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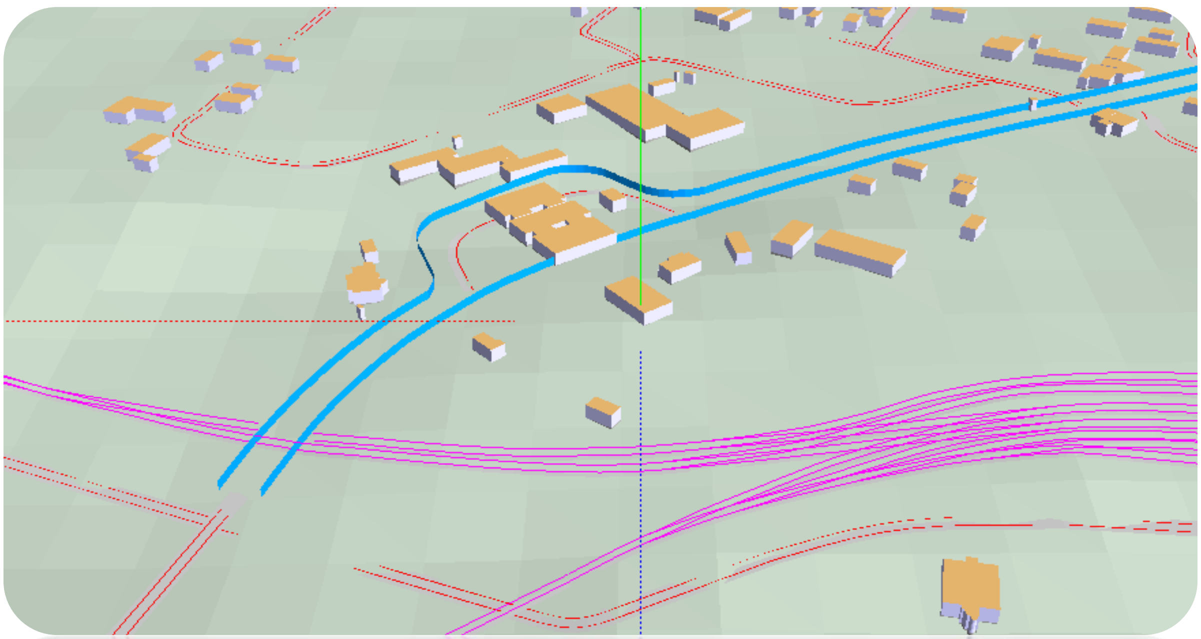
REPORT ON NOISE CALCULATION AND PROPAGATION DURING THE CONSTRUCTION AND OPERATION PHASES OF THE PROJECT



Project beneficiary: MM CONSULTING & ENGINEERING

Prepared by: GEOSTUD

MARCH 2026

Rehabilitation of the M3 Road (Chișinău – Comrat – Giurgiulești – Romanian Border), km 211.98–213.69, and of the M3.1 Road (Giurgiulești – Ukrainian Border), km 0.0–0.65 (connection road to the Giurgiulești–Reni and Giurgiulești–Galați border crossing points)

BENEFICIARY: MM CONSULTING & ENGINEERING SRL

PREPARED BY: GEOSTUD S.R.L

SIGNATURE AND STAMP

C.E.O. of GEOSTUD S.R.L

Dr. Petru NICOLAE

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Executive Summary

This report was prepared at the request of the beneficiary, MM CONSULTING & ENGINEERING SRL, and is intended to conduct a noise study, specifically to estimate and analyze the propagation of noise levels generated both during the construction phase and during the operation phase of the project.

The analysis covers the rehabilitation works on the M3 national highway (Chișinău – Comrat – Giurgiulești – Romanian border), on the section between km 211+980 and km 213+690, as well as the construction of the M3.1 Giurgiulești – Ukrainian border, on the section km 0+000 – km 0+650, representing the connecting road to the Giurgiulești – Reni and Giurgiulești – Galați state border crossing points.

At the same time, the report includes an assessment of the potential impact of noise on environmental factors and on sensitive receptors in the vicinity of the project, which may be affected by the noise levels generated during construction and subsequently, during the operation phase of the new road infrastructure.

Legislative and methodological framework for noise assessment

The noise impact assessment for the road rehabilitation project was conducted in accordance with the national legislation of the Republic of Moldova and the harmonized European methodology applicable to ambient noise generated by transport infrastructure.

The main regulatory acts considered for the preparation of this report are as follows:

- Law No. 272/2018 on the assessment and management of environmental noise, which regulates the assessment and management of environmental noise, transposes the principles of Directive 2002/49/EC, and introduces the use of the harmonized European indicators Lden and Lnight;
- Law No. 86/2014 on Environmental Impact Assessment, which establishes the obligation to analyze and prevent impacts on environmental factors, including noise, for road infrastructure projects;
- Law No. 1515/1993 on Environmental Protection, which establishes general e principles regarding the prevention and reduction of physical pollution, including noise;

- The Sanitary Regulation on Noise in Urban and Rural Areas, which establishes permissible limit values for residential, mixed-use, and industrial zones. (Government Decision No. 1346 of November 27, 2007)

Acoustic modeling was performed using the common European method CNOSSOS-EU, established by:

- Directive 2002/49/EC on the assessment and management of environmental noise;
- Delegated Regulation (EU) 2015/996, which establishes the common method for noise calculation in the European Union (CNOSSOS-EU).

Law No. 272/2018 harmonizes the national framework with the European methodology, justifying the use of the CNOSSOS-EU method within the analyzed project.

