# CEYHAN PROPANE DEHYDROGENATION - POLYPROPYLENE PRODUCTION AND JETTY PROJECT

## NOISE SUPPORTING INFORMATION

(ANNEX-G)

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**ANKARA**

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# 1. INTRODUCTION

This report presents the assessment of the noise and vibration impacts that will be generated by the construction and operation of the *CEYHAN PDH-PP and Jetty investment project.* In order to evaluate the impact of noise and vibration due to the construction and operation activities, a noise modelling and analysis study and vibration calculation study were undertaken covering the Project area and its surroundings.

This report is prepared by Frekans Acoustics & Environmental Laboratory in March 2021. Report is prepared by Mahmut Tuncer Çetin (BSc. EnvE), Ozan Kaya (BSc. EnvE) Erdem Kesen (BSc. Phys) and noise model is generated by Mahmut Tuncer Çetin (BSc. EnvE). General supervisor of the project is Ekim Şükrü Bakırcı technical manager (Bsc. ME). This report figures out the main aspects of noise and vibration impacts of construction and operation phases of the Ceyhan PDH-PP chemical complex project and associated Jetty. Noise and vibration related definitions, methodology which should be followed, regulations and limit values are covered in this document.

The purpose of the impact assessment is to characterize the existing ambient conditions at each of the proposed sites and evaluate the potential impact significance at surroundings and to recommend relevant mitigation measures.

The anticipated activities at each site were modelled using the CadnaA acoustical software. The predicted impacts were compared against the ambient criteria established for each critical location.

Noise impacts were assessed in accordance with the recommendations outlined in the IFC Environmental, Health, and Safety (EHS) Guidelines which is based on the Guidelines for Community Noise, World Health Organization (WHO), 1999 and local legal legislation intact in Republic of Turkey, Regulation on Assessment and Management of Environmental Noise (RAMEN).

Vibration impacts were assessed in accordance with the vibration damage criteria defined in BS 5228-2:2009 international standard document.

## Definitions

Before explaining the studies that were undertaken, it would be helpful to provide definitions of basic acoustical terms and concepts, as given below.

Sound: Sound is vibrational disturbance, exciting hearing mechanisms, transmitted in a predictable manner determined by the medium through which it propagates. To be audible, the disturbance must fall within the frequency range 20Hz to 20,000Hz.

Noise: Noise is typically defined as "unwanted sound", sound being the human sensation of pressure fluctuations in the air. Sound levels are expressed in decibels (dB) on a logarithmic scale, where 0 dB is nominally the "threshold of hearing" and 120 dB is nominally the "threshold of pain".

Background (Baseline) noise: Prevailing noise in a specified environment measured in the absence of the noise being studied.

Decibels (dB): It is the unit describing the amplitude of the sound. The human hear responds to sound logarithmically. The bel is logarithm of the ratio of the two powers and decibel is 1/10 bel.

Frequency: The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or Hz.

Sound pressure level (Lp): It is a logarithmic measure of the effective sound pressure of a sound relative to a reference value. It is measured in decibels (dB) above a standard reference level. The commonly used "zero" reference sound pressure in air is 20 µPa RMS (root mean square), which is usually considered the threshold of human hearing (at 1 kHz).

Sound power level (Lw): Ten times the logarithm of the ratio of the sound power under consideration of the standard reference power of 1 pW (10-6 W). The quantity obtained is expressed in decibels.

Equivalent Sound Level (Leq): Quantifies the noise environment as a single value of sound level for any desired duration. Leq correlates well with the effects of noise on people. Leq is also sometimes known as Average Sound Level.

L10: Sound pressure level that is exceeded 10% of the time of measurement.

L90: Sound pressure level that is exceeded 90% of the time of measurement.

A-Weighting: A measure of sound pressure level designed to reflect the response of the human ear, which does not respond equally to all frequencies. To describe sound in a manner representative of the human ear’s response, it is necessary to reduce the effects of the low and high frequencies with respect to medium frequencies. The resultant sound level is said to be A-weighted, and the units are in decibels (dBA).

Noise Barrier: A physical obstruction that is constructed between the highway noise source and the noise sensitive receptor(s) that lowers the noise level, including standalone noise walls, noise berms (earth or other material), and combination berm/wall systems.

Noise Berms: Noise barriers constructed from natural earthen materials such as soil, stone, rock, rubble, etc. in a natural, unsupported condition are termed, noise berms.

Noise Walls: Noise barrier systems that is manufactured according to a technical design and assembled on-site to obstruct the noise propagating from noise source to receptors.

A – Weighting: Several methods are present to characterize sound. The most common is the A-weighted sound level or dBA. This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Studies have shown that the A-weighted level is closely correlated with annoyance.

C-Weighting: A measure of sound pressure level designed to reflect the response of the human ear, for higher levels above 100 dB when the human ear's response is flatter.

LAeq: A weighted equivalent sound pressure level.

LAmax: The maximum A weighted sound pressure level detected in the measurement time domain.

LCeq: C weighted equivalent sound pressure level.

Point Source: A source of sound which is concentrated to a point.

Area Source: A source of sound which is distributed over an area.

Line Source: A source of sound emanating from a linear geometry.

The threshold of perception of the human ear is approximately 3 dB, and a 5 dB change is considered to be clearly noticeable to the ear. This is primarily due to the logarithmic measuring metric typically associated with decibels.

**Table 1-1.** Perception of Sound

| Change in sound level | Perceived Change to the Human Ear |
|---|---|
| ± 1 dB | Not perceptible |
| ± 3 dB | Threshold of perception |
| ± 5 dB | Clearly noticeable |
| ± 10 dB | Twice as loud |
| ± 20 dB | Four-fold change |

## Specific Objectives

The specific objectives of the noise impact assessment are to:

- assess noise impacts on sensitive receptors in the vicinity of project area;
- identify the vibration impact
- assess and define mitigation measures against noise and vibration impacts;

## Overview of Key Issues

Potential sources of noise impact in the PDH-PP and Jetty can be outlined as:

- Construction activities at sensitive receptors
- Truck activities related to construction works
- PDH Plant
- PP Plant
- Truck Loading
- Heating and Cooling
- Miscellaneous Pumping and Valve Equipment
- Jetty Noise Sources

## 1.1 Area of Influence

The Project's area of influence for the noise impact was determined as the area where cumulative noise generated by the Project around reaches below WHO night time noise limits. The noise modeling results will help us determine the noise impact area.

While determining the area of noise modelling, a very simple propagation model is created in order to find out the distance noise levels drops below 40 dBA which is 5 dBA lower than the critical night time limit given in WHO guidelines. While determining the critical distance maximum potential area source level 90 dBA/m$^2$ is used to describe PDH-PP and Jetty noise.

Below Figure 1-1 represents simple propagation model used for modelling area determination. For that reason an area of 10000m x 10000m was used in modelling process.

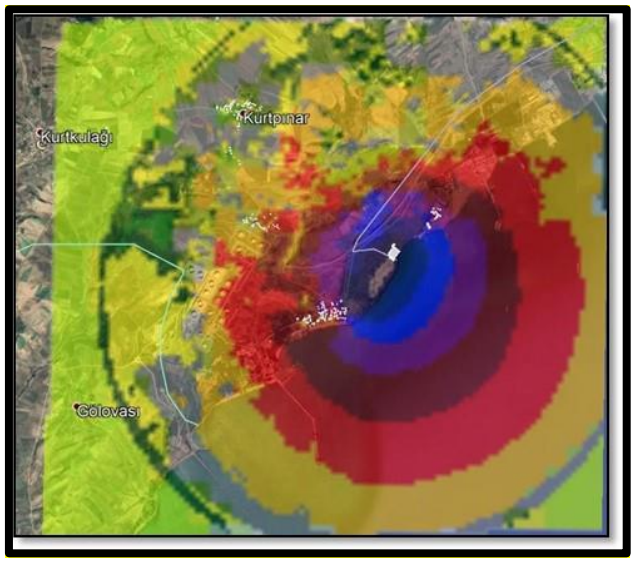



**Figure 1-1.** Calculation Area Determination Model

For vibration impacts; determined receptors and relevant distances to the closest vibration creating activity is considered as area of influence.

## 1.2 Temporal Scope

Impacts were assessed for the construction stage (28 months) and operation stages of the PDH-PP complex and associated Jetty.

Operational noise impact of the project will be evaluated with all machine and equipment working at full power simultaneously.

# 2. LEGAL BASIS

Legal basis and evaluation criteria for the project are gathered from international standard documents and Regulation about Assessment and Measurement of Environmental Noise (RAMEN).

## 2.1 Applicable Noise Standards

Noise standards and recommendations outlined in the WHO Noise Guidelines were applied in noise impact assessment.

Noise impacts should not exceed the levels presented in Table 2-1 or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

**Table 2-1.** WHO Noise Thresholds

| Receptor | Daytime (07:00 - 22:00) | Nighttime (22:00 - 07:00) |
|---|---|---|
| Residential areas | 55 | 45 |
| Commercial/industrial areas | 70 | 70 |
| Source: Guidelines for Community Noise, World Health Organization (WHO), 1999 | | |

WHO states cumulative noise level limits which depends on the background noise levels. In the determination of WHO's limits, background noise levels are taken into consideration. In order to evaluate the cumulative noise levels, energetic summation of background noise and project noise exposure are assessed. When the cumulative noise levels are less than the given limiting values of Lday= 55 dBA and Lnight= 45 dBA, the limits are set to these values. On the contrary, if the cumulative noise values are higher than these ratings, the cumulative noise levels should not exceed background noise more than 3 dBA.

In other words; limiting values are fundamentally defined for two circumstances; first, if background noise level values are less than 55 dBA for day and 45 dBA for night than these limits are valid and second, if background noise levels are higher than these limits than limits set to background noise level plus 3 dBA.

The impact assessment was conducted with respect to the arithmetic difference between cumulative project noise and limiting values. Due to the increase in the cumulative noise climate, impact magnitude of the project was determined.

## Turkish Legislation

Environmental noise is regulated by the Turkish Regulation on the Assessment and Management of Environmental Noise (RAMEN) (Official Gazette Date/Number: 04.06.2010/27601). The regulation sets noise limits applicable to various areas (e.g. industrial areas, residential areas or combination of both) for three time periods (day, evening and night time). Noise limits for construction sites are given in Table 2-2.

**Table 2-2.** Environmental Noise Limits for Construction Sites

| Receptor | Daytime (07:00 - 19:00) |
|---|---|
| Building | 70 |
| Road | 75 |
| Other Sources | 70 |

In accordance with the mentioned regulation, construction activities inside or close to residential areas are not allowed to be conducted within evening and night time periods unless a consent is obtained from the relevant authorities. Moreover; after the consent taken the noise, limits lowers 5 dBA for evening time period and 10 dBA for night time period. Related to the operation phase of the project, limit value for noise emission sources of industrial facilities in the Turkish Regulation on the Assessment and Management of Environmental Noise is presented in Table 2-3 which gives maximum allowable environmental noise levels that shall be met at the nearest off-site receptor.

**Table 2-3.** Environmental Noise Limits for Industrial Facilities

| Areas | Daytime (07:00 - 19:00) | Evening (19:00 - 23:00) | Nighttime (23:00 - 07:00) |
|---|---|---|---|
| Areas where sensitive receptors are located including education, culture, health, summer houses, and camping areas | 60 | 55 | 50 |
| **Commercial and residential areas where residential buildings dominate** | 65 | 60 | 55 |
| Commercial and residential areas where workplaces dominate | 68 | 63 | 58 |
| Industrial Areas | 70 | 65 | 60 |

According to Article 22 – b of RAMEN, it is forbidden to exceed baseline noise levels more than 5 dB during day, evening and night time periods.

## 2.2 Applicable Vibration Standards

The following standards for vibration impacts were used in this assessment:

- Environmental vibration limits defined in RAMEN (Table 2-4)
- Guidance on effects of vibration levels on humans provided by BS 5228-2:2009 (Table 2-5);
- Transient vibration guide values for cosmetic damage of buildings provided in BS 7385-2:1993 (Table 2-6).

**Table 2-4.** RAMEN Environmental Vibration Limits

| Category | Maximum Allowable Peak Vibration (mm/s) | |
|---|---|---|
| | Continious Vibration | Discontinious Vibration |
| Residential Locations | 5 | 10 |
| Industrial and Commercial Districts | 15 | 30 |

**Table 2-5.** Guidance on Effects of Vibration Levels on Humans

| Vibration level, mm/s | Effect |
|---|---|
| 0.14 | Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration. |
| 0.3 | Vibration might be just perceptible in residential environments. |
| 1.0 | It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents. |
| 10 | Vibration is likely to be intolerable for any more than a very brief exposure to this level. |
| Source: BS 5228-2:2009. Code of practice for noise and vibration control on construction and open sites. Vibration | |

**Table 2-6.** Transient Vibration Guide Values for Cosmetic Damage of Buildings

| Type of building | Peak component particle velocity in frequency range of predominant pulse, mm/s | |
|---|---|---|
| | 4 Hz to 15 Hz | 15 Hz and above |
| Reinforced or framed structures | 50 | 50 |
| Industrial and heavy commercial buildings | | |
| Unreinforced or light framed structures | 15-20 | 20-50 |
| Residential or light commercial buildings | | |
| Note: Values referred to are at the base of the building | | |
| Source: BS 7385-2:1993. Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration | | |

According to BS 7385-2:1993, minor damage to buildings is possible at vibration levels greater than twice those given in Table 2-6, and major damage to a building structure can occur at values greater than four times the tabulated values.

In addition, the values in Table 2-6 are related predominantly to transient vibration that does not generate resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as generate resonance, then the guide values in Table 2-6 might need to be reduced by up to 50% Therefore, the lower limit for vibration level that may cause cosmetic damage to residential buildings is 5 mm/s, while the limit of human perception is much lower, comprising 0.14 to 0.30 mm/s.

# 3. IMPACT ASSESSMENT METHODOLOGY

In order to evaluate the significance of impact from the project, magnitude of impact and responsivity of the receptors need to be identified throughout the project area.

Magnitude of impact is a parameter defined as characteristics of impact and project. On the other hand, responsivity is defined as characteristics of receptors.

## 3.1 Significance of Impact, Noise

The category of *significance* is identified based on the combinations of *magnitude* and *responsivity* of receptors in accordance with Table 3-1.

**Table 3-1.** Determination of Impact Significance

| **Magnitude of Impact** | **Responsivity of Receptor** | | |
|---|---|---|---|
| | ***Low*** | ***Medium*** | ***High*** |
| ***No Impact*** | No Impact | | |
| ***Negligible*** | Negligible | | Minor |
| ***Small*** | Negligible | Minor | Moderate |
| ***Medium*** | Minor | Moderate | Major |
| ***Large*** | Moderate | Major | |

### 3.1.1 Magnitude of Impact

Magnitude of impacts was determined as a combination of the extent and the scale of impact. (Table 3-2)

**Table 3-2.** Determination of Impact Magnitude

| **Extent** | **Scale** | | | | |
|---|---|---|---|---|---|
| | **No Impact** | *Neg.* | *Small* | *Medium* | *Large* |
| *Single* | *No impact* | Negligible | | | Small |
| *Site* | | Negligible | Small | Medium | Large |
| *Local* | | Small | Medium | Large | |
| *Regional* | | Medium | Large | | |

### Extent of Impact

The impact extent characterizes spatial distribution of the given impact. The impact extent categories are detailed in Table 3-3.

**Table 3-3.** Categories of Impact Extent

| Category of impact extent | Criteria |
|---|---|
| **Single** | Possible noise impact on a single building. |
| **Site** | Possible noise impact on 5 - 10 buildings. |
| **Local** | Possible noise impact on 10 - 100 buildings. |
| **Regional** | Possible noise impact on 100 - 1000 buildings |

### Scale of Impact

The scale of noise impact is the measure of how much noise is cumulated over limiting values at receptor locations. Noise impact receptors are residential, office, institutional, educational, health centers and commercial buildings.

Scale of noise impact is evaluated according to exceedance level. Any increase occurs with respect to WHO's Guidelines limit values or baseline noise levels (more than 3 dBA) will be noted down as exceedance. Criteria identifying the scale of noise impact during the operation of the Project are detailed in Table 3-4.

**Table 3-4.** Criteria for evaluation of the Scale of noise impact on receptors

| Category of impact scale | Exceedance from WHO noise limits | |
|---|---|---|
| | Daytime* | Nighttime* |
| **No impact** | **<1** | **<1** |
| **Neg.** | 1-3 | 1-3 |
| **Small** | 3-5 | 3-5 |
| **Medium** | 5-10 | 5-10 |
| **Large** | >10 | >10 |
| * Daytime: 07:00 – 22:00; Nighttime: 22:00 – 07:00 | | |

## 3.1.2 Responsivity of Receptors

The second component for evaluation of impact *significance* is *responsivity* of a possibly affected receptor.

*Responsivity* is an integral characteristic comprising of:

- Importance characteristics of the affected receptor and
- Sensitivity of the affected receptor to the given impact.

The category of responsivity is identified based on the combinations of *importance* and *sensitivity* of receptors in accordance with the *responsivity* matrix (Table 3-5).

