Environmental and Social Impact Assessment

PUBLIC

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Uzbekistan: Samarkand 1 Solar PV and BESS Project

Appendixes – Part 3

Prepared by ACWA Power for the Asian Development Bank (ADB).

APPENDIX C – BASELINE SURVEY REPORTS

Samarkand Solar 1 ESIA
& Samarkand Solar 2 ESIA

Soil and Water Assessment Report

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1 Introduction

An analysis of the soil and groundwater samples taken from identified locations within the project sites is provided in the report. Chemical and physical characteristics, including pH, nitrates, heavy metals, and chlorides with sulfates for groundwater, have been covered by the analysis. The results are compared to relevant national and international standards.

The projects area has a cold semi-arid climate (BSk), which is defined by long hot summers and cold winters with unstable snow cover. The average annual precipitation is 331mm. July typically sees average temperatures ranging from +25 to +28^0 C, while February records an average air temperature of 0^{0}C.

The project sites encompass abandoned, non-irrigated arable lands and they are mainly used for grazing purposes. The vegetation in this region is characterized by a bluegrass-camel thorn community, featuring Alhagi pseudalhagi subsp. kirghisorum and Poa bulbosa, along with sporadic occurrences of harmel (Peganum harmala) and Cousinia resinosa. The plant distribution is scattered or clustered, exhibiting a limited species composition.

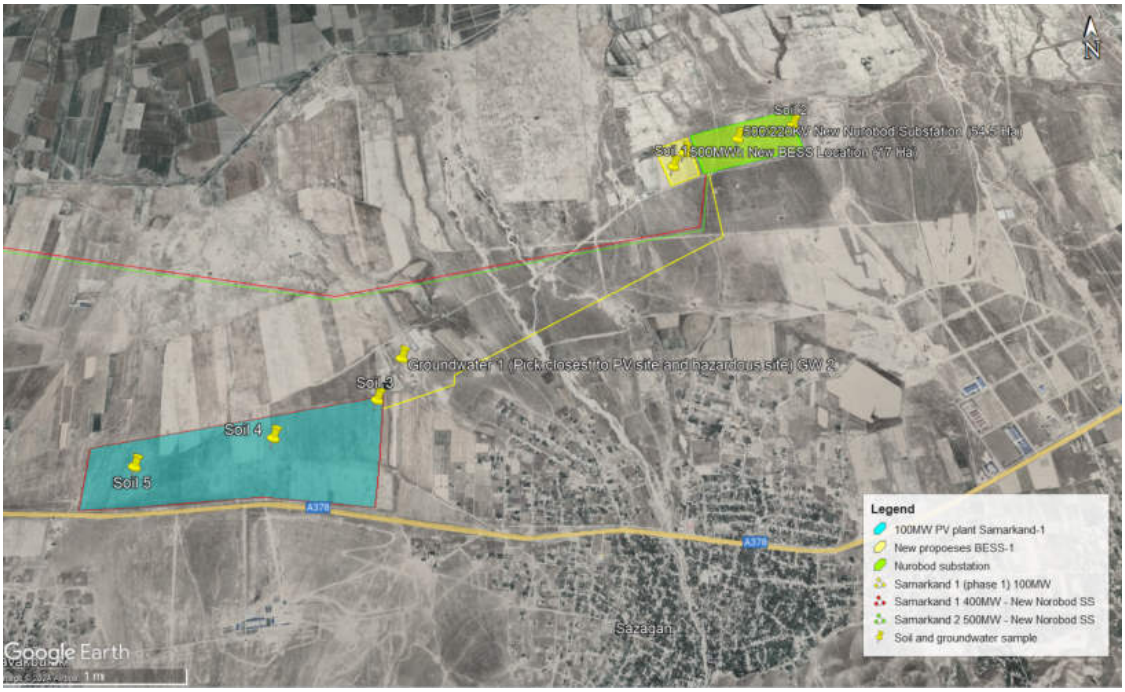
Regarding the hydrographic network in the project areas linked to the Samarkand depression, it includes the Zarafshan River, its Kardarya and Akdaryab branches, irrigation canals, and discharges. The groundwater deposits within the modern Zarafshan River valley and the surrounding territory consist of Quaternary sediments, reaching depths of at least 200 meters.