The modeling was performed using SoundPLAN software, version 9.0, which implements the CNOSSOS-EU 2015/2021 method for road traffic sources and construction sites typical of the road construction period.

Introduction

The noise generated at construction sites and work fronts associated with road infrastructure projects constitutes a significant source of noise pollution, with the potential to impact the environment, neighboring communities, biodiversity, public health, and, consequently, quality of life. In this context, proper management of noise emissions becomes an essential component of the project implementation process, as it is necessary to maintain a balance between infrastructure development and the protection of the environment and sensitive receptors.

Construction phase

Reducing noise levels associated with construction activities carried out near residential areas or protected natural areas is a top priority. Specific works include the operation of heavy machinery, excavation and grading, earthworks, material transport, road paving, asphalt and concrete pouring, installation of drainage systems, relocation of existing utilities, as well as the installation of traffic signs and road safety systems. These activities introduce additional sources of noise into the environment, which may lead to increased noise levels in areas adjacent to the project, affecting both local communities and the personnel involved in the execution of the works.

The main sources of noise and vibration associated with the construction phase are:

- the operation of machinery for site preparation and grading (excavators, bulldozers, front-end loaders, compactors, vibratory plates, motor graders, mobile cranes, dump trucks, concrete mixers, trucks, water tankers, generators, etc.);
- the use of transport vehicles for the delivery of materials and the removal of waste or excess excavated soil;
- carrying out manual or mechanized activities that generate noise (digging, cutting, handling, and loading/unloading materials).

Noise assessment and control at this stage are necessary to limit temporary effects on sensitive receptors and to reduce acoustic discomfort.

Operation phase

During the operation phase, the main source of noise is road traffic on the upgraded infrastructure. Noise emissions are generated primarily by tire-road interaction, engine operation, exhaust and braking systems, as well as traffic dynamics (acceleration, deceleration, and gear changes). The noise level is influenced by traffic volume and composition (proportion of heavy vehicles), travel speed, pavement type, road geometry, and topographic conditions at the site.

Unlike the construction phase, the noise impact generated during the operation phase is permanent and has long-term effects, potentially affecting residential areas, public institutions, and other categories of sensitive receptors located near the road. For this reason, predictive analysis of noise levels during the infrastructure's operation period is essential for identifying potential exceedances of permissible limits and for justifying mitigation measures, such as the installation of sound-absorbing panels, the use of low-noise road surf s, or the implementation of traffic management measures.

Accordingly, the project's noise impact assessment was conducted for both the construction and operation phases to ensure compliance with applicable legal requirements and international best practices in the field, as well as to protect public health and the environment.

Assessment of the existing acoustic situation

The assessment of the existing acoustic situation aims to characterize the current acoustic environment in the study area prior to the implementation of the analyzed project. This assessment serves as the baseline for analyzing potential changes in noise levels generated during the construction phase and during the operation phase of the proposed road infrastructure.

To determine existing ambient noise levels, field acoustic measurements were taken at representative points located near the analyzed route and sensitive receptors. The measurements were performed in accordance with applicable standards for ambient noise monitoring using a Brüel & Kjær Class 1 integrating sound level meter, Model 2245, equipped with a dedicated microphone, serial number: 200247/100863, calibration date: April 29, 2024.

The determinations were made through integrated measurements of the equivalent noise level (LAeq), with five successive measurements taken at each monitoring point, each lasting 15 minutes, at time intervals representative of the existing acoustic environment. The measurements were taken under weather conditions favorable to sound propagation and in the absence of atypical events that could significantly influence the results.

The measurements were performed using integrated measurements of the equivalent noise level (LAeq,T), with five successive measurements taken at each monitoring point, each lasting 15 minutes, at time intervals representative of the existing acoustic environment. The measurements were taken under weather conditions favorable to sound propagation and in the absence of atypical events that could significantly influence the results.

To ensure the accuracy of the measurements, the sound level meter was verified through acoustic calibration before and after each series of measurements, using a Brüel & Kjær Type 4231 acoustic calibrator, Class 1, serial number 200248/3026686. The purpose of the calibration verification was to confirm the proper functioning of the measurement equipment throughout the entire monitoring campaign.

The measurement points were specified by the client and were located in relevant areas near the analyzed route, particularly near noise-sensitive receptors. These points were used to characterize the existing acoustic situation in the study area. The location of the measurement points is shown in Figure 1, and the determined noise level values are summarized in Table 1. The table also presents the measurement uncertainty values associated with the acoustic measurements.

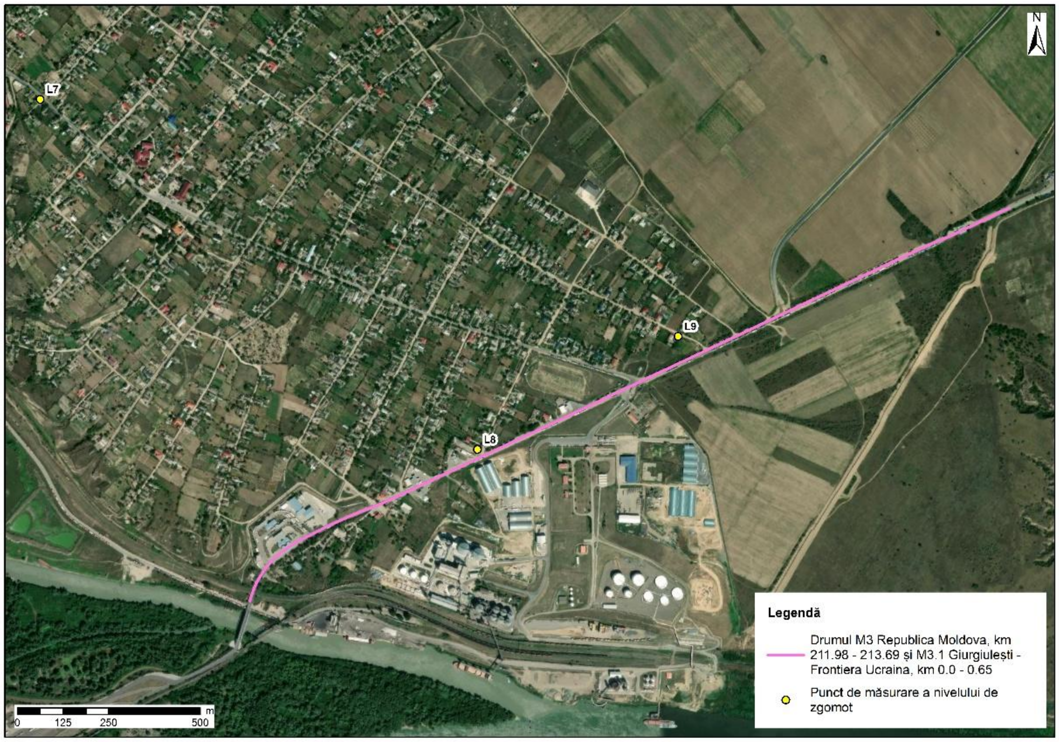

Figure1 – Location of the ambient noise measurement points used to characterize the existing acoustic conditions

Table 1 – Results of ambient noise level measurements at monitoring points

Measurement Measurement	Coordinates (Stereo70)		Noise level (averaged value) (dB)	Noise level (corrected value) (dB)	Measurement uncertainty U (dB)
	X	Y			
L7	749478.6649	447729.3692	70.68	70.68	±4.154
L8	750673.8576	446773.1760	70.98	70.98	±4.397
L9	751222.5806	447081.9723	62.31	62.31	±4.242

The values presented in Table 1 reflect the ambient noise levels recorded at the monitoring points at the time of measurement. The results indicate the variability of noise levels depending on proximity to the road infrastructure and local conditions in the study area. The values obtained are used as a reference for comparative analysis with the results of acoustic modeling related to the construction and operation scenarios of the analyzed project.

SoundPLAN noise methodology

The methodology presented in this chapter describes the process of noise analysis and modeling, specifically the determination of sound levels and their propagation mechanisms, using the specialized software SoundPLAN Noise, version 9.0.

SoundPLAN is an internationally recognized professional tool used for acoustic simulations and the predictive assessment of noise impact on the environment. The platform allows for the integration of data regarding noise sources, topographical conditions, terrain characteristics, infrastructure configuration, and the presence of any obstacles or protective measures, in order to generate acoustic models compliant with European and internationally recognized methodologies.

The generated models are designed to estimate, analyze, and represent the spatial distribution of noise levels associated with various types of activities in different contexts—urban, industrial, road or rail transport infrastructure, construction sites, or other anthropogenic sources. The results obtained form the basis for assessing the impact on sensitive receptors and for justifying noise reduction and control measures.

The steps required to create the noise maps for the investment project described in this report are outlined below, based on the principle of developing models that are as accurate as possible, i.e., that reflect the actual situation to the greatest extent possible.

1. **Definition of the Project**

The first step is to clearly define the purpose of creating the noise model, considering this aspect from three perspectives:

a. assessment of the noise generated;
b. assessing the noise exposure of various sensitive receptors potentially affected by the noise;
c. verifying compliance with the maximum permissible limits set by current legislation for the protection of various sensitive receptors and, if necessary, proposing mitigation measures.

2. **Data collection and input**

Creating a reliable model is directly linked to the use of a relevant amount of information and the entry of accurate data for input. The data used for this purpose are:

a. topographic data for creating a digital elevation model (DEM) and/or contour maps to represent the terrain;
b. data on noise sources: construction sites, road traffic, and other present noise sources
   - construction site noise: operation of machinery, vehicles, performance of specific activities by workers, whether manual or mechanized, as well as noise levels of equipment used within construction site organizations and at active work fronts;
   - Road traffic noise: information on traffic volume, vehicle speed, vehicle category, and the physical characteristics of roads and road surfaces.
c. land use data: information regarding the type and degree of surface coverage, as this can influence sound propagation;
d. zoning regulations and types of functional areas: residential, commercial, and industrial areas; parks; recreational and leisure areas; medical and balneological- -climatic facilities; school campuses; daycare centers and kindergartens; stadiums; open-air cinemas and theaters; outdoor cultural, sporting, and entertainment events; and parking lots.

3. **Model Setup in SoundPLANnoise 9.0**

After collecting the information mentioned above in points 1 and 2, the model is configured in the SoundPLANnoise 9.0 software by following these steps:

a. Constructing the three-dimensional model of the study area by integrating topographic data and defining relevant elements (buildings, transportation infrastructure, technical structures, noise barriers), as well as surfaces with specific acoustic properties, defined by absorption parameters and reflection/diffraction conditions, which influence noise propagation mechanisms;
b. definition of noise sources: all noise sources are entered, and the characteristics of each potential noise source (mobile/static, continuous/intermittent), their frequency, the emission height of the sound source, and the acoustic power and maximum potential noise level generated are considered;
c. selection of the propagation model: the appropriate noise propagation model is chosen based on the type of noise sources and the standards used (depending on the study area);

4. **Model calibration**

Depending on the source of the information used in the model, in order to ensure the accuracy and relevance of the model, any discrepancies between the data entered into the model and the measurements and observations obtained from field visits are checked prior to running the simulations.

a. adjusting the terrain geometry and the physical characteristics of the site to the elevation values measured in the field, respectively to the observations made at the site;
b. Calibration of model parameters by adjusting noise source levels and their effects on the terrain.