**Table 3-5.** Determination of Responsivity of Receptors

| | Sensitivity | | |
|---|---|---|---|
| **Importance** | *Low* | *Medium* | *High* |
| *Low* | Low | Low | Medium |
| *Medium* | Low | Medium | High |
| *High* | Medium | High | High |

## Importance of Receptors

In general, evaluation of *importance* of the affected receptors is based on their properties as follows:

- Protected status;
- Policy of the regional government;
- Stakeholders opinion;
- Economic value;
- Special features of ecosystems, such as resistance to change, rarity, adaptability, diversity, and fragility, ability for recovery;
- Importance of individual components as environmental components, etc.

If one of the above constraints could be considered as relevant for any receptors, importance can be evaluated as medium or high subjectively. Otherwise, the importance is considered as low.

## Sensitivity of Receptors

*Sensitivity* of a receptor can be explained as the usage of the specific buildings (Table 3-6).

**Table 3-6.** Designation of Sensitivity of Receptors

| Sensitivity | Receptor |
|---|---|
| **Low** | High ability to recover the initial properties and functions, minor changes of spatial and dynamic indicators.<br>Office Buildings, farm buildings, industrial or commercial facilities. |
| **Medium** | Limited / low ability to recover the initial properties and functions. Measures to minimize disturbance of ecosystems are required.<br>Residential Buildings, hotels. |
| **High** | Lack of ability to recover the initial properties and functions. Irreversible disturbances may be caused by minor impacts.<br>Recreational facilities, educational facilities and health care centers. |

### 3.1.3 Possible Mitigation Alternatives

Possible mitigation measures should be considered for operation phases are explained in this part.

- Border Noise barriers
- Plant building façade treatment

The main issue in PDH-PP plant and Jetty noise mitigation should be identifying the source of noise and implementing the effective noise reduction technique on the source.

Noise barriers are engineered structures that lower the noise exposure at determined receptors. However; it is not reasonable to build noise barriers at every situation.

Rather than reducing the noise exposure, physical characteristics of noise barriers are also needed to be considered such as; static and wind loads.

Optimized height of the noise barriers should not be exceeding around 4 meters in order to maintain effectiveness of sound reduction and practicality of construction.

Possible mitigation measures should be considered for construction phase;

- Time management of heavy machinery (operating them when the background level is maximum)
- Turning off any unnecessary equipment that may cause noise propagation
- As long as possible limiting simultaneous usage of the equipment with higher sound power levels

### 3.1.4 Vibration Assessment Methodology

Since construction vibration damage criteria gathered from relevant documents is the damage criteria indeed, vibration impacts will be assessed accordingly. If any receptor exposes to any limit exceedance according to damage criteria it means total impact is severe in terms of vibration and if there is not any exceedance it means total impact is none or negligible.

Operational vibration assessment criteria are given in Table 3-7.

**Table 3-7.** Criteria for evaluation of the Scale of vibration impact on receptors

| Category of impact scale | PPV (mm/sec) |
|---|---|
| No Impact | <0,14 |
| Negligible | <0,3 |
| Small | <1 |
| Medium | <10 |
| Large | >10 |

# 4. BACKGROUND FINDINGS

To evaluate the background noise climate of the existing conditions, in the area of influence, noise level measurements were conducted at close residential locations.

The receiver locations were selected depending on the sections of the possibility of having potential noise impact from the facility. Along the project field, 5 different receiver locations were selected to conduct noise impact assessment to predict the potential impact of construction and operation phases.

## 4.1 Identified receivers

Selected receiver locations are representing a cluster of receivers which have the same or similar background characteristics in terms of environmental noise levels. Moreover, receivers to be evaluated can be defined as representative points which have the highest possibility to expose to noise due to complex operations.

Information about receivers is presented in Figure 4-1.


**Figure 4-1.** Receiver Locations

**Table 4-1.** Receivers

| Rec No. | Comments | Extent | Sensitivity | Importance | Distance to project border (m) | Coordinate, X | Coordinate, Y |
|---|---|---|---|---|---|---|---|
| 1 | Residential | Local | Medium | Medium | 1435 | 36.907205 | 35.934833 |
| 2 | Residential | Local | Medium | Medium | 200 | 36.892394 | 35.949960 |
| 3 | Residential | Local | Medium | Medium | 360 | 36.892656 | 35.948108 |
| 4 | Residential | Local | Medium | Medium | 660 | 36.894238 | 35.944635 |
| 5 | Residential | Local | Medium | Medium | 1465 | 36.911943 | 35.975076 |

## 4.2 Background Noise Levels

Background environmental noise measurements were conducted in between 02 - 04 March 2021 at 5 different locations. All the selected locations baseline noise climate is representative for the closest receiving bodies and the measurements were conducted for 48 hours.

Results of baseline noise measurements are presented in below tables.

**Table 4-2.** Noise Measurement Results

| Location | Lday 07:00-22:00 (dBA) | | Lnight 22:00-07:00 (dBA) | |
|---|---|---|---|---|
| | First Day | Second Day | First Day | Second Day |
| Receiver-1 | 54.9 | 53.2 | 46.6 | 45.7 |
| Receiver-2 | 53.1 | 54.2 | 46.7 | 46.9 |
| Receiver-3 | 53.3 | 53.6 | 47.7 | 46.7 |
| Receiver-4 | 48.5 | 45.1 | 43.3 | 43.6 |
| Receiver-5 | 46.3 | 49.3 | 44.7 | 45.8 |

# 5. ASSUMPTIONS ON NOISE MODELLING STRATEGY

## 5.1 Construction Noise

Most logical way to express constructional noise is to create area noise sources with noise modelling software. Since many constructional equipment will be used during whole construction period, it may be tricky to mirror the real noise case into modelling software.

Logic used while modelling constructional noise is determining the reasonable and necessary amount of constructional equipment in a reasonable area.

After determination of necessary equipment and reasonable area, this area of concern is modelled as if construction activities are held at the nearest zones to the receptors. By this approach, maximum noise levels could occur at receptors during whole construction period are tried to be modelled.

**Table 5-1.** Construction Machine and Equipment List

| Quantities of Machines/Equipment | | |
|---|---|---|
| **Machine/Equipment** | **Earthworks Phase Construction Assembly** | **Main Construction Phase** |
| **Tower Crane(1000-1500 ton)** | - | 1 |
| **Crawler(600-800 ton)** | - | 1 |
| **Crawler(300-400 ton)** | - | 2 |
| **Crawler(160-250 ton)** | - | 2 |
| **Mobile Telescopic(150-200 ton)** | - | 5 |
| **Mobile Telescopic(60-100 ton)** | - | 12 |
| **Mobile Telescopic(25-50 ton)** | - | 10 |
| **Tower Crane(10 ton)** | - | 4 |
| **Trailer(10-60 ton)** | - | 15 |
| **Boom Truck(10 ton)** | - | 8 |
| **Forklift(5 ton)** | - | 5 |
| **Manlift(40 meter)** | - | 15 |
| **Excavator** | 15 | - |
| **Truck** | 60 | - |
| **Dozer** | 3 | - |
| **Vacuum Street Sweeper** | 2 | - |
| **Mixer** | 5 | - |

**Table 5-2.** Construction Machine and Equipment Reference Acoustical Traits

| Sound Power Level for Each Machine/Equipment | | | | | |
|---|---|---|---|---|---|
| Machine/Equipment | Impact | LAmax | Referance Distance (m) | % Operation Time | Lw (dBA) |
| **Tower Crane(1000-1500 ton)** | No | 85 | 15 | 16 | 100.6 |
| **Crawler(600-800 ton)** | No | 85 | 15 | 16 | 100.6 |
| **Crawler(300-400 ton)** | No | 85 | 15 | 16 | 100.6 |
| **Crawler(160-250 ton)** | No | 85 | 15 | 16 | 100.6 |
| **Mobile Telescopic(150-200** | No | 85 | 15 | 16 | 100.6 |
| **Mobile Telescopic(60-100** | No | 85 | 15 | 16 | 100.6 |
| **Mobile Telescopic(25-50 ton)** | No | 85 | 15 | 16 | 100.6 |
| **Tower Crane(10 ton)** | No | 85 | 15 | 16 | 100.6 |
| **Trailer(10-60 ton)** | No | 84 | 15 | 40 | 103.5 |
| **Boom Truck(10 ton)** | No | 84 | 15 | 40 | 103.5 |
| **Forklift(5 ton)** | No | 55 | 15 | 40 | 74.5 |
| **Manlift(40 meter)** | No | 85 | 15 | 20 | 101.5 |
| **Excavator** | No | 85 | 15 | 40 | 104.5 |
| **Truck** | No | 84 | 15 | 40 | 103.5 |
| **Dozer** | No | 85 | 15 | 40 | 104.5 |
| **Vacuum Street Sweeper** | No | 80 | 15 | 10 | 93.5 |
| **Mixer** | No | 80 | 15 | 50 | 100.5 |
| **Sound power level calculation conducted according to Roadway Construction Noise Model User's Guide (RCNM) of the U.S. Federal Highway Administration" document* | | | | | |

**Table 5-3.** Construction Machine and Equipment Calculated Sound Power Levels

| Sound Power Level for Equipments | | |
|---|---|---|
| Machine / Equipment | Earthworks Phase (Lw dBA) | Main Construction Phase(Lw dBA) |
| **Tower Crane(1000-1500 ton)** | - | 103.5 |
| **Crawler(600-800 ton)** | - | 104.5 |
| **Crawler(300-400 ton)** | - | 101.5 |
| **Crawler(160-250 ton)** | - | 93.5 |
| **Mobile Telescopic(150-200 ton)** | - | 100.6 |
| **Mobile Telescopic(60-100 ton)** | - | 102.5 |
| **Mobile Telescopic(25-50 ton)** | - | 92.5 |
| **Tower Crane(10 ton)** | - | 99.5 |
| **Trailer(10-60 ton)** | - | 104.5 |
| **Boom Truck(10 ton)** | - | 100.5 |
| **Forklift(5 ton)** | - | 100.5 |
| **Manlift(40 meter)** | - | 96.5 |
| **Excavator** | 116.3 | - |
| **Truck** | 115.3 | - |
| **Dozer** | 109.3 | - |
| **Vacuum Street Sweeper** | 93.5 | - |
| **Mixer** | 107.5 | - |
| **Total Lw (dBA)** | **119.3** | **121.3** |

Machine and equipment information are gathered from the delivered documents from client and fundamental construction necessities.

As a final note for construction noise modelling; it is important to remember that, assessment procedures implemented only for day time period for pile driving activities. Reason for that situation is because of the operating conditions it is nearly impossible to conduct pile driving activities at dark.

## 5.2 Construction Vıbration

During construction period regarding to the distances of the main construction areas most major vibration source for receptors are pile driving activities.

In order to simulate maximum vibration that may occur at receptors, calculations and assessment will be conducted in terms of environmental vibration sourced from pile driving activities. Experimental reference values will be used gathered with similar activities in order to calculate the vibration impact from piling.

Reference vibration values of the piling will be reduced according to distance and relevant impact classes will be assigned where necessary.

In addition to this situation, blasting activities will be carried out for ground preparation works.

Vibration risk analysis report was prepared by Istanbul University for blasting activities and has been calculated how much explosive substance will be used in which location.

## 5.3 Operation Noise

Using the site layout all of the noise sources, delivered by the client, will be defined into the noise modelling software at relevant locations.

Not only location but also relevant definition types are also important at this stage. For instance, while a simple pump needs to be defined as point source more complex noise sources need to be defined with relevant method.

The main assumption while modelling operational noise from an industrial plant is accepting all of the noise sources are operating at full performance and full time. This modelling strategy provide us to not to underestimate any of the noise events in the facility.

According to the information gathered from client about operational machine and equipment fire water pumps and flares are the type of equipment that only operates during emergency situations. Operational noise model of this project is created for steady-state working conditions, hence; flares and fire water pumps are not included.

Truck traffic defined to be working inside of the facility is modeled as a road noise source.

This worst case scenario strategy does not include any of the emergency equipment or maintenance/substitute lines.

Machine and equipment information are gathered from the delivered documents from client.

Operation machine and equipment list and truck traffic knowledge are presented in Table 5-4 and Table 5-5.

**Table 5-4.** Operation Machine and Equipment List

| Unit | Type of Equipment | Item No. | Service | Q'TY | Location | If Outdoor Average Height of Noise Source (m) | Sound Pressure Level at 1 meter (dBA) |
|---|---|---|---|---|---|---|---|
| PDH | Heater | 01-H-101 | Charge Heater | 1 | Outdoor | 10 | =<85 |
| PDH | Heater | 01-H-102 | No 1 Interheater | 1 | Outdoor | 10 | =<85 |
| PDH | Heater | 01-H-103 | No 2 Interheater | 1 | Outdoor | 10 | =<85 |
| PDH | Heater | 01-H-104 | No 3 Interheater | 1 | Outdoor | 10 | =<85 |
| PDH | Compressor | 01-K-101 | Reactor Effluent Compressor Stage 1 | 1 | Outdoor | 4 | about 90 |
| PDH | Compressor | 01-K-102 | Reactor Effluent Compressor Stage 2 | 1 | Outdoor | 4 | =<85 |
| PDH | Compressor | 01-K-103A/ B | Hydrogen Compressors | 2 | Outdoor | 4 | =<85 |
| PDH | Compressor | 01-K-201 | Heat Pump Compressor | 1 | Outdoor | 4 | about 90 |
| PDH | Pump | 01-P-101A/ B/ C/ D | Sulfur Injection Pumps | 4 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-102A/ B | Solvent Circulation Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-103A/ B | Caustic Circulation Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-104A/ B | Wash Water Injection Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-105A/ B | Wash Water Circulation Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-106 | Spent Caustic Transfer Pump | 1 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-107A/ B | Solvent Recovery Column Bottoms Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-108A/ B | Solvent Recovery Column Overhead Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-109A/ B | Depropanizer Bottoms Stripper Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-110A/ B | Circulating Water Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-111A/ B | Heavy Hydrocarbon Transfer Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-112 | Solvent Start-Up Circulation Pump | 1 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-114 | Neutralization Filling Pump | 1 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-113 | Neutralization Circulation Pump | 1 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-201A/ B | Feed Drier Regenerant Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-202A/ B | Depropanizer Overhead Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-203A/ B | Deethanizer Stripper Reflux Pumps | 2 | Outdoor | 0,5 | =<85 |

| Unit | Type of Equipment | Item No. | Service | Q'TY | Location | If Outdoor Average Height of Noise Source (m) | Sound Pressure Level at 1 meter (dBA) |
|---|---|---|---|---|---|---|---|
| PDH | Pump | 01-P-204A/ B | Deethanizer Rectifier Reflux Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-205A/ B | Propane Recycle Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-206A/ B | Propylene Product Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-207A/ B | Heat pump Surface Condenser Condensate Pumps | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-501A/B | Condensate Transfer Pump | 2 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-502 | Spent Solvent Truck Loading Pump | 1 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-503 | Closed Drain Drum Pump | 1 | Outdoor | 0,5 | =<85 |
| PDH | Pump | 01-P-504 | Caustic Drain Pump | 1 | Outdoor | 0,5 | =<85 |
| PDH | Package | 01-PK-402 | Air Drier Package | 1 | Outdoor | 0,5 | =<85 |
| PDH | Miscellaneous | 01-J-101 | Steam Jet Ejector | 1 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-MX-101 | Neutralization Tank Mixer | 1 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-X-202 | Refrigeration Equipment | 1 | Outdoor | 2 | about 90 |
| PDH | Miscellaneous | 01-BL-401 | Cooler Blower | 1 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-BL-402 | Lower Regeneration Blower | 1 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-BL-403 | Upper Regeneration Blower | 1 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-BL-404 | Fines Removal Blower | 1 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-BL-405 A/B | Lift Gas Blowers | 2 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-J-401 | Chlorination Zone Chlorine Eductor | 1 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-J-402 | Burn Zone Chlorine Eductor | 1 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-X-102 | Silencer | 1 | Outdoor | 2 | =<85 |
| PDH | Miscellaneous | 01-MX-102 | Caustic Mixer | 1 | Outdoor | 2 | =<85 |
| PP | Compressor | 02-BL-502A/B | Dryer Blowers | 2 | Outdoor | 4 | =<85 |
| PP | Compressor | 02-BL-812 | Nitrogen Suction Blower | 1 | Outdoor | 4 | =<85 |
| PP | Compressor | 02-K-610 | Drying Circuit Compressor | 1 | Outdoor | 4 | =<85 |
| PP | Compressor | 02-PK-301 | Recycle Gas Compressor Unit | 1 | Outdoor | 4 | =<85 |
| PP | Compressor | 02-PK-501 | Steamer Off Gas Compression Unit | 1 | Outdoor | 4 | =<85 |

| Unit | Type of Equipment | Item No. | Service | Q'TY | Location | If Outdoor Average Height of Noise Source (m) | Sound Pressure Level at 1 meter (dBA) |
|---|---|---|---|---|---|---|---|
| PP | Compressor | 02-PK-602 | Instrument Air Booster Compressor Package | 1 | Outdoor | 4 | =<85 |
| PP | Compressor | 02-PK-603 | Nitrogen Compression Unit | 1 | Outdoor | 4 | =<85 |
| PP | Compressor | 02-K-401 | 02-R-401 Recycle Gas Compressor (4) | 1 | Outdoor | 4 | =<85 |
| PP | Pump | 02-P-101A/B | Teal Metering Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-102 | Exhaust Oil Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-103 | Donor Loading Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-104A/B | Donor Metering Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-105A | Grease Loading Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-105B | Oil Loading Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-106A/B | 02-D-106A/B Jacket Circulation Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-107A/B | Pressurization Oil Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-109 | Liquid Additive Loading Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-110A/B | Liquid Additive Metering Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-113 | Cylinder Jacket Circulation Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-200 | 02-R-200 Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-201 | 02-R-201 Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-202 | 02-R-202 Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-203 | 02-D-201 Jacket Circulation Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-204 | 02-R-200 Jacket Circulation Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-205 | 02-R-201 Jacket Water Circulation Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-206 | 02-R-202 Jacket Water Circulation Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-301A/B | Propylene Feed Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-302A/B | Propylene Recycle Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-303 | Oil Load Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-501A/B | Steamer Scrubber Reflux Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-502A/B | Dryer Scrubber Reflux Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-601A/B | Chilled Water Pumps | 2 | Outdoor | 0,5 | =<85 |

| Unit | Type of Equipment | Item No. | Service | Q'TY | Location | If Outdoor Average Height of Noise Source (m) | Sound Pressure Level at 1 meter (dBA) |
|---|---|---|---|---|---|---|---|
| PP | Pump | 02-P-602 | Propylene Glycol Loading Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-603A/B | Steam Condensate Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-605 | Oil Loading Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-606A/B | Oil Delivery Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-607 | Atmer 163 Loading Pump | 1 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-810A/B | Peroxide Feed Pumps | 2 | Indoor | 0,5 | =<85 |
| PP | Pump | 02-P-901A/B | Silo Washing Water Pumps | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-401A/B | 02-R-401 Jacket Water Circulation Pumps (4) | 2 | Outdoor | 0,5 | =<85 |
| PP | Pump | 02-P-430 | 02-C-430 Bottom Pump (3) | 1 | Outdoor | 0,5 | =<85 |
| PP | Package | 02-PK-502 | Steamer Off Gas Drying Unit Package | 1 | Outdoor | 2 | =<85 |
| PP | Package | 02-PK-601 | Refrigeration Unit Package | 1 | Outdoor | 2 | =<85 |
| PP | Package | 02-PK-701 | Propylene Drying Unit | 1 | Outdoor | 2 | =<85 |
| PP | Package | 02-PK-801 | Polymer Pneumatic Transport to Intermediate Silos | 1 | Outdoor | 2 | about 90 |
| PP | Package | 02-PK-803 | Extrusion & Pelletizing Package | 1 | Indoor/Outdoor | 2 | about 90 |
| PP | Package | 02-PK-804 | Pellets Pneumatic Transport Package | 1 | Indoor/Outdoor | 2 | about 90 |
| PP | Package | 02-PK-809 | TALC Transport System | 1 | Outdoor | 2 | =<85 |
| PP | Package | 02-PK-810 | Vacuum Cleaning Package | 1 | Outdoor | 2 | =<85 |
| PP | Package | 02-PK-811 | Solid Additives Handling Package | 1 | Outdoor | 2 | =<85 |
| PP | Package | 02-PK-901 | PP Pellets Recycle To Homogenizing Silos And Transport To Bulk Loading Station | 1 | Outdoor | 2 | about 90 |
| PP | Package | 02-PK-902 | PP Pellets Transport To The Bagging Hoppers | 1 | Outdoor | 2 | about 90 |
| PP | Package | 02-PK-904 | Blenders Blowing System | 1 | Outdoor | 2 | about 90 |
| PP | Miscellaneous | 02-A-105A | Grease Mixer | 1 | Outdoor | 2 | =<85 |
| PP | Miscellaneous | 02-A-105B | Oil Agitator | 1 | Outdoor | 2 | =<85 |
| PP | Miscellaneous | 02-A-106A/B | Catalyst Mixers | 2 | Outdoor | 2 | =<85 |

| Unit | Type of Equipment | Item No. | Service | Q'TY | Location | If Outdoor Average Height of Noise Source (m) | Sound Pressure Level at 1 meter (dBA) |
|---|---|---|---|---|---|---|---|
| PP | Miscellaneous | 02-A-110A/B | 02-D-110A/B Mixers | 2 | Outdoor | 2 | =<85 |
| PP | Miscellaneous | 02-A-201 | Precontacting Pot Agitator | 1 | Outdoor | 2 | =<85 |
| PP | Miscellaneous | 02-A-501 | Steamer Agitator | 1 | Outdoor | 2 | =<85 |
| PP | Miscellaneous | 02-A-607 | Oil Treating Mixer | 1 | Outdoor | 2 | =<85 |
| PP | Miscellaneous | 02-X-857A/B | Fork Lift Trucks | 2 | Outdoor | 2 | =<85 |
| PP | Miscellaneous | 02-X-401 | Silencer | 1 | Outdoor | 2 | =<85 |
| U&O | Compressor | 41-K-001A/B | Propane BOG Compressor | 2 | Outdoor | 4 | =<85 |
| U&O | Package | 21-P-001A/B | Raw Water Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 22-P-001A/B | Firewater Pump-Engine Driven | 2 | Outdoor | 2 | about 100 |
| U&O | Package | 22-P-002 | Firewater Pump-Motor Driven | 1 | Outdoor | 2 | about 90 |
| U&O | Package | 22-P-003A/B | Jockey Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 23-P-001A/B/C/D | Cooling Water Pumps | 4 | Outdoor | 2 | =<85 |
| U&O | Package | 24-P-001A/B | Service Water Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 24-P-002A/B | Drinking Water Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 24-P-003A/B | Fire Water Transfer Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 25-P-001A/B/C | BFW Pumps | 3 | Outdoor | 2 | =<85 |
| U&O | Package | 25-P-002A/B | Untreated Condensate Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 25-P-003A/B | Condensate Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 25-P-004A/B | Demi Water Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 34-P-001 | Oily Waste Water Pit Pumps-1 | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 34-P-0016 | Oily Waste Water Pit Pumps-2 | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 34-P-0017 | Oily Waste Water Pit Pumps-3 | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 34-P-002 | Sanitary Waste Water Pit Pumps in Administration Building | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-003A/B | POCS Transfer Pumps in FFB-01 | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 34-P-004A/B/C | POCS Transfer Pumps in FFB-02 | 3 | Outdoor | 2 | =<85 |
| U&O | Package | 34-P-005 | Sanitary Waste Water Pit Pumps in Control Building | 1 | Indoor | 2 | =<85 |

| Unit | Type of Equipment | Item No. | Service | Q'TY | Location | If Outdoor Average Height of Noise Source (m) | Sound Pressure Level at 1 meter (dBA) |
|---|---|---|---|---|---|---|---|
| U&O | Package | 34-P-006 | Sanitary Waste Water Pit Pumps in Canteen Building | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-007 | Sanitary Waste Water Pit Pumps in Fire Station & Medical Center | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-008 | Sanitary Waste Water Pit Pumps in Laboratory Building | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-009 | Sanitary Waste Water Pit Pumps in Workshop & Warehouse | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-010 | Sanitary Waste Water Pit Pumps in Main Gate House & Guard House | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-011 | Sanitary Waste Water Pit Pumps in Gate House(Process) | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-012 | Sanitary Waste Water Pit Pumps in Marine Operation Building | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-013 | Sanitary Waste Water Pit Pumps in Operator Shelter | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-014 | Sanitary Waste Water Pit Pumps in PP Warehouse | 1 | Indoor | 2 | =<85 |
| U&O | Package | 34-P-015 | Sanitary Waste Water Pit Pumps in PP Process Building | 1 | Indoor | 2 | =<85 |
| U&O | Package | 41-P-001A/B | Fresh Solvent Transfer Pumps | 3 | Outdoor | 2 | =<85 |
| U&O | Package | 41-P-002A/B | Propane Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 41-P-003A/B | Propylene Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 41-P-004 | Offspec Propylene Pump | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 41-P-005A/B | Propane Heater Condensate Pumps | 2 | Outdoor | 2 | =<85 |
| U&O | Package | 21-PK-001 | Raw Water Treatment Package | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 23-CT-001 | Cooling Tower | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 25-PK-001A/B/C | Utility Boiler Package | 2 | Outdoor | 10 | =<85 |
| U&O | Package | 25-PK-002 | Polishing Package | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 31-PK-001A/B/C | Air Compressor Package | 3 | Outdoor | 2 | =<85 |
| U&O | Package | 31-PK-002 | Air Dryer Package | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 31-PK-003A/B | I.A. Booster Compressor Package | 2 | Outdoor | 2 | =<85 |

| Unit | Type of Equipment | Item No. | Service | Q'TY | Location | If Outdoor Average Height of Noise Source (m) | Sound Pressure Level at 1 meter (dBA) |
|---|---|---|---|---|---|---|---|
| U&O | Package | 32-PK-001 | Nitrogen Generation Package | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 33-PK-001 | NG Metering & Depressurization Package | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 33-PK-002 | NG Boosting Compressor Package | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 34-PK-001 | Waste Water Treatment Package | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 41-PK-001 | Tank LP Flare | 1 | Outdoor | 54 | About 119 |
| U&O | Package | 42-PK-001 | Flare | 1 | Outdoor | 155 | About 131 |
| U&O | Package | 44-PK-001 | Bagging and Palletizing Unit | 1 | Outdoor | 2 | =<85 |
| U&O | Package | 44-PK-003 | Regenerative Thermal Oxidizer (RTO) | 1 | Outdoor | 2 | =<85 |
| U&O | Miscellaneous | 23-J-001 | CW Instrument Pit Ejector | 1 | Outdoor | 2 | =<85 |
| U&O | Miscellaneous | 25-X-001 | Deaerator Silencer | 1 | Outdoor | 2 | =<85 |
| U&O | Miscellaneous | 25-X-002 | LP Steam Header Silencer | 1 | Outdoor | 2 | =<85 |
| Jetty | Hydraulic Oil Pumps for Loading Arms | - | - | 4 | Outdoor | 0,5 | <85 |

**Table 5-5.** Truck Traffic

| Truck Traffic | Quantity | | | Remark |
|---|---|---|---|---|
| | Day (07:00-19:00) | Eve (19:00-23:00) | Night (23:00-07:00) | |
| In plant roads | 74 | 15 | 30 | Onshore |
| Loading area large | 2 | 2 | 2 | Offshore |
| Loading area small | 2 | 2 | 2 | Offshore |

## 5.4 Operation Vibration

Operational vibration risks are mostly consisting of operating vibration from stationary machine and equipment.

After finalization possible operational vibration sources from Jetty need to be considered also.

In ISO 10816-3 standard, vibration from machine and equipment is defined.

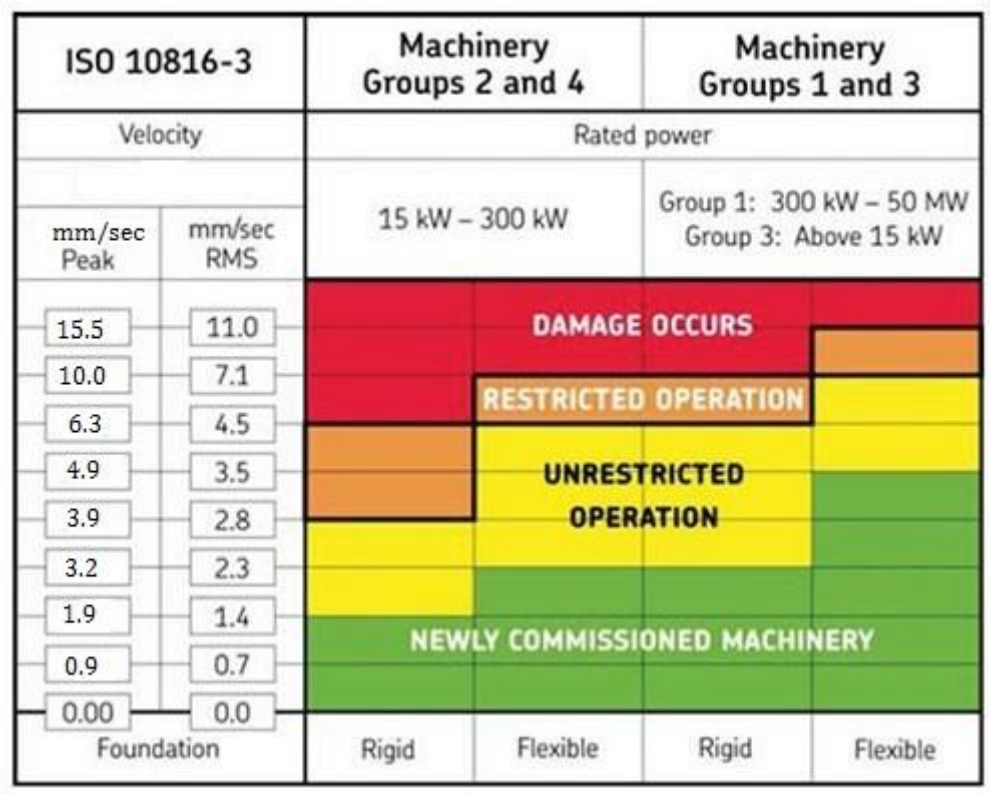



**Figure 5-1.** Machine Equipment Damage Criteria

As can be seen from image above, the maximum vibration level that a machine can produce before damage itself is 15.5 mm/sec peak. While determining and evaluating operational vibration this information will be used as reference. Assuming vibration producing machine is operating at the damage threshold and calculating the vibration at receptors from this data gives us the vibration levels at receptors with the worst case scenario approach.

# 6. NOISE AND VIBRATION RESULTS

Noise modeling and vibration calculations were carried out based on the construction and operation stage noise sources explained in the previous sections. All of the calculation, modelling, simulation and assessment efforts are conducted for five critical locations determined. Selected critical receiving locations are presented in the Figure 6-1. All of the receptors are located at critical noise sensitive residential locations.


**Figure 6-1.** Critical Receptor Locations

## 6.1 Construction Noise Modelling and Vibration Results

Construction works are significant noise sources for neighboring communities and land uses. Sources of noise from construction of the Project will include earth works and building of the machine and equipment. The major noise and vibration source in construction phase is pile driving activities and noise from service roads belongs to the project.

### 6.1.1 Construction Noise Levels

Three different scenarios are developed for construction phase. These are construction activities, construction with piling at the closest location to the residential locations and construction with piling at near middle section of the Jetty. In construction with closest piling variant, it is aimed to determine the impact at the nearest point of piling. In order to observe the impact reduction as the distance between receivers and source increases, piling activities

are modelled at two different regions. These scenarios and noise levels at receptors are given Table 6-1.

**Table 6-1.** Construction Noise Levels at Receptors

| Receptor | Construction Only | | | | | Construction + Closest Piling | | | | | Construction + Mid. Range Piling | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ldn (dBA) | | Lden (dBA) | | | Ldn (dBA) | | Lden (dBA) | | | Ldn (dBA) | | Lden (dBA) | | |
| | Ld | Ln | Ld | Le | Ln | Ld | Ln | Ld | Le | Ln | Ld | Ln | Ld | Le | Ln |
| 1 | 37.4 | 39.0 | 37.4 | 38.3 | 39.0 | 38.8 | 40.4 | 38.8 | 39.7 | 40.4 | 42.6 | 44.2 | 42.7 | 43.5 | 44.2 |
| 2 | 52.2 | 53.5 | 52.2 | 52.9 | 53.5 | 74.7 | 75.7 | 74.7 | 75.3 | 75.8 | 61.2 | 62.3 | 61.2 | 62.0 | 62.6 |
| 3 | 55.8 | 56.3 | 55.8 | 56.1 | 56.3 | 58.5 | 59.4 | 58.5 | 59.0 | 59.4 | 57.5 | 58.4 | 57.5 | 58.0 | 58.4 |
| 4 | 51.9 | 53.1 | 51.9 | 52.6 | 53.1 | 59.3 | 60.7 | 59.4 | 60.1 | 60.7 | 54.8 | 56.1 | 54.8 | 55.5 | 56.1 |
| 5 | 48.1 | 49.5 | 48.1 | 48.8 | 49.5 | 52.1 | 53.6 | 52.1 | 52.9 | 53.6 | 52.0 | 53.5 | 52.0 | 52.8 | 53.5 |

### 6.1.2 Construction Noise Maps

Noise maps are created for day, evening and night time periods; however, only day time noise maps are presented. Because of the fact that; day, evening and night time maps have slight differences due to the meteorological effects. The construction phase day time noise map outputs for each scenario are presented in Figure 6-2, Figure 6-3 and Figure 6-4.