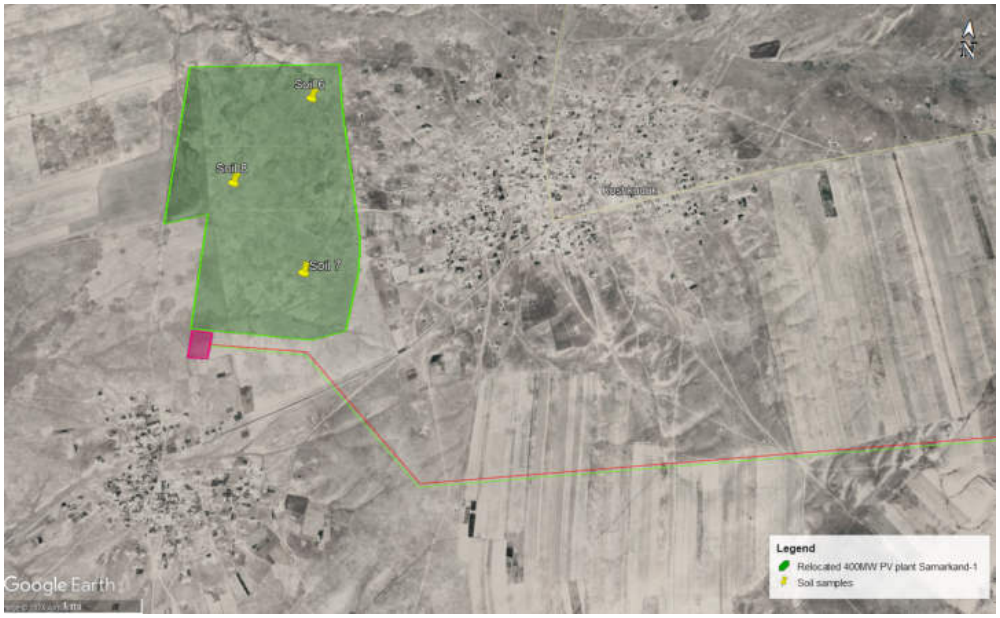
The predominant soil type at the Samarkand 1 and Samarkand 2 sites can be identified as light sierozem. Sierozem soils typically originate from loess parent material and tend to have alkaline pH conditions.
They are brownish gray at the surface characterized by a light topsoil layer low in humus content.

2 Soil and Water sampling

Soil samples were taken from 20 cm in accordance with the established State standard 17.4.4.02-2017 “Nature protection. Soils. Methods for sampling and preparation of soil for chemical, bacteriological, helminthological analysis”. From each location, 0.5 kg of soil was collected.

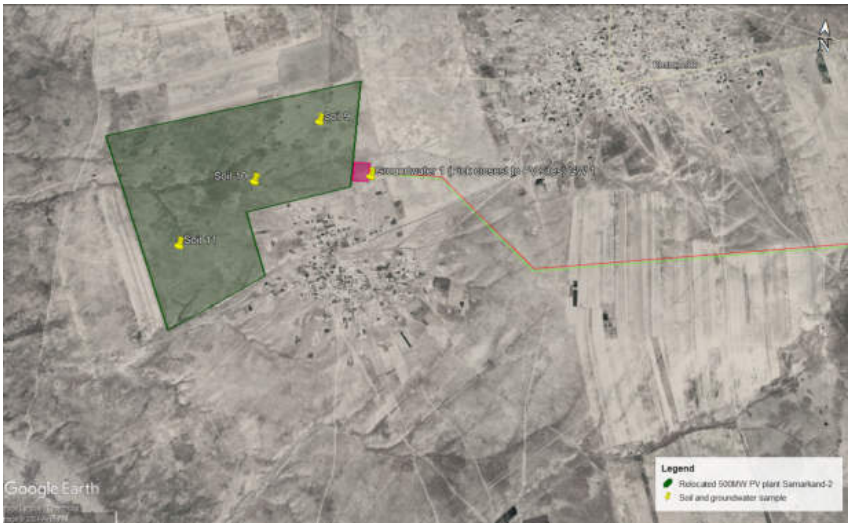
Water sampling was carried out in accordance with the established State standard 31861-2012 “Water. General requirements for sampling”. Water samples were collected and stored in 1 liter of plastic bottles. Figure 1 and 2 shows the locations and coordinates of the sample’s points.





Name of sample	Coordinates
S1	39.572975° 66.737459°
S3	39.550541° 66.702101°
S4	39.547404° 66.690833°
S5	39.545242° 66.675963°
S6	39.457136° 65.982844°
S7	39.435259° 65.986082°
S8	39.445345° 65.973322°
GW2	39.554326° 66.704692°

Figure 1 Location of soil and water samples for project site Samarkand 1



Name of sample	Coordinates
S2	39.577156° 66.752873°
S9	39.433378° 65.963384°
S10	39.422601° 65.952905°
S11	39.411641° 65.941327°
GW1	39.425038° 65.974789°

Figure 2 Location of soil and water samples for project site Samarkand 2

Name of sample	Coordinates
S4	39.515917° 63.872771°
S5	39.516684° 63.869015°
S6	39.519455° 63.871714°

Figure 3 Location of soil and water samples for project site of Samarkand 2 Karakul BESS site

3 Results of soil and water analyses for Samarkand 1

3.1 Soil

The pH levels in the majority of the soil samples indicated a slightly alkaline condition, except for sample S3, which exhibited acidity with a pH value of 6.61.

