PART 3

# Initial Environmental Examination

August 2020

# Uzbekistan: Central Asia Regional Economic Cooperation Corridor 2 (Pap-Namangan-Andijan) Railway Electrification Project – Additional Financing

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# Noise Survey and Modeling

**FOR**

# Central Asia Regional Economic Cooperation Corridor 2
## (Angren-Pop-Fergana - Andijan)
# Railway Electrification Project

**FIRST DRAFT REPORT**

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**Tashkent, 2020**

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# 1. EXECUTIVE SUMMARY

1. Rail transport has a unique competitive advantage over road transport for moving commodities and goods in bulk over long distances. The 4,669 km Uzbekistan rail network carries about 60 million tons of freight and 15 million passengers annually.

2. The Government of Uzbekistan (the government) has requested Asian Development Bank (ADB) assistance for the electrification of the railway line from Pap to Namangan to Andijan. The presented sub-project is about the electrification of Angren-Pop-Fergana Railway.

3. The developed report gives the determination of the noise level caused by the railway transport on buildings and premises located adjacent to Angren-Pop-Fergana Railway. Within the scope of the assignment, the Consultant provided both, the instrumental measurement of the baseline noise level and 3D expected noise propagation modeling before and after the project implementation by using German software CadnaA.

4. Instrumental measurement of the baseline noise level was accomplished simultaneously at two points adjacent to the project area, on the territory of village Karanchitugay. The equipment was calibrated the day before the measurements.

5. In order to clearly demonstrate modeling results, the project zone of Angren-Pop-Fergana–Andijan was divided into 33 sections. The document gives both, the existing and expected noise modeling results after the project implementation for 33 sections.

6. Following the architectural peculiarities of Uzbekistan, all private houses have at least 2-meter-high block, brick or concrete walls around. The given walls virtually represent noise-attenuating barriers and significantly reduce the noise impact on the residential houses. Detailed analysis of this fact is given in Chapter 7 of the present document.

7. At the modeling stage, the existing fences were not fed into the software program. Due to lack of time, the group of experts could not take time to visualize all buildings (there are approximately 20 207 buildings within 300 m radius of the project zone). Consequently, at the modeling stage, the existing fences were not fixed in the software program, as the group of consultants did not have exact information about all houses found in the project zone. We may assume that in case of fixing the concrete and brick walls in the software, the noise level will be much less.

8. As per the existing situation, 20 207 buildings are found within a 300-m radius area from the project zone. As the accomplished modeling results suggest, the noise level on 4808 (23.8%) buildings during the day and at night exceeds the admissible level. In particular, the noise level exceeds the admissible level only at 468 (2.3 %) buildings.

9. In the construction phase, the noise level exceeds the baseline level only at five buildings as the noise of train exceeds the noise level originated during the use of heavy techniques for the rehabilitation works.

10. As the information issued by the Uzbekistan Railways evidences, twice as many trains cross the project zone at night time than during the day. At the same time, admissible noise level is much lower at night time than during the day. Consequently, noise level for most of the houses in the project zone exceeds the admissible level.

11. As per the results of modeling accomplished after the project implementation, the noise level all over the project area as compared to the existing level will be reduced by 2-3 DB.

12. In line with the requirements of IFC instructions, the noise impact level for all buildings and premises after the project implementation is within the admissible limits.

13. There is no need to take additional mitigation measures to reduce noise level within the scope of the planned project.

## 2. PROJECTDESCRIPTION

14. The project aims to electrify the missing 306 kilometers (km) of single-track non-electrified track linking major cities Angren-Pop-Fergana–Andijan. This will facilitate direct and efficient operation of both freight and passenger train services and thereby promotes economic and social development of the Fergana Valley. The project will be aligned with the following impacts: (i) stimulated economic growth in the Fergana Valley, and (ii) increased regional trade along CAREC Corridor.

15. The alignment of single-track non-electrified track linking major cities Angren-Pop-Fergana–Andijan railway line is given on Figure 1.

**Figure 1: Project alignment**


16. The project will produce two outputs. First, railway infrastructure along the Angren-Pop-Fergana–Andijan railway line will be upgraded. This includes electrification of 306 km of the main railway. The project also envisages the modernization of signaling and communications facilities, and construction of external power supply facilities which will transmit electricity from the main grid to the traction substations.

# 3. GOALS AND OBJECTIVES

17. Within the scope of the given Project, the assignment of “Eco-Spectri” Ltd. (Georgia) was to identify major sensitive receptors along the project corridor and to evaluate the noise impact level caused by the railway transport on the receptors by using both, instrumental measurements and 3D modeling. It was necessary to evaluate noise impact level both, before the project implementation (baseline) and after the project implementation. As necessary, the consultant had to develop mitigation measures.

18. In order to accomplish the assignment, the consultant had to do the following actions:

- Prepare a three-dimensional terrain model (maps / landscape drawings are provided by the executing agency);
- Identify sources and noise levels at source / railways;
- Identify sensitive receptors in the vicinity of the project area;
- Provide 3D modeling of noise propagation taking into account all aspects of the environment;
- 3D modeling of noise propagation should be carried out for two different alternatives (current / prospective number of trains);
- If necessary, develop mitigation measures.

19. In order to make sure of the efficiency of modeling results it was decided to provide an instrumental measuring of the existing noise level (for the detailed information, see Chapter 7).

## 4. NOISE LEVEL STANDARDS

21. The project was implemented in line with both, the legislation of the Republic of Uzbekistan and IFC requirements. In line with the legislative base of Uzbekistan, admissible noise level both, in the construction and operation phases is identified by the following normative acts:

- "Sanitarian Norms of allowed level of noise at the construction sites" SanR&N №0120-01 (29.10.2001);
- SanR&N No.026709 „Sanitarian Rules and Norms on providing allowed noise level into the living building, public building and territory of living areas" (19.06.2009).

22. The maximum admissible noise level allowed by the IFC is set out in IFC Environmental, Health, and Safety (EHS) Guidelines 1.7 - "Noise Management".

23. Admissible noise standards of IFC and Uzbekistan national standards for the residential areas are similar. The law determines both the admissible norms of noise and the maximum of the admissible norms for several zones of the territories. For the adjacent territory of residential areas, the standard requirements for noise are given in the **Table 1**.

24. For IFC noise impacts should not exceed the levels presented in **Table 2** or result in a maximum increase in background levels of 3 dB at the nearest receptor location off site. This project will comply with both IFC Guidelines and Uzbekistan standards.

**Table 1:Uzbekistan Standards for Noise Levels**

| Receptor | One hour $L_{aeq}$ (dBA) | |
|---|---|---|
| | Daytime 07.00-23.00 | Night-time 23.00 – 07.00 |
| Residential; institutional; educational | 55 | 45 |

**Table 2: IFC Noise Level Guidelines**

| Receptor | One hour $L_{aeq}$ (dBA) | |
|---|---|---|
| | Daytime 07.00-22.00 | Night-time 22.00 – 07.00 |
| Residential; institutional; educational | 55 | 45 |
| Industrial; commercial | 70 | 70 |

25. As the tables show, the main requirements of legislative base of the Republic of Uzbekistan and IFC standards are adequate. However, it should be noted that there are a number of differences between the given requirements, in particular: (i) as per the requirements of the legislation of the Republic of Uzbekistan, day hours are considered „7am-11 pm", while according to IFC instructions, day hours are - "7 am-10 pm"; (ii) IFC instructions, when determining maximum admissible noise level, considers existing baseline noise and admits an excess of the baseline noise level by 3 dB, while as per the legislative base of the Republic of Uzbekistan, no such admission is envisaged.

26. In case of divergence between the legislation of Uzbekistan and IFC standards, more stringent standards are applicable. Accordingly, the present Report prioritizes the requirements of IFC instructions.

## 5. MAIN RECEPTORS

28. The total length of Angren-Pop-Fergana–Andijan project is 306 km. the project runs across 56 settled areas. No other sensitive receptors except the settled area are fixed adjacent to the project line. Consequently, within the scope of the project, modeling of the noise propagation caused by the railway traffic was done only for the said section.

29. As already mentioned, the total length of the project line is 306 km. following the large scale of the project, it has been decided to divide the project zone into 5 sections (see Figure 1, page 4), in particular:

- The first section: KP 0 - KP 44.5 (the calculation of kilometers starts at city Angren and ends at city Andijan). Noise along the given section was modeled for 5 sections (See the map of all five project sections in Annex 1 showing all the sections where noise modeling was provided).
- The second section: KP 44.5 - KP 163.7 – along this section, noise modeling was done for 9 sections.
- The third section: KP 163.7 - KP 235.6 - along this section, noise modeling was done for 8 sections.
- The fourth section: KP 235.6 - KP 278.4 - along this section, noise modeling was done for 6 sections.
- The fifth section: KP 278.4 - KP 306 - along this section, noise modeling was done for 5 sections.

30. In total, noise modeling was provided for 33 sections within the scope of the project. as for other sections, no noise modeling was provided for them as there were no sensitive receptors adjacent to those sections.

## 6. NOISE SOURCES

32. The objective of this report is to determine the noise emissions caused by the railway line between Angren and Andijan. Identifying other noise sources to determine cumulative impact on sensitive receptors was not a part of the assignment given to the consultant.

33. As per the provided information, under the daily schedule, 55 trains of different designations and content travel along the design section. The information about the designation, volume, speed and traffic schedule of long-distance trains is given in **Table 3**. The same table also gives the information about the expected number and technical characteristics of the long-distance trains after the project implementation.

**Table 3: Traffic information for long-distance trains**

| Parameter | Passenger trains | | Freight trains | |
|---|---|---|---|---|
| | Current | Design | Current | Design |
| Andijan-Kokand-Angren line | | | | |
| Type of coach | First-class | | Freight coaches | |
| Number of coaches per stock | 14 | 14 | 35 | 35 |
| Number of a couple of wheels | 56 | 56 | 140 | 140 |
| Per coach | 4 | 4 | 4 | 4 |
| Type of locomotive | 2O'z-EL(R), 2O'zbekiston | | 3ВЛ80с, #ЭС5К, ИЛ80С | |
| Number of trains during the day | 5 | 8 | 4 | 5 |
| Number of trains at night | 2 | 4 | 4 | 5 |

34. **Table 4** gives the information about the traffic of local trains. The same table gives full information about the current stocks and expected number of trains after the project implementation.

**Table 4: Traffic information for local trains**

| Suburban trains, Andijan-Angren line | | | | |
|---|---|---|---|---|
| Type of coach | First-class | | Freight coaches | |
| Number of coaches per stock | 6 | 6 | 25-30 | 30 |
| Number of a couple of wheels | 24 | 24 | 100-120 | 120 |
| Type of locomotive | Electric train | | Pick-up train | |
| Number of trains during the day | 2 | 2 | 1 | 2 |

35. As **Tables 3 and 4** show, twice as many trains travel across the project zone during the night than during the day.

# 7. RESULTS OF THE BASELINE NOISE MEASUREMENTS

36. On January 17-18 of 2020, the specialists of Eco-Spectri Ltd. accomplished a 24-hour-long instrumental measurements of baseline noise level on the territory of village Karanchitugay in the project zone, at two points simultaneously **(Figures 2 and 3**). Total 43000-44000 data were obtained from every point. The results of 24-hour-long measurements are given in Annex 2 as graphical tables.

37. The points were selected in line with the requirements of **IFC Environmental, Health, and Safety (EHS) Guidelines 1.7 - "Noise Management".** Noise meters were installed at 1.5 m height from the ground, and the distance from the noise reflecting plane was minimum 3 meters. The microphone of the noise meter was directed towards the noise source.

**Figure 2: Measuring baseline noise level 10 m from the railway (42612184.00 E, 4551139.00 N)**

**Figure 3: Measuring baseline noise level 50 m from the railway (42612156.00 E, 4551163.00 N)**

38. Sampling was done with American noise meter „REED 8080". The given equipment is a II-class noise meter[1]. The equipment was calibrated before commencement of the measurements. Calibration was done with the calibrator of the same brand (REED R8090) (IEC 60942 Class 2). The calibrator checks the noise efficiency at two frequencies: 94 dB and 114 dB. As **Figures 4 and 5** show, the results of the noise meters in both cases correspond to the standards.

39. Noise calibrator (IEC 60942 Class 2) is calibrated by the National Institute of Standards and Technology (NIST). For calibration certificate, see **Annex 3**.

[1] "Noise monitoring should be carried out using a Type 1 or 2 sound level meter meeting all appropriate IEC standards" – IFC Environmental, Health, and Safety (EHS) Guidelines 1.7 "Noise Management".

**Figure 4: Noise meter calibration at 94 dB noise level**

**Figure 5: Noise meter calibration at 104 dB noise level**

40. As per the internal instructions of Eco-Spectri Ltd., before the noise meter was installed, the given location was studied in order to identify other sources of noise, which could affect the results. No other important permanent and/or impulse sources of noise were identified at the locations where the noise meters were installed. As **Figure 6** shows, there is an open housing for goats located adjacent to the second installation point of the noise meter. This may be considered as an impulse noise source. However, the given kind of source is not an important impulse source and it cannot affect the general situation.

**Figure 6: Housing for goats**

**Figure 7: Concrete wall between the first and second noise meters**

41. **Tables 5 and 6** give average hourly data of 24-hour-long measurements. As the gained results show, the difference between the day and night time noise levels is only 0.5 -1 dB what evidences that no additional anthropogenic noise level is fixed in the given village during the day.

**Table 5: Results of instrumental measurement (the first point)**

| N1 measurement | | |
|---|---|---|
| Date | Location | Distance from the source |
| 17.01.2020 - 18.01.2020 | Adjacent to the railway track | 10 ∂ |
| Results of measurement N1 | | |
| Average | Day (07:00-23:00) | Night (23:00-07:00) |
| | 41.6 | 40.1 |
| Hourly | | |
| 1 | 17/01/2020 - 15:00-16:00 | 43.6 |
| 2 | 17/01/2020 - 16:00-17:00 | 42.3 |
| 3 | 17/01/2020 - 17:00-18:00 | 41.6 |
| 4 | 17/01/2020 - 18:00-19:00 | 41.4 |
| 5 | 17/01/2020 - 19:00-20:00 | 41.3 |
| 6 | 17/01/2020 - 20:00-21:00 | 39.6 |
| 7 | 17/01/2020 - 21:00-22:00 | 39.7 |
| 8 | 17/01/2020 - 22:00-23:00 | 40.8 |
| 9 | 17/01/2020 - 23:00-24:00 | 39.7 |
| 10 | 18/01/2020 - 00:00-01:00 | 38.1 |
| 11 | 18/01/2020 - 01:00-02:00 | 39.5 |
| 12 | 18/01/2020 - 02:00-03:00 | 40 |
| 13 | 18/01/2020 - 03:00-04:00 | 40.5 |
| 14 | 18/01/2020 - 04:00-05:00 | 39.3 |
| 15 | 18/01/2020 - 05:00-06:00 | 40.1 |
| 16 | 18/01/2020 - 06:00-07:00 | 42.5 |
| 17 | 18/01/2020 - 07:00-08:00 | 41.9 |
| 18 | 18/01/2020 - 08:00-09:00 | 42.9 |
| 19 | 18/01/2020 - 09:00-10:00 | 42.3 |
| 20 | 18/01/2020 - 10:00-11:00 | 41 |
| 21 | 18/01/2020 - 11:00-12:00 | 39.7 |
| 22 | 18/01/2020 - 12:00-13:00 | 40.9 |
| 23 | 18/01/2020 - 13:00-14:00 | 44.9 |
| 24 | 18/01/2020 - 14:00-15:00 | 40.9 |

**Table 6: Results of instrumental measurement (the second point)**

| N2 measurement | | |
|---|---|---|
| Date | Location | Distance from the source |
| 17.01.2020 - 18.01.2020 | At the fence of a residential house | 50 ∂ |
| Results of measurement N2 | | |
| Average | Day (07:00-22:00) | Night (22:00-07:00) |
| | 41 | 40 |
| Hourly | | |
| 1 | 17/01/2020 - 15:00-16:00 | 44.5 |
| 2 | 17/01/2020 - 16:00-17:00 | 41.6 |
| 3 | 17/01/2020 - 17:00-18:00 | 41.4 |
| 4 | 17/01/2020 - 18:00-19:00 | 41.2 |
| 5 | 17/01/2020 - 19:00-20:00 | 41.1 |
| 6 | 17/01/2020 - 20:00-21:00 | 40 |
| 7 | 17/01/2020 - 21:00-22:00 | 40.3 |
| 8 | 17/01/2020 - 22:00-23:00 | 40.8 |
| 9 | 17/01/2020 - 23:00-24:00 | 40.1 |
| 10 | 18/01/2020 - 00:00-01:00 | 38.4 |
| 11 | 18/01/2020 - 01:00-02:00 | 39.2 |
| 12 | 18/01/2020 - 02:00-03:00 | 39.9 |
| 13 | 18/01/2020 - 03:00-04:00 | 40.5 |
| 14 | 18/01/2020 - 04:00-05:00 | 39.2 |
| 15 | 18/01/2020 - 05:00-06:00 | 40.1 |
| 16 | 18/01/2020 - 06:00-07:00 | 41.9 |
| 17 | 18/01/2020 - 07:00-08:00 | 41.7 |
| 18 | 18/01/2020 - 08:00-09:00 | 42 |
| 19 | 18/01/2020 - 09:00-10:00 | 39.8 |
| 20 | 18/01/2020 - 10:00-11:00 | 39.4 |
| 21 | 18/01/2020 - 11:00-12:00 | 38.4 |
| 22 | 18/01/2020 - 12:00-13:00 | 39.5 |
| 23 | 18/01/2020 - 13:00-14:00 | 43.4 |
| 24 | 18/01/2020 - 14:00-15:00 | 40 |

Note:

| | |
|---|---|
| (light) | Night hours: 10 pm -7 am |
| (dark) | Day hours: 7 am-10 pm |

42. In addition, as the given results show, it is clear that the noise caused by the railway traffic does not have a great impact on the hourly noise level. As the tables show **(Table 5 and 6**), at the same time interval, the difference between the average noise values of the noise

meters installed at the first and second points varies from 0.5 to 1 dB. If considering that the distance between the two points is 40 m, the difference between the noise levels must be much more.

43. For comparison, we can consider noise level values in the short time interval when the train travels adjacent to the noise meter location. **Figure 8 and 9** show the results produced by the noise meter in a 2-minute interval when the train traveled there.

**Figure 8: Noise level fixed at the moment of the train traveling through (first point)**

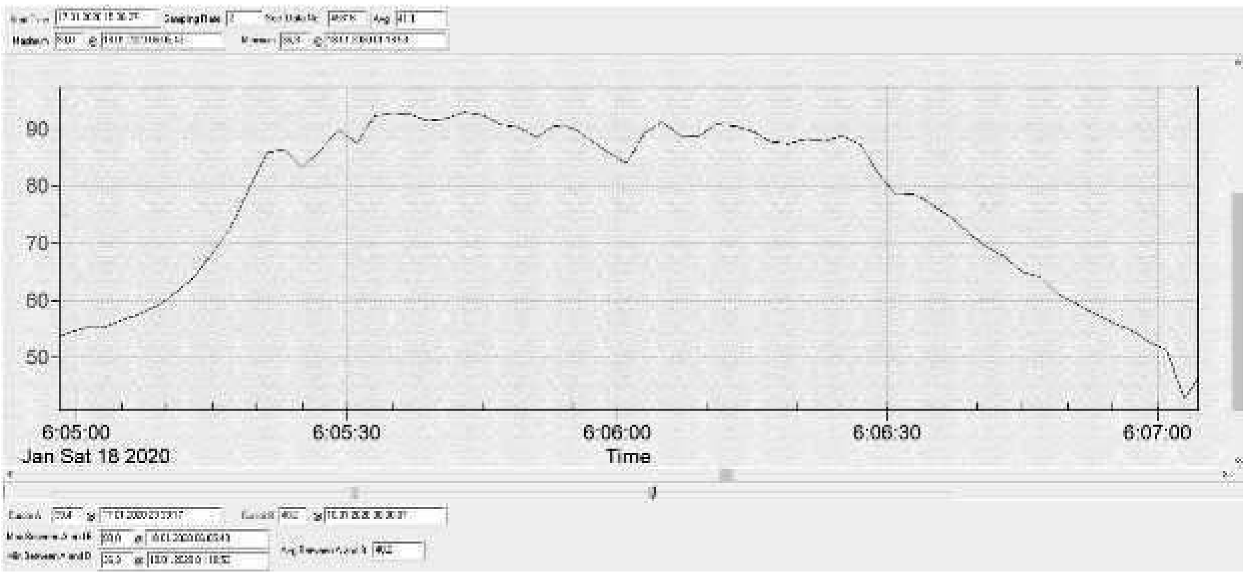
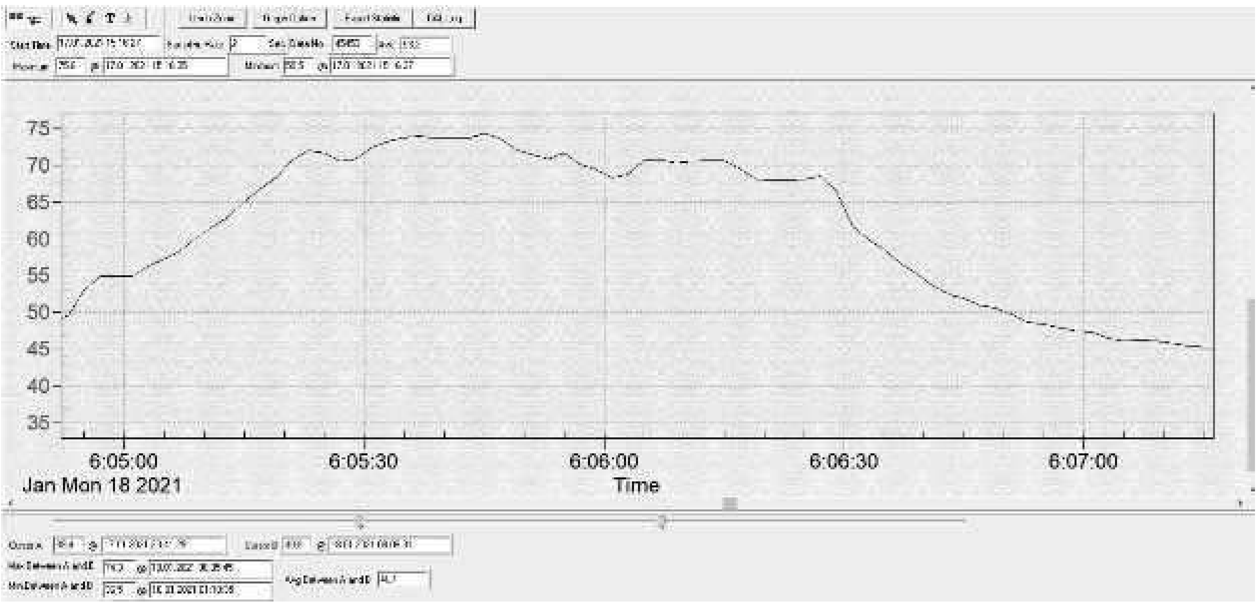



**Figure 9: Noise level fixed at the moment of the train traveling through (second point)**




44. As the figures show, at the moment of train traveling through, the maximum noise level at the first noise meter, which is installed 10 meters from the noise source was fixed at 6:06:45 sec. and it made 93 dB. At the same time, at the noise meter installed at the second point, which is distanced from the noise source by 50 m, the value was fixed at 73 dB. As we can

see, the noise level difference between the first and second points, when the train traveled adjacent to the instrumental measurement point, was 20 dB.

45. Reduction of the noise level by 20 dB at the distance of 40 m is too much. This fact can be explained only as follows: as Figure 4 shows, there is a block wall built between the noise meter installed at the second point and the source of noise (railway). This wall played a noise attenuating role in the given case. Building a concrete or block wall around the residential house is an architectural peculiarity in Uzbekistan. All over the country, similar fences are made around all private houses.

46. In order to obtain real results at the stage of modeling, it was desirable to enter all block, brick and concrete walls made around all buildings in the software program. However, as the group of specialists could not take time to visualize all buildings found in the project zone due to the lack of time (there are approximately 10 000 buildings and premises found in the project zone, in 300 m radius of the railway), it was decided (?) not to fix the fences in the modeling program due to the lack of accurate information. With great probability, if the fences are shown in the program, the existing noise level would be much less on the existing buildings and premises.

## 8. EXISTING AND EXPECTED NOISE MODELING WITH 3D SOFTWARE

### 8.1 Methods of 3D noise modeling

47. CadnaA (Computer Aided Noise Abatement) is the leading software for calculation, presentation, assessment and prediction of environmental noise. Whether your objective is to study the noise emission of an industrial plant, of a mart including a parking lot, of a new road or railway scheme or even of entire towns and urbanized areas: CadnaA is designed to handle all these tasks.

48. With more than 30 implemented standards and guidelines, powerful calculation algorithms, extensive tools for object handling, outstanding 3D visualization and the very user-friendly interface CadnaA is the perfect software to handle national and international noise calculation and noise mapping projects of any size.

49. With its technical capabilities and its ease of use CadnaA represents state-of-the-art technology. CadnaA is developed in C/C++ and communicates perfectly with other Windows applications like word processors, spreadsheet calculators, CAD software and GIS-databases. CadnaA includes a multi-lingual user interface and is successfully applied in more than 60 countries all over the world.