5. **Simulation**

After calibrating the model, simulations of noise level propagation in the study area can be performed.

By calibrating and adjusting the parameters of the developed acoustic model, various operational and project evolution scenarios can be simulated. These scenarios reflect variations in noise generation and propagation conditions, as well as changes in operational or environmental parameters, allowing for a comparative assessment of acoustic impact in various relevant situations.

In this context, the following types of simulations were performed:

a. Scenarios corresponding to different time intervals (day, evening, night), or combinations thereof, depending on the noise generation period and the acoustic indicators analyzed;

b. Scenarios that include variations in the characteristics of noise sources, such as changes in the number of active machines and equipment, operating modes, operational dynamics, or sound power levels associated with machinery, vehicles, and activities carried out at work sites;

c. Traffic scenarios for the operation phase, which take into account the evolution over time of road traffic volume and structure, including the projected increase in the number of vehicles and changes in the proportion of traffic categories transiting the analyzed sector.

This approach allows for the assessment of noise impact under both current conditions and future development scenarios, serving as the basis for identifying and designing appropriate noise reduction measures.

6. **Analysis of Results**

The SoundPLAN software enables the generation of thematic noise maps based on the sound sources entered into the model, representing the spatial distribution of sound pressure levels within the study area. The results are graphically illustrated by contour lines (isophones) corresponding to different sound level values, according to the chromatic scale used, thus facilitating the interpretation and analysis of the extent of the acoustic impact.

The results obtained from the simulations are subsequently analyzed to assess the impact on sensitive receptors by identifying the number of residents, residential buildings, and other vulnerable targets exposed to noise levels that may exceed the limit values established by applicable legislation and standards. This stage allows for determining the project's compliance with current regulatory requirements and justifying any measures to reduce acoustic impact.

7. **Mitigation Measures (if applicable)**

In situations where the noise levels estimated by modeling exceed the limit values established by applicable legislation for the various categories of functional spaces, appropriate measures to reduce acoustic impact are analyzed and proposed. The SoundPLAN Noise platform integrates specialized features that allow for the configuration, sizing, and simulation of the effectiveness of various noise mitigation solutions, with the aim of identifying the optimal option from a technical and acoustic effectiveness standpoint.

The measures analyzed may include:

a. Installation of noise barriers, by modeling their effect on reducing noise levels at sensitive receptors requiring protection;

b. Optimization of the project's technical solutions, including adaptation of the road's longitudinal or transverse profile (e.g., creation or expansion of shoulder areas), where technical and spatial conditions permit;

c. Implementation of temporary structures serving as noise barriers during the construction phase, by installing temporary vertical elements within the construction site layout, with the aim of reducing noise levels at nearby receptors;

d. Noise source management measures, such as reducing traffic speeds, optimizing transport volumes and routes associated with the construction site, phasing the work, or limiting the operating hours of stationary noise sources;

e. The use of low-noise road surfacing, through the adoption of wearing courses with sound-absorbing properties or optimized roughness;

f. Establishing forest belts or green buffer zones near the analyzed infrastructure, which play a complementary role in reducing and dispersing noise.

A comparative evaluation of these measures through simulation allows for the quantification of each solution's effectiveness and the justification of selecting the option that ensures compliance with regulatory requirements, under conditions of technical and economic feasibility.

8. **Verification and sensitivity analysis**

A sensitivity analysis of the acoustic model is performed to assess the degree of uncertainty associated with input parameters and to identify variables with a significant influence on the results. The analysis involves the controlled modification of key model parameters (e.g., traffic volumes, percentage distribution by time intervals, proportion of heavy vehicles, sound power levels of sources, travel speeds, surface characteristics, or propagation conditions) and quantifying the corresponding variations in estimated noise levels at the analyzed receptors.

During this stage, alternative scenarios and conservative assumptions are tested to determine the model's robustness and the stability of the results in relation to reasonable fluctuations in the input data. The magnitude of the resulting variations (ΔdB) is analyzed, and the critical parameters that cause significant changes in the acoustic impact are identified.

Based on the conclusions obtained, the model is adjusted, calibrated, and optimized, as appropriate, to ensure methodological coherence, internal consistency of the results, and a realistic representation of noise propagation in the study area. This approach contributes to increasing the credibility of the analysis and providing a solid basis for conclusions regarding the impact and the need for mitigation measures.

Acoustic Model Configuration

The acoustic models and simulations performed in this report were developed based on technical information provided in the project documentation, including site plans, longitudinal and cross-sectional profiles, technical reports, traffic estimates, and data regarding the organization of construction work. The configuration of the three-dimensional model accurately reflected the proposed technical and e al solutions, the geometric parameters of the infrastructure, the functional characteristics of the road, as well as the topographic and land-use conditions in the study area.

The modeling assumptions, noise source parameters, and analyzed scenarios were established in correlation with available official data and traffic forecast trends, ensuring the traceability and methodological consistency of the analysis.

In this context, specific simulations were developed for the following relevant components and phases of the project:

a. assessment of noise levels generated during the construction phase as a result of road infrastructure rehabilitation works;

b. assessment of road traffic noise during the operation phase of the investment project;

c. analysis of the exposure of sensitive receptors to the estimated noise levels;

d. verification of compliance with applicable limit values established by current legislation and standards for the protection of various categories of receptors;

e. assessment of the effectiveness and sizing of noise protection measures intended to reduce the impact on sensitive receptors.