The concentration of heavy metals, such as nickel (Ni), chromium (Cr), zinc (Zn), and copper (Cu), in all the samples that were examined is higher than the maximum permissible concentration set by standard SanPiN № 0191-05. According to national criteria, these metals fall into the category of moderately hazardous substances. However, it is notable that the concentrations of these metals remain below the acceptable international values, such as Dutch interventional values, except for copper(S4), which exceeds the MPC on the international scale. Specifically addressing copper (Cu) concentrations, the highest recorded value was observed in sample S4, reaching 1000 mg/kg.

In terms of nitrates, all sampled points consistently show low nitrate levels. Notably, S3 exhibits a relatively lower amount of nitrates compared to the other sampling points.

Table 1: Results of the soil analyses (Samarkand 1)

Name of parameters	Locations							The lower limit of detection	MPC in mg/kg	Dutch intervention Value / Target Value[1]	
	S1	S3[2]	S4	S5	S6	S7	S8				
pH	7.36	6.61	7.34	7.90	7.39	7.54	7.95	1-14	-	-	-
Nitrate (NO_3), mg/dm^3	0.75	0.73	1.37	2.28	1.39	1.38	2.59	0.001 mg/dm^3	130.0 (gross content)		
Zinc (Zn), mg/kg	56.0	71.0	63.0	67.0	58.0	64.0	60.0	1.0 mg/kg	23,0	720	140
Chromium (Cr), mg/kg	51.0	57.0	52.0	60.0	54.0	59.0	57.0	1.0 mg/kg	6.0	180	-
Cadmium (Cd), mg/kg	0.200	0.300	0.350	0.200	0.350	0.250	0.200	0.005 mg/kg	-	13	0.8
Copper (Cu), mg/kg	41.0	39.0	1000	39.0	35.0	35.0	310	1.0 mg/kg	3.0	190	36
Manganese (Mn), mg/kg	710	600	510	840	630	630	630	20 mg/kg	1500.0 (gross content)	-	-
Mercury (Hg), mg/kg	0.40	<0.03	0.30	0.10	0.20	0.40	<0.03	0.03 mg/kg	2.1	36	0.3

[1] Dutch Standards for Soil and groundwater Contamination (2013)

[2] The numerical order aligns with the site layout on the map and results of the laboratory analysis (e.g., S2 within the site Samarkand 2)

Name of parameters	Locations							The lower limit of detection	MPC in mg/kg	Dutch intervention Value / Target Value[1]	
	S1	S3[2]	S4	S5	S6	S7	S8				
Nickel (Ni), mg/kg	52.0	38.0	33.0	42.0	40.0	39.0	39.0	1.0 mg/kg	4.0	100	35
Lead (Pb), mg/kg	21.0	17.0	16.0	23.0	22.0	18.0	16.0	0.1mg/kg	32.0	530	85

3.2 Groundwater

The observed groundwater sample, characterized by a pH of 7.45, displayed slight alkalinity, with concentrations of sulfates and chlorides falling below established permissible norms. Notably, the recorded low levels of chlorides and sulfates suggest a diminished salinity potential in the water. Additionally, the analysis revealed low concentrations of nitrates and ammonium, further indicating a limited presence of nitrogenous compounds. The concentrations of heavy metals in all the samples remained significantly below the Maximum Permissible Concentration (MPC), indicating the absence of detectable pollution with heavy metals in the analyzed water samples.

Table 4: Results of water analysis (Samarkand 2)

	pH	**Nitrates (NO_3) mg/l**	**Chlorides (Cl^-) mg/l**	**Sulphates (SO_4^{2-}) mg/l**	**Ammonium NH_4^- mg/l**	**Cadmium (Cd) mg/l**	**Chromium (Cr), mg/l**	**Copper (Cu) mg/l**	**Lead (Pb) mg/l**	**Manganese (Mn), mg/l**	**Mercury (Hg) mg/l**	**Nickel (Ni) mg/l**	**Zinc (Zn) mg/l**	**Arsenic (As) mg/l**
The lower limit of detection	1-14	0.001	0.5	25-500	0.01	0.0001	0.002	0.002	0.000.2	0.0002	$1*10^{-4}$	0.002	0.0002	0.0001
Sample GW2	7.45	2	9	67	<0.05	0.0001	0.068	0.002.3	0.0002	$1.8*10^{-4}$	$<1*10^{-4}$	0.0053	0.00057	0.0057
MPC for Irrigation use	6.5-8.5	-	-	-	1.5	-	-	1	0.2	-	-	-	5	0.1
MPC Fishery water use	6.5-8.5	40	300	100	0.5	0.005	-	0.001	0.03	-	-	0,01	0.01	0.05
Dutch intervention Value	-	-	-	-	-	0.006	0.03	0.075	0.075	-	0.0003	0.075	0.8	0.06

4 Results of soil and water analyses for Samarkand 2

4.1 Soil

In all the examined samples, the concentrations of heavy metals, including nickel (Ni), chromium (Cr), zