, upstream of the confluence with the Dumitra:*

For this secondary intake on the Jiu River, a ramp-type passage with a natural substrate of stone and gravel can be put into operation, the main condition being to ensure speeds of up to 1.3 m/s, only occasionally a maximum of 1.5 m/s, with a minimum water depth of 0.4 m above the substrate. This ramp must be set up over the entire width of the minor bed. This ramp comes into operation only when the installed flow of the catchment is exceeded, by transiting the water over the crest of the spillway and implicitly over the rockfill ramp (mainly the ramp will work in the high water regime). In the regime of small and medium waters, connectivity will be achieved by setting up a passage with the characteristics of the one in Livezeni.

*Ecological flow:*

The establishment of the hydrological regime to ensure the satisfaction of water use requirements and compatibility with ecological requirements is the subject of the updated Management Plan for Hydrographic Basins, approved by Government Decision no. 392/2023. Thus, the method of calculating and determining the ecological flow is regulated by Government Decision no. 148/2020, based on the provisions of the European Commission Guide no. 31 Guide for determining ecological flow.

The determination of the ecological flow is based on the following principles:

- Natural variability of the hydrological regime taking into account seasonal variation;
- Defining the Ecological Flow according to the typology of water courses in Romania;
- The habitat needs of the dominant fish species, corresponding to each typology.

” It is advisable not to use solutions based on ultrasound, which can limit the transit of fish, but solutions based on pressure transducers for flow monitoring activities.”

” The monitoring of the servitude flow (and implicitly the ecological flow) must be carried out during the entire operation of the MHC. The monitoring must be carried out with frequencies lower than ½ hour, and the data must be posted in real time on an internet page without restricted access.”

*Protection of fish and downstream migration:*
Considering that a significant proportion of the flows will transit through the intakes to the detriment of fish passages, it is evident that aquatic fauna will be attracted and/or entrained into the water intakes. Best practices and specialized literature emphasize the advantages of screens over other protection methods. Screens represent a physical and behavioral barrier for fish and other organisms to avoid entrainment in turbines.

Thus, for the intakes on the Jiu River, best practices recommend installing horizontal screens, which are more effective in protecting fish. Common are screens with spacing from 20 to 10 mm (LUBW 2016) or down to 2 mm (Courret & Larinier 2008) which have proven their functionality over a long period, even for much higher installed flows compared to the present project (Scherngell & Balestra 2020, Ebel et al. 2018, DWA 2004, Calles 2013). These screens, when properly placed, can thus safely guide fish towards the bypass channel that ensures transit over the dam.

Also, at the intakes on the Dumitra and Bratcu streams, it is necessary to ensure fish protection at the water intake: there are numerous applications, e.g. with Coanda-type screens (Coanda screen, Coanda Rechen), which prevent fish from being sucked into turbines. Such protection needs to be set up to avoid fish entering the power generation chain.

Given that a significant amount of flow will be removed from the Bumbești HPP level (this will attract fish towards the tailrace canal), fish entry into the tailrace canal must be avoided. Thus, at the confluence with the Jiu River, a barrier in the form of a threshold where a drop greater than 0.4 m results will need to be provided. If necessary, other solutions can be chosen, such as arranging inclined screens, possibly fixed mobile to transit solid objects from the water volume, so that fish can continue their upstream migration route on the Jiu River, without entering the tailrace canal.

*Hydropeaking:*

The association between hydromorphology and hydrology, especially the phenomenon of "hydropeaking", is a subject that is treated superficially in most cases. The reduction of flows downstream of dams will be operated in such a way as to allow fish to retreat to deeper sections of the river.

Hydropeaking can occur on the sector downstream of the Bumbești Jiu discharge and not only there, due to rapid variations in water level as a result of hydrotechnical exploitation works (maneuvers to open gates to wash deposits in front of the intake, which are carried out periodically, through specific gate maneuvers). These fluctuations have a negative impact on the hydromorphology of rivers and need to be studied relative to the duration curve of average daily flows, in natural hydrological regime versus modified hydrological regime. It is recommended to install level sensors to monitor water fluctuations in real time.

The increase in flows at the Bumbești Jiu discharge level must be done gradually, in such a way as to avoid purging the riverbed.

*Sediment transport:*
To prevent erosion phenomena and to ensure the presence of natural substrate in the riverbed, it is necessary that the sediments resulting from the cleaning of the settling tanks and from the desilting of the accumulation be released into the river, in predetermined periods, at flows that will be able to ensure their dilution. These works must be carried out at high flows, outside the breeding period of fish species and the immediate following period (such works should be avoided during April-July).

It is necessary to ensure the transport of sediments deposited upstream of the dam to areas downstream of the dam.

According to Nistorescu et al. (2016), to reduce the impact on aquatic ecosystems, the washing of sand traps must be carried out exclusively during high water periods, preferably with reduced durations of time (e.g. maximum 15 min), or continuously by partially opening the sand trap washing valve, thus resulting in lower velocities on the fish ladder.

*Other proposed measures:*
It is recommended to prohibit any intervention in the minor riverbed of the Jiu River, except for the arrangement of the fish ladder at the Livezeni dam level, the arrangement of the secondary intake on the Jiu River (upstream of the confluence with Dumitra) together with the arrangement of the ramp or fish ladder that will ensure the migration of fish species and the arrangement of the fish ladder on the Bratcu stream.
In the case of concreting works, special attention must be paid so that neither concrete nor excess water from concreting infiltrates into the Jiu River or its tributaries.

The execution of water diversion works must be carried out at low flows, in the second part of summer, first part of autumn (in August-October) so that these works do not lead to the entrainment of solid suspensions in the water mass and do not affect either the deposited eggs or the freshly hatched fry, which is very susceptible to changes.

Corrective/additional measures must ensure the achievement of the residual impact level as estimated in the EIA and EA studies and mentioned in the regulatory acts (Nistorescu et al., 2016)

**G.8. Proposed monitoring:**

*General monitoring of ichthyofauna:*

Given that the effects of the proposed project will manifest in the long term, it is necessary to monitor the ichthyofauna as follows:

- annually twice before construction and during construction;
- annually twice in the first 5 years after commissioning.

Ichthyofauna monitoring must be carried out on all 17 sectors where assessments were made for the present study. The length of the sectors must be 150 m.

*Interpretation of results gathered during ichthyofauna monitoring:*

Given that out of the 17 monitored sectors at the level of 8 stations the flow will be considerably lower than it was in the case of the present assessments (due to the use of flows for the operation of hydropower plants), the results must be treated in such a way that this aspect is taken into account. Most likely, due to easier evaluation conditions (ichthyofaunal evaluations can be carried out much more easily at a reduced river flow), the density of identified fish species will be apparently higher, which is very likely not to reflect reality. For this reason, when drawing conclusions, it is necessary for this aspect to be taken into account and to compare the data from the stations where part of the river flow is used with the results from the 9 stations where the flow will not be used.

*Monitoring of fish ladders/passages:*

If a fish ladder or fish ramp is arranged, it must be monitored to document its functionality or non-functionality. The fish ladder/fish ramp must be equipped with an automatic telemetry monitoring system based on PIT tags. This monitoring system must be included in the design phase. It is necessary to place two readers: one at the entrance to the fish ladder (downstream part) and one at the exit of the fish ladder (upstream part), the same for the fish ramp, thus making it possible to track whether fish have managed to enter the fish ladder, the time spent by them in the fish ladder and whether fish have managed to pass over the fish ladder or have returned. If it is proven that the fish ladder needs changes, these must be made as soon as possible. Monitoring of fish ladders/fish ramps must be carried out for a minimum period of 5 years, by specialized personnel.

Fig. 182 Example of "PIT Tag" + needle and gun used for marking fish species for monitoring fish ladders.

*Table no. 49 Results of field activities*

| Uncertainty identified | Proposed approach | Aspects analyzed | Clarification of uncertainties | Was the uncertainty clarified (Yes/No/Partially) |
|---|---|---|---|---|
| The presence, distribution and activity of species in the project implementation area is not known | Field trips during the optimal study period, identification of species of conservative interest in the project's area of influence | Presence of species of community interest | The presence of 5 fish species of community interest was identified (*Barbus* sp., *Eudontomyzon* sp., *Cottus gobio*, *Romanogobio uranoscopus* and *Sabanejewia balcanica*), as well as the Eurasian otter (*Lutra lutra*) in the project's area of influence | Yes |
| | | Distribution of species | All 5 fish species of community interest and the otter were identified in the sectors of the Jiu River course | Yes |
| The presence and distribution of allochthonous plant species (ruderal, nitrophilous, uncharacteristic) is not known | Field trips, making monitoring transects and observation points | Presence of allochthonous plant species (ruderal, nitrophilous, uncharacteristic) | During field trips, specimens of the following species were identified: *Reynoutria japonica*, *Robinia pseudoacacia*, *Salix caprea*, *Betula pendula* | Yes |
| | | Distribution of invasive species | Distribution of species identified in the vicinity of the project site | Yes |

| Uncertainty identified | Proposed approach | Aspects analyzed | Clarification of uncertainties | Was the uncertainty clarified (Yes/No/Partially) |
|---|---|---|---|---|
| Are there areas occupied by habitats of community interest on the project's objective sites? | Field trips, analysis of spatial habitat distribution data, data that formed the basis for the elaboration of the Management Plan of ROSCI0063 Defileul Jiului | Presence of habitats of community interest | On the sites of the project objectives located within the perimeter of the Natura 2000 site ROSCI0063 Defileul Jiului, no areas occupied by plant associations corresponding to types of habitats of community interest were identified | Yes |
| Are species of invertebrates of community interest present on the sites targeted by the remaining execution works? | Field trips, making monitoring transects and observation points | Presence of invertebrate species | In the monitored areas, no invertebrate species of community interest were identified | Yes |
| Are aquatic habitats corresponding to the ecological habitat requirements of amphibian species of community interest present? | Field trips, making monitoring transects and observation points | Presence of aquatic habitats corresponding to the ecological habitat requirements of amphibian species of community interest within the perimeter of the project sites | On the sites of the project objectives located within the perimeter of the Natura 2000 site ROSCI0063 Defileul Jiului, habitats corresponding to the minimum requirements of amphibian species of community interest were identified (most in abandoned anthropic structures) | Yes |

*e) Climate and climate change*

***e.1.) General information***

In the context of increasing the importance given to aspects regarding climate change, given the requirements regarding the analysis of the impact on climate from Law no. 292/2018 on the assessment of the impact of certain public and private projects on the environment, in order to approach uniformly at national level the measures that must be taken in order to avoid doubling assessments and taking into account the European Commission's guidelines on immunizing infrastructure projects to climate change, the objective of this assessment is to analyze the project for climate change and formulate adaptation measures. The assessment and management of climate change for this project was based on the "National Strategy on Adaptation to Climate Change for the period 2022-2030 with the perspective of 2050" (SNASC) and "The national action plan for its implementation" (PNASC), from available climate data and European Commission documents (e.g. Technical guidance on the climate proofing of infrastructure in the period 2021-2027).

The priority objective of the assessment took into account the fact that climate change and associated risks cause major changes in the interactions between socio-economic systems and the natural environment. Adaptation and capitalizing on new opportunities are priorities for increasing the resilience of society, economy and the natural environment to the impact of climate change and also constitute improving the adaptive capacity and increasing the resilience of socio-economic and natural systems to the effects of climate change, on different areas and time intervals. The Ex-Ante assessment of vulnerability to climate change is an important step in the process of establishing appropriate adaptation measures to climate change. This Ex-Ante vulnerability analysis is divided into three modules that include sensitivity analysis from the point of view of climate change, assessment of exposure to current and future climate variables, respectively combining the two for the analysis of vulnerability to climate change.

The Ex-Ante vulnerability analysis for the analyzed project is based on the guide developed by the Directorate General for Climate Policy (DG Clima Action) within the European Commission - Guidelines for Project Managers, its requirements being applied according to relevance and available data. According to the mentioned guide, the following stages were covered in the climate change vulnerability analysis:

- Identification of the area's sensitivity from a climatic point of view;;
- Assessment of the project's exposure to current and future climate factors (climate variables);
- Vulnerability analysis;
- Risk assessment;
- Identification of adaptation options;
- Evaluation of adaptation options;
- Integration of adaptation measures.

Infrastructure is usually long-lasting and can be exposed for many years to a changing climate, with extreme weather events and increasingly unfavorable and frequent climate effects. Under the supervision and control of the relevant public authorities, the assessment of climate vulnerability and risks contributes to the identification of significant climate risks. The assessment represents the basis for identifying, examining and implementing specific adaptation measures. This will help reduce the residual risk to an acceptable level.

Climate change adaptation measures for infrastructure projects focus on ensuring an adequate level of resilience to climate change impacts, which includes extreme phenomena such as more intense floods, cloudbursts, drought, heat waves, forest fires, storms and landslides and hurricanes, as well as slow-evolving phenomena, such as the expected sea level rise and changes in average precipitation, soil moisture and air humidity. In addition to considering the project's resistance to climate change, there must be measures to ensure that the project does not increase the vulnerability of neighboring economic and social structures.

Analyzing a project's vulnerability to climate change is an important step in identifying appropriate adaptation measures that need to be taken. The analysis is divided into three stages, which include a sensitivity analysis, an assessment of current and future exposure and then a combination of the two for the vulnerability assessment. The purpose of the vulnerability analysis is to identify climate hazards relevant to the specific type of project in the planned location. A project's vulnerability is a combination of two aspects: how sensitive the project components are to climate hazards in general (sensitivity) and the likelihood that these hazards will occur at the project site now and in the future (exposure). These two aspects can be assessed separately or together.

***e.2.) Climate change mitigation***

According to Romania's Energy Strategy 2016-2030, with the perspective of 2050, climate and environmental policies, centered on reducing GHG emissions and changing social attitudes in favor of "clean energies" constitute a second determining factor, which shapes investment behavior and consumption patterns in the energy sector.

In the long term, renewable energy sources (RES) will be substantially found in the structure of the energy mix, with management systems and mechanisms that will facilitate their integration. The phenomenon of global warming will force the transformation of the global economy according to a sustainable model, both in terms of emissions and raw material consumption. The 2015 Paris Agreement and European climate change prevention policies contribute to achieving a sustainable energy system. The commitments made within COP21 drive the development of technologies and fuels with low CO2 emissions. According to the International Energy Agency, in 2015 CO2 emissions from the energy sector worldwide stagnated, amid a 1.8% reduction in energy intensity, respectively an increase in the share of RES. In the central scenario of the International Energy Agency, in 2040 most RES will be competitive without dedicated support schemes; photovoltaic technology will have an average cost reduction of 40-70% by 2040, and offshore wind technology will have average costs at least 10-25% lower. Among fossil fuels, natural gas is seen as a favorite, due to the relatively low GHG emissions and the flexibility of combustion installations that use it. Coal increased its share in the global energy mix, from 23% in 2000 to 29% at present, but this wave of growth has come to an end.

***e.3.) Project exposure to climate change***

According to the Ministry of Environment, Waters and Forests Circular no. DGEICPSC/108047/08.08.2023 regarding the degree of importance given to aspects regarding climate change in approving requests for financing from European funds, in order to use the recommendations from Communication COM no. 2021/C372/01 - Technical guidelines on climate proofing for the period 2021-2027, for the AHE Livezeni-Bumbești project, analyses were carried out regarding the main identified risks: flood risk, risk of exposure to minimum-maximum temperatures over a time horizon, as well as the risk of exposure to potential landslides.

One of the main objectives of the National Strategy on Climate Change 2022-2030 is the implementation of strategic measures for direct and indirect reduction of greenhouse gas emissions.

Climate changes are complex elements that can be analyzed through the prism of several determining factors. The impact of climate change on hydropower projects is one analyzed internationally from the perspective of the multiple effects they can have both operationally and at the level of project development/modernization.

The project's sensitivity analysis took into account the following climate variables:

- average annual temperatures;
- extreme high temperatures;
- average annual precipitation;
- extreme heavy precipitation;
- average wind speeds;
- extreme wind speeds;
- humidity;
- snow;
- frost;
- solar radiation,
- storms (tornadoes);
- floods;
- landslides/soil erosion;
- drought;
- vegetation fires.

*Table no. 50 Key climate variables and associated hazards identified*

| No. | Climatic factors | Secondary effects/hazards related to climatic factors |
|---|---|---|
| 1. | Air temperature (air temperature increase, extreme temperatures, heat waves, sudden decrease in air temperature) | Storms (torrential rains, snow, blizzard, dust storms), threats to biodiversity for certain avifauna species, mammal species |
| 2. | Change in precipitation, extreme precipitation | Floods, landslides |
| 3. | Wind (change in wind speed and/or direction) | Reduced visibility, wildfires, landslides |
| 4. | Drought | Vegetation fires, soil erosion, land use change, damage to ecosystem services in agriculture, forestry, fisheries |
| 5. | Moisture | Threats to Biodiversity for certain types of animal and plant species facing changes in their life cycle |
| 6. | Solar radiation | Threats to biodiversity, to certain types of species and habitats |

*Table no. 51 Degrees of sensitivity to climatic factors*

| No. | Sensitivity to climatic factors | Description |
|---|---|---|
| 1. | High | Climatic factors (climate variables/associated hazards) may have a significant impact on the proposed project |
| 2. | Average | Climatic factors (climatic variables) may have a moderate impact on the proposed project |
| 3. | Low | Climatic factors (climate variables) have no associated impact on the proposed project. |

Following the above analysis, the project sensitivity assessment highlighted the following climatic variables with an average sensitivity on the project components:
- extremely high temperatures;
- extreme heavy precipitation;
- extreme wind speeds;
- frost;
- storms (tornadoes);
- floods;
- landslides/soil erosion;

- vegetation fires.

After assessing climate sensitivity, the next step is to assess exposure (to current and future climate variables). Assessment of project exposure should be performed based on current as well as future climate conditions.

*Table no. 52 Climatic degrees of exposure*

| No. | Exposure to climatic factors | Description |
|---|---|---|
| 1. | High | Exposure to climate factors can have a significant impact on assets and input, output processes. |
| 2. | Average | Exposure to climate factors can have a moderate impact on assets and processes of inputs, outputs. |
| 3. | Low | Exposure to climatic factors has no associated impact on it. |

### *e.4.) The role of the energy sector in climate change mitigation and adaptation*

The energy sector, including the burning of heating fuels and fuels in internal combustion engines, is the main responsible for GHG emissions. For this reason, the energy sector plays a central role in mitigating global warming, with a gradual but drastic reduction in GHG emissions necessary. The reduction of GHG emissions in the electricity segment can take place through the gradual transition from the use of fossil fuels to the use of those without GHG emissions – SRE and nuclear energy, with the intermediate stage of replacing coal by natural gas. Coal and natural gas can retain a place in the electricity mix by adopting the most efficient and clean technologies – including, in the long term, the installation of CO2 capture equipment with the transport and storage of CO2 in geological formations (GSC). CCS technology (the process of geological capture, transport and storage of CO2 emissions) is at an early stage, with high costs. In transport, the reduction of GHG emissions takes place, first of all, by increasing the efficiency of motor vehicles. However, the reduction in specific fuel consumption is compensated by the increase in mobility, so that total emissions are still slightly increasing. For Romania, the sustainable utilization of biomass on a large scale is important. The use of electricity-based heat pumps from RES is also expected to expand, while natural gas will continue to play an important role for heating. However, the most important contribution to the reduction of GHG emissions in the heating sector will come from the decrease in demand, by increasing the energy efficiency of buildings. In the short term, thermal insulation measures for homes are required, in compliance with high quality standards; in the long term, energy efficiency standards for new buildings, including passive and active houses, will take effect. Romania has commitments at the European level for 2020 regarding the RES share in final energy consumption and in the transport sector, respectively targets for reducing GHG emissions and increasing energy efficiency. The national targets for 2030 will be subject to the iterative and multilateral quantification process at European level, through the Integrated National Energy and Climate Plan (PNIEC), part of the new approach to the governance of the Energy Union. Romania will contribute fairly to the EU's common objective of reducing GHG emissions. Romania will face more and more extreme weather events, such as heat waves, drought, floods and hail. The energy sector also plays an essential role in the process of adapting to climate change. The most important, in this context, will be the judicious management of the forest fund, the sustainable development of energy plant crops, respectively the hydropower development of watercourses. In all these areas of activity, current activities must take into account the adaptive capacity of ecosystems to climate change anticipated in the latest detailed profile studies. It is equally important that related investment projects contribute constructively to the adaptation process of ecosystems to climate change, in a timely manner and at the necessary scale to avoid further degradation of ecosystems and reduction of biodiversity. Examples of such investments are those in increasing the degree of safety of dams and dykes; effective monitoring of forest health, avoiding monocultures, etc.

The effects of climate change are increasingly visible in Romania and internationally, whether it is intense heat waves, droughts that destroy agricultural production, floods or threats to biodiversity caused by wildfires. Climate change is one of the biggest challenges facing humanity and implicitly Romania, given that we are going through a period of climate emergency.

For example, within the National Strategy on Adaptation to Climate Change 2022 - 2030, the following challenges were identified in the energy sector at the level of Romania:

- the decrease in the demand for electricity for heating during the winter, as a result of the increase in the global average temperature;
- the increase in electricity consumption required for the operation of air conditioners and cooling devices on hot days;
- the change in the seasonal demand for electricity, which will be lower in winter and higher in summer;
- the reduction of hydroelectric energy due to the decrease in water resources (the decrease in water resources also affects the operation of the cooling systems of nuclear power plants).

The risks identified by the International Energy Agency in the energy sector due to the impact of climate change are represented by extreme weather events (storms, forest fires, landslides, floods, extreme temperatures), which affect energy production and distribution infrastructure, cause interruptions in supply and affects the infrastructure that depends on the power supply. The risk to energy infrastructure increases as the frequency and intensity of certain types of extreme weather events increase.

Changes in water availability will accentuate existing challenges for energy production. The reduced availability of water and the increase in water demand from the population will generate constraints in hydropower, bioenergy (especially biogas production), solar energy systems, as well as the operation of thermal plants (fossil and nuclear fuels), which require water for cooling. On the other hand, too much water (floods, extreme precipitation, storms) poses challenges for the energy infrastructure.

Unusual seasonal temperatures can change energy demand patterns. For example, higher summer temperatures increase electricity demand for cooling, and corresponding peak loads may require additional generation capacity, while warmer winters will reduce heat demand.

Sea level rise will affect energy infrastructure in coastal and offshore areas. The greatest concern is storm surges due to the fact that larger amounts of water are transported by winds, tides, waves.

*f)* *Noise*

Currently, the project site area is characterized by a low level of noise and vibrations due to the lack of industry and other major sources of auditory discomfort in the main localities adjacent to the project. The main source of noise and vibrations is represented by road and rail traffic as well as mineral aggregate extractions (quarries), as follows:

- Livezeni dam area - traffic on DN66, Simeria-Petroșani-Târgu Jiu-Filiași railway and mineral aggregate extraction (including crushing and sorting station) at Iscroni;
- Murga Mică Platform - traffic on DN66;
- CHE Dumitra area - traffic on DN66, Simeria-Petroșani-Târgu Jiu-Filiași railway;
- Bratcu Construction Site - mineral aggregate extraction - Meri quarry;
- Bumbești HPP area - - traffic on DN66, Simeria-Petroșani-Târgu Jiu-Filiași railway, Pleșa quarry (including ballast and sorting station) and Dacorex ballast pit;

The generated noise levels indicate values that fall within the limit values for population protection.

In order to determine the background noise in the project area, specific measurements were carried out in November 2023 with a BRUEL & KJAER 2250 Light Integrating Sound Level Meter on A, C weighting networks.

➢ **Principle of the method**

For ambient noise measurements, there are two main strategies:

– A single measurement is performed under favorable meteorological conditions, while closely monitoring the operating conditions of the source;
– Long-term measurement or multiple point measurements, dispersed over time, with monitoring of meteorological conditions.

Both types of measurement require subsequent processing of the measured data. Each result will have a certain uncertainty, which must be determined.

The principle of the method consists in determining the A-weighted equivalent continuous sound pressure level (LAeqT) using a class 1 integrating-averaging sound level meter.

The determination of LAeqT can be performed:

– by continuous measurement over the time interval T;
– by measuring the A-weighted equivalent continuous sound pressure levels over subintervals of T in which the noise is stationary, LAeqT being obtained by calculation based on the results of these measurements;

– by measuring the sound exposure levels of individual events occurring over the time interval T, LAeqT being obtained by calculation based on the results of these measurements;
– by combining the methods presented above.

The acoustic sources that contribute to the total exposure in the field may or may not be distinct. Measurements are performed in the field, and the determinations can be supplemented with calculation stages, including the use of specific validated software.

- **Equipment**

– Bruel&Kjaer 2250 Light Integrating Sound Level Meter on A, C weighting networks, class 1, serial number 3011282

Technical specifications:
- class 1 precision integrating sound level meter;
- measurement range 16.4 dB - 140 dB(A);
- frequency range 5 Hz - 18 kHz;
- frequency analysis module, providing real-time 1/1 and 1/3 octave analysis;
- A, B, C, Z frequency weightings;
- automatic/manual measurement mode;
- touchscreen;
- backlit keyboard;
- USB interface, PC software.
- Bruel&Kjaer Type 4231 Class 1 Acoustic Calibrator

Technical specifications:
- Compliant with SR ISO 6926:2003 standard;
- Sound pressure level 94±0.2 dB or 114±0.2 dB;
- Frequency 1000 Hz.
- Bruel&Kjaer Sound Level Meter Tripod

Measurements were carried out in the 5 project areas as follows:
- Zone 1 - Livezeni dam;
- Zone 2 - Murga Mică Platform;
- Zone 3 - CHE Dumitra;
- Zone 4 - Bratcu Construction Site
- Zone 5 - CHE Bumbești

The obtained values are evaluated in relation to:
- The A-weighted equivalent continuous sound pressure level, L~AeqT~ provided in SR 10009/2017 "Acoustics. Permissible limits of ambient noise level", point 4.1 "Permissible limits of noise level at the boundary of functional spaces", table 1, position 4, which provides:

*Table 53 Limits for sound pressure level*

| No. | Functional spaces | A-weighted equivalent continuous sound pressure level, LAeqT (dB) |
|---|---|---|
| 1 | Recreation and leisure spaces, medical and balneo-climatic treatment | 45 |
| 2 | School, nursery or kindergarten premises and children's playgrounds | 75 |
| 3 | Stadiums, open-air cinemas and theaters, cultural, sports and entertainment events held outdoors[1] | 90[2] |
| **4** | **Industrial premises and spaces assimilated to industrial activities[3]** | **65** |
| 5 | Markets, spaces with commercial activity, outdoor restaurants[4] | 65 |
| 6 | Car parks[5] | 70 |

Nota 1 – The limit of these spaces is considered to be the space exclusively arranged for the specific activity and not the property boundary of which the respective spaces are part, which may be more extensive
Nota 2 – The time period taken into account for applying the permissible limit is the actual one, corresponding to the service duration
Nota 3 – Any space that has commercial production or maintenance activities (such as auto service, car washes, etc.) and which is not positioned in an industrial area established by the General Urban Plan. The limit of the functional space represents the boundary of the property of this space according to the cadastral plan (including land)
Nota 4 – The limit of these spaces is considered to be the boundary of the space arranged for the specific activity and not the property boundary of which these spaces are part, which may be more extensive
Nota 5 - The limit of this space is considered to be the boundary of the space exclusively arranged as a car park and not the property boundary of which this space is part, which may be more extensive, and the permissible limit applies only to car parks serving large economic facilities (shopping complexes, office buildings, etc.) or which are similar to car parks serving such facilities and does not apply to parking lots arranged along traffic arteries.

*Table no. 54 Measured values of the A-weighted equivalent continuous sound pressure level, LAeqT*

| Cod probă | Metoda de încercare | UM | Valoare obținută | Valori limită admisibile |
|---|---|---|---|---|
| Zone 1 | SR 6161-1/2022; SR ISO 1996-1:2016; SR ISO 1996-2:2018; PSL 28 | dB(A) | **50,6** | **65** |
| Zone 2 | | | **39,6** | |
| Zone 3 | | | **40,1** | |
| Zone 4 | | | **32,7** | |
| Zone 5 | | | **51,3** | |

As can be seen from the table above, at present, the noise values in the monitored area fall below the maximum admissible thresholds. Maps showing noise dispersion in areas with remaining works are presented in chapter 1.4..

***Sources of vibrations and noise during the construction phase***

During the execution of construction works, noise sources will have a temporary character, generating local and time-limited effects. The physical pollution associated with the project at this stage is determined by the noise and vibrations generated by construction activities (vehicle and equipment engines, material handling, operation of earthmoving equipment used for land development, etc.).

The noise level regulated by STAS 10009/2017, "Urban Acoustics, Permissible Limits of Noise Level" is 65 dB(A) at the site boundary. According to the Order of the Ministry of Health no. 119/2014 for the approval of Hygiene and Public Health Norms regarding the living environment of the population, the A-weighted equivalent continuous sound pressure level (AeqT), measured outside the dwelling according to SR ISO 1996/2-08 standard, at 1.5 m height from the ground, should not exceed 55 dB and the Cz 50 noise curve. During the night (23:00 - 7:00), the continuous equivalent acoustic level should not exceed 45 dB and the Cz 40 noise curve.

In order to evaluate the impact level generated by the proposed project, a modeling of noise sources was performed using the Sound Plan Essential 2.0 software application. A scenario considered very likely was taken into account, namely the one in which several noise sources operate simultaneously during the execution of works, considering the following noise levels:

- 1 backhoe loader 110 dB(A);
- 1 truck 105 dB(A);
- 1 compactor 100 dB(A);
- 1 crane 104 dB(A);

Noise sources will have a temporary character, being represented by:

- ✓ construction operations loading/unloading/materials and equipment;
- ✓ operation of equipment and vehicles involved in construction/assembly works;
- ✓ traffic of vehicles necessary for the execution of works.

Normally, the interval for carrying out construction works will take place during the day between 08:00 - 18:00. However, there are also operations that need to be carried out continuously, such as pouring concrete for foundations, for which night work may also be necessary.

The results of the modeling performed using SoundPLAN software show that, in the phase of construction, through the generated noise level, the project will not generate a significant impact on the quality of living in the neighboring villages, at the level of the closest receptors, the operation of the equipment used in modeling generating a maximum noise level of approximately 48 dB. The noise generated by construction activities is not likely to change the current noise level mainly induced by car traffic in the area.

At the level of protected natural areas, the noise generated by construction activities can lead to an increase in the equivalent noise level up to 100 dB(A) over a distance of maximum 50 m, which could lead to a disturbance of species activity (especially birds) during the

execution of works, but given the location of the site in a forested area, this increase will be significantly reduced in the immediate vicinity of the project.
Also, taking into account the location of the works in relation to inhabited areas (Bumbești-Jiu town), the noise value falls within the limits provided by Order no. 119/2014.
Given the fact that the works carried out within the analyzed project will have a reduced contribution in terms of the noise level generated at the level of inhabited areas, we consider that no measures are necessary to reduce the noise level towards localities.

Sources of vibrations and noise during the operational phase.
During the operation of the facility, there will be no additional sources of noise and vibrations compared to the current road traffic.

*g) Inhabited areas - population*

***g.1.) Project location in relation to inhabited areas***

The interventions within the project (remaining works to be executed) are in the area of influence of 3 administrative-territorial units, namely:

- Aninoasa administrative-territorial unit - partially the works at Livezeni dam - constructions on the dam body will be carried out over 300 m from the houses in the Iscroni district (village);
- Petroșani administrative-territorial unit - partially the works at Livezeni dam - constructions on the dam body will be carried out over 400 m from the houses in the Sașa district (village);
- Bumbești-Jiu administrative-territorial unit - the rest of the works - the distance to the nearest dwelling is approximately 100 m from CHE Bumbești (houses on Luncani street).


Fig. 183
Distance to dwellings – Bumbești HPP area


Fig. 184 Distance to dwellings - Livezeni dam area

***g.2.) Description of inhabited areas in the project area***

❖ ***Aninoasa Administrative-Territorial Unit***

The town of Aninoasa is located in the southern part of Hunedoara County, in the Jiu Valley coal basin, being bordered to the northeast by Petroșani municipality, to the south by Gorj County, and to the west by Vulcan Municipality. The town of Aninoasa is crossed by the Aninoasa stream, along whose valley most of the town extends.

The housing stock constitutes the totality of living quarters, regardless of the form of ownership, including dwelling houses, specialized houses (dormitories, boarding houses for disabled people, veterans, special houses for lonely elderly people and others), apartments, service quarters and other living quarters in other constructions useful for living.

The housing stock by forms of ownership is divided as follows:

- public housing stock - the housing stock that is state-owned and in full economic administration of state enterprises; municipal housing stock that is owned by the town, as well as the stock that is in the economic administration of municipal enterprises or in the operational administration of municipal institutions;
- private housing stock - the stock that is owned by citizens (individual dwelling houses, privatized and purchased apartments and dwelling houses, apartments in housing construction cooperative houses) and the stock that is owned by legal entities (created based on private owners), built or purchased from own funds;
- mixed ownership housing stock - the stock that is in personal ownership, in common ownership or in shares of different subjects of public and private property;
- property of joint ventures - the housing stock that is owned by joint ventures with foreign participation.

*Table no. 55 – Evolution of the housing stock in Aninoasa town during 2015-2019*

| **Year** | **Total dwellings (number)** | **Total living area (sq m)** | **Public property (number)** | **Private property (number)** | **Private property (mixed)** |
|---|---|---|---|---|---|
| 2016 | 2027 | 61579 | 520 | 1507 | - |
| 2017 | 2023 | 66580 | 597 | 1426 | - |
| 2018 | 2024 | 66712 | 593 | 1431 | - |
| 2019 | 2025 | 66812 | 592 | 1433 | - |
| 2020 | 2026 | 66889 | 590 | 1436 | - |

*Source: INSSE, ANINOASA TOWN HALL*

There is a need to increase the housing stock in Aninoasa town, as currently there are 89 requests registered at the Aninoasa Town Hall for the allocation of housing. Most requests are submitted by young families and families with social problems.

Compared to the 2011 census, when the stable population was 5,022 inhabitants, and compared to the Population Records Service, the population number has decreased to 4,485 inhabitants, the reasons being reduced birth rate, increased mortality, and population migration abroad.

The massive layoffs in the mining sector have led to a decrease in the standard of living in this area. In this situation, the migration phenomenon began, being one of the main factors that contributed to the numerical decrease of the population - *source - Civil status of the population in Aninoasa town*

The population density in Aninoasa town is 1.52 inhabitants/sq km, being below the county average of 59.46 inhabitants/sq km.

By ethnicity, the inhabitants of Aninoasa are over 90.11% Romanian and only 9.89% represent the Roma population or other ethnicities (Hungarians, Germans). At the October 2011 census, the registration of ethnicity, mother tongue, and religion was done based on the free declaration of the surveyed persons. For persons who did not want to declare these three characteristics, as well as for persons for whom information was collected indirectly from administrative sources, the information is not available for these characteristics.

The main economic agents operating in Aninoasa town are presented in the table below.

*Table no. 56 - List of main economic agents in Aninoasa town*

| No. | Company name | Location | Number of employees | Field of activity |
|---|---|---|---|---|
| 1. | S.C. ADARCO IINVEST | ANINOASA | 85 | Metal constructions |
| 2. | S.C. MODA SHOP | ANINOASA | 56 | Second hand - textiles |
| 3. | S.C. AUTOCOM AMICII | ANINOASA | 52 | Factory of textile articles |
| 4. | S.C. VENERE INVEST | ANINOASA | 50 | Sofa manufacturing |
| 5. | S.C. VIS BOEM SRL | ANINOASA | 40 | Restaurants, bars and other sports activities |
| 6. | S.C. ELECTROUTIL ALISER SRL | ANINOASA | 20 | Factory of metal constructions and component parts of metal structures |
| 7. | S.C. TED INTERNATIONAL 2000 SRL PETROŞANI | ANINOASA | 5 | Retail trade in non-specialized stores |
| 8. | S.C. PUBLIC GAMES SRL BUCUREŞTI | ANINOASA | 2 | Gambling and sports betting activities |
| 9. | S.C. INDAL COM SRL ANSA | ANINOASA | 5 | Retail trade in non-specialized stores |
| 10. | S.C. KIELA COMIMPEX SRL ANSA | ANINOASA | 4 | Retail trade in non-specialized stores |
| 11. | S.C. ADRIANA CONTRASIMPEX SRL | ANINOASA | 12 | Retail trade in non-specialized stores |
| 12. | S.C. COCOTA SERV SRL | ANINOASA | 6 | Retail trade in non-specialized stores |

| | | | | |
|---|---|---|---|---|
| 13. | S.C. BALACI TRAVEL SRL | ANINOASA | 3 | Bars and other beverage service activities |
| 14. | S.C. GEPROD EXPERT SRL | ANINOASA | 9 | Cutting and planing wood |
| 15. | S.C. TIGER VALS SRL | ANINOASA | 10 | Cutting and planing wood |
| 16. | S.C. GAMBRINUS IMPEX SRL | ANINOASA | 12 | Restaurants and hotels |
| 17. | ADMINISTRAȚIA BAZINALĂ DE APĂ JIU – SHI PETROȘANI | ANINOASA | 20 | Administration and monitoring of water courses Jiu |
| 18. | STAȚIA DE EPURARE DĂNUȚONI | ANINOASA | 26 | Water purification activities |
| 19. | SC TOP NET SRL | ANINOASA | 10 | Storage |

❖ ***<u>Petroșani Administrative-Territorial Unit</u>***

The municipal city of Petroşani is located in the central part of Romania, in the south of Hunedoara county, at the confluence of the East Jiu with the West Jiu and consists of the component localities Dâlja Mare, Dâlja Mică, Peştea, Petroșani (residence) and Slătinioara, an area considered at reduced seismic risk.

Due to various economic and social factors, the population of Petroșani is decreasing. Thus, compared to 2002, when 45,195 people lived in Petroșani, of which 21,810 were men and 23,385 were women, on January 1, 2020, 40,970 people were registered, of which 19,738 were men and 21,232 were women. According to the data provided by the Hunedoara County Directorate of Statistics, which are also available at the web address: https://hunedoara.insse.ro, the population by domicile on 01.01.2020 was 40,970 people, of which 19,738 were men and 21,232 were women.

In the period after 1989, significant changes took place in Hunedoara county in terms of the number, demographic structure, socio-economic and territorial distribution of the population, due to negative economic developments in the county (closing or restricting production capacities, reducing incomes, increasing unemployment etc.), of the change in demographic behavior through migration to other areas. Most of the inhabitants of Petroșani are Romanian (83.22%). The main minorities are Hungarians (6.05%) and Roma (1.61%). For 8.55% of the population, ethnicity is unknown.

The restructuring processes in the mining industry, triggered between 1997 and 1999, caused a very large number of people to leave this activity. A number of other economic units in the respective areas reduced their activity, a phenomenon that determined a sudden economic fall in these areas and amplified social problems by increasing unemployment.

The total number of people employed in the mining activity at the end of 2020 was 3,036, and the total number of employees at E.M. Livezeni had 795 people, a decrease compared to 2019. At the end of 2020, 53 employees retired from this unit, an increase compared to 2019, and there were no layoffs. The municipal city of Petroșani is the most affected area, where unemployment, expressed by the share of the unemployed in the total stable population, was at a very high level.

Most companies established in 2020 in Valea Jiului are in Petroșani. Of the total number of companies registered in Petroșani, most were established in 2017, while in 2019 a number of 100 new companies were established. At the end of 2020, 168 companies were registered in Petroșani Municipality.

❖ ***Bumbești-Jiu Administrative-Territorial Unit***

The town of Bumbești Jiu is located between the parallel 45°10' north latitude and the meridian 23°20' east longitude halfway between the Equator and the North Pole in the full temperate zone. As part of the county, the administrative territory of the town of Bumbești Jiu is located in the northern part of the county and in its central area, forming a border with Hunedoara county (to the north) and having as neighbors the municipality of Târgu Jiu (to the south) and the communes of Mușetești and Bălănești (to the east), Schela and Turcinești (to the west). The landforms encountered in the territorial limits studied are mostly mountains (here the demarcation is made between the Vulcan mountains and the Parâng mountains) which continue to the south with the area of hills. The town of Bumbești Jiu is crossed from North to South by the Jiu River. The Bumbești Jiu administrative unit also includes the towns of Curtișoara, Lăzărești, Pleșa and Tetila.

According to the census carried out in 2021, the population of the town of Bumbești-Jiu amounted to 7,684 inhabitants, down from the previous census in 2011, when 8,932 inhabitants had been registered. Most of the inhabitants are Romanian (85.37%), with a minority of Roma (2.12%), and for 12.34% the ethnicity is unknown. From a religious point of view, most of the inhabitants are Orthodox (85.66%), and for 13.5% the religious affiliation is unknown.

The natural potential of the soil and subsoil of the administrative territory places the town of Bumbeşti - Jiu among the localities with special natural resources, a fact that determined a diverse and complex economic activity. The economic potential highlights the existence of complex economic activities in the field of industry, agriculture and forestry that offer the town of Bumbeşti - Jiu a special place in the economic context of the county. The main industrial unit is represented by UM SADU - whose objective is the manufacture of special products for defense and economic products for mass consumption. The history of this unit established in 1938, as well as the stages in which the production experienced both diversifications specific to the moment but also periods of momentum or stagnation make this important objective for the town the main provider of jobs for an area that exceeds the limit of the studied administrative territory. Among the industrial units are the eight quarries of construction materials whose products are in demand both in Gorj county and outside it for the modernization of roads, railways, industrial and civil constructions, etc. We also specify that SC Parc Industrial SRL Bumbeşti Jiu was established in May 2003, at the former UM Sadu II, being under the tutelage of the Gorj County Council. This industrial park has an area of 18.62 ha and has all utilities: road network, water supply, sewerage, treatment plant, natural gas, electricity, in conclusion a very strong infrastructure. There are approximately 434 legal entities in the town. Commercial companies with activity are profiled by industrial production, semi-finished products, services, trade (most), food products, etc. There are also untapped capacities that have a very good infrastructure and related equipment at the Bumbeşti Jiu Industrial Park (Sadu II).

*h) Material goods*

The site area is identified as being quite rich in historical, cultural and archaeological elements including those of cultural heritage, so in the impact analysis a detailed assessment of these elements in the project area was necessary.

In Romania, the protection of archaeological heritage is regulated by the following normative acts:

- Law 5/2000 on the approval of the National Territorial Development Plan – Section III – protected areas;
- Law 350/2001 on territorial development and urban planning, with subsequent amendments and additions;
- Law 422/2001 on the protection of historical monuments, with subsequent amendments, republished;
- Law 50/1991 regarding the authorization of the execution of construction works, republished, with subsequent amendments;
- G.O. 43/2000 regarding the protection of the archaeological heritage and the declaration of some archaeological sites as areas of national interest, approved with amendments by Law 378-2001, with subsequent amendments;
- Law 190 of June 26, 2013 regarding the approval of the Government Emergency Ordinance no. 7/2011 for the amendment and completion of Law no. 350/2001 regarding territorial development and urban planning
- G.D. 525/1996 on the approval of the General Urban Planning Regulation, republished
- Order of the Minister of Culture and Cults no. 2260/2008 regarding the approval of the Methodological Norms for the classification and inventory of historical monuments Published in the Official Gazette, Part I no. 540 of 07/17/2008

## 1. Research methodology

It started by verifying information about archaeological finds from several categories of sources.

1. The archaeological repertoire of Banat
2. The National Archaeological Repertoire (NAR);
3. List of Historical Monuments (LHM, Caraș-Severin county)
4. Specialized articles and books;
5. Other databases.

The archaeological study carried out in the project area involved the completion of several documentation stages, organized as follows:

1. a prior documentation about the known and documented archaeological sites in the respective area;
2. writing the text for the description of each archaeological area and processing the images.

Starting from the information regarding the location of the facilities needed for the Livezeni-Bumbești hydropower plant, the report presents the archaeological discoveries in the area targeted by the facilities for the hydropower plant.

## 2. Archaeological discoveries in the area of Livezeni (Hunedoara county) and Bumbești (Gorj county)

*LIVEZENI*

It belongs, from an administrative point of view, to the municipality of Petroșani. There are no known archaeological finds in the area under discussion.

*BUMBEŞTI*

From the documentation received from the beneficiary, it appears that the balance castle is located north of Bumbești, in an area where no archaeological remains are known.

In Bumbești, there are known points with archaeological discoveries, south of the town.

### *1. The Fort and the civil settlement from Bumbeşti-Jiu – Railway station*

The information from the National Archaeological Repertoire site sheet is as follows (National Archaeological Directory (cimec.ro)):

| | |
|---|---|
| Location | Display on the map of Romania * |
| Cod NAR | 79317.01 |
| Cod LHM (List of Historical Monuments) | GJ-I-s-A-09126 |
| Name | The fort and the civil settlement from Bumbeşti-Jiu – Railway station |
| County | Gorj |
| Administrative Territorial Unit | Town |
| Town | Bumbeşti-Jiu |
| Point | Railway Station |
| Landmark | The site is located approx. 2 km S of the town of Bumbeşti - Jiu and approx. 40 m SW of the town's train station, on the left bank of the Jiu |
| Hydrographic landmark - name | Jiu |
| Hydrographic landmark - type | râu |
| Landform | plain |
| Categories | housing |
| Type | military settlement; civil settlement |
| Description | More than half of the fort's surface was destroyed by the Jiu waters. Today, only 76.60 m of the southern side and 168.80 m of the eastern side are preserved from it. The resulting archaeological material consists of pieces of weaponry (spearheads and spears), a Roman helmet shell, numerous ceramic fragments, bricks stamps, coins. |
| Date of discovery | 1897 |
| Site surface | 20 ha |

| | |
|---|---|
| Property regime | state |
| Owner | Municipality |
| The date of the last modification of the file | 10.07.2020 |

In Felix Marcu's work, The internal planning of Roman forts in Dacia, Ed. Mega, Cuj-Napoca, 2009, the author refers to the topography of the Bumbești fort (p. 120): „*Overseeing the southern entrance to Jiu valley, on the road connecting Oltenia to Transilvania, two forts placed at 800 m distance one from the other (pl. 23) were identified at Bumbesti. One of two is 'better' known. Its western part was destroyed by Jiu River, the single undamaged side measuring 167.00 m. The very odd shape of the fortification stands out. The military unit of garrison erecting the stone enclosure by the beginning of the 3rd century AD was milliaria, yet the sizes of the fort's southern side is much reduced750. A few buildings were partially excavated inside the fortification, however their function is unknown. Their location inside the fort seems atypical. Troops. Archaeologists performing the excavations supposed, based on the discovered tile stamps, that the fort was used by coh. IIII Cypria and detachments of legio V Macedonica, IIII Flavia or VII Claudia. Considering numerous tile stamps attesting it, coh. IIII Cypria stationed here probably sometime in the 2nd century AD. It is known for certain that by the beginning of the 3rd century AD, coh. I Aurelia Brittonum milliaria rebuilt the fortification enclosure in stone. Still, the towers of the two known gates are not at all projecting outwards, on the contrary, they are very elongated inwards. The situation is interesting considering the fact the numerous forts from Dacia were dated in the first half of the second century precisely because of the rectangular and not outward projecting towers. The identification of coh. I Aurelia Brittonum milliaria Antoniniana, erecting the stone enclosure of Bumbesti fort with coh. I Ulpia Brittonum754 which was quartered at Porolissum until the second half of the 2nd century AD is possible755. To this end, I remind that the troop of Britons, compared to the other military units from Porolissum, is not attested by tile stamps, except for two exemplars dated in an early period*."
In the work of Nicolae Gudea, Der dakische limes. Materialen zu seiner geschichte. JRGZ 44, 1–113, shows that the fortification is located north of the town, in the loop made by Jiu, between the railway and the river.

The fort is also presented in an older article, published in 1959 by Expectatus Bujor, Bumbești Archaeological Site (Tîrgu-Jiu district, Craiova reg.), in Archaeological Materials and Researches 5, 1959, p. 419-423. There is no map with the location of the fort, but only one with the materials discovered in the archaeological excavations of the 1956 campaign (Fig. 1). The study also describes the position of the fort in relation to the current landmarks: "in the 1956 campaign, the attention of the research was directed to the second fort on the territory of Bumbeşti commune — the earthen fort at km 83 on the Târgu Jiu-Petroşani road, where it passes over the Vârtop stream. The construction of the road and the railway, which pass through this point, caused a part of the fort — the western half — to be largely destroyed.

The other half - the eastern one - was exploited, from 1923 until today, by the various brick factories, a brick factory even operated here in the years 1933 - 1945. Very few portions, restricted and irregular, escaped the massive destruction that took place, thus making research extremely difficult. Of the entire fort, part of the west and south sides, a few portions on the east side and a tiny rest in the center are still preserved, in turn, in the very near future it is exposed to total destruction, following the exploitation of the seasonal brickyards, which continues its activity. Because of this situation, the rescue excavations, carried out in the last ten days of September 1956, had to be undertaken in the most endangered points, with the aim of obtaining maximum information; and to a very limited extent we tried to perform recognition surveys, with the aim of framing and controlling the data obtained. The north side is completely lost and with it a good part of the contents of the castle. From the eastern side, three portions are still preserved, of which the one near the southeast corner is the only one that could provide us with archaeological documents usable for studying the castle.

The other two portions, extremely small and shapeless, were nevertheless probed, from the first moment, obtaining little data - the only ones otherwise - that we could have obtained."

The sections made during the excavation campaign are also described further on (p. 419-423):

"With the help of the sections made, we managed to place these two remains on the plan of the fort, marking on this occasion the eastern side, whose route we would not have been able to specify later, if we had not made this last attempt now. The portion from the north was sectioned for a length of 30 m in the W 290° direction, crossing the enclosure wave (S I). Up to — 100 cm on the wave we encounter a chestnut soil, and on the outer slope reddish soil.

The few ceramic fragments encountered were more on the inner slope. Under this layer of brown soil, up to 200 cm, there is another clayey soil, very hard and without ceramic fragments. Inside, on a width of 3 m, we find a layer of gravel at 20 cm below the chestnut soil. The land was so walked, that in the western part the section was from the beginning in the clayey-gray soil. In the western end, at — 10 cm, two oxidized bronze coins and a fragment of a bronze appliqué were found.

The second portion on the eastern side, roughly in its middle, was sectioned once perpendicular to the surrounding wave (S II), with orientation 290° W, for a length of 15 m, and once parallel to the wave (S III), with N 50° orientation, over a length of 10 m. Up to — 100 cm, the soil is brown, containing few ceramic and metal fragments (nails) on the outer slope. On the inner slope (S III), to the north, at — 20 cm is a 20 cm thick layer of gravel placed on the gray soil, 30 cm thick, with few ceramic fragments, under which there is a 30 cm layer of soil yellowish, over the clay-gray earth.

The southeast corner, as I said, presents much more favorable research possibilities. In this part, it seems that the land suffered less from the activity of the brickyards. The height is much higher than in the previous portions, and the space has remained larger. On the east side, towards the corner, the section (S IV) oriented W 315° and 18 m long, encountered up to — 100 cm a reddish-chestnut soil, with few ceramic fragments, above the clayey-gray soil. Inside, under a sandy-gray soil, there is a layer of stones, over a thick layer of rubble — bricks, tiles, tiles, fragments of vessels — mixed with coals and burning.

On the south side, also towards the corner, the section (SW) 20 m long, perpendicular to the previous one, met up to — 100 cm a reddish-brown soil, with few ceramic fragments, over a sandy soil, without ceramic fragments. Also in the eastern half, but in the center of the fort, a section (S VI), oriented north-south, with a length of 23 m, parallel to the road, was executed to see if this portion, in the course of destruction, can provide us with more substantial data in relation to the plan of the fort. In the layer of brown soil, 100 cm thick, a layer of gravel was found at — 40 cm, on a distance of 6 m, which ends at the southern end with a group of river stones slid down the slope, which had in the gray earth between the stones, brick fragments, leaving the impression of a gutter; and at the north end, in the box made, this layer of gravel proved to be placed over a leveling of rubble, with fragments of brick, which continues to the south. A small gold leaf button was found at the southern end of this section.

Parallel to this section, but to the west of the railway, a last section (S VII), 25 m long, encountered a 1 m thick stone wall bound with mortar in the southern part. At a distance of 6 m, to the north, at 30 cm, there is a layer of stones, 25 cm thick, in a blackish soil, full of burn. A large bronze coin, a bronze tweezer, a circular clay pot and numerous nails were found here, among the brick and tile fragments.

The research undertaken here revealed few archaeological materials, very badly preserved and in a fragmentary state. The ceramics, rich in fragments, do not provide us with vessel shapes, so we will present them according to the type of paste, highlighting some characteristics of the shapes. Among the imported ceramics we find a large proportion of amphora fragments. They are made of a reddish-yellowish paste, clean, compact, covered with a light-colored sheet. The lip in some specimens faces outwards, (pl. 1/5), in others slightly bent inwards; a short conical bottom is preserved, made of the same paste and with the same kind of lining. On the lip of an amphora, made of red paste, we can distinguish prints that seem to be more like a stamp, than an ornamental motif. Along with this, and in a larger proportion, you can find local ceramics. The paste is more sandy, with impurities, more chestnut in color. The vessels are for domestic use and have outer walls, in some cases, blackened by subsequent burning. The few flat and thick bottoms indicate pots with thick walls.

According to the preserved lip fragments, the pots had a very short and straight neck, and the body bulged just below the lip (pl. 1/3, 4, 6, 7, 8, 12, 13). Next to it are covers made of sandy paste, chestnut (pl. I /14). Pears are much less represented than pots. The lip of the crossbars is bent inwards in some specimens and without decoration, and in other specimens it is bent outwards and with grooves on a horizontal plane (pl. 1/10, 11, 15, 16). A few fragments of horizontal lips on the outside show the presence here of cups with a straight neck and fluted ladle (pl. 1/9). Among the ceramic fragments there are only a few of gray paste, but since they are not characteristic, we cannot say anything about the shape of the vessels; the paste is clean, compact and well kneaded. Iron is abundantly represented by nails and nails with a rectangular section and a flat head. The only weapon is a narrow lance, which still has a part of the miner with a glove hole (pl. 1/1).

As a common object, we have a straight knife blade. The bronze is represented by a fragment of an appliqué, a fragment of a stylus and a tweezer (pl. 1/2). There is only one piece of gold: a small sphere, made of a thin sheet, and found in the center of the castle (VI century). The copper coins, three in number, are all heavily oxidized. Of these, two, due to the poor state of conservation, cannot give us any other indication than that they are from the 10th century.

II AD; the third, a sestertius from Faustina Senior, specifies the mid-century. II. The sections on the eastern side had the purpose of fixing this side and connecting it to the southern one.

The northeast corner has not been preserved, so we cannot know the exact length of this side; thanks to the remaining portions, today we still have about 100 m from this side. The south-east and south-west corners limit the south side to about 90 m. About 75 m are preserved from the west side, and the north side is definitely lost. On the occasion of sectioning the eastern side, it was noticed that the surrounding wave has at its base a beaten clay soil, over which a chestnut soil was raised. This side being badly preserved, and the wave much leveled, I did not find the indications of earth furrows; we hope that in the southern part we will encounter a clearer situation. In the southeast corner we tried to catch the inner tower, but as our excavations had a salvage character, we did not uncover this portion, contenting ourselves with the indications we obtained and which we will use in future research.

The section in the western portion, freed from the railway, revealed a fragment of a stone wall bound with mortar, from a building within the fort. The thick layer of burn, from this point, as well as the one found inside, in the southeast corner, prove a strong fire suffered by this military camp. The three coins give us indications about the time of use of the fort: it would therefore be from the second century, or more precisely until the middle of the second century, taking into account the large bronze coin from Faustina Senior, located in the burn layer next to the wall found in the western part (S VII). In addition to this, we also add the ceramic material, which presents the characteristics of the second century, the greater proportion of imported ceramics, in relation to that of local ceramics, which does not abound, extremely rare gray ceramic fragments. In addition to the duration of use of the fort, the knowledge of its plan and organization, the relationship between this earthen fort and the stone one 1, located only 1 km from each other, as well as the relationship between the now researched fort and the fort of land from Mălăeşti, reg. Ploeşti 2, both for the knowledge of the technical construction data, as well as for the connections that could be made with the historical events contemporary to them."

The point is precisely located in the NAR (fig. below) (Map Server for the National Cultural Heritage (cimec.ro)).

Details about the fort, the state of conservation, planimetry, location and discovered materials can also be seen from the plans and figures published online, in the NAR database (fig. below), source National Archaeological Inventory (cimec.ro)

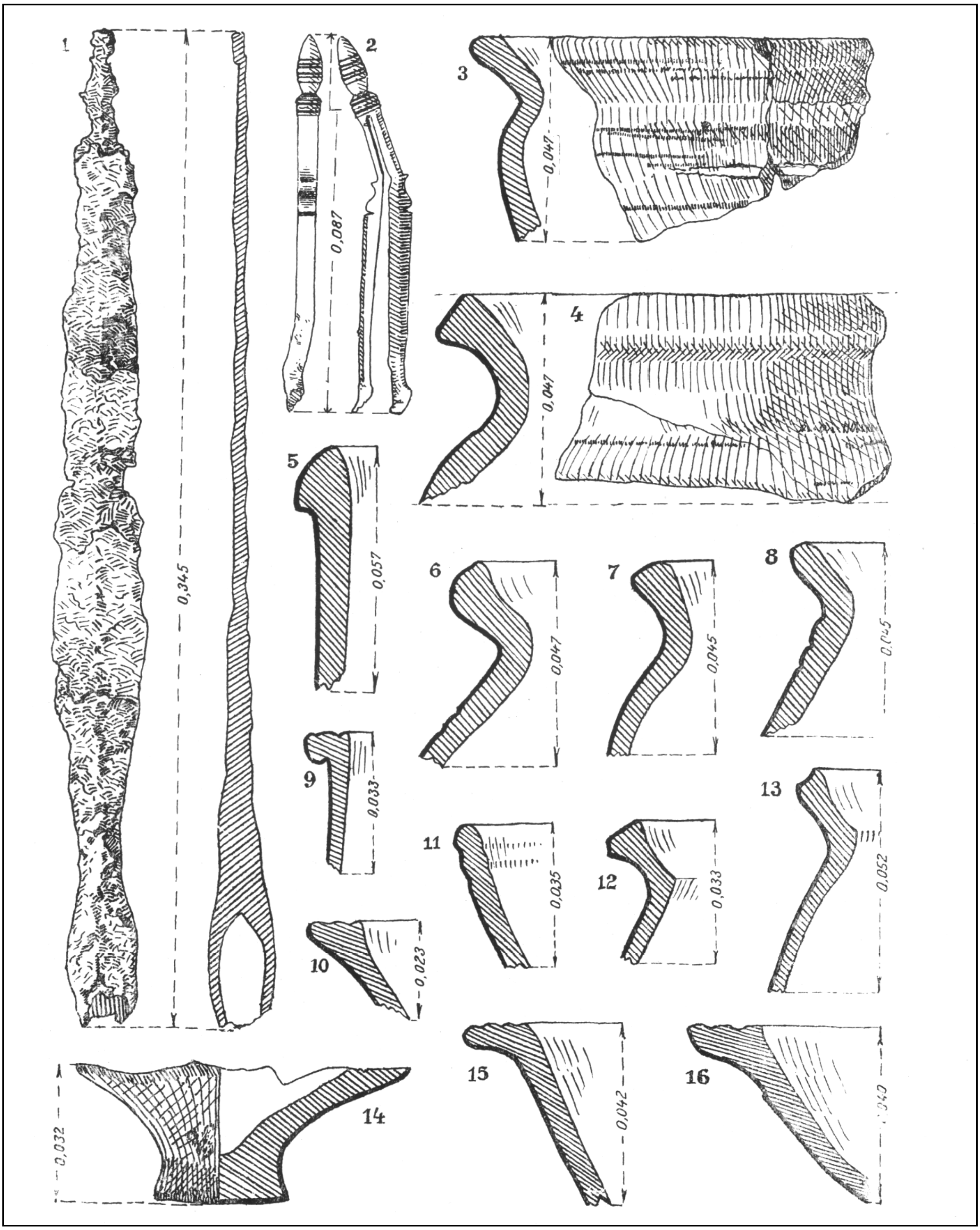



Fig. 185 The materials discovered in the archaeological excavations of the 1956 campaign

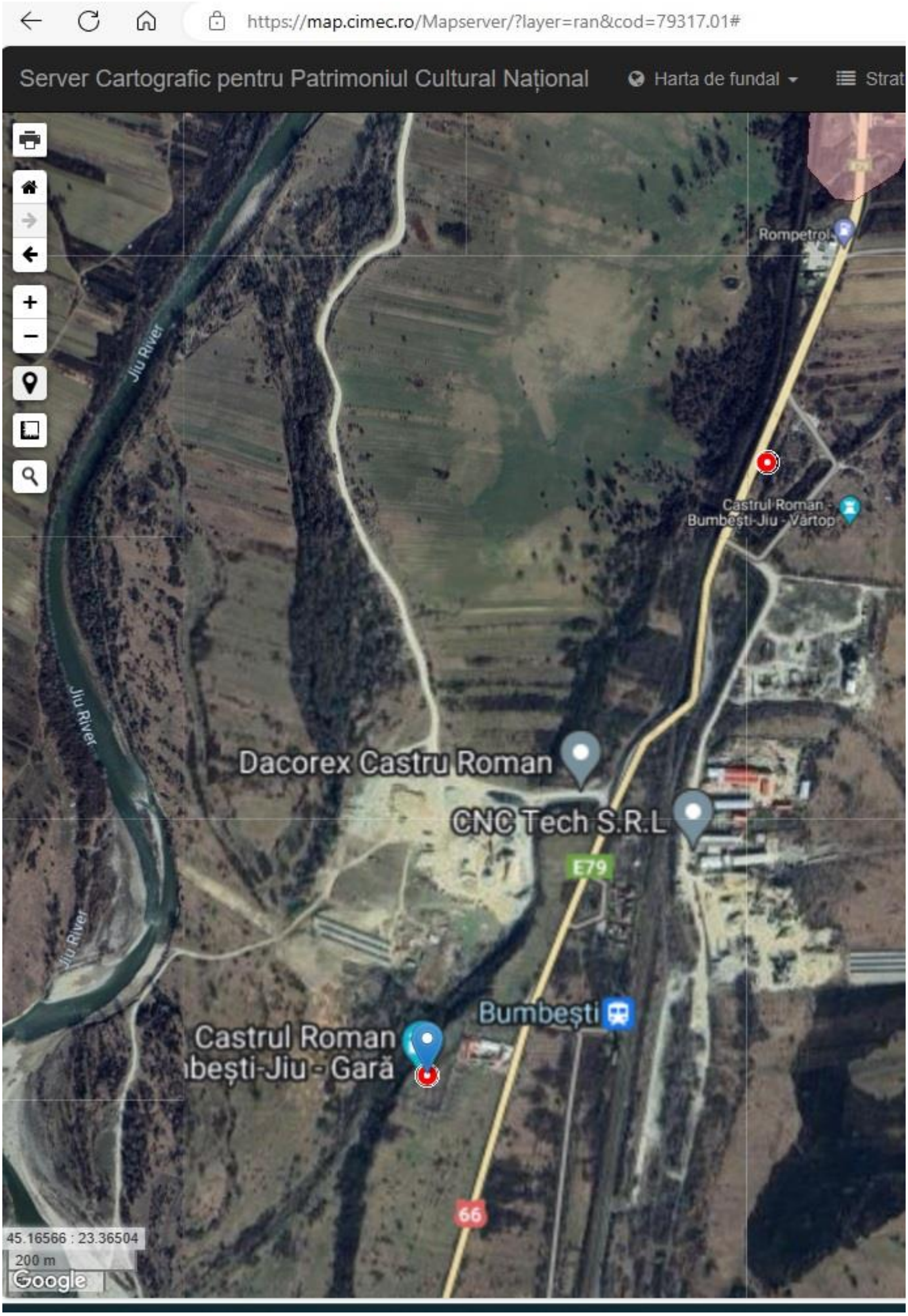



Fig. 186 Location of the Roman Fort, Bumbești – Jiu - Railway Station (zone 1)

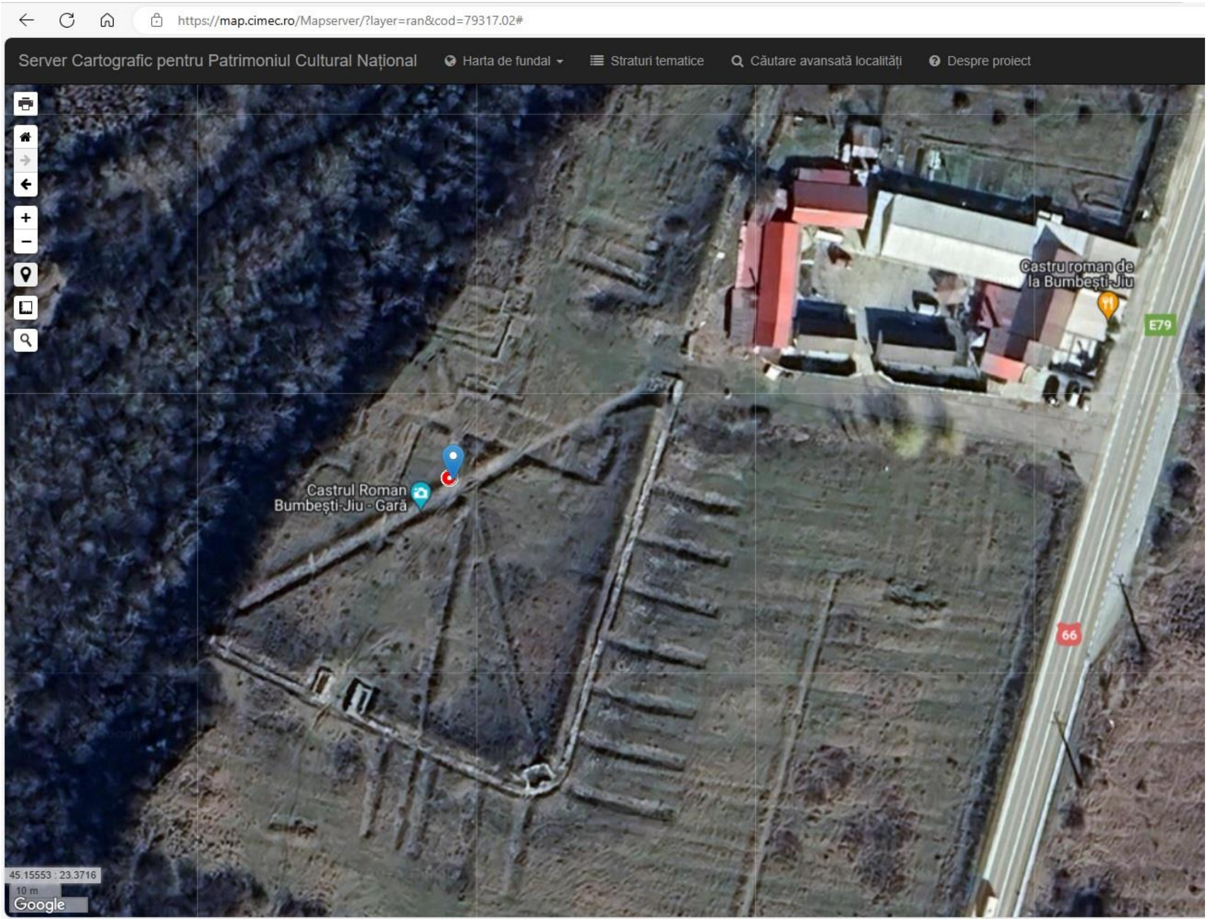


Fig. 187 Location of the Roman fort, Bumbești – Jiu - Gară (zona 2)


Fig. 188 Area plan for the Roman Fort, Bumbești – Jiu

Fig. 189 Images of the Roman Fort, Bumbești – Jiu

Fig. 190 Excavation images of the Roman Fort, Bumbești – Jiu – zona 1


Fig. 192 Excavation images of the Roman Fort, Bumbești – Jiu – zona 2

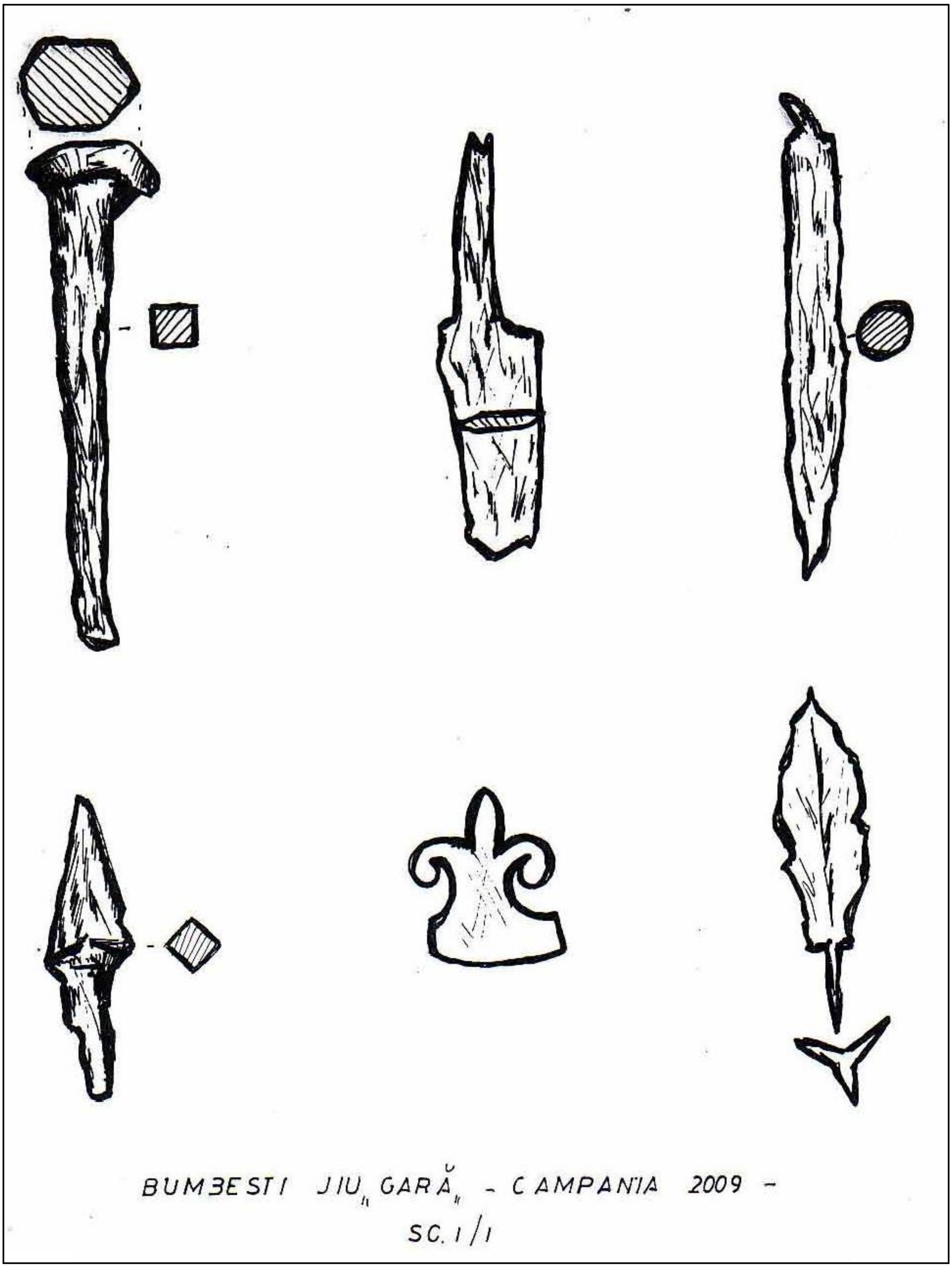



Fig. 193 Sketches Bumbești - Jiu „Railway station" - 1

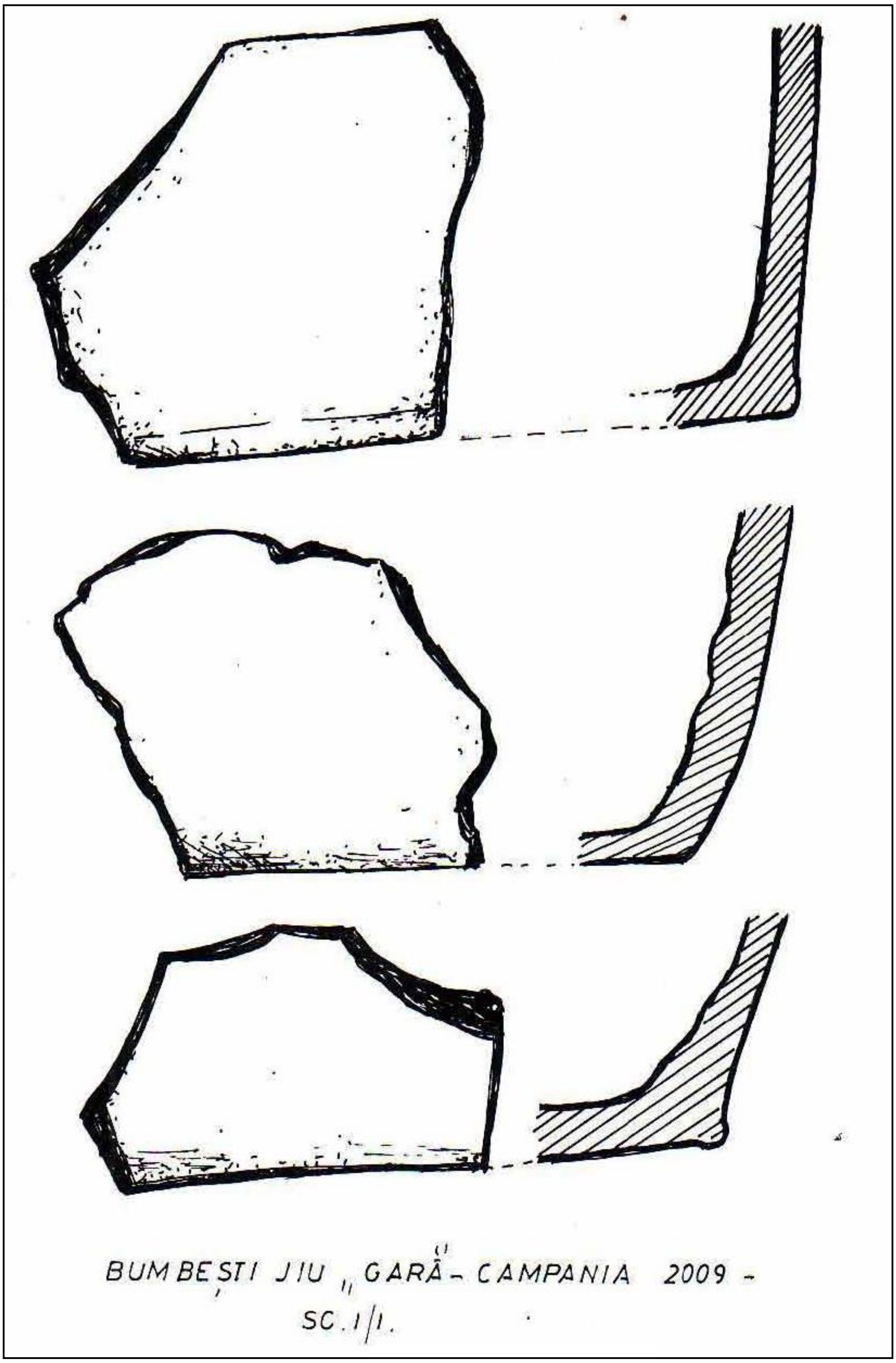



Fig. 194 Sketches Bumbești - Jiu „Railway station" - 2

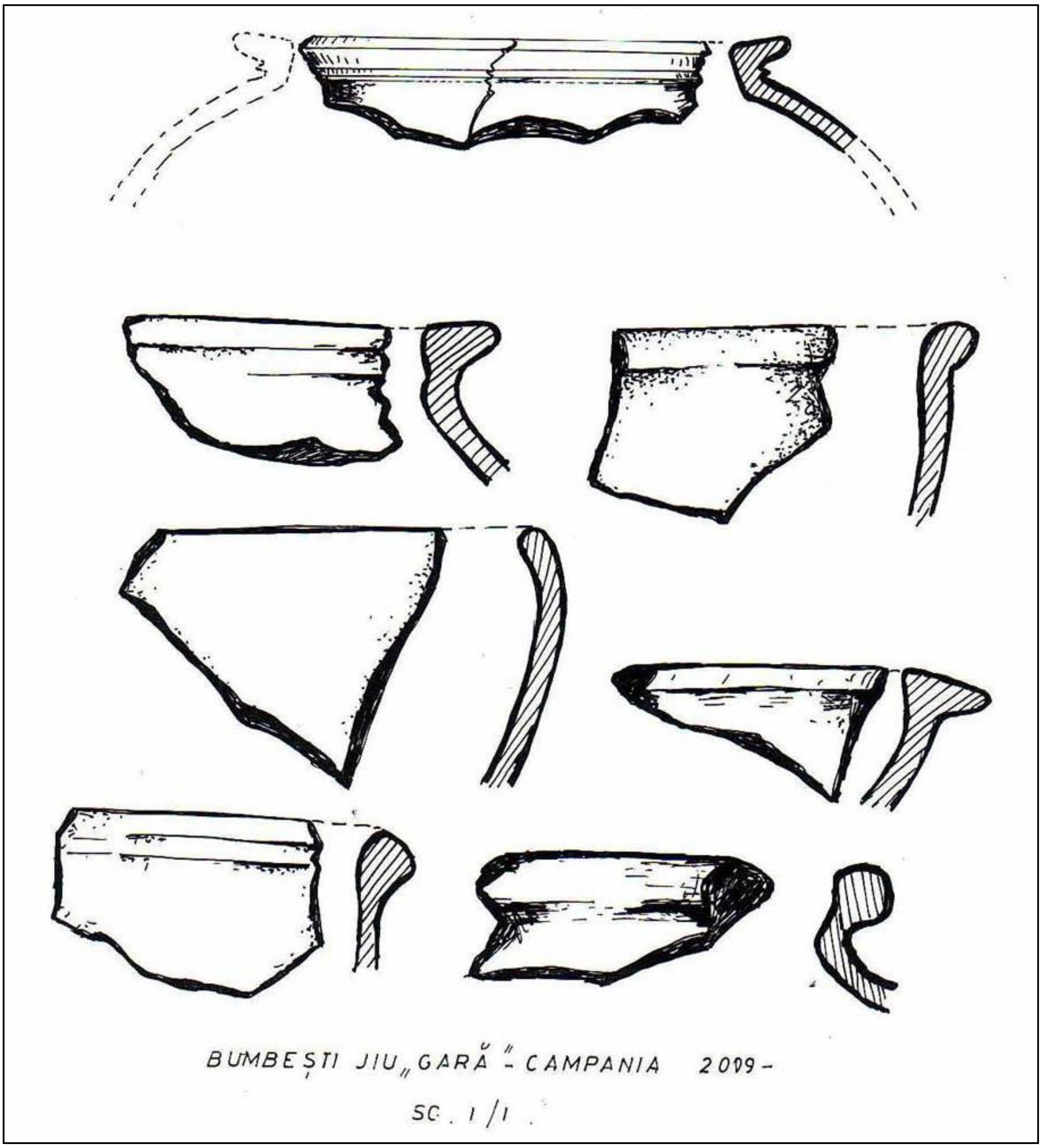



Fig. 195 Sketches Bumbești - Jiu „Railway station" - 3

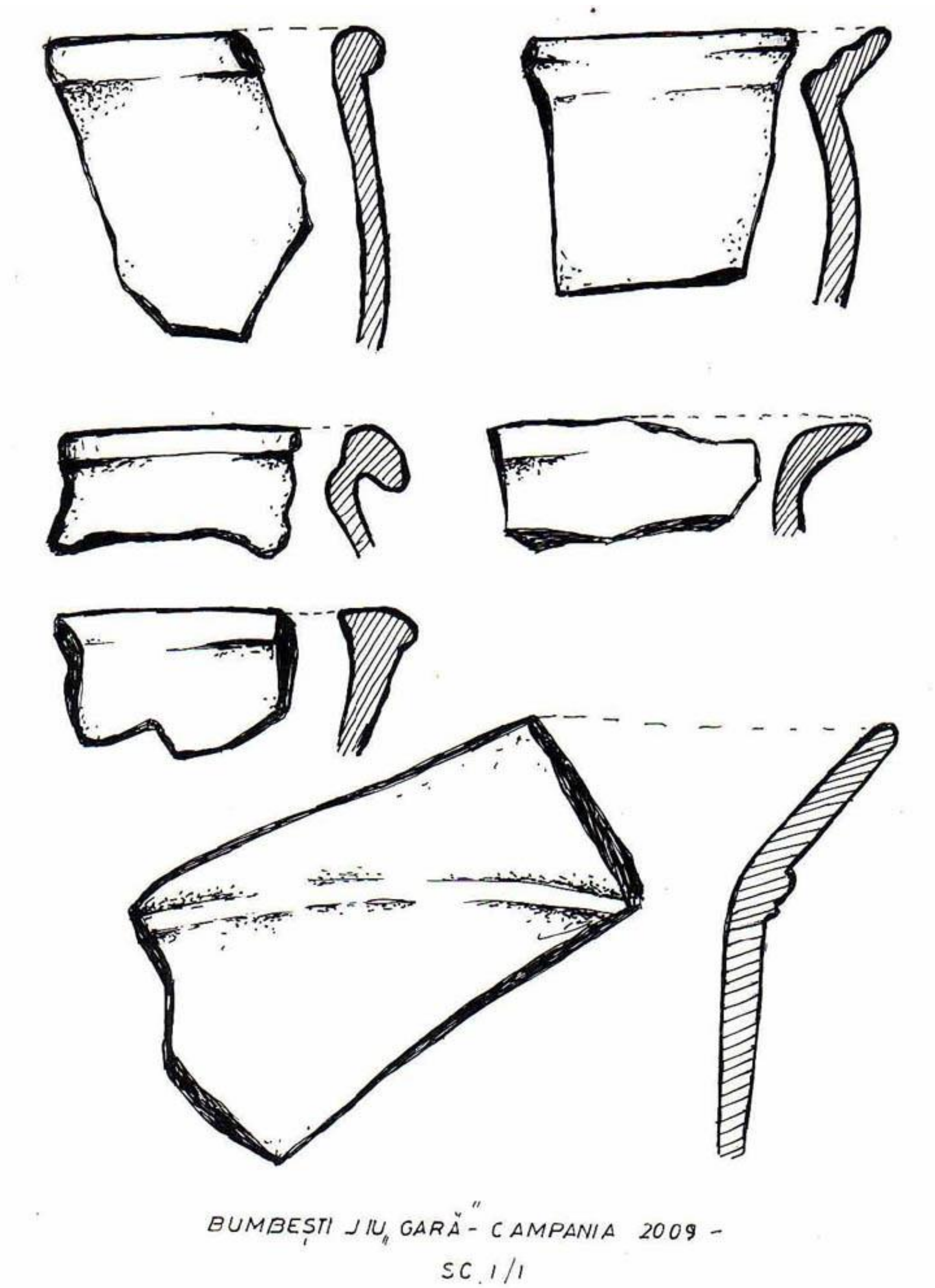



Fig. 196 Sketches Bumbești - Jiu „Railway station” - 4

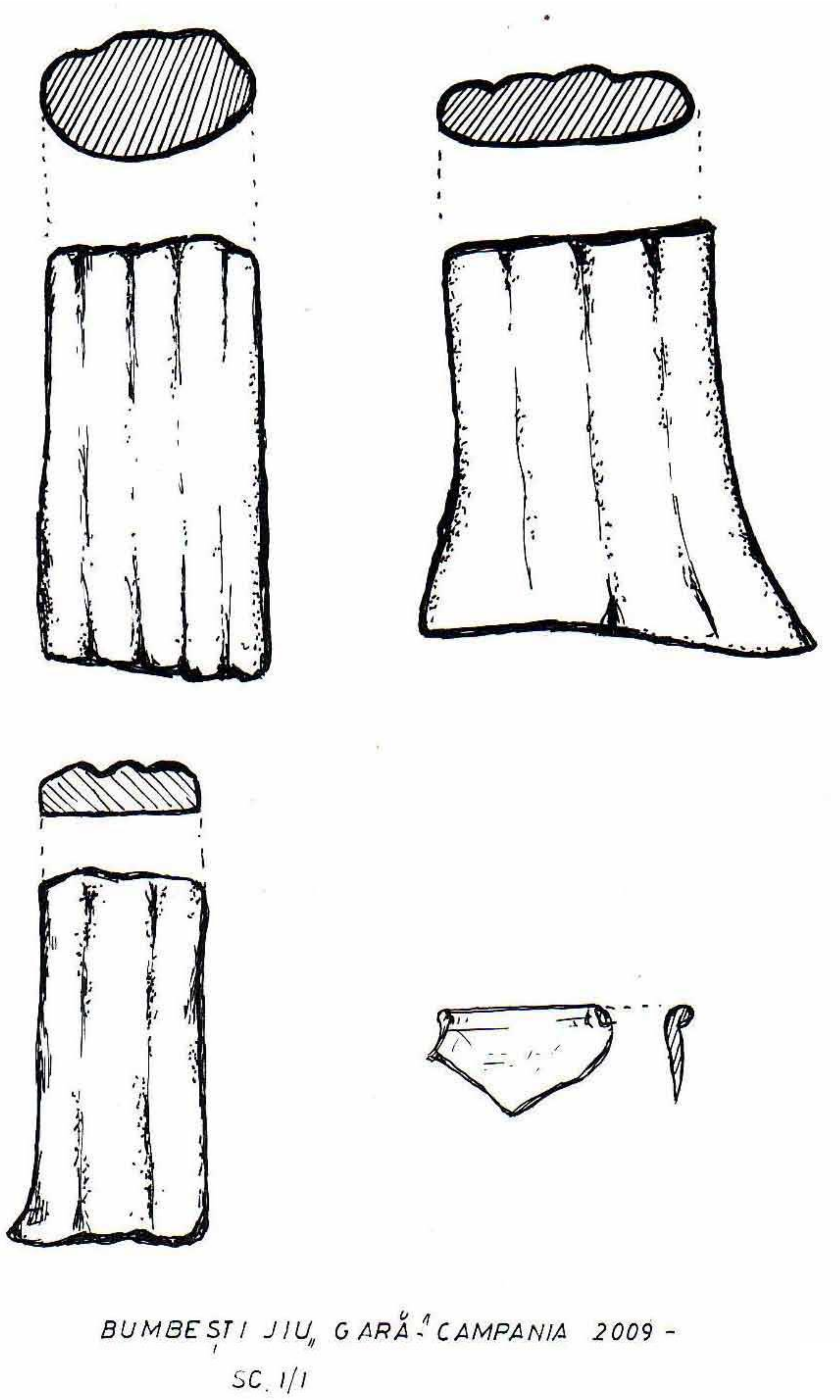



Fig. 197 Sketches Bumbești - Jiu „Railway station" - 5

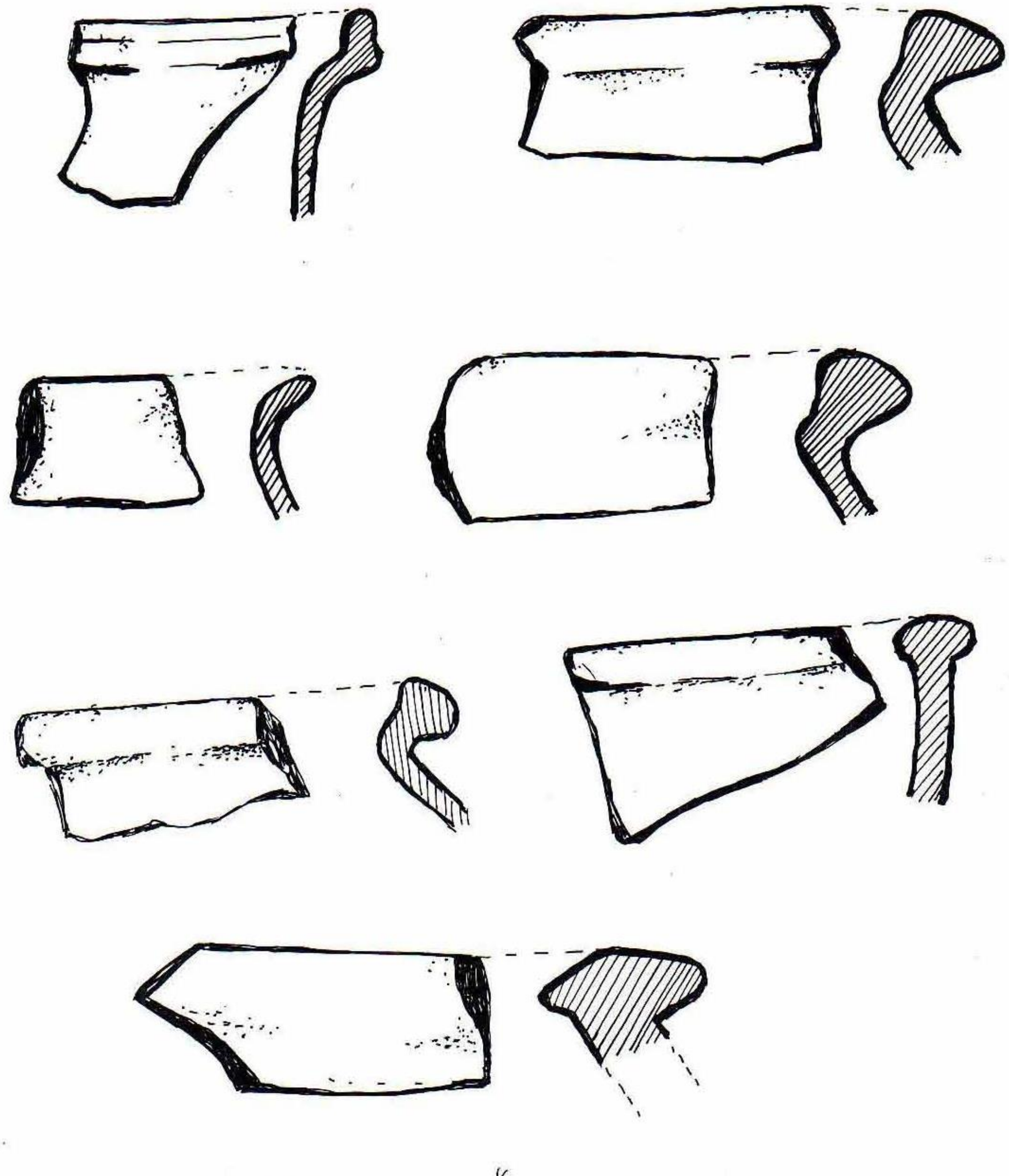



Fig. 198 Sketches Bumbești - Jiu „Railway station" - 7

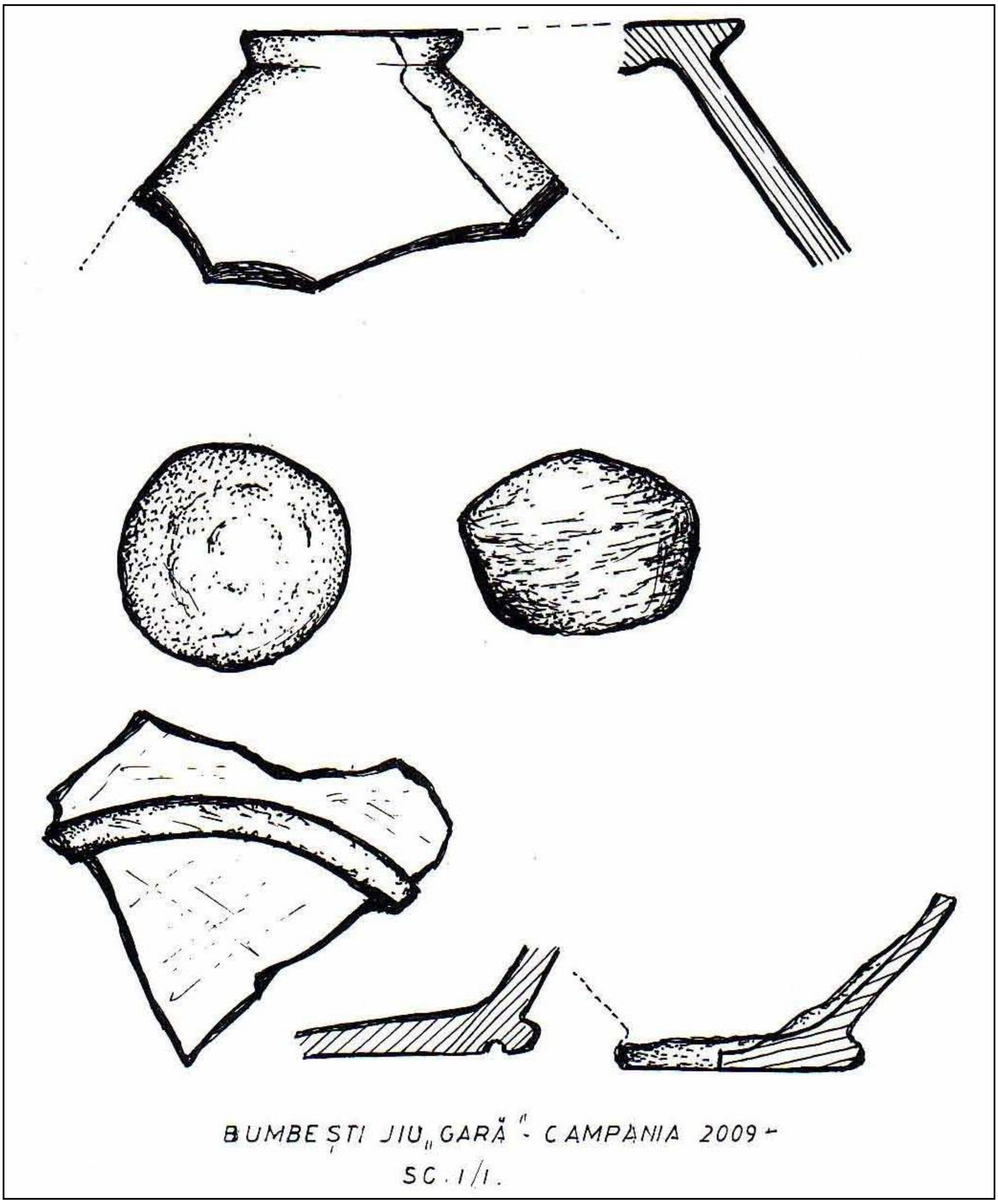



Fig. 199 Sketches Bumbești - Jiu „Railway station" - 8

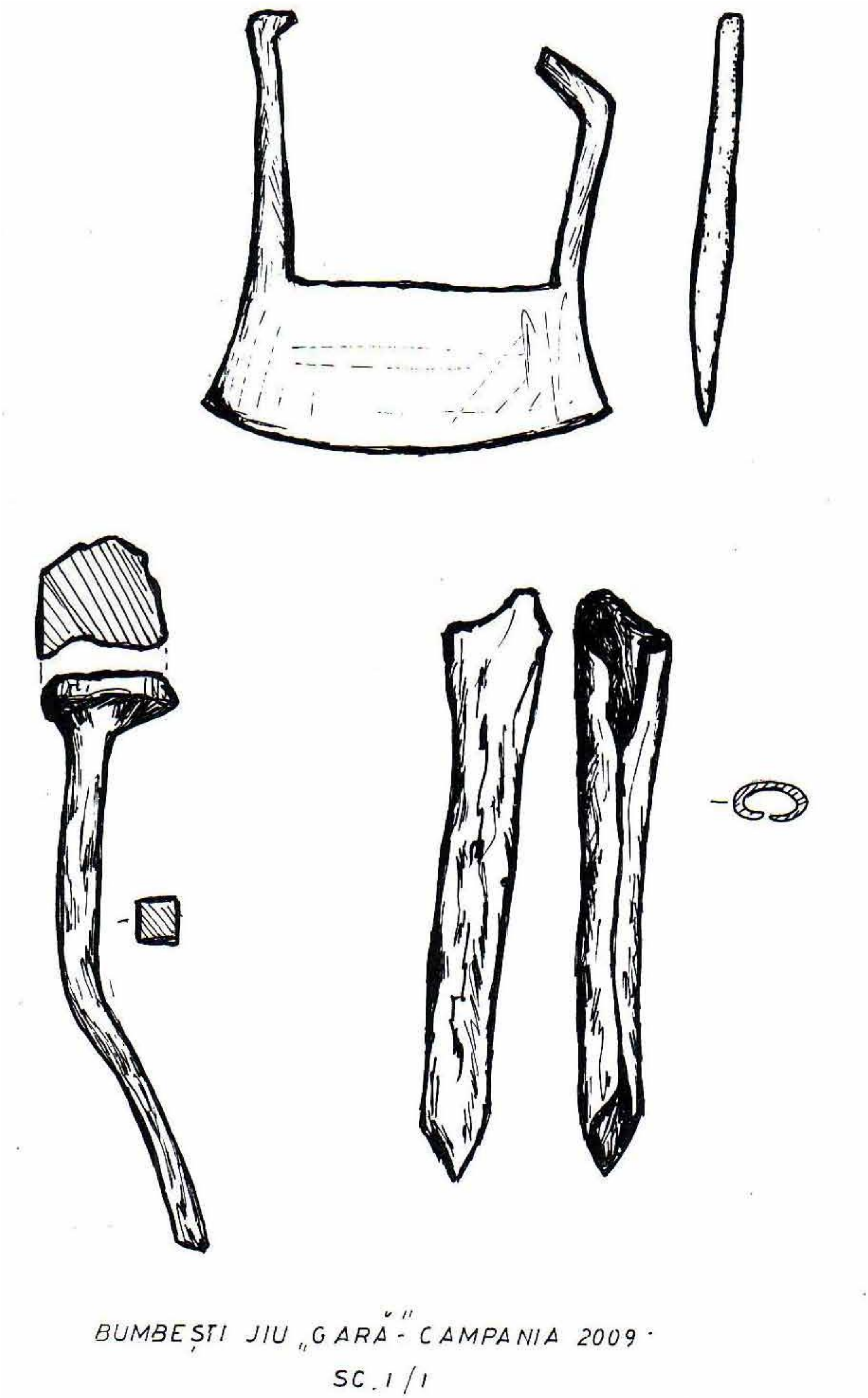



Fig. 200 Sketches Bumbești - Jiu „Railway station” - 9

**Fig. 16.**

Fig. 201 Aerial view Bumbești Jiu fort

Fig. 202 Aerial view of Bumbești Jiu fort, fragment with stone wall

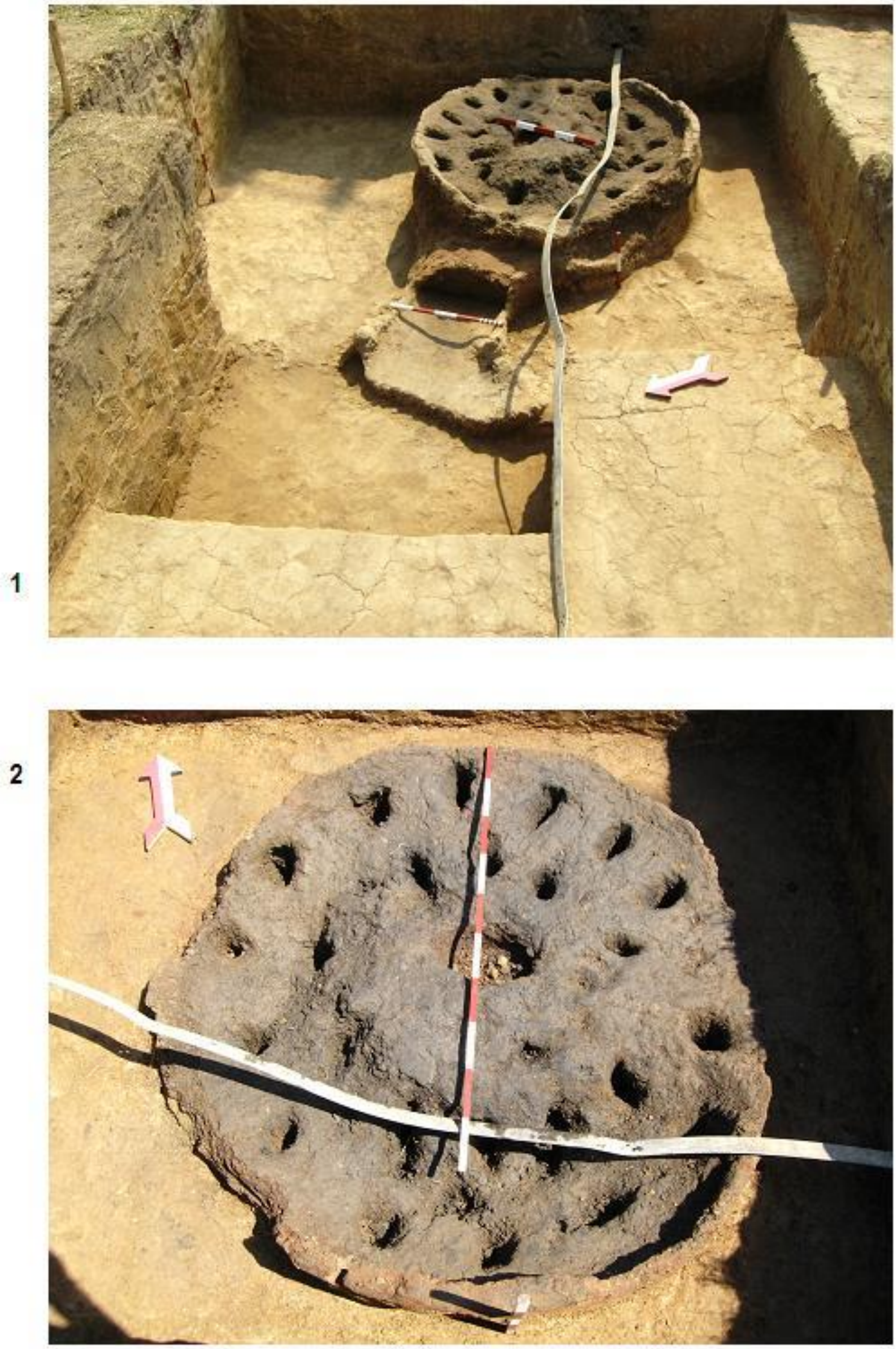



Fig. 203 Aspects of Bumbești Jiu excavation

Fig. 204 Excavation aspects Bumbești Jiu – area 2

Fig. 205 Excavation aspects Bumbești Jiu – area 3

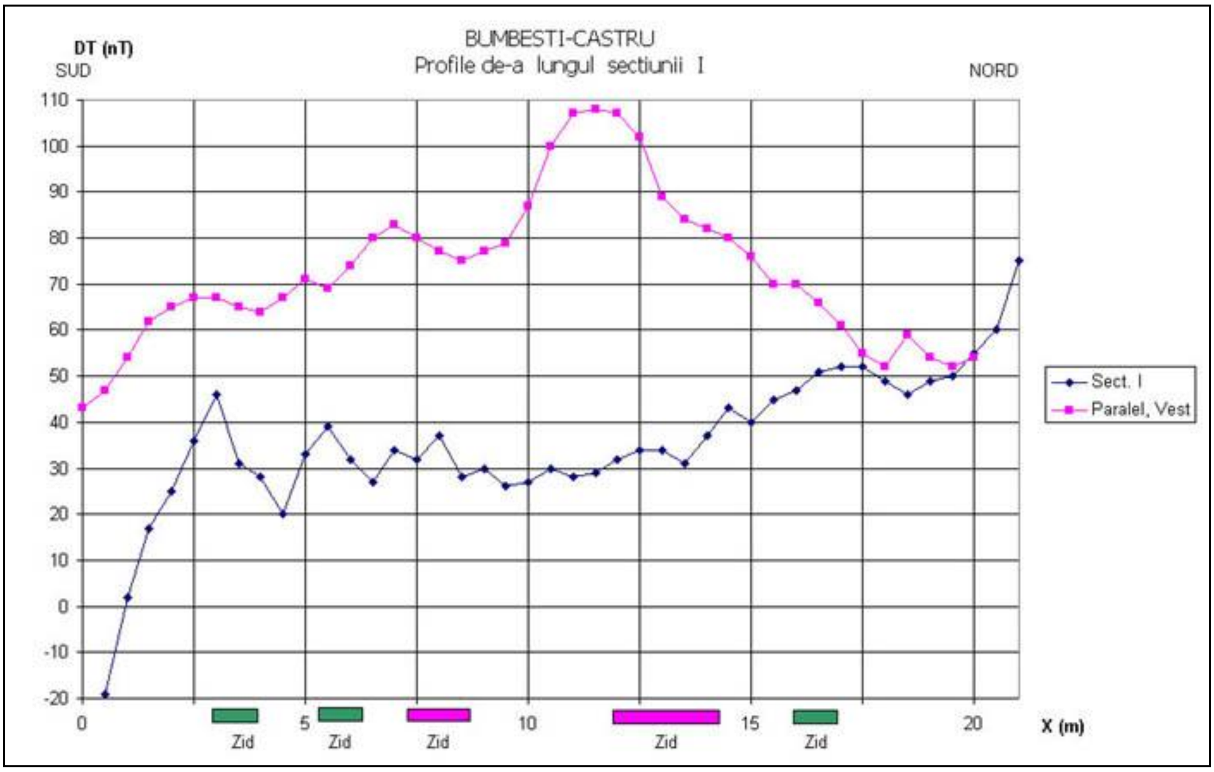



Fig. 206 Excavation section profile

***2. The archaeological site from the Roman era at Bumbeşti Jiu - Vârtop***

The information from the NAR site sheet is as follows (National Archaeological Repertoire (cimec.ro)):

| | |
|---|---|
| Localization | Show on the map of Romania * |
| NAR code | 79317.02 |
| Cod LHM (List of Historical Monuments) | GJ-I-s-B-09127 |
| Name | The archaeological site from the Roman era at Bumbeşti Jiu - Vârtop |
| County | Gorj |
| Administrative Territorial Unit | Bumbeşti-Jiu Town |
| Town | Bumbeşti-Jiu |
| Point | Vârtop |
| Landmark | The site is located 800 m N from the stone-walled fort at the "Railway Station" point and 1.8 km S from the Bumbești Jiu town, 1 km E from the riverbed. |
| Hydrographic landmark - name | Jiu |
| Hydrographic landmark - type | river |
| Landform | hill |
| Categorie | housing |
| Type | Settlement and fort |
| Observații | The first researches took place here in 1897, led by Grigore Tocilescu, then resumed in 1937 by C. S. Nicolăescu-Plopșor, and from 1956 to 1981 (with small interruptions) by Grigore Florescu and Expectatatus Bujor, from the IAB. From 1982 to 1994, the research was led by col. dr. Christian Vlădescu, from MMN, and after 1994 and currently by a team from MJ Gorj, with Dr. Vasile Marinoiu as scientific supervisor. |
| Date of Discovery | 1988 |
| Conservation status | Precarious / 29.01.2015 |
| Date of last change | 14.07.2022 |

*Table no. 57 The structure of the Roman-era archaeological site from Bumbesti Jiu - Vartop*

| Category/ Type | Age (Dating) | Culture/cultural phase | Documentary attestation | Description/ Observations | LHM code |
|---|---|---|---|---|---|
| Civilian settlement | Roman age (1/2 second century A.D.) | roman | - | - | GJ-I-m-B-09127.01 |
| Thermae | Roman age (second – third century A.D.) | roman | - | The thermal building is 15.90 m long and 13.75 m wide. It has five large rooms and two adjacent. | - |
| Fort | Roman Age (1/2 second century A.D.) | roman | - | The fortification is closed by an earth mound, 14 m wide at the base. It has an 11 m wide and 0.50 - 1.00 m deep ditch in front.<br>A national road, built in the years 1880-1890, cuts the fort in the middle, between kilometer 82 and 83. Its shape is almost square, with sides of 126 m in the N-S direction and 115 m in the E-W direction. Most of the fort was destroyed by the Vârtop stream and the construction of the road. | GJ-I-m-B-09127.02 |
| Earth mound | Roman age (second – third century A.D.) | roman | - | - | GJ-I-m-B-09127.03 |

There is more information about the Bumbești-Vârtop castrum.

For example, in a study from 1994, Dan Ionescu and Vasile Marinoiu present the results of archaeological rescue research determined by the hydropower works here (Dan Ionescu, Vasile Marinoiu, Archaeological research from Vîrtop-Bumbești-Jiu from 1993, in LITHUANIA Studies and research 6, 1994, p. 52-56): "Archaeological research at Bumbeşti-Jiu, rescue research determined by the hydropower works here, took place between August 16 and September 16 in the area of the fortifications and the Romanian civil settlement in the points:

- Bumbeşti-Jiu - Train station, the Roman civil settlement, research carried out by specialists of the Institute of Archaeology.

- Porceni - Pleşa, within the fortification, research carried out by specialists of the National Military Museum.

- Vârtop - Bumbeşti-Jiu, in the premises of the Roman fort, research carried out by specialists of the Gorj County Museum. In what follows, we will refer to the Vârtop - Bumbeşti-Jiu sector, the sector assigned to the Gorj County Museum, more precisely on the territory of the Roman fort located next to Km. 83 of D.N. no. 66 Târgu-Jiu - Petroşani, on the left bank of the Jiu, next to the Vârtop stream and about 900 meters north of the stone-walled castle of Bumbeşti-Jiu.

A section S1 with a length of 25 x 2 m oriented roughly in the east-west direction, perpendicular to the defensive wall of the Roman fort and a section S2 with a size of 10 x 2 m oriented in the north-south direction, was drawn, on the gate area on the western side of the castrum. In relation to the location of the fort, we can appreciate that the Roman builders went on to set up the military fortification using a well-defended natural position towards the north and west sides.

Thus, the location of the fort on the foot of a hill in the immediate vicinity of a relatively deep valley that stretched towards the Jiu course gave the fortification greater security in case of a possible attack that could come from the Vâlcan pass, located about 2 km northwest. The castle wall on the west side was built right on the edge of the hill. The berm, with a width of 0.80 m, was practically the western limit of the hill, from it following a steep descent of the hill to the level of the Jiu course, about 15 meters, difference in level, compared to the bottom of the wave. The width of the wave, captured by us, is 11 meters, the crest of the wave having a peak height of 1.30 m. The wave is made of dark yellow soil. At 1.30 m from the berm, the wave was transversally pierced by a trench used by the soldiers of the Romanian army during the battles carried out in this area during the first world war. The soil resulting from digging the trench was placed right on the Roman berm, thus creating a good defensive position. At 2.30 meters from the berm, the Roman wave has a width of 1.30 m, possibly as a later construction of the wave.

The cavity was made by digging in the dark yellow earth, earth that had been used for the actual creation of the wave. The upper part of the wave belonging to squares 4 and 6, practically the crest of the wave, is made of "murus caespiticius" with a remarkable consistency. At the base of the wave in square 6 at 1.90 m a fragment of prehistoric pottery was discovered. If the core of the wave is made of a dark yellow clay, the inner slope of the wave is made of a dark brown clay.

The crest of the wave is 7.50 m from via sagularis. In squares 11 and 12, a large amount of rubble consisting of fragments of tiles and tiles was found. Practically, the rubble covered the entire level, the via sagularis, the collapsed tiles and tiles belonging to the construction located in close proximity to the eastern side of the via sagularis. This communication path was made by placing a bed of river stones on top of which flat river stones were laid, then covered by a layer with a thickness of about 0.25 m of gravel. A new layer of river stones was placed over this coarse layer of gravel, which was finally leveled with a new layer of gravel. The width of the sagularis vineyard is 2.60 meters, with no gutters. Practically, it borders on the east side with the impressive foundation due to its dimensions, if we take into account the information we have about the Vârtop castrum. The short time and the real possibilities of the actual excavation did not allow us to expand and implicitly completely dismantle the construction whose western foundation was caught in squares 15 and 16."

Another study about the Vârtop castrum is the one signed by Vasile Marinoiu, Olimpia Bratu, Archaeological research from Bumbești-Jiu, Gorj county, 1997-1999 campaigns, where the authors describe the archaeological research carried out during the mentioned period. The plan of the excavation and the discoveries made were published and illustrated.

Over time, restoration and consolidation works were also carried out at these forts. These aspects are discussed in a short study by Expectatus Bujor, Restoration and consolidation works at the stone-walled fort from Bumbeşti-Jiu (Gorj county), in Materials and archaeological researches 15, 1983, p. 350-351: " Known from specialized literature, this fortification seems to be definitively ranked among the objectives exhausted in terms of archaeological research. The excavations from 1897 noted in the manuscripts of Gr. Tocilescu and P. Polonic, those from 1937 by C. S. Nicolăescu-Plopşor, those from 1955 by Gr. Florescu, were all synthesized by D. Tudor in the Romanian Oltenia. The witness left on the ground, from what used to be safety for some and danger for others, does not show enough confidence that it would be worth investing new concerns, efforts and funds, the essential elements being known: form, construction system, historical stage, unity military. At the first reading of the bibliographic material, it would seem so.

A closer analysis of the sources of information shows that the researches that had been carried out for this objective caused problems to appear, but did not answer them. The inscription found by Tocilescu - Polonic at the castrum gate names the military unit that built the fortification wall - Cohors I Aurelia Brittonum milliaria Anloniniana; but we have no evidence that this unit was garrisoned here. Instead, on the occasion of the same excavations, bricks were found with the unit stamp C(ohors) IV C(ypria); and Al. Barcăcila signaled a brick with the stamp of a large military unit - L(egio) V M(acedonica) (!). Resuming the research, in order to consolidate and preserve the historical monument in situ, we found an impressively large number of bricks bearing different types of stamps of the C(ohors) IV C(ypria) unit, fallen together with the rubble of the enclosure wall in the pit next to the only tower that has been preserved, the southeast one. And in one of the pilae in the hypocaustum at the thermae, I found (ten years ago) a brick with the stamp of a large military unit - Leg(io) IV Fl(avia). These discoveries raise problems: of the ratio between the military units, of the stationing time, of their range of action, for the solution of which testimonies, conclusive situations, which may still appear, are needed.

It was known that the wall was made of stone and mortar; but for the conservation works, studies on the construction technique were still needed. By clearing the rubble, but also by the sections that we executed outside the premises, some observations were obtained. In addition to the use of white lime mortar with sand and gravel, deposited only after the first two rows of boulders at the base, the presence of horizontal layers of mortar was found at different heights of the wall. These levels would indicate construction stages necessary to dry the mortar, as well as to ensure a good construction resistance. River boulders were used for the foundation, and river stone and rock stone were used to build the wall, these with a straight face when placed outwards. These are observations that we will have to take into account during the restoration works.

Previous research noted the presence of the defense ditch - the pit, which would have been sometimes 9 m, sometimes 15 m wide, depending on the author. And the berm would not have existed, or it would have been 2.50 m wide between the wall and the defense ditch. As a result of the sections executed outside the enclosure, both on the east and south sides, in the portions adjacent to the southeast tower, we found that the contemporary moat of the wall was only 7 m wide; and the berm was very narrow, only near the tower it reached a width of 1 m. This widening indicates a removal of the defense ditch around the corner tower; but it can also indicate the initial shape of the rounding of the corner of the fortification, widening outwards, with an earth embankment.

This observation prompts us to draw a parallel between this possible initial form and the one found at the eastern corners of the fortification at Pleşa (=Porceni), which precisely because of this particularity, according to some, could not be attributed to the Roman era, nor after the discovery inside it of Roman ceramics. At the same time, this observation could explain, perhaps, the sharp angle at the southeast corner of the stone-walled castle, through the same non-perpendicularity of the sides, just like at Pleşa.

But observations are also needed in the other two halves of the sides, which, together with those obtained, help to elucidate some problems of construction, stages and even historical framing. The fossa, with the ruins of the enclosure wall, was arranged in the dirty earth, which filled a previous fossa, devoid of construction debris. This situation is in accordance with the statement in the mentioned inscription, as if the castrum was rebuilt in stone with earthworks furrows muros cespiticios vetustate dilapsos lapide eos restituerunt. But both the restoration inscription and the two overlapped defense trenches imply the existence inside the fortification of some equivalent situations, either of deposits, or of constructions, or restorations over time. However, so far, we have no news from previous investigations.

Even for the vallum, the closest element to the defense ditch, we have no construction details. Or, without these observations, the problem cannot be considered solved. And the finding of a third fossa, 2 m away from the overlapping ones and 5 m wide, opens a problem for which, apart from this observation, we have no other elements to elucidate, for now. As you can see, the problem of defense trenches is under study; it is a barely open problem and it concerns the chronology. The tower in the southeast corner of the fortification is marked inside it on the Polonic plan; the outer side is curved, and the other sides - straight, having the dimensions known in the bibliography. But we know nothing about the deposits inside it. However, the corner tower is a component part of the enclosure wall and one of the elements of weight and wear in the existence of the fortification, both in the earth phase, but especially in the stone phase, from which the numerous stamped bricks ended in the defense ditch. Also, the towers at the gates require special attention, because they were simply destroyed by the stone extractors. So that every observation has great value for a good and adequate conservation.

The presence, near the castrum both of the thermae, but especially of the numerous dwellings, requires the inclusion of the fortification in the Roman civic ensemble, following the relationship between the stages of existence of the military fortification and those of the civil constructions. They form a unitary whole. The three fortifications: from the Bumbeşti train station, from the Vârtop stream and from the Pleşa school, with the civilian settlement developed around the first, had a well-established role in the military and administrative organization of the Roman province of Dacia. The link between the Empire and the capital of the province was also provided on this short road between Drobeta and Sarmizegetusa - Ulpia Traiana, the one that passed through the Vulcan Pass. In the short history of the province of Dacia, the mandatory crossing point at Bumbeşti - Jiu was always in full activity, which led to the permanent military stationing and the development of the civilian settlement.

As can be seen, the in situ consolidations and conservations at the stone-walled fort from Bumbeşti - Jiu required and continue to require the execution of appropriate field studies, which would form the basis of the requested technical works. These documentary studies, which are always done before the design of the works, continue during the execution. Without them, consolidation and preservation are unthinkable.

The realization in recent years of the archaeological reserve, which includes a good part of the Roman settlement together with the stone-walled fort, gave the possibility to the Committee for Culture and Socialist Education of Gorj County to include in its work plan the action of preserving the monuments and, at the same time, to finance it, the beneficiary being the Gorj County Museum, which will enrich its cultural heritage with a collection of archaeological objects, the result of the collaboration it has had for several years with the Institute of Archeology in Bucharest."

Another interesting study on aspects regarding the conservation and restoration of the Bumbești-Jiu castle is the one written by Vasile Marinoiu, Iulian Camui, The Roman Castrum of Bumbești-Jiu. Conservation-restoration problems in LITHUA. Studies and researches 3, 1986, p. 138-155: "On the map of archaeological discoveries from the Roman era in Gorj county, the locality of Bumbeşti-Jiu stands out as one of the most important: the complex of Roman fortifications here includes the earth fort from Pleşa (Porceni) - castrum aestiva - on the right bank of the Jiu, dating from the period of the first Daco-Roman war, the earthen fort from Vîrtop that existed in the middle of the 2nd century AD (according to the last coin from Faustina Senior - 141 A.D - discovered here) and the stone-walled castrum from Bumbeşti-Jiu built in 201 A.D, on the site of the old earth fort, the last ones located on the left bank of the Jiu. Around the latter, an important civil settlement developed over an appreciable area.

The grouping of the three forts in this area had the purpose of defending and securing the Jiu gorge and supervising the subject population. The first two were abandoned over time, their function being of course taken over by the one from Bumbeşti-Jiu. It is located about 3 km southeast of Pleşa and 1 km south of Vârtop. It is located on the left bank of the Jiu River - about 15 m high next to the fortification - currently more than half of it has been destroyed by the waters of the Jiu River. Only the eastern side is preserved in its entirety and 3/4 of the southern one. The archaeological research started in 1897 by Grigore Tocilescu and Pamfil Polonic and continued in 1937 by C.S. Nicolăescu-Plopşor, and from 1955 by Grigore Florescu and Expectatus Bujor, they continued every year from 1968. These latest researches were carried out by the Institute of Archeology Bucharest and the Central Military Museum in collaboration with the Gorj County Museum. Archaeological excavations revealed the walls and foundations of the existing sides, the towers of the two gates and those in the southeast corner, part of the foundations of the praetorium, the route of the foundations from the constructions inside the castle (south of the gate on the east side and north), as well as the foundations of thermal baths, workshops and houses in the civil settlement. The archaeological excavations of the last four years have focused on the research of the Roman fort with a stone wall, with the aim of consolidating and preserving in situ the respective historical monument.

In 1984, the conservation-restoration of the walls of the Bumbeşti-Jiu castrum continued. First, the facade of the towers of the east gate was consolidated over a length of about 6 m, a thickness of 1.40 m and a height between 1 m and 1.30 m. Then the conservation-restoration of the southern wall of the enclosure continued for another length of 5 m and a height of 0.40 m. Research inside the fortification brought to light other walls of the praetorium and military barracks with a length of 30 m, a height between 0.10 and 0.30 m and a thickness of 0,70 m, walls that have now been consolidated. In the coming years, parallel to the archaeological excavations, the conservation-restoration works of the enclosure walls of the fortification on the east and south sides, including the towers of the east gate, as well as all the vestiges that will appear as a result of these investigations as well as the foundations of the civil buildings around the fort. At the same time, in order to prevent the destruction of the wall by the erosion of the bank by the rainwater and those of the Jiu, the execution of concrete beams with spurs will be pursued, which will limit and strengthen the existing extremities.

The Roman fort and the civil settlement at Bumbeşti-Jiu played a special role in Romanian Dacia both as a strategic factor in the defense of the Roman road that started from Drobeta - Putinei - Cătunele - Vârț - Bumbeşti-Jiu towards Sarmizegetusa Regia, and as a Romanization factor of the Geto-Dacian population. This is highlighted by the archaeological discoveries in the castrum and the Roman civil settlement, where the presence of provincial Roman ceramics of Dacian style can be observed (the log motif, ceramics with gray, coarse paste). We note that this pottery is found everywhere, in military barracks and civilian dwellings, throughout the depth of the residential layer, alongside Roman archaeological material. There is a mutual influence between the traditional Dacian ceramics made by hand and the Roman provincial ones made with the wheel. The research makes an important contribution to the knowledge of the internal organization of Roman Dacia, the technical endowment and daily life. The presence of Dacian vessels discovered during the research testifies both the connection of native Dacians with the camp, but also the existence near it of a strong Dacian community. Thus, the archaeological remains from Bumbeşti-Jiu have a special historical value and significance in the context of the formation of the Romanian people from the symbiosis of the Geto-Dacian population with the roman one. The archaeological complex from Bumbeşti-Jiu through its archaeological inventory, through its vestiges, represents a true open-air museum."

It is also worth mentioning the study by Vasile Marinoiu, The military units stationed in the Roman camps from Bumbești Jiu, in LITHUA. Studies and researches 9, 2003, pp. 57-66.

Also in the Chronicle of archaeological research, information is included regarding the systematic archaeological research carried out in the Bumbești forts. (CHRONICLE OF ARCHAEOLOGICAL RESEARCH IN ROMANIA – CAMPAIGN 2005 (cimec.ro)).

Another study about these castres is the one signed by Cristian Vladescu, the Fortification Complex in Bumbesti and their role in spreading the romance, in LITHUA 3, 1986, p. 132-137b.

In Felix Marcu's work, The internal planning of Roman forts in Dacia, Ed. Mega, Cuj-Napoca, 2009, the author refers to the topography of the Bumbești fort (p. 174): "The second fort in the Bumbesti-Jiu fortification area is the one at VÂRTOP, also flood-damaged. A few coins discovered inside the fort and dated from Trajan to Commodus suggest the fort dating during the 2nd century AD 170. Such dating corresponds to the finding of the single tile stamp bearing legion's IV Flavia Felix symbol. Inside the fort, the single stone building partially researched is close to the western enclosure, near via sagularis, the walls foundations being made of cobbles bound in the lower part with clay, while the proper elevation consists of cobbles bound with mortar. The excavators deemed it horreum, yet a hypocaust pile contradicts such interpretation. It is obvious that this pile could not have come from a hypocaust system, although it was obviously designed to carry a floor in order to vent and not heat it."

The point is precisely localised in the RAN (Cartographic Server National Cultural Heritage (cimec.ro)).

Details regarding the castrum, state of preservation, planimetry, location and discovered materials can also be seen from the plans and figures published online, in the RAN database.

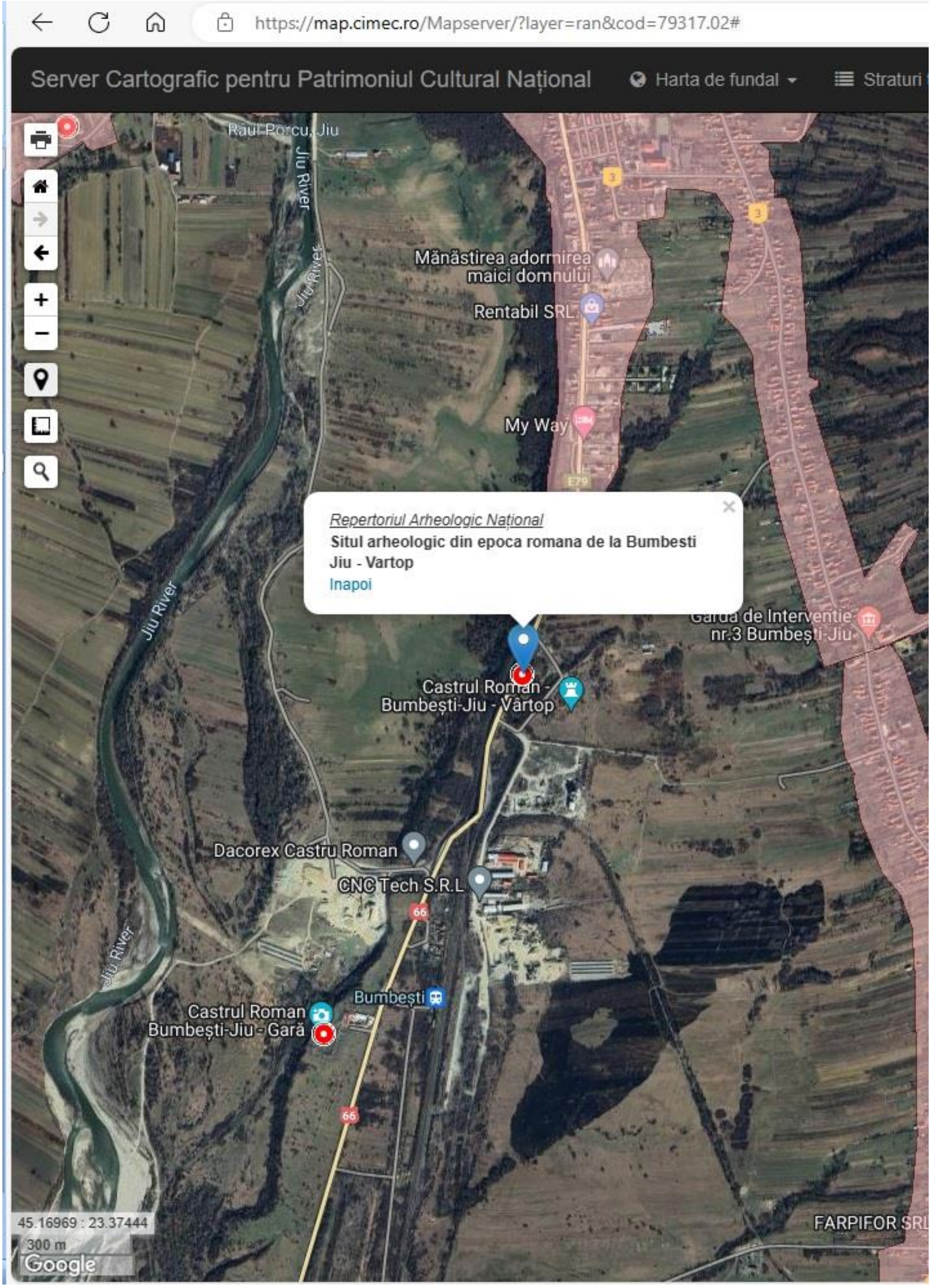



Fig. 207 Location of the Bumbești-Jiu-Vârtop archaeological site - zone 1

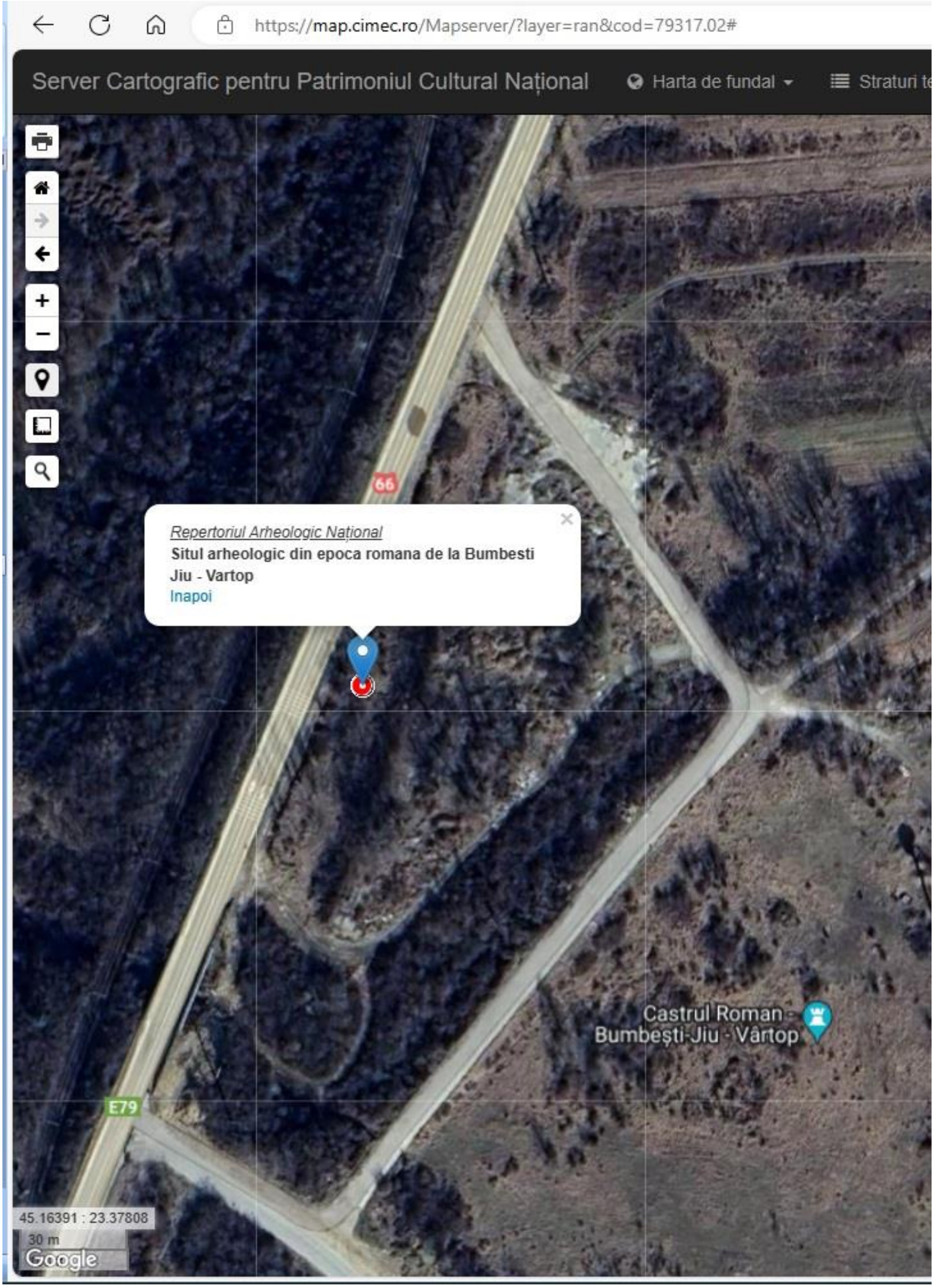



Fig. 208 Location of the Bumbești-Jiu-Vârtop archaeological site - zone 2

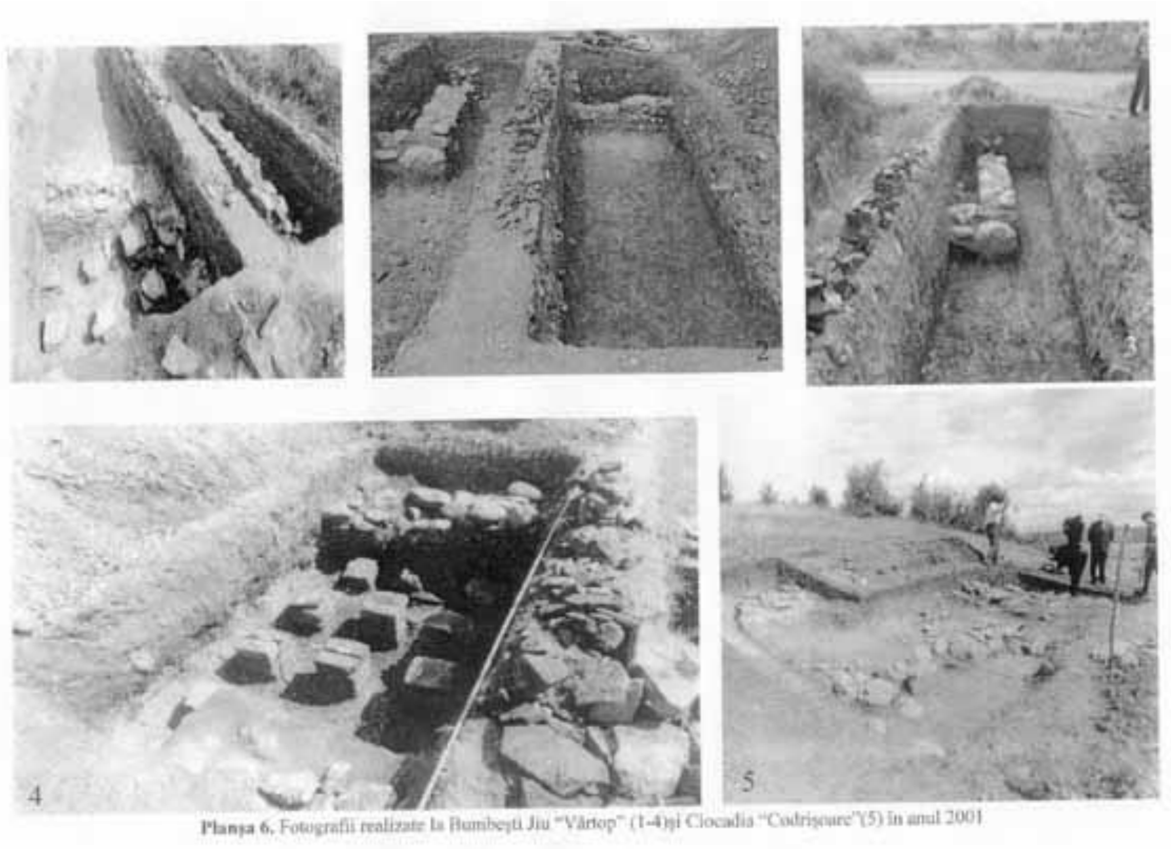



Fig. 209 Bumbești-Jiu-Vârtop archaeological site - excavations

***3. St. Trinity Monastery of Bumbeşti Jiu - At Vişina***

The information from NAR (National Archaeological Repertory) (https://ran.cimec.ro/sel.asp?descript=bumbesti-jiu-oras-bumbesti-jiu-gorj-manastirea-sf.-treime-de-la-bumbesti-jiu-la-visina-cod-sit-ran-79317.03 ) is as follows:

| | |
|---|---|
| Location | Show on Romania's map](https://map.cimec.ro/Mapserver?layer=ran&cod=79317.03 ) * |
| NAR code | 79317.03 |
| LHM Code (List of Historical Monuments): | GJ-I-s-B-09128 |
| Name | St. Trinity Monastery of Bumbeşti Jiu - At Vişina |
| County | Gorj |
| Administrative Territorial Unit | Bumbeşti-Jiu town |
| Locality | Bumbeşti-Jiu |
| Adress | Vişina Street no. 15-16 |
| Point | At Vişina |

| | |
|---|---|
| Landmark | The monastery is located 1 km north of the town, on the right bank of the Jiu River; About 200 m west of DN. 66 Târgu Jiu -- Petroşani; north of Bumbeşti Jiu town, at the entrance to the Jiu Gorge and 50 m west of the Jiu River, on its right bank. |
| Hydrographic landmark - name: | Jiu |
| Hydrographic landmark - type: | river |
| Landform: | mountain |
| Category | cult structure |
| Type | monastery |
| Description | Description: Vişina Monastery is documented at the beginning of the 16th century, but the two documents, the one from March 23, 1513, and especially the one from December 14, 1514 (when its first abbot, Grigorie, is mentioned), issued by the chancellery of Prince Neagoe Basarab, mention that the monastery's boundaries had been established since ".... From the days of Mircea Voivode ....", so it existed at the end of the 14th century, or at the beginning of the following century. |
| Site area | approx. 3100 sq.m. |
| Conservation status | medium / 13.05.2016 |
| Natural risks | Earthquake: 3 / 13.05.2016; Floods: 2 / 13.05.2016; Acid rain: 1 / 13.05.2016; Natural fire: 3 / 13.05.2016; Fires: 1 / 13.05.2016; Animals: 1 / 13.05.2016; Tornadoes: 1 / 13.05.2016; Excess water in soil: 1 / 13.05.2016; Excess salinity in soil: 1 / 13.05.2016; Excess acidity in soil: 1 / 13.05.2016 |
| Antropic risks | Demolare: 3 / 13.05.2016; Afectare parţială: 4 / 13.05.2016; Vandalism: 1 / 13.05.2016; Furturi: 1 / 13.05.2016; Incendii provocate: 2 / 13.05.2016 |
| Property regime | state |
| Owner | City Hall |
| Date of last modification of the file | 24.04.2020 |

*Table no. 58 Structure of St. Trinity Monastery of Bumbeşti Jiu - At Vişina*

| Category/ Type | Era (Dating) | Culture/ Cultural phase | Documentary attestation | Description/ Remarks |
|---|---|---|---|---|
| Monastery | Epoca medievală (sec. XIV - XV) | - | - | - |
| Hermitages (cells) | Medieval and late medieval era (16th-18th centuries) | - | - | In section S2, the substructures of a building appeared, a complex marked by us with Cx 1. Here there is, probably since the Middle Ages, the body of cells of the old monastery, unknown until now. In this area, we made a box where we discovered the foundations of some constructions, and inside one, a semicircular hearth, made of roman bricks (one even with the stamp in a CIVC semicircular cartouche - IV Cypria cohort), brought from the two castres from Bumbeşti Jiu, located approx. 5 km south of the monastery. This archaeological complex discovered by us is an annex of the Vișina monastery, having a rectangular shape and probably composed of several rooms (the research in box C1 highlighting the existence of three rooms with foundations made of shaped mountain and river stone, and at the corners with bricks). In the largest room, a hearth of a household oven was discovered, and in the room at the northwestern limit of the box, the stone foundations and the pedestal of a stove (near it fragments of tiles were discovered). The foundations of the cells made of stone (river and rock), with additions of calcareous tuff and brick, have been strongly affected, over time, by natural phenomena (landslides, penetration of tree roots, etc.), or various anthropogenic interventions. |

| Category/ Type | Era (Dating) | Culture/ Cultural phase | Documentary attestation | Description/ Remarks |
|---|---|---|---|---|
| | | | | The path of the foundations, in some areas of the building, is shifted to the east and north, probably due to landslides, the complex being positioned at the base of a slope oriented N-S. At some corners, the foundation is completed with Roman bricks of different sizes (28 x 14 x 6 cm; 14 x 14 x 5 cm and 21 x 15 x 6 cm). The hearth of the domestic oven, of circular shape, has a diameter of 1.40 m, being arranged mostly from fragments of Roman bricks, placed horizontally, and its edges delimited with rectangular shaped stone and bricks placed vertically, on the narrow side. To the east, at the edge of the hearth, there is a circular hole of approx. 0.40 m (probably for smoke evacuation), and around it fragments of burnt adobe, coals and ashes. |

### *4. The Lainici Monastery ensemble from Bumbeşti-Jiu*

The information from NAR (National Archaeological Repertory) are as follows: (National Archaeological Repertory (cimec.ro)):

| | |
|---|---|
| Location | Show on Romania's map * |
| NAR Code | 79317.05 |
| LHM Code (List of Historical Monuments): | GJ-II-m-B-09254 |
| Name | The Lainici Monastery ensemble from Bumbeşti-Jiu |
| County | Gorj |
| Administrative Territorial Unit | Bumbeşti-Jiu town |
| Locality | Bumbeşti-Jiu |
| Adress | Lainici street |
| Landmark | Lainici Monastery is located in the northern part of the UAT Bumbeşti - Jiu territory, in the Jiu gorge, on the right bank of this river, close to the confluence of Jiu and Chiţiu rivers, about 9 km north of Vişina Monastery, on the side of the European road E79. |
| Hydrographic landmark - name | Jiu |
| Hydrographic landmark - type | river |
| Forma de relief | hill |
| Utilizare teren | housing |
| Landform: | cult structure; burial discovery |
| Type | monastery; necropolis |
| Site area | 1,2 ha |
| Property regime | private |
| Owner | Romanian Orthodox Church |
| Date of last modification of the file | 15.02.2023 |

*Table no.. 59 Structure of the Lainici Monastery ensemble from Bumbeşti-Jiu*

| Category/ Type | Era (Dating) | Culture/ Cultural phase | Documentary attestation | Description/ Remarks | LHM Code |
|---|---|---|---|---|---|
| Monastery | The modern era (1812 - 1827) | - | - | - | - |
| Church | Modern era (19th century) | - | 1812 - 1817 | The church was built between 1812 and 1817 on the foundation of an older church from the 18th century.<br>It was painted inside and outside in 1860 and repaired in 1859, 1935, 1990 and 2007 - 2008. | - |
| Necropolis | premodern era (18th century) | romanian | - | - | - |

***5. The Roman road through the Vâlcan pass***

**<u>The investment does not affect this archaeological objective. (located over 5 km from Dumitra HPP)</u>**

We offer a description of this road, based on our research from the period between the years 2002-2006, published in the work of F. Fodorean, Roads from Roman Dacia, Cluj-Napoca, 2006, p. 235-237: "The Roman road between Drobeta and Ulpia Traiana crosses mostly the Valcan Mountains and the Parâng Mountains. The delimitation of the Vulcan Mountains was done by Professor Grigor P. Pop. These mountains start, in the west, in the starting area of Motru, Cerna and Jiul de West, where they connect with the Godeanu Mountains. In the east they reach Jiu, having a length of about 40 km and a width of about 18-20 km.

Between these limits, the Vulcan Mountains have a west-east direction, with heights that exceed 1900 m in the west, then descend to 1600-1800 m in the center and rise again, in the east, to 1869 m. They are constituted in the largest part of crystalline schists, crystalline limestones, conglomerates, Tismana and Şuşita granites. In the high area, the average annual temperatures are 2-3ºC, the precipitation is 1300-1400 mm/year and on the southern slope, foehn effects are recorded. Over the Vâlcan Mountains, more precisely through the Vâlcan pass (1621 m), starting from Bumbeşti-Jiu, a Roman road went up that reached the Petroşani Depression, at Vulcan. The choice of this route was determined by the wilderness of the Jiu Gorge, with very steep slopes and a narrow valley, which did not allow the organization of an appropriate road network.

***Ancient, medieval and modern springs***

No ancient or medieval source mentions any Roman section between Drobeta and Ulpia Traiana over the Vulcan Mountains.

***Mentions in modern historiography***

The first to mention the existence of this road is Al. Stefulescu, in an article published in "Revista noua" from April 15, 1893 (Al. Stefulescu, A Roman road discovered in Gorj, in Revista noua, year VI, no. 1, April 15, 1893, p. 340-342).

The author primarily refers to the state of preservation of the Roman fort in Bumbeşti, stating that at that time the 3 m high walls of the fort were still visible. Next, Stefulescu refers to the Roman road, stating that the locals know it by the name of the "big, old road", which went to the mouth of the Porceni plain through Vulcan, towards the east of Buliga". Stefulescu also states that "there are still old people in Porceni and Bumbeşti who remember hearing from their parents, that when they were small their parents would have told them that the imperial (Austrian) armies entered the village coming on the old road (s.n.)". The author provides details regarding the route of the road, noting that "the mountaineers who crossed it and continue to cross it give the following information about it: The old road (s.n.) starts from the Cetate (castle) at the mouth of the Porcenii plain, through the Scarisora command, up through Zănoga mountain, through the Horezu valley, Moiasa mountain, Porcenii, Cărtianu, Bordeiul lui Crăcan, Nemțesc mountain, Şeaua lui Craiu, Stânele, Lespedea, Fântâna Ghedy, Alunişiu, Vâlcanu, Crivedia, Muratorea, Délu de Baba, Meruşoru, Baru , Livadia, Puiu, Băesti, St. Maria, Haţeg, Toteştii, and reaches Grădişte". The Roman road continued to be used in the modern era, because "over the mountains that separate Bumbeşti from Grădişte, it is at most a day's walk". Wanting to be convinced of the "truth of the popular tradition", the author made a periegesis in the area and discovered that it was indeed a Roman road with a width of 2-3 m, information also confirmed by C. Cichorius.

V. Christescu mentions this road when discussing the road sections identified by Tocilescu in Oltenia. More details about this road are provided by M. Macrea, who states that "in Dacia Inferior, a road started from Drobeta, passing by the Puţinei and Cătunele castles, reached Jiul at the Vârţu castle and then continued up the river via Bumbeşti and Vârtop, entering through the Vâlcan pass into Transylvania, where, passing from the upper Jiu valley to the Streiului valley, it led to Sarmizegetusa. This was the shortest, but difficult, road between Drobeta and the metropolis of the province".

In the work dedicated to the Roman Oltenia, D. Tudor makes a brief reference to this road, specifying that "from Drobeta there was a road through Puținei-Cătune-Pinoasa-Bumbeşti that went through the Vâlcan pass to Sarmizegetusa. The traces of this road were specified in Bâlvăneştii de Jos (formerly Băseşti), Crăgueşti and Corcova. In Crăguesti, there is a pavement with broken bricks. This was the shortest way from Transylvania to the port of Drobeta".

***Topometric features***

Based on the mentioned information and the topographical maps at a scale of 1:100000 we can reconstruct the route of the Roman road between Drobeta and Ulpia Traiana Sarmizegetusa.

A first alignment starts from Drobeta towards Bumbeşti-Jiu, oriented in the north-east direction, with a length of approximately 84 km. The Roman road passes through the following localities: Drobeta, Halânga, Puținei, Malovaţ, Lazu, Cocorova, Şişeşti, Cărămidaru, Peşteana, Stroeşti, Dealu Viilor, Câmpu Mare, Cătunele, then over the Hill of Comorâştea and past Valea Şindrillor, through Vârtopu and Pinoasa. Further, the roman road reaches Bumbeşti-Jiu passing through Dâmbova, Cârbeşti, Drăguțeşti, Iaşi-Gorj, Romaneşti, Târgu Jiu, Turcineşti, Sânbotin and Gornicel.

The second alignment is between Bumbeşti - Jiu and Sarmizegetusa. The road changes its direction to the northeast and has a length, in this sector, of approximately 70 km. From Bumbeşti-Jiu to Petroşani, the road crosses the most difficult section and passes through Pleşa, over the Pleşei Height, past the Porcului valley, over the Scărișoara Height and past the Priporul Mare Hill.

Next, the roman road passes to the east of Căpățânii Peak, over Şaua lui Crai, past Dâmbul Caşilor and Merișoara Valley and after another 8 km it reaches Vulcan, after passing Dâmbul Custurii and Ungurului Valley.

From Vulcan, the road changes its direction to the northwest and passes through the localities mentioned by Al. Stefulescu: Babii Hill, next to the Crevedia valley, through Merisor, Crivadia, Petros, Baru, Livadia, Pui, Galati, Rusor, Băieşti, Subcetate and Sântămaria Orlea. From the last mentioned locality, the road again changes its direction to the southwest and passing through Vadu, Pâclişa, Cârneşti and Ostrov, it reaches Sarmizegetusa.

***Points with roman finds along the way***

On the Roman road between Drobeta and Bumbeşti there are several rural settlements and military fortifications. A castrum is located at Puţinei, in the village (commune) of Malovaţ (Mehedinţi county). Coins and fragments of funerary monuments were discovered in the borders of the communes of Malovaţ and 23 August. In Baloteşti, a village located on the Topolniţa valley, at the "Martalogi" point, D. Tudor mentions the discovery of remains of walls, ceramics, coins, some brick tombs and inscriptions, which indicate the existence of a rural settlement. Roman bricks were discovered near the ancient road in Crăgueşti, and traces of Roman walls were also discovered in Bâlvăneştii de Jos.

At the confluence of the Chivădar stream into the Motru river, there is the Cătune civil settlement and castrum, where ceramic fragments, bricks, wall substructures, coins from Severus Alexander, a bronze hand and an epigraph altar were discovered. Next is the important settlement of Bumbeşti-Jiu (Gorj county), located at the entrance to the Vâlcan pass. The most important objective is the roman fort located at the "Vârtop" point, between km 82 and 83 of the current road. Also with the same importance was the other castrum, located 900 m south of the Vârtop one, investigated for the first time by Grigore Tocilescu and Pamfil Polonic, later by C.S. Nicolaescu-Plopsor. The civil settlement stretches between the fort and the current road. Traces of walls and roman ceramics were discovered here.

The roman road has a total length between Drobeta and Sarmizegetusa via Pasul Vâlcan of approximately 155-160 km. It was the shortest way from the Danube to the capital of Dacia, but at the same time the most difficult. On this route, a few forts were placed, those from Puţinei, Cătunele, Pinoasa, Bumbeşti and Vârtop, so the road was fortified with forts to ensure its protection."

## 3. Conclusions

Following the analysis of the documentation related to the archaeological sites in the areas that will be affected by the project "Increasing the share of electricity production from renewable sources by completing the works and ensuring the permanent monitoring of the environmental impact of the hydropower development of the Jiu River on the Livezeni-Bumbești sector", the elements of archaeological interest that were previously described were identified.

***The two main water intakes***

It crosses the hilly peaks to the west of the Jiu course, starting from the north of Bumbești, between the Pleșa Hill to the west and the railway to the east, further north, passing to the west of the Silva Peak, past the Lainici pass and Sirbin Height, reaching at the Jiu river catchment.

From here, the main intake continues north, towards the Livezeni dam area. Otherwise, as we stated at the beginning of our study, there are no known archaeological discoveries in the area where the adit from the Livezeni dam is located.

Regarding the area where the surge tank for Bumbești HPP will be located, in the north of the town, the researched documentation did not lead to the identification of archaeological sites in the area. The Vișina monastery is located on the outskirts of the town, in the loop that the Jiu river makes from the Sadu mechanical plant to the north, towards the Vișina tourist stop. There are no known archaeological traces along the route of the two headraces.

*According to the archaeological legislation in force, archaeological surveillance is recommended in the case of the main headrace and related facilities (the adit from Livezeni, the surge tank from Dumitra, the adit from Dumitra, the Valea Rea adit, the Bratcu adit, the Bumbești surge tank) of the respective area at the time of the start of the works and throughout their duration. Hunedoara and Gorj County Heritage Directorates will make the necessary recommendations for the beneficiary of the investment.*

*Table no. 60 The archaeological sites discussed in the study regarding the hydropower development of the Jiu River on the Livezeni-Bumbești sector and their interference with the project*

| **No.** | **Archaeological objective in the project area** | **Location / distance from the project** | **Possible impairment of the objective by the project** | **Recomandări** |
|---|---|---|---|---|
| BUMBEȘTI | | | | |
| 1. | The castrum and the civil settlement from Bumbeşti-Jiu – Train station. NAR code 79317.01, LHM code GJ-I-s-A-09126. | The site is located approx. 2 km South of the town of Bumbeşti - Jiu and approx. 40 m South-West of the town's train station, on the left bank of the Jiu. This archaeological objective is located more than 250 m from the foundation of an overhead power line pillar within the project. | The archaeological objective will not be affected by the project. | N/A |
| 2. | The archaeological site from the roman era at Bumbeşti Jiu - Vârtop. NAR code 79317.02, LHM code GJ-I-s-B-09127. | The site is located 800 m North from the stone-walled fort at the "Train station" point and 1.8 km South from the town of Bumbeşti Jiu, 1 km East from the riverbed. This archaeological site is located over 250 m from the foundation of an overhead power line pillar within the project. | The archaeological objective will not be affected by the project. | N/A |
| 3. | St. Trinity Monastery of Bumbeşti Jiu - At Vişina. NAR code 79317.03, LHM code GJ-I-s-B-09128. | The monastery is located 1 km north of the town, on the right bank of the Jiu; At approx. 200 m west of National Road 66 Târgu Jiu – Petroşani; north of the town of Bumbeşti Jiu, at the entrance to the Jiu gorge and 50 m west of the Jiu river, on its right bank. This archaeological objective is located over 1.2 km from the Bumbeşti HPP. | The archaeological objective will not be affected by the project. | N/A |
| 4. | The Lainici Monastery ensemble from Bumbeşti-Jiu. NAR code 79317.05, LHM code GJ-II-m-B-09254. | Lainici Monastery is located in the northern part of the Bumbeşti – Jiu town territory, in the Jiu gorge, on the right bank of this river, close to the confluence of Jiu and Chiţiu rivers, about 9 km north of Vişina Monastery, on the side | The archaeological objective will not be affected by the project. | N/A |

| | | | | |
|---|---|---|---|---|
| | | of the European road E79. This archaeological objective is located over 3.5 km from the Dumitra HPP | | |
| | 5. Main Headrace Livezeni-Bumbeşti | *General recommendation: According to the legislation in force, from the start of the investment until the end, archaeological surveillance will be carried out.* | | |

*i) Landscape*

The site area is located in the natural framework of the Jiu Valley, a river that shaped a deep and narrow canyon over time. The landscape of the Jiu Gorge is remarkable for its wildness and diversity, offering visitors picturesque views and a variety of landforms.

The Jiu Gorge is formed by the continuous erosion of the Jiu River, which has dug into the hard rocks of the Parâng and Vâlcan mountains, creating steep slopes, high cliffs and spectacular formations. This wild and rugged landscape is covered in dense forests of european beech and fir, and the biodiversity of the area is extremely rich. The flora and fauna of the Jiu Gorge are well preserved, the area being home to rare species of animals, such as the brown bear, the wolf, the lynx, and numerous species of birds and plants.

The landscape, the territory falls into the category of "medium and low mountain landscapes under the influence of the oceanic, partially sub-Mediterranean climate", respectively in the landscape type "Balkan beech forests with hornbeam and linden and thermophilic elements" (Stoiculescu, 2004). Also, the landscape of the area includes the course of the Jiu river in the area of the gorge, with one of the most impressive Carpathian passes, Lainici.

In the deep and winding valley of the Jiu river, wooded, steep slopes converge, covered with compact natural forests, consisting of pure and mixed stands of beech - Fagus sylvatica and sessile oak - Quercus petraea, Quercus polycarpa, Quercus dalechampii, which give the gorge its spectacularity. The european red pine – Pinus sylvestris – appears on the rocks, azonally.

On the banks of the Jiu river, the black alder - Alnus glutinosa and the golden willow - Salix alba grow, edifying species of the priority habitat 91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior. At higher altitudes, the green alder - Alnus viridis, the common juniper - Juniperus communis appear, the mountain hollow being covered with meadow vegetation.

In the specialized literature, there are two levels of vegetation in the area (Doniţă, Leandru and Pușcaru-Soroceanu, 1960), respectively the first level - mountain vegetation that includes mixed forests of beech, spruce, fir, in places spruce or pure beech on small areas, secondary mountain meadows on the site of forests, a mixture of beech, spruce, fir and mountain beech forests and the second stage - pure and mixed/alternating beech with sessile oak, in places with other deciduous species such as european hornbeam, silver linden, ash, sycamore maple, black cherry, sorb tree.

The landscape in the area of the Jiului Gorge is one with a high degree of naturalness, the constructions being quite low in number, generally roads and railways, as well as a few small residential areas. Both at the entrance to the gorge (Livezeni area) and at the exit from it (Bumbești HPP area) the landscape is humanized, with numerous human interventions and built perimeters.

# 4. DESCRIPTION OF ENVIRONMENTAL FACTORS LIKELY TO BE AFFECTED BY THE INVESTMENT OBJECTIVE

a) *Environmental factor: water*

**a.1.) Evaluation of the impact of the project on water bodies and protected areas**

Completing the type 1 tables (according to Annex 3 of Order 828/2019) allowed the identification of cause-effect mechanisms at the quality element level according to the type of work and the measures provided for in the project. In the case of 2 bodies of surface water (Jiu - East Jiu confluence – Vădeni Reservoir and Bratcu - spring - Jiu confluence) a causal mechanism was identified for a direct effect for the following categories of quality elements:

hydro-morphological elements

• hydrological regime (flow), morphological conditions (depth and width, bed structure and substrate) in the case of the Jiu water body - confl. Eastern Jiu – Vadeni Reservoir (RORW7-1-1_B14);

• hydrological regime (flow rate), longitudinal connectivity, morphological conditions (depth and width, bed structure and substrate) in the case of the Bratcu - spring - Jiu confluence (RORW7-1-19_B18) water body.

biological elements

• benthic invertebrates in the case of the Jiu water body - conf. Eastern Jiu – Vadeni Reservoir;

• benthic invertebrates and fish fauna in the case of the Bratcu water body - spring - Jiu confluence (RORW7-1-19_B18).

Regarding the completion of the type 2a tables (according to Order no. 828/2019) considering the types of pressures/works mentioned in chapter C.7 of this study as well as the justifications related to the type 1a tables, no cause - effect mechanisms were identified at the quality element level of the proposed project cumulated with the approved/under approval/planned projects for any of the water bodies potentially affected by the project.

With regard to protected areas, both for type 1a and type 2a tables, the analysis was considered preliminary considering that the environmental impact study and the appropriate assessment study were not completed at the time of this study.

As indicated by the legislation in force (Order no. 828/2019) for the quality elements for which no possible cause-effect mechanism was identified by filling in tables of type 1 and 2, it was not necessary to further evaluate or complete the tables of type 3 and 4 of Annex 3 of Order no. 828/2019. Therefore, the analysis continued only for the quality element(s) for which a possible cause-effect mechanism was established (those with a YES/INCERT answer in tables of type 1 and 2). In order to establish a potential impact at the quality element level, both the impact of the project and the cumulative impact, the approaches used are presented below.

**Hydromorphological elements**

- The hydromorphological elements for which a cause-effect mechanism was identified are the following: flow rate, longitudinal connectivity, water depth, width and substrate.
- The approaches regarding flow and longitudinal connectivity are the result of research carried out within the INHGA (2015 INHGA study; 2019 MMAP study; 2022 INHGA study) and capitalized on by the publication of scientific works in specialized journals (Moldoveanu et al., 2023).
- Hydrological regime - flow
- In order to identify a possible impact of water capture works or water refunds at the level of the water body, 3 spatial scales of analysis were used: section, river sector and water body. In this sense, an adaptation of the Average Flow Consumption Indicator was carried out, which is an integral part of the Methodology for determining hydro-morphological indicators for water courses in Romania - INHGA 2015 study, in the sense that it was applied at the level of each catchment (section - local scale) but with the use of the same method of calculation, classification system and the same parameters from the Methodology. Thus, a calculation was made of the average flow rate consumed at the level of each catchment work using the following parameters:
- • average flow captured (provided by the beneficiary of the study for captures related to the project or by ANAR for other captures);
- • multiannual average flow (Qmma) in the section of each catchment - values calculated for the development of hydrological studies to determine the ecological flows developed by the National Institute of Hydrology and Water Management (Calculation of the ecological flow on the Jiu River, in the Livezeni dam section, in order to issue of the amending opinion "Study of the impact on the water bodies for the „Hydropower development project on the Livezeni-Bumbeşti sector" - 2020; Hydrological study in 3 sections for issuing the amending opinion water for Hydropower development of the Jiu river. Continuation of the work" - 2021).

The application of this indicator at the level of each catchment allowed the inclusion in a certain quality class (from I to V) at the section level. Any section for which the quality classification result corresponded to a moderate (class III), poor (class IV) or bad (class V) state, was considered to be significantly affected at the local level (a locally significant impact). For the sections in which the result of the classification into quality classes corresponded to a very good (class I) and good (class II) state, it was considered that the environmental objective was achieved. For a spatial extension of the impact (extension at the river sector level), in the situations where the quality class at the section level was III, IV or V (corresponding to the moderate, weak or bad conditions), the river sector associated with that sections was considered to be included in the same class and therefore affected by a significant impact. Next, in order to reach the determination of the impact at the scale of the water body, it was conventionally considered that if the impact is significant on more than 30% of the length of the water body, then the impact is significant at the level of the water body.

**River continuity – longitudinal connectivity**

In the case of longitudinal connectivity, it was considered that any barrage work that is not provided for in the project or does not present a structure for the passage of fish fauna, generates a significant impact at the section level (local scale). For a spatial extension of the impact (extension at river sector level), the river sector/sectors with interrupted longitudinal connectivity were considered from the first threshold (identified from downstream to upstream) to the source area. There can be various situations, but for the present study, only one situation was identified corresponding to the threshold related to the Bratcu catchment located on the Bratcu water course (water body made up of a water course without tributaries) and the length of the affected sector is measured from the work of barrage to the spring.
To establish the impact at the scale of the water body, the sectors with interrupted longitudinal connectivity are summed up, related to the length of the water body and expressed as a percentage; it was conventionally considered that if more than 30% of the length of the water body has its longitudinal connectivity interrupted, then the impact of the barrage works on the longitudinal connectivity is extended to the level of the water body and is considered significant.

<u>Morphological conditions – the depth, width and substrate of the bed</u>
*According to the Methodology for determining hydro-morphological indicators for water courses in Romania (INHGA, 2015) the average depth and average width indicators corresponding to the average multiannual flow* and the granulometric composition of the bed is expressed as a percentage in the form of a relative deviation from the reference state (natural conditions or a slight deviation from this state), the current situation (the influenced one) being represented by the situation with works (for example, catchment works of water). Given that the establishment of the two periods (reference and current) takes into account the construction year of the hydrotechnical works and the water collection works related to Hydropower development Livezeni Bumbeşti are not built (so currently no water is captured), it is not possible to make a distinction between the two periods necessary for the application of the two indicators. Therefore, considering the mentioned aspects, as well as the fact that:

- the flow rate is one of the elements for which a cause-effect mechanism has been identified for water bodies potentially affected by the project,
- the depth, width and substrate parameters are closely related to the flow and any change in the flow leads to changes in these parameters which represent essential elements of the aquatic habitat,

for establishing the impact on the depth, width and substrate parameters, it was conventionally considered that if the impact on the flow is significant for more than 30% of the length of the body of water, then the impact on the depth, width and substrate is extended over the same length of the body of water and therefore, it is significant at the level of the water body.

**Physico-chemical elements**

In this section, the results of the analysis of the specialized literature on the effects of hydropower facilities on the physico-chemical elements and the chemical state on water bodies are briefly presented. The results of this analysis were used in the identification of effects and impacts.

Dissolved oxygen is considered one of the most important parameters to be taken into account in the analysis of the impact of hydroelectric facilities on water quality, considering that their location at the level of a river causes changes in the concentration of dissolved oxygen, especially downstream of the place of location of the capture (Danil et al., 1991). Flow reduction can result in a removal of up to 90-95% of the average annual discharge, which can affect the physical characteristics of a stream (eg water velocity, water temperature, suspended solids, fines and nutrients), changing the amount and the quality of the aquatic habitat, with cascading impacts on fauna and flora (Anderson et al., 2006, Vaikasas et al., 2015). Vaikasas et al., (2015) indicated that the impact on river water quality, nutrient regime and biota in sites influenced by MHCs is manifested only at the local level. It is argued that the larger area of the watershed and the intensive use of land for agriculture in the watershed play a much more important role than microhydropower. Álvarez et al. (2020) investigated the impact of four hydropower plants in northwestern Spain on water quality in four river sections where these hydropower plants are located. The results showed that the presence of hydroelectric plants had no significant effect on the physical and chemical properties of water. The water quality of the Lérez River, which flows in northwestern Spain, was studied after the construction of a small hydroelectric plant. No statistically significant differences were observed between the upper and lower reaches of the river, which does not mean that the microhydropower plant did not have a significant impact on water quality during operations. The purpose of the article "Analysis of the physico-chemical water quality due to the hydropower plant on the Ślęza River in Wrocław (south-west Poland)" (Pawel Tomczyk 2021) was to assess the potential impact of hydropower plants on water quality. The study used the results of monthly tests from three measuring points in relation to the hydropower station on the Ślęza River in the city of Wrocław (upstream, reference point, downstream), from June 2018 to May 2020. The analyzes covered 10 physico-chemical parameters, i.e. : pH, electrical conductivity (EC), water temperature, turbidity, NH4-N, NO3-N, NO2-N, total phosphorus, dissolved oxygen and BOD5. The analysis carried out showed that the hydropower plant does not have a clear influence on the physico-chemical quality of the water in the Ślęza river, but rather other interactions present in the hydrographic basin have a greater influence. Visible effects were found in the results for the hydropower downstream temperature indicator. Another additional effect was the change in oxygen concentration, but it did not show a statistically significant change. The biggest exceedances of the limit values concerned NO2-N. The reason for the high NO2-N was most likely due to runoff from agricultural land and resuspension of nutrient-rich sediments.

**Biological elements**

Considering that among the 5 biological elements required by the Water Framework Directive for the evaluation of the ecological status/ecological potential, some are not specific/representative for mountain rivers (for example phytoplankton) or are not sensitive to pressures of the type analyzed within the present study and the fact that a potential cause-effect mechanism was identified only for benthic invertebrates and fish fauna, the approaches to establishing the impact for these quality elements are presented below. In addition, recent research aimed at evaluating the impact of the construction and operation of microhydropower

plants on the ecological state of some rivers in Romania (study carried out by the EPC-INHGA consortium in 2019 - MMAP beneficiary) showed, based on the results of the monitoring of quality elements upstream and downstream of the catchments related to some MHPPs, changes in the benthic invertebrate communities as well as a decrease in the number of fish specimens from downstream to upstream in the case of water courses with several catchments in a cascade.
Benthic invertebrates represent a very heterogeneous taxonomic group that is sensitive to a wide spectrum of disturbing factors, including those that generate morphological changes in the aquatic habitat (Rosenberg and Resh, 1993). It is known that these aquatic organisms have relatively long life cycles that mostly take place at the level of the benthic horizon. The literature mentions that the substrate is an important element for invertebrate communities, with certain species having preferences for a certain type of substrate (Waters, 1995; Angradi, 1999; Miyake and Nakano, 2002; Gilmore, 2002; Buss et al., 2004; Gonçalves and Menezes, 2011). The quality and quantity of sediment organic matter and substrate stability can modify the structure of benthic invertebrate communities (Buss et al., 2004), but also the chemical composition of fine sediments (Von Bertrab et al., 2013). Therefore, any change in the composition of the sediments (substrate), for example a decrease in the amount of sediments, can lead to a decrease in the abundance of predatory invertebrate species (families Gomphidae, Tipulidae, Libelulidae) and species of the Trichoptera order, which use the substrate for shelter ( Mantel et al., 2010).
Considering the close connection between the benthic invertebrates and the substrate, for establishing the impact at the level of this quality element, it was conventionally considered that if the impact on the substrate is significant at the level of the water body, then the impact on the benthic invertebrates is also significant at the level of the water body (see the approach from the element longitudinal connectivity – spatial extension from a local scale of analysis to whole water body analysis).
The fish fauna is primarily associated with maintaining the longitudinal connectivity of the watercourse, being very well known their high mobility in search of habitats for food, shelter, refuge and reproduction. Maintaining the continuity of the river and the natural hydrological regime are two essential elements that can allow the creation of diverse and complex aquatic habitats, as well as the free movement of aquatic organisms.
Considering that the element of longitudinal connectivity is closely related to the existence of barrier works that can represent obstacles to the movement of fish and can fragment their habitat, it was conventionally considered that if the impact on longitudinal connectivity is significant at the level of the water body (more more than 30% of the length of the water body has interrupted longitudinal connectivity) then the impact on the fish fauna is significant at the level of the water body (see the approach from the element longitudinal connectivity – spatial extension from a local scale of analysis to analysis at the level of the whole body of water).
It is mentioned that the approaches used to assess the impact (including the cumulative impact) were based on a series of methodological and legislative instruments as well as on "expert opinion". An intense monitoring of the quality elements (which are the basis of the evaluation of the ecological state/ecological potential) for the initial situation (without works related to

A.H.E. Livezeni Bumbeşti) and the situation after project implementation, can be the basis of comparative analyzes that can lead to a more accurate evaluation precise of the effects/impact.

- ***East Jiu* Water Body *- Petrila - confl. Jiu (RORW7-1-15_B10)***

Table type 3a did not require completion for this water body because no cause-effect mechanisms were identified within table type 1a.

- ***West Jiu* Water Body *- Paroşeni-confl. East Jiu (RORW7-1_B4)***

Table type 3a did not require completion for this water body because no cause-effect mechanisms were identified within table type 1a.

➢ **Jiu Water Body - *confl. East Jiu – Vădeni Reservoir (RORW7-1-1_B14)***

*Table no. 61 (3a) Table defining the scope of the assessment of compliance with the requirements of the Water Law (Rivers)*

| **Identification of the quality indicator (parameter) that could be affected by the project** | **Will the effect be temporary in the water body? Yes / No / Uncertain** | **Justification** | **Will the effect be insignificant at the level of the water body? Yes / No / Uncertain** | **Justification** |
|---|---|---|---|---|
| **Elemente hidromorfologice** | | | | |
| *Hydrological regime: quantity and dynamics of flow* | No. The effect will be permanent | The application of the average flow consumed indicator at the section level (Livezeni dam section and Jiu catchment section) determined the classification in class V (bad condition). Therefore, the affected river sector (between Livezeni dam and Bumbeşti HPP) has a length of about 32.26 km, representing 64.22% of the length of the water body. | No. The effect will be significant | The affected river sector represents more than 30% of the length of the Jiu water body - confl. Eastern Jiu – Vădeni Reservoir. What this means is that the potential impact of the completion and operation of the Livezeni Dam and secondary intakes is significant on the water body in terms of flow. |
| *Hydrological regime: connectivity with groundwater* | - | - | - | - |
| *Longitudinal continuity of the river* | - | - | - | - |
| *The lateral continuity of the river* | - | - | - | - |
| *Morphological conditions:* depth and width of the river | No. The effect will be permanent | Considering the depth and width parameters are closely related to the flow, the spatial extension of the impact generated by the flow reduction can be associated with these parameters as well. Therefore, the river sector that can be affected in terms of depth and width is contained between | No. The effect will be significant | The affected river sector represents more than 30% of the length of the Jiu water body - confl. Eastern Jiu – Vădeni Reservoir. What this means is that the potential impact of the completion and operation of the Livezeni Dam and the Jiu catchment it is significant at the |

| **Identification of the quality indicator (parameter) that could be affected by the project** | **Will the effect be temporary in the water body? Yes / No / Uncertain** | **Justification** | **Will the effect be insignificant at the level of the water body? Yes / No / Uncertain** | **Justification** |
|---|---|---|---|---|
| | | Livezeni dam and Bumbeşti HPP over a length of about 32.26 km, representing 64.22% of the length of the water body. | | level of the water body in terms of depth and width parameters. |
| *Morphological conditions: bed structure and substrate* | No. The effect will be permanent | Given that the parameter of the bed substrate is closely related to the flow, the spatial extent of the impact generated by the reduction of the flow can be associated with this parameter as well. Therefore, the river sector that can be affected from the point of view of the substrate of the bed is contained between Livezeni dam and Bumbeşti HPP for a length of about 32.26 km, representing 64.22% of the length of the water body. | No. The effect will be significant | The affected river sector represents more than 30% of the length of the Jiu water body - confl. Eastern Jiu – Vădeni Reservoir. What this means is that the potential impact of the operation of the Livezeni dam and the Jiu catchment is significant at the level of the water body from the point of view of the substrate. |
| *Morphological conditions: the structure of the riparian zone* | - | - | - | - |
| **Physical - chemical elements** | | | | |
| *Thermal conditions* | Yes | Modificarea condițiilor termice apare temporar, doar în perioadele cu temperaturi extreme (veri calde și secetoase) și durează până la reinstalarea vegetației. Vegetația acționează ca un buffer în perioadele calde de vară, protejând împotriva evaporării apelor și creșterii concentrației de $CO_2$. | Yes | Impactul este nesemnificativ, corpul de apă analizat fiind unul de deal şi podiş în care se propun lucrările. Acesta este caracterizat de o curgere relativ rapidă și ape cu temperaturi relativ scăzute. |
| *Oxygenation conditions* | Yes | Appears temporarily, during the works. | Yes | Corpul de apă analizat fiind de deal şi podiş, este caracterizat de |

| Identification of the quality indicator (parameter) that could be affected by the project | Will the effect be temporary in the water body? Yes / No / Uncertain | Justification | Will the effect be insignificant at the level of the water body? Yes / No / Uncertain | Justification |
|---|---|---|---|---|
| | | The effect is indirectly caused by growth turbidity of the waters during the periods when the works are in progress. | | o curgere relativ rapidă, astfel că efectele se mențin la un nivel nesemnificativ. |
| *Salinity* | - | - | - | - |
| *Acidified* | - | - | - | - |
| *Nutrient conditions* | - | - | - | - |
| *Specific synthetic pollutants – organic micropollutants* | - | - | - | - |
| *Specific non-synthetic pollutants – metals* | - | - | - | - |
| **Quality biological elements** | | | | |
| *Phytoplankton* | - | - | - | - |
| *Phytobenthos* | - | - | - | - |
| *Macrophyte* | - | - | - | - |
| *Benthic invertebrate fauna* | No. The effect will be permanent | Given that:<br>· benthic invertebrates are in close relation with the substrate,<br>· the approach considered in the case of the bed substrate,<br>it was considered that the river sector for which a change in benthic invertebrate communities can be generated has a length of about 32.26 km representing 64.22% of the length of the water body. | No. The effect will be significant | The affected river sector in terms of benthic invertebrates represents more than 30% of the length of the Jiu Water Body - confl. Eastern Jiu – Vădeni Reservoir. What this means is that the potential impact of the operation of the Livezeni dam and the Jiu catchment is significant at the level of the water body from the point of view of this group of aquatic organisms. |
| *Fish fauna* | - | - | - | - |
| **Starea chimică** | | | | |
| *Priority substances (see Annex 1)* | - | - | - | - |

| **Identification of the quality indicator (parameter) that could be affected by the project** | **Will the effect be temporary in the water body? Yes / No / Uncertain** | **Justification** | **Will the effect be insignificant at the level of the water body? Yes / No / Uncertain** | **Justification** |
|---|---|---|---|---|
| *Priority dangerous substances (Annex 1)* | - | - | - | - |
| **Zone protejate (vezi Anexa nr. 1^2 din Legea Apelor)** | **Ar putea fi compromisă starea zonelor protejate?** ***Da / Nu / Incert*** | | | |
| *Salmonidae area* | - | | | |
| ** ROSCI0063 Defielul Jiului* | - | | | |
| ** RONPA0933 Parcul Naţional Defileul Jiului* | - | | | |

“-” - element for which assessment was not required.

“*” - the analysis is preliminary to be correlated with the results of environmental impact studies and appropriate evaluation.

- **Bratcu water body – spring – Jiu confluence (RORW7-1-19_B18)**

*Table no. 62 (3a) Table defining the scope of the assessment of compliance with the requirements of the Water Law (Rivers)*

| Identification of the quality indicator (parameter) that could be affected by the project | Will the effect be temporary in the water body? Yes / No / Uncertain | Justification | Will the effect be insignificant at the level of the water body? Yes / No / Uncertain | Justification |
|---|---|---|---|---|
| **Elemente hidromorfologice** | | | | |
| *Hydrological regime: quantity and dynamics of flow* | No. The effect will be permanent | The application of the average flow consumed indicator at the section level (Bratcu catchment section) determined the classification in class IV (poor condition). Therefore, the affected river sector (between the Bratcu catchment and the confluence with the Jiu river) has a length of about 2.29 km representing 19.62% of the length of the water body. | Yes. The effect will be insignificant | The affected river sector represents less than 30% of the length of the Bratcu water body - spring - Jiu confluence, which means that the potential impact of the completion and operation of the Bratcu catchment is insignificant at the level of the water body in terms of flow. |
| *Hydrological regime: connectivity with groundwater* | - | - | - | - |
| *Longitudinal continuity of the river* | No. The effect will be permanent | The threshold related to the Bratcu intake (h=6.9 m) represents an obstacle for the movement of fish fauna. Longitudinal connectivity will be affected on the Bratcu catchment sector - the spring area of the Bratcu river, respectively, on a length of 9.38 km representing 80.37% of the length of the water body. | No. The effect will be significant | Sectorul de râu afectat reprezintă mai mult de 30% din lungimea corpului de apă *Bratcu – izvor – confluența Jiu* ceea ce înseamnă că potențialul impact al finalizării și operării captării Bratcu este semnificativ la nivelul corpului de apă din punct de vedere al conectivității longitudinale. |
| *The lateral continuity of the river* | - | - | - | - |
| *Morphological conditions: depth and width of the river* | No. The effect will be permanent | Considering that the depth and width parameters are closely related to the flow, the spatial extension of the impact | Yes. The effect will be insignificant | The affected river sector represents less than 30% of the length of the Bratcu water body - spring - Jiu |

| Identification of the quality indicator (parameter) that could be affected by the project | Will the effect be temporary in the water body? Yes / No / Uncertain | Justification | Will the effect be insignificant at the level of the water body? Yes / No / Uncertain | Justification |
|---|---|---|---|---|
| | | generated by the flow reduction can be associated with these parameters as well. Therefore, the river sector for which a change in depth and width is generated is contained between the Bratcu catchment and the confluence with the Jiu River over a length of about 2.29 km representing 19.62% of the length of the water body. | | confluence, which means that the potential impact of the completion and operation of the Bratcu catchment is insignificant at the water body level in terms of depth and width parameters. |
| *Morphological conditions: bed structure and substrate* | No. The effect will be permanent | Given that the parameter of the bed substrate is closely related to the flow, the spatial extent of the impact generated by the reduction of the flow can be associated with this parameter as well. Therefore, the river sector that can be affected from the point of view of the substrate of the bed is contained between the Bratcu catchment and the confluence with the Jiu river for a length of about 2.29 km representing 19.62% of the length of the water body. | Yes. The effect will be insignificant | The affected river sector in terms of bed substrate represents less than 30% of the length of the Bratcu - spring - Jiu confluence water body which means that the potential impact of the completion and operation of the Bratcu catchment is insignificant at the level of the water body from the point of view of the substrate. |
| *Morphological conditions: the structure of the riparian zone* | - | - | - | - |
| **Elemente fizico – chimice** | | | | |
| *Thermal conditions* | Yes | The change in thermal conditions occurs temporarily, only during periods of extreme temperatures (hot and dry summers) and lasts until the vegetation is reestablished. Vegetation acts as a buffer during hot summer periods, | Yes. The effect will be insignificant | The impact is insignificant, due to the mountain floor in which the works are proposed. They naturally present fast flows and waters with low temperatures. |

| Identification of the quality indicator (parameter) that could be affected by the project | Will the effect be temporary in the water body? Yes / No / Uncertain | Justification | Will the effect be insignificant at the level of the water body? Yes / No / Uncertain | Justification |
|---|---|---|---|---|
| | | protecting against water evaporation and growth of the CO2 concentration. | | |
| *Oxygenation conditions* | Yes | Appears temporarily, during the works. The effect is indirectly caused by the increase in water turbidity during the periods when the works are being carried out. | Yes. The effect will be insignificant | The proposed works in the mountain floor are characterized by high flow velocities, so the effects are kept at an insignificant level |
| *Salinity* | - | - | - | - |
| *Acidified* | - | - | - | - |
| *Nutrient conditions* | - | - | - | - |
| *Specific synthetic pollutants – organic micropollutants* | - | - | - | - |
| *Specific non-synthetic pollutants – metals* | - | - | - | - |
| **Quality biological elements** | | | | |
| *Phytoplankton* | - | - | - | - |
| *Phytobenthos* | - | - | - | - |
| *Macrophyte* | - | - | - | - |
| *Benthic invertebrate fauna* | No. The effect will be permanent | Given that:<br>· benthic invertebrates are in close relation with the substrate,<br>· the approach considered in the case of the bed substrate,<br>it was considered that the river sector for which a change in benthic invertebrate communities can be generated has a length of about 2.29 km representing 19.62% of the length of the water body. | Yes. The effect will be insignificant | The affected river sector in terms of benthic invertebrates represents less than 30% of the length of the Bratcu - spring - Jiu confluence water body which means that the potential impact of the completion and operation of the Bratcu catchment is insignificant at the level of the water body in terms of of this group of aquatic organisms. |

| Identification of the quality indicator (parameter) that could be affected by the project | Will the effect be temporary in the water body? Yes / No / Uncertain | Justification | Will the effect be insignificant at the level of the water body? Yes / No / Uncertain | Justification |
|---|---|---|---|---|
| *Fish fauna* | No. The effect will be permanent | Considering that:<br>· the fish fauna is in close relation with the existence of barrier works that can represent obstacles to the movement of fish and can fragment their habitat,<br>· the approach used for the longitudinal connectivity element,<br>it was considered that the fish fauna is affected along a length of 9.38 km representing 80.37% of the length of the water body. | No. The effect will be significant | The affected river sector represents more than 30% of the length of the Bratcu water body - spring - Jiu confluence, which means that the potential impact of the completion and operation of the Bratcu catchment is significant at the level of the water body from the point of view of the fish fauna element. |
| **Starea chimică** | | | | |
| *Priority substances (see Annex 1)* | - | - | - | - |
| *Priority dangerous substances (Annex 1)* | - | - | - | - |
| **Protected areas (see Annex no. 1^2 of the Water Law)** | **Could the status of protected areas be compromised? Yes / No / Uncertain** | | | |
| *Salmonidae area* | Yes. The completion and operation of the Bratcu catchment, as a result of the fragmentation of the watercourse, may generate a reduction of the fish resource on the river sector upstream of the Bratcu catchment. | | | |
| **RONPA0933 Parcul Național Defileul Jiului* | Yes. The completion and operation of the Bratcu catchment, as a result of the fragmentation of the watercourse, may generate a reduction of the fish resource on the river sector upstream of the Bratcu catchment. | | | |
| **ROSCI0063 Defielul Jiului* | Yes. The completion and operation of the Bratcu catchment prevents the fulfillment of at least one conservation objective at the level of fish species that provides for the lack of fragmentation elements both within the site and within a distance of 30 km upstream and downstream of the site. | | | |

"-" - element for which assessment was not required.
"*" - the analysis is preliminary to be correlated with the results of environmental impact studies and appropriate evaluation.

Type 3a tables have been completed for Jiu water bodies –Eastern Jiu – Vădeni Reservoir confluence (RORW7-1-1_B14) and Bratcu – spring – Jiu confluence (RORW7-1-19_B18) being identified possible permanent and significant effects for the following quality elements:

• flow rate, depth, width, substrate and benthic invertebrates in the case of the Jiu water body – Eastern Jiu – Vădeni Reservoir confluence.

• longitudinal connectivity and fish fauna in the case of the Bratcu - spring - Jiu confluence water body.

According to the Jiu River Basin Management Plan 2022-2027, the water bodies for which possible permanent and significant effects have been identified currently meet the environmental objectives (good ecological status and good chemical status). Therefore, these bodies of water may be at risk of deterioration at the level of some quality elements.

**a.2.) Formulation of conclusions – (taken from the impact assessment study on water bodies)**

The impact assessment study on water bodies analyzed the potential impacts on the ecological state/ecological potential and the chemical state of surface water bodies (rivers), respectively the state of protected areas as a result of the implementation of the project. This study was developed according to Annex 3 of Order no. 828/2019 - framework content of the Impact Assessment Study on water bodies. The study also took into account a series of methodological and legislative tools used in the field of water resources management (Water Framework Directive 2000/60/EC, Law 107/1996 with subsequent amendments and additions, European guidelines, methodologies).

Of the 4 water bodies potentially affected by the project, the works related to Livezeni Bumbeşti HPP are located/designed on 2 bodies of water.

The main quality elements affected by the completion and commissioning of the Livezeni Bumbeşti HPP, respectively of the water capture activity, are the flow rate and the longitudinal connectivity. The decrease in flow can also generate effects on the parameters of depth, width and substrate, as well as on benthic invertebrates. Also, in the situation where the longitudinal connectivity is interrupted by the barrier works related to the Livezeni Bumbeşti hydropower development (this is the case of the Bratcu water body - spring - Jiu confluence) on more than 30% of the length of the water body (see the approach from the longitudinal connectivity element - spatial extension from a local scale of analysis to the analysis at the level the entire body of water), this fragmentation of the aquatic habitat was considered to have an effect on the fish fauna.

Regarding the cumulative impact, possible permanent and significant effects were identified only in the case of two bodies of water (Jiu - East Jiu confluence – Vădeni Reservoir and Bratcu - spring - Jiu confluence).

All analyzed water bodies for which possible effects were identified (impact/cumulative impact) currently meet the environmental objectives (good ecological status and good chemical status) and therefore may present the risk of deterioration at the level of some quality elements .

b) *Environmental factor: air*

During the execution of the works, the sources of air pollution will be generated on the one hand by the noxes and dusts coming from the exhaust gases of the contractor's machinery/means of transport, and on the other hand by their circulation on the technological/access roads related to the execution of the works and which connect with the existing public roads as follows:

- ✓ Bumbești-Jiu area – DC 149 and DN66, Aleea Luncani street to HPP Bumbești and the technological roads to the surge tank and butterfly valve room Bumbești;
- ✓ Dumitra-Livezeni area – DN66, and the Bratcu site organization access roads.

The presence of pollutants emitted during the performance of these operations (CO, NOx, VOC, H2S, cement powders) will be felt exclusively locally, in the area where the said operation is carried out; under the action of atmospheric factors, their dispersion will be achieved in a short time.

Under these conditions, the negative impact thus generated will be one that will be limited in space, being an insignificant one.

The executor will be required to keep his own equipment/means of transport in good working order, respectively the permanent maintenance (sprinkling, leveling) of the technological/access roads.

The cleaning/sandblasting operations of the various elements of the equipment that have already been purchased and require works to restore anti-corrosion protection (shields, watertight gates, forced pipe sections, expansion compensator, etc.) will generate local air pollution, which will require protective measures of work for the execution staff.

Under these conditions, the negative impact generated in this way will be one that will manifest itself during the entire period of the works, but which will be within admissible limits and which must be accepted.

With the completion of the works and the entry into operation of this inlet drop, there will be no more sources of air pollution.

***Emissions***

The main sources of pollution in the project area are atmospheric emissions from:

- Excavation, digging and landscaping activities;
- Moving activities, in the preparatory site works, of the materials used;
- Transport activities.

*Emissions from non-road mobile sources*

Execution stage

In the execution stage, non-road mobile sources will be represented by the machinery and equipment involved in the construction works (bulldozer; excavator; crane; compactor cylinder; front loader). The emissions generated as a result of the operation of these sources were estimated using the EMEP/EEA calculation methodology - 1.A.4 Non road mobile machinery, Tier1, which takes into account the type and consumption of fuel used and the emission factors corresponding to the characteristic pollutants.

Operation stage

At this stage, non-road mobile sources will be represented by electric generators. It must be specified that these sources will work occasionally, only in case of breakdowns in the electricity supply network. The estimation of pollutant emissions generated by these sources was made using the EMEP/EEA calculation methodology - 1.A.4 Non road mobile machinery, TIER1, which takes into account the type and consumption of fuel used and the emission factors corresponding to the characteristic pollutants.

The results of the emission calculations are presented in the following table.

*Table no. 63 Emissions from non-road mobile sources during the execution phase*

| Name of the source | Polutant | Mass flow | | | The concentration in the emission (mg/m3)* |
|---|---|---|---|---|---|
| | | kg/h | g/h | g/s | |
| Mobile crane | Powders | 0,015 | 14,09 | 0,004 | 132,19 |
| | $SO_2$ | 0,002 | 1,66 | 0,0005 | 15,7 |
| | $NO_x$ | 0,22 | 217,18 | 0,06 | 2048,9 |
| | CO | 0,07 | 71,71 | 0,02 | 676,5 |
| Excavator/Front End Loader | Powders | 0,02 | 24,51 | 0,01 | 132,5 |
| | $SO_2$ | 0,003 | 2,91 | 0,001 | 15,7 |
| | $NO_x$ | 0,38 | 380,06 | 0,11 | 2054,4 |
| | CO | 0,13 | 125,50 | 0,03 | 678,4 |
| Bulldozer | Powders | 0,02 | 21,01 | 0,01 | 133,0 |
| | $SO_2$ | 0,002 | 2,50 | 0,001 | 15,8 |
| | $NO_x$ | 0,33 | 325,77 | 0,09 | 2061,8 |
| | CO | 0,11 | 107,57 | 0,03 | 680,8 |
| Compactor | Powders | 0,01 | 14,00 | 0,004 | 132,1 |
| | $SO_2$ | 0,002 | 1,66 | 0,0005 | 15,7 |
| | $NO_x$ | 0,22 | 217,18 | 0,06 | 2048,9 |
| | CO | 0,07 | 71,71 | 0,02 | 676,5 |

* Due to falling below the limit value from Order no. 462/1993 - Annex 1 of the estimated mass flows for the calculated pollutants, the maximum permissible values of the pollutant concentrations from the previously mentioned Order do not apply to the analyzed sources.

*Emissions from undirected stationary sources*

*Execution stage*

The undirected stationary sources of atmospheric pollution during the execution period of the works proposed to achieve the objective are represented by the activities of handling earth masses (excavation, excavations, fillings, leveling, loading - unloading, transport) for the development of the site. These operations will mainly constitute sources of dust emission into the atmosphere.

An additional source of dust is represented by wind erosion, a phenomenon that accompanies construction works. The phenomenon appears due to the existence, for a certain period of time, of uncovered land surfaces exposed to the action of the wind. However, the phenomenon of wind erosion can be controlled by appropriate measures to reduce the space and time of land surfaces not covered with vegetation.

The dust generated by material handling and wind erosion is mainly of natural origin (soil particles, mineral dust).

The cutting and welding operations of the metal elements that will make up the constructions will generate emissions of: fine particles that mainly contain metal oxides (iron oxide, manganese oxide, nickel oxide, etc.), carbon monoxide resulting from decomposition carbon dioxide from the atmosphere in the area of the electric arc, nitrogen dioxide resulting from the oxidation of atmospheric nitrogen due to the high temperature in the area of the electric arc, ozone. However, these sources will not generate significant amounts of pollutants in the atmosphere and were not included in the calculation of atmospheric emissions.

The sources characteristic of the activities in the execution stage of the works cannot be associated with emission concentrations, being free, open, undirected sources. For the same reason, they cannot be evaluated in relation to the provisions of Order no. 462/1993 nor with other regulations regarding emissions.

*Operation stage*

During the operation stage, there will be no sources of undirected stationary emissions.

*Emissions from mobile sources*

*Execution stage*

During the execution of the works, the mobile sources will be represented by the heavy vehicles that will ensure the transport of the construction materials and the vehicles of the employees involved in the construction works. All these sources will not work simultaneously on the site, and the effective duration of operation will be short, sufficient for movement inside the construction site and for their parking in the specially arranged places.

The estimation of pollutant emissions generated by mobile sources was carried out using the calculation methodology EMEP/EEA – 1.A.3.b.i-iv Road transport 2016, Tier 1, which takes into account the type of vehicle, the type of fuel, the fuel consumption used and the emission factors corresponding to the characteristic pollutants. In this sense, we considered an average number of 10 heavy vehicles per day, operating on diesel, 10 light vehicles per day, operating on diesel and 5 light vehicles per day, operating on gasoline.

*Operation stage*

During the operation stage of the objective, the mobile sources will be represented by the employees' vehicles, respectively 5 vehicles per day (estimated).

We specify that the sources of emissions represented by employees' vehicles will not operate simultaneously on site, the busiest period of a day being at the start of work shifts. Also, the duration of operation of a vehicle within the site will be short, as much as is necessary for moving to the parking place and for performing maneuvers to park it.

*Table no. 64 Emissions from mobile sources*

| Types of mobile sources | Fuel type | Polutants | Emissions (g/h) | Emissions during the execution period (g/h) | Emissions during operation (g/h) |
|---|---|---|---|---|---|
| Employees' vehicles | Diesel fuel | CO | 4,23 | 33,28 | 339,60 |
| | | $NO_x$ | 16,68 | 129,57 | 1320,79 |
| | | Powders | 1,47 | 11,04 | 112,55 |
| | | $SO_2$ | 0,04 | 0,20 | 1,67 |
| Employees' vehicles | Benzine | CO | 105,68 | 210,48 | 2146,89 |
| | | $NO_x$ | 11,10 | 21,99 | 221,83 |
| | | Powders | 0,04 | 0,09 | 0,84 |
| | | $SO_2$ | 0,15 | 0,27 | 2,10 |

Order no. 462/1993 does not provide limits for mobile sources. The order indicates that the polluting emissions of road vehicles are limited as a preventive measure by the technical conditions stipulated in the technical inspections carried out periodically throughout the use of road vehicles registered in the country.

The preventive limitation of emissions from motor vehicles is done through the technical conditions imposed upon their homologation, in order to be registered in circulation, and throughout the duration of their use through mandatory periodic technical inspections.

c) *Environmental factor: soil/subsoil*

During the execution of the works, the only possibility of soil pollution would be generated by possible accidental losses of fuels and/or lubricants from the executor's machinery/means of transport.

In order to intervene in the event of such accidental soil pollution, the executor will be required to have a minimum of absorbent materials (handkerchiefs, pillows, biodegradable absorbent, etc.).

The executor will pay special attention to fueling operations (from mobile tanks) of the machines required for the works. It should be noted that for the remaining works to be executed, additional areas of land will not be occupied.

In the conditions in which the executor will keep his own machinery/means of transport in good working order, correlated with a quick and efficient intervention, the negative impact on the soils will be limited in space, being an insignificant one.

Once the works are completed, the entry into operation of this fall step will not generate sources of soil pollution.

*d) <u>Biodiversity</u>*

***d.1.) Analysis of pressures and threats on species and habitats***

The location of the project "The project on increasing the share of electricity production from renewable sources by completing the works and ensuring the permanent monitoring of the environmental impact of the hydropower development of the Jiu river on the Livezeni - Bumbești sector" partially overlaps with the Natura 2000 Site ROSCI0063 Jiu Gorge.

The locations targeted for the execution remains are located in the perimeter of the site of community importance ROSCI0063 Defileul Jiului and in its immediate vicinity. In the vicinity of the natural protected area are the Livezeni dam (including the Livezeni dam diversion channel with fish passability), the Livezeni MHPP, the Livezeni reservoir, the Livezeni technological platform, the Livezeni adit, the Bumbești HPP and the connection routes to the National Energy Sistem of the MHC Livezeni and CHE Bumbești.

Currently, the Defileul Jiului National Park and the site of community importance ROSCI0063 Defileul Jiului benefit from a new Integrated Management Plan, which is in the process of environmental approval.

The following provides an analysis of the pressures and threats identified in the Integrated Management Plan of ROSCI0063 Jiu Gorge for the habitat and species of community interest assessed to be present in the area of influence of the remaining works.

The following table presents the analysis of the pressures/threats from the draft management plan (opposed/potentially opposed to the characteristics of the analyzed project, intended for species of community interest within ROSCI0063 Jiului Gorge, assessed as being present or potentially present in the area of the project site), according to the structure of the table no. 17 (Analysis of pressures/threats from management plans and other PPs) from Annex no. 5A (Framework content of the appropriate assessment study) to the Annex to MMAP Order no. 1,682/2023 for the approval of the Methodological Guide regarding the adequate assessment of the potential effects of plans or projects on natural areas protected by community interest.

*Table no. 65 Analysis of pressures/threats from the draft management plan of ROSCI0063 Jiului Gorge*

| Natural protected area of community interest | Species/habitats of community interest | Affected parameter | Pressure / threat according to PM | Level of pressure / threat according to PM | PP contributing to pressure / threat | Observations |
|---|---|---|---|---|---|---|
| ROSCI0063 Defileul Jiului | *Lutra lutra*, *Barbus balcanicus*, *Romanogobio uranoscopus* and *Sabanejewia balcanica* | The degree of fragmentation | J02.06.06 - The area of the species' habitat | Pressure - low; Threat - High | Other works carried out upstream of the Livezeni dam, on the West and east Jiu tributaries, which produce longitudinal fragmentation. | - |
| | *Lutra lutra*, *Barbus balcanicus*, *Romanogobio uranoscopus* *Sabanejewia balcanica* and *Bombina variegata* | The area of the species' habitat | J02.06.06 - Surface water intakes for hydroelectric plants | Pressure - low; Threat - High | Any existing or future project/activity located upstream, which contributes to the continuous or discontinuous intake of some volumes of water from the bed of the west and east Jiu watercourses | - |
| | | | M01.05 Flow changes | Pressure - medium; Threat - High | | |
| | *Bombina variegata* | Potential habitat area | J03.01 - Reduction or loss of specific habitat characteristics | Pressure - medium; Threat - medium | According to the analyzes carried out, in this study it is found that the implementation of the remaining works does not lead to loss or degradation of aquatic habitats corresponding to the ecological habitat requirements of the Bombina variegata species. | - |

| **Natural protected area of community interest** | **Species/habitats of community interest** | **Affected parameter** | **Pressure / threat according to PM** | **Level of pressure / threat according to PM** | **PP contributing to pressure / threat** | **Observations** |
|---|---|---|---|---|---|---|
| | *91E0* - Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)* | Habitat area | J02.06.06 - Surface water intakes for hydroelectric plants | Pressure - low; Threat - High | According to the analyzes carried out, in this study it is found that the implementation of the remaining works does not lead to the damage of areas occupied by habitat 91E0* inside the Natura 2000 site ROSCI0063 Jiului Gorge | - |
| | | | M01.05 Flow changes | Pressure - low; Threat - High | | |
| | *Myotis myotis* and *Myotis blythii* | Area of foraging habitat | A10.01 - Removal of hedges and groves or bushes | Pressure - low; Threat - low | According to the analyzes carried out, in this study it is found that the implementation of the remaining works does not lead to the damage of suitable surfaces as feeding habitat for the chiropteran species of community interest Myotis myotis and Myotis blythii | - |

***d.2.) Impact assessment***

The assessment of the impacts on the natural protected area of community interest was carried out on the basis of their conservation objectives, established by MMAP and ANANP, and approved by:

o MMAP Note no. 13.421/CA /11.09.2020 regarding the approval of the minimum set of special measures for the protection and conservation of biological diversity, as well as the conservation of natural habitats, flora and fauna, safety of the population and investments in ROSCI0063 Jiu Gorge;

o MMAP Note no. 11140/BT/21.04.2021 regarding the approval of the minimum set of special measures for the protection and conservation of biological diversity, as well as the conservation of natural habitats, flora and fauna, safety of the population and investments in ROSCI0217 Retezat;

o MMAP Note no. 253925/MF/18.12.2020 regarding the approval of the minimum set of special measures for the protection and conservation of biological diversity, as well as the conservation of natural habitats, flora and fauna, safety of the population and investments in the ROSPA0084 Retezat Mountains.

The following table presents the identification and quantification of the impacts as a result of the implementation of the project on the species and habitats of community interest identified in the area of influence of the project, according to the structure of table no. 18 (Identification and quantification of impacts) from Annex no. 5A to the Annex to MMAP Order no. 1,682/2023 for the approval of the Methodological Guide regarding the adequate assessment of the potential effects of plans or projects on natural areas protected by community interest.

*Assessing the significance of impacts*

In the appropriate evaluation study, all forms of impact of the project likely to significantly affect the natural protected area of community interest were identified and evaluated, as follows:

1. direct, indirect, secondary;
2. cumulative;

The cumulative impact analysis was carried out from two points of view, on the one hand from the point of view of the works already carried out within the project and on the other hand from the point of view of the projects/activities in the area of implementation of the works.

In the impact analysis, the construction and operation stage was taken into account (the objective operating for a very long time - over 50 years, its subsequent destination being also a dam/hydropower development). At the same time, the impact quantifications took into account the degradation/alteration of the habitat for species of conservation interest possibly affected by the implementation of the project.

Regarding the rest of the elements that could generate an impact on the elements of conservative interest at the time of the works (respectively: increased noise level, waste generation, dust pollution) it was found that their effect was, most likely, only during the construction period of the works, so that at the present time no phenomena of drying of the stands (generated by dust emissions) were observed and at the same time several species of community interest were observed in the site area, so it can be stated that the impact of the works was one punctual and short-lived.

The evaluation of the significance of the project implementation impacts is dealt with in Annex no. 1 to the Appropriate Evaluation Study (The evaluation tables of the impact induced by the implementation of the “Project regarding the increase in the share of electricity production from renewable sources by completing the works and ensuring the permanent monitoring of the environmental impact of the hydropower development of the Jiu River on the Livezeni - Bumbești sector" - continuation of works remaining to be executed at the Livezeni – Bumbești investment objective on the habitats and species of community interest within the site of community importance ROSCI0063 Defileul Jiului, evaluated as present or potentially present in the area of influence of the project), according to the table in Annex no. 3C of the Methodological Guide regarding the appropriate assessment of the potential effects of plans or projects on protected natural areas of community interest, approved by Order of the Minister of Environment, Water and Forests no. 1.682/2023.

*Table no. 66 Identification and quantification of impacts*

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification | Impact quantification | Quantification mode |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | The potential impact | Justification of the estimated impact | |
| CONSTRUCTION | The possibility of expanding the species of trees/shrubs characteristic of the types of habitats | Habitat degradation by increasing the proportion of non-characteristic species | Habitat degradation for some species dependent on riparian habitats | - | Degradation of the habitat as a result of possible works on the national road 66 | Short-term impact, during the period of the works | *91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)* | Presence of invasive/non-native species | insignificant | The habitat fragment in the site area occupies an area of 0.1-0.15 ha (0.3% of the habitat area at the site level). Given that in the area of the works there are specimens of black locust, european aspen, birch that can be cut down once the works are carried out and their branches can extend to the area of the habitat (on its border shared with the site) taking into account the sprouting distance of the species, it was estimated that the percentage of growth of these species in the composition of the alder grove is a maximum of 5%. | Analysis of the degree of dispersion of non-characteristic species, as well as the possibility of their expansion through sprouting |
| | Increasing the degree of turbidity in the sectors targeted by the execution of works in the Jiu River bed | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Barbus balcanicus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting river flow) | Estimation of the change in the degree of water quality in the project areas taking into account the technical and constructive details of the project |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Cottus gobio* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | European Fish Index) | | well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Romanogobio uranoscopus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Austropotamobius torrentium* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Barbus balcanicus* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Cottus gobio* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | | | | | | | | | | out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Romanogobio uranoscopus* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Sabanejewia balcanica* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | | | *Austropotamobius torrentium* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | | | | | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | | inorganic micro-pollutants) | | well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Sabanejewia balcanica* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Short-term impact, strictly during the period of the works in the river bed | *Lutra lutra* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact during the construction stage will be insignificant, punctual and reversible due to the chosen execution technology (the works in the riverbed will be carried out by temporary diverting the river flow) | |
| CONSTRUCTION | Noise level increased in areas where the project will be carried out, located in quiet areas, with a low degree of anthropization in the vicinity. | Disturbance of the activity of the species | - | - | Disturbance of the species in a maximum of one presence location | Short-term impact, during the period of the works | *Canis lupus* | Prey population density | insignificant | The area of this species is very large at the level of the site (over 10000 ha), the very low accessibility of the forest fund on the surface of the site and the large quiet areas make the prey species have excellent habitat conditions. The works within the project are carried out on very small areas and in anthropic areas with continuous disturbance (all the works, except for the Bratcu preparatory site works) being in the vicinity of the national road 66 (a heavily traveled road that creates disturbances), so the impact generated by the | Analiza/modelarea nivelului de zgomot, analiza lucrărilor propuse, a termenului de realizare a acestora |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | | | | | | | | | | noise on distribution of prey species will be insignificant. | |
| | | Disturbance of the activity of the species | - | - | Disturbance of the species in a maximum of one presence location | Short-term impact, during the period of the works | *Ursus arctos* | Prey population density | insignificant | The area of this species is very large at the level of the site (over 10000 ha), the very low accessibility of the forest fund on the surface of the site and the large quiet areas make the prey species have excellent habitat conditions. The works within the project are carried out on very small areas and in anthropic areas with continuous disturbance (all the works, except for the Bratcu preparatory site works) being in the vicinity of the national road 66 (a heavily traveled road that creates disturbances), so the impact generated by the noise on distribution of prey species will be insignificant. | |
| | | Disturbance of the activity of the species | - | - | Disturbance of the species in a maximum of one presence location | Short-term impact, during the period of the works | *Lynx lynx* | Prey population density | insignificant | The area of this species is very large at the level of the site (over 10000 ha), the very low accessibility of the forest fund on the surface of the site and the large quiet areas make the prey species have excellent habitat conditions. The works within the project are carried out on very small areas and in anthropic areas with continuous disturbance (all the works, except for the Bratcu preparatory site works) being in the vicinity of the national road 66 (a heavily traveled road that creates disturbances), so the impact generated by the noise on distribution of prey species will be insignificant. | |
| | | Disturbance of the activity of the species | - | - | Disturbance of the species in a | Short-term impact, during the period of the works | *Barbastella barbastellus* | Distribution of the species in the protected area | insignificant | Considering the small area on which the works will be carried out, as well as the | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | | | | | maximum of one presence location | | | | | fact that the noise will be reduced below 50dB at an average distance of 100 m from the site (due in particular to the fact that the project implementation areas are small and they are predominantly located in forested areas) it was estimated that the general impact of carrying out the works (remaining to be executed) will be negative-insignificant. At the same time, the works within the project will be carried out exclusively during the day, when this species has little activity. | |
| | | Disturbance of the activity of the species | - | - | Disturbance of the species in a maximum of one presence location | Short-term impact, during the period of the works | *Myotis myotis* | Distribution of the species in the ETRS89 European 1 kmp grid system | insignificant | Considering the small area on which the works will be carried out, as well as the fact that the noise will be reduced below 50dB at an average distance of 100 m from the site (due in particular to the fact that the project implementation areas are small and they are predominantly located in forested areas) it was estimated that the general impact of carrying out the works (remaining to be executed) will be negative-insignificant. At the same time, the works within the project will be carried out exclusively during the day, when this species has little activity. | |
| | | Disturbance of the activity of the species | - | - | Disturbance of the species in a maximum of one presence location | Short-term impact, during the period of the works | *Myotis blythii* | Distribution of the species in the ETRS89 European 1 kmp grid system | insignificant | Considering the small area on which the works will be carried out, as well as the fact that the noise will be reduced below 50dB at an average distance of 100 m from the site (due in particular to the fact that the project implementation areas are small and they are predominantly located in forested areas) it was estimated that the general impact of carrying out the works (remaining to be | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | | | | | | | | | | executed) will be negative-insignificant. At the same time, the works within the project will be carried out exclusively during the day, when this species has little activity. | |
| | Affecting the riparian vegetation in the area of the bed (Jiu catchment, Dumitra stream area, Livezeni area), including bed regularization | Degradation of species habitat quality | - | - | Probability of drying of specimens of trees/shrubs from riparian species as a result of traffic in the DN66 area | Short-term impact, during the period of the works at the Livezeni dam, the Jiu catchment and Dumitra | *Barbus balcanicus* | The length of riparian tree vegetation on both banks of the water | insignificant | On the surface of the natural area, the hydrological network is very rich, only the course of Jiu river measures here 31 km. Taking into account that it crosses more than 95% forest areas, the woody vegetation almost completely covers both banks of the river course. Within the project, the woody riparian vegetation on the banks of the water course will be affected for a length of 100 m, which represents 0.3% of the total length of the bank of the R. Jiu in the protected area. | Measurements regarding the length of the riparian vegetation that will be affected within the project in relation to the total length of the riparian vegetation in the river courses |
| | | Degradation of species habitat quality | - | - | - | Short-term impact, during the period of the works at the Livezeni dam, the Jiu catchment and Dumitra | *Barbus balcanicus* | Natural bed with a complex (natural) structure/Number of meanders | insignificant | On the river sector in the protected natural area, a number of over 55 meanders, were analyzed (using satellite images) one of which is also in the area of the Jiu catchment, where a 100 m bed regularization will be carried out, thus, implicitly, a remodeling of the meander. Considering the big numer of meanders in the protected natural area (on the course of the Jiu) as well as the short length of the regularization, it was estimated that the impact generated by the project on this parameter will be insignificant. | |
| | | Degradation of species habitat quality | - | - | Probability of withering and dying of specimens of trees/shrubs from riparian species as | Short-term impact, during the period of the works at the Livezeni dam, the Jiu catchment and Dumitra stream | *Austropotamobius torrentium* | The length of riparian tree vegetation on both sides of the water | insignificant | The length of the Dumitra Stream (considered habitat for the species) is 4.8 km, the works within the project (remaining to be executed) will be carried out over a length of | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | | | | | a result of traffic in the DN66 area | | | | | approx. 100 m, from where the spontaneously grown vegetation will be cut. In this area, the riparian vegetation has already been affected by the implementation of the project, so the impact of the remaining works will be insignificant. | |
| | | Degradation of species habitat quality | - | - | - | Short-term impact, during the period of the works at the Livezeni dam, the Jiu catchment and Dumitra stream | *Austropotamobius torrentium* | Natural bed with a complex (natural) structure / Number of meanders depending on the size of the water course | insignificant | On the river sector in the protected natural area, a number of over 55 meanders, were analyzed (using satellite images) one of which is also in the area of the Jiu catchment, where a 100 m bed regularization will be carried out, thus, implicitly, a remodeling of the meander. Considering the big numer of meanders in the protected natural area (on the course of the Jiu) as well as the short length of the regularization, it was estimated that the impact generated by the project on this parameter will be insignificant. | |
| | | Degradation of species habitat quality | - | - | Probability of withering and dying of specimens of trees/shrubs from riparian species as a result of traffic in the DN66 area | Short-term impact, during the period of the works at the Livezeni dam, the Jiu catchment and Dumitra stream | *Lutra lutra* | Length of riparian vegetation with an average width of at least 3 m on both sides of the watercourse in each 500 m section | insignificant | On the surface of the natural area, the hydrological network is very rich, only the course of the river Jiu here measures 31 km. Taking into account that it crosses more than 95% forest areas, the woody vegetation covers almost entirely both banks of the river course. Within the project, the woody riparian vegetation on the banks of the water course will be affected for a length of 100 m, which represents 0.3% of the total length of the bank of the river Jiu in the protected area. | |
| CONSTRUCTION | Losses of individuals of species with reduced mobility | Losses of individuals of the species | - | - | Reducing the size of the species population in the case of national | On short term, only during the works | *Bombina variegata* | Population size | insignificant | The population size of the species was estimated to be between 2000-5000 specimens, a maximum of | Estimate number of individuals of the species population, |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | (amphibians, invertebrates) as well as losses of characteristic habitats (some anthropogenic) of these species | | | | road rehabilitation works | | | | | 10 individuals were observed in the site area (representing 0.1% of the population size in the site). The execution of the works (remaining to be executed) has the potential to lead to accidental mortalities in areas of characteristic habitats. | measurements regarding the area of the habitats |
| | | Losses of individuals of the species | - | - | - | On short term, only during the works | *Austropotamobius torrentium* | Population size | Significant | Considering the importance of this species (priority species), as well as its very small population size, any possible impact on the population can be considered significant, therefore special attention must be paid to the species during the entire period of the works. | |
| | | Reducing the area of the species' habitat | - | - | - | On short term, only during the works | *Bombina variegata* | Area of potential habitat | insignificant | The habitats where individuals of the species have been observed, some are anthropically formed, as a result of the abandonment of works and the accumulation of stagnant water. Completion of the project leads to the elimination of these habitats, but considering the large number of habitat areas for the species, as well as the fact that there are no natural habitats in the observation areas, the impact on this parameter is insignificant. | |
| | | Reducing the area of the species' habitat | - | - | - | On short term, only during the works | *Austropotamobius torrentium* | The area specific to the habitat of the species | insignificant | The remaining works will be carried out on approximately 800 square meters of the species' habitat (estimated according to the specific conservation objectives at 277 ha), which corresponds to 0.03% of the species' habitat. | |
| OPERATION | The decrease of the natural flow (including changes in the composition and | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the Jiu River course, in the | Long-term impact through changes in water composition and quality, | *Barbus balcanicus* | Water quality based on ecological indicators (macroinvertebrates, | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network | Estimation of the degree of water pollution in case of accidental pollution, calculations |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | quality of the water) of the Jiu River between the Livezeni dam and the return section of the processed water in the Bumbești HPP | | | | sense of reducing its flow | including sediment structure | | phytobenthos, phytoplankton) | | favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | regarding the dispersion of pollutants in water |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the Jiu river course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Cottus gobio* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Romanogobio uranoscopus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | | | | | | | | | | 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Austropotamobius torrentium* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Barbus balcanicus* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | | | | | | | | | | flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Cottus gobio* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Romanogobio uranoscopus* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification | Impact quantification | Quantification mode |
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| | | | | | | | | | The potential impact | Justification of the estimated impact | |
| | | | | | | | | | | estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Sabanejewia balcanica* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Austropotamobius torrentium* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
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| | | | | | | | | | | the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micro-pollutants) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Sabanejewia balcanica* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | elements in the structure of the river course. | |
| | | Degradation of aquatic habitat quality | - | - | Modification of the current flow of the river Jiu course, in the sense of reducing its flow | Long-term impact through changes in water composition and quality, including sediment structure | *Lutra lutra* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index) | insignificant | The quantification of the impact on this parameter was made starting from the very high density of the hydrographic network favorable to fish species as well as from the obligations and regulations provided for in GD 148/2020 regarding the approval of the method of determining and calculating the ecological flow, with subsequent amendments and additions, so that the impact in the operational stage was estimated as insignificant taking into account the ecological flow that must be respected imposed by the legislation in force, which is sufficient to maintain the benthic elements in the structure of the river course. | |
| CONSTRUCTION AND OPERATION | Longitudinal fragmentation of the Jiu watercourse into two sections | Disruption of aquatic habitat connectivity | Changes in the structure of the sediments in the river bed of the river Jiu | Reducing the current flow of the river | - | Long-term impact through changes in water composition and quality, including sediment structure | *Lutra lutra* | The degree of fragmentation | significant | Considering that fragmentation represents one of the biggest problems in the aquatic habitats of fish species (trophic base for otter) as well as the fact that these fragmentations reduce the connectivity between habitats favorable to species that are prey for the otter, it was estimated that the impact generated by the introduction of the two fragmentations will be a significant one. | Construction details regarding no. fragmentation elements within the project (work remaining to be executed) |
| | | Disruption of aquatic habitat connectivity | Changes in the structure of the sediments in the river bed of the river Jiu | Reducing the current flow of the river | - | Long-term impact through changes in water composition and quality, including sediment structure | *Barbus balcanicus* | The degree of fragmentation | significant | Considering that fragmentation represents one of the biggest problems in the aquatic habitats of fish species, as well as the fact that these fragmentations reduce the connectivity between habitats favorable to this species, it was estimated that the impact generated by the introduction of the | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification<br>The potential impact | Impact quantification<br>Justification of the estimated impact | Quantification mode |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | two fragmentations will be significant. | |
| | | Disruption of aquatic habitat connectivity | Changes in the structure of the sediments in the river bed of the river Jiu | Reducing the current flow of the river | - | Long-term impact through changes in water composition and quality, including sediment structure | *Cottus gobio* | The degree of fragmentation | significant | Considering that fragmentation represents one of the biggest problems in the aquatic habitats of fish species, as well as the fact that these fragmentations reduce the connectivity between habitats favorable to this species, it was estimated that the impact generated by the introduction of the two fragmentations will be significant. | |
| | | Disruption of aquatic habitat connectivity | Changes in the structure of the sediments in the river bed of the river Jiu | Reducing the current flow of the river | - | Long-term impact through changes in water composition and quality, including sediment structure | *Romanogobio uranoscopus* | The degree of fragmentation | significant | Considering that fragmentation represents one of the biggest problems in the aquatic habitats of fish species, as well as the fact that these fragmentations reduce the connectivity between habitats favorable to this species, it was estimated that the impact generated by the introduction of the two fragmentations will be significant. | |
| | | Disruption of aquatic habitat connectivity | Changes in the structure of the sediments in the river bed of the river Jiu | Reducing the current flow of the river | - | Long-term impact through changes in water composition and quality, including sediment structure | *Sabanejewia balcanica* | The degree of fragmentation | significant | Considering that fragmentation represents one of the biggest problems in the aquatic habitats of fish species, as well as the fact that these fragmentations reduce the connectivity between habitats favorable to this species, it was estimated that the impact generated by the introduction of the two fragmentations will be significant. | |
| | | Disruption of aquatic habitat connectivity | Changes in the structure of the sediments in the river bed of the river Jiu | Reducing the current flow of the river | - | Long-term impact through changes in water composition and quality, including sediment structure | *Austropotamobius torrentium* | The degree of fragmentation | significant | Considering that fragmentation represents one of the biggest problems in the aquatic habitats of fish species, as well as the fact that these fragmentations reduce the connectivity between habitats favorable to this species, it was estimated that the impact generated by the introduction of the | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | The species/habitat | Parameter/ affected target | Impact quantification | Impact quantification | Quantification mode |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | The potential impact | Justification of the estimated impact | |
| | | | | | | | | | | two fragmentations will be significant. | |

***d.3.) Conclusions of the Appropriate Assessment***

"The project regarding the increase in the share of electricity production from renewable sources through the completion of works and the continuous monitoring of environmental impact at the hydroelectric development of the Jiu River in the Livezeni – Bumbești sector" – remaining works to be executed at the investment objective AHE Livezeni – Bumbeşti will be implemented almost entirely (except for the LEA area) on the territory of the Natura 2000 site ROSCI0063 Defileul Jiului.

In order to correctly substantiate the measures for preventing, avoiding, and reducing the impact generated by the project on the elements of conservational interest within the protected natural area, specific studies were conducted on each group of species/habitats, the results of which were presented in the previous chapters, with an emphasis on evaluating the project's impact on each species/habitat of conservational interest.

This study paid special attention to the connectivity of the aquatic habitat present within the surface of the protected natural area, focusing on maintaining its connectivity.

The estimated residual impact after the project's implementation has been assessed as insignificant, provided that the proposed measures for preventing, avoiding, and reducing the impact outlined in this study are respected. Additionally, both during the construction period and subsequently, in the operational phase, monitoring of biodiversity elements is necessary to accurately calculate the generated impact and, if necessary, recalibrate the impact reduction measures.

*Table no. 67 Conclusions of the appropriate assessment*

| Description of PP components | ANPIC affected | Species/ habitats affected | Conservation targets/parameter affected | Types of impact, including cumulative | Reduction measures | Residual impact | The chosen alternative solution | Imperative reasons of major public interest | Compensatory measures | Other aspects |
|---|---|---|---|---|---|---|---|---|---|---|
| CONSTRUCTION | ROSCI0063 Defileul Jiului | *91E0* Riparian forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)* | Presence of invasive/non-native species | insignificant | M1, M2, M6, M9, M22 | insignificant | Completion of the remaining works to be executed | Established by CSAT Decision no. 169 regarding the improvement of Romania's energy resilience to ensure security in the field through operational adaptation and the development of new energy production capacities, in the context of the war in Ukraine, and by Emergency Ordinance no. 175/2022 for establishing measures regarding investment objectives for the execution | Not applicable | - |
| | | *Barbus balcanicus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton) | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Cottus gobio* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Romanogobio uranoscopus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Austropotamobius torrentium* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |

| Description of PP components | ANPIC affected | Species/ habitats affected | Conservation targets/parameter affected | Types of impact, including cumulative | Reduction measures | Residual impact | The chosen alternative solution | Imperative reasons of major public interest | Compensatory measures | Other aspects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | phytoplankton, European Fish Index). | | | | | of ongoing hydroelectric developments, as well as other major public interest projects utilizing renewable energy, and for the amendment and completion of certain normative acts | | |
| | | *Barbus balcanicus* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Cottus gobio* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Romanogobio uranoscopus* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Sabanejewia balcanica* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Austropotamobius torrentium* | Water quality based on physicochemical indicators (oxygen | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining | | Not applicable | - |

| Description of PP components | ANPIC affected | Species/ habitats affected | Conservation targets/parameter affected | Types of impact, including cumulative | Reduction measures | Residual impact | The chosen alternative solution | Imperative reasons of major public interest | Compensatory measures | Other aspects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | regime, nutrients, salinity, metals, organic and inorganic micropollutants). | | | | works to be executed | | | |
| | | *Lutra lutra* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the distribution area | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Sabanejewia balcanica* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Lutra lutra* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton) in the distribution area | insignificant | M3, M4, M5, M6, M21 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Canis lupus* | The density of the prey population | insignificant | M6, M7, M8, M9, M10, M21, M22 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Ursus arctos* | The density of the prey population | insignificant | M6, M7, M8, M9, M10, M21, M22 | insignificant | Completion of the remaining | | Not applicable | - |

| Description of PP components | ANPIC affected | Species/ habitats affected | Conservation targets/parameter affected | Types of impact, including cumulative | Reduction measures | Residual impact | The chosen alternative solution | Imperative reasons of major public interest | Compensatory measures | Other aspects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | works to be executed | | | |
| | | *Lynx lynx* | The density of the prey population | insignificant | M6, M7, M8, M9, M10, M21, M22 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Barbastella barbastellus* | Species distribution in the protected area | insignificant | M6, M7, M8, M9, M10, M21, M22 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Myotis myotis* | Species distribution in the European grid system ETRS89 of 1 km² | insignificant | M6, M7, M8, M9, M10, M21, M22 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Myotis blythii* | Species distribution in the European grid system ETRS89 of 1 km² | insignificant | M6, M7, M8, M9, M10, M21, M22 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Barbus balcanicus* | Length of arboreal riparian vegetation on both banks of the water. | insignificant | M11 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Barbus balcanicus* | Natural bed with a complex (natural) structure/Number of meanders depending on the size of the watercourse | insignificant | M12 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Austropotamobius torrentium* | Length of arboreal riparian vegetation on both banks of the water. | insignificant | M11 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |

| Description of PP components | ANPIC affected | Species/ habitats affected | Conservation targets/parameter affected | Types of impact, including cumulative | Reduction measures | Residual impact | The chosen alternative solution | Imperative reasons of major public interest | Compensatory measures | Other aspects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Austropotamobius torrentium* | Natural bed with a complex (natural) structure/Number of meanders depending on the size of the watercourse | insignificant | M12 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Lutra lutra* | Length of riparian vegetation with an average width of at least 3 m on both banks of the watercourse in each 500 m section. | insignificant | M11 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Bombina variegata* | Population size | insignificant | M9, M13 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Austropotamobius torrentium* | Population size | Significant | M9, M14 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Bombina variegata* | The surface of the potential habitat | insignificant | M9, M13 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Austropotamobius torrentium* | Specific area of the species' habitat | insignificant | M9, M14 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| OPERATION | | *Barbus balcanicus* | Water quality based on ecological indicators (macroinvertebrates, | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |

| Description of PP components | ANPIC affected | Species/ habitats affected | Conservation targets/parameter affected | Types of impact, including cumulative | Reduction measures | Residual impact | The chosen alternative solution | Imperative reasons of major public interest | Compensatory measures | Other aspects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | phytobenthos, phytoplankton) | | | | | | | |
| | | *Cottus gobio* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Romanogobio uranoscopus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Austropotamobius torrentium* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Barbus balcanicus* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Cottus gobio* | Water quality based on physicochemical indicators (oxygen regime, nutrients, | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining | | Not applicable | - |

| Description of PP components | ANPIC affected | Species/ habitats affected | Conservation targets/parameter affected | Types of impact, including cumulative | Reduction measures | Residual impact | The chosen alternative solution | Imperative reasons of major public interest | Compensatory measures | Other aspects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | salinity, metals, organic and inorganic micropollutants). | | | | works to be executed | | | |
| | | *Romanogobio uranoscopus* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Sabanejewia balcanica* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Austropotamobius torrentium* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Lutra lutra* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the distribution area | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |

| Description of PP components | ANPIC affected | Species/ habitats affected | Conservation targets/parameter affected | Types of impact, including cumulative | Reduction measures | Residual impact | The chosen alternative solution | Imperative reasons of major public interest | Compensatory measures | Other aspects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Sabanejewia balcanica* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Lutra lutra* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton) in the distribution area | insignificant | M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| CONSTRUCTION AND OPERATION | | *Lutra lutra* | Degree of fragmentation | Significant | M3, M4, M5, M6, M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Barbus balcanicus* | Degree of fragmentation | Significant | M3, M4, M5, M6, M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Cottus gobio* | Degree of fragmentation | Significant | M3, M4, M5, M6, M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Romanogobio uranoscopus* | Degree of fragmentation | Significant | M3, M4, M5, M6, M15, M16, M17, M18, M19, | insignificant | Completion of the remaining works to be executed | | Not applicable | - |

| Description of PP components | ANPIC affected | Species/ habitats affected | Conservation targets/parameter affected | Types of impact, including cumulative | Reduction measures | Residual impact | The chosen alternative solution | Imperative reasons of major public interest | Compensatory measures | Other aspects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M20, M22, M23 | | | | | |
| | | *Sabanejewia balcanica* | Degree of fragmentation | Significant | M3, M4, M5, M6, M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |
| | | *Austropotamobius torrentium* | Degree of fragmentation | Significant | M3, M4, M5, M6, M15, M16, M17, M18, M19, M20, M22, M23 | insignificant | Completion of the remaining works to be executed | | Not applicable | - |

Given the overlaps between ROSCI0063 Defileul Jiului and the Jiului Gorge National Park in the project area, the previously presented measures also apply to the National Park.

*e) Climate and Climate Change*

***e.1.) Vulnerability of the project to climate change***

The climate in the project area is moderately continental with sub-Mediterranean nuances, characterized by the Banat climate subtype, influenced by the circulation of Atlantic air masses and the invasion of Mediterranean air masses, which gives the region a moderate thermal regime, with frequent warming periods during winter, early springs, and relatively high average precipitation.

The climate is temperate-continental, with slight Mediterranean influences and local aspects determined by the presence of high and mid-altitude mountains, sub-Carpathian hills, depressions, etc. The climate regime is generally characterized by cool summers with abundant rainfall, and cold winters (especially in the mountainous sector) with frequent blizzards and a stable snow cover for extended periods.

During the cold season, the hilly areas are often invaded by warmer air from the Mediterranean, causing thawing and melting of the snow cover. The average annual temperature ranges from 10.2°C in the depressions (at Târgu Jiu), 6°C in the hilly regions, 3.4°C in mid-altitude mountains, and 0°C on the high mountain peaks. The absolute maximum temperature (40.6°C) was recorded at Târgu Jiu (September 8, 1946), while the absolute minimum (-31°C) was also recorded at Târgu Jiu (January 24, 1942). Average annual precipitation is unevenly distributed, with substantial increases with altitude: 585 mm in the Jiu floodplain, 753 mm in the depression areas, 925 mm in the sub-Carpathian hills, and over 1,200 mm on the high mountain peaks.

The general characterization of the climate is determined mainly by the thermal, wind, and precipitation regimes.

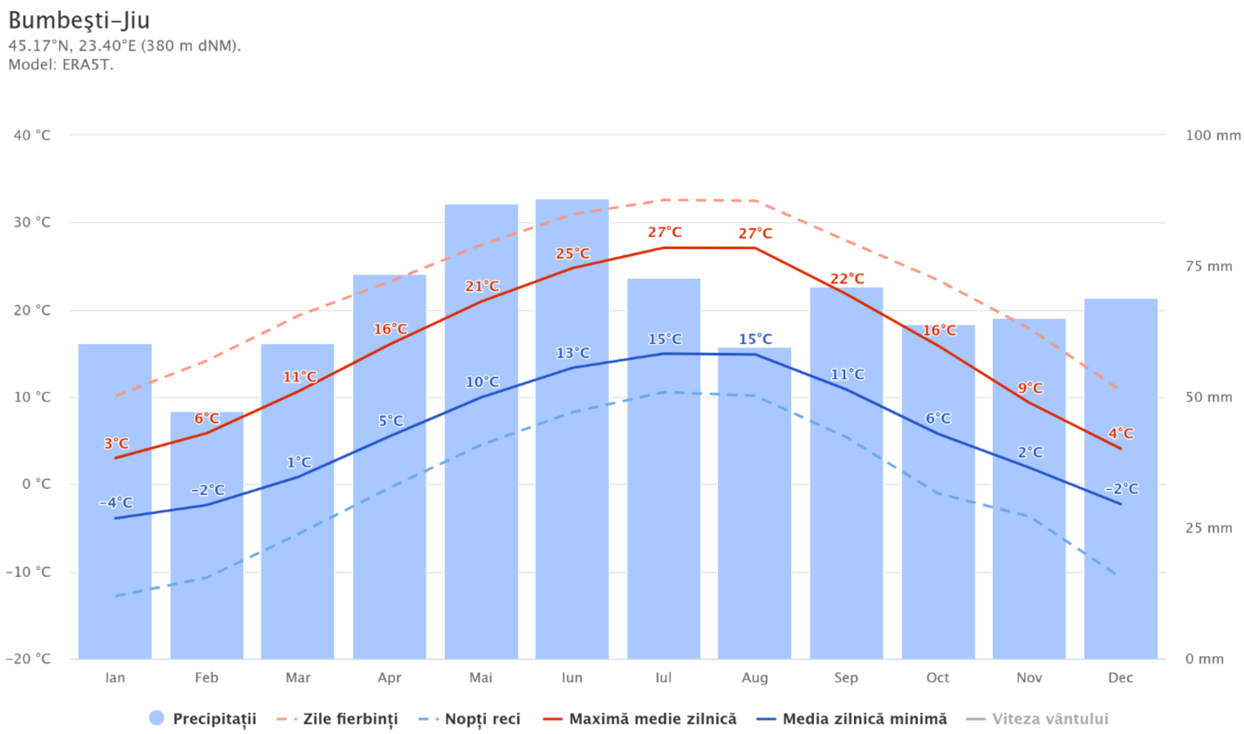


Fig. 210 Average temperature and precipitation in Bumbești-Jiu (source: Meteoblue)

„Average daily maximum" (solid red line) shows the average maximum temperature of a day for each month. Similarly, „average daily minimum" (solid blue line) shows the average minimum temperature. Warm days and cold nights (dotted red and blue lines) show the average of the warmest day and coldest night of each month over the past 30 years. Wind speed is not normally displayed but can be added from the bottom of the graph.

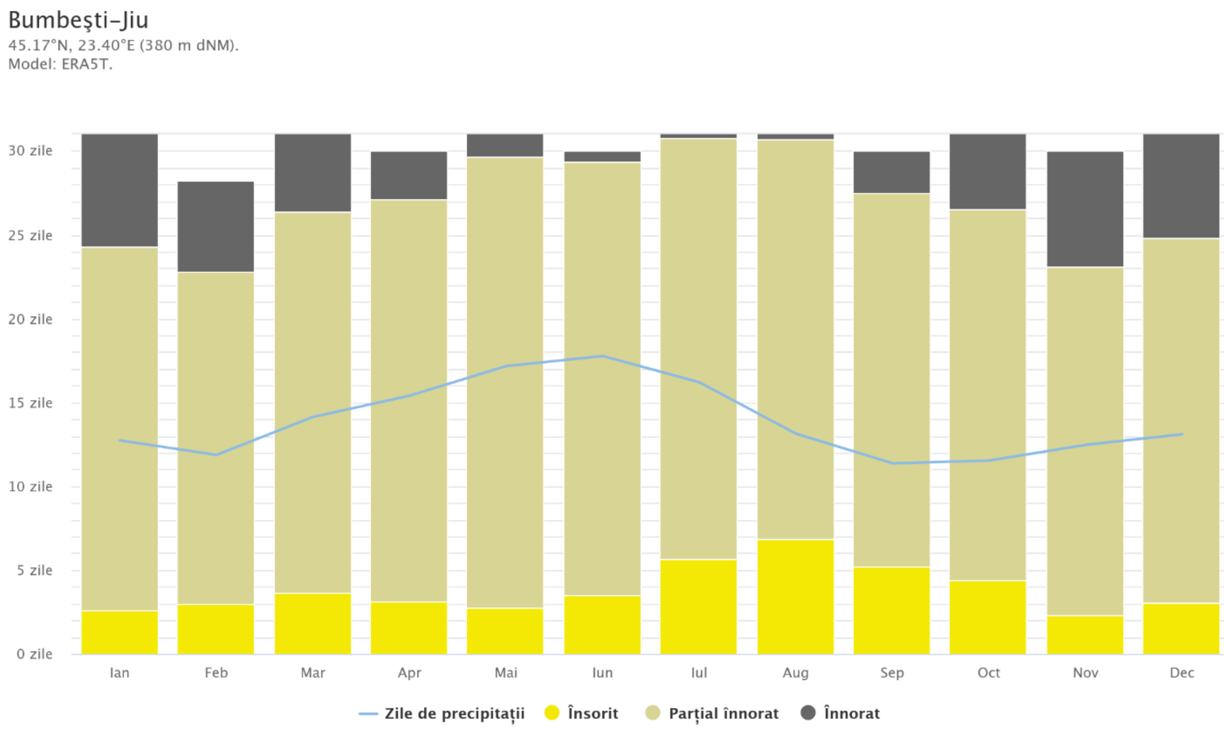


Fig. 211 Cloud cover, sunshine, and precipitation days in Bumbești-Jiu (source: Meteoblue)

The graph shows the monthly number of sunny, partly cloudy, cloudy, and rainy days. Days with less than 20% cloud cover are considered sunny, those with 20-80% cloud cover as partly cloudy, and those with over 80% cloud cover as cloudy.

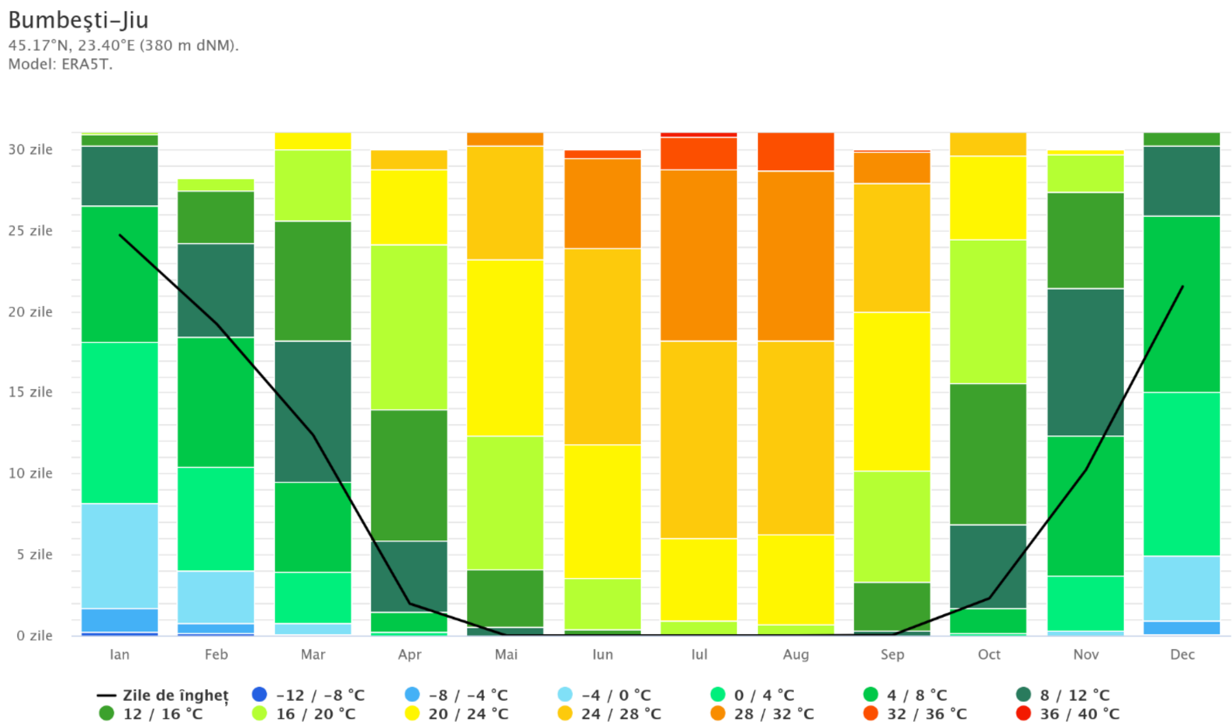


Fig. 212 Maximum temperatures in Bumbești-Jiu (source: Meteoblue)

The maximum temperature chart for Bumbești-Jiu shows how many days per month reach certain temperatures.

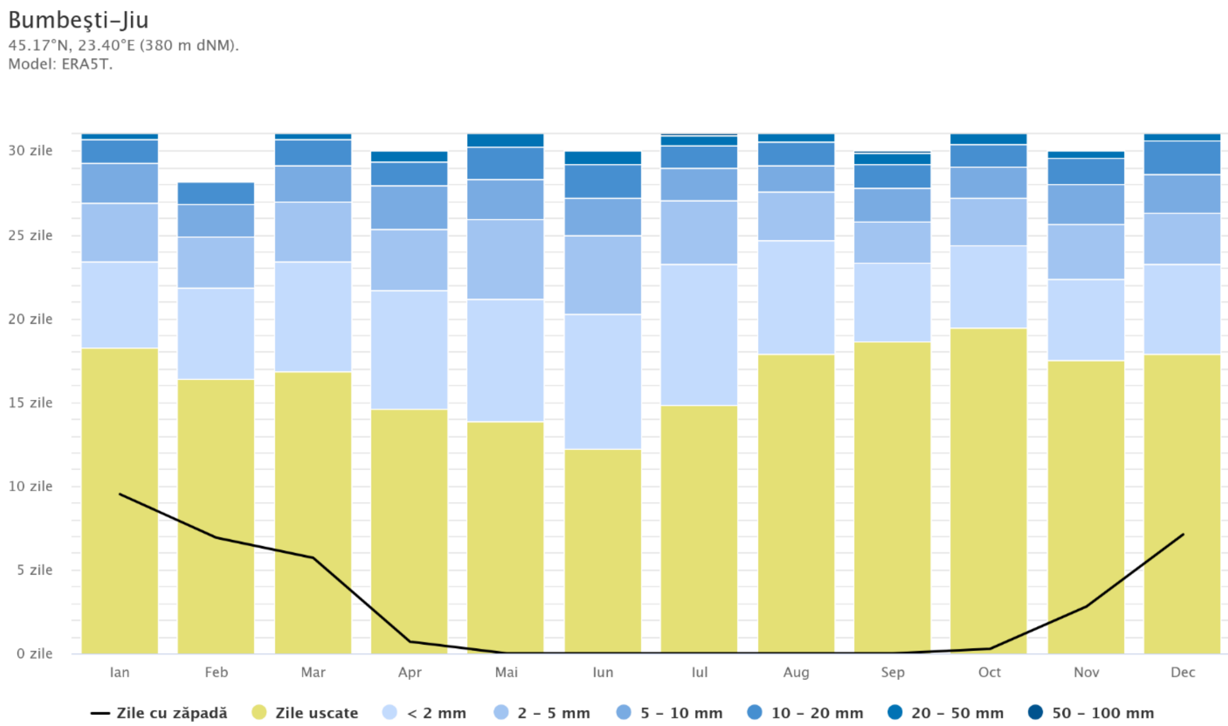


Fig. 213 Precipitation amount in Bumbești-Jiu (source: Meteoblue).

The precipitation chart shows how many days per month a certain amount of precipitation is reached.

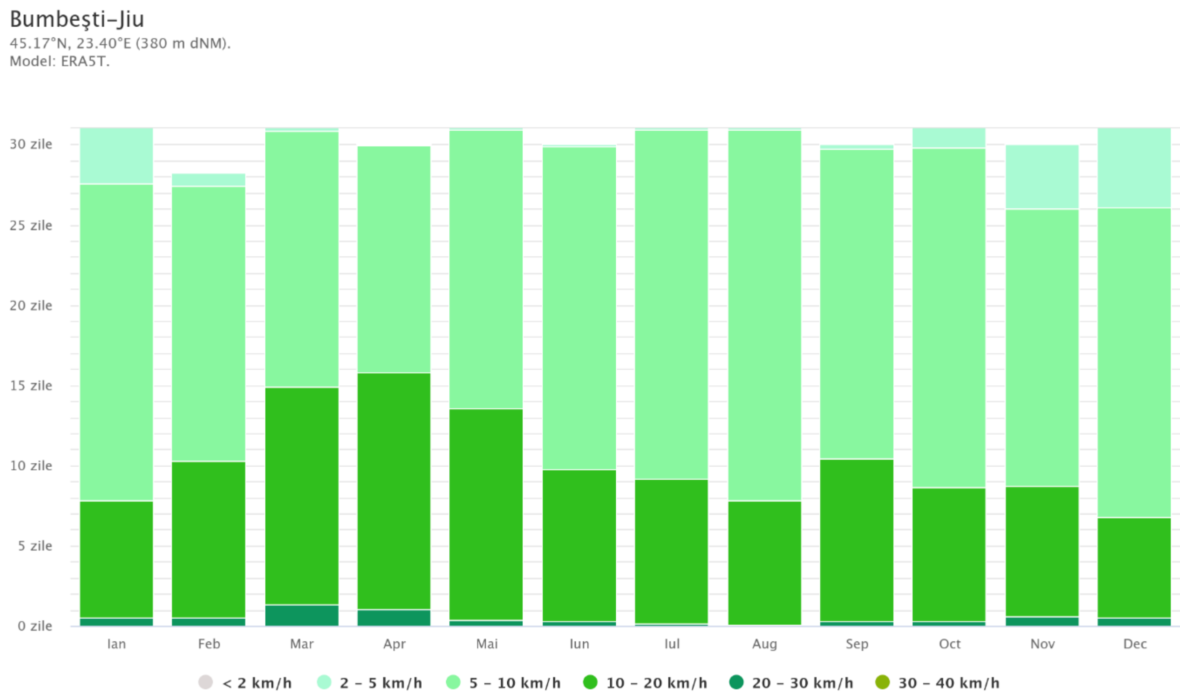


Fig. 214 Wind speed in Bumbești-Jiu (source: Meteoblue)

The chart indicates the days in a month when the wind reaches a certain speed.

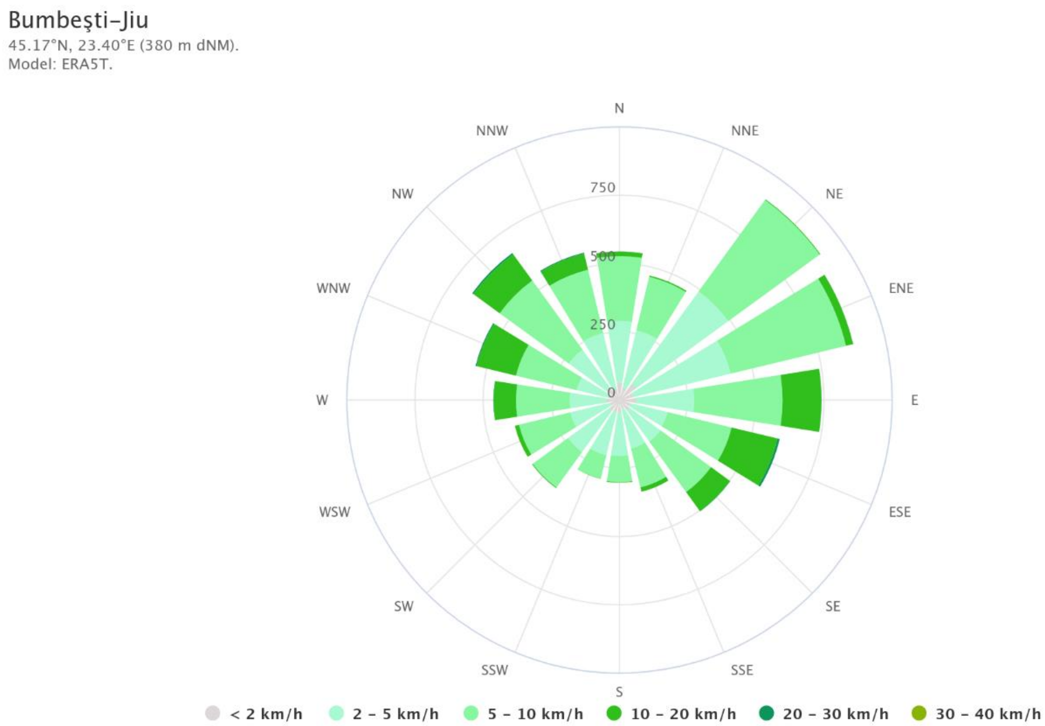


Fig. 215 Wind rose in Bumbești-Jiu (source: Meteoblue)

The wind rose shows how many hours per year the wind blows from the indicated direction. For example, SW: The wind blows from the Southwest (SW) towards the Northeast (NE).

The main risks and vulnerabilities, as well as opportunities, are presented below.

*Table no. 68 Identified risks, vulnerabilities, and opportunities*

| Risks/Vulnerabilities | Opportunities/Actions |
| --- | --- |
| Increase in heating costs for households due to the dismantling of the centralized heating system and the installation of gas-fired heating units | Reestablishment, rehabilitation, and modernization of the infrastructure of the centralized thermal energy production and distribution system |
| High proportion of housing that is not thermally rehabilitated (generating $CO_2$ emissions) and constructed from energy-inefficient materials, with truss-type roofs. | Utilization of renewable energy resources by establishing solar and wind farms |
| Increase in electricity and natural gas consumption in public buildings and a low proportion of public buildings that have | Improving energy consumption efficiency and reducing costs for powering households, |

| | |
|---|---|
| benefited from energy efficiency improvements | public buildings, industrial units, public lighting, and public transport |
| Increase in electricity costs consumed by the public lighting system due to its low energy efficiency<br>- Increase in energy prices during drought years, amid a decrease in the proportion of hydroelectric energy in favor of thermal energy (which is more expensive) | **Establishment of hydropower plants** |

The reduction in electricity demand for heating in winter due to the increase in global average temperatures does not compensate for the increased electricity needed to operate air conditioning and cooling devices during hot days. Climate change will alter the seasonal demand for electricity, which will be lower in winter and higher in summer. Climate change may also lead to a decrease in hydropower production due to reduced water resources. The decrease in water resources also affects the cooling systems of nuclear power plants.

***e.2.) Assessment of Risks in the Energy Sector***

The electricity demand in Romania is covered by an energy mix, where hydropower accounts for about 17% in a normal hydrological year. As a result of prolonged droughts during the summer (2003, 2007), the deficit in the electricity system was covered by energy produced from coal combustion, creating significant pressure regarding coal production as well as electricity prices, given that hydropower is the cheapest energy source. One threat is linked to the fact that using coal jeopardizes Romania's commitments concerning emissions of $SO_2$, $NO_x$, and particulates from thermal power plants. Another pressure will be exerted on electricity costs by exceeding the quantity of greenhouse gas emission certificates allocated to thermal power plants under the National Allocation Plan. Another danger arises from the increased demand for air conditioning during the summer, with peaks in electricity consumption approaching those in winter. This will create pressure on the entire energy sector, knowing that during winter, cogeneration plants operate, which are much less utilized during summer.

The dangers regarding energy infrastructure are represented by extreme weather phenomena; there have been many situations where, due to strong storms, thousands of homes were left without electricity. The dangers include: the collapse of transmission and distribution lines, damage to electrical transformers due to lightning, prolonged power outages for consumers due to the rapid increase in energy demand for air conditioning during summer, which the electrical distribution networks are not prepared to cover, siltation of dams due to river floods, and the inability to meet cooling requirements for large electricity generation installations, which could lead to their shutdown (in 2003, it was necessary to shut down Unit 1 of the Cernavodă NPP due to a lack of water in the Danube).

The realization of the AHE Livezeni-Bumbești project will increase investments in the use of renewable energy sources, harnessing the economic and technical potential that Romania possesses. This will be even more important as global prices for fossil fuels rise alarmingly and for meeting EU commitments.

The assessment of risks and their prioritization was carried out by estimating the impact of climate change on each risk and considering the probability of a particular change occurring, using a scale from 1 to 5 and constructing a matrix (where 1 represents very low impact-probability, and 5 represents very high impact-probability).

In the AHE Livezeni-Bumbești project, the matrix for the identified risks in the Energy and Telecommunications sectors is:

*Table no. 69: Matrix for the Identified Risks in the Energy and Telecommunications Sector*

| Hazard | Vulnerabilities | Risks | Effects | Probability | Impact | Total score |
|---|---|---|---|---|---|---|
| Rising Temperatures | Unrenovated homes | Increase in the number of air conditioning units | Increase in costs; Increase in energy consumption | 5 | 2 | 10 |
| Extreme Temperatures (Frost) | Increase in the number of individual heating plants | Decrease in gas pressure | Decline in quality of life | 1 | 2 | 2 |
| Climate change | Old network segments; Low energy consumption | Unprofitability in certain segments/networks | Price increase; Difficulties for those who cannot afford it | 5 | 2 | 10 |
| Drought | Decrease in hydro production | Energy mix change (price increase) | Impact on industrial and residential consumers | 5 | 2 | 10 |

| Hazard | Vulnerabilities | Risks | Effects | Probability | Impact | Total score |
|---|---|---|---|---|---|---|
| Storm/ frozen rains | High percentage of overhead distribution cables; High dependence on energy | Cable collapse | Interruption of energy supply; Interruption of public lighting | 5 | 3 | 19 |

Vulnerability analysis involves identifying the climate variables or hazards that could impact the proposed project based on sensitivity and exposure, for both current and future climate conditions.

Vulnerability (V) is calculated as V = S x E, where S is the degree of sensitivity to a specific climate factor, and E is the degree of exposure to that specific climate factor.

*Table no. 70 Project vulnerability analysis*

| No. | Climate variables | Exposure to current conditions | Exposure to future conditions |
|---|---|---|---|
| DIRECT EFFECTS | | | |
| 1. | Average annual temperatures | The trend of the average annual temperature for the project area, from 1960 to 2023, is an increase at a rate of approximately 0.09°C | In the project area, the increase in average annual temperature could be between 1.20°C and 1.29°C |
| 2. | High extreme temperatures, drought | In Caraș-Severin County, 2023 recorded more heatwave days (with temperatures ≥35˚C). The temperature record, which had stood since 1938 at 39.8 degrees, was surpassed on August 5, 2017, reaching 39.9 degrees | The future trend of temperatures is upward |
| 3. | Extreme heavy precipitation, flooding | In the studied project area, increases in annual precipitation extremes have been recorded | The average number of days per year with a higher amount of precipitation increases in Caraș-Severin County by 0.30 to 0.90 compared to the reference period of 1970-2000 |

| No. | Climate variables | Exposure to current conditions | Exposure to future conditions |
|---|---|---|---|
| 4. | Extreme wind speeds | Slight increase in the frequency of strong winds | Slight increase in the frequency of strong winds |
| 5. | Humidity | Between 1960 and 2023, the recorded values in the project area indicated the onset of drought | The multiyear average values for the future period indicate significant reductions compared to the current climate for snowpack thickness in the winter season |
| 6. | Frost | The current risk of the meteorological phenomenon of freezing rain shows a slight increasing trend. | Trends of a slight increase in the risk of freezing rain meteorological phenomena |
| 7. | Solar radiation | here has been a trend of increasing solar radiation between 1960 and 2023 | Increases in solar radiation values are estimated |

**e.3.) Immunization of the project against climate change in the context of its vulnerability**

*Risk assessment based on vulnerability analysis*

The risk assessment is based on the vulnerability analysis and focuses on identifying the risks and opportunities associated with high or medium vulnerabilities. It consists of evaluating the probability and magnitude of the consequences associated with the identified climate hazards, as well as assessing the importance of the risk for the proposed projects.

*Table No. 71 Vulnerability of the project in relation to climatic variables*

| No. | Climate variables | Sensitivity | | Exposure to current conditions | Vulnerability to current conditions | |
|---|---|---|---|---|---|---|
| | | Inputs | Outputs | | Inputs | Outputs |
| 1. | Average annual temperatures | 0 | 0 | 1 | 0 | 0 |
| 2. | Extreme high temperatures, drought | 1 | 1 | 2 | 2 | 2 |
| 3. | Extreme heavy precipitation, floods | 1 | 1 | 2 | 2 | 2 |
| 4. | Extreme wind speeds | 1 | 1 | 2 | 2 | 2 |
| 5. | Humidity | 0 | 0 | 1 | 0 | 0 |
| 6. | Frost | 1 | 1 | 2 | 2 | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7. | Solar radiation | 0 | 0 | 1 | 0 | 0 |

Legend

| | | | |
|---|---|---|---|
| Vulnerability | low (score 0 -1) | medium (score 2 -3) | high (score 4 -6) |

Analysis of the project's vulnerability to climate change has considered the following climate variables:

- High extreme temperatures;
- Extreme heavy precipitation;
- Extreme wind speeds;
- Frost;
- Storms (tornadoes);
- Flooding;
- Landslides/soil erosion;
- Wildfires.

The analysis established a medium vulnerability level for four climate variables: high extreme temperatures, extreme heavy precipitation, extreme wind speeds, and frost.

**Mitigation of climate change (climate neutrality), adaptation measures**

Mitigating climate change involves decarbonization, energy efficiency, energy savings, and the use of renewable energy forms. It entails taking measures to reduce greenhouse gas (GHG) emissions or enhance GHG sequestration and is guided by EU policy regarding emission reduction targets for 2030 and 2050. Additionally, a significant portion of the infrastructure projects to be supported during the 2021-2027 period will have a lifespan extending beyond 2050.

In these guidelines, the carbon footprint method is used not only to estimate greenhouse gas emissions for a project when it is ready to be implemented but also, more importantly, to support the analysis and integration of low-carbon solutions during the planning and design stages. Therefore, it is essential for climate change immunity to be integrated from the outset into project lifecycle management.

In the energy sector, effective measures must be taken to reduce greenhouse gas emissions, primarily at the planning level. Carbon footprint methodologies can be expanded to provide an immediate assessment of the extent to which the plan produces the anticipated positive effects on GHG emissions. This could be one of the key performance indicators for such plans.

For the analysis of climate neutrality aspects, specific studies have been conducted based on the European Commission's Communication on Technical Guidelines for Climate Resilience of Infrastructure during the 2021-2027 period (2021/C 373/01).

**The process of preparing for climate change resilience has taken into account:**

- Assessing and specifying the project context, as well as the boundaries and interactions between projects;
- Selecting the evaluation methodology, including key parameters for assessing vulnerability and risks;
- Compiling key reference documents, such as the applicable National Energy and Climate Plan (NECP) and relevant adaptation strategies and plans, including, for example, national and local disaster risk reduction strategies;
- Ensuring compliance with applicable laws, norms, and regulations.

Climate change resilience is a process that integrates measures for mitigating climate change and adapting to it in project development. This enables institutional and private investors in Europe to make informed decisions regarding projects deemed compatible with the Paris Agreement.

The process encompasses two pillars (mitigation, adaptation) and two stages (screening, detailed analysis). The detailed analysis depends on the outcome of the screening stage, which contributes to reducing administrative burden.

For the assessment of CO2e emissions, the methodologies mentioned in the European Commission's Communication on Technical Guidelines for Climate Resilience of Infrastructure during the 2021-2027 period (2021/C 373/01) were used.

According to the applicable guidelines and methodologies, specific studies were conducted following the specific stages of the process, presented below:

***Mitigation (climate neutrality)***

- Phase 1: Screening with the assessment of the project's impact on greenhouse gas (GHG) emissions
- Phase 2: Detailed analysis, presenting the principles of energy efficiency and GHG emissions reduction in the design and planning of the investment, including calculating the GHG emissions generated by the project and comparing them with the existing situation and the situation without the project (reference scenario) – only if the project generates emissions of over 20,000 tons of CO2/ year.

***II. Adaptation (resilience to climate change):***

- Stage 1: Screening with the following steps:
  1. Sensitivity analysis of the project to climate variables;
  2. Assessment of exposure to risks generated by climate variables in the project implementation area;
  3. Vulnerability analysis;
  4. Risk assessment.
- Stage 2: Adaptation solutions with the following steps:
  1. Identification of adaptation options;
  2. Evaluation of adaptation options;

Below is a summary of these specialized studies:

The proposed project will emit carbon dioxide (CO2) during the execution of the works, totaling 51.46 tons of CO2 over the entire implementation period of 60 months.

In accordance with the provisions of the European Commission's Communication on Technical Guidelines regarding the immunization of infrastructure to climate change, the project does not require a detailed assessment of the carbon footprint.

The project will not lead to an increase in GHG emissions in the area.

The conclusion of the analysis regarding climate immunization, after completing stage 1 (screening), was that the project does not require a detailed assessment of the carbon footprint, considering that the implementation and operation of the project generates less than 20,000 tons of CO2e/year, and the type of project is included in the list of projects for which a detailed assessment of the carbon footprint is not required.

The project does not generate additional impacts on emissions and cannot negatively influence climate variables; on the contrary, its implementation will support the climate mitigation process.

The project does not involve activities that could lead to an increase in GHG emissions in the area, will not significantly influence energy demand, and includes solutions for utilizing renewable energy sources.

The project will not result in a significant increase in personal travel or freight transport.

The objective has taken into account all relevant aspects regarding the reduction of GHG emissions, mitigation, and adaptation to climate change. Thus, the objective does not

present significant vulnerability to climate change, considering that all measures and technical works for addressing the identified climate risks during execution have been included and no additional protective or adaptive works are required.
Additionally, the project does not have the capacity to significantly influence the level of GHG emissions in the project area.
During the operational phase, it will represent an alternative to conventional energy sources by providing a volume of renewable energy, thus supporting the reduction of GHG emissions at the national level

*f)Population*

The interventions within the project (remaining works to be executed) are located in the area of influence of 3 administrative-territorial units (ATUs), namely:

- Aninoasa ATU – partially, the works at the Livezeni dam – construction at the dam body will take place more than 300 meters from the houses in the Iscroni neighborhood (village);
- Petroșani ATU – partially, the works at the Livezeni dam – construction at the dam body will take place more than 400 meters from the houses in the Sașa neighborhood (village);
- Bumbești-Jiu ATU – the remaining works – the distance to the nearest dwelling is approximately 100 meters from the Bumbești Hydropower Plant (the houses on Luncani Street);

The inhabited areas are at considerable distances from the location of the remaining works to be executed, so the implementation of the project will not generate any impact on the houses or residents in the area (maps showing the distances from inhabited areas have been presented in Chapter 3).

The continuation of the works will generate a relatively short-term positive social impact during the execution period by creating new jobs.

Considering that a large part of these jobs requires a certain level of professional qualification (driver, surveyor, construction materials technician, construction equipment operator, blaster, rebar worker, carpenter, injector, etc.), it is expected that the contractor who will carry out the works will bring their own employees; under these conditions, the positive social impact on the area surrounding the project site will be limited.

Additionally, given the nature of such works, it is expected that the number of male employees will be higher than the number of female employees.

With the commissioning of the Livezeni reservoir/dam and the two hydropower plants (Dumitra and Bumbești), the positive social impact generated will be strictly limited, considering the small number of new jobs that will be created.

***<u>The workforce required for the project</u>***

the completion works of the investment

- The table below presents an estimate of the workforce required to complete the investment, based on professional qualifications and the specific trades for this type of construction work; we note that it is possible not all of these positions will be filled simultaneously during the investment period.

*Table no. 72 Workforce required during the investment implementation period*

| Professional qualification/specific trade | No of persons |
|---|---|
| Site Manager | 1 |
| Construction Engineer | 2 |
| Electro-mechanical Engineer | 1 |
| TESA staff (Technical, Economic, and Administrative Services) | 3 |
| Foreman | 2 |
| Surveyor | 1 |
| Concrete Plant Operator | 4 |
| Concrete Laboratory Operator | 2 |
| General Transport Vehicle Driver | 3 |
| Dump Truck Driver (on-site) | 5 |
| Construction Equipment Operator | 5 |
| Blaster | 2 |
| Carpenter | 2 |
| Rebar Worker | 3 |
| Concrete Worker | 4 |
| Injector | 2 |
| Unskilled Worker | 14 |
| **TOTAL** | **56** |

*a.2.) in operation*

- *Foreman - 1 person*
- *Dam Installation Electrician - 3 people*
- *Hydrotechnical Installer Operator - 3 people*
- *Hydrotechnical Engineers - 5 people*

*g)Safety and human health*

*Risks to human health and safety, cultural heritage, or the environment due to accidents, armed attacks, or disasters*

In the case of these risks, the following have been considered:

- Floods caused by natural overflow of watercourses, blockages caused by ice, landslides; floods triggered by incidents, accidents, or malfunctions at constructions;
- Dangerous meteorological phenomena: torrential rains, heavy snowfall, storms and blizzards, deposits of ice, rime, glaze, early or late frosts, heatwaves, hail, droughts, tornadoes, avalanches;
- Armed attacks, fires, explosions, accidental pollution of watercourses, soil, accidental pollutant emissions into the atmosphere, earthquakes, damage or destruction of installations, equipment, and hydrotechnical constructions, flash floods, morphological and geological changes in the slopes of reservoirs, and other severe natural disasters.

For all these situations, measures are included in the beneficiary's action plan, prepared with the county prevention and defense committees. In this case, warning-alarm measures are applied for the rescue of people and goods; the hydropower plant is shut down; the quick valve is closed; the dispatcher and the Emergency Situations Cell are notified; the water level in the lake is monitored, and if the danger of flooding the power plant arises, all installations of the hydropower plant are de-energized, and the facility is evacuated.

*Table no. 73 Critical thresholds*

| River | Defense parameters | | | | | |
|---|---|---|---|---|---|---|
| | Attention | | Alert | | Danger | |
| | Level (cm) | Flow ($m^3/s$) | Level (cm) | Flow ($m^3/s$) | Level (cm) | Flow ($m^3/s$) |
| Jiu | 100 | 28.8 | 150 | 64.4 | 200 | 104 |

Characteristic defense measures defined in case of floods are:

a) For the leveeed areas of watercourses:
   - Phase I of defense - when the water level reaches the base of the outer slope of the levee over one-third of its length;
   - Phase II of defense - when the water level reaches halfway between the elevation of Phase I and that of Phase III of defense;
   - Phase III of defense - when the water level reaches 0.2 m - 1.5 m below the levels of the highest known water or below the maximum level for which the levee was designed, or when a critical point is exceeded.

b) For the non-leveed areas of watercourses, at the hydrometric station sections:
   - Flood level (F.L.) - the level at which significant overflow occurs, potentially leading to the flooding of the first objective;
   - Danger level (D.L.) - the level at which special evacuation measures for people and goods

may be necessary, restrictions on the use of bridges and roads, as well as special measures in the operation of hydrotechnical constructions.

For reservoirs, phases I, II, and III of defense are established based on the water level in the lake and the inflow discharge and are calculated by the designer/expert within the range between the Normal Retention Level (N.R.L.) and Maximum Operational Level (M.O.L.), as established by operating regulations.

For the behavior of dams, critical thresholds are established by the designer for each objective based on:

- the water level in the lake when it exceeds the Normal Retention Level (N.R.L.);
- Reaching certain limit values in the behavior of the construction.

The limit values in the behavior of the construction are:

- Attention threshold - values of some parameters approach or even exceed the considered normal range without altering the overall stability of the construction;
- Alert threshold - dangerous changes in behavior parameters indicating the evolution towards initial failure phenomena;
- Danger threshold - the dam undergoes changes that may lead to serious damage or collapse of the construction.

In case of flood danger due to ice jam and overflow of waters, the following characteristic sizes are established:

- Phase I - when the ice detaches and ice floes flow down the watercourse and small accumulations appear;
- Phase II - when ice floes accumulate and levels rise upstream;
- Phase III - when the ice floes block, forming jams that lead to damage due to overflow upstream or by the flow of floes downstream as a result of the jam's failure.

In case of flood danger caused by the rise of the groundwater table (internal water floods) on agricultural lands, the following characteristic sizes are established:

- Attention threshold - the appearance of ponding on at least 30% of the total area of the potentially affected land;
- Warning threshold - water stagnates in the flooded area for up to 72 hours;
- Warning/Danger threshold - water stagnates in the flooded area for more than 72 hours.

*<u>Radioactive Pollution</u>*

Radioactive pollution refers to the contamination produced by radioactive substances handled in technological processes, as well as the waste resulting from these processes. No radioactive substances are used on-site.

However, there is an electromagnetic field near power plants, transformer stations (specifically those of 110kV), and high-voltage transmission lines (110kV, 400kV). The electromagnetic field is a physical field produced around bodies that are electrically charged and affects other electrically charged particles. The electromagnetic field propagates indefinitely through space, constituting one of the main forces of nature. The electromagnetic field that propagates in space is called an electromagnetic wave.

Thus, the electromagnetic field is the combination of electric and magnetic fields that oscillate and generate each other as electric current passes through a conductor. The electromagnetic field is a rotating field and propagates in the form of electromagnetic waves, with a speed that depends on the permittivity and permeability of the medium. The frequency of the waves is equal to the frequency at which electrons move. The wavelengths of electromagnetic waves vary over a very wide range.
There are different types of electromagnetic radiation, presented in the spectrum below, which can be grouped into ionizing radiation and non-ionizing radiation.

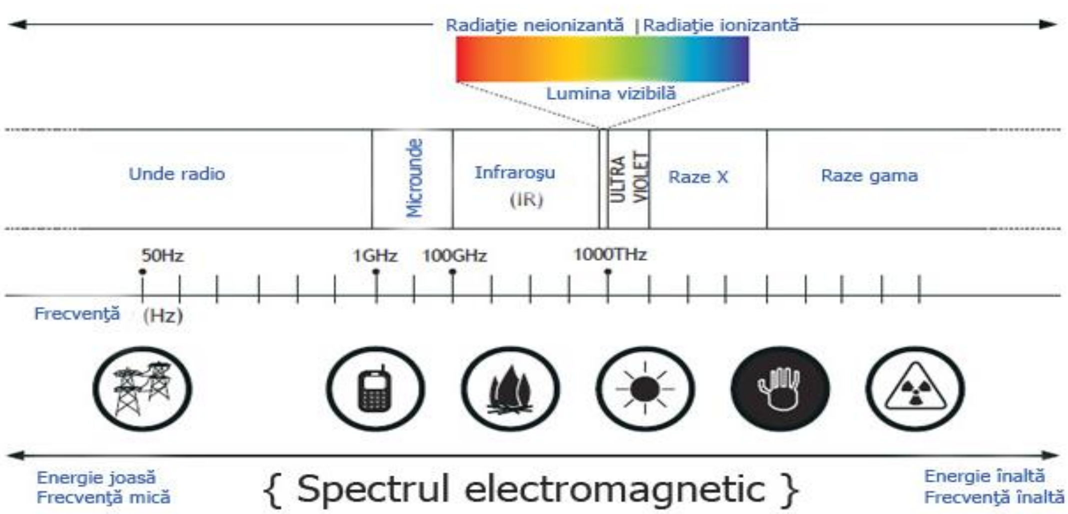


Fig. 216 Electromagnetic Spectrum

An electromagnetic wave is composed of two orthogonal fields, varying over time: the electric field and the magnetic field. The behavior of electromagnetic radiation depends on the wavelength. High frequencies have shorter wavelengths, while low frequencies have longer or very long wavelengths.

In Romania, the maximum allowable exposure levels to electromagnetic waves (fields) for the general population (non-professional exposure) are stipulated in the Regulations on the Reference Levels for Allowable Exposure of the General Population to Electromagnetic Fields with Frequencies Ranging from 0 Hz to 300 GHz, approved by the Order of the Minister of Public Health no. 1193/29.09.2006. These regulations ensure maximum protection against radiofrequency electromagnetic fields. In the aforementioned regulatory act, the specific absorption rate (SAR) averaged over the entire body or over a certain part of the body is defined as the rate at which energy is absorbed per unit mass of body tissue. This is expressed in watts per kilogram (W/kg). The SAR for the entire body is a widely accepted measure for establishing the link between thermal effects and exposure to RF. In addition to the SAR averaged over the entire body, localized SAR values are also necessary to assess and limit excessive energy accumulation in small areas of the body under special exposure conditions. Examples of such conditions include: a grounded person exposed to RF fields in the very low frequency range or individuals exposed to the near field of an antenna.

We believe that the inclusion of equipment that generates electromagnetic radiation (including radiative ones) within buildings significantly reduces the frequency of this radiation, so that the provisions of the Order of the Minister of Health no. 1193/29.09.2006 are complied with, both during the construction period and during operation, even in the immediate vicinity of sources that generate electromagnetic fields, as well as those of Government Decision no. 520/2016 regarding the minimum security and health requirements concerning workers' exposure to risks generated by electromagnetic fields.

*h) Material goods*

As part of the archaeological study, a series of recommendations were made for analyzing the impact on archaeological areas within the project's scope, as follows:

*Table no. 74 Archaeological Sites Discussed in the Study Regarding the Livezeni-Bumbești Hydropower Development*

| No. | Archaeological Objective in the Project Area | Location / Distance from the Project | Possible Impact of the Project on the Objective | Recommendations |
|---|---|---|---|---|
| BUMBEȘTI | | | | |
| 1. | The fort and civil settlement at Bumbești-Jiu – Train Station. RAN Code 79317.01, LMI Code GJ-I-s-A-09126 | The site is located about 2 km S of the town of Bumbești - Jiu and about 40 m SV of the train station on the left bank of the Jiu. This archaeological site is located more than 250 m from the foundation of an LEA pillar of the project. | The archaeological objective will not be affected by the project. | Not applicable. |
| 2. | The archaeological site from the Roman era at Bumbești Jiu – Vârtop. RAN Code 79317.02, LMI Code GJ-I-s-B-09127 | The site is located 800 m N of the stone-walled fortress of the "Gară" point and 1.8 km S of the town of Bumbești Jiu 1 km E of the river bed This archaeological site is located more than 250 m from the foundation of a LEA pole within the project. | The archaeological objective will not be affected by the project. | Not applicable. |
| 3. | The Monastery of the Holy Trinity at Bumbești Jiu - La Vișina. RAN Code 79317.03, LMI Code GJ-I-s-B-09128. | The monastery is located 1 km north of the city on the right bank of the Ji; approx. 200 m west of DN. 66 Târgu Jiu - Petroșani; north of the town of Bumbești Jiu at the entrance to the gorge of the Jiului and 50 m west of the Jiu river on its right bank. This archaeological site is located over 1.2 km from CHE Bumbești. | The archaeological objective will not be affected by the project. | Not applicable. |
| 4. | The Complex of Lainici Monastery at Bumbești-Jiu. RAN Code 79317.05, LMI Code GJ-II-m-B-09254. | Lainici Monastery is located in the northern part of the Bumbești - Jiu UAT territory in the gorge of the Jiu on the right bank of this river near the confluence of the Jiu and the Chițiu river about 9 km north of the Visina Monastery on the edge of the European road E79. This archaeological site is located over 3.5 km CHE Dumitra | The archaeological objective will not be affected by the project. | Not applicable. |

| No. | Archaeological Objective in the Project Area | Location / Distance from the Project | Possible Impact of the Project on the Objective | Recommendations |
|---|---|---|---|---|
| | 5. Main adduction Livezeni-Bumbești | General recommendation: In accordance with the legislation in force archaeological monitoring will be carried out from the beginning of the investment until the end. | | |

As can be seen in the table above the sensitivity of the works (rest to be carried out) on the archaeological elements can be seen in particular in two areas namely the Castrum and the civil settlement of Bumbești-Jiu - Gară. RAN code 79317.01 LMI code GJ-I-s-A-09126 and the Roman archaeological site of Bumbești Jiu - Vârtop - RAN code 79317.02 LMI code GJ-I-s-B-09127 located approximately 250 m from the foundation of a LEA pillar of the project.
In analyzing impacts to archaeological sites in the project area the following were considered:
- The distance of the work areas from the location of archaeological sites (more than 250 m for those with known location);
- The area on which the works will be carried out: no additional areas of land in the area of the archaeological sites will be occupied no excavations will be carried out in areas other than those already occupied by works;
- Sensitivity of these archaeological sites to works (remaining to be executed): sensitivity to noise and vibrations concreting or transportation of materials and machinery to the project areas (e.g.: sensitivity of degraded historic buildings to vibrations);

The impact generated during the works on elements of the archaeological heritage will be insignificant negative and mainly due to the sensitivity of the monument buildings to vibrations generated by the traffic of machinery and trucks during the works. It is worth mentioning that the impact will be limited reversible reduced in intensity and limited in time only during the works during the operation phase there will be no impact on archaeological elements.

*i)Landscape*

Visual perception of the landscape is subjective, which makes evaluating the impact on this environmental factor difficult. It is important to note that the landscape is a result of the interrelation of other environmental factors, so the impact generated on the factors of water, air, soil/subsoil, biodiversity, and the socio-economic and cultural environment will be reflected in the quality of the landscape, especially in protected areas.

During the execution of the works, especially for the completion of the Livezeni dam, Bumbești hydropower station, and Dumitra hydropower station, the landscape may be aesthetically affected by:

- The containers for storing waste generated by workers;
- The trucks involved in carrying out the works;
- The raising of the dam crest to the designed level;
- The dust generated by machinery and the suspended particles resulting from the transportation of raw materials necessary for the remaining works on site.

During the execution period of the works provided for in the project, waste will be collected in special containers and temporarily stored at the construction site facilities, and will later be recycled/disposed of by an authorized economic operator. There will also be areas for the temporary storage of construction materials at the construction site facilities.

An insignificant negative impact on the landscape may occur during the remaining works on the entire Livezeni-Bumbești hydropower project due to the temporary storage of waste and reusable materials on the temporary storage platform, as well as from the actual works on site.

The landscape was affected once the works began, and the failure to complete them, especially in the area of the Livezeni dam and Dumitra hydropower station, may generate an impact on the landscape in this area due to landslides, erosion, and runoff, all of which will be eliminated once the Livezeni dam is filled.

In summary, it can be assessed that the estimated impact during the execution of the works on the landscape is insignificantly negative, reducing to neutral (no impact) once the works are completed, the Livezeni dam is filled, and the platforms at Dumitra, Murga Mică, Livezeni, and Bratcu are restored.

## 5.DESCRIPTION OF THE SIGNIFICANT EFFECTS THAT THE INVESTMENT OBJECTIVE MAY HAVE ON THE ENVIRONMENT

### *5.1. Use of resources for the realization of the project (work remaining to be executed)*

This project falls within the context of the correct and rational use of available resources, addressing issues related to the increase and development of electricity production from renewable sources and the rational use of the available energy potential.

In addition to achieving the primary objective—electricity production—the implementation of the project will also pursue other objectives, such as:

- Land development for the placement of project facilities, including the construction of access and operational roads;
- Development of the infrastructure for transporting the produced electrical energy;
- Creation of new jobs during the implementation phase;
- Contribution to increasing the share of electricity produced from renewable energy sources;
- Ensuring ecological flows;
- The realization of the project involves the consumption of natural resources during both the construction phase and the operational phase. During construction, this includes the use of construction materials (wood, gravel, sand, stone, etc.). Water can also be specified as a natural resource used in concrete production.
- Given the nature of the proposed investment, it is estimated that there will be no negative effects on the environment concerning the use of natural resources.
- During the operational phase, water will be used as a natural resource for the operation of the hydropower facilities, while also ensuring the ecological flow for the Jiu River, which will support the viability of species and the proper functioning of riparian habitats.

- It is important to mention that the water used in operations is fully returned to the watercourse downstream of the Bumbești Hydropower Plant.
- The transport of aggregates from quarries and/or gravel pits to the project site will be carried out using specialized vehicles on national and/or local roads, as applicable. Front-end loaders will be used for transportation within the construction organization/work points.
- Material supply will be carried out gradually, in stages of construction, so that materials are implemented and long-term storage of raw materials is avoided.
- Additionally, the procurement of necessary natural resources will be done only from authorized companies located as close as possible to the project site.
- Regarding the source of supply for the material resources that will be used for the planned works, these will be purchased from authorized companies specialized in this regard, which will provide materials ready for implementation at the project site, considering its specifics.

*Table No. 75: Quantities of Works*

| Object | surfaces/volumes |
|---|---|
| **1. Livezeni Dam and Energy Intake Platform** | |
| 1.1. Construction of Technological | |
| Grading of the platform | V = 99 mc |
| Concrete pouring for the platform and fence post foundations | V = 69 mc |
| 1.2. Lake Basin Construction | |
| Removal of dry vegetation | S = 900 mp |
| Upstream riverbed leveling | V= 11.165 mc |
| 1.3. Closure of Diversion Channel with Fish Migration Assurance | |
| Construction of fish ladder | V = 640 mc |
| Breaking concrete and transporting to authorized landfill | V = 100 mc |
| Filling with local materials | V = 3.000 mc |
| 1.4. Downstream Regularization | |
| Removal of dry vegetation | S= 1.372 mp |
| Calibration excavations | V = 20.800 mc |
| **2. Dumitra Hydropower Plant** | |
| 2.1. External Works: Platforms, Fences, and Ditches | |
| Excavations | V = 25,1 mc |
| Concrete pouring, including fence foundations | V = 176,67 mc |
| Construction of the OS Dumitra platform | S=6400 mp |
| 2.2. Bridge over the Still Basin | |
| Concrete pouring | V = 3 mc |
| **3. Dumitra Intervention Block** | |
| Excavations | V = 1.029 mc |

| Object | surfaces/volumes |
|---|---|
| Filling with local materials | V= 1.351 mc |
| Concrete pouring | V = 460 mc |
| Macadam | V = 75 mc |
| **4. Dumitra Water Intake** | |
| Concrete pouring for the sand separator, including connection to the discharge channel | V= 1.512 mc |
| Filling with rockfill on the right bank of the intake | V = 50 mc |
| Concrete pouring for the diversion of Dumitra intake waters | V = 1,8 mc |
| Excavations for downstream regularization of Dumitra intake | V = 120 mc |
| **5. Access Roads to Dumitra Hydropower** | |
| 5.1. Access Road to the External Platform of Dumitra Hydropower Plant (L = 580 m) | |
| Earthworks | V = 5.414 mc |
| Rock excavation | V = 14.962 mc |
| Raw stone retaining walls | V = 2.590 mc |
| Foundation with crushed stone | V = 844 mc |
| 50 cm thick concrete surfacing | V = 568 mc |
| 5.2. Access Road over the Dumitra Water Intake Weir (L = 80 m) | |
| Excavations | V = 1.511 mc |
| Road superstructure (compacted ballast) | V = 51 mc |
| Retaining walls (concrete) | V = 63 mc |
| **6. Bumbești Pressure Node** | |
| 6.1. Concrete Pouring for the Bumbești Gate House Superstructure | |
| Filling with local materials | V = 159 mc |
| Concrete pouring | V = 269 mc |
| 6.2. Betonare masiv M1 conductă forțată Bumbești | |
| - betonare | V = 304 mc |
| **7. Bumbești Hydropower Plant** | |
| 7.1. External Works: Platforms, Fences, and Ditches | |
| Excavations | V = 217 mc |
| Filling with local materials | V = 173 mc |
| Concrete pouring | V = 273 mc |
| 7.2. Concrete Pouring for the Connection Between the Still Basin and the | |
| Excavations | V = 23 mc |

| Object | surfaces/volumes |
|---|---|
| Filling with local materials | V = 93 mc |
| Concrete pouring | V = 135 mc |
| 7.3. 110 kV Station | |
| Excavations | V = 614 mc |
| Filling with local materials | V = 114 mc |
| Concrete pouring | V = 319 mc |
| **8. Access Road to Bumbești Hydropower Plant (L = 1370 m)** | |
| 50 cm thick concrete surfacing | V = 3.345 mc |
| **9. Access Road over the M3 Mass of Bumbești Hydropower Plant (L** | |
| Excavations | V = 81 mc |
| Filling with local materials | V = 2310 mc |
| Concrete wall + foundations for deformable parapets | V = 305 mc |
| Surfacing with crushed stone + ballast + sand, 50 cm thick | V = 178,5 mc |
| **10. Bratcu Water Intake** | |
| Excavations | V = 30 mc |
| Filling with local materials | V = 6 mc |
| Concrete pouring | V = 2 mc |
| **11. Secondary Jiu Intake** | |
| 11.1. Concrete Pouring for the Infrastructure + Superstructure of Jiu Intake, Including Fish Ladder | |
| Excavations | V = 6.555 mc |
| Concrete pouring | V = 3.543 mc |
| Water diversion (restoration of stage I + stage II) | |
| Excavations | V = 1.327 mc |
| Filling with local materials | V = 3.007 mc |
| Concrete pouring | V = 388 mc |
| Decommissioning of C2 boxes + temporary bridge | V = 1.121 mc |
| 11.2 Jiu Intake Pipeline | |
| Excavations | V = 7.875 mc |
| Fillings | V = 12.250 mc |
| **12. Access Road to Jiu Intake (L = 400 m)** | |
| Superstructure with crushed stone + ballast | V = 2.720 mc |

| Object | surfaces/volumes |
|---|---|
| Rock protection for slopes | V = 6.912 mc |
| Concrete for road ditches, undercrossing road | V = 51 mc |
| **13. Site Organizations** | |
| 13.1. Decommissioning of Temporary Bridge Upstream of the Livezeni | |
| Decommissioning of gabions | V = 768 mc |
| Breaking concrete and transporting it to an authorized dump | V = 226 mc |
| 13.2. Decommissioning of Platform Upstream of the Livezeni Dam and Establishing Permanent Connection for Wastewater Pipeline | |
| Excavations and breaking concrete and transporting it to an authorized dump | V = 47 mc |
| 13.3. Development of Platform and Access Road to the Attack Window | |
| Stripping | V= 29 mc |
| Concrete pouring | V = 43 mc |
| Fillings with local materials | V = 53 mc |
| 13.4. Platform Development at the Attack Window Murga Mică | |
| Platform development: | |
| Ballasting the platform: | V = 75 mc |
| Perimeter concrete ditch: | V = 13 mc |
| Slope protection: shotcrete mesh | |
| Protective mesh | S = 657 mp |
| Protective shotcrete | V = 33 mc |
| Torrent development: undercrossing box + loading chamber + connection well | |
| Excavations (transported to the spoil heap) | V = 286 mc |
| Concrete pouring | V = 78 mc |
| 13.5. Decommissioning of Site Organization Established at the Bratcu | |
| Breaking concrete and transporting it to an authorized dump (Platform + concrete station) | V = 281 mc |
| **14. Connection to the National Energy System (SEN)** | |
| 14.1. Livezeni Hydro Power Plant (MHC Livezeni) | |
| Excavations for pillar foundations and LES trench | V =1.088 mc |
| Concrete for pillar foundations and culvert | V = 62 mc |
| Bentonite for the culvert | V = 13 mc |
| 14.2. Dumitra Hydroelectric Power Plant (CHE Dumitra) | |

| Object | surfaces/volumes |
|---|---|
| Excavations for pillar foundations, road, platform | V = 1.313 mc |
| Concrete for pillars, road, platform | V = 527 mc |
| 14.3. Bumbești Hydroelectric Power Plant (CHE Bumbești) | |
| Excavations | V = 754 mc |
| Concrete for foundations | V = 754 mc |
| **15. Dumitra - Bumbești Water Supply** | |
| - Development of the Valea Rea platform | S=3446 mp |
| - Concrete closure plug for Valea Rea | V = 840 mc |

The lands on which the remaining works will be carried out and that overlap with the forest fund have been removed from the forest fund and deforested according to the documents presented in the table below.

*Table no. 76: Areas Required for the Project Removed from the Forest Fund and Deforested*

| Approval Act | Area removed from the forest fund - ha | Forestry Office | U.P. | U.a. |
|---|---|---|---|---|
| Approval from MAPDR – Territorial Inspectorate for Forestry and Hunting, Timişoara, no. 154/17.01.2006. | 0,2880 | Petroşani | VI Petroşani | 70A% |
| Approval from MAPDR – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea, no. 2/24.05.2004. | 0,6270 | Bumbeşti | III Bratcu | 23%, 25%, 61%, 135%, 139% |
| Approval from MAPDR – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea, no. 3/24.05.2004. | 0,8189 | Bumbeşti | III Bratcu | 91A%, 97% |
| | | | IV Chitu | 49A%, 50% |
| Approval from MAPDR – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea, no. 5/24.05.2004 | 0,9188 | Bumbeşti | III Bratcu | 109A%, 122%, 123% |
| Approval from MAPDR – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea, no. 84/29.07.2004. | 0,2930 | Proprietate a Obştii Porceni-Pleşa | | 163A%, 163E% |
| Approval from MAPDR – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea, no. 244/04.02.2005. | 0,2939 | Bumbeşti | III Bratcu | 107%, 108% |
| Approval from MAPDR – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea, no. 243/04.02.2005 | 0,8028 | Bumbeşti | III Bratcu | 108% |
| Approval from MAPDR – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea, no. 280/08.04.2005. | 0,8400 | Bumbeşti | III Bratcu | 109A%, 122%, 123% |

| | | | | |
|---|---|---|---|---|
| MAPDR – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea Decision no. 46/22.08.2005. | 0,9721 | Bumbești | III Bratcu | 109A%, 122%, 123% |
| Territorial Inspectorate for Forestry and Hunting, Hunedoara Decision no. 237/19.05.2004. | 0,7739 | Petroșani | II Straja | 11D, 12C |
| Territorial Inspectorate for Forestry and Hunting, Hunedoara Decision no. 238/19.05.2004. | 0,1990 | Petroșani (proprietate a Mirci Traian) | II Straja | 12C |
| Decision of the Ministry of Environment and Forests (MMP) – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea, no. 336/03.11.2011. | 0,7618 | Ocolul Silvic Privat Valea Oltului | UP Obștea de Pădure Porceni - Pleșa | 164A%, 164B% |
| Decision of the Ministry of Environment and Forests (MMP) – Territorial Inspectorate for Forestry and Hunting, Râmnicu Vâlcea, no. 337/03.11.2011. | 0,9810 | Ocolul Silvic Privat Valea Oltului | UP Obștea de Pădure Porceni - Pleșa | 163A%, 163C%, 163E%, 164A%, 164B%, 164D%, 164E% |
| Decision of the Territorial Inspectorate for Forestry and Hunting Timișoara no. 1996/09.05.2006 for the definitive removal from the national forest fund of the land area of 0.0310 hectares owned by the Romanian state, for the realization of the objective "Widening and undercrossing of national road 66." | 0,0310 | Petroșani | II Straja | 12C |

| | | | | |
|---|---|---|---|---|
| **Total** | **8,6012** | - | - | - |

The execution of the proposed works also involves the use of materials that, due to their composition or potential effects on the health of employees, fall into the category of toxic and hazardous substances.
These substances and materials include:

- paints; primers (restoration of anti-corrosion protection);
- fuels/lubricants (for the operation of machinery/transport vehicles);
- oils (hydraulic; turbine; transformer) (for the operation of installed equipment).

The management of these substances will comply with current legislation and the instructions on the packaging of these products, as well as the safety data sheets that accompany the products.
Upon delivery, all these categories of substances will be accompanied by safety data sheets that specify the strict conditions to be imposed for their transport, handling, storage, and use.
The supplier of all these substances will provide proof of pre-registration/registration of the substances in accordance with the requirements of REACH 1907/2006 (Regulation on the Registration, Evaluation, Authorization, and Restriction of Chemicals), with subsequent amendments and completions.
All equipment/subassemblies to be installed must possess, where applicable: * Certificate of conformity and CE marking – for permanent contact with water.

For the completion of this investment, a series of raw materials and auxiliary materials, energy, and fuels will be used during both the operational phase and the project implementation phase. The following sections will present the raw and auxiliary materials utilized, their sources, and their management methods.

To complete this investment, a series of raw and auxiliary materials, energy and fuels will be used, both in the exploitation phase and in the implementation phase of the project. In the following, the raw and auxiliary materials used, their origin and their management will be presented.

## 1. Dumitra Drop

### 1.1. Livezeni Dam and Livezeni Hydropower Plant

The raw materials that will be used to complete the remaining works (as previously presented) at Livezeni Dam and Livezeni Hydropower Plant (which includes the following components: Livezeni Dam, Livezeni Reservoir, Livezeni Hydropower Plant, Livezeni Energy Intake, and the Settling Basin) are presented in the following table.

*Table no. 77: List of Raw Materials Used and Their Quantities – Livezeni Dam and Livezeni Hydropower Plant*

| No. | Raw material | Quantity | Unit of measure |
|---|---|---|---|
| 1. | cement | 37,50 | tons |
| 2. | sorted aggregates | 140 | mc |
| 3. | welded mesh | 40 | pieces |
| 4. | lumber/wood | 5 | mc |
| 5. | compressed oxygen | 60 | mc |
| 6. | acetylene | 20 | kg |
| 7. | car batteries | 10 | pieces |
| 8. | car tires | 20 | pieces |

*Table no. 78: List of Fuels and Lubricants Used and Their Quantities – Livezeni Dam and MHC Livezeni*

| No. | Raw material | Quantity | Unit of measure |
|---|---|---|---|
| 1. | Diesel | 2.300 | l/month |
| 2. | Gasoline | 200 | l/month |
| 3. | Lubricants | 60 | l/month |

### 1.2. Dumitra HPP

The raw materials that will be used for the completion of the remaining works (as previously presented) at Dumitra HPP (which includes the following components: the pressure node Dumitra consisting of: underground/surface balancing tower, valve house, metal forced pipe; Dumitra HPP, connection box with the main water supply, Dumitra, Bratcu, and Jiu intake, Murga Mică platform, access road to Jiu intake, intervention block) are presented in the following table.

*Table No. 79 List of Raw Materials Used and Quantities for CHE Dumitra*

| No. | Raw material | Quantity | Unit of measure |
|---|---|---|---|
| 1. | Cement | 41,25 | tons |
| 2. | Sorted aggregates | 160 | mc |
| 3. | Welded mesh | 20 | pieces |
| 4. | Timber/wood | 5 | mc |
| 5. | Compressed oxygen | 60 | mc |
| 6. | Car batteries | 10 | pieces |
| 7. | Car tires | 40 | pieces |

*Table No. 80 List of Fuels and Lubricants Used and Their Quantities for CHE Dumitra*

| No. | Raw material | Quantity | Unit of measure |
|---|---|---|---|
| 1. | Diesel | 2.500 | l/month |
| 2. | Gasoline | 200 | l/month |
| 3. | Lubricants | 30 | l/month |

**2. Bumbești Drop**

The raw materials that will be used for the completion of the remaining works (as previously presented) at the Bumbești drop (which includes the following investment objects: the main Dumitra-Bumbești aqueduct; the Bumbești pressure node consisting of: underground/surface balancing tower, valve house, metal forced pipe; CHE Bumbești; Bumbești spillway; exterior works for the technical block; exterior works for CHE Bumbești, transformer station) are presented in the following table.

*Table no. 81: List of Raw Materials Used and Their Quantities – Bumbești Drop*

| No. | Raw material | Quantity | Unit of measure |
|---|---|---|---|
| 1. | cement | 375 | tons |
| 2. | sorted aggregates | 1400 | mc |
| 3. | einforced steel | 150 | Tons |
| 4. | Welded mesh | 100 | pieces |
| 5. | Timber | 20 | mc |
| 6. | Compressed oxygen | 90 | mc |
| 7. | acetylene | 30 | kg |
| 8. | car batteries | 10 | pieces |
| 9. | car tires | 20 | pieces |

*Table no. 82 Listing the fuels and lubricants used and their respective quantities for the Bumbești step*

| No. | Raw material | Quantity | Unit of measure |
|---|---|---|---|
| 1. | Diesel | 2.500 | l/month |
| 2. | Gasoline | 200 | l/month |
| 3. | Lubricants | 50 | l/month |

*Table no. 83 Listing the raw materials used and their respective quantities for the SEN connection*

| No. | Raw material | Quantity | Unit of measure |
|---|---|---|---|
| 1. | cement | 882 | mc |
| 2. | metal poles | 187 | tons |
| 3. | electrical conductors | 20 | tons |
| 4. | electrodes | 1.000 | pieces |
| 5. | marking paint | 100 | kg |

### *5.2. Effects Generated by the Project Interventions*

#### *a) Description of Project Effects*

Based on the analyses presented earlier, it is evident that the effects generated by the project mainly focus on two environmental factors, namely water and biodiversity. For the other factors, it can be stated that the effects generated by the project are very low in intensity or almost non-existent.

For the two factors mentioned above, the effects have been divided into two categories: effects during the construction phase and effects during the operational phase.

During the construction phase, we can enumerate:

- Loss of individuals from species with limited mobility (amphibians, invertebrates) as well as the loss of characteristic habitats (some anthropogenic) of these species.
- Increase in noise levels in project implementation areas located in quiet zones with a low degree of anthropization nearby.
- Increased turbidity in the sections targeted for construction works in the Jiu River bed.
- Reduction of the natural flow of the Jiu River due to the abstraction of water for power generation.

- Impact on riparian vegetation in the riverbed area (Jiu intake, Pr. Dumitra area, Livezeni area), including channel regularizations.
- Possibility of the expansion of non-characteristic tree/shrub species in the types of habitats.

During the operational phase, the effects can include:

- Decrease in the natural flow (including changes in the composition and quality of the water) of the Jiu River between the Livezeni dam and the section for the return of the treated water in the CHE Bumbești.
- Longitudinal fragmentation of the Jiu River course into two sections.

Given the complexity of the project and the necessity for an objective analysis, the table below presents a summary of the effects generated by the project implementation, as well as the methods for quantifying these effects in relation to the project areas and sensitive habitats.

*Table No. 84 Summary of Effects Generated by the Implementation of the PP*

| Phase | Effects | Type of intervention | Method of quantification | Quantification of effects | The distance at which the effects are noticeable | ANPIC potentially affected |
|---|---|---|---|---|---|---|
| CONSTRUCTION | Loss of individuals of species with reduced mobility (amphibians, invertebrates), as well as the loss of characteristic habitats (some anthropogenic) of these species | Works on closing the diversion canal of the Livezeni dam ensuring fish passability<br>Concrete works for connecting the stilling basin with the Bumbești tailrace canal<br>Works on the Dumitra River | Estimation of the number of individuals and the areas of characteristic habitats | To quantify the effects field surveys and monitoring were conducted to evaluate the population of specimens belonging to species with limited mobility (e.g. *Bombina variegata*) and to estimate the habitat area occupied by these species within the project site. | Locally, only in the area where the works are being carried out | ROSCI0063 Jiului Gorge (including the neighboring area - adjacent) |
| | Increased noise levels in project implementation areas located in quiet zones, with a low degree of anthropization in the vicinity | Lucrări de excavații și umpluturi cu anrocamente pentru protecția închiderii în versantul drept Captarea Bratcu<br>Lucări în zona CHE Dumitra | Calculation and noise dispersion modeling | To evaluate the noise levels produced by the implementation of the project a worst-case scenario was analyzed specifically the operation of all equipment and machinery utilized in construction activities within a confined working area pertaining to the Bratcu catchment. | Considering the presence of forest land adjacent to the project site which possesses the capability to attenuate noise levels it has been determined that at a distance of 100 meters from the work area the noise will be mitigated to acceptable levels (below 50 dB). | ROSCI0063 Jiului Gorge |
| | Increase in turbidity levels in the sections targeted by the construction works in the Jiu Riverbed | Riverbed regulation works on the Jiu River downstream of the Livezeni dam | Information on the project characteristics | The activity will take place in the short term. By adhering to a work schedule, the effects will occur intermittently | Variable distance depending on the existing water flow rates | ROSCI0063 Jiului Gorge |

| Phase | Effects | Type of intervention | Method of quantification | Quantification of effects | The distance at which the effects are noticeable | ANPIC potentially affected |
|---|---|---|---|---|---|---|
| | Reduction of the natural flow of the Jiu River due to water intake for processing Impact on riparian vegetation in the riverbed area (Jiu intake, Pr. Dumitra area, Livezeni area), including riverbed regulation | | | and with reduced intensity. | | |
| | | Construction of the secondary intake on the Jiu River and the regulation of a downstream section of the river for better flood flow management, as well as ensuring a level to allow the flushing of the desander. | Information on the project characteristics | The activity will take place in the short term. By adhering to a work schedule, the effects will occur intermittently and with reduced intensity. | Variable distance depending on the existing water flow rates | |
| | | Connection of the Dumitra intake weir to the concrete canal area, which requires downstream regulation works through excavation. | Information on the project characteristics | The activity will take place in the short term. By adhering to a work schedule, the effects will occur intermittently and with reduced intensity. | Variable distance depending on the existing water flow rates | |
| | The potential expansion of tree/shrub species that are uncharacteristic of the habitat types. | Works in the Jiu intake area (including access road) | The degree of expansion of uncharacteristic species | At the project's site boundary, habitat 91E0 was identified, and in the area where work has already been done (for example, on the road between the Dumitra Hydroelectric Power Plant and the Jiu intake), specimens of *Salix caprea*, *Populus tremula*, *Betula* | Considering the degree of closure of habitat 91E0 in the project area, as well as the potential for dispersion of these species, and the fact that the works are carried out fairly isolated and in a pinpoint manner, uncharacteristic/alien species may expand up to | ROSCI0063 Jiului Gorge |

| Phase | Effects | Type of intervention | Method of quantification | Quantification of effects | The distance at which the effects are noticeable | ANPIC potentially affected |
|---|---|---|---|---|---|---|
| | | | | *pendula*, *Robinia pseudacacia*, etc. (uncharacteristic species of the habitat type) were observed. There is a possibility that, following their cutting (as these do not belong to the forest fund but have spontaneously established in the work area), their shoots/root suckers may reach the habitat areas | 50 m into the interior of the habitat. | |
| OPERATION | Reduction of the natural flow (including changes in the composition and quality of the water) of the Jiu River between the Livezeni dam and the section for the return of processed water at the Bumbești Hydroelectric Power Plant. | Operation of the intake at Livezeni and the secondary intake on the Jiu near the Dumitra Hydroelectric Power Plant. | Calculations established by authorities regarding the assurance of ecological flow. | Reduction of the natural flow of the Jiu River in the section between the Livezeni dam and the return section of the processed water at the Bumbești Hydroelectric Power Plant. | The section between the Livezeni dam and the return section of the processed water at the Bumbești Hydroelectric Power Plant. | ROSCI0063 Jiului Gorge |
| | Longitudinal fragmentation of the Jiu River into two sections. | Operation of the intake at Livezeni and the secondary intake on the Jiu near the Dumitra Hydroelectric Power Plant. Works in the confluence area of | scientific data | The implementation of fish ladders designed without considering the necessary parameters to ensure passability for local fish species (such as weir height, water current velocity, etc.) leads to the fragmentation of fish | The section between the Livezeni dam and the return section of the processed water at the Bumbești Hydroelectric Power Plant.. | ROSCI0063 Jiului Gorge<br><br>Note: The Natura 2000 site ROSCI0217 Retezat, located about 33 km upstream on the Jiul de Vest River, |

| Phase | Effects | Type of intervention | Method of quantification | Quantification of effects | The distance at which the effects are noticeable | ANPIC potentially affected |
|---|---|---|---|---|---|---|
| | | the Dumitra Stream with the Jiu River. | | populations in the project's area of influence. | | cannot be affected by the possible longitudinal fragmentation at the Livezeni dam. In addition to the large distance, the river flows through a series of localities (Vulcani, Lupeni, etc.) where there are numerous barriers that interrupt the longitudinal connectivity of the river. |

***b) Emissions***

The main sources of pollution in the project area are atmospheric emissions resulting from:

- Excavation, digging, and land preparation activities.
- Activities related to the movement of materials used in the construction site organization.
- Transportation activities.

Emissions from non-road mobile sources.

<u>Execution phase</u>

In the execution phase, non-road mobile sources will be represented by the machinery and equipment involved in construction works (bulldozer; excavator; crane; compactor roller; front loader). The emissions generated from the operation of these sources have been estimated using the EMEP/EEA calculation methodology – 1.A.4 Non-road mobile machinery, Tier 1, which considers the type and fuel consumption used, as well as the corresponding emission factors for specific pollutants.

<u>Functioning phase</u>

In this phase, non-road mobile sources will be represented by electric generators. It should be noted that these sources will operate occasionally, only in the event of failures in the electrical supply network. The estimation of pollutant emissions generated by these sources has been carried out using the EMEP/EEA calculation methodology – 1.A.4 Non-road mobile machinery, Tier 1, which considers the type and fuel consumption used, as well as the corresponding emission factors for specific pollutants.

The results of the emission calculations are presented in the following table.

*Table No. 85 Emissions from non-road mobile sources during the execution phase*

| **Source name** | **Pollutant** | **Mass flow** | | | **Emission concentration (mg/m³)*** |
|---|---|---|---|---|---|
| | | **kg/h** | **g/h** | **g/s** | |
| Mobile crane | Powders | 0,015 | 14,09 | 0,004 | 132,19 |
| | $SO_2$ | 0,002 | 1,66 | 0,0005 | 15,7 |
| | $NO_x$ | 0,22 | 217,18 | 0,06 | 2048,9 |
| | CO | 0,07 | 71,71 | 0,02 | 676,5 |
| Excavator/ front loader | Powders | 0,02 | 24,51 | 0,01 | 132,5 |
| | $SO_2$ | 0,003 | 2,91 | 0,001 | 15,7 |
| | $NO_x$ | 0,38 | 380,06 | 0,11 | 2054,4 |
| | CO | 0,13 | 125,50 | 0,03 | 678,4 |
| Bulldozer | Powders | 0,02 | 21,01 | 0,01 | 133,0 |
| | $SO_2$ | 0,002 | 2,50 | 0,001 | 15,8 |
| | $NO_x$ | 0,33 | 325,77 | 0,09 | 2061,8 |

| | | | | | |
|---|---|---|---|---|---|
| | CO | 0,11 | 107,57 | 0,03 | 680,8 |
| Compactor | Powders | 0,01 | 14,00 | 0,004 | 132,1 |
| | $SO_2$ | 0,002 | 1,66 | 0,0005 | 15,7 |
| | $NO_x$ | 0,22 | 217,18 | 0,06 | 2048,9 |
| | CO | 0,07 | 71,71 | 0,02 | 676,5 |

* Due to being below the limit value in Order No. 462/1993 - Annex 1 of the estimated mass flows for the calculated pollutants, the maximum allowable concentrations of pollutants from the aforementioned order do not apply to the analyzed sources.

*<u>Emissions from uncontrolled stationary sources</u>*

*Execution phase*

Stationary uncontrolled sources of air pollution during the execution phase of the proposed works for the realization of the objective are represented by activities involving the handling of earth masses (clearing, excavation, filling, leveling, loading – unloading, transportation) for site preparation. These operations will primarily serve as sources of dust emissions into the atmosphere.

An additional source of dust is represented by wind erosion, a phenomenon that accompanies construction activities. This phenomenon occurs due to the existence, for a certain period of time, of uncovered land surfaces exposed to wind action. However, the phenomenon of wind erosion can be controlled through appropriate measures to reduce the spatial and temporal extent of uncovered areas lacking vegetation.

The dust generated from material handling and wind erosion is mainly of natural origin (soil particles, mineral dust).

Operations involving cutting and welding of metal elements that will make up the structures will generate emissions of fine particles that mainly contain metallic oxides (iron oxide, manganese oxide, nickel oxide, etc.), carbon monoxide resulting from the decomposition of carbon dioxide in the atmosphere in the electric arc zone, nitrogen dioxide resulting from the oxidation of atmospheric nitrogen due to the high temperatures in the electric arc zone, and ozone. However, these sources will not generate significant amounts of pollutants in the atmosphere and have not been included in the calculation of atmospheric emissions.

Emission concentrations cannot be associated with sources characteristic of the activities during the execution phase of the works, as they are open, uncontrolled sources. For the same reason, they cannot be evaluated against the provisions of Order No. 462/1993 or other regulations related to emissions.

*Operation stage*

During the operation stage, there will be no sources of undirected stationary emissions.

*Emissions from mobile sources*
*Execution phase*
During the execution phase of the works, mobile sources will be represented by heavy vehicles that will transport construction materials and by vehicles of employees involved in the construction activities. All these sources will not operate simultaneously on site, and the actual operating time will be short, sufficient for movement within the construction site and for parking in designated areas.
The estimation of pollutant emissions generated by mobile sources was carried out using the EMEP/EEA calculation methodology – 1.A.3.b.i-iv Road transport 2016, Tier 1, which considers the type of vehicle, type of fuel, fuel consumption, and the corresponding emission factors for specific pollutants In this regard, we considered an average number of 10 heavy vehicles per day operating on diesel, 10 light vehicles per day operating on diesel, and 5 light vehicles per day operating on gasoline.

*Functioning phase*
During the operation phase of the objective, mobile sources will be represented by employees' vehicles, specifically an estimated 5 vehicles per day.

It should be noted that the emission sources represented by employees' vehicles will not operate simultaneously on site, with the busiest period of the day occurring at the start of work shifts. Furthermore, the operating time of a vehicle on site will be short, just enough for movement to the parking area and for carrying out parking maneuvers.

*Table No. 86 Emissions from mobile sources*

| Tipuri de surse mobile | Tip combustibil | Poluanţi | Emisii (g/h) | Emisii în perioada de execuţie (g/h) | Emisii în perioada de funcţionare (g/h) |
|---|---|---|---|---|---|
| Employees' vehicles | Diesel Fuel | CO | 4,23 | 33,28 | 339,60 |
| | | $NO_x$ | 16,68 | 129,57 | 1320,79 |
| | | Powders | 1,47 | 11,04 | 112,55 |
| | | $SO_2$ | 0,04 | 0,20 | 1,67 |
| Employees' vehicles | Benzine | CO | 105,68 | 210,48 | 2146,89 |
| | | $NO_x$ | 11,10 | 21,99 | 221,83 |
| | | Powders | 0,04 | 0,09 | 0,84 |
| | | $SO_2$ | 0,15 | 0,27 | 2,10 |

Order no. 462/1993 does not establish limits for mobile sources. The order indicates that pollutant emissions from road vehicles are limited preventively through the technical conditions set forth in periodic technical inspections conducted throughout the entire duration of use of road vehicles registered in the country. The preventive limitation of emissions from vehicles is achieved through the technical conditions imposed during their type approval for registration and throughout their entire period of use through mandatory periodic technical inspections.

As can be seen from the details presented earlier regarding the emissions generated during the implementation phase of the project, it is estimated that the impact generated will be **insignificant.**

### *c) Greenhouse Gases*

Greenhouse gas emissions from Romania's energy sector are on a downward trend as the share of electricity generated from fossil fuels decreases and the share from renewable sources increases. Hydropower is a renewable energy source with low carbon emissions and a reliable, cost-effective alternative to electricity generation from fossil fuels.

The use of hydropower instead of fossil fuels for electricity generation has helped avoid over 100 billion tons of carbon dioxide in the last 50 years alone. All energy sources, even renewables, produce carbon emissions over their life cycle due to emissions generated during their manufacturing, construction, or operation. Hydropower assets have a very long lifespan, meaning that the emissions associated with their construction can be amortized over a much longer period compared to technologies with shorter lifespans.

The secondary effects related to greenhouse gas emissions occur during construction, installation, and decommissioning or cessation of the project.

These effects are identified by considering whether the project activity will require any practices, processes, consumption, or production of energy or materials during its establishment and termination that will lead to a change in greenhouse gas emissions unrelated to the primary effect.

For some types of projects, significant effects may arise during construction through equipment transport. During the decommissioning phase, the effects to consider may be associated with waste disposal offsite and the dismantling of equipment.

Effects may also occur for certain land-use projects. For example, reforestation and afforestation projects often require clearing vegetation to prepare the land for planting. This results in greenhouse gas emissions from the machinery used for land clearing, as well as from the release of carbon stored in the cleared vegetation and soil.

Reducing greenhouse gas emissions or increasing greenhouse gas sequestration is essential for mitigating climate change. According to the “Commission Communication - Technical Guidelines on Integrating Climate Dimension at Infrastructure Level for the Period 2021-2027,” climate neutrality aims at the following steps

***Project Analysis***

- Description of greenhouse gas emissions and comparison with thresholds for absolute and relative emissions;
- Description of the project's alignment with relevant EU and national energy and climate plans, with the EU's goal of reducing emissions by 2030 and achieving climate neutrality by 2050;
- Provision of other relevant information, such as regarding the reference scenario for the carbon footprint, as follows:

*Table no. 87: Thresholds for the EIB Methodology on Carbon Footprint*

| |
|---|
| Absolute emissions greater than 20,000 tons of $CO_2e$/year (positive or negative) |
| Relative emissions greater than 20,000 tons of $CO_2e$/year (positive or negative) |

Greenhouse gases included in the EIB Carbon Footprint Methodology consist of the seven gases listed in the Kyoto Protocol to the United Nations Framework Convention on Climate Change, namely: carbon dioxide ($CO_2$); methane ($CH_4$); nitrous oxide ($N_2O$); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulfur hexafluoride ($SF_6$); and nitrogen trifluoride ($NF_3$). The process of quantifying greenhouse gas emissions converts all emissions into tons of carbon dioxide referred to as $CO_2e$ (equivalent) using global warming potential (GWP).

Infrastructure projects with absolute and/or relative emissions exceeding 20,000 tons of $CO_2e$/year (positive or negative) must be subject to both examination and a detailed analysis of the climate change resilience process for climate change mitigation (Figure no. 216).

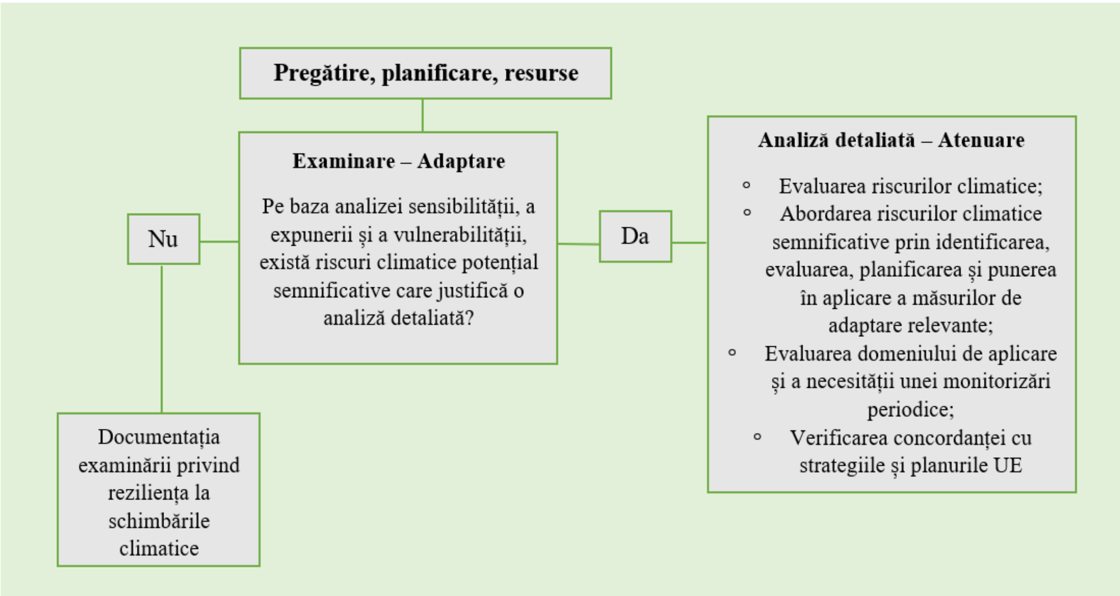


Fig. 217 - Overview of the climate change adaptation process for climate change resilience.

If, for the AHE Bumbești-Livezeni project, the fictitious cost of carbon exceeds the threshold level of emissions of over 20,000 tons of CO2/year, GHG emissions will be monetized.

***d) Waste***

The Directive 2014/955/EU on the establishment of a waste list establishes the obligation for economic operators and any other waste generators, whether natural or legal persons, to keep records of waste management.

For the execution period, we present the following list of potentially generated waste:

20 03 01 Mixed municipal waste
15 01 01 Paper and cardboard packaging
15 01 02 Plastic packaging
15 01 03 Wooden packaging
15 01 10* Packaging containing residues of hazardous substances or contaminated with hazardous substances
15 02 02* Absorbents, filtering materials (including oil filters without further specification), polishing materials, and protective clothing contaminated with hazardous substances
13 02 07* Biodegradable motor, transmission, and lubrication oil
17 01 01 Concrete
17 02 01 Wood
17 02 03 Plastic materials
17 04 07 Mixed metals
17 04 11 Cables, other than those specified in 17 04 10*
17 05 04 Soil and stones, other than those specified in 17 05 03*
17 06 04 Insulating materials, other than those specified in 17 06 01 and 17 06 03

*Storage, Transport, and Valorization/Disposal of the Waste Mentioned Above:*

Ferrous and non-ferrous metal waste will be collected and temporarily stored at the construction site on an impermeable and covered surface. This waste will be valorized through authorized economic operators.
Construction waste (concrete debris) will be temporarily stored on-site in specially designated areas for each work point and will be used as fill material in foundation pits.
Inert waste (excess soil) from digging/drilling foundation pits will be transported and deposited by the contractor on areas designated by the local municipalities where the waste is generated. No waste will be deposited within the ROSCI0063 Defileul Jiului site or its proximity, keeping a distance of 500 meters from the site's boundary.
Cable, conductor, and insulator remnants will be collected within the construction site and handed over to an authorized economic operator.
Packaging waste will include:

- Reusable packaging returned to the supplier (wooden slat pallets (15 01 03) from pole component packaging; wooden drums (15 01 03) from conductors; wooden crates (15 01 03) from fitting packaging) and recyclable packaging waste such as:

- Cardboard waste (15 01 01) from insulator chain, clamps, and grounding connector packaging;
- Plastic bottles (PET) (15 01 02).
- Reusable packaging (pallets, wooden drums, and crates) will be temporarily stored at the construction site and then returned to the economic operator from which they were purchased.

Cardboard and plastic bottle waste (PET) will be separately collected and handed over to an authorized economic operator.

*Household Waste Management* will be generated by the personnel involved in carrying out the works.

This waste will be collected in polyethylene bags and transferred daily to eurocontainer or europubela bins, placed on an impermeable surface within the construction site's organization, preventing leakage into the soil. The waste will be handed over to an authorized economic operator.

Temporary Waste Storage Procedures: Specific operational procedures will be followed, based on existing guides, for the temporary storage of various waste types. These procedures cover:

- Waste transport;
- Waste reception;
- Waste handling;
- Waste delivery.

Special areas will be set up for the temporary storage of waste, categorized accordingly and respecting the provisions of specialized guides. Waste management will be conducted through practical and planning activities for the short (current), medium, and long term. Temporary storage will take place within the construction site, and no waste will be deposited on undeveloped land within the ROSCI0063 Jiului Gorge area.

If hazardous waste results during or after the works, it will be removed from the site by an authorized company.

**Waste Management During the Operational Phase**

The following waste types may be generated during the operational phase of the project:

- 20 03 01: Mixed municipal waste
- 13 02 05*: Non-chlorinated mineral motor, transmission, and lubrication oils
- 13 01 10*: Non-chlorinated mineral hydraulic oils
- 20 01 21*: Fluorescent tubes and other mercury-containing waste
- 16 06 05: Other batteries and accumulators
- 13 03 07*: Non-chlorinated mineral insulating and heat transfer oils
- 17 04 07: Metal waste from maintenance activities
- 17 04 11: Cables other than those specified under 17 04 10*

Waste from group 20: Originating from upstream river flows

These wastes will be generated in insignificant quantities and sporadically. All waste generated will be handed over to authorized economic operators for recycling or disposal.

Waste from group 20, brought down during flood situations, will be collected by a cleaning machine installed on the dam near the energy intake. This waste will be removed from the site and handed over to an authorized operator for further processing or disposal.

**Waste Management Plan**

During the construction phase, waste management is the responsibility of the contractor. Waste will be collected in special containers within designated areas and handed over to authorized operators for recycling or final disposal.

During the operational phase, waste management is the responsibility of the investment beneficiary. Waste will also be collected in special containers in designated areas and handed over to authorized operators for recycling or disposal.

The project will generate hazardous, non-hazardous, and inert waste that must be processed and disposed of according to O.U.G. no. 92/2021 on waste management, with subsequent modifications and amendments.

**Waste Management Monitoring**: Monitoring will be conducted in accordance with H.G. no. 856/2002 on waste management records and approval of the list of waste, including hazardous waste. Reporting will be made to the competent environmental protection authority.

***e) Noise and Vibration***

During the construction phase, noise sources will have a temporary nature, generating local and time-limited effects. Physical pollution associated with the project at this stage will be due to the noise and vibrations generated by construction activities (vehicle and machinery engines, material handling, operation of earthmoving equipment used for land preparation, etc.).

The noise level regulated by STAS 10009/2017 "Urban Acoustics, Permissible Noise Levels" is 65 dB(A) at the boundary of the site. According to Order of the Ministry of Health No. 119/2014 for the approval of hygiene and public health norms regarding the population's living environment, the equivalent continuous weighted acoustic pressure level (AeqT), measured outside the dwelling in accordance with SR ISO 1996/2-08 at 1.5 m above the ground, must not exceed 55 dB and noise curve Cz 50. During the night (23:00 – 7:00), the equivalent continuous noise level must not exceed 45 dB and noise curve Cz 40.

To assess the level of impact generated by the proposed project, a noise source modeling was carried out using the Sound Plan Essential 2.0 software application. A highly probable scenario was considered, in which multiple noise sources operate simultaneously during the construction phase, with the following noise levels taken into account:
The noise sources during the construction phase include:

- 1 backhoe loader: 110 dB(A);
- 1 truck: 105 dB(A);
- 1 compactor: 100 dB(A);
- 1 crane: 104 dB(A).

These noise sources will be temporary and will result from:

- Construction operations such as loading/unloading materials and equipment;
- Operation of machinery and vehicles involved in construction/assembly work;
- Traffic of vehicles required for the execution of the works.

Normally, construction work will take place during the day between 08:00 and 18:00. However, certain operations, such as concrete pouring for foundations, may require continuous work, including during the night.

The results of the modeling using the SoundPLAN software show that during the construction phase, the noise levels generated by the project will not have a significant impact on the living conditions in the nearby villages. For the closest receptors, the operation of the equipment used in the modeling will generate a maximum noise level of approximately 48 dB. The noise from construction activities will not significantly alter the current noise level, which is primarily influenced by local traffic.

Within protected natural areas, the noise from construction activities could increase the equivalent noise level to 100 dB(A) at a distance of up to 50 meters. This could disturb the activity of certain species (especially birds) during the construction phase. However, given the forested area surrounding the site, this noise increase will be significantly reduced in the immediate vicinity of the project.

Additionally, considering the location of the construction work in relation to inhabited areas (such as the town of Bumbești-Jiu), the noise levels will comply with the limits set by Order No. 119/2014.

Given that the analyzed project's construction works will have a limited contribution to the noise levels in residential areas, special noise reduction measures will not be necessary for the nearby localities.

### *5.3. Cumulative Impact*

To assess the cumulative impact of the project with other projects in the area, information was requested from the relevant authorities, and publicly available data were consulted.

From the responses received, no other projects were identified that would generate a cumulative impact or overlap with the remaining construction activities of the Livezeni-Bumbești Hydropower Development project. Therefore, potential nearby projects, such as modernizations or rehabilitations, were considered.

Additionally, the construction activities could have a cumulative impact when combined with the existing traffic on access roads, national road DN66, and communal roads in the Bumbești-Jiu area.

Given the nature of the project and the traffic levels on the mentioned roads, the cumulative impact is expected to be low to moderate and will not require additional measures beyond those already established for protecting air quality in the environmental documentation prepared for this project.

In the unlikely event that the execution of this project overlaps with other ongoing projects, the cumulative impact is anticipated to be moderate and will be managed through operational measures for executing the works.

*Table No. 88: Characteristics of Other Projects/Plans (PPs) in Implementation, Approved, or Under Evaluation That May Have a Cumulative Impact with the Evaluated PP on the Protected Areas of Community Interest (PACI)*

| No. | Name PP | Lcation towards ANPIC | Effects generate | Impacts |
|---|---|---|---|---|
| 1. | Any existing or future project/activity located upstream that contributes to the continuous or discontinuous extraction of water volumes from the beds of the Jiul de Vest and Jiul de Est rivers. | In the vicinity of the community importance site ROSCI0063 Jiului Gorge, upstream of the Livezeni dam. | Reducerea debitului natural al râului Jiu | In periods of drought, the extraction of additional flows from the Jiul de Vest and Jiul de Est rivers (for irrigation or other uses) can lead to a significant reduction in the flow of the Jiu River in the project's area of influence, with potential negative effects on the ichthyofauna habitat. From this perspective, to reduce the impact on fish fauna, it is necessary to ensure the continuous provision of the ecological flow established by the competent authorities. |
| 2. | Rehabilitation works on the railway in the area of influence of the analyzed project. | Within the community importance site ROSCI0063 Jiului Gorge. | Increase in noise levels that may lead to a heightened disturbance of certain species of community interest (large carnivores primarily, their prey species, etc.). | Potential slight spatial withdrawal of certain species of community interest (primarily large carnivores and their prey species, etc.) due to the fact that pressure will manifest in heavily anthropized areas. |
| 3. | Rehabilitation works on the roadway of road E79 (DN66) and related works. | Within the community importance site ROSCI0063 Jiului Gorge. | Increase in noise levels that may lead to a heightened disturbance of certain species of community interest (large carnivores primarily, their prey species, etc.). | Potential slight spatial withdrawal of certain species of community interest (primarily large carnivores and their prey species, etc.) due to the fact that pressure will manifest in heavily anthropized areas. |

In the Jiu hydrographic basin, there are several intakes, lakes, or micro-hydropower plants, the locations of which are presented in the table below.

*Table no. 89 Objectives in the Jiu hydrographic basin (according to S.H.I. Petroșani address no. 2578/CS/07.08.2024)*

| No. | Name of catchment/watercourse used | Catchment type | Qzi max |
|---|---|---|---|
| 1 | Mining Lonea/Voievodu stream<br>left tributary of the Eastern Jiu river | Waterside | Qzi max<br>1385, 19 mc/day |
| 2 | SC Hidro Clear SRL/Taia stream, right tributary of the Eastern Jiu river | Intake with reinforced concrete profile<br>Summer and winter intake | Qmax cap<br>1,324 mc/s |
| 3 | SC Hidro Clear SRL/Aușelu stream, right tributary of the Taia stream | Intake with reinforced concrete profile<br>Summer and winter intake | Qmax cap<br>2,102 mc/s |
| 4 | Apa Serv Valea Jiului/Taia stream, right tributary of the Eastern Jiu river | Spillway dam, side intake<br>with two openings | Q proiectat<br>300 l/s |
| 5 | Apa Serv Valea Jiului/Jieț stream, left tributary of the Eastern Jiu river | Spillway dam | Q proiectat<br>150 l/s |
| 6 | SC Groapa Seacă SRL/2 unregistered watercourses<br>right tributaries of the Jieț stream | Two intakes with concrete sill | Qzi max<br>49,48mc/day<br>Qzi max<br>15,55 mc/day |
| 7 | SC General Trans SA Cabana Mija energy producțion/Mija stream, left tributary of the Jieț stream | Water intake with concrete dam | Qzi max<br>6000 mc/day |
| 8 | SC General Trans SA Cabana Mija/Mija stream left tributary of the Jieț stream | 5 pre-drilled pipes | Qzi max<br>8, 2 mc/day |
| 9 | Mining Livezeni/Maleia stream left tributary of the Eastern Jiu river | Bottom sill, shore intake | Qzi max<br>168,58 mc/day |
| 10 | Local Council of Petroșani City - Parâng Snow cannons/<br>Maleia stream, left tributary of the Eastern Jiu river | Perforated tube with Dn=300mm | Qzi max<br>330,31 mc/day |
| 11 | Asociația Ecologică Rusu/Gruniu stream, unregistered, tributary of the Eastern Jiu river | Sorb with filter placed in the bed of<br>Gruniu stream | Qzi max<br>85,01 mc/day |
| 12 | Apa Serv Valea Jiului/Polatiște stream, left tributary of the Eastern Jiu river | Concrete dam/streambed intake | Q proiectat<br>300 l/s |
| 13 | SC MN trading RO SRL/Negaru stream, right tributary of the Eastern Jiu river | Catchment chamber with two compartments | Qzi max<br>9,97 mc/day |

| No. | Name of catchment/watercourse used | Catchment type | Qzi max |
|---|---|---|---|
| 14 | Mining Vulcan/Crevedia stream, left tributary of the western Jiu river | Intake provided with iron grill | Qzi max 2606,22 mc/day |
| 15 | Mining Lupeni/Sohodol stream, right tributary of the western Jiu river | Lateral streambed intake, left bank and discharge dam | Qzi max 128,32 mc/day |
| 16 | SC Termoplast SRL Vila Straja/Sohodol stream afl. de dreapta al râului Jiul de Vest | Concrete catchment chamber | Qzi max 3,01 mc/day |
| 17 | Apa Serv Valea Jiului/ pr. Braia, right tributary of the western Jiu river | Reinforced concrete dam with side spillway, summer and winter intake | Q proiectat 120 l/s |
| 18 | SC Energetic Valea Jiului SA-SE Paroşeni/ western Jiu river | Weir type weight dam, water intake with free level | Qzi max 601,320 mc/day |
| 19 | SC Energetic Valea Jiului SA-SE Paroşeni/ Baleia stream | streambed intake | Qzi max 6 mc/zi |
| 20 | Apa Serv Valea Jiului/Lazăr stream, left tributary of the western Jiu river | Reinforced concrete dam with Central spillway, summer and winter intake | Q proiectat 700 l/s |
| 21 | A.B.A Jiu- SHI Petroşani/Valea de Peşti Reservoir, on the Valea de Peşti stream (right tributary of the western Jiu river) | Rockfill dam with concrete face | Volum 4,2 mil. mc |
| 22 | SC Hidroelectrica SA Suc. Hidrocentrale Haţeg/Valea de Peşti Reservoir | Rockfill dam | Qinstatat 0,74 mc/s |
| 23 | SC Hidroelectrica SA Suc. Hidrocentrale Haţeg/Buta stream, left tributary of the western Jiu river | Transverse bottom sill on the bed of the stream, overflow spillway | Qinstalat 0,9 mc/s |

**a) Assessment of the cumulative impact of the proposed project with authorized/in the process of authorization/approved/in the process of approval/planned projects on the identified water bodies (SEICA reference)**

According to Annex 3 of Order No. 828/2019, the analysis of the cumulative impact of the proposed project with authorized/in the process of authorization/approved/in the process of approval/planned projects is conducted only for water bodies for which cause-effect mechanisms have been identified within type 2a tables, specifically for the quality elements potentially affected (those for which the response was "Yes" or "Uncertain" in the type 2a table).

Considering the types of pressures/works mentioned in Chapter C.7 of this study, as well as the justifications related to the type 2a tables, it was not necessary to complete type 4a tables for any of the water bodies potentially affected by the project.

**b) Assessment of the cumulative impact of the proposed project with authorized/in the process of authorization/approved/in the process of approval/planned projects on biodiversity**

The cumulative impact analysis was conducted from two perspectives: firstly, from the viewpoint of works already completed within the project, and secondly, from the perspective of projects/activities in the implementation area of the works.

It should be noted that the works related to the Livezeni-Bumbeşti hydropower development were approved in 2004, so in the analysis of the cumulative impact on community interest protected natural areas, we will refer to the works carried out on the surface of these areas starting from the year of their designation.

For the project implementation, deforestation was carried out (according to Table 76), prior to the assessment of the conservation status in the management plan project. Thus, the rocky area where the Dumitra MHC (Micro Hydropower Plant) constructions were installed affects, according to our assessments, 800 sq m of habitat 8220 and 91L0 out of the approximately 2100 sq m initially estimated in the rocky area, and about 750 sq m of habitat 9180* out of the approximately 2300 sq m estimated to exist initially on its eastern flank. The affected areas are very small at the level of the left slope of the Dumitra valley (about 5% of habitat 8220, 1% of habitat 91L0, and 3% of habitat 9180* existing on the slope), and at the level of Defileul Jiului National Park, this proportion is negligible, below 1%.

Regarding the other elements that could have generated impact on the elements of conservation interest at the time of the works (namely: increased noise levels, waste generation, dust pollution), it was found that their effect was, most likely, only during the period of the works. Thus, at present, no phenomena of tree stand drying (generated by dust emissions) have been observed, and several species of community interest have been observed in the site area, so it can be stated that the impact of the works was localized and short-term.

*Table no. 90 Impacts identification and quantification*

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact | Quantifying impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Potential impact | Motivating the estimated impact | |
| CONSTRUCTION | The possibility of the expansion of tree/shrub species that are not characteristic of the habitat types | Habitat degradation due to the increase in the proportion of non-characteristic species | Habitat degradation for some species dependent on riparian habitats | - | Habitat degradation as a result of possible works on National Road 66 | Short-term impact during the construction period | *91E0* Păduri aluviale cu Alnus glutinosa și Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)* | Presence of invasive/alien species | insignificant | The habitat fragment in the site area occupies an area of 0.1-0.15 ha (0.3% of the site-wide habitat area). Taking into account that in the area of the works there are specimens of acacia aspen birch that may be cut once the works are carried out and their dredgers may extend into the habitat area (on the common boundary with the site) taking into account the dredging distance of the species it is estimated that the percentage of growth of these species in the anenescence composition is maximum 5%. | Analysis of the degree of dispersion of uncharacteristic species as well as the possibility of their expansion by dredging/sprouting |
| | Increase in turbidity levels in the sections targeted for construction work in the Jiu riverbed. | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Barbus balcanicus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton) | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | Estimation of changes in water quality levels in the project areas considering the technical and construction details of the project |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a | Short-term impact strictly during the construction period in the riverbed | *Cottus gobio* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact | Quantifying impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Potential impact | Motivating the estimated impact | |
| | | | | | reduction in flow rate. | | | phytoplankton, European Fish Index). | | favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Romanogobio uranoscopus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Austropotamobius torrentium* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact | Quantifying impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Potential impact | Motivating the estimated impact | |
| | | | | | | | | | | amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Barbus balcanicus* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Cottus gobio* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Romanogobio uranoscopus* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Sabanejewia balcanica* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Austropotamobius torrentium* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | inorganic micropollutants). | | and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Lutra lutra* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). în aria de răspândire | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Sabanejewia balcanica* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Short-term impact strictly during the construction period in the riverbed | *Lutra lutra* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton) in the distribution area | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| CONSTRUCTION | Increase in noise levels in project areas located in quiet zones with low anthropogenic impact nearby | Disruption of species activity | - | - | Disruption of the species in a maximum of one presence location | Short-term impact during the construction period | *Canis lupus* | The density of the prey population | insignificant | The range of this species is very large at the site level (over 10 000 ha) the very low accessibility of the forest fund on the site surface and the large quiet areas make the prey species have excellent habitat conditions. The works within the project are carried out on very small areas and in anthropized areas with continuous disturbance (all the works except for the organization of the Bratcu site) being in the vicinity of national road 66 (intensely trafficked road that creates disturbances) so the impact generated by noise on the distribution prey species will be insignificant. | Noise level analysis/modeling, analysis of the proposed works, and their completion timeline |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact | Quantifying impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Potential impact | Motivating the estimated impact | |
| | | Disruption of species activity | - | - | Disruption of the species in a maximum of one presence location | Short-term impact during the construction period | *Ursus arctos* | The density of the prey population | insignificant | The range of this species is very large at the site level (over 10 000 ha) the very low accessibility of the forest fund on the site surface and the large quiet areas make the prey species have excellent habitat conditions. The works within the project are carried out on very small areas and in anthropized areas with continuous disturbance (all the works except for the organization of the Bratcu site) being in the vicinity of national road 66 (intensely trafficked road that creates disturbances) so the impact generated by noise on the distribution prey species will be insignificant. | |
| | | Disruption of species activity | - | - | Disruption of the species in a maximum of one presence location | Short-term impact during the construction period | *Lynx lynx* | The density of the prey population | insignificant | The range of this species is very large at the site level (over 10 000 ha) the very low accessibility of the forest fund on the site surface and the large quiet areas make the prey species have excellent habitat conditions. The works within the project are carried out on very small areas and in anthropized areas with continuous disturbance (all the works except for the organization of the Bratcu site) being in the vicinity of national road 66 (intensely trafficked road that creates disturbances) so the impact generated by noise on the distribution prey species will be insignificant. | |
| | | Disruption of species activity | - | - | Disruption of the species in a maximum of one presence location | Short-term impact during the construction period | *Barbastella barbastellus* | Species distribution in the protected area | insignificant | Considering the limited spatial extent of the proposed works and the anticipated noise reduction to below 50 dB at an average distance of 100 meters from the site—primarily attributable to the confined project | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | implementation areas which are predominantly situated within forested regions—it has been assessed that the overall impact of the remaining works will be classified as negative-insignificant. Furthermore the execution of the project activities will be strictly confined to daylight hours coinciding with periods of reduced activity for the affected species. | |
| | | Disruption of species activity | - | - | Disruption of the species in a maximum of one presence location | Short-term impact during the construction period | *Myotis myotis* | Species distribution in the European grid system ETRS89 of 1 km² | insignificant | Considering the limited spatial extent of the proposed works and the anticipated noise reduction to below 50 dB at an average distance of 100 meters from the site—primarily attributable to the confined project implementation areas which are predominantly situated within forested regions—it has been assessed that the overall impact of the remaining works will be classified as negative-insignificant. Furthermore the execution of the project activities will be strictly confined to daylight hours coinciding with periods of reduced activity for the affected species. | |
| | | Disruption of species activity | - | - | Disruption of the species in a maximum of one presence location | Short-term impact during the construction period | *Myotis blythii* | Species distribution in the European grid system ETRS89 of 1 km² | insignificant | Considering the limited spatial extent of the proposed works and the anticipated noise reduction to below 50 dB at an average distance of 100 meters from the site—primarily attributable to the confined project implementation areas which are predominantly situated within forested regions—it has been assessed that the overall impact of the remaining works will be classified as negative-insignificant. Furthermore the execution | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact | Quantifying impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Potential impact | Motivating the estimated impact | |
| | | | | | | | | | | of the project activities will be strictly confined to daylight hours coinciding with periods of reduced activity for the affected species. | |
| | Impact on riparian vegetation in the riverbed area (Jiu intake, Pr. Dumitra area, Livezeni area), including riverbed regulation | Degradation of the habitat quality of species | - | - | Probability of drying of riparian tree/shrub species due to traffic in the DN66 area | Short-term impact during the construction period de la barajul Livezeni, captarea Jiu și Pr. Dumitra | *Barbus balcanicus* | Length of riparian arboreal vegetation on both banks of the water | insignificant | On the surface of the natural area, the hydrological network is very rich, with the course of the Jiu River alone measuring 31 km here. Considering that it crosses over 95% forested areas, the riparian woody vegetation almost entirely covers both banks of the river's course. Within the project, the riparian woody vegetation along the riverbanks will be affected over a length of 100 m, which represents 0.3% of the total length of the Jiu River banks within the protected area. | Measurements regarding the length of riparian vegetation that will be affected by the project in relation to the total length of riparian vegetation along the river courses |
| | | Degradation of the habitat quality of species | - | - | - | Short-term impact during the construction period de la barajul Livezeni, captarea Jiu și Pr. Dumitra | *Barbus balcanicus* | Natural riverbed with a complex (natural) structure/Number of meanders | insignificant | In the river section within the protected natural area, over 55 meanders have been assessed (with the help of satellite images), one of which is located in the area of the Jiu intake, where a 100-meter riverbed regulation will be carried out, implicitly remodeling the meander. Given the large number of meanders in the protected natural area (along the Jiu River) and the short length of the regulation, the project's impact on this parameter has been estimated to be insignificant. | |
| | | Degradation of the habitat quality of species | - | - | Probability of drying of riparian tree/shrub species due to traffic in the DN66 area | Short-term impact during the construction period de la barajul Livezeni, captarea Jiu și Pr. Dumitra | *Austropotamobius torrentium* | Length of riparian arboreal vegetation on both banks of the water | insignificant | The length of the Dumitra Stream (considered a habitat for the species) is 4.8 km, and the remaining project works will be carried out over a length of approximately 100 meters, where spontaneously grown vegetation will be cut. In this area, the riparian vegetation has | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | already been affected by the implementation of the project, so the impact of the remaining works will be insignificant. | |
| | | Degradation of the habitat quality of species | - | - | - | Short-term impact during the construction period de la barajul Livezeni, captarea Jiu și Pr. Dumitra | *Austropotamobius torrentium* | Length of riparian arboreal vegetation on both banks of the water depending on the size of the watercourse | insignificant | In the river section within the protected natural area, over 55 meanders have been assessed (with the help of satellite images), one of which is located in the area of the Jiu intake, where a 100-meter riverbed regulation will be carried out, implicitly remodeling the meander. Given the large number of meanders in the protected natural area (along the Jiu River) and the short length of the regulation, the project's impact on this parameter has been estimated to be insignificant. | |
| | | Degradation of the habitat quality of species | - | - | Probability of drying of riparian tree/shrub species due to traffic in the DN66 area | Short-term impact during the construction period de la barajul Livezeni, captarea Jiu și Pr. Dumitra | *Lutra lutra* | Length of riparian vegetation with an average width of at least 3 meters on both banks of the watercourse in each 500-meter section | insignificant | On the surface of the natural area, the hydrological network is very rich, with the course of the Jiu River alone measuring 31 km here. Considering that it crosses over 95% forested areas, the riparian woody vegetation almost entirely covers both banks of the river's course. Within the project, the riparian woody vegetation along the riverbanks will be affected over a length of 100 m, which represents 0.3% of the total length of the Jiu River banks within the protected area. | |
| CONSTRUCTION | Loss of individuals of low-mobility species (amphibians, invertebrates) as well as loss of characteristic habitats (some anthropogenic) of these species | Loss of individuals of species | - | - | Reduction in the size of species populations in the case of national road rehabilitation works | In the short term, only during the construction period | *Bombina variegata* | Population size | insignificant | The population size of the species has been estimated to be between 2,000 and 5,000 individuals, with a maximum of 10 individuals observed in the project area (representing 0.1% of the site's population size). The completion of the remaining works has the potential to lead to | Estimation of the number of individuals in the species population, measurements regarding the area of habitats |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | accidental mortalities in characteristic habitat areas | |
| | | Loss of individuals of species | - | - | - | In the short term, only during the construction period | *Austropotamobius torrentium* | Population size | Significant | Given the importance of this species (a priority species) and its very small population size, any potential impact on the population can be considered significant. Therefore, special attention must be given to the species throughout the duration of the works. | |
| | | Reduction of the species' habitat area | - | - | - | In the short term, only during the construction period | *Bombina variegata* | Potential habitat area | insignificant | The habitats where individuals of the species have been observed are anthropogenic, formed as a result of abandoned works and the accumulation of stagnant water. The completion of the project will lead to the removal of these habitats; however, considering the large number of areas with habitat for the species and the fact that there are no natural habitats in the observation areas, the impact on this parameter is insignificant | |
| | | Reduction of the species' habitat area | - | - | - | In the short term, only during the construction period | *Austropotamobius torrentium* | Specific area of the species' habitat | insignificant | The remaining works to be executed will take place on approximately 800 square meters of the species' habitat (estimated in the OSC at 277 hectares), which corresponds to 0.03% of the species' habitat | |
| OPERATION | Reduction of the natural flow (including changes in composition and quality of the water) of the Jiu River between the Livezeni dam and the section for returning the treated water in the Bumbești hydropower plant | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Barbus balcanicus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton) | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be | Estimarea gradului de poluare a apelor în caz de poluări accidentale, calcule privind dispersia poluanților în apă |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Cottus gobio* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Romanogobio uranoscopus* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact | Quantifying impact | Method of quantification |
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| | | | | | | | | | Potential impact | Motivating the estimated impact | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Austropotamobius torrentium* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Barbus balcanicus* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Cottus gobio* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact | Quantifying impact | Method of quantification |
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| | | | | | | | | | Potential impact | Motivating the estimated impact | |
| | | | | | | | | | | 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Romanogobio uranoscopus* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river). | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Sabanejewia balcanica* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
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| | | | | | | | | | | reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Austropotamobius torrentium* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants). | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Lutra lutra* | Water quality based on physicochemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the distribution area | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. | Long-term impact through changes in water composition | *Sabanejewia balcanica* | Water quality based on ecological indicators | insignificant | The quantification of the impact on this parameter was conducted based on | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Jiu to achieve a reduction in flow rate. | and quality, including sediment structure. | | (macroinvertebrates, phytobenthos, phytoplankton, European Fish Index). | | the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| | | Degradation of aquatic habitat quality | - | - | Adjustment of the existing hydraulic regime of the R. Jiu to achieve a reduction in flow rate. | Long-term impact through changes in water composition and quality, including sediment structure. | *Lutra lutra* | Water quality based on ecological indicators (macroinvertebrates, phytobenthos, phytoplankton) in the distribution area | insignificant | The quantification of the impact on this parameter was conducted based on the very high density of the hydrographic network favorable to fish species, as well as the obligations and regulations set forth in Government Decision 148/2020 regarding the approval of the method of determining and calculating the ecological flow with subsequent amendments and additions so that the impact in the construction stage will be insignificant punctual and reversible due to the chosen execution technology (the works in the bed will be carried out by temporarily diverting the course of the river) | |
| CONSTRUCTION AND OPERATION | Longitudinal fragmentation of the Jiu river into two sections | Disruption of aquatic habitat connectivity | Changes in the sediment structure of the Jiu River bed | Reduction of the current flow of the river course | - | Long-term impact through changes in water composition and quality, including sediment structure. | *Lutra lutra* | Degree of fragmentation | Significant | Considering that fragmentation is one of the biggest problems in the aquatic habitats of fish species and that such fragmentation reduces connectivity between habitats favorable to this species, it has been estimated that the impact generated by the introduction of the two | Construction details regarding the number of fragmentation elements within the project (remaining works to be executed) |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | fragmentations will be significant | |
| | | Disruption of aquatic habitat connectivity | Changes in the sediment structure of the Jiu River bed | Reduction of the current flow of the river course | - | Long-term impact through changes in water composition and quality, including sediment structure. | *Barbus balcanicus* | Degree of fragmentation | Significant | Considering that fragmentation is one of the biggest problems in the aquatic habitats of fish species and that such fragmentation reduces connectivity between habitats favorable to this species, it has been estimated that the impact generated by the introduction of the two fragmentations will be significant | |
| | | Disruption of aquatic habitat connectivity | Changes in the sediment structure of the Jiu River bed | Reduction of the current flow of the river course | - | Long-term impact through changes in water composition and quality, including sediment structure. | *Cottus gobio* | Degree of fragmentation | Significant | Considering that fragmentation is one of the biggest problems in the aquatic habitats of fish species and that such fragmentation reduces connectivity between habitats favorable to this species, it has been estimated that the impact generated by the introduction of the two fragmentations will be significant | |
| | | Disruption of aquatic habitat connectivity | Changes in the sediment structure of the Jiu River bed | Reduction of the current flow of the river course | - | Long-term impact through changes in water composition and quality, including sediment structure. | *Romanogobio uranoscopus* | Degree of fragmentation | Significant | Considering that fragmentation is one of the biggest problems in the aquatic habitats of fish species and that such fragmentation reduces connectivity between habitats favorable to this species, it has been estimated that the impact generated by the introduction of the two fragmentations will be significant | |
| | | Disruption of aquatic habitat connectivity | Changes in the sediment structure of the Jiu River bed | Reduction of the current flow of the river course | - | Long-term impact through changes in water composition and quality, including sediment structure. | *Sabanejewia balcanica* | Degree of fragmentation | Significant | Considering that fragmentation is one of the biggest problems in the aquatic habitats of fish species and that such fragmentation reduces connectivity between habitats favorable to this species, it has been estimated that the impact generated by the introduction of the two | |

| Intervention | Effects | Direct impacts | Indirect impacts | Secondary impacts | Cumulative impacts | Short and long term impacts | Species/habitat | Parameter/target affected | Quantifying impact<br>Potential impact | Quantifying impact<br>Motivating the estimated impact | Method of quantification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | fragmentations will be significant | |
| | | Disruption of aquatic habitat connectivity | Changes in the sediment structure of the Jiu River bed | Reduction of the current flow of the river course | - | Long-term impact through changes in water composition and quality, including sediment structure. | *Austropotamobius torrentium* | Degree of fragmentation | Significant | Considering that fragmentation is one of the biggest problems in the aquatic habitats of fish species and that such fragmentation reduces connectivity between habitats favorable to this species, it has been estimated that the impact generated by the introduction of the two fragmentations will be significant | |

### 5.4. Transboundary nature of the impact

The project is not subject to the provisions of the Convention on Environmental Impact Assessment in a Transboundary Context, adopted in Espoo on February 25, 1991, ratified by Law 22/2001, as the site's distance from borders is:

- Over 170 km from the CHE Bumbești works area to the Bulgarian border;
- Over 140 km from the CHE Bumbești works area to the Serbian border;

It should be noted that the utilized flow in CHE Bumbești is returned to the Jiu River in its immediate vicinity, and on the distance between the flow restitution area and the confluence of the Jiu River with the Danube, there are numerous dams and river course regulation zones that control the flow and state of the river course.

### 5.5. Impact matrix of the proposed project

The impact assessment on environmental factors (air, soil/subsoil, population, noise and vibrations, landscape and cultural heritage) was conducted based on an evaluation matrix, assigning scores according to the type of impact: significant negative impact, insignificant negative impact, no impact.

For the most sensitive environmental factors in the project area, namely water and biodiversity, the impact analysis (including medium and long-term, direct and indirect) was carried out in detail for each water body or for each species/habitat of conservation interest in protected natural areas (the results being detailed in the previous tables).

It should be noted that the sensitivity of the project area is given by its implementation zone in relation to protected natural areas and water bodies, which is why the impact assessment on these elements was carried out in detail, based on certain information from the project area and taking into account the most sensitive elements of interest (for example: species of community interest with reduced mobility, the area of priority habitats).

In determining the significance of the impact, the nature of the impact was considered (direct, indirect, secondary, cumulative, short, medium or long-term, permanent and temporary impact, positive and negative impact) including the reversibility of the impact and its probability of occurrence.

These impact categories were also associated with colors, as follows:

*Table no. 91 Significance of impact*

| Color code | Significance of impact |
|---|---|
| | Significant negative impact |
| | Insignificant negative impact |
| | No impact |

The following presents the impact matrix of the proposed project on environmental factors. This provides a synthetic overview of the impact of the remaining works proposed by the project on environmental factors, allowing for tracking the effect associated with each of the proposed works on the environmental factors.

*Table No. 92 Impact assessment matrix*

| Environmental factor | Initial state | Impact during construction period (remaining works) | Residual impact during execution | Impact during operational period | Observations/Details |
|---|---|---|---|---|---|
| Air quality | Good | Insignificant negative | Insignificant negative | No impact | During the construction period, sources of air pollution will be generated, on one hand, by the exhaust gases from the machinery/transport vehicles of the contractor, and on the other hand, by their circulation on the technological/access roads related to the execution of the works, which connect with existing public roads, as follows:<br>• Bumbești-Jiu area – DC 149 and DN66, Aleea Luncani Street towards the Bumbești hydropower plant and the technological roads to the equilibrium castle and butterfly valve house in Bumbești;<br>• Dumitra-Livezeni area – DN66, and access roads for the Bratcu construction site organization.<br>The presence of pollutants emitted during these operations (CO, NOx, VOCs, $H_2S$, cement powders) will be felt exclusively locally, in the area where the operation takes place; under the action of atmospheric factors, their dispersion will occur in a short time.<br>The impact generated by the project on this environmental factor will be negative-insignificant, |

| Environmental factor | Initial state | Impact during construction period (remaining works) | Residual impact during execution | Impact during operational period | Observations/Details |
|---|---|---|---|---|---|
| | | | | | temporary, and reversible, and will only occur during the construction period (remaining works). |
| Soil/subsoil | Good | Insignificant negative | Insignificant negative | No impact | During the construction period, the only possibility of soil pollution would arise from potential accidental leaks of fuels and/or lubricants from the contractor's machinery/transport vehicles.<br>To enable a response in case of such accidental soil pollution, the contractor will be required to have a minimum amount of absorbent materials (pads, pillows, biodegradable absorbents, etc.) available.<br>The contractor will pay particular attention to the fueling operations (from mobile tankers) of the machinery necessary for the works. It should be noted that no additional land areas will be occupied for the remaining works.<br>If the contractor maintains their machinery/transport vehicles in good working condition, along with a rapid and efficient intervention, the negative impact on the soils will be limited in scope, resulting in an insignificant impact. In this regard, Chapter 7 outlines a series of measures in case of accidental soil pollution. |
| Landscape | Good | Insignificant negative | Insignificant negative | Positive | The works within the project are already at a very advanced stage, so the landscape in the Jiu Gorge area has already been affected. The remaining works will not have a significant negative impact, and this |

| Environmental factor | Initial state | Impact during construction period (remaining works) | Residual impact during execution | Impact during operational period | Observations/Details |
|---|---|---|---|---|---|
| | | | | | impact will diminish once the investments are completed and the affected areas are restored. |
| Population | Good | Insignificant negative | Positive, as presented in the last column | No impact | The population in the project area will not be affected by the implementation of the project, except for the increase in emissions in the work areas. Furthermore, after the project's completion (as well as during the construction period), the impact will be positive due to the increase in the number of job opportunities. |
| Cultural heritage | Good | Insignificant negative | Insignificant negative | No impact | As mentioned in previous chapters, the cultural heritage will not be affected by the implementation of the project, as all archaeological sites included in the National Archaeological Record (RAN) are located at distances from the project sites. Furthermore, the majority of archaeological sites are situated in karst areas, which are unsuitable for the development of hydrotechnical constructions. |
| Noise and vibrations | Good | Insignificant negative | Insignificant negative | No impact | Noise and vibrations will exceed the permitted limits only in the work areas and strictly during the construction period. Considering the considerable distance from sensitive receptors, the noise will generate an insignificant negative impact, which will be manifested strictly during the construction period (time-limited and reversible). The impact of this factor on biodiversity elements has been described in the specific chapter. |

## 6. DESCRIPTION OF FORECASTING METHODS USED TO IDENTIFY AND ASSESS SIGNIFICANT EFFECTS ON THE ENVIRONMENT, INCLUDING DETAILS OF DIFFICULTIES ENCOUNTERED

Types of pollution that can occur in the proposed project site and the surrounding area:

- Pollution specific to construction works consisting of dust pollution, chemical emissions, noise and vibrations generated by construction equipment and means of transport;
- Accidental pollution, especially with petroleum products accidentally spilled due to equipment and vehicle failures, emergency refueling with fuels from inappropriate containers and without taking safety measures, etc.

Main pollutants generated by the proposed project during the construction period:

- ✓ Dust, generated in the construction site (excavation operations, loading - unloading, handling and transport of excavated earth and bulk construction materials) and on the access road during transport (dust resulting from the movement of transport vehicles on the temporary dirt road).
- ✓ Chemical emissions, generated by fuel combustion in equipment engines and transport vehicles, on the access road;
- ✓ Noise, generated by equipment and transport vehicles;
- ✓ Vibrations, generated by equipment and transport vehicles;
- ✓ Improperly managed waste.

The proposed project does not anticipate the use of radiation sources, therefore, the value of the natural radiation background will not be modified in any way in the area.

The implementation of the proposed project does not involve the use of chemical substances dangerous to flora, fauna or public health.

The methodology considered for the project analysis proposes a differentiation between the concept of "effect" and that of "impact".

Effects refer to changes caused to the bio-physical environment as a direct consequence of the causes (interventions) generated by the project (both in the execution and operation stages).

Impacts include changes to sensitive receptors, such as Natura 2000 components (Natura 2000 habitats, population numbers, habitats of Natura 2000 species). The identification of effects involved the following steps:

• Analysis of the interventions proposed within the project;

• Identification of activities resulting from the execution and operation of project components;

• Identification of changes (effects) occurring in the physical environment as a result of the realization and operation of project components.

Of interest for evaluation are mainly those effects that can be quantified and that certainly lead to the appearance of a form of impact. The magnitude of the impact is a combination of all elements characterizing an impact (nature, type, reversibility, extent, duration, intensity) made based on the evaluator's experience. The criteria for determining the magnitude of the impact differ for physical, biological and social environmental factors.

*Table No. 93 Establishing the Significance of Impact Based on Magnitude and Sensitivity of the Receptor*

| | Small magnitude | Medium magnitude | Large magnitude |
|---|---|---|---|
| Low Value/Sensitivity | Minor | Minor | Moderat |
| Medium Value/Sensitivity | Minor | Moderat | Major |
| High Value/Sensitivity | Moderat | Moderat | Major |
| Impact significance | | | |
| No impact or insignificant | The impact does not generate quantifiable effects (visible or measurable) on the natural state of the environment. | | |
| Minor significance | The impact has a low magnitude, falls within standards, and/or is associated with receptors of low or medium value/sensitivity. It is an impact of medium magnitude that affects receptors with low value. | | |
| Moderate significance | An impact that falls within limits, with low magnitude affecting receptors of high value, or medium magnitude affecting receptors of medium value, or high magnitude affecting receptors of medium value. | | |
| Major significance | An impact that exceeds limits and standards, with high magnitude affecting receptors of medium value, or medium magnitude affecting receptors of high value. | | |

The estimation of emissions was carried out according to the provisions of *Order no. 3299/2012 for the approval of the methodology for the realization and reporting of inventories regarding pollutant emissions into the atmosphere* - mobile sources represented by the operation of mobile motorized equipment and machinery and mobile sources represented by vehicle traffic at the project site, taking into account the necessary equipment, machinery and heavy vehicles used in the construction stage as well as the duration of the project realization.

The methodology applied in noise assessment includes establishing the noise level, evaluated according to the noise-generating sources based on available information regarding the machinery and equipment used in the project realization and taking into account the provisions of Government Decision no. 1756/2006 on limiting the level of environmental noise emissions produced by equipment intended for use outside buildings.

An element of difficulty in preparing this study was the evaluation of the cumulative impact of the proposed project with other projects. Although existing activities on neighboring sites were taken into account, it is possible that during the execution of the proposed project works, new projects may appear which are not known at present.

## 7. DESCRIPTION OF MEASURES INTENTED TO AVOID, PREVENT, REDUCE OR, IF POSSIBLE, COMPENSATE FOR ANY IDENTIFIED SIGNIFICANT NEGATIVE EFFECTS ON THE ENVIRONMENT AND A DESCRIPTION OF ANY PROPOSED MONITORING MEASURES

### A. *Proposed measures*

Although the impact on environmental factors was assessed as negative-insignificant and manifested only during the period of work realization (for air, soil, noise, population and cultural heritage), a series of organizational measures are required that will be adopted throughout the construction period.

#### a) *Measures for the Water environmental factor (SEICA reference)*

As a result of the impact assessment on water bodies, a series of impact mitigation measures were proposed in the study to minimize the impact on those quality elements for which cause-effect mechanisms were identified.

Therefore, in the case of all water bodies for which intakes related to A.H.E. Livezeni Bumbeşti are provided, ensuring the ecological/servitude flow and improving longitudinal connectivity are identified and proposed as main measures (table 32). In fact, according to PMBH 2021-2027, these proposed measures for reducing the effects of hydromorphological pressures are basic, mandatory measures that apply to all water bodies.

*Table no. 94 - Measures proposed for mitigating/reducing impacts on water bodies*

| ***Quality element/indicator (Quality parameter)*** | ***Proposed additional measure*** | ***Water body targeted for measure implementation*** |
|---|---|---|
| Flow, Depth, Width, Substrate, Fish fauna, Benthic invertebrates | Ensuring ecological/service flow downstream of the dam and water intake works, considering the provisions of Government Decision no. 148/2020 regarding the approval of the method for determining and calculating ecological flow. | *Jiu - confluence of Jiu de Est - Acum. Vădeni, Bratcu - spring - cf. Jiu* |
| Longitudinal connectivity, fish fauna | Construction of fish passage structures in accordance with current regulations. | *Bratcu - spring - cf. Jiu* |
| Substrat | Reintroduction of sediments downstream of the water intake works. | *Jiu - confluence of Jiu de Est - Acum. Vădeni* |

| | | |
|---|---|---|
| fish fauna | Installing fish screens at each water intake associated with the Livezeni Bumbești Hydropower Plant to reduce the accidental entry of fish into the water intakes | *Jiu - confluence of Jiu de Est - Acum. Vădeni, Bratcu - spring - cf. Jiu* |

It is mentioned that the ecological flows have been determined according to G.D. no. 148/2020 within hydrological studies elaborated by INHGA (*Calculation of the ecological flow on the Jiu river, in the Livezeni dam section, in order to issue the modifying opinion "Study on the impact assessment on water bodies for the hydropower development project of the Jiu river on the Livezeni-Bumbeşti sector. Continuation of the work" - 2020; Hydrological study in 3 calculation sections for issuing the modifying opinion "Study on the impact assessment on water bodies for the hydropower development of the Jiu river on the Livezeni-Bumbeşti sector. Continuation of the work" - 2021*). Ensuring downstream ecological/servitude flows must be analyzed in relation to longitudinal continuity assurance systems, as appropriate, in accordance with art. 53(4) of the Water Law 107/1996 with subsequent modifications and completions.

Resuming the analysis (tables of type 2a and 3a) in the case of water bodies targeted by the implementation of proposed measures, can no longer lead to the identification of cause-effect mechanisms and implicitly of significant effects for the quality elements for which cause-effect mechanisms were initially mentioned.

The analysis regarding the possibility of ensuring longitudinal continuity and ecological flow downstream of the Bratcu and Jiu secondary intakes as well as downstream of the Livezeni dam is presented below:

In accordance with CIS Guide no. 36 "Exemptions from environmental objectives according to article 4 paragraph (7)" within the "Common Strategy for the implementation of the Water Framework Directive and the Floods Directive" article 4 paragraph (7) transposed in the water law by article 2\^7 applies only to:

1. new modifications of the physical characteristics of a surface water body,
2. changing the level of groundwater bodies and
3. new sustainable human development activities that may lead to failure to meet WFD objectives.

For the elaboration of the SEICA Study, based on existing data and information at national and international level (including the above-mentioned Guide), the scheme below was compiled. This was done to facilitate the analysis process.

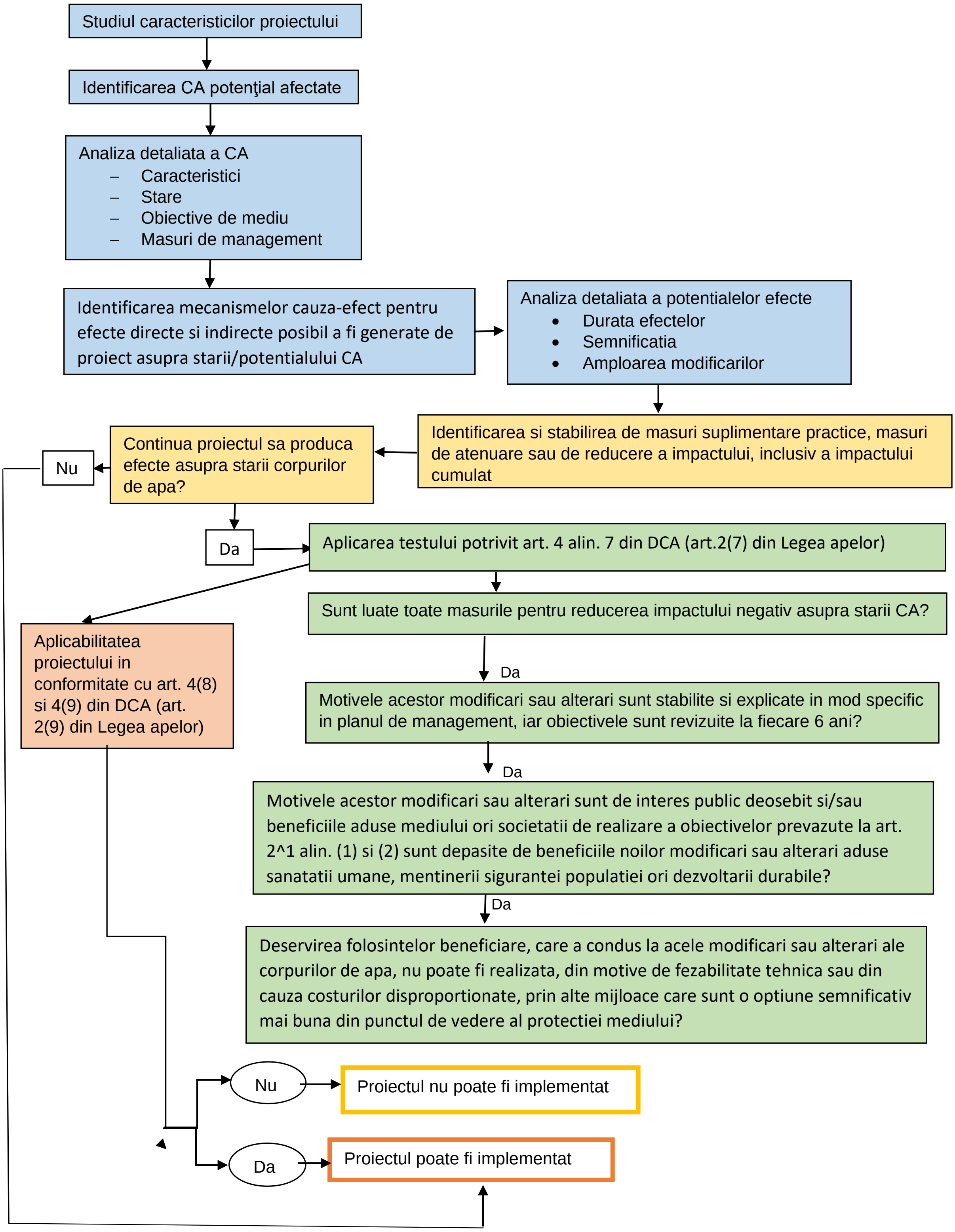


Fig. 217 Impact analysis scheme

In the case of water bodies: Jiu - confluence of East Jiu - Vădeni Reservoir and Bratcu - source - confluence Jiu, the previous analysis highlighted a significant impact due to existing works, with the change in physical characteristics of the water body clearly translated into a significant effect. At the same time, the assessment of ecological status (carried out in the 2021 Management Plan) indicates a good class, in other words, the environmental objective is achieved, so the reference situation starts from this aspect.

**Art. 2^7 - (1) The objectives outlined in Article 2^1, paragraphs (1) and (2), shall not be considered unmet when:**
a) the failure to achieve a good status of groundwater, a good ecological status, or, where applicable, a good ecological potential, or the failure to prevent the deterioration of the status of a surface or groundwater body results from new modifications to the physical characteristics of a surface water body or from changes in the levels of groundwater bodies;
b) the failure to prevent deterioration from a very good status to a good status of water bodies results from new human activities aimed at sustainable development.
**(2) The provisions of paragraph (1) apply only when the following conditions are cumulatively met:**
a) all measures are taken to reduce the negative impact on the status of water bodies;
b) the reasons for these modifications or alterations are specifically established and explained in the management plan, and the objectives are reviewed every six years;
c) the reasons for these modifications or alterations are of exceptional public interest and/or the benefits brought to the environment or society by achieving the objectives outlined in Article 2^1, paragraphs (1) and (2), are outweighed by the benefits of the new modifications or alterations concerning human health, the maintenance of public safety, or sustainable development;
d) the provision of the beneficial uses that led to those modifications or alterations of the water bodies cannot be achieved, for reasons of technical feasibility or due to disproportionate costs, by other means that are a significantly better option from an environmental protection standpoint.

In accordance with Article 2^7 of the Water Law, in the context of achieving the environmental objectives provided in Article 2^1 paragraphs (1) and (2), namely achieving good ecological status, respectively not achieving/not falling within the parameters/limits specific to the hydromorphological/biological elements corresponding to good ecological status, it is not considered a failure to meet the environmental objective when **failure to achieve good ecological potential or failure to prevent deterioration of the surface water body status is the result of new modifications to the physical characteristics of a surface water body (i.e., modification of longitudinal connectivity through the construction of the frontal dam on the water course)** and in accordance with the provisions of paragraph (1) Article 2^7 applies only when the following conditions are cumulatively met:

a) all measures are taken to reduce the negative impact on the status of water bodies;

b) the reasons for these modifications or alterations are specifically established and explained in the management plan, and the objectives are revised every 6 years;

c) the reasons for these modifications or alterations are of overriding public interest and/or the benefits to the environment or society of achieving the objectives provided in Article 2^1 paragraphs (1) and (2) are outweighed by the benefits of the new modifications or alterations to human health, maintaining population safety or sustainable development;

d) the servicing of the beneficiary uses, which led to those modifications or alterations of the water bodies, cannot be achieved, for reasons of technical feasibility or due to disproportionate costs, by other means which are a significantly better option from an environmental protection point of view.

**1. Analysis of applicability according to Article 4 paragraph (7)**

Following the initial analysis due to changes in the physical characteristics of the water bodies *Jiu - confluence of East Jiu - Vădeni Reservoir (RORW7-1_B14)* and *Bratcu - source - confluence Jiu (RORW7-1-19_B18)* as a result of changes in hydromorphological characteristics, an effect on quality elements is anticipated.

**2. Requirements of Article 4 paragraph (7) of the WFD (transposed into national legislation through Water Law 107/1996 with subsequent amendments and completions in Article 2^7)**

**a. All practical measures are taken to mitigate the negative impact on the status of the water body;**

Regarding the water bodies targeted by the application of Article 2^7, namely: *Jiu - confluence of East Jiu - Vădeni Reservoir (RORW7-1_B14)* and *Bratcu - source - confluence Jiu (RORW7-1-19_B18)*, over which the project works will overlap, all practical measures aimed at mitigating the potential negative impact on ecological status have been identified.

The study proposed impact reduction measures for the component elements of water bodies: biological, hydromorphological, and physicochemical. Additionally, mitigation measures were provided, particularly aimed at protecting and improving the status of aquatic ecosystems.

In this context, we mention that a wide range of mitigation measures (additional measures to the existing project) and impact reduction measures have been proposed for the potentially impacted water bodies, namely:

**Water body: Jiu - confluence of East Jiu - Vădeni Reservoir (RORW7-1_B14)**

**Mitigation/impact reduction measures on hydromorphological and biological elements**

- ensuring ecological/servitude flow. These proposed measures for reducing the effects of hydromorphological pressures are basic, mandatory measures that apply to all water bodies.

Additionally, the possibility of constructing a sediment reintroduction system downstream of the water intake works was analyzed, a measure aimed at mitigating the impact on the *Substrate* element (hydromorphology), but this is not feasible to implement due to the disproportionate costs of this measure.

**Water body: Bratcu - source - confluence Jiu (RORW7-1-19_B18)**

**Mitigation/impact reduction measures on hydromorphological and biological elements**

- ensuring ecological/servitude flow. These proposed measures for reducing the effects of hydromorphological pressures are basic, mandatory measures that apply to all water bodies.
- construction of fish passage structures. This measure aims to mitigate the impact on the fish fauna element.

***b) Measures for the air environmental factor***

Even though the impact generated by the project implementation on the air environmental factor has been assessed as insignificant, some organizational measures are required. The proposed measures for controlling particle emissions resulting from the entrainment of dust by transport vehicles are operational measures specific to this type of source, as follows:

- limiting particle emissions generated by soil handling activities will be achieved through:
    - surface wetting activities;
    - covering loaded transport vehicles carrying dusty materials;
    - limiting the speed of heavy vehicles for material transport.
    - use of equipment and machinery that are technically compliant with the best existing technologies;
- ✓ during periods without precipitation, watering of access roads and areas with active works will be ensured to reduce particle emissions and maintain concentrations (PM10 / PM2.5) within the limit values provided by the legislation in force;
- ✓ transport of soil, waste, and any dust-generating materials will be carried out throughout the entire project exclusively with trucks covered with tarpaulins (tarpaulins for dump bodies) in order to reduce particle emissions;
- ✓ cleaning vehicle wheels before exiting the construction site onto public roads;
- ✓ periodic technical checks of vehicles and machinery used in carrying out the works;
- ✓ avoiding the execution of works involving the handling of soil quantities (excavations/fillings) during periods with strong winds;
- ✓ ensuring correct management of materials used during the construction period;
- ✓ stopping the engines of machinery during periods when they are not involved in activity;
- ✓ proper disposal of resulting waste;
- ✓ stabilization of areas where construction materials were obtained, respectively areas where slope works were carried out and where surplus excavated material deposits were arranged;
- ✓ landscaping of all areas affected by execution works.

During the operation period, no specific measures are necessary to reduce the impact on the air environmental factor.

***c) Measures for the soil/subsoil environmental factor***

- ❖ within the construction site organization, priority will be given to solutions that ensure the reduction of surfaces to the minimum level;
- ❖ soil pollution with oils and petroleum products will be avoided by ensuring the proper functioning of machinery and carrying out maintenance operations in specially designated spaces;

- ❖ avoiding direct placement on the soil of construction materials and waste resulting from the works;
- ❖ temporary storage of waste resulting from the works, as well as municipal-type waste, until collection by specialized firms for final disposal or recovery, will be carried out in appropriate containers, in specially arranged spaces;
- ❖ installation of local control measures such as sediment retention fences or settling tanks;
- ❖ collection and evacuation of rainwater to avoid mixing with sediment-containing waters;
- ❖ use of technically appropriate vehicles for the execution of works, as well as for the transport of materials and for the collection and transport of waste resulting from construction works;
- ❖ maintenance, refueling, or cleaning of vehicles and machinery will be carried out in specially arranged places, away from sensitive areas or within the construction site organization;
- ❖ strict compliance with waste management norms, fuel distribution and supply, wastewater disposal, and ecological toilet emptying;
- ❖ in case of soil contamination, the affected portion will be removed and treated/disposed of depending on the type of contamination; the construction site organization will be properly equipped with specific absorbent materials for each type of material/substance that can cause pollution due to improper management;

❖ in the final arrangement of the platforms at Bolvașnița I and II, the natural slope of the land will be taken into account to allow rainwater drainage;

❖ it is strictly forbidden to plant/grass with allochthonous, invasive, ruderal, nitrophilous species or species not characteristic of the areas where this is carried out;

During the operation period, no specific measures are necessary to reduce the impact on the soil/subsoil environmental factor.

***d) Measures for limiting noise/vibrations***

During the execution period, the following operational measures are recommended:

- ✓ use of modern work equipment/machinery that generates the lowest possible noise level;
- ✓ the noise absorption system with which the machinery is equipped must be periodically maintained;
- ✓ works will be carried out only during the day (7:00 AM - 8:00 PM);
- ✓ reduction of heavy vehicle speed in the construction site organization area (according to specialized literature, low speed can reduce noise levels by up to 5 dB);
- ✓ to limit vibrations produced by heavy traffic, it is recommended that the speed does not exceed 20 km/h when passing through the locality;
- ✓ periodic checking and repairing of machinery to fall within the admissible noise level;
- ✓ construction materials will be stored, when necessary and possible, within the construction site organization in such a way as to create an acoustic barrier in the direction of the dwellings;
- ✓ the construction site will be fenced and work will not be carried out during rest hours;

- ✓ for the transport of construction materials, residential areas will be avoided as much as possible, and in case localities are crossed, the travel speed will be limited to a maximum of 40 km/h.

During the operation period, no specific measures are necessary to reduce the impact on the noise/vibration environmental factor.

***e) Measures for the biodiversity environmental factor (taken from the Approppriate Assessment Study)***

*Table no. 95 Measures to prevent (P), avoid (E) and reduce (R) impacts*

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| M1. In order to avoid the risk of introduction or spread of allochthonous, non-native, ruderal or nitrophilous species (e.g. *Robinia pseudacacia*, *Salix capraea*, *Betula pendula*, *Populus tremula*) into the habitat type 91E0*, these species will be removed during construction works | E | Habitat 91E0* | The presence of invasive/allochthonous species | Habitat degradation by increasing the proportion of uncharacteristic species | Permanent, under construction | In the area of the secondary intake on the Jiu, including the road between CHE Dumitra and this catchment | - |
| M2. Throughout the construction period, non-native, non-habitat type, ruderal or nitrophilous tree and shrub species identified on the project site will be carefully monitored to prevent their spread. If necessary, their removal will be accomplished, including removal of shoots/roots from their roots. | E | Habitat 91E0* | The presence of invasive/allochthonous species | Habitat degradation by increasing the proportion of uncharacteristic species and Habitat degradation for some riparian habitat-dependent species | Permanent, under construction | In the area of the secondary intake on the Jiu, including the road between CHE Dumitra and this catchment | - |
| M3 Water diversion works shall be carried out outside the closed season for fish | P | Fish species, *Lutra lutra* and | Water quality based on physico-chemical indicators (oxygen | Degradation of aquatic habitat quality | Permanent, under construction | In the Livezeni dam area, the area of the | The water diversion works should be carried out at low flows in the second part of |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| species and only during low flow periods, preferably in August-October. | | *Austropotamobius torrentium* | regime, nutrients, salinity, metals, organic and inorganic micropollutants) Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) | | | secondary intake on the Jiu and the works in the Dumitra Stream | summer, first part of fall (August-October) so that they do not lead to the entrainment of solid suspensions in the water mass and do not affect either the spawning eggs or the newly hatched young, which are very susceptible to the changes that occur. |
| M4 In works to be carried out on the watercourse involving various substances/materials (e.g. concrete, oils, paints, primers) special attention shall be paid to their handling in order to minimize the risk of accidental pollution. | R | Fish species, *Lutra lutra* and *Austropotamobius torrentium* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) | Degradation of aquatic habitat quality | Permanent, under construction | On all sites connected to the River Jiu and its tributaries Dumitra and Bratcu | In the case of concreting works, special care must be taken to ensure that neither the concrete nor the excess water from the concreting seep into the River Jiu or its tributaries. |
| M5. Washing of machinery in riverbeds is prohibited, subject to other measures related to the water bodies indicated in the SEICA. For work in riverbeds, only | R | Fish species, *Lutra lutra* and *Austropotamobius torrentium* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, | Degradation of aquatic habitat quality | Permanent, under construction | On all sites connected to the River Jiu and its tributaries Dumitra and Bratcu | The works to be carried out in the river/riverbeds will be carried out with well-equipped machinery, checked and inspected daily to prevent accidental spills of oil or fuels |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| tested machinery, which does not leak oil/fuel into the riverbeds, shall be used. | | | organic and inorganic micropollutants)<br>Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) | | | | into the riverbed. At the same time, access to the Jiu riverbed will be reduced to the minimum necessary, strictly only during the construction period. |
| M6. An accidental pollution prevention and response plan will be implemented, including concrete measures to prevent accidental spills of diesel, oil or other hazardous substances/pollutants into water or onto land. | P | All species of Community interest assessed as present or potentially present in the project area of influence and habitat 91E0* | All parameters referring to the habitat quality of species | Degradation of aquatic habitat quality<br>Habitat area (for *Bombina bombina and Austropotamobius torrentium)* | Permanent, under construction | In all areas with works | - |
| M7. The project works will be carried out exclusively during the day, between 07:00-20:00 | E | Chiroptera species, | Species distribution in the protected area<br>The distribution of the species in the 1 km² European ETRS89 grid system | Increased noise levels in project areas located in quiet zones with low anthropization in the vicinity. | Permanent, under construction | In all areas with works | - |
| | | *Canis lupus, Ursus arctos*<br>*Lynx lynx* | Predator population density | | | | |
| | E | Chiroptera species, | Species distribution in the protected area | | | | - |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| M8. Quiet machinery and means of transport will be used to reduce noise due to specific activities, as well as equipment with efficient systems to minimize and contain pollutants in the atmosphere. At the same time, machinery will be checked periodically to avoid oil and fuel spills on the surface of habitats or near watercourses. | | | Species distribution within the 1 km² European ETRS89 grid system | Increased noise levels in project areas located in quiet zones with low anthropization in the vicinity. | Permanent, under construction | In all areas with works | |
| | | *Canis lupus, Ursus arctos*<br>*Lynx lynx* | Predator population density | | | | |
| M9. Proper waste management shall be practiced; selective collection, recovery and regular disposal of waste shall be carried out in order to avoid attracting animals, making them ill or causing them injury. | P | Chiroptera species, Large carnivore species, *Austropotamobius torrentium*<br>*Lutra lutra, Bombina variegata, and habitat 91E0** | - | Degradation of aquatic habitat quality<br>Habitat area (for *Bombina variegata)* | Permanent, under construction | In all areas with works | |
| M10 Mobile sound absorbing panels shall be used for site fencing on all sites where works will be carried out | E | Chiroptera species, | Species distribution in the protected area<br><br>Species distribution within the 1 km² European ETRS89 grid system | Increased noise levels in project areas located in quiet zones with low | Permanent, under construction | In all areas with works | - |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| | | *Canis lupus, Ursus arctos*<br>*Lynx lynx* | Predator population density | anthropization in the vicinity. | | | |
| M11 Upon completion of the project works on both banks of the R. Jiu and on the banks of Dumitra Stream (where the terrain allows) alder trees (*Alnus sp), will be planted in* order to restore the affected riparian vegetation. | E | *Barbus balcanicus*<br>*Austropotamobius torrentium*<br>*Lutra lutra* | Length of arboreal riparian vegetation on both banks<br>Length of riparian vegetation with an average width of at least 3 m on both banks of the watercourse in each 500 m section | The impact on riparian vegetation in the riverbed area (Jiu intake, Dumitra Stream area, Livezeni area), including riverbed regulation. | At the end of the construction period | Livezeni dam area, Jiu catchment, works Dumitra Stream confluence with R. Jiu | - |
| M12 Gabions will be used for the riverbed regularization works (Jiu river downstream Livezeni dam and downstream Jiu catchment) (if constructively possible) | R | *Barbus balcanicus*<br>*Austropotamobius torrentium* | Natural riverbed with a complex (natural) structure / Number of meanders<br>Natural meanders with a complex (natural) structure/Number of meanders depending on stream size | The impact on riparian vegetation in the riverbed area (Jiu intake, Dumitra Stream area, Livezeni area), including riverbed regulation. | During the construction period | Livezeni dam area, Jiu catchment, works Dumitra Stream confluence with R. Jiu | Regularizing streambanks can represent lateral fragmentation elements if concrete blocks are used. Gabions reduce fragmentation and can also create refuge areas for fish species (fish habitat). |
| M13. Prior to the start of construction works, all areas within the project site will be inspected (with emphasis on the CHE Bumbești and Livezeni dam area) in order to | R | *Bombina variegata* | Population size | Loss of individuals of species with reduced mobility (amphibians, invertebrates) as well as loss of | Before the construction period | In all areas with works | Considering that specimens of *Bombina variegata* have been observed in the habitat areas of abandoned anthropogenic structures (in the CHE Bumbești area and in the Livezeni dam area), all sites |

| **Measure-description** | **Type of measure (P/E/R)** | **Affected species/habitat** | **Parameter addressed by the measure** | **Target impact** | **Period of implementation of the measure** | **Location of implementation of the measure** | **Comments (details of the measure)** |
|---|---|---|---|---|---|---|---|
| identify specimens of *Bombina variegata* and in case individuals of this species are observed, all necessary measures will be taken to relocate them to other favorable habitats. | | | | characteristic habitats (some anthropogenic) of these species | | | will be inspected and if specimens of this species are identified, they will be relocated (after obtaining legal approvals) in characteristic habitats on the surface of the protected natural area, so that those individuals will not be affected. |
| M14. Prior to the start of construction works, the work sites in the Dumitra Stream (including R. Jiu downstream and upstream of the confluence with Dumitra) in order to identify specimens of *Austropotamobius torrentium* and if individuals of this species are observed, all necessary measures will be taken to relocate them to other favorable habitats | R | *Austropotamobius torrentium* | Population size | Loss of individuals of species with reduced mobility (amphibians, invertebrates) as well as loss of characteristic habitats (some anthropogenic) of these species | Before the construction period | In the areas with works at CHE Dumitra (including the R. Jiu downstream and upstream of the confluence with Dumitra) | Considering that the potential habitats of this species (Dumitra Stream) are in the area of the works site, as well as the fact that it is a priority species with small and isolated populations, special attention has been paid to it, so this measure is aimed to protect each individual of the species. |
| M15 Restoring longitudinal connectivity at Livezeni dam | R | All fish species, *Austropotamobius torrentium* *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, | Degradation of aquatic habitat quality Disruption of aquatic habitat connectivity | Throughout construction and operation | Livezeni Dam | For this type of barrier and for this type of river, the most appropriate solution is the slotted passage, where the slot is provided along the entire |

| **Measure-description** | **Type of measure (P/E/R)** | **Affected species/habitat** | **Parameter addressed by the measure** | **Target impact** | **Period of implementation of the measure** | **Location of implementation of the measure** | **Comments (details of the measure)** |
|---|---|---|---|---|---|---|---|
| | | | organic and inorganic micropollutants) Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) Degree of fragmentation | | | | height of the dividing walls between the pools. This type of passage can be more easily adapted to upstream level fluctuations. The fish ladder proposed by this project requires modification, as it was designed at a constant water level, although the water level variation in the lake upstream of the catchment is 3 m. The main requirements for passage are given by the size of the clean and the level difference, which must be provided for a minimum of 300 days per year (DWA 2014, Schmutz & Mielach 2013). Clean is the largest species present in this sector in terms of size after native trout (Telcean et al. 2017, Nagy 2021, Nagy et al. 2023, present study). In addition to the fact that indigenous trout were present in very low numbers, this is also the best swimmer of the species |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| | | | | | | | present, thus the fish ladder cannot be designed for the requirements of trout (as they have generally been designed for all micro-hydropower schemes in Romania), as in this case the fish ladder would not meet the needs of the less poorly swimming species, so it is proposed that the fish ladder should be designed for the size of the clean. Thus, the main characteristics of the fish ladder should be as follows (DWA 2014, Schmutz & Mielach 2013):<br>Slot width: minimum 0.3 m<br>Pool length: minimum 2.45 m<br>Minimum pool width 1.85 m<br>Quasi-natural substrate thickness: 0.3 m<br>Water depth: minimum 0.7 m above the substrate<br>Water speed Jiu Livezeni: maximum 1.55 m/s<br>Specific wattage: maximum 200 W/m3.<br>The entrance to the passage should be oriented as parallel |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | | as possible to the flow axis, as close as possible to the movable rhizberm. The attraction current should be released in the immediate vicinity of, and parallel to, the inlet to the passage. Any concurrent flow on the opposite bank (e.g. from the MHC for ecological flow) will detract from the attraction of the passage, resulting in low efficiency. For this reason, the discharge from the MHC at the level of the Livezeni dam should be made in the immediate vicinity of the fish ladder (i.e. on the bank opposite the micro-hydropower plant), in the vicinity of the fish ladder inlet, parallel to it. |
| M16 Restoration of longitudinal connectivity at the secondary intake on the Jiu river, upstream of the confluence with Dumitra | R | All fish species, *Austropotamobius torrentium* *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) | Degradation of aquatic habitat quality Disruption of aquatic habitat connectivity | Throughout construction and operation | Jiu secondary intake | For this secondary intake on the river Jiu, a ramp type passage with natural substrate of stone and gravel can be installed, the main condition being to ensure velocities of up to 1.3 m/s, only punctual |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| | | | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area<br>Degree of fragmentation | | | | maximum 1.5 m/s, with a water depth of at least 0.4 m above the substrate. This ramp shall be installed along the entire width of the minor bed. This ramp will only come into operation when the installed flow rate of the catchment is exceeded, by the transit of water over the spillway crest and thus over the anrocity ramp (the ramp will mainly operate in the high-water regime). In the low and medium-water regime, connectivity will be achieved by installing a passage with the characteristics of the Livezeni passage. |
| M17 Maintaining the ecological flow on the Jiu River as well as Dumitra Stream and Bratcu River | R | All fish species, *Austropotamobius torrentium* *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants)<br>Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, | Degradation of aquatic habitat quality<br>Disruption of aquatic habitat connectivity | Throughout construction and operation | All works on the R. Jiu and Dumitra Stream and Bratcu | In order to ensure the ecological flow necessary to maintain viable populations of ichthyofauna species, the provisions and methods of calculation of the ecological flow set out in the Government Decision no. 148/2020 on the approval of the method of determining and calculating the ecological flow, with subsequent |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| | | | organic and inorganic micropollutants) in the catchment area<br>Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton)<br>Degree of fragmentation | | | | amendments and additions, shall be complied with.<br>"It is advisable not to use ultrasound-based solutions for flow monitoring activities, which can limit fish transit, but solutions based on pressure transducers."<br>"The monitoring of the easement flow (and by implication the ecological flow) must be carried out throughout the MHC's operational life. Monitoring should be conducted at frequencies of less than ½ h, and data should be posted in real time on an unrestricted-access web page." |
| M18 Protection of fish species and their downstream migration will be ensured | R | All fish species | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants)<br>Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area | Degradation of aquatic habitat quality<br>Disruption of aquatic habitat connectivity | During the whole period of operation | All catchment areas (including the Livezeni dam) as well as the CHE Bumbești outlet | Given that a significant proportion of flows will pass through power intakes at the expense of fish passage, it is obvious that aquatic fauna will be attracted and/or entrained in the intakes. Good practice and literature emphasize the advantages of grates over other protection methods. Screens provide a physical and behavioral barrier for fish and |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| | | | Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) Degree of fragmentation | | | | other organisms to avoid entrainment in turbines. Thus, for catches on the Jiu River, good practices recommend the installation of horizontal grates, which are more effective in fish protection, the usual ones being grates with 20 to 10 mm spacing (LUBW 2016) or up to 2 mm (Courret et Larinier 2008) which have proven their functionality over a long period of time, even for much higher installed flows compared to the present project (Scherngell & Balestra 2020, Ebel et al. 2018, DWA 2004, Calles 2013). These correctly placed grates can thus lead fish safely to the bypass channel that provides transit across the dam. Also, at the catchment on Dumitra Stream it is necessary to provide fish protection at the intake: there are numerous applications, e.g. with Coanda screens (Coanda screen, |

| **Measure-description** | **Type of measure (P/E/R)** | **Affected species/habitat** | **Parameter addressed by the measure** | **Target impact** | **Period of implementation of the measure** | **Location of implementation of the measure** | **Comments (details of the measure)** |
|---|---|---|---|---|---|---|---|
| | | | | | | | Coanda Rechen), which prevent fish from being sucked into the turbines. Such protection is necessary to avoid fish entering the processing chain. Given that a significant amount of flow will be removed from the CHE Bumbești (this will attract fish to the offtake), fish must be prevented from entering the offtake. Thus, at the confluence with the Jiu River, a barrier in the form of a sill should be provided where the resulting drop is greater than 0.4 m. If necessary, other solutions may be chosen, such as the installation of inclined grates, possibly fixed movably in order to transit solid objects in the water volume, so that fish can continue their migration route upstream, up the Jiu River, without entering the offtake. |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| M19 The discharge (return) of the utilized water flows into the watercourse will be done in such a way as to take into account the phenomenon of “hydropeaking” | R | All fish species, *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants)<br>Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area<br>Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton)<br>Degree of fragmentation | Degradation of aquatic habitat quality<br>Disruption of aquatic habitat connectivity | During the whole period of operation | CHE Dumitra, CHE Bumbești | The association between hydromorphology and hydrology, in particular hydropeaking, is a subject that is treated superficially in most cases. Flow reduction downstream of dams will be operated in such a way as to allow fish to retreat to deeper sections of the river. Hydropeaking can occur not only in the sector downstream of the Bumbești Jiu outlet, due to rapid variations in water level due to hydro-technical exploitation works (the maneuvers of opening the gates in order to wash the deposits from the outlet, which are periodically performed by specific maneuvers of the gates). These fluctuations have a negative impact on the hydromorphology of rivers and should be studied in relation to the duration curve of mean daily flows under natural versus modified hydrological regimes. It is |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| | | | | | | | recommended to install level sensors to monitor water fluctuations in real time. Increasing the flow rate at the Bumbești Jiu outlet must be done gradually, in such a way as to avoid purging the river bed. |
| M20 Particular attention will be paid to sediment management so that sediment is returned to the river bed as efficiently as possible | R | All fish species, *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) | Degradation of aquatic habitat quality | During the whole period of operation | Dam Livezeni, CHE Dumitra, CHE Bumbești | In order to prevent erosion and to ensure the presence of natural substrate in the river bed, it is necessary to release the sediments resulting from the clealder treesg of the settling basins and the de-silting of the accumulation into the river at predetermined times, at flows that will ensure their dilution. This work should be carried out at high flows, outside the spawning period of fish species and the period immediately following (such work should be avoided during the period April-July). It is necessary to ensure transportation of sediments deposited upstream of the dam |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | | to areas downstream of the dam. According to Nistorescu et al. (2016), in order to reduce the impact on aquatic ecosystems, the flushing of the denisers should be carried out exclusively during periods of high water, preferably with reduced durations (e.g. maximum 15 min), or by continuous through partial opening of the denisers flushing valve, thus also resulting in lower velocities on the fish ladder. |
| M21. There shall be no harvesting, capture, killing, destruction or harming of specimens of nationally and/or internationally protected wild flora and fauna species in their natural environment, at any stage of their life cycle, that could accidentally end up in the area of the work perimeter; in this regard, the training program for the | P | All species of Community interest assessed as present or potentially present in the area of influence of the project | - | - | Permanent, during construction and operation | In all areas with works | - |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| personnel involved shall also include specific information on protection and management of situations in which employees interact with flora and fauna species within protected natural areas. | | | | | | | |
| M22 All elements of biodiversity (amphibian, reptile, mammal, bird and fish species) in the project area will be monitored throughout the construction period and for a minimum of 3 years (except for ichthyofauna, which is recommended for a minimum of 5 years) during the operational period. In order to be able to compare presence/absence data we recommend that monitoring is carried out in the same locations presented in the | P | All species and habitats in the area of the site or in its vicinity | - | - | Permanent (recommended monthly) during the construction phase and the first 3 years during the operational phase for all habitats and species except for ichthyofauna, which are recommended for a minimum of 5 years | In all project areas | Monitoring details for ichthyofauna:<br>Given that the effects of the proposed project will be long-term, it is necessary to monitor the ichthyofauna in this way:<br>twice a year before and during construction<br>twice a year for the first 5 years after commissioning<br>Ichthyofauna monitoring shall be conducted in all 17 sectors where assessments were conducted for this study. The length of the sectors shall be 150 m.<br>Interpretation of results gathered during ichthyofauna monitoring: |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| Appropriate Assessment Study. | | | | | | | Considering the fact that out of the 17 sectors monitored at 8 stations the flow will be considerably lower than in the present assessments (due to the use of flows for the operation of hydropower plants), the results should be treated in such a way that this aspect is taken into account. Most likely, due to the easier assessment conditions (ichthyofaunal assessments can be carried out much more easily at low river flow), the density of fish species identified will apparently be higher, which most likely will not reflect reality. For this reason, when drawing conclusions it is necessary to take this into account and compare the data from the stations where part of the river flow is used with the results from the 9 stations where the flow will not be used. |
| M23 Monitoring fish ladders/passages | P | Fish species | - | - | For a minimum period of 5 years | In all project areas where | In the event that a fish ladder or fish ramp is installed, they |

| Measure-description | Type of measure (P/E/R) | Affected species/habitat | Parameter addressed by the measure | Target impact | Period of implementation of the measure | Location of implementation of the measure | Comments (details of the measure) |
|---|---|---|---|---|---|---|---|
| | | | | | | such elements have been built | must be monitored to document their functionality or lack thereof. The fish ladder/ramp must be equipped with an automatic telemetry monitoring system based on PIT tags. This monitoring system must be included in the design phase. Two readers are required: one at the entrance of the fish ladder (downstream side) and one at the exit of the fish ladder (upstream side), similarly for the fish ramp. This will allow tracking whether the fish managed to enter the fish ladder, the time spent in the ladder, and whether they successfully passed through or returned. If it is proven that the fish ladder requires changes, these must be made as soon as possible. Monitoring of the fish ladders/ramps must be carried out for a minimum of 5 years by specialized personnel. |

f) Landscape

Considering that the visual and aesthetic value of the landscape is determined by the combination of structuring factors, namely relief, climate, hydrography, vegetation, fauna, and anthropogenic factors, all measures to reduce the impact on the landscape overlap with the proposed measures for the other environmental factors mentioned earlier.

The proposed measures to prevent or reduce any significant adverse effects on the environment, both during the construction phase and during operation, are as follows:

- All necessary measures will be taken to avoid pollution of environmental factors or to protect the health and comfort of the population as a result of dust and/or noise-generating activities, with mandatory compliance with environmental protection norms, standards, and legislation.
- Waste generated from construction activities will not be burned and will be handled by an accredited operator or will be stored in a temporary storage facility for later disposal or recovery.
- Strict prohibition of occupying areas other than those already affected by the project implementation.
- Reduced vehicle speed to avoid generating a large amount of dust.
- Regular cleaning of areas where activities are conducted.
- Frequent emptying of waste containers to avoid overflowing.
- During the operation of the hydropower facility, it is recommended to maintain the built elements of the facility, and maintenance work should be carried out using the latest and most efficient machinery that does not leak oil/fuel and has lower emissions and fuel consumption.

### *f) Population and material goods*

The measures to reduce or prevent the impact on the human component during the project's construction and operation phases include:

- Signage and fencing of areas where construction work is to take place to prevent access and reduce direct risks to public safety.
- Cleaning the site of waste before and after construction activities.
- Conducting activities only during daylight hours (including the transportation of materials to and from the site).
- Periodic checks on the operational condition of machinery to avoid any malfunctions and accidents that could endanger personnel on the site.
- Requesting data regarding the forecast and levels of water flow from the competent authorities to avoid potential damage downstream that may reach localities.
- Access to the site with machinery will only be allowed on already established roads.
- Utilizing modern machinery equipped with soundproofed engines.
- Limiting the speed and frequency of timber transport vehicles within localities.

- It is recommended that local labor (preferably from the administrative-territorial units in the area of the site) be employed for the construction and operational phases.
- According to the applicable legislation, archaeological monitoring will be conducted from the beginning of the investment until its completion, and in the event that archaeological elements are discovered, the competent authorities will be notified.

## B. ***Monitoring***

Environmental monitoring, both during the construction and decommissioning phases, as well as during the operation of the Livezeni Bumbești Hydropower Plant, will aim to implement additional measures, as necessary, to minimize impact on the surrounding environment, the population, and human settlements, thereby respecting the concept of sustainable development.

Monitoring is the only method that can accurately determine the impact generated in various phases of a project. Moreover, only correct monitoring can verify whether the impact reduction measures are properly implemented and effective, or if additional reduction measures (with the approval of the Ministry of Environment, Waters, and Forests - MMAP / Environmental Protection Agencies - APM / County Environmental Protection Agencies - ACPM) are necessary, allowing for their adaptation to updated field conditions to enhance their efficiency.

It is recommended that monitoring be conducted according to the proposed plans, playing an essential role in identifying and establishing sensitive areas regarding the impact caused by the project's implementation on environmental components.

Periodic measurements will be conducted according to the established monitoring plan, using an accredited laboratory to ensure that the activities undertaken within the working fronts comply with the permitted pollution limits regarding concentrations of pollutants in the air, water, soil, and noise levels.

Based on the data resulting from the monitoring, the monitoring plan will be periodically updated, in agreement with the competent environmental protection authorities.

In the event that maximum permissible limits are exceeded, measures to mitigate environmental impact will be proposed, which will be analyzed by the competent environmental protection authorities for implementation.

The monitoring results will be transmitted and kept by the holder/contractor/construction company and will be presented upon request to the MMAP, the National Agency for Environmental Protection (ANPM), APM, the Water Management System (SGA), the National Environmental Guard (GNM-CG), and/or the County Environmental Guard (GNM-CJ).

### *B.1. Monitoring program for project impact on water bodies*

The proposed monitoring program outlined in Table 96 pertains to the quality elements for which cause-effect mechanisms have been identified in the case of the water bodies affected by the Livezeni Bumbești Hydropower Plant works.

*Table no. 96 - Monitoring program for the impact of the project on water bodies*

| Water body | Monitoring section | Monitored quality elements | Monitoring timing | Monitoring frequency and duration |
|---|---|---|---|---|
| Jiu - confl. Jiu de Est - Acum. Vădeni | Upstream of Livezeni Dam | Flow, depth, width, substrate, benthic invertebrates, fish fauna, temperature, dissolved oxygen, CBO5, CCO-Cr | Current situation | at least 3 times/year for 2 years |
| | | | Post construcție (operare) | at least 3 times/year for 2 years |
| | Downstream of Livezeni Dam | | Current situation | at least 3 times/year for 2 years |
| | | | Post construcție (operare) | at least 3 times/year for 2 years |
| Jiu - confl. Jiu de Est - Acum. Vădeni | Upstream of the secondary intake on the Jiu River (upstream of the confluence with the Dumitra River) | | Current situation | at least 3 times/year for 2 years |
| | | | Post construcție (operare) | at least 3 times/year for 2 years |
| Jiu - confl. Jiu de Est - Acum. Vădeni | Downstream of the secondary intake on the Jiu River | | Current situation | at least 3 times/year for 2 years |
| | | | Post construcție (operare) | at least 3 times/year for 2 years |
| Jiu - confl. Jiu de Est - Acum. Vădeni | Downstream of the Bumbeşti Hydropower Plant discharge | | Current situation | at least 3 times/year for 2 years |
| | | | Post construcție (operare) | at least 3 times/year for 2 years |
| Bratcu - spring - cf. Jiu | Upstream of the Bratcu intake | Flow, longitudinal connectivity, depth, width, substrate, benthic invertebrates, fish fauna, temperature, dissolved oxygen, CBO5, CCO-Cr | Current situation | at least 3 times/year for 2 years |
| | Downstream of the Bratcu intake | | Current situation | at least 3 times/year for 2 years |

The proposed monitoring section locations are presented in Figure 218.
Monitoring, including measurements and sampling, must be conducted according to the applicable standards, SR or EN/ISO, mentioned in Annex V of the Water Framework Directive. Additionally, the monitoring/determination of hydromorphological parameters must be carried out with specific equipment and in accordance with national guidelines/methodologies.

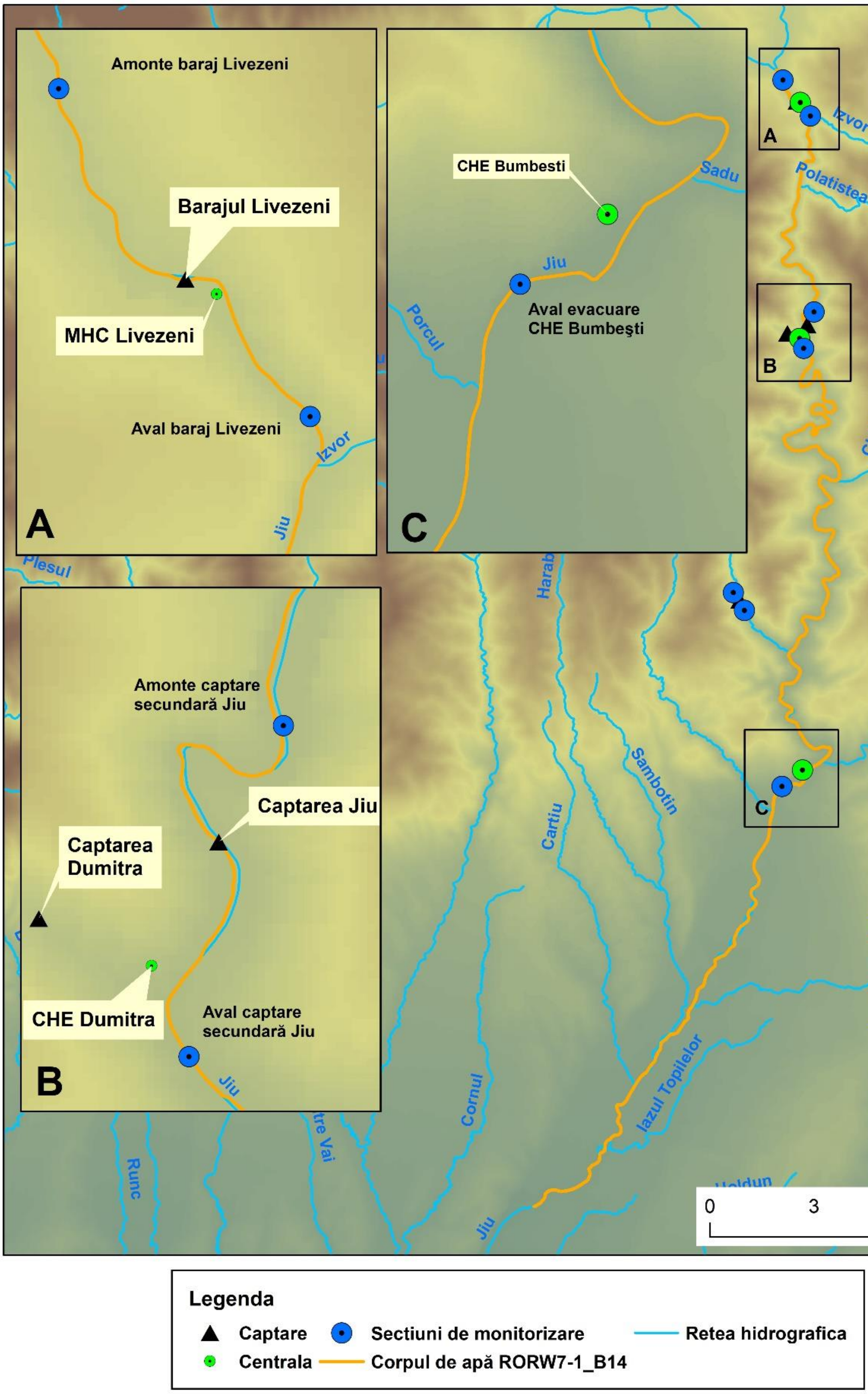


Fig. 218 Proposed monitoring section locations

*B.2. Program for monitoring the impact of the project on biodiversity*

*Table no. 97 Monitoring program of measures*

| ANPIC affected (CODE, name) | Conservation objective/ Species/ habitat affected/ parameter | | Form of impact | Mitigation measure | Implementation period of the measure | Location of measure implementation | Monitoring indicators | Units of measurement | Monitoring frequency | Monitoring locations | Monitoring duration | Effectiveness of the measure | Budget* | Monitoring responsibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Affected species/habitat | Parameter addressed by the measure | | | | | | | | | | | | |
| ROSCI0063 Jiului gorge | Habitat 91E0* | The presence of invasive/allochthonous species | Habitat degradation by increasing the proportion of uncharacteristic species | M1. In order to avoid the risk of introduction or extinction of allochthonous, non-native, ruderal or nitrophilous species (e.g. *Robinia pseudacacia*, *Salix capraea*, *Betula pendula*, *Populus tremula*) in the area of habitat type 91E0*, specimens of these species will be removed during construction works | Permanent, under construction | In the area of the secondary intake on the Jiu, including the road between CHE Dumitra and this catchment | Proportion and distribution of unsuitable, allochthonous, nitrophilous species including unsuitable ecotypes | Degree of coverage+attendance places | Monthly from April to September | On areas of habitat 91E0* in the CHE Dumitra area | During construction | high | 1000 lei/month | Contractor/ Builder |
| | Habitat 91E0* | The presence of invasive/allochthonous species | Habitat degradation by increasing the proportion of uncharacteristic species and Habitat degradation for some riparian habitat-dependent species | M2. Throughout the construction period, non-native, non-habitat type, ruderal or nitrophilous tree and shrub species identified on the project site will be carefully monitored to prevent their spread. If necessary, their removal will be accomplished, including removal of shoots/roots from their roots. | Permanent, under construction | In the Jiu secondary intake area, including the road between the CHE Dumitra and the Jiu secondary intake | | | | | | | | |
| | Fish species, *Lutra lutra* and *Austropotamobius torrentium* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) | Degradation of aquatic habitat quality | M3 The water diversion works will be carried out outside the closed periods for fish species and only during low flow periods, preferably in August-October. | Permanent, under construction | In the Livezeni dam area, the area of the secondary intake on the Jiu and the works in the Dumitra Stream | Length of watercourse where diversions have been made | km | Monthly | Jiu catchment, Livezeni Dam | During construction | high | 500 lei/month | Contractor/ Builder |
| | Fish species, *Lutra lutra* and *Austropotamobius torrentium* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) | Degradation of aquatic habitat quality | M4 In works to be carried out on the watercourse involving various substances/materials (e.g. concrete, oils, paints, primers), particular attention shall be paid to their handling in order to | Permanent, under construction | On all sites connected to the River Jiu and its tributaries Dumitra and Bratcu | Water quality by pH, COD-Cr, $BOD_5$ , petroleum products, heavy metals (Mn, Cd, Pb, Ni, Cu, Zn) | Feature of each parameter | Monthly | Minimum one monitoring point on the R. Jiu in the area of Livezeni | During construction | high | 1500 lei/month | Contractor/Builder |

| ANPIC affected (CODE, name) | Conservation objective/ Species/ habitat affected/ parameter: Affected species/habitat | Conservation objective/ Species/ habitat affected/ parameter: Parameter addressed by the measure | Form of impact | Mitigation measure | Implementation period of the measure | Location of measure implementation | Monitoring indicators | Units of measurement | Monitoring frequency | Monitoring locations | Monitoring duration | Effectiveness of the measure | Budget* | Monitoring responsibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) | | minimize the risk of accidental pollution. | | | | | | dam, Dumitra catchment, and CHE Bumbești, minimum one monitoring point of Dumitra Stream (catchment area) and one point on Bratcu River (downstream site organization) | | | | |
| | Fish species, *Lutra lutra* and *Austropotamobius torrentium* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants)<br>Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) | Degradation of aquatic habitat quality | M5. The washing of machinery in riverbeds is prohibited, subject to other measures related to the water bodies indicated in the SEICA. For work in riverbeds, only tested machinery, which does not leak oil/fuel into the riverbeds, shall be used. | Permanent, under construction | On all sites connected to the River Jiu and its tributaries Dumitra and Bratcu | | | | | | | | |
| | All species of Community interest assessed as present or potentially present in the area of influence of the project | All parameters referring to the habitat quality of species | Degradation of aquatic habitat quality<br>Habitat area (for *Bombina bombina and Austropotamobius torrentium)* | M6. An accidental pollution prevention and response plan will be implemented, including concrete measures to prevent accidental spills of diesel, oil or other hazardous/polluting substances into water or onto land. | Permanent, under construction | In all areas with works | | | | | | | | |
| | Chiroptera species, | Species distribution in the protected area<br>Species distribution within the 1 km$^2$ European ETRS89 grid system | Increased noise levels in project areas located in quiet zones with low anthropization in the vicinity. | M7. The project works will be carried out exclusively during the day, between 07:00-20:00 | Permanent, under construction | In all areas with works | Noise level | dB(A) | Monthly | At least one monitoring point in each of the work zones | During construction | high | 500 lei/month | Contractor/ Builder |
| | *Canis lupus, Ursus arctos Lutra lutra* | Predator population density | | | | | | | | | | | | |
| | Chiroptera species, | Species distribution in the protected area<br>Species distribution within the 1 km$^2$ European ETRS89 grid system | Increased noise levels in project areas located in quiet zones with low anthropization in the vicinity. | M8. Quiet machinery and means of transport will be used to reduce noise due to specific activities, as well as equipment with efficient systems to minimize and contain pollutants in the atmosphere. At the same time, machinery will be checked periodically to avoid oil and fuel spills on | Permanent, under construction | In all areas with works | | | | | | | | |
| | *Canis lupus, Ursus arctos Lutra lutra* | Predator population density | | | | | | | | | | | | |

| ANPIC affected (CODE, name) | Conservation objective/ Species/ habitat affected/ parameter | | Form of impact | Mitigation measure | Implementation period of the measure | Location of measure implementation | Monitoring indicators | Units of measurement | Monitoring frequency | Monitoring locations | Monitoring duration | Effectiveness of the measure | Budget* | Monitoring responsibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Affected species/habitat** | **Parameter addressed by the measure** | | | | | | | | | | | | |
| | | | | the surface of habitats or near watercourses. | | | | | | | | | | |
| | Chiroptera species, Large carnivore species, *Lutra lutra*, *Bombina variegata* | - | Degradation of aquatic habitat quality Habitat area (for *Bombina variegata)* | M9. Proper waste management shall be practiced; selective collection, recovery and regular disposal of waste shall be carried out in order to avoid attracting animals, making them ill or causing them injury. | Permanent, under construction | In all areas with works | Number of construction waste disposal sites (including waste related to the activity) | No. locations | Monthly during the construction period | In all areas with works in protected natural areas | Monthly | high | 500 lei/month | Contractor/Builder |
| | Chiroptera species, | Species distribution in the protected area<br>Species distribution within the 1 km² European ETRS89 grid system | Increased noise levels in project areas located in quiet zones with low anthropization in the vicinity. | M10 Mobile sound absorbing panels shall be used for site fencing at all work sites | Permanent, under construction | In all areas with works | Sound absorbing panels placed | Achieved/ Unfulfilled | Monthly | In all areas with works | During construction | high | 3500 lei/month | Contractor/ Builder |
| | *Canis lupus, Ursus arctos Lutra lutra* | Predator population density | | | | | | | | | | | | |
| | *Barbus balcanicus Austropotamobius torrentium Lutra lutra* | Length of arboreal riparian vegetation on both banks Length of riparian vegetation with an average width of at least 3 m on both banks of the watercourse in each 500 m section | The impact on riparian vegetation in the riverbed area (Jiu intake, Dumitra Stream area, Livezeni area), including riverbed regulation. | M11 Upon completion of the project works on both banks of the R. Jiu and on the banks of Dumitra Stream (where the terrain allows) will be planted alder trees (*Alnus sp), in* order to restore the affected riparian vegetation. | At the end of the construction period | Livezeni dam area, Jiu catchment, works Dumitra Stream confluence with R. Jiu | Areas of land planted+no. of seedlings planted+locations with restored riparian vegetation | Ha/nr. pieces/nr | Once upon completion of the works | Where riparian vegetation has been affected | On completion of the construction period | high | 1500 lei/month | Contractor/ Builder |
| | *Barbus balcanicus Austropotamobius torrentium* | Natural riverbed with a complex (natural) structure / Number of meanders Natural riverbed with a complex (natural) structure / Number of meanders depending on the size of the watercourse | The impact on riparian vegetation in the riverbed area (Jiu intake, Dumitra Stream area, Livezeni area), including riverbed regulation. | M12 Gabions will be used for the riverbed regularization works (Jiu river downstream Livezeni dam and downstream Jiu catchment) (if constructively possible) | During the construction period | Livezeni dam area, Jiu catchment, works Dumitra Stream confluence with R. Jiu | No. of locations with gabions used, areas | Nr./ha | Once upon completion of the works | Where channel regularization has been carried out | On completion of the construction period | high | 2500 lei/month | Contractor/ Builder |
| | *Bombina variegata* | Population size | Loss of individuals of species with reduced mobility (amphibians, invertebrates) as well as loss of characteristic habitats (some anthropogenic) of these species | M13. Prior to the start of construction works, all areas within the project site will be inspected (with emphasis on the CHE Bumbești and Livezeni dam area) in order to identify specimens of *Bombina variegata* and in case individuals of this species are observed, all | Before the construction period | In all areas with works | No. of specimens relocated, species relocated, location of relocation (report according to the regulations in force)+photos | No. relocation reports | Once, at the start of work | In all project areas | At the beginning of the construction period | high | 2500 lei/month | Contractor/ Builder |

| ANPIC affected (CODE, name) | Conservation objective/ Species/ habitat affected/ parameter | | Form of impact | Mitigation measure | Implementation period of the measure | Location of measure implementation | Monitoring indicators | Units of measurement | Monitoring frequency | Monitoring locations | Monitoring duration | Effectiveness of the measure | Budget* | Monitoring responsibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Affected species/habitat | Parameter addressed by the measure | | | | | | | | | | | | |
| | | | | necessary measures will be taken to relocate them to other favorable habitats. | | | | | | | | | | |
| | *Austropotamobius torrentium* | Population size | Loss of individuals of species with reduced mobility (amphibians, invertebrates) as well as loss of characteristic habitats (some anthropogenic) of these species | M14. Prior to the start of construction works, the work sites in the Dumitra Stream (including R. Jiu downstream and upstream of the confluence with Dumitra) in order to identify specimens of *Austropotamobius torrentium* and if individuals of this species are observed, all necessary measures will be taken to relocate them to other favorable habitats | Before the construction period | In the areas with works at CHE Dumitra (including the R. Jiu downstream and upstream of the confluence with Dumitra) | No. of specimens relocated, species relocated, location of relocation (report according to the regulations in force)+photos | No. relocation reports | Once, at the start of work | In the area of CHE Dumitra (including the area R. Jiu downstream and upstream of the confluence with Dumitra) | At the beginning of the construction period | high | 2500 lei/month | Contractor/ Builder |
| | All fish species, *Austropotamobius torrentium* *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants)<br>Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area<br>Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton)<br>Degree of fragmentation | Degradation of aquatic habitat quality<br>Disruption of aquatic habitat connectivity | M15 Restoring longitudinal connectivity at Livezeni dam | Throughout construction and operation | Livezeni Dam | Fish ladder/channel realized (location + construction details, species that can use it, flow rate, other elements considered relevant for it, etc.) | Report | Once upon completion of the works | Livezeni Dam | On completion of the construction period | high | 2500 lei/month | Contractor/ Builder |
| | All fish species, *Austropotamobius torrentium* *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants)<br>Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area | Degradation of aquatic habitat quality<br>Disruption of aquatic habitat connectivity | M16 Restoration of longitudinal connectivity at the secondary intake on the Jiu river, upstream of the confluence with Dumitra | Throughout construction and operation | Jiu secondary intake | Fish ladder/channel realized (location + construction details, species that can use it, flow rate, other elements considered relevant for it, etc.) | Report | Once upon completion of the works | Jiu catchment | On completion of the construction period | high | 2500 lei/month | Contractor/ Builder |

| ANPIC affected (CODE, name) | Conservation objective/ Species/ habitat affected/ parameter | | Form of impact | Mitigation measure | Implementation period of the measure | Location of measure implementation | Monitoring indicators | Units of measurement | Monitoring frequency | Monitoring locations | Monitoring duration | Effectiveness of the measure | Budget* | Monitoring responsibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Affected species/habitat | Parameter addressed by the measure | | | | | | | | | | | | |
| | | Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) Degree of fragmentation | | | | | | | | | | | | |
| | All fish species, *Austropotamobius torrentium Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) Degree of fragmentation | Degradation of aquatic habitat quality Disruption of aquatic habitat connectivity | M17 Maintaining the ecological flow on the Jiu River as well as Dumitra Stream and Bratcu River | Throughout construction and operation | All works on the R. Jiu and Dumitra Stream and Bratcu | Average monthly values of ecological flow | Report | Monthly | On R. Jiu downstream of Livezeni dam, downstream of Jiu catchment and downstream of CHE Bumbești, on Dumitra Stream and Bratcu | During construction and during operation (minimum 5 years) | high | 3500 lei/month | Contractor/ Builder and holder |
| | All fish species, | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) Degree of fragmentation | Degradation of aquatic habitat quality Disruption of aquatic habitat connectivity | M18 Protection of fish species and their downstream migration will be ensured | During the whole period of operation | All catchment areas (including Livezeni dam) as well as the CHE Bumbești outlet | No. of grates (other elements to ensure species migration) | Nr. | Once upon completion of the works | All catchment areas (including the Livezeni dam) as well as the CHE Bumbești outlet | On completion of the construction period | high | 2500 lei/month | Contractor/ Builder |

| ANPIC affected (CODE, name) | Conservation objective/ Species/ habitat affected/ parameter | | Form of impact | Mitigation measure | Implementation period of the measure | Location of measure implementation | Monitoring indicators | Units of measurement | Monitoring frequency | Monitoring locations | Monitoring duration | Effectiveness of the measure | Budget* | Monitoring responsibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Affected species/habitat | Parameter addressed by the measure | | | | | | | | | | | | |
| | All fish species, *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) Degree of fragmentation | Degradation of aquatic habitat quality Disruption of aquatic habitat connectivity | M19 The discharge (return) of used flows to the watercourse shall be done in such a way that hydropeaking is taken into account | During the whole period of operation | CHE Dumitra, CHE Bumbești | Water fluctuations. (Analysis of the duration curve of mean daily flows under natural versus modified hydrological regime. It is recommended to install level sensors to monitor water fluctuations in real time). | Report | Annual | CHE Dumitra, CHE Bumbești | In operation | high | 4500 lei/month | Holder |
| | All fish species, *Lutra lutra* | Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) Water quality based on physico-chemical indicators (oxygen regime, nutrients, salinity, metals, organic and inorganic micropollutants) in the catchment area Water quality based on ecological indicators (macronevertebrates, phytobenthos, phytoplankton) | Degradation of aquatic habitat quality | M20 Particular attention will be paid to sediment management so that sediment is returned to the river bed as efficiently as possible | During the whole period of operation | Livezeni Dam, CHE Dumitra, CHE Bumbești | No. of washouts + period of realization | Report | Annual | Dam Livezeni, CHE Dumitra, CHE Bumbești | In operation | high | 1500 lei/month | Holder |
| | All species of Community interest assessed as present or potentially present in the project area of influence | - | - | M21. There shall be no harvesting, capture, killing, destruction or harming of specimens of nationally and/or internationally protected wild flora and fauna species in their natural environment, at any stage of their life cycle, that could accidentally end up in the area of the work perimeter; | Permanent, during construction and operation | In all areas with works | Accidental fatalities during construction (species+location+cause of death+photos) | No of specimens per species | Monthly | In all areas with works | In the construction phase | high | 1500 lei/month | Contractor/ Builder |

| ANPIC affected (CODE, name) | Conservation objective/ Species/ habitat affected/ parameter | | Form of impact | Mitigation measure | Implementation period of the measure | Location of measure implementation | Monitoring indicators | Units of measurement | Monitoring frequency | Monitoring locations | Monitoring duration | Effectiveness of the measure | Budget* | Monitoring responsibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Affected species/habitat | Parameter addressed by the measure | | | | | | | | | | | | |
| | | | | in this regard, the training program for the personnel involved shall also include specific information on protection and management of situations in which employees interact with flora and fauna species within protected natural areas. | | | | | | | | | | |
| | All species and habitats in the area of the site or in its vicinity | - | - | M22 All biodiversity features (amphibian, reptile, mammal, bird and fish species) in the project area will be monitored throughout the construction period and for a minimum of 5 years during the operational period. In order to be able to compare presence/absence data we recommend that monitoring is carried out in the same locations as presented in the Appropriate Assessment Study. | Permanent (recommended monthly) during the construction phase and the first 3 years during the operational phase for all habitats and species except for ichthyofauna, which are recommended for a minimum of 5 years | In all project areas | Presence of species of Community interest in areas affected by construction - qualitative and quantitative data. Quantitative data will be collected for the groups for which such data can be collected. Distribution of species of community interest in areas affected by construction. Dynamics influenced by construction works on species of community interest. Significance of the impact on the habitats of fauna species of Community interest for those species that are strictly associated with the habitats to be affected (wetlands, etc). Significance of the impact on fauna species of Community interest). | Database (list) of identified species | Monthly | In all areas with works | Permanent (recommended monthly) during the construction phase and the first 3 years during the operational phase for all habitats and species except for ichthyofauna, which are recommended for a minimum of 5 years | high | 3500 lei/month | Contractor/Builder and Holder for the operating prioada |
| | Fish species | - | - | M23 Monitoring fish ladders/passages | For a minimum period of 5 years | In all project areas where such elements have been built | Species using the fish ladder, assessing the degree of ladder use, proposing measures to improve the efficiency | Report | Monthly | All fish ladders made | For a minimum period of 5 years | high | 3500 lei/month | Holder for the operating period |

| ANPIC affected (CODE, name) | Conservation objective/ Species/ habitat affected/ parameter | | Form of impact | Mitigation measure | Implementation period of the measure | Location of measure implementation | Monitoring indicators | Units of measurement | Monitoring frequency | Monitoring locations | Monitoring duration | Effectiveness of the measure | Budget* | Monitoring responsibility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Affected species/habitat | Parameter addressed by the measure | | | | | | | | | | | | |
| | | | | | | | of the ladder, finding malfunctions | | | | | | | |

*The estimated budget for monitoring the measure, based on the prices charged by various certified companies specialized in biodiversity monitoring.

*B.3. Monitoring Program for the Impact of the Project on Other Environmental Factors*

*Table No. 98 Monitoring Program for Environmental Factors*

| Environmental Factor | Frequency | Monitoring Points | Monitored Parameters | Location | Responsible |
|---|---|---|---|---|---|
| Air | Monthly, throughout the construction period | - Livezeni Dam, CHE Dumitra, Platforma Murga Mică, Organizare de șantier Bratcu, CHE Bumbești | Imissions ($NO_2$, $SO_2$, suspended particulates, VOCs), emissions (CO, NO, $NO_x$) | - work fronts. | contractor |
| Soil | Monthly, throughout the construction period | - Livezeni Dam, CHE Dumitra, Platforma Murga Mică, Organizare de șantier Bratcu, CHE Bumbești | pH, heavy metals (cadmium, copper, chromium, manganese, nickel, lead, zinc), TPH | - construction sites | contractor |
| Noise | Monthly, throughout the construction period | - Livezeni Dam, CHE Dumitra, Platforma Murga Mică, Organizare de șantier Bratcu, CHE Bumbești | Noise level, dB (A) | - work fronts;<br>- construction sites | contractor |

## 8. DESCRIPTION OF THE SIGNIFICANT NEGATIVE EFFECTS ANTICIPATED ON THE ENVIRONMENT, DETERMINED BY ITS VULNERABILITY TO THE RISKS OF MAJOR ACCIDENTS AND/OR RELEVANT DISASTERS FOR THE OBJECTIVE IN QUESTION

Risk is defined as the probability of exposure of humans, human-made assets, and environmental components to the action of a specific hazard of a certain magnitude. Risk represents the probable level of losses and damages caused by a particular natural phenomenon or group of phenomena in a specific place and time.

Risk is defined as:

R = f x C

Where:

- R = risk, in units of "consequence" per unit time;
- f = frequency of the event occurrence (units of time);
- C = consequence of the event, in corresponding units (financial losses, health impacts).

The choice of a risk assessment method primarily depends on the activity, objective, or substance under analysis, as well as the available data and knowledge.

The risk assessment procedure includes the following steps:

- Identification of hazards;
- Exposure assessment (determination of the magnitude of the physical effects of undesirable events);
- Consequence assessment (evaluation of potential damages caused by the manifestation of undesirable events);
- Risk estimation (integration of the probability of the occurrence of the undesirable event with the assessment of the consequences).
- Environmental risk assessment is not always mathematically quantifiable.

Reasons include the lack of a generally accepted methodology, the absence of case studies, and, not least, the necessary data to conduct a comprehensive risk analysis.

For the project under analysis, the following risk factors have been identified:

- Seismic risk (natural risk factor);
- Anthropogenic risk factors:
- Risk of accidental pollution;
- Risk of work accidents;
- Risk of stormwater discharge from the collection basin.

Natural risk factors:

- Seismic risk. This refers to the occurrence of an exceptional seismic event, associated or not with the emergence of other risk factors.

The characterization of seismic risk has been discussed in previous chapters

*Risk Analysis for Human Health and Safety, Cultural Heritage, or the Environment Due to Accidents, Armed Attacks, or Disasters*

In considering these risks, the following have been taken into account:

- Flooding caused by natural overflow of watercourses, blockages produced by ice, landslides; flooding caused by incidents, accidents, or failures at constructions;
- Dangerous meteorological phenomena: torrential rains, heavy snowfall, storms and blizzards, deposits of "ice, frost, glaze, early or late frosts, heat waves, hail, and droughts, tornadoes, avalanches;
- Armed attacks, fires, explosions, accidental pollution of watercourses, soil, accidental pollutant emissions into the atmosphere, earthquakes, damage or destruction of installations, equipment, and hydraulic constructions, floods, morphological and geological changes in the slopes of reservoirs, and other serious natural disasters.

For all these situations, there are measures included in the action plan of the beneficiary, prepared with the county prevention and defense commissions. In this case, warning and alarm measures are applied for the protection of people and property; the Hydro Accumulation (H.A.) is stopped; the quick valve is closed; the dispatcher and the Emergency Situations Cell are notified; the water level in the reservoir is monitored, and if there is a risk of flooding the hydroelectric power plant, all installations of the Hydroelectric Power Station (HPS) are de-energized, and the HPS is evacuated.

*Table no. 99 Critical thresholds*

| River | Defense Parameters | | | | | |
|---|---|---|---|---|---|---|
| | Attention | | Alertă | | Pericol | |
| | Level (cm) | Debit ($m^3/s$) | Cotă (cm) | Debit ($m^3/s$) | Cotă (cm) | Debit ($m^3/s$) |
| Jiu | 100 | 28.8 | 150 | 64.4 | 200 | 104 |

Characteristic Defense Measures Defined in Cases of Flooding:

a) For the leveed areas of watercourses:

- Phase I of Defense - when the water level reaches the toe of the outer slope of the levee over one-third of its length;
- Phase II of Defense - when the water level reaches halfway between the Phase I height and the Phase III height;
- Phase III of Defense - when the water level is between 0.2 m and 1.5 m below the level of the highest known water levels or below the maximum level for which the levee was designed, or when it exceeds a critical point.

b) For the un-leveed areas of watercourses, at the sections of hydrometric stations:

- Flood Level (C.I.) - the level at which significant overflow occurs that may lead to the flooding of the first objective;
- Danger Level (C.P.) - the level at which special evacuation measures for people and goods may be necessary, restrictions on the use of bridges and roads, as well as special measures in the operation of hydrotechnical constructions.

For accumulations, Phases I, II, and III of defense are established based on the water level in the lake and the inflow rate, calculated by the designer/expert within the range between the Normal Retention Level (N.N.R.) and the Maximum Operating Level (N.M.E.) established by operational regulations.

For dam behavior, critical thresholds are set by the designer for each objective based on:

- The water level in the lake when it exceeds the Normal Retention Level (N.N.R.);
- Reaching limit values in the construction's behavior. Limit values in construction behavior include:
- ➢ Attention Threshold - values of some parameters approach or even exceed the normal range, without altering the overall stability of the construction;
- ➢ Alert Threshold - dangerous changes in behavioral parameters indicating the potential onset of failure;
- ➢ Danger Threshold - the dam undergoes changes that may lead to serious damage or structural failure.

In cases of flood danger due to ice accumulation and overflow, the following characteristic sizes are established:

- Phase I - when ice breaks off and ice floes flow down the watercourse, causing small accumulations;
- Phase II - when ice floes accumulate and increase upstream levels;
- Phase III - when ice floes block, forming ice jams that lead to damage from overflow upstream or downstream flow of ice floes due to jam failure.

In cases of flooding caused by the rise of the groundwater table on agricultural land (internal water flooding), the following characteristic sizes are established:

- Attention Threshold - the appearance of ponding on at least 30% of the potentially affected land area;
- Warning Threshold - water stagnates in the flooded area for up to 72 hours;
- Warning/Danger Threshold - water stagnates in the flooded area for more than 72 hours.

## 9. NON-TECHNICAL SUMMARY OF THE INFORMATION PROVIDED IN PREVIOUS SECTIONS

The project is located in the counties of Hunedoara (Livezeni dam and MHC Livezeni) and Gorj (Dumitra hydroelectric power station, Dumitra intake, Jiu intake, Bratcu intake, and Bumbești hydroelectric power station). It spans two administrative-territorial units: Aninoasa in Hunedoara County, which is part of the West Development Region, and Bumbești Jiu in Gorj County, which is part of the South-West Development Region, located in the Jiu hydrographic basin.

The project site is situated in the western part of the Southern Carpathians, between the Vâlcan Mountains to the west and the Parâng Mountains to the east. The hydroenergy development scheme of the Jiu River in the Livezeni – Bumbești sector includes two diversion power stations and a micro-hydropower plant for the service flow, namely: Dumitra HPP, Bumbești HPP, and MHC Livezeni.

The project falls under Annex 2, point 3, letter (h) of Law no. 292/2018. Additionally, it complies with the provisions of Article 48, paragraph (1) - a and Article 54 of the Water Law no. 107/1996, with subsequent amendments and completions.

The project has been designated as being of major public interest, utilizing renewable energy, and is considered an exceptional situation in the sense of the provisions of Article 5 paragraph (2) of Law no. 292/2018 regarding the assessment of the environmental impact of certain public and private projects. It is also a project of national interest/national security according to the provisions of O.U.G. no. 175/2022, which establishes measures regarding investment objectives for the completion of ongoing hydroenergy developments, as well as other major public interest projects utilizing renewable energy, and for amending and completing various normative acts.

Currently, the project "Hydroenergy Development of the Jiu River in the Livezeni-Bumbești Sector" represents the necessary works for the completion of the investment, which is regulated from an environmental protection perspective through environmental agreement GJ-51/18.04.2003.

The investment objective is approved by H.G. no. 10/2003 and declared a "public utility investment objective of national interest" by H.G. no. 1.297/2006. It provides for the realization of a hydroenergy development scheme in the gorges of the Jiu River between Livezeni and the confluence with the Sadu River, over a length of approximately 20 km and a drop of 263 m, through the construction of two diversion hydroelectric power stations, namely: Dumitra HPP and Bumbești HPP, as well as the micro-hydropower plant (MHC) Livezeni, located on the stretch that will ensure the service flow.

The general objective of the project is to exploit the hydroenergy potential of the Livezeni-Bumbești sector of the Jiu River in the gorge area by completing the remaining works at the two hydroelectric power stations and the micro-hydropower plant.

For this reason, the current environmental impact assessment procedure has been initiated, with appropriate assessment, to ensure, on one hand, the evaluation of new solutions, and on the other hand, the updating of information regarding the impact on protected species and habitats at the level of Natura 2000 areas.
The energy produced by the power plants built on the Jiu River allows the electrification of over 100,000 households with an average monthly consumption of 200 kWh/month.

The commissioning of the "Hydroenergy Development of the Jiu River in the Livezeni-Bumbești Sector" will contribute to an increase in energy production by 259 GWh/year and to the security of electricity supply for the national energy system, especially considering that our country has committed to the phased elimination of power plants that operate on lignite and coal. By December 31, 2022, 2,355 MW had been shut down (1,695 MW by December 31, 2021, and 660 MW by December 31, 2022) and will be gradually decommissioned by no later than 2025—1,425 MW from the total installed capacity of electricity based on lignite and coal.

The hydroenergy development scheme is divided into two steps. The two steps are connected by two underground concrete intake galleries that do not impact protected natural areas.

**The works have been completed to an extent of 87%.**

**The project aims to increase the share of electricity production from renewable sources by completing the works and ensuring permanent monitoring of the environmental impact of the hydroenergy development of the Jiu River in the Livezeni - Bumbești sector, focusing solely on the remaining works necessary for the commissioning of the objective.**

**Projected Environmental Impact:**

The documentation provides information regarding how the proposed project interacts with environmental factors and the effects it may have on them, relative to their current state, as described in the previous chapters.

***a) WATER (Conclusions – taken from SEICA)***
The SEICA study aimed to analyze the potential impacts on the ecological state/potential ecological status and chemical status of surface water bodies (rivers), as well as the state of protected areas, resulting from the implementation of the project. This study was developed in accordance with Annex 3 of Order 828/2019 - the framework content of the impact assessment study for water bodies. Additionally, the study took into account a series of methodological and legislative tools used in water resource management (Framework Water Directive

2000/60/EC, Law 107/1996 with subsequent amendments, European guidelines, methodologies).

Out of the four water bodies potentially affected by the project, the works related to the A.H.E. Livezeni Bumbești are located/designed on two water bodies.

The main quality elements affected by the completion and commissioning of the A.H.E. Livezeni Bumbești, specifically the water intake activity, are flow and longitudinal connectivity. The reduction of flow can also affect parameters such as depth, width, substrate, and benthic invertebrates. Furthermore, if longitudinal connectivity is interrupted by the dam works related to A.H.E. Livezeni Bumbești (this applies to the Bratcu water body – spring – confluence with the Jiu), for more than 30% of the length of the water body (see the approach regarding longitudinal connectivity – the spatial extension from a local analysis scale to the analysis at the level of the entire water body), this habitat fragmentation is considered to impact fish fauna.

Regarding the cumulative impact, potential permanent and significant effects were identified only in the case of two water bodies (Jiu - confluence with Jiu de Est - Acumulare Vădeni and Bratcu – spring – confluence with Jiu). All analyzed water bodies for which potential effects (impact/cumulative impact) were identified currently meet environmental objectives (good ecological status and good chemical status) and therefore may present a risk of deterioration at the level of some quality elements.

***b) AIR***

During the execution of the works, sources of air pollution will be generated partly by the exhaust gases and dust from the construction and transport equipment, and partly by their circulation on the access/technological roads related to the works, which connect to existing public roads, as follows:

Bumbești-Jiu area – DC 149 and DN66, Aleea Luncani towards CHE Bumbești and technological roads to the balance castle and butterfly valve house in Bumbești;
Dumitra-Livezeni area – DN66, and access roads for site organization in Bratcu.
The presence of pollutants emitted during these operations (CO, NOx, VOCs, H2S, cement dust) will be felt exclusively locally, in the area where the respective operation takes place; under the action of atmospheric factors, their dispersion will occur in a short time.

In these conditions, the resulting negative impact will have a limited spatial character, being insignificant. The contractor will be required to maintain their equipment and transport vehicles in good working condition, as well as to ensure ongoing maintenance (watering, leveling) of the technological/access roads.

Operations to clean/sandblast various elements of the equipment that have already been purchased and require restoration of anticorrosive protection (shields, sealing gates, forced pipe sections, expansion compensators, etc.) will generate local air pollution, necessitating occupational safety measures for the construction personnel.

In these conditions, the resulting negative impact will manifest throughout the entire construction period but will remain within acceptable limits and must be accepted. Once the works are completed and this step of the fall is operational, there will be no more sources of air pollution.

***g) SOIL/SUBSOIL***

During the execution of the works, the only potential source of soil pollution would arise from accidental leaks of fuels and/or lubricants from the contractor's equipment and transport vehicles.

To respond effectively in the event of such accidental soil pollution, the contractor will be required to have a minimum supply of absorbent materials (such as pads, pillows, biodegradable absorbents, etc.) on hand.

The contractor will pay special attention to the refueling operations (from mobile tanks) of the machinery required for the works. It should be noted that no additional land areas will be occupied for the remaining works.

Provided that the contractor maintains their equipment and transport vehicles in good working condition, coupled with a rapid and effective intervention strategy, the negative impact on the soils will be spatially limited and deemed insignificant.

Once the works are completed and this step of the fall is operational, there will be no sources of soil pollution.

***h) NOISE AND VIBRATIONS***

The modeling results obtained using Sound PLAN software show that, during the construction phase, the noise levels generated by the project will not significantly impact the quality of life in the neighboring villages. At the closest receptors, the operation of the equipment used in the modeling generates a maximum noise level of approximately 48 dB. The noise generated by construction activities will not alter the current noise level, which is primarily induced by road traffic in the area.

At the level of the protected natural areas, the noise generated by construction activities may lead to an increase in the equivalent noise level up to 100 dB(A) over a distance of up to 50 m, which could cause disturbances to species activities (especially birds) during the

construction period. However, considering that the project site is in a forested area, this increase will be significantly reduced in the immediate vicinity of the project.
Furthermore, given the location of the works in relation to inhabited areas (the city of Bumbești-Jiu), the noise levels fall within the limits established by Order no. 119/2014.
Taking into account that the activities conducted as part of the analyzed project will have a minimal contribution to the noise levels in inhabited areas, we consider that no measures are necessary to reduce noise levels concerning the localities.

***i) BIODIVERSITY (Conclusions of the Appropriate Assessment))***

The project includes elements that have not been completed as part of the project for the Increase of the Share of Electricity Production from Renewable Sources by Completing the Works and Ensuring Permanent Monitoring of Environmental Impact at the Hydroelectric Arrangement of the Jiu River on the Livezeni – Bumbești Sector – continuation of the remaining works for the investment objective AHE Livezeni – Bumbești, which will be implemented almost entirely (except for the LEA area) within the Natura 2000 site ROSCI0063 Defileul Jiului.

To correctly substantiate the measures for preventing, avoiding, and reducing the impact generated by the project on the conservation significant elements of the protected natural area, specific studies were conducted for each species/habitat group. The results of these studies were presented in previous chapters, emphasizing the assessment of the project's impact on each conservationally significant species/habitat.

The adequate assessment study paid special attention to the connectivity of aquatic habitats present within the protected natural area, in terms of maintaining its connectivity.

The estimated residual impact after the implementation of the project was assessed as insignificant, provided that the proposed prevention, avoidance, and impact reduction measures in this study are respected. Furthermore, both during the construction phase and subsequently, in the operational stage, monitoring of biodiversity elements is necessary to accurately calculate the generated impact and potentially recalibrate the impact reduction measures.

Following the detailed analysis carried out in this study, it can be stated that the impact resulting from the implementation of the project, in all its phases, on the species and habitats for which the protected natural areas of community interest were designated will be **insignificant**, not affecting their structure and functions.

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**ENVIRONMENTAL IMPACT REPORT**
**FOR**
**„The Project on increasing the share of electricity production from renewable sources by completing the works and ensuring permanent monitoring of the environmental impact of the hydropower plant on Jiu river in the Livezeni - Bumbești sector" - continuation of the remaining works to be executed at the AHE Livezeni - Bumbești**

**Beneficiary:**
**Society for the Production of Electricity in Hydropower Plants HIDROELECTRICA S.A.**

**Provider:**
**Association S.C. GREEN COLLECTIVE S.R.L. – S.C. WILDLIFE MANAGEMENT CONSULTING S.R.L.**

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