50. In order to use the software, it was necessary to accomplish a number of studies to collect all the information needed for modeling.

### 8.2 3D Modeling

51. As already mentioned, following the scale of the project zone, the project area was divided into 33 sections. The sections were identified for the areas of the project zone with sensitive receptors on them. Only settlements adjacent to the project area are considered to be sensitive receptors for this project. As **Tables 3 and 4** show, more trains travel at night time across the project zone than during the day. At the same time, maximum admissible noise level is much less at night than during the day. As per the modeling results of the existing situation the excess noise occurs at more buildings at night than during the day. **Annex 4** gives noise modeling results for all 33 sections. The modeling results are given for night hours when the noise level caused by the railway traffic is maximum. The given figures show the

buildings near which the noise level exceeds the admissible level at night in red. At the same time, it should be noted that not all buildings at which noise level exceeds the admissible level are residential buildings. Most of these buildings are auxiliary infrastructural facilities of the railway.

52. Noise modeling was provided both, for the current phase and for the post-project phase. As the modeling results suggest, noise level after the project implementation will be by 2-3 DB less on average than before the project implementation. Electric locomotives tend to be quieter than diesels. The diesel engine sound carry further than the sound of the blowers and electrical gear on an electric locomotive. However, the locomotive is only part of the sound and the overall noise level decreases only slightly.

53. The figures show the results of 3D modeling on three sites before and after the project (the buildings where noise level exceeds the admissible level are marked red).

**Figure: 10. First site - current situation**


**Figure 11: First site - after the project implementation**

**Figure 12. Second site - current situation**

**Figure 13: Second site - after the project implementation**


**Figure: 14. Third site - current situation**


**Figure 15: Third site - after the project implementation**

54. As the figures show, after the project implementation, the noise level at all sites is 1-4 DB less than before the project implementation. Consequently, in line with the requirements of IFC instructions, with the aim to reduce noise level within the scope of the project, no additional mitigation measures are necessary.

**8.3 Mitigation Measures**

55. As already mentioned, as a result of the project implementation, the noise level on all buildings and premises adjacent to the project zone is within the norm. Consequently, there is no need for additional mitigation measures in the operation phase.

56. In the construction phase, the noise level exceeds the admissible norm at 5 buildings. It should be noted that the noise level at the given buildings will exceed the admissible level only for some days, only when the rehabilitation activities are realized immediately adjacent to the said buildings. Notwithstanding this fact, in the construction phase, the following mitigation measures are recommended to realize adjacent to the said buildings.

**Mitigation et the Source**

57. Source control is, in general, the most effective form of noise mitigation and involves controlling a noise source before it is able to emit potentially offensive noise levels. Construction noise (exclusive of blasting) is typically generated by two source types: (i) Stationary equipment; and (ii) Mobile equipment.

- **Less noisy equipment:** One of the most effective methods of diminishing the noise impacts caused by individual equipment is to use less noisy machinery. By specifying and/or using less noisy equipment, the impacts produced can be reduced or, in some cases, eliminated. Source control requirements may have the added benefits of promoting technological advances in the development of quieter equipment.

- **Mufflers:** Most construction noise originates from internal combustion engines. A large part of the noise emitted is due to the air intake and exhaust cycle. Specifying the use of adequate muffler systems can control much of this engine noise

- **Shields:** Employing shields that are physically attached to the particular piece of equipment is effective, particularly for stationary equipment and where considerable noise reduction is required (**Figure 6).** No table of figures entries found.

- **Aprons:** Sound aprons generally take the form of sound absorptive mats hung from the equipment or on frames attached to the equipment. The aprons can be constructed of rubber, lead-filled fabric, or PVC layers with possibly sound absorptive material covering the side facing the machine. Sound aprons are useful when the shielding must be frequently removed or if only partial covering is possible.

- **Enclosures:** Enclosures for stationary work may be constructed of wood or any other suitable material and typically surround the specific operation area and equipment. The walls could be lined with sound absorptive material to prevent an increase of sound levels within the structure. They should be designed for ease of erection and dismantling.

**Mitigation Along the Path**

- In some situations, such as in urban areas or on isolated sections of a project (tunnel installation area), it may be beneficial and necessary to construct barriers adjacent to the work area or at the right-of-way (RoW). These can take the form of natural shielding, temporary shielding, and/or permanent shielding.

- Temporary abatement techniques include the use of temporary and/or movable shielding for both specific and nonspecific operations. Some mobile shielding is capable of being moved intact or being repeatedly erected and dismantled to shield a moving operation. An example of such a barrier utilizes noise curtains in conjunction with trailers to create an easily movable, temporary noise barrier system.

**Mitigation at the Receiver**

- Mitigation at a receiver can vary in its complexity, ranging anywhere from relocating residents for a day to insulation of a building. Even after mitigation measures have been applied, the outcome may still be unpredictable with no guarantees that the implemented methods achieve expected results. Therefore, mitigation at the receiver should only be considered as a last alternative. However, there are cases where creative techniques have been successfully implemented.

## 9. CONCLUSIONS AND RECOMMENDATIONS

58. **Conclusions:**

- As per the schedule more trains travel across the project zone at night than during the day. As the maximum admissible noise level is much less at night than during the day, the noise level exceeds the maximum admissible level at a number of buildings located adjacent to the project zone at both, the pre-project and post-project stages.
- As the number of trains traveling across the project section is not great (55 trains per day) and no great increase of their number is planned after the project implementation, we can state that the noise caused by this source does not affect the average noise level;
- As per the existing situation, 20 207 buildings are found within a 300-m radius area from the project zone. As the accomplished modeling results suggest, the noise level on 4808 (23.8%) buildings during the day and at night exceeds the admissible level. In particular, the noise level exceeds the admissible level only at 468 (2.3 %) buildings.
- Annex 4 gives the locations of all buildings along the project zone and building numbers assigned by the consultant. In addition, baseline noise levels are given for each building both, during the day and at night. Annex 4 also gives the expected noise level on all buildings and premises during the day and at night in the construction and operation phases.
- In the construction phase, the noise level exceeds the baseline level only at five buildings as the noise of train exceeds the noise level originated during the use of heavy techniques for the rehabilitation works.
- As Annex 4 shows, the noise level in the operation phase will reduce as compared to the baseline level. Following the modeling results, the noise level does not increase at any building as a result of the project implementation. Consequently, no additional mitigation measures, including noise barriers, are necessary to abate the noise level.
- Following the architectural peculiarities of Uzbekistan, all private houses have block or concrete walls around, which virtually represent noise-attenuating barriers. As due to the lack of accurate information, the existing walls were not indicated in the modeling software, the results of the accomplished modeling could be much less in reality.
- Noise level in the project zone after the project implementation, decreased by 1-2 DB as compared to the existing level (there are also the sections where the noise level decreased by 3-4 DB). Consequently, following IFC standards, after the project implementation, the noise level is within the norm in the project zone.

59. **Recommendations**

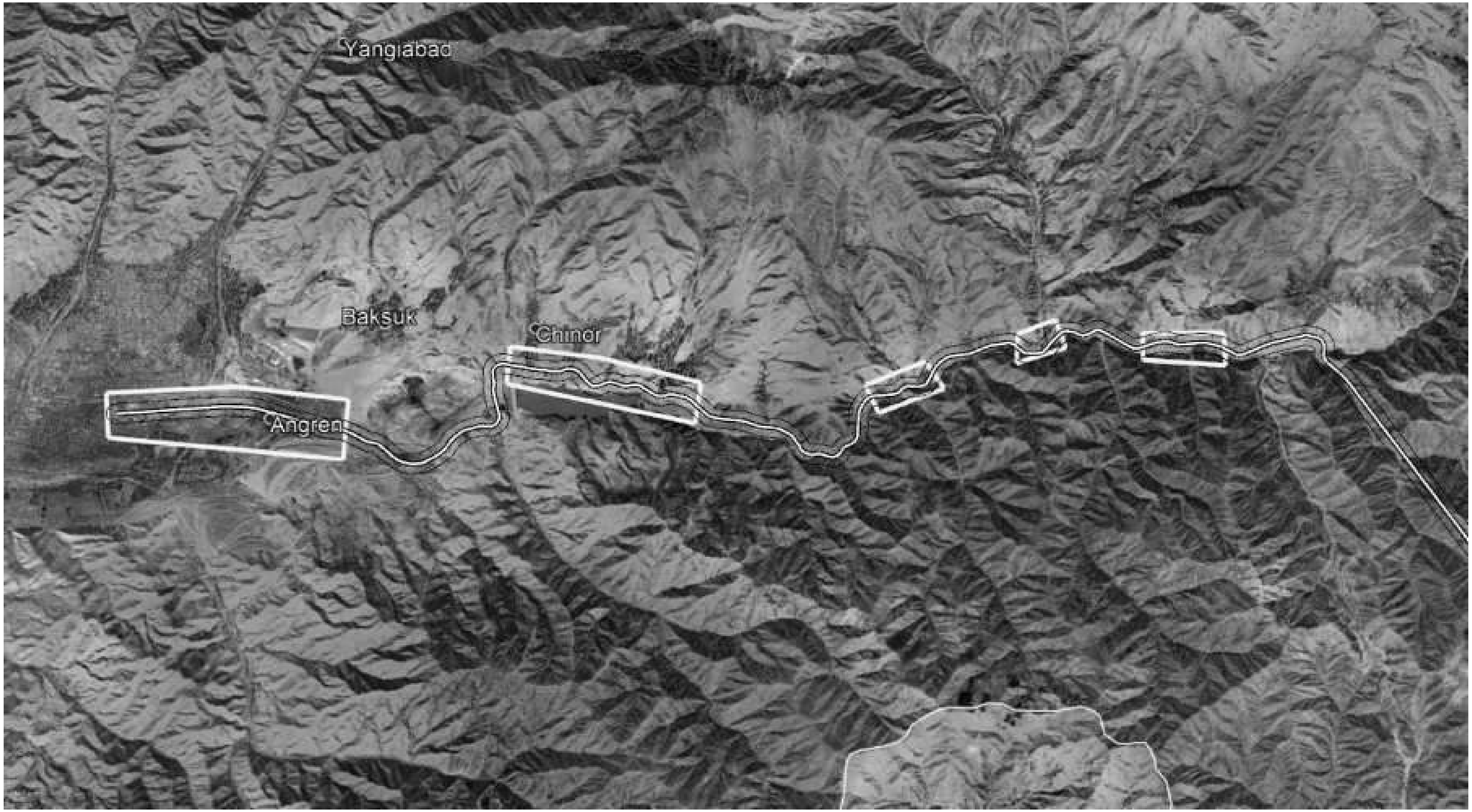
- At the project implementation phase, no additional mitigation measures are necessary to reduce the existing noise level;
- In case of a significant increase of the number of trains in the project zone, additional instrumental measurements near the sensitive receptors will be

necessary and if the noise level exceeds the current level by 3 DB, additional mitigation measures must be developed and realized;

- In the construction phase, the noise level exceeds the admissible norm at 5 buildings. It should be noted that the noise level at the given buildings will exceed the admissible level only for some days, only when the rehabilitation activities are realized immediately adjacent to the said buildings. Notwithstanding this fact, in the construction phase, the mitigation measures are recommended to realize adjacent to the said buildings.
- If the number of trains traveling across the project zone increases, the train traffic schedule is desirable to develop in the way as to limit their traffic across the project zone to day time hours.

## Annex 1: Maps of 5 sections of the project line showing the modeling sections

### Map 1.1: First section - KP 0 - KP 44.5 KP



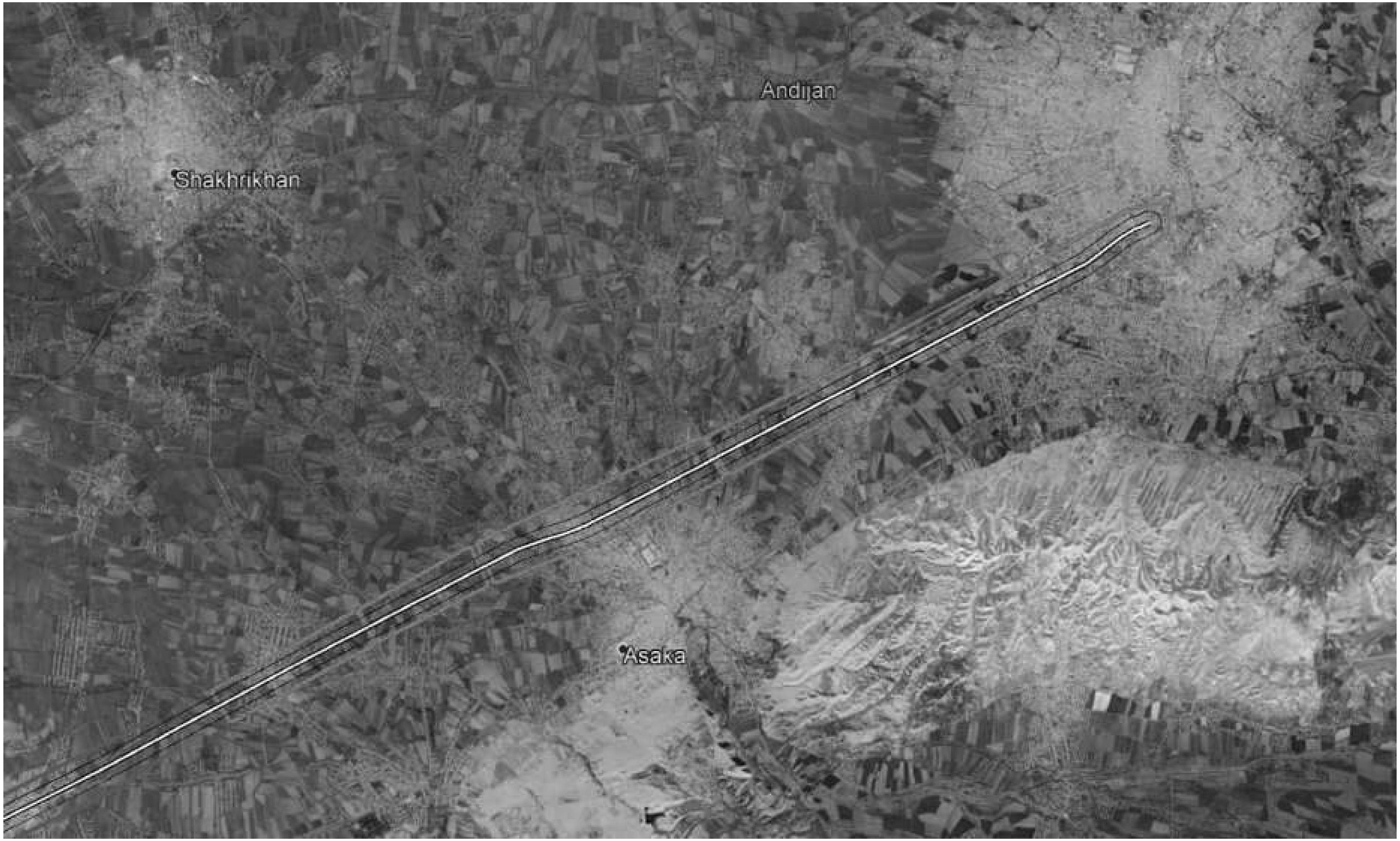

**Map 1.2: Second section - KP 44.5 - KP 163.7**


Sarvan
Chadak
Namangan
Chust
Pop
Turakurgon
Besharyk

**Map 1.3: Third section - KP 163.7 - KP 235.6**


**Map 1.4: Fourth section - KP 235.6 - KP 278.4**


**Map 1-5: Fifth section - KP 278.4 - KP 306**


Andijan
Shakhrikhan
Asaka

## Annex 2: Noise level 24-hour measurement results in 2 points of the project zone

**Figure 2-1: First point 10 m from the project line**

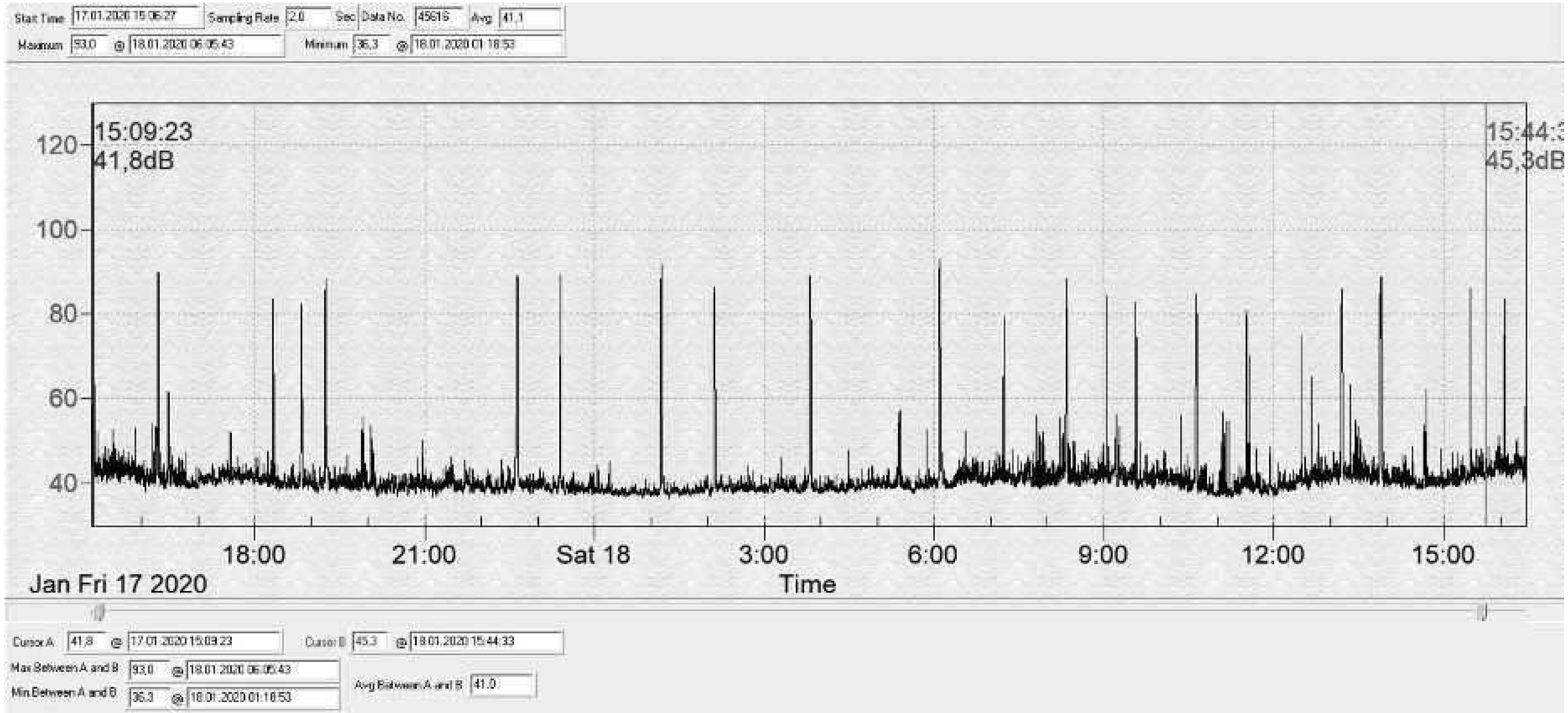
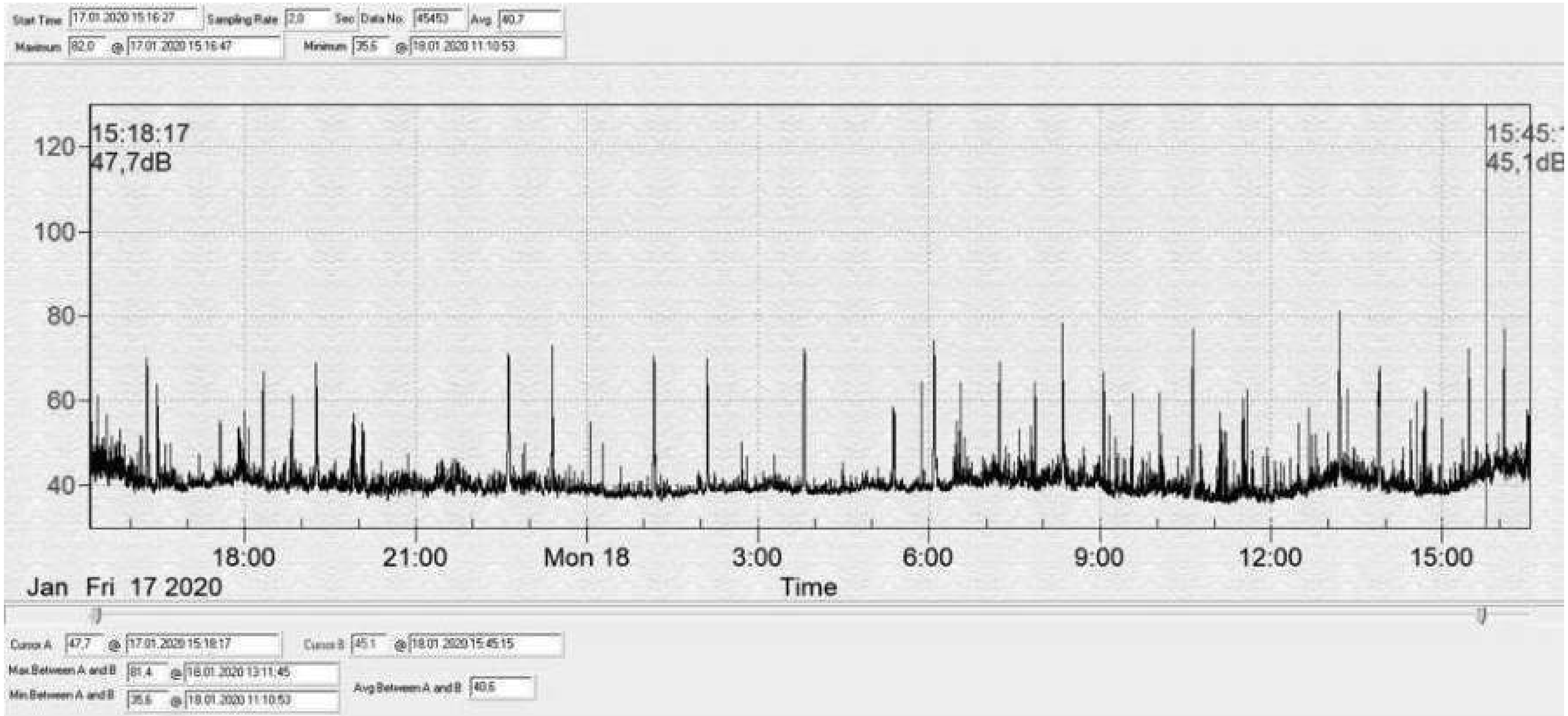


**Figure 2-1: Second point 50 m from the project line**



**Annex 3: Calibration Certificate**

**GLOBAL TEST SUPPLY**
**The Test, Measurement & Supply Co!**

312 Raleigh Street, Suite 9
Wilmington, NC 28412
1-888-610-7664

www.GlobalTestSupply.com • sales@GlobalTestSupply.com

# Calibration Certificate

**Customer:** *Global Test Supply*

**Certificate: C275227-00-01**

**Unit Identification**

Manufacturer: **Reed Instruments**
Model: **R8090**
Description: **Sound Calibrator**
Serial: **180923980**
Unit ID: **N/A**

**Calibration Date**

Calibration Date: **7-May-2019**
Due Date: **7-May-2020**

**Calibration Conditions**

Temperature: **19.74°C**
Humidity: **41.86 %**
Barometric Pressure: **N/A**

**General Information**

Remark: N/A

**Standards Used**

| Unit ID | Manufacturer | Model | Cal Date | Due Date |