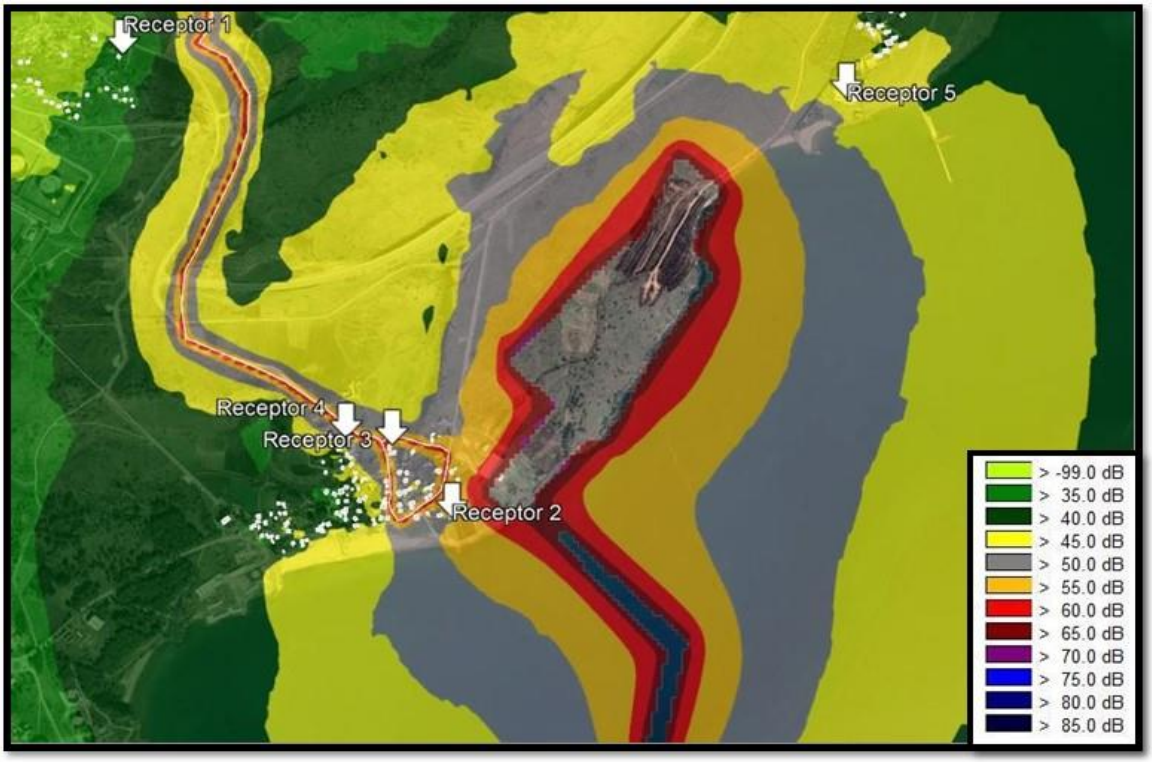



**Figure 6-2.** Construction – Noise Map Day

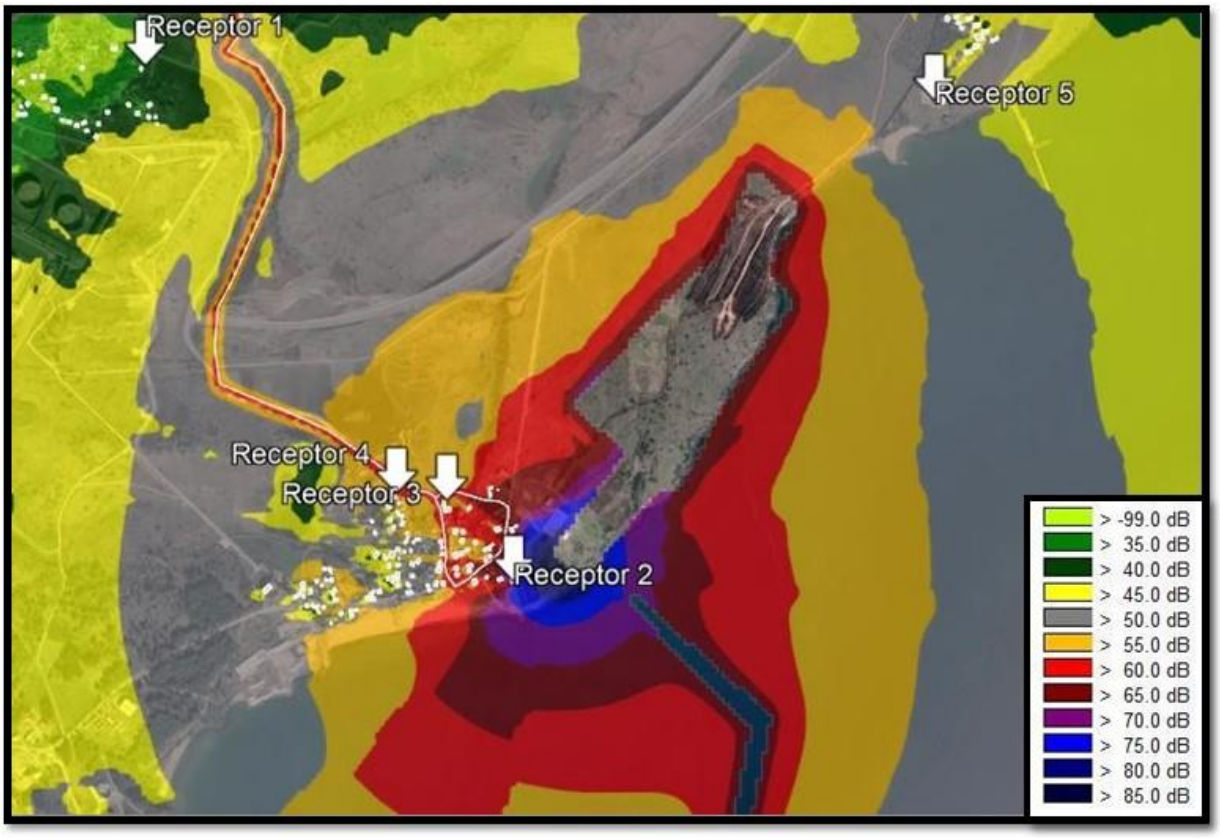



**Figure 6-3.** Construction + Closest Piling – Noise Map Day

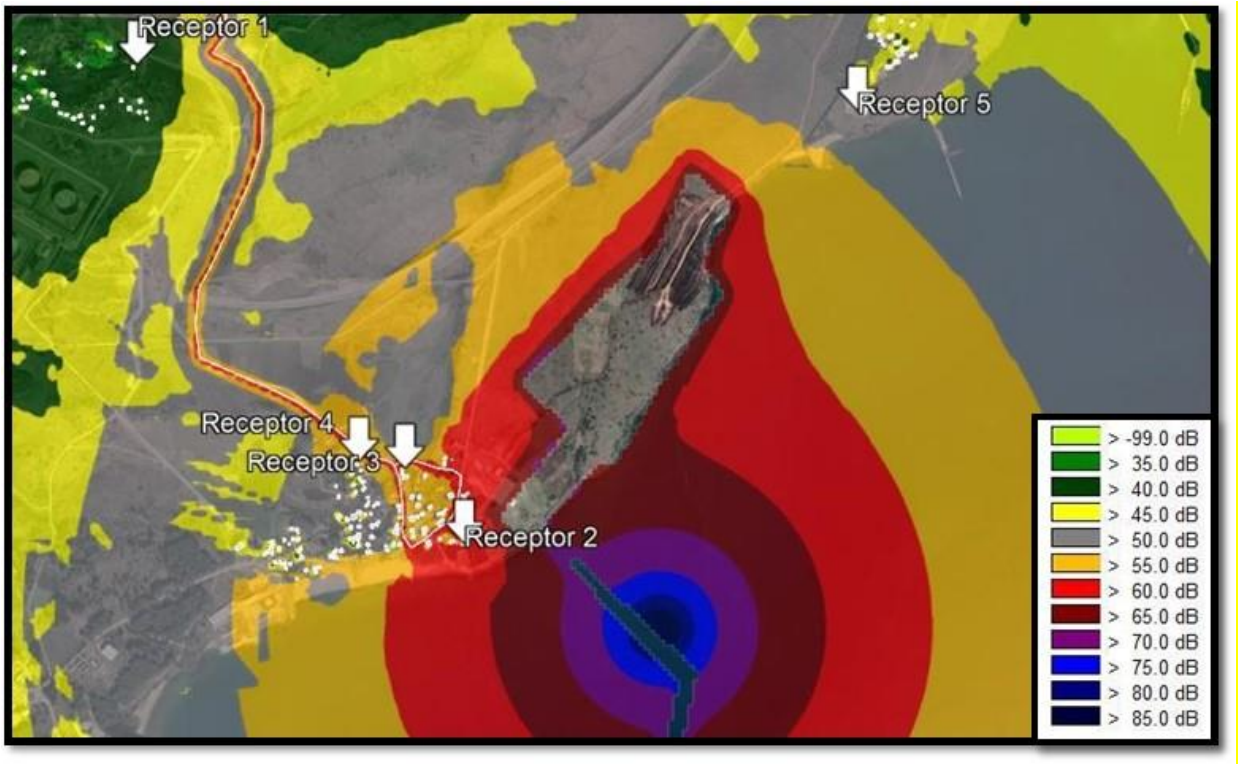



**Figure 6-4.** Construction + Mid-Range Piling – Noise Map Day

### 6.1.3 Construction Vibration Levels

Calculations were carried out based on the reference source vibration measurement which conducted in the previous projects. The reference value is obtained from numerous experiments conducted during similar pile driving activities. Reference piling vibration level is given Table 6-2.

**Table 6-2.** Reference Vibration Level of Piling

| Reference Vibration (mm/s) @ 15.0 m | |
|---|---|
| Pile Driving | 9 |

The vibration effect with respect to the distance and limit value graph of is shown in Figure 6-5.

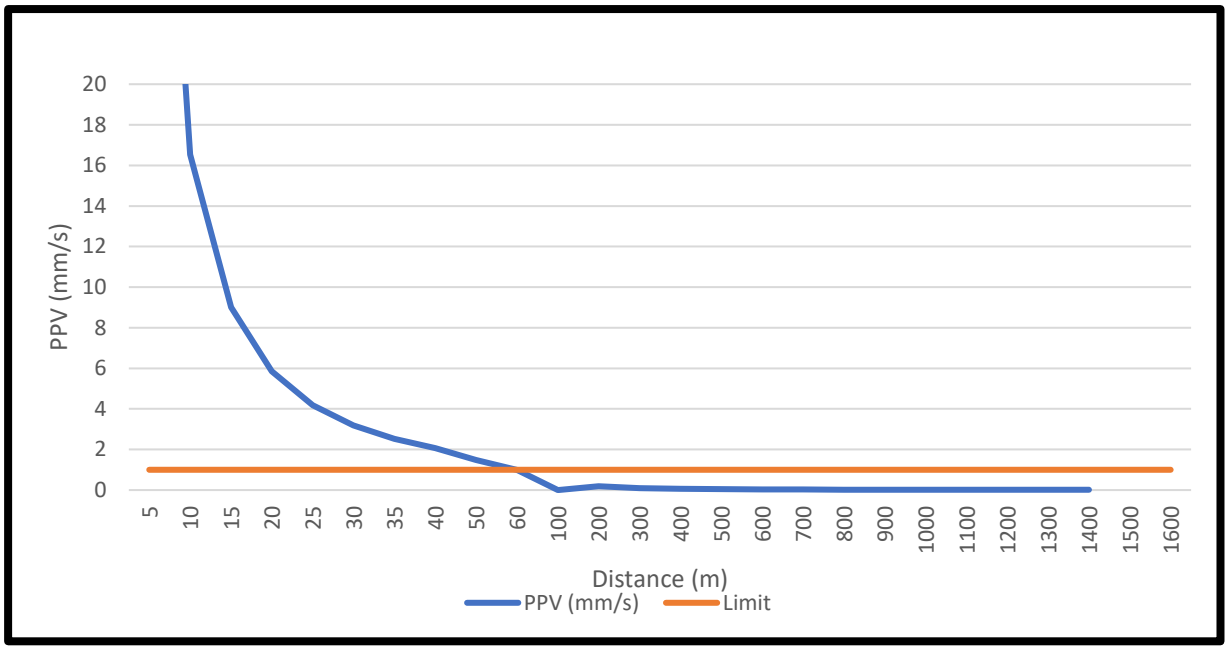



**Figure 6-5.** Vibration Critical Distance for Construction Activities

Construction vibration levels at receiver points are given Table 6-3.

**Table 6-3.** Construction Vibration Levels at Receivers

| Receiver | Distance (m) | PPV (mm/s) |
|---|---|---|
| R1 | 2300 | 0.0047 |
| R2 | 100 | 0.5229 |
| R3 | 400 | 0.0654 |
| R4 | 580 | 0.0374 |
| R5 | 1780 | 0.0070 |

### 6.1.4 Blasting Activities Vibration Levels

Blasting activities will be carried out instead of piling at the parts where ground structure is hard rock.

Blasting area is shown in Figure 6-6.


**Figure 6-6.** Blasting Area

**Table 6-4.** Nearest Structures Around The Blasting Area

| Sensitive Structures | Remark | Distance(m) |
|---|---|---|
| Botaş Pipeline | Closest point of the blasting region to the pipeline is north-west | 205 |
| Antique Waterway | Closest point of the blasting region to the antique waterway is north-west | 30 |
| Residential Buildings | Closest point of the blasting region to the antique waterway is west | 247 |

An estimation equation was developed to calculate effect of blasting activities at nearest structures around blasting area. This equation was developed in 2004 during construction of the highway passing near pipeline.

$$ppv = 15301 * (\frac{R}{\sqrt{W}})^{-2.4027}, (r = 0.8662)$$

Where;

ppv: maximum particle velocity (mm/sec.)

R:distance to blasting area (m)

W: charge per delay (kg)

In this study maximum amount of explosive substances to be used per delay was determined for blasting activities at different distances.

According to report prepared by Istanbul University, it has been said that vibration frequencies of the blasting areas containing basalt will generally be medium and high.

Therefore, 19 mm/sec particle velocity limit value was chosen according to Turkish Regulation on the Assessment and Management of Environmental Noise (RAMEN)

According to this approach, the charge amount allowed per hole was calculated with estimation formula for antique waterway located on northern border of the blasting area.

**Table 6-5.** Maximum amount of explosive per hole

| Distance(m) | Closest Risk Point | Ramen Limit Value(mm/s) | Amount of explosives per hole(kg) |
|---|---|---|---|
| 10 | Antique Waterway | 19 | 0.4 |
| 20 | | | 1.5 |
| 30 | | | 3.4 |
| 50 | | | 9.5 |
| 75 | | | 21.4 |
| 100 | | | 38.1 |
| 150 | | | 85.8 |
| 200 | | | 152.5 |
| 250 | | | 238.2 |
| 300 | | | 343.0 |
| 350 | | | 466.9 |
| 400 | | | 609.8 |

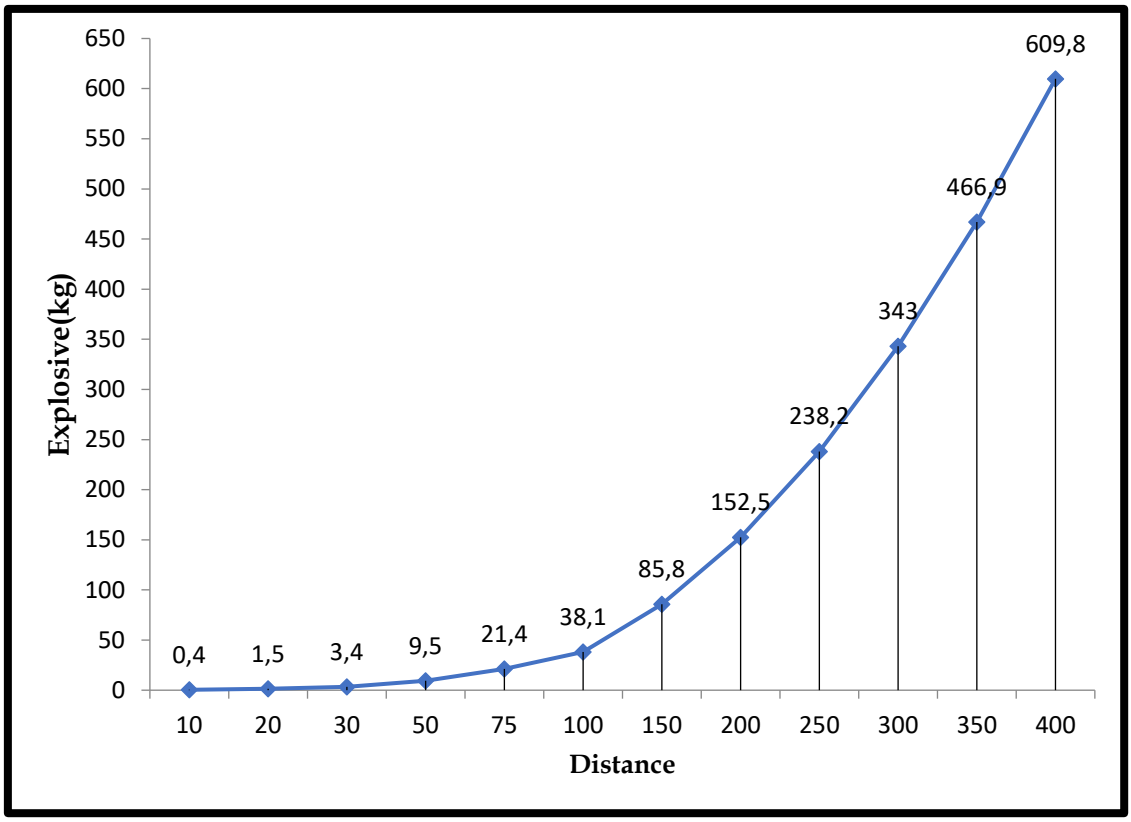



**Figure 6-7.** Graph of explosive amount with respect to distance

As a result maximum 3.4 kg explosives can be used at distance of 30 meters.

Preliminary design models were prepared for blasting. These are step blasting and presplit blasting pre-design models.

Information related with prepared pre-determined blasting model are shown below.

**Table 6-6.** Step Blasting Design Models

| Parameter | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Explosive substance type | ANFO | ANFO | ANFO |
| Explosive density(kg/dm^3) | 900 | 900 | 900 |
| Hole curve | 85 | 85 | 85 |
| Charge Concentration | 5 | 5 | 5 |
| Hole diameter(mm) | 89 | 89 | 89 |
| Step height(m) | 5 | 5 | 10 |
| Hole length(m) | 5 | 5 | 10 |
| Slice Thickness | 1.0 | 1.5 | 2.0 |
| Distance between holes(m) | 1.5 | 2.0 | 2.5 |
| Tightening length(m) | 3.0 | 3.0 | 3.0 |
| Secondary Tightening length(m) | 1 | - | - |
| First Level Feeding(kg) | 0.5 | 0.5 | 0.5 |
| Second Level Feeding(kg) | 0.5 | - | - |
| First Level Charge Length(m) | 0.5 | 2.0 | 7.0 |

| Parameter | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Second Level Charge Length(m) | 0.5 | | |
| Hole Charge Amount(kg) | 6.6 | 11.8 | 39.9 |
| Maximum Charge Amount Delay per Hole | 3.3 | 11.8 | 39.9 |
| Specific Charge(kg/m^3) | 0.88 | 0.79 | 0.80 |
| Specific Drilling(m/m^3) | 0.70 | 0.35 | 0.21 |
| The closest distance of antique waterway | 30-56 | 56-100 | >100 |

**Table 6-7.** Presplit Blasting Design Models

| Parameter | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Hole diameter(mm) | 89 | 89 | 89 |
| Step height(m) | 5 | 5 | 10 |
| Hole curve | 72 | 72 | 72 |
| Hole length(m) | 10 | 10 | 10 |
| Charge Concentration | 5.6 | 5.6 | 5.6 |
| Explosive density(kg/dm^3) | 900 | 900 | 900 |
| Distance between holes(m) | 0.9 | 0.9 | 0.9 |
| Slice Thickness | 1.0 | 1.5 | 2.0 |
| Amount of detonating suppository(gr/m) | 80 | 80 | 80 |
| Hole load(gr/hole) | 800 | 800 | 800 |
| Maximum Charge Amount Delay per Hole(gr/hole) | 500 | 500 | 500 |
| Number of holes to blast together | 5 | 5 | 5 |
| Charge per Delay(kg) | 6.5 | 6.5 | 6.5 |
| Intergroup delay(milisec) | 17 | 17 | 17 |
| The closest distance of antique waterway | 30-56 | 56-100 | >100 |

Below figure shows the buffer zone (red area) of critical distance of 30 m to the blasting region.

**Figure 6-8.** Blasting Areas in Project

Results and comments related to the blasting activities are presented below;

- Since the ground structure of the excavation area is basalt, blasting activity is inevitable

- The vibration velocity estimation formula was used in the risk analysis study. The estimating equation was developed in 2004 during construction of the highway passing near pipeline.

- In the risk analysis studies, 19 mm/sec particle velocity limit value was chosen according to Turkish Regulation on the Assessment and Management of Environmental Noise (RAMEN) and evaluations were made according to this limit value.

- The amount of explosive to be used per delay presented in Table 6-5 for not to exceed of RAMEN limit values.

- Safe distance for the closest sensitive body to the blasting region (antique waterway) is calculated as 30 meters. With allowed amount of explosives which is 3.4 kg per hole it is ok to conduct blasting. However; if more explosive need is solid than design must be re-evaluated.

- Step blasting and presplit blasting model 1 can be used in the entire blasting area, as well as for blasts distant than 30 meters from antique waterway and outside red zone.

- Step blasting and presplit blasting model 2 can be used at distances greater than 56 meters from antique waterway.

- Step blasting and presplit blasting model 3 can be used at distances greater than 100 meters from antique waterway.

- In the Step blasting model each hole will be exploded separately. The model is developed to keep the charge per delay parameter minimum.

- Oblique hole application has been considered in order to ensure that energy is canalized to breaking and translation activities.

- In terms of controlling environmental effects, vibration and air shock should be measured by using vibration meters in sufficient quality and quantity during blasting.

## 6.2 Operation Noise Modelling and Vibration Results

The noise model has been developed using the commercial noise modeling software CadnaA from Datakustik.

The information on ground topography is important to be included in the noise model, since sound propagation is strongly affected by the terrain levels as obstacles. To develop the noise model of the Project, ground topography data was obtained from Digital Elevation Model Dataset from NASA, Reverb Earth Science Discovery tool as shown in Figure 6-9.


**Figure 6-9.** Terrain Levels Over Project Area (NASA's USGS dataset)

In addition, 3D model of plant introduced to software with noise power levels.

Sources for noise power levels database delivered to the project team in detail.

The industrial noise levels calculations carried out by following ISO 9613-2 method which is the recommended standard by Eu. Noise Directive.

Another important parameter for the noise model is the ground absorption (G). Ground absorption varies between 0 to 1 for hard - reflective surfaces and soft - absorptive surfaces, respectively. When calculating the noise propagation, G was assumed to be 0.9 for land area.

3D view of the noise model is given in Figure 6-10.

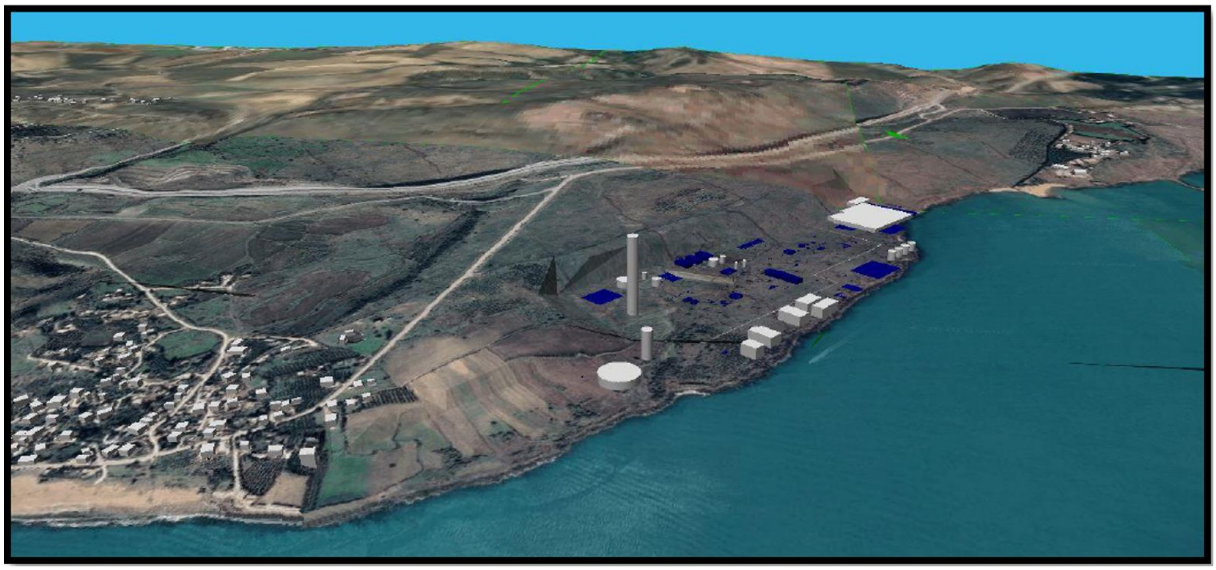


**Figure 6-10.** 3D Noise Model

### 6.2.1 Operation Noise Levels

Operation phase noise levels at receiver locations are presented in the Table 6-8. Since; no variation is expected in terms of environmental acoustics in the operation dynamics of the project, only one worst-case scenario is modelled and calculated for operation phase.

**Table 6-8.** Operation Noise Levels at Receivers

| Receptor | Operation Phase | | | | |
|---|---|---|---|---|---|
| | Ldn (dBA) | | Lden (dBA) | | |
| | Ld | Ln | Ld | Le | Ln |
| 1 | 32,1 | 33,6 | 32,1 | 32,9 | 33,6 |
| 2 | 45,2 | 46,5 | 45,2 | 45,9 | 46,5 |
| 3 | 45,0 | 46,4 | 45,0 | 45,8 | 46,4 |
| 4 | 44,9 | 46,4 | 44,9 | 45,7 | 46,4 |
| 5 | 48,0 | 49,5 | 48,0 | 48,8 | 49,5 |

### 6.2.2 Operation Noise Map

The day time noise propagation maps of operation phase are presented in Figure 6-11 and Figure 6-12 in 2D and 3D forms.

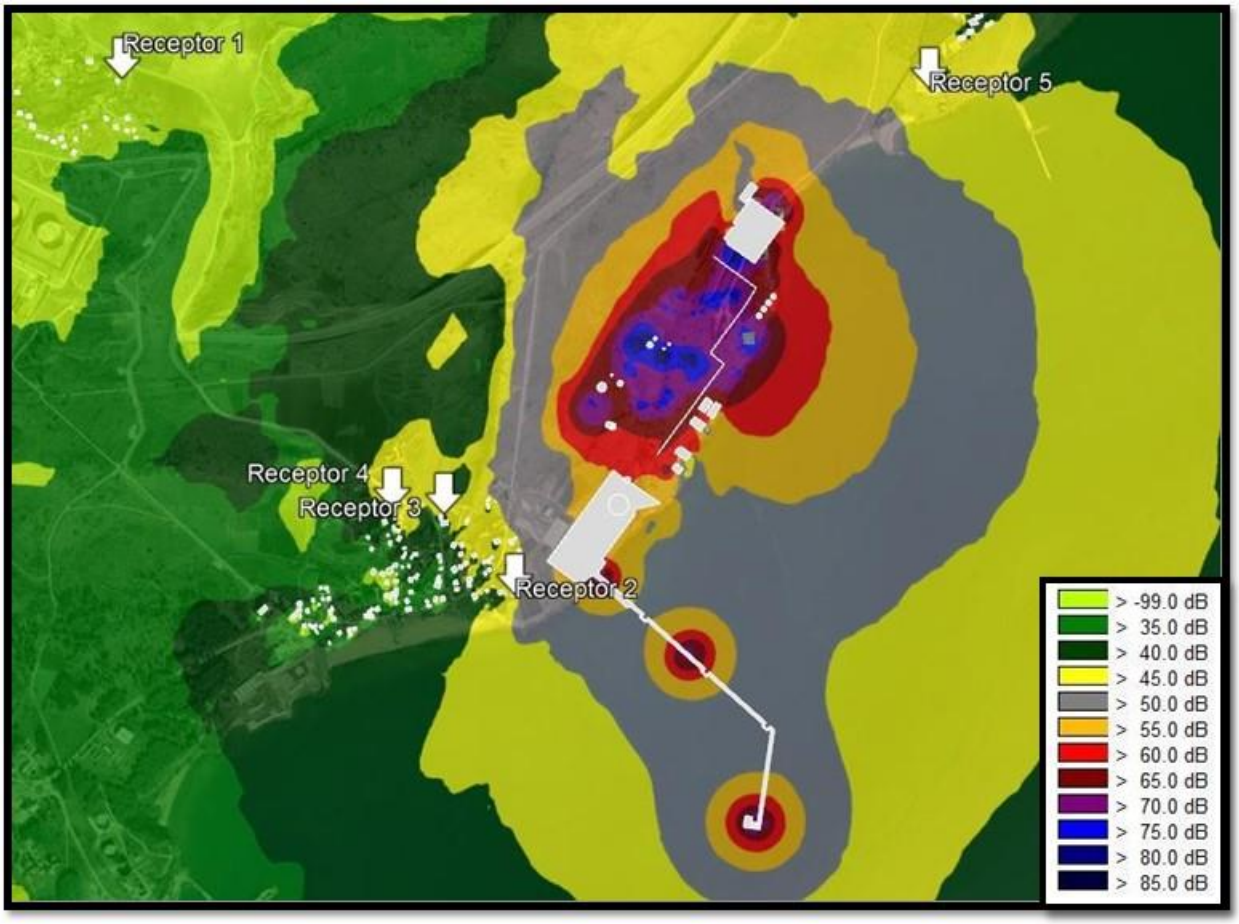



**Figure 6-11.** Operation Noise Map – Day

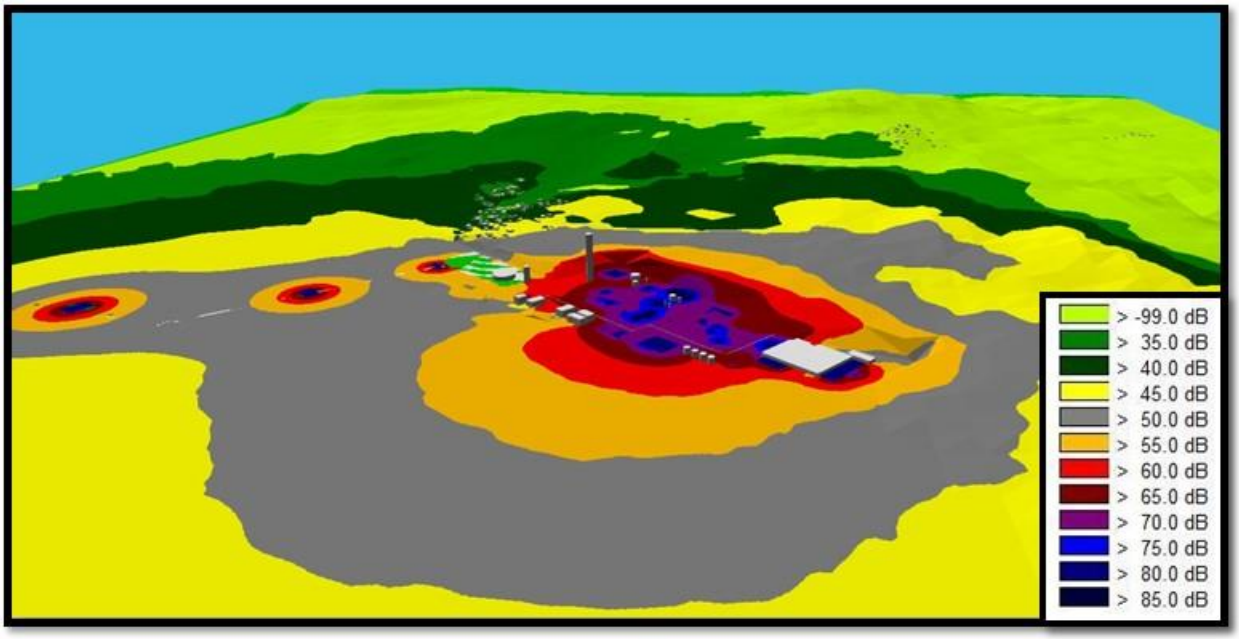



**Figure 6-12.** Operation 3D Noise Map – Day

### 6.2.3 Operation Vibration Results

Calculations were carried out according to the limiting vibration levels of ISO 10816 vibration estimation standard for machine and equipment. Reference vibration levels for the weakest mounting conditions accepted and calculations were conducted for the worst possible case. Reference vibration levels for machine and equipment is given in Table 6-9.

**Table 6-9.** Reference Vibration Levels for Machine and Equipment

| Surface Filling | Reference Vibration (mm/s) @ 0.5m |
|---|---|
| Reference Equipment | 15.5 |

The vibration effect with respect to the distance and limit value graph of is shown in Figure 6-13.

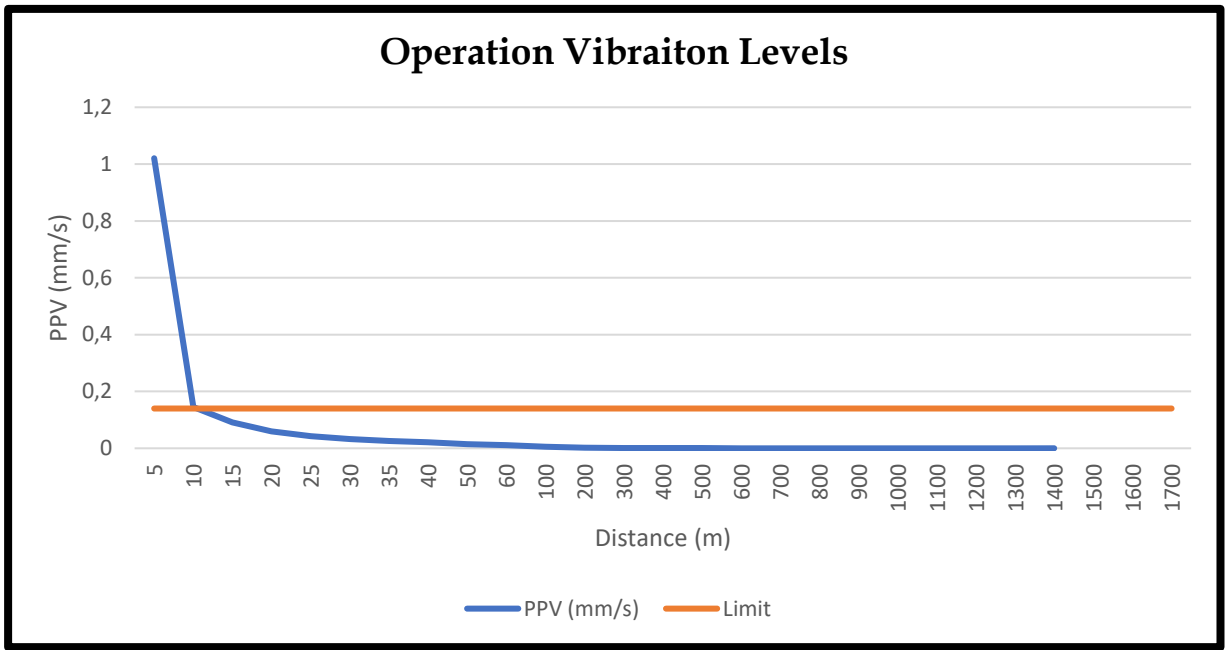



**Figure 6-13.** Vibration Critical Distance for Operation Activities

Operation vibration levels at receiver points are given Table 6-10.

**Table 6-10.** Operation Vibration Levels at Receivers

| Receiver | Distance (m) | PPV (mm/s) |
|---|---|---|
| R1 | 1900 | 0.0001 |
| R2 | 100 | 0.0053 |
| R3 | 400 | 0.0005 |
| R4 | 580 | 0.0004 |
| R5 | 590 | 0.0004 |

# 7. IMPACT ASSESSMENT

According to defined Impact assessment methodology, the entire receiver points' final impact significances for both construction and operation phases are calculated and determined.

## 7.1 Construction Noise Impact Assessment

**Table 7-1.** Construction Impact Assessment WHO Limits

| | Receivers | Source Leq (dBA) | | Baseline Leq (dBA) | | Cumulative Level (dBA) | | Limit Value (dBA) | | Limits WHO Exceedance | Magnitude Of Impact | | | Responsivity | | | Impact Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ld | Ln | Ld | Ln | Ld | Ln | Ld | Ln | Max | Scale Of Impact | Extent | Impact Mag | Importance | Sensitivity | Responsivity | |
| Only Construction | R1 | 37.4 | 39.0 | 54.1 | 46.2 | 54.2 | 46.9 | 55.0 | 49.2 | 0.0 | No Impact | Local | No Impact | Medium | Medium | Medium | No Impact |
| | R2 | 52.2 | 53.5 | 53.7 | 46.8 | 56.0 | 54.3 | 55.0 | 49.8 | 4.5 | S | Local | M | Medium | Medium | Medium | Moderate |
| | R3 | 55.8 | 56.3 | 53.5 | 47.2 | 57.8 | 56.8 | 55.0 | 50.2 | 6.6 | M | Local | L | Medium | Medium | Medium | Major |
| | R4 | 51.9 | 53.1 | 47.1 | 43.5 | 53.1 | 53.5 | 55.0 | 45.0 | 8.5 | M | Local | L | Medium | Medium | Medium | Major |
| | R5 | 48.1 | 49.5 | 48.1 | 45.3 | 51.1 | 50.9 | 55.0 | 48.3 | 2.6 | N | Local | S | Medium | Medium | Medium | Minor |
| Construction + Worst Piling | R1 | 38.8 | 40.4 | 54.1 | 46.2 | 54.3 | 47.2 | 55.0 | 49.2 | 0.0 | No Impact | Local | No Impact | Medium | Medium | Medium | No Impact |
| | R2 | 74.7 | 75.7 | 53.7 | 46.8 | 74.7 | 75.7 | 55.0 | 49.8 | 25.9 | L | Local | L | Medium | Medium | Medium | Major |
| | R3 | 58.5 | 59.4 | 53.5 | 47.2 | 59.7 | 59.7 | 55.0 | 50.2 | 9.4 | M | Local | L | Medium | Medium | Medium | Major |
| | R4 | 59.3 | 60.7 | 47.1 | 43.5 | 59.6 | 60.8 | 55.0 | 45.0 | 15.8 | L | Local | L | Medium | Medium | Medium | Major |
| | R5 | 52.1 | 53.6 | 48.1 | 45.3 | 53.5 | 54.2 | 55.0 | 48.3 | 5.9 | M | Local | L | Medium | Medium | Medium | Major |
| Construction + Mid Piling | R1 | 42.6 | 44.2 | 54.1 | 46.2 | 54.4 | 48.3 | 55.0 | 49.2 | 0.0 | No Impact | Local | No Impact | Medium | Medium | Medium | No Impact |
| | R2 | 61.2 | 62.3 | 53.7 | 46.8 | 61.9 | 62.4 | 55.0 | 49.8 | 12.6 | L | Local | L | Medium | Medium | Medium | Major |
| | R3 | 57.5 | 58.4 | 53.5 | 47.2 | 58.9 | 58.7 | 55.0 | 50.2 | 8.5 | M | Local | L | Medium | Medium | Medium | Major |
| | R4 | 54.8 | 56.1 | 47.1 | 43.5 | 55.5 | 56.3 | 55.0 | 45.0 | 11.3 | L | Local | L | Medium | Medium | Medium | Major |
| | R5 | 52.0 | 53.5 | 48.1 | 45.3 | 53.5 | 54.1 | 55.0 | 48.3 | 5.8 | M | Local | L | Medium | Medium | Medium | Major |

**Table 7-2.** Construction Impact Assessment RAMEN Limits

| | Receivers | Source Leq (dBA) | | | Limit Value (dBA) | | | Limits RAMEN Exceedance |
|---|---|---|---|---|---|---|---|---|
| | | Lday | Levening | Lnight | Lday | Levening | Lnight | Max |
| Only Construction | R1 | 37.4 | 38.3 | 39.0 | 70.0 | 65.0 | 60.0 | 0.0 |
| | R2 | 52.2 | 52.9 | 53.5 | 70.0 | 65.0 | 60.0 | 0.0 |
| | R3 | 55.8 | 56.1 | 56.3 | 70.0 | 65.0 | 60.0 | 0.0 |
| | R4 | 51.9 | 52.6 | 53.1 | 70.0 | 65.0 | 60.0 | 0.0 |
| | R5 | 48.1 | 48.8 | 49.5 | 70.0 | 65.0 | 60.0 | 0.0 |
| Construction + Worst Piling | R1 | 38.8 | 39.7 | 40.4 | 70.0 | 65.0 | 60.0 | 0.0 |
| | R2 | 74.7 | 75.3 | 75.8 | 70.0 | 65.0 | 60.0 | 15.8 |
| | R3 | 58.5 | 59.0 | 59.4 | 70.0 | 65.0 | 60.0 | 0.0 |
| | R4 | 59.4 | 60.1 | 60.7 | 70.0 | 65.0 | 60.0 | 0.7 |
| | R5 | 52.1 | 52.9 | 53.6 | 70.0 | 65.0 | 60.0 | 0.0 |
| Construction + Mid Piling | R1 | 42.7 | 43.5 | 44.2 | 70.0 | 65.0 | 60.0 | 0.0 |
| | R2 | 61.2 | 62.0 | 62.6 | 70.0 | 65.0 | 60.0 | 2.6 |
| | R3 | 57.5 | 58.0 | 58.4 | 70.0 | 65.0 | 60.0 | 0.0 |
| | R4 | 54.8 | 55.5 | 56.1 | 70.0 | 65.0 | 60.0 | 0.0 |
| | R5 | 52.0 | 52.8 | 53.5 | 70.0 | 65.0 | 60.0 | 0.0 |

As can be seen from assessment tables related with the construction phase of the project, 4 “Major” and 1 “No Impact” final impact significances are observed out of 5 receiver locations according to WHO Guidelines with any piling activity.

Moreover; in terms of rules defined in RAMEN, limiting values are exceeded at R2 for all scenarios.

## 7.2 Construction Vıbratıon Impact Assessment

Even though vibrational limits defined in RAMEN is 10 mm/s for discontinuous vibration, lowest tolerable vibration limiting value defined in the legal framework of this project is 1 mm/s for residential locations. This limiting value is also equivalent to the “Small” impact scale in the defined methodology for the project. In order to be on the safe side evaluation will be conducted accordingly. Calculations shows us that; safe distance before vibration levels comes under the 1 mm/s level is 65 meters for construction activities. Thus; no impact is expected from constructional vibration activities as long as necessary precautions are taken and proper warnings are delivered, since, there are no receivers detected closer than 65 meters to the project area according to information shared with Frekans by client.

Client need to guarantee that no piling activities will be held closer than 65 meters to the sensitive receptors.

## 7.3 Operation Noise Impact Assessment

**Table 7-3.** Operation Impact Assessment WHO Limits

| Receptor | Source Leq (dBA) | | Baseline Leq (dBA) | | Cumulative Level (dBA) | | Limit Value (dBA) | | Limits WHO Exceedance | Magnitude Of Impact | | | Responsivity | | | Impact Significance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ld | Ln | Ld | Ln | Ld | Ln | Ld | Ln | Max | Scale Of Impact | Extent | Impact Mag | Importance | Sensitivity | Responsivity | |
| Receptor 1 | 32.1 | 33.6 | 54.1 | 46.2 | 54.2 | 46.4 | 55.0 | 49.2 | 0.0 | No Impact | Local | No Impact | Medium | Medium | Medium | No Impact |
| Receptor 2 | 45.2 | 46.5 | 53.7 | 46.8 | 54.3 | 49.7 | 55.0 | 49.8 | 0.0 | No Impact | Local | No Impact | Medium | Medium | Medium | No Impact |
| Receptor 3 | 45.0 | 46.4 | 53.5 | 47.2 | 54.0 | 49.8 | 55.0 | 50.2 | 0.0 | No Impact | Local | No Impact | Medium | Medium | Medium | No Impact |
| Receptor 4 | 44.9 | 46.4 | 47.1 | 43.5 | 49.2 | 48.2 | 55.0 | 45.0 | 3.2 | S | Local | M | Medium | Medium | Medium | Moderate |
| Receptor 5 | 48.0 | 49.5 | 48.1 | 45.3 | 51.0 | 50.9 | 55.0 | 48.3 | 2.6 | N | Local | S | Medium | Medium | Medium | Minor |

**Table 7-4.** Operation Impact Assessment RAMEN Limits

| Receptor | Source Leq (dBA) | | | Limit Value (dBA) | | | Limits RAMEN Exceedance | Baseline + 5 dBA | | Baseline +5 dBA Exceedance Max |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lday | Levening | Lnight | Lday | Levening | Lnight | Max | Lday | Lnight | |
| Receptor 1 | 32.1 | 32.9 | 33.6 | 70.0 | 65.0 | 60.0 | No Impact | 59.1 | 51.2 | - |
| Receptor 2 | 45.2 | 45.9 | 46.5 | 70.0 | 65.0 | 60.0 | No Impact | 58.7 | 51.8 | - |
| Receptor 3 | 45.0 | 45.8 | 46.4 | 70.0 | 65.0 | 60.0 | No Impact | 58.5 | 52.2 | - |
| Receptor 4 | 44.9 | 45.7 | 46.4 | 70.0 | 65.0 | 60.0 | No Impact | 52.1 | 48.5 | - |
| Receptor 5 | 48.0 | 48.8 | 49.5 | 70.0 | 65.0 | 60.0 | No Impact | 53.1 | 50.3 | - |

As can be seen from assessment tables related with the operation phase of the project, it can be seen that moderate final impact significances are observed at R2 and R4 while, minor final impact significance observed at R5.

Moreover; in terms of rules defined in RAMEN, limiting values are exceeded at R2 for operation phase.

## 7.4 Operatıon vıbratıon Impact Assessment

Even though vibrational limits defined in RAMEN is 10 mm/s for discontinuous vibration, lowest vibration limiting value defined in the legal framework of this project is 0.14 mm/s for residential locations. This limiting value is also equivalent to the “No Impact” impact scale in the defined methodology for the project. In order to be on the safe side evaluation will be conducted accordingly. Calculations shows us that; safe distance before vibration levels comes under the 0.14 mm/s level is 11 meters for operation activities. Thus; no impact is expected from operational vibration activities since, there are no receivers detected closer than 11 meters to the project area according to information shared with Frekans by client.

Client need to guarantee that no machine or equipment will operate closer than 11 meters to the receiving bodies.

# 8. MITIGATION MEASURES AND RESIDUAL IMPACTS

## 8.1 Construction Mitigation Measures

As can be seen in the former sections of this acoustical report main impact from construction activities are sourced from pile driving and service roads will be used for the project. Since, impact from construction activities are ultimately temporary, no permanent mitigation measures are suggested. However; it is strongly advised that, in order to overcome problems and inquiries from local residents and maintain the comfort of them, possible mitigation measures defined in this report should be considered. Possible mitigation measures are listed below;

- Project-specific Noise and Vibration Management Plan will be developed and implemented.
- The management will enforce speed limits for the Project vehicles that will transport construction materials/equipment and control it.
- Machinery, equipment and vehicles with lower sound power levels and sound reduced models will be preferred.
- Properly refurbished and/or new machinery, equipment and vehicles will be used to the extent possible.
- Maintenance of construction vehicles will be conducted regularly by means of a regular vehicle maintenance and repair program as per the recommendations of the manufacturer.
- Portable barriers and acoustic enclosures will be put around equipment where necessary and possible.
- Construction traffic through the settlements will be avoided, whenever alternative routes and/or service roads are available.
- Idling of construction vehicles will be avoided.
- For all of the receptors except R1, needed to be included to a continuous monitoring noise measurement campaign.

All of the decisions and needed and suggested mitigation measures should be ensured and detailed via Noise Management Plan.

Consequently; since all construction activities are temporary no residual impact expected after completion.

## 8.2 Operation Mitigation Measures

As results are presented in impact assessment chapter; final impact significances for R2 and R4 are “Moderate”, for R5 is “Minor” and for remaining receptors are “No Impact”.

For impacted receptors following mitigation measures should be considered;

- For R2, major contributor to the total operation noise is Jetty machine and equipment. In order to overcome noise impact at this receptor 5 dB of noise insulation measures at source (at machine and equipment itself) need to be achieved. Details of the needed insulation should be ensured and detailed in Noise Management Plan.
- For R4, major contributors to the total operation noise are numerous machines and equipment (for instance; heaters, compressors, pumps etc.) thus, it is not logical to reduce the noise at source. In order to overcome noise impact at this receptor 5 dB of noise mitigation measure should be considered. Noise mitigation structures such as noise berms or noise barriers should considered. Final decisions and detailed design of this mitigation measure should be ensured and detailed in Noise Management Plan.
- Receptors R2, R4 and R5 will be included in periodic noise monitoring for the first three years of the operation. Noise measurments will be performed for 24 hours at week and weekend days in order to sustain national and international requirements.

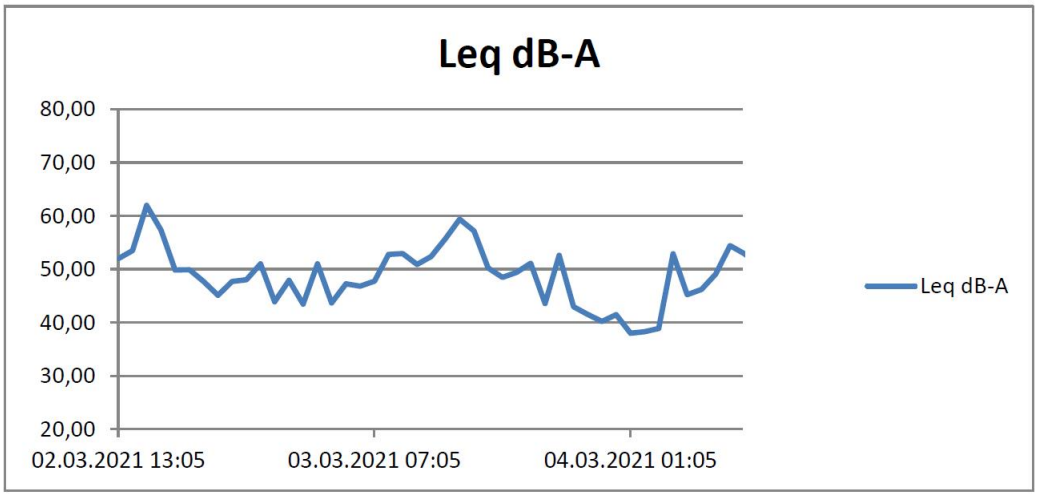
# 9. APPENDIX

Noise Measurement Results

| Location | Kurtpınar-Karatepe | Measurement No. | Point 1 |
|---|---|---|---|
| Standard | ISO 1996-2 | Measurement Date | 02-04.03.2021 |


| Measurement Info | | | |
|---|---|---|---|
| SLM | Device Type: Type 1 | Coordinates | 761479.00 d E |
| SLM No | Convergence | | 4088602.00 m N |
| Data No | - | Distance to Source (m) | - |
| Start Time | 02.03.2021 | Time Period | Day, Evening, Night |
| Total Period | 48 Hours | Mic. Height (m) | 6 meters |

Logger Graph (dBA)



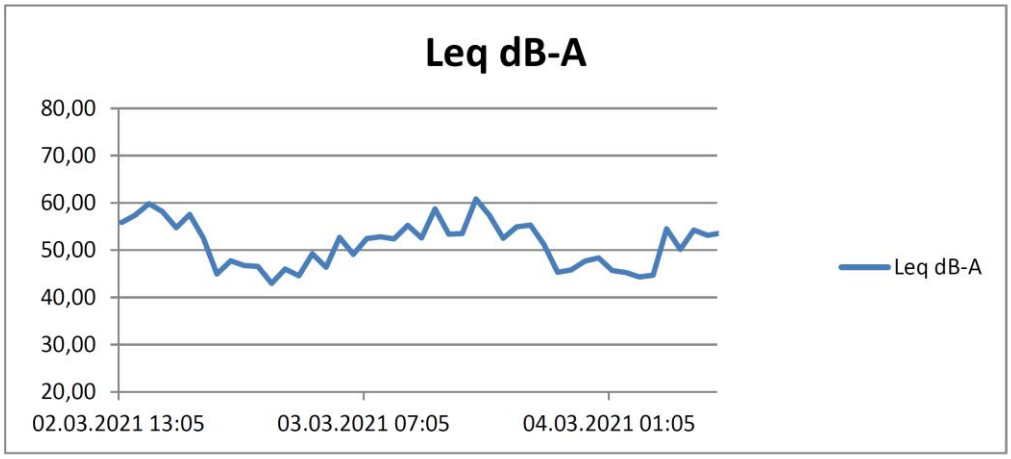
| Location | Kurtpınar-Karatepe | | | Measurement No. | Point 1 | | |
|---|---|---|---|---|---|---|---|
| Standard | ISO 1996-2 | | | Measurement Date | 02-04.03.2021 | | |
| Hourly Measurement Results (dBA) | | | | | | | |
| Date&Time | Leq | Lmin | Lmax | Date&Time | Leq | Lmin | Lmax |
| 02.03.2021 13:05 | 52,0 | 48,4 | 55,2 | 03.03.2021 13:05 | 59,4 | 49,9 | 67,3 |
| 02.03.2021 14:05 | 53,5 | 49,6 | 56,9 | 03.03.2021 14:05 | 57,2 | 52,4 | 60,3 |
| 02.03.2021 15:05 | 61,9 | 57,9 | 65,3 | 03.03.2021 15:05 | 50,2 | 47,1 | 52,9 |
| 02.03.2021 16:05 | 57,3 | 53,1 | 60,8 | 03.03.2021 16:05 | 48,4 | 46,1 | 50,9 |
| 02.03.2021 17:05 | 49,9 | 45,2 | 54,3 | 03.03.2021 17:05 | 49,4 | 45,5 | 53,2 |
| 02.03.2021 18:05 | 49,9 | 47,1 | 52,9 | 03.03.2021 18:05 | 51,1 | 47,4 | 54,8 |
| 02.03.2021 19:05 | 47,7 | 45,7 | 50,6 | 03.03.2021 19:05 | 43,5 | 41,3 | 46,1 |
| 02.03.2021 20:05 | 45,1 | 42,4 | 48,7 | 03.03.2021 20:05 | 52,6 | 40,5 | 60,2 |
| 02.03.2021 21:05 | 47,7 | 41,6 | 53,9 | 03.03.2021 21:05 | 43,0 | 38,7 | 47,3 |
| 02.03.2021 22:05 | 48,0 | 45,3 | 50,7 | 03.03.2021 22:05 | 41,5 | 38,5 | 45,3 |
| 02.03.2021 23:05 | 51,0 | 47,0 | 54,4 | 03.03.2021 23:05 | 40,2 | 38,7 | 42,1 |
| 03.03.2021 00:05 | 43,9 | 39,6 | 48,2 | 04.03.2021 00:05 | 41,5 | 39,2 | 43,7 |
| 03.03.2021 01:05 | 47,9 | 42,6 | 54,7 | 04.03.2021 01:05 | 38,0 | 36,4 | 40,0 |
| 03.03.2021 02:05 | 43,4 | 39,8 | 47,6 | 04.03.2021 02:05 | 38,3 | 35,6 | 41,0 |
| 03.03.2021 03:05 | 51,0 | 47,4 | 54,6 | 04.03.2021 03:05 | 38,9 | 36,6 | 41,1 |
| 03.03.2021 04:05 | 43,6 | 40,4 | 47,5 | 04.03.2021 04:05 | 52,9 | 43,5 | 58,6 |
| 03.03.2021 05:05 | 47,3 | 44,0 | 50,2 | 04.03.2021 05:05 | 45,2 | 41,7 | 48,1 |
| 03.03.2021 06:05 | 46,8 | 43,3 | 51,2 | 04.03.2021 06:05 | 46,2 | 43,4 | 48,7 |
| 03.03.2021 07:05 | 47,7 | 45,3 | 50,3 | 04.03.2021 07:05 | 49,1 | 46,9 | 51,3 |
| 03.03.2021 08:05 | 52,8 | 48,5 | 56,8 | 04.03.2021 08:05 | 54,4 | 51,1 | 57,1 |
| 03.03.2021 09:05 | 52,9 | 49,0 | 57,7 | 04.03.2021 09:05 | 52,9 | 49,0 | 57,7 |
| 03.03.2021 10:05 | 50,9 | 47,9 | 55,7 | 04.03.2021 10:05 | 50,9 | 47,9 | 55,7 |
| 03.03.2021 11:05 | 52,3 | 48,4 | 57,2 | 04.03.2021 11:05 | 52,3 | 48,4 | 57,2 |
| 03.03.2021 12:05 | 55,7 | 49,5 | 62,4 | 04.03.2021 12:05 | 55,7 | 49,5 | 62,4 |

| Results Lden | | | | | | |
|---|---|---|---|---|---|---|
| | First Day Results(dBA) | | | Second Day Results(dBA) | | |
| | Day | Evening | Night | Day | Evening | Night |
| Time | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 |
| Leq dBA | 56,4 | 47,1 | 46,6 | 53,8 | 47,8 | 47,9 |
| Results Ldn | | | | | | |
| | First Day Results(dBA) | | | Second Day Results(dBA) | | |
| | Day | | Night | Day | | Night |
| Time | 07:00-22:00 | | 22:00-07:00 | 07:00-22:00 | | 22:00-07:00 |
| Leq dBA | 54,9 | | 46,6 | 53,2 | | 45,7 |
| From raw data extraneous noise events excluded to reach processed data | | | | | | |

| Location | Kurtpınar-Esentepe | Measurement No. | Point 2 |
|---|---|---|---|
| Standard | ISO 1996-2 | Measurement Date | 02-04.03.2021 |


| Measurement Info | | | | |
|---|---|---|---|---|
| SLM | Device Type | Type 1 | Coordinates | 762811.00 d E |
| SLM No | Convergence | | | 4086961.00 m N |
| Data No | - | | Distance to Source (m) | - |
| Start Time | 02.03.2021 | | Time Period | Day, Evening, Night |
| Total Period | 48 Hours | | Mic. Height (m) | 5 meters |

Logger Graph (dBA)



| Location | Kurtpınar-Esentepe | Measurement No. | Point 2 |
|---|---|---|---|
| Standard | ISO 1996-2 | Measurement Date | 02-04.03.2021 |

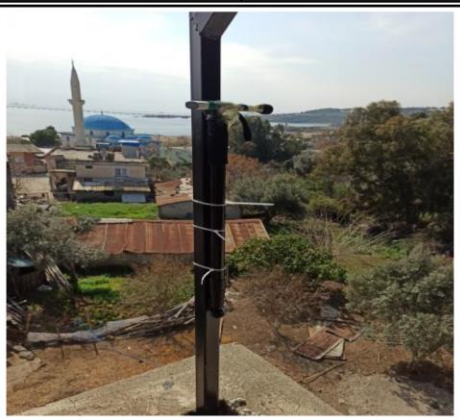
| Hourly Measurement Results (dBA) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date&Time | Leq | Lmin | Lmax | Date&Time | Leq | Lmin | Lmax |
| 02.03.2021 13:19 | 55,8 | 53,4 | 58,6 | 03.03.2021 13:19 | 53,4 | 49,9 | 56,7 |
| 02.03.2021 14:19 | 57,4 | 54,2 | 59,9 | 03.03.2021 14:19 | 53,5 | 50,5 | 56,1 |
| 02.03.2021 15:19 | 59,8 | 56,3 | 62,4 | 03.03.2021 15:19 | 60,8 | 56,4 | 64,7 |
| 02.03.2021 16:19 | 58,2 | 55,9 | 60,5 | 03.03.2021 16:19 | 57,4 | 52,9 | 60,7 |
| 02.03.2021 17:19 | 54,7 | 52,0 | 57,3 | 03.03.2021 17:19 | 52,5 | 49,6 | 55,4 |
| 02.03.2021 18:19 | 57,6 | 55,0 | 59,7 | 03.03.2021 18:19 | 54,9 | 51,9 | 57,6 |
| 02.03.2021 19:19 | 52,5 | 50,2 | 54,8 | 03.03.2021 19:19 | 55,3 | 53,2 | 57,4 |
| 02.03.2021 20:19 | 45,0 | 42,8 | 47,1 | 03.03.2021 20:19 | 51,2 | 48,0 | 54,6 |
| 02.03.2021 21:19 | 47,7 | 44,2 | 51,3 | 03.03.2021 21:19 | 45,3 | 44,1 | 46,7 |
| 02.03.2021 22:19 | 46,8 | 43,5 | 50,0 | 03.03.2021 22:19 | 45,8 | 44,4 | 47,5 |
| 02.03.2021 23:19 | 46,5 | 44,4 | 49,0 | 03.03.2021 23:19 | 47,7 | 46,2 | 49,2 |
| 03.03.2021 00:19 | 43,0 | 39,3 | 47,1 | 04.03.2021 00:19 | 48,3 | 45,2 | 51,8 |
| 03.03.2021 01:19 | 46,0 | 42,3 | 51,5 | 04.03.2021 01:19 | 45,7 | 44,2 | 47,4 |
| 03.03.2021 02:19 | 44,5 | 39,3 | 49,4 | 04.03.2021 02:19 | 45,2 | 43,8 | 47,0 |
| 03.03.2021 03:19 | 49,2 | 44,0 | 53,8 | 04.03.2021 03:19 | 44,3 | 43,3 | 45,4 |
| 03.03.2021 04:19 | 46,4 | 42,6 | 50,5 | 04.03.2021 04:19 | 44,7 | 42,9 | 46,3 |
| 03.03.2021 05:19 | 52,7 | 50,2 | 54,9 | 04.03.2021 05:19 | 54,5 | 52,5 | 56,3 |
| 03.03.2021 06:19 | 49,1 | 45,9 | 52,0 | 04.03.2021 06:19 | 50,2 | 48,3 | 52,1 |
| 03.03.2021 07:19 | 52,5 | 50,5 | 54,4 | 04.03.2021 07:19 | 54,3 | 51,8 | 56,8 |
| 03.03.2021 08:19 | 52,8 | 49,4 | 55,6 | 04.03.2021 08:19 | 53,2 | 50,5 | 56,0 |
| 03.03.2021 09:19 | 52,4 | 48,6 | 55,5 | 04.03.2021 09:19 | 53,7 | 48,6 | 55,5 |
| 03.03.2021 10:19 | 55,3 | 51,7 | 58,1 | 04.03.2021 10:19 | 56,5 | 51,7 | 58,1 |
| 03.03.2021 11:19 | 52,6 | 49,2 | 56,1 | 04.03.2021 11:19 | 53,8 | 49,2 | 56,1 |
| 03.03.2021 12:19 | 58,7 | 55,9 | 61,2 | 04.03.2021 12:19 | 56,7 | 55,9 | 61,2 |

| Results Lden | | | | | | |
|---|---|---|---|---|---|---|
| | First Day Results(dBA) | | | Second Day Results(dBA) | | |
| | Day | Evening | Night | Day | Evening | Night |
| Time | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 |
| Leq dBA | 54,3 | 49,9 | 46,7 | 55,1 | 51,9 | 47,1 |

| Results Ldn | | | | |
|---|---|---|---|---|
| | First Day Results(dBA) | | Second Day Results(dBA) | |
| | Day | Night | Day | Night |
| Time | 07:00-22:00 | 22:00-07:00 | 07:00-22:00 | 22:00-07:00 |
| Leq dBA | 53,1 | 46,7 | 54,2 | 46,9 |

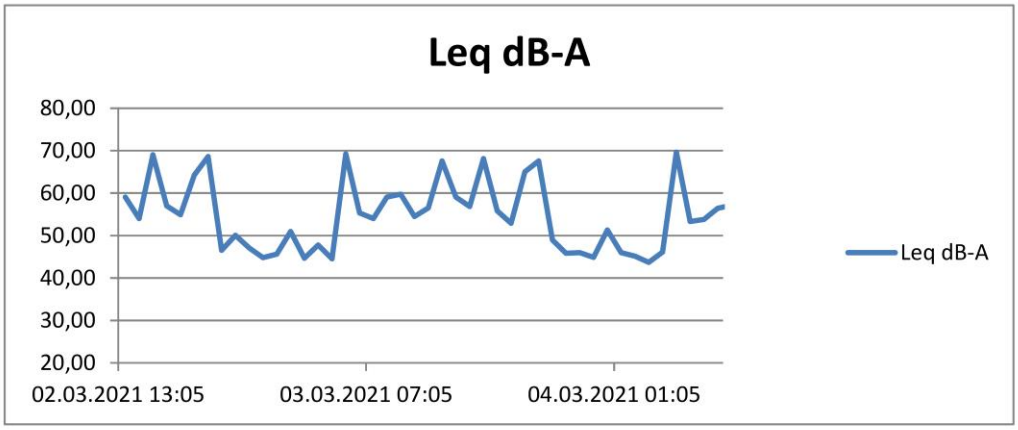
From raw data extraneous noise events excluded to reach processed data

| Location | Kurtpınar-Esentepe | Measurement No. | Point 3 |
|---|---|---|---|
| Standard | ISO 1996-2 | Measurement Date | 02-04.03.2021 |




| Measurement Info | | | | |
|---|---|---|---|---|
| SLM | Device Type | Type 1 | Coordinates | 762712.00 d E |
| SLM No | Convergence | | | 4087024.00 m N |
| Data No | - | | Distance to Source (m) | - |
| Start Time | 02.03.2021 | | Time Period | Day, Evening, Night |
| Total Period | 48 Hours | | Mic. Height (m) | 6 meters |