For the situations mentioned above, simulations were performed using a conservative "worst-case" scenario, representing the most unfavorable plausible assumption from a technical and operational standpoint. This scenario does not assume an improbable extreme situation, but rather reflects reasonably anticipated conditions that may lead to maximum noise levels, such as the simultaneous operation of relevant sources, traffic volumes at the upper limit of forecasts, or operational parameters operating at maximum capacity. The spatial distribution of noise sources was established to reflect as accurately as possible the organization of work fronts, based on information regarding the type of work, the estimated number of machines allocated to each activity, the duration and sequence of operations, as well as other relevant technical data provided in the project documentation.

Regarding the operation phase, noise levels associated with road traffic were determined based on data provided by the traffic study made available by the project beneficiary. The modeling was performed using traffic forecasts for the year 2030, the target year for the medium-term impact assessment, including the structure and estimated volume of road traffic.

In the acoustic modeling performed, the maximum traffic speed considered for the analyzed road section was 110 km/h, and the travel speeds introduced into the model were spatially adapted for each vehicle category, in accordance with the CNOSSOS-EU methodology, using values at the upper limit of the ranges characteristic of arterial roads, so as to reflect a conservative scenario for assessing noise levels.

The approach adopted is consistent with the precautionary principle applicable in environmental impact assessment, ensuring the analysis of a maximum potential impact level within a realistic and methodologically justified framework. This method ensures that any acoustic risks are assessed conservatively, and that the proposed mitigation measures are appropriately scaled to protect sensitive receptors, workers, and vulnerable areas in the vicinity of the site.

Given the specific nature of the construction work, as well as the number, density, dispersion, and mobility of the active machinery at the work sites, and the dynamic nature and uneven distribution of point noise sources within the project's right-of-way, modeling each source individually would not realistically reflect the actual operating conditions on-site.

In this context, to ensure a consistent and conservative acoustic representation of the noise emissions generated during the construction phase, the decision was made to model the work area as an area-type source (a single noise-generating zone), characterized by an equivalent sound power level distributed across the surface of the active front. This approach allows for the integration of the cumulative effect of machinery and activities carried out simultaneously, providing a realistic and conservative estimate of the acoustic impact on sensitive receptors.

Information regarding land use, applicable urban planning regulations, and the typology of functional spaces within the project's area of interest was primarily obtained from publicly available official sources, relevant databases, and specialized literature pertaining to the analyzed site. For areas located in the immediate vicinity of the road infrastructure, this data was verified and calibrated through field observations to ensure the most accurate representation of the existing situation.

The acoustic model incorporates all relevant information likely to influence the propagation or attenuation of noise generated during the construction phase. It includes all sensitive receptors identified at the time of this report's preparation that are potentially exposed to the acoustic impact of the works, as well as existing geometric features in the study area that may affect the propagation of sound waves.

Thus, the built structures, infrastructure elements, and any natural or artificial obstacles serving as acoustic barriers were modeled, as well as the characteristics of the terrain (soil type, forested areas, vegetation, forest belts, trees, above-ground structures, etc.), to the extent that these can contribute to the absorption, reflection, or diffraction of noise.

The type of surfaces in the vicinity of the work fronts was also considered, with coefficients related to the effects (propagation and/or absorption of noise) potentially generated by the type of land surface cover being integrated into the models.

The horizontal simulations were performed at a height of 1.5 m above the ground surface, which is considered the average height of the human ear.

After the simulations were completed, the results were analyzed in relation to the requirements of applicable legislation and standards, in order to assess the potential acoustic impact on sensitive receptors. The analysis focused both on the estimated noise levels at the boundaries of various zones and categories of functional spaces, as well as on the values calculated at the facades of buildings exposed to noise generated by construction work related to the investment project and, subsequently, by road traffic during the operation phase.

Given the specific nature of the project under review, which involves the construction of a connecting road to the Giurgiulești – Reni and Giurgiulești – Galați, the acoustic modeling also included an additional scenario that accounts for reduced travel speeds and potential traffic congestion near the customs checkpoint. This scenario reflects the actual operating conditions of the road infrastructure in the vicinity of border crossings, where vehicle flow may be temporarily slowed or even come to a standstill due to inspection and control procedures.

The purpose of this scenario is to assess potential variations in noise levels generated under non-uniform traffic conditions, characterized by low speeds, frequent stops, and successive accelerations of vehicles. Thus, the analysis allows for a more realistic estimate of potential acoustic levels in the area of the border crossing point and in the vicinity of sensitive receptors, contributing to a more comprehensive assessment of the acoustic impact associated with the operation of the planned road infrastructure.

Following these assessments, situations were identified in which measures to reduce noise impact must be implemented. Consequently, additional scenarios incorporating mitigation measures were developed and simulated, covering both the construction phase and the operation phase of the road infrastructure, to verify their effectiveness and ensure compliance with applicable limit values.

Details regarding the analyzed and proposed mitigation measures can be found in the "Mitigation Solutions" section of this report.

Results

The results of the acoustic calculations and the corresponding graphical representations of the simulations performed for the construction period—both in the scenario without the implementation of protective measures and in the scenario that includes these measures—are presented in Annexes 1.1 and 1.2 of this report.

Similarly, the results for the operation period of the investment project, for the analyzed scenarios (with and without the implementation of protective measures for sensitive receptors), are presented in Annexes 2.1 and 2.2.

The results of the supplementary scenario, which takes into account reduced travel speeds and potential traffic congestion in the area of the customs checkpoint, are presented in Annex 3.1. The results of the simulations conducted for the same scenario, under conditions where measures to protect sensitive receptors are implemented, are presented in Annex 3.2.

The noise maps illustrate the spatial distribution of estimated noise levels for the analyzed scenarios, highlighting areas where the influence of noise sources is more pronounced. The modeling results indicate that maximum sound levels are recorded in the immediate vicinity of noise sources (work fronts, construction sites, or operational road infrastructure), with values decreasing progressively as the distance from these sources increases, due to the propagation and attenuation of sound waves.

A comparative analysis of the modeled scenarios highlights the effectiveness of the proposed noise protection measures, particularly sound-absorbing panels, in reducing estimated noise levels in the areas where the analyzed sensitive receptors are located. A detailed interpretation of the modeling results and an assessment of the impact on sensitive receptors (population and species of conservation interest) are presented in the chapter "Potential Impact."

Potential Impact

The construction of new road infrastructure or the rehabilitation of existing infrastructure can lead to the generation of significant noise levels, with a potential impact on nearby sensitive receptors, such as residential buildings, educational facilities, public institutions, or protected natural areas. Noise emissions associated with the construction phase are generated primarily by activities such as excavation and earthwork, material transport, the operation of heavy machinery and equipment, as well as the construction of road layers (asphalt laying and compaction).

The magnitude of the acoustic impact is influenced by a number of factors, including the duration and intensity of the work, the operating mode of the equipment, the distance from sensitive receptors, the topographical configuration of the site, and the existing background noise level in the area under analysis. Assessing these elements is essential for determining the potential degree of impact and for establishing appropriate noise mitigation measures.

This subsection analyzes the potential effects of construction-related noise on sensitive receptors within the project's area of influence. In accordance with the methodology described above, noise propagation simulations were performed using a conservative "worst-case" scenario, representing the most unfavorable situation that is technically and operationally plausible.

This scenario does not reflect theoretical extremes, but rather realistic yet conservative assumptions regarding the simultaneous operation of relevant sources, equipment operating modes, and work conditions, so as to capture the maximum reasonable potential impact anticipated on a typical workday.

The graphical models and results presented in the report illustrate the spatial distribution of the noise levels estimated under this conservative scenario, which is time-invari , and represents the conditions corresponding to a day of activity carried out under intensive but plausible operational parameters.

Consequently, the actual noise impact associated with the project may vary depending on the actual organization of the works, the sequence of activities, and their duration. However, the assessment provides a conservative basis for evaluating the potential negative impact and for justifying mitigation measures, in accordance with the applicable legislative and regulatory framework.

The conclusions presented are intended to assist decision-makers in anticipating and effectively managing the noise impact associated with construction activities, with a view to reducing potential effects on local communities and ecosystems within the project's area of influence.

This report includes, in the appendix, thematic maps illustrating the location of vulnerable groups and sensitive ecosystems in relation to the project's right-of-way.

The potential impact on species of conservation interest identified in protected natural areas located in the vicinity of the project was also assessed. In the absence of explicitly defined limit values in national legislation regarding noise thresholds that may generate negative effects on various species or taxonomic classes, the analysis was based on information available in the scientific literature. In this regard, indicative values extracted from relevant scientific sources, presented in Table 2, were used to estimate the potential impact on biodiversity.

Table 2 – Maximum permissible noise levels for different taxonomic classes

Taxonomic class	**dB (A)**
Pisces (fish)	90
Amphibians	60
Reptilia (reptiles)	70
Mammalia (mammals)	70
Aves (Birds)	60

Regarding invertebrates, sensitivity to noise varies significantly depending on the ecological and biological characteristics of each species, including habitat type, morphology, vibration perception mechanisms, and specific behavior. The scientific literature on the effects of noise on invertebrates is still developing, and the available results indicate different responses depending on the experimental context and the taxon under analysis .

In the absence of legally established limit values for this category of fauna, the assessment was based on the information available in the scientific literature at the time this report was prepared. Thus, for the invertebrate species identified within the analyzed protected natural areas, a guideline value of 70 dB(A) was used, considered in the reference literature as a conservative threshold associated with a low probability of significant behavioral changes or disruption of communication mechanisms in certain species.

As part of the assessment of the acoustic impact on biodiversity, a spatial analysis was conducted by overlaying the noise contour lines generated by the modeling with the boundaries of the sites in the EMERALD network that are relevant to the project's area of influence.

In the absence of detailed public spatial datasets on the exact distribution of each species of conservation interest at the intra-zonal level, the official boundaries of EMERALD sites were used as spatial reference units for assessing potential impacts. This approach is justified by the fact that EMERALD sites are designated under the Bern Convention for the conservation of species and habitats of Community interest, and their boundaries reflect the areas considered relevant for maintaining a favorable conservation status.

In addition, the analysis was cross-referenced with information available in the standard site forms (species and habitats of conservation interest), as well as with the scientific literature on the acoustic sensitivity of various taxonomic groups.

Consequently, the assessment of areas potentially affected by noise within EMERALD sites provides a prudent and consistent estimate of the possible impact on biodiversity, in accordance with the precautionary principle and international best practices applicable to environmental impact assessment.

Table 3 presents the areas estimated to be potentially exposed to noise levels that may have adverse effects on species of conservation concern present in the EMERALD site MD0000012 Lacurile Prutului de Jos, which is crossed by the right-of-way expropriated for the construction phase and by the track laid for the operation phase.

Table 3 – Exposure of species of conservation interest to noise generated during the construction and operation phases of the project

Code	Species	Class	Protected site	Distribution area (ha)	Area affected by noise (ha)		
					Construction	Operation	Operation – congested traffic scenario (customs checkpoint area)
1188	*Bombina bombina*	Amphibians	MD0000012	16420	1,307	0.846	0.402
A402	*Accipiter brevipes*	Birds	MD0000012	16420	1,307	0.846	0.402
A229	*Alcedo atthis*	Birds	MD0000012	16,420	1,307	0.846	0.402
A090	*Aquila clanga*	Birds	MD0000012	16420	1,307	0.846	0.402
A029	*Purple Heron*	Birds	MD0000012	16,420	1,307	0.846	0.402
A024	*Ardeola ralloides*	Birds	MD0000012	16,420	1,307	0.846	0.402
A222	*Asio flammeus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A060	*Aythya nyroca*	Birds	MD0000012	16,420	1,307	0.846	0.402
A021	*Botaurus stellaris*	Birds	MD0000012	16,420	1,307	0.846	0.402
A396	*Branta ruficollis*	Birds	MD0000012	16,420	1,307	0.846	0.402
A198	*Chlidonias leucopterus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A197	*Chlidonias niger*	Birds	MD0000012	16,420	1,307	0.846	0.402
A031	*Ciconia ciconia*	Birds	MD0000012	16,420	1,307	0.846	0.402
A030	*Ciconia nigra*	Birds	MD0000012	16,420	1,307	0.846	0.402
A081	*Circus aeruginosus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A082	*Circus cyaneus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A231	*European Roller*	Birds	MD0000012	16420	1,307	0.846	0.402
A122	*Corncrake*	Birds	MD0000012	16,420	1,307	0.846	0.402
A038	*Cygnus cygnus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A026	*Little Egret*	Birds	MD0000012	16420	1,307	0.846	0.402
A103	*Falco peregrinus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A002	*Arctic tern*	Birds	MD0000012	16420	1,307	0.846	0.402
A001	*Gavia stellata*	Birds	MD0000012	16420	1,307	0.846	0.402

A075	*Haliaeetus albicilla*	Birds	MD0000012	16,420	1,307	0.846	0.402
A131	*Himantopus himantopus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A022	*Ixobrychus minutus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A177	*Larus minutus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A073	*Milvus migrans*	Birds	MD0000012	16,420	1,307	0.846	0.402
A023	*Nycticorax nycticorax*	Birds	MD0000012	16,420	1,307	0.846	0.402
A533	*Pied Wheatear*	Birds	MD0000012	16420	1,307	0.846	0.402
A071	*Oxyura leucocephala*	Birds	MD0000012	16,420	1,307	0.846	0.402
A094	*Pandion Haliaetus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A020	*Pelecanus crispus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A019	*Pelecanus onocrotalus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A39,	*Phalacrocorax pygmeus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A151	*Philomachus pugnax*	Birds	MD0000012	16,420	1,307	0.846	0.402
A234	*Picus canus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A034	*Platalea leucorodia*	Birds	MD0000012	16420	1,307	0.846	0.402
A032	*Plegadis falcinellus*	Birds	MD0000012	16,420	1,307	0.846	0.402
A120	*Little Crake*	Birds	MD0000012	16420	1,307	0.846	0.402
A119	*Porzana porzana*	Birds	MD0000012	16,420	1,307	0.846	0.402
A195	*White-fronted Tern*	Birds	MD0000012	16420	1,307	0.846	0.402
A193	*Sterna hirundo*	Birds	MD0000012	16,420	1,307	0.846	0.402
A397	*Rusty-backed Shelduck*	Birds	MD0000012	16,420	1,307	0.846	0.402
A166	*Wood Sandpiper*	Birds	MD0000012	16,420	1,307	0.846	0.402
1279	*Elaphe quatuorlineata*	Reptiles	MD0000012	16420	0.420	0.285	0.056
1220	*Emys orbicularis*	Reptiles	MD0000012	16420	0.420	0.285	0.056
1355	*Lutra lutra*	Mammals	MD0000012	16420	0.420	0.285	0.056

Regarding the impact on residential areas, mixed-use areas, protection zones for public institutions, and quiet zones (green spaces, parks, gardens, etc.), the simulations performed revealed exceedances of the maximum permissible values established by current legislation at certain sensitive receptors, particularly during the project's construction phase.

During the operation phase, exceedances will occur only at receptors located in the immediate vicinity of the analyzed road, namely sensitive receptors near the intersections of Dunărea and Sportivă streets with the analyzed road, located within a strip of up to 40 meters from the right-of-way of the road in question.

The analysis of the scenario considering reduced travel speeds and potential traffic congestion near the customs checkpoint indicates slightly higher noise levels in the vicinity of the customs area. However, in terms of the impact on nearby sensitive receptors, the differences from the standard operating scenario are not significant. Furthermore, provided the proposed noise protection measures are implemented, the estimated noise levels at sensitive receptors tend to even out between the two analyzed scenarios, effectively reducing to zero the differences caused by traffic conditions specific to the customs checkpoint area.

Analysis of noise contour lines indicates that levels exceeding regulatory thresholds may be experienced during the construction period at distances of several hundred meters from the site boundary/construction corridor, depending on local propagation conditions (topography, natural or artificial barriers, and the type of built-up area). Sensitive receptors in the commune of Giurgiulești potentially impacted by noise levels exceeding the limits set by current legislation are: residents at the intersection at the southwestern end of C. Street. Additionally, sensitive receptors on Plotnivov, Sportivă, and Dunărea Streets, as well as those on the eastern side of the intersection of Plotnivov Street with Dunărea Street and Ion Creangă Street up to the intersection with Sportivă Street, will be affected. Furthermore, receptors located across from the customs checkpoint on the southern side will be impacted.

This represents a conservative scenario modeled for the construction period (assuming simultaneous/continuous operation of the sources along the analyzed section). This estimate represents a 'worst-case' scenario, and under actual construction conditions, due to the mobile and discontinuous nature of the activities and the segmentation of the work fronts, the spatial extent of exceedances is generally smaller.

Mitigation solutions

To mitigate the high noise levels generated by construction work, it is recommended that the project utilize modern technologies, construction machinery, and vehicles equipped with noise-reduction features (high-performance noise dampers, low-noise tread profiles), as well as noise and vibration protection equipment for workers. Furthermore, the project beneficiary/contractor must ensure compliance with all conditions and best practices, such as avoiding the simultaneous use of multiple machines, in order to reduce the potential noise impact generated by the project.

Upon analyzing the project in question, we recommend that the beneficiary/contractor procure and use, at active work sites in the immediate vicinity of noise-generating activities, mobile sound-absorbing panels to protect species of conservation interest within the EMERALD MD0000012 Prutului de Jois Lakes site, as well as sensitive receptors, particularly residential buildings in the immediate vicinity of the project site. The use of sound-absorbing panels with a minimum height of 4 meters is recommended. Table 4 presents the recommended locations for the use of mobile sound-absorbing panels.

Table 4 – Locations for sound-absorbing panels during the project’s construction phase

Start Chainage (km)	End Chainage (km)	Location in relation to the road
212+000 (M3) – intersection with Highway M3 (Chișinău – Giurgiulești; bypass section around the villages of Slobozia, Cișlița-Prut and Giurgiulești	213+690 (M3)	right
213+035 (M3)	212+445 (M3) – entrance area to the Giurgiulești International Free Port (PILG)	left

For the operation period of the M3 road, the installation of sound-absorbing panels is also recommended. Considering its layout, with sensitive receptors located near the road route, the installation of 4-meter-high sound-absorbing panels is recommended. In the models and simulations performed, Forster 20-type sound-absorbing panels made of wood were included. This type of panel is characterized by predominantly absorptive behavior, with sound absorption coefficients specific to treated wood panels for road noise protection applications. The intervals at which the panels must be installed are presented in Table 5.

Table 5 - Installation locations of sound-absorbing panels for the project's operation period

Start Chainage (km)	**End Chainage (km)**	**Location in relation to the road**
212+495 (M3)	213+690 (M3)	right
213+035 (M3)	213+690 (M3)	left

To illustrate the local context of noise-sensitive receptors and the road sections where the installation of sound-absorbing panels is proposed, representative photographs of the analyzed route are presented in Appendix 4.

Conclusions

For the duration of the works on the project " Rehabilitation of the M3 Road (Chișinău – Comrat – Giurgiulești – Romanian Border), km 211.98–213.69, and of the M3.1 Road (Giurgiulești – Ukrainian Border), km 0.0–0.65 (connection road to the Giurgiulești–Reni and Giurgiulești–Galați border crossing points)", based on the relevant information used to make predictions regarding the propagation of noise generated by activities carried out at the work fronts and on the construction sites, it is estimated that the maximum permissible levels set by current legislation may be exceeded at certain sensitive receptors in the commune of Giurgiulești.

Potentially affected residents include those living in the area around the intersection at the southwest end of C Street. Additionally, residents on Plotnivov, Sportivă, and Dunărea Streets, as well as those located on the eastern side of the intersection of Plotnivov and Dunărea Streets, and along Ion Creangă Street up to the intersection with Sportivă Street, may be affected. Receptors located across from the customs checkpoint, on its southern side, may also be affected.

However, it should be noted that the models in this report represent a conservative scenario modeled for the construction period (assuming simultaneous/continuous operation of the sources on the analyzed section). This estimate represents a "worst-case" scenario over a 24-hour period; however, under actual construction conditions, due to the mobile and discontinuous nature of the activities and the segmentation of the work fronts, the temporal and spatial extent of exceedances is generally reduced. Furthermore, the use of mobile sound-absorbing panels during construction, in accordance with the recommendations presented in this report, will ensure the protection of sensitive receptors by creating a screening and diffraction effect of sound waves behind them. Under these conditions, the potential acoustic impact will be significantly reduced, to the extent that any residual effects will manifest only in functional spaces located in the immediate vicinity of the analyzed road.

It should be noted that the noise generated by the project-related construction work will overlap with the existing noise to which most of the sensitive receptors are already exposed; these receptors are currently exposed to higher noise levels generated by road traffic on the roads in the project area.

During the facility's operation period, the acoustic modeling analysis indicates the possibility of occasional exceedances of the maximum permissible values set forth in current legislation, particularly for certain functional zones located in the vicinity of the analyzed road route. The implementation of the noise reduction measures proposed in this report, namely the installation of sound-absorbing panels, leads to a significant reduction in estimated noise levels.

It is estimated that the noise levels generated during the operation period, in the context of implementing the protective measures proposed in this report, will result in enhanced protection for sensitive receptors and compliance with legislation.

In the event that full compliance is not achieved, particularly for receptors located at short and medium distances from the road right-of-way and topographically positioned above the maximum efficiency level of the sound-absorbing panels (above the screening angle), it is recommended to conduct additional analyses at the receptor level and evaluate the feasibility of implementing local mitigation measures, such as installing sound-absorbing screens at the property line or in the immediate vicinity of the receptor, in order to ensure the fullest possible compliance with applicable legislative requirements.