|---|---|---|---|---|
| INV127 | Agilent | 34401A | 20-Jun-2018 | 20-Jun-2019 |
| INV148 | Brüel & Kjær | 4188/2671 | 5-Sep-2018 | 5-Sep-2019 |
| INV149 | Brüel & Kjær | 4228 | 7-Sep-2018 | 7-Sep-2019 |
| INV150 | Brüel & Kjær | Nexus 2693-OS4 | 5-Sep-2018 | 5-Sep-2019 |

The calibration was performed using measurement standards traceable to the National Measurement Institute Standards (NMIS) part of the Natural Research Council of Canada (NRC) or the National Institute of Standards and Technology (NIST), or to accepted intrinsic standards or measurements, or is derived by ratio type self-calibration techniques. Measurement uncertainties given in this report are based on a coverage factor of k=2 corresponding to a confidence level of approximately 95%.

Calibrated by: *J. Naidoo*

Approved by:

Certificate: C275227-00-01
Asset: ITM0024973

Calibration Certificate

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**Test Results**
**Procedure: Reed R8090 /Nexus Rev: 2**
**Data Type: As Found Results: Pass**

| Test Description | True Value | Reading | Lower Limit | Upper Limit | Test Status | Exp Uncert |
|---|---|---|---|---|---|---|
| -- dB Level Accuracy -- | | | | | | |
| 94.00 dB | | 93.81 dB | 93.50 dB | 94.50 dB | Pass | 1.3e-001 dB |
| 114.00 dB | | 113.89 dB | 113.50 dB | 114.50 dB | Pass | 1.3e-001 dB |
| Frequency Accuracy | | | | | | |
| 1000 Hz | | 1026 Hz | 960 Hz | 1040 Hz | Pass | 5.8e-001 Hz |