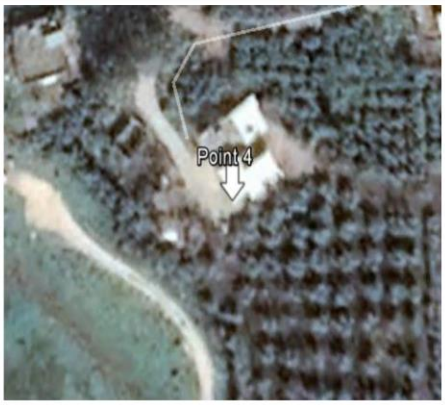
Logger Graph (dBA)



| Location | Kurtpınar-Esentepe | | | Measurement No. | Point 3 | | |
|---|---|---|---|---|---|---|---|
| Standard | ISO 1996-2 | | | Measurement Date | 02-04.03.2021 | | |
| Hourly Measurement Results (dBA) | | | | | | | |
| Date&Time | Leq | Lmin | Lmax | Date&Time | Leq | Lmin | Lmax |
| 02.03.2021 13:36 | 59,1 | 54,7 | 62,1 | 03.03.2021 13:36 | 59,1 | 54,0 | 62,5 |
| 02.03.2021 14:36 | 54,0 | 50,0 | 57,5 | 03.03.2021 14:36 | 56,8 | 51,1 | 61,4 |
| 02.03.2021 15:36 | 69,1 | 66,5 | 71,2 | 03.03.2021 15:36 | 68,2 | 66,2 | 70,2 |
| 02.03.2021 16:36 | 57,0 | 54,0 | 60,0 | 03.03.2021 16:36 | 55,8 | 51,7 | 59,3 |
| 02.03.2021 17:36 | 54,9 | 50,9 | 58,5 | 03.03.2021 17:36 | 52,9 | 48,3 | 56,8 |
| 02.03.2021 18:36 | 64,3 | 61,8 | 66,6 | 03.03.2021 18:36 | 65,0 | 62,7 | 67,0 |
| 02.03.2021 19:36 | 68,6 | 66,3 | 70,7 | 03.03.2021 19:36 | 67,6 | 65,8 | 69,1 |
| 02.03.2021 20:36 | 46,5 | 43,8 | 49,2 | 03.03.2021 20:36 | 49,0 | 47,5 | 50,3 |
| 02.03.2021 21:36 | 50,0 | 45,5 | 53,7 | 03.03.2021 21:36 | 45,9 | 44,4 | 47,7 |
| 02.03.2021 22:36 | 47,1 | 42,4 | 51,2 | 03.03.2021 22:36 | 46,0 | 44,6 | 47,6 |
| 02.03.2021 23:36 | 44,8 | 43,5 | 46,3 | 03.03.2021 23:36 | 44,9 | 43,6 | 46,4 |
| 03.03.2021 00:36 | 45,6 | 44,8 | 46,7 | 04.03.2021 00:36 | 51,3 | 46,9 | 55,3 |
| 03.03.2021 01:36 | 51,0 | 50,3 | 51,9 | 04.03.2021 01:36 | 46,0 | 43,8 | 48,2 |
| 03.03.2021 02:36 | 44,6 | 42,6 | 46,7 | 04.03.2021 02:36 | 45,2 | 43,9 | 46,6 |
| 03.03.2021 03:36 | 47,8 | 45,0 | 50,5 | 04.03.2021 03:36 | 43,7 | 42,2 | 45,5 |
| 03.03.2021 04:36 | 44,5 | 41,3 | 47,1 | 04.03.2021 04:36 | 46,1 | 43,9 | 48,3 |
| 03.03.2021 05:36 | 69,3 | 66,8 | 71,3 | 04.03.2021 05:36 | 69,6 | 67,6 | 71,5 |
| 03.03.2021 06:36 | 55,3 | 50,5 | 59,3 | 04.03.2021 06:36 | 53,3 | 50,8 | 55,8 |
| 03.03.2021 07:36 | 54,0 | 50,8 | 56,9 | 04.03.2021 07:36 | 53,8 | 50,8 | 56,7 |
| 03.03.2021 08:36 | 59,1 | 54,5 | 63,1 | 04.03.2021 08:36 | 56,5 | 51,9 | 60,5 |
| 03.03.2021 09:36 | 59,7 | 54,0 | 63,3 | 04.03.2021 09:36 | 57,1 | 51,4 | 60,7 |
| 03.03.2021 10:36 | 54,5 | 49,7 | 57,9 | 04.03.2021 10:36 | 51,9 | 47,1 | 55,3 |
| 03.03.2021 11:36 | 56,5 | 51,9 | 59,7 | 04.03.2021 11:36 | 53,9 | 49,3 | 57,1 |
| 03.03.2021 12:36 | 67,6 | 65,6 | 69,3 | 04.03.2021 12:36 | 54,2 | 50,2 | 58,6 |

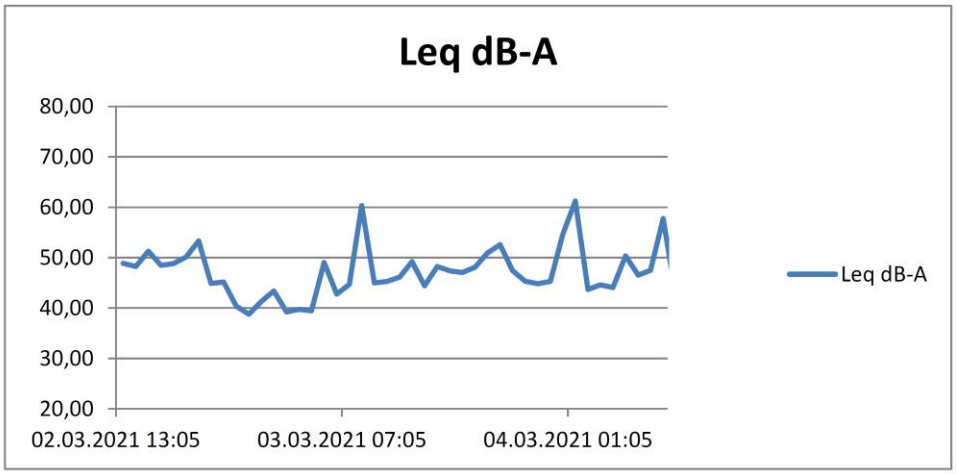
| Results Lden | | | | | | |
|---|---|---|---|---|---|---|
| | First Day Results(dBA) | | | Second Day Results(dBA) | | |
| | Day | Evening | Night | Day | Evening | Night |
| Time | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 |
| Leq dBA | 54,8 | 47,4 | 47,6 | 53,2 | 46,5 | 47,1 |
| Results Ldn | | | | | | |
| | First Day Results(dBA) | | | Second Day Results(dBA) | | |
| | Day | | Night | Day | | Night |
| Time | 07:00-22:00 | | 22:00-07:00 | 07:00-22:00 | | 22:00-07:00 |
| Leq dBA | 53,3 | | 47,7 | 53,6 | | 46,7 |
| From raw data extraneous noise events excluded to reach processed data | | | | | | |

| Location | Kurtpınar-Esentepe | Measurement No. | Point 4 |
|---|---|---|---|
| Standard | ISO 1996-2 | Measurement Date | 02-04.03.2021 |




| Measurement Info | | | | |
|---|---|---|---|---|
| SLM | Device Type | Type 1 | Coordinates | 762397.00 d E |
| SLM No | Convergence | | | 4087190.00 m N |
| Data No | - | | Distance to Source (m) | - |
| Start Time | 02.03.2021 | | Time Period | Day, Evening, Night |
| Total Period | 48 Hours | | Mic. Height (m) | 2,5 meters |

Logger Graph (dBA)



| Location | Kurtpınar-Esentepe | Measurement No. | Point 4 |
|---|---|---|---|
| Standard | ISO 1996-2 | Measurement Date | 02-04.03.2021 |

| Hourly Measurement Results (dBA) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date&Time | Leq | Lmin | Lmax | Date&Time | Leq | Lmin | Lmax |
| 02.03.2021 13:40 | 48,9 | 47,2 | 51,2 | 03.03.2021 13:40 | 44,4 | 39,3 | 49,1 |
| 02.03.2021 14:40 | 48,2 | 46,1 | 51,1 | 03.03.2021 14:40 | 48,2 | 43,5 | 51,9 |
| 02.03.2021 15:40 | 51,3 | 48,7 | 54,1 | 03.03.2021 15:40 | 47,4 | 43,6 | 51,9 |
| 02.03.2021 16:40 | 48,5 | 47,6 | 49,8 | 03.03.2021 16:40 | 47,1 | 45,2 | 49,2 |
| 02.03.2021 17:40 | 48,8 | 46,7 | 51,5 | 03.03.2021 17:40 | 48,1 | 46,8 | 49,8 |
| 02.03.2021 18:40 | 50,1 | 44,8 | 54,5 | 03.03.2021 18:40 | 50,9 | 45,0 | 56,6 |
| 02.03.2021 19:40 | 53,3 | 49,1 | 56,6 | 03.03.2021 19:40 | 52,6 | 47,9 | 56,5 |
| 02.03.2021 20:40 | 44,9 | 40,7 | 48,8 | 03.03.2021 20:40 | 47,4 | 44,6 | 50,8 |
| 02.03.2021 21:40 | 45,2 | 40,1 | 50,1 | 03.03.2021 21:40 | 45,4 | 42,8 | 48,4 |
| 02.03.2021 22:40 | 40,4 | 36,2 | 45,1 | 03.03.2021 22:40 | 44,8 | 42,9 | 47,3 |
| 02.03.2021 23:40 | 38,8 | 34,7 | 44,5 | 03.03.2021 23:40 | 45,3 | 44,3 | 46,7 |
| 03.03.2021 00:40 | 41,3 | 37,2 | 48,0 | 04.03.2021 00:40 | 54,6 | 46,0 | 60,2 |
| 03.03.2021 01:40 | 43,4 | 39,6 | 48,0 | 04.03.2021 01:40 | 61,2 | 48,8 | 67,7 |
| 03.03.2021 02:40 | 39,3 | 36,2 | 43,2 | 04.03.2021 02:40 | 43,7 | 42,1 | 45,2 |
| 03.03.2021 03:40 | 39,7 | 36,9 | 44,5 | 04.03.2021 03:40 | 44,6 | 42,7 | 46,5 |
| 03.03.2021 04:40 | 39,5 | 36,6 | 42,2 | 04.03.2021 04:40 | 44,1 | 42,2 | 45,9 |
| 03.03.2021 05:40 | 49,0 | 46,0 | 52,0 | 04.03.2021 05:40 | 50,3 | 47,7 | 52,6 |
| 03.03.2021 06:40 | 42,7 | 39,4 | 46,4 | 04.03.2021 06:40 | 46,5 | 42,7 | 51,4 |
| 03.03.2021 07:40 | 44,7 | 41,3 | 48,6 | 04.03.2021 07:40 | 47,5 | 43,9 | 51,8 |
| 03.03.2021 08:40 | 60,3 | 53,0 | 64,8 | 04.03.2021 08:40 | 57,7 | 50,4 | 62,2 |
| 03.03.2021 09:40 | 45,0 | 40,5 | 49,4 | 04.03.2021 09:40 | 42,4 | 37,9 | 46,8 |
| 03.03.2021 10:40 | 45,3 | 40,7 | 49,7 | 04.03.2021 10:40 | 42,7 | 38,1 | 47,1 |
| 03.03.2021 11:40 | 46,1 | 41,6 | 50,3 | 04.03.2021 11:40 | 43,5 | 39,0 | 47,7 |
| 03.03.2021 12:40 | 49,2 | 45,4 | 53,2 | 04.03.2021 12:40 | 54,2 | 50,2 | 58,6 |

| Results Lden | | | | | | |
|---|---|---|---|---|---|---|
| | First Day Results(dBA) | | | Second Day Results(dBA) | | |
| | Day | Evening | Night | Day | Evening | Night |
| Time | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 |
| Leq dBA | 49,1 | 46,5 | 43,2 | 45,9 | 44,6 | 43,2 |

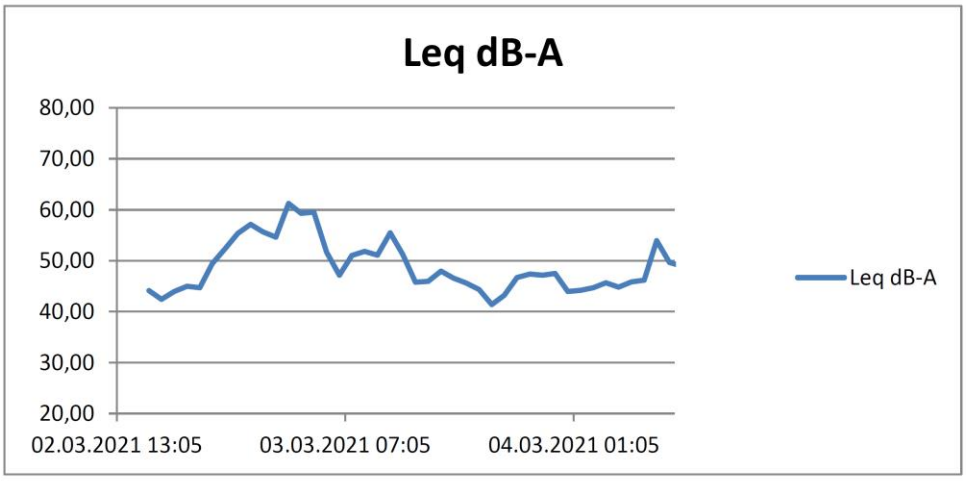
| Results Ldn | | | | |
|---|---|---|---|---|
| | First Day Results(dBA) | | Second Day Results(dBA) | |
| | Day | Night | Day | Night |
| Time | 07:00-22:00 | 22:00-07:00 | 07:00-22:00 | 22:00-07:00 |
| Leq dBA | 48,5 | 43,3 | 45,1 | 43,6 |

From raw data extraneous noise events excluded to reach processed data

| Location | Kurtpınar | Measurement No. | Point 5 |
|---|---|---|---|
| Standard | ISO 1996-2 | Measurement Date | 02-04.03.2021 |


| Measurement Info | | | | |
|---|---|---|---|---|
| SLM | Device Type | Type 1 | Coordinates | 765049.00 d E |
| SLM No | Convergence | | | 4089239.00 m N |
| Data No | - | | Distance to Source (m) | - |
| Start Time | 02.03.2021 | | Time Period | Day, Evening, Night |
| Total Period | 48 Hours | | Mic. Height (m) | 2,5 meters |

Logger Graph (dBA)



| Location | Kurtpınar | Measurement No. | Point 5 |
|---|---|---|---|
| Standard | ISO 1996-2 | Measurement Date | 02-04.03.2021 |

| Hourly Measurement Results (dBA) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date&Time | Leq | Lmin | Lmax | Date&Time | Leq | Lmin | Lmax |
| 02.03.2021 15:37 | 44,1 | 42,2 | 46,2 | 03.03.2021 15:37 | 46,6 | 44,7 | 48,8 |
| 02.03.2021 16:37 | 42,4 | 41,0 | 43,8 | 03.03.2021 16:37 | 45,6 | 43,9 | 47,5 |
| 02.03.2021 17:37 | 44,0 | 42,8 | 45,2 | 03.03.2021 17:37 | 44,4 | 43,1 | 45,7 |
| 02.03.2021 18:37 | 45,0 | 43,9 | 46,0 | 03.03.2021 18:37 | 41,4 | 40,1 | 42,6 |
| 02.03.2021 19:37 | 44,7 | 43,8 | 45,6 | 03.03.2021 19:37 | 43,2 | 42,0 | 44,4 |
| 02.03.2021 20:37 | 49,4 | 48,6 | 50,3 | 03.03.2021 20:37 | 46,7 | 45,9 | 47,6 |
| 02.03.2021 21:37 | 52,4 | 51,5 | 53,3 | 03.03.2021 21:37 | 47,4 | 46,6 | 48,2 |
| 02.03.2021 22:37 | 55,4 | 52,1 | 58,6 | 03.03.2021 22:37 | 47,2 | 46,3 | 48,1 |
| 02.03.2021 23:37 | 57,2 | 53,3 | 60,7 | 03.03.2021 23:37 | 47,5 | 46,5 | 48,5 |
| 03.03.2021 00:37 | 55,7 | 52,1 | 59,0 | 04.03.2021 00:37 | 43,9 | 43,2 | 44,7 |
| 03.03.2021 01:37 | 54,6 | 50,8 | 58,1 | 04.03.2021 01:37 | 44,2 | 43,1 | 45,4 |
| 03.03.2021 02:37 | 61,2 | 57,4 | 64,7 | 04.03.2021 02:37 | 44,7 | 43,8 | 45,8 |
| 03.03.2021 03:37 | 59,3 | 55,4 | 62,9 | 04.03.2021 03:37 | 45,7 | 44,7 | 46,8 |
| 03.03.2021 04:37 | 59,5 | 55,7 | 63,1 | 04.03.2021 04:37 | 44,8 | 43,9 | 45,9 |
| 03.03.2021 05:37 | 51,7 | 47,7 | 55,4 | 04.03.2021 05:37 | 45,9 | 44,8 | 47,0 |
| 03.03.2021 06:37 | 47,2 | 44,1 | 50,5 | 04.03.2021 06:37 | 46,2 | 44,8 | 48,0 |
| 03.03.2021 07:37 | 51,0 | 49,5 | 52,7 | 04.03.2021 07:37 | 53,9 | 52,1 | 56,1 |
| 03.03.2021 08:37 | 51,8 | 50,1 | 54,3 | 04.03.2021 08:37 | 49,6 | 47,9 | 52,1 |
| 03.03.2021 09:37 | 51,1 | 48,8 | 53,7 | 04.03.2021 09:37 | 48,9 | 46,6 | 51,5 |
| 03.03.2021 10:37 | 55,5 | 51,7 | 59,0 | 04.03.2021 10:37 | 53,3 | 49,6 | 56,9 |
| 03.03.2021 11:37 | 51,2 | 48,8 | 53,8 | 04.03.2021 11:37 | 49,1 | 46,6 | 51,6 |
| 03.03.2021 12:37 | 45,8 | 44,0 | 47,8 | 04.03.2021 12:37 | 43,6 | 41,8 | 45,7 |
| 03.03.2021 13:37 | 45,9 | 44,1 | 48,0 | 04.03.2021 13:37 | 43,8 | 42,0 | 45,8 |
| 03.03.2021 14:37 | 48,0 | 45,6 | 50,6 | 04.03.2021 14:37 | 45,8 | 43,5 | 48,4 |

| Results Lden | | | | | | |
|---|---|---|---|---|---|---|
| | First Day Results(dBA) | | | Second Day Results(dBA) | | |
| | Day | Evening | Night | Day | Evening | Night |
| Time | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 | 07:00-19:00 | 19:00-23:00 | 23:00-07:00 |
| Leq dBA | 46,1 | 44,1 | 44,3 | 49,9 | 45,9 | 47,1 |

| Results Ldn | | | | |
|---|---|---|---|---|
| | First Day Results(dBA) | | Second Day Results(dBA) | |
| | Day | Night | Day | Night |
| Time | 07:00-22:00 | 22:00-07:00 | 07:00-22:00 | 22:00-07:00 |
| Leq dBA | 46,3 | 44,7 | 49,3 | 45,8 |

From raw data extraneous noise events excluded to reach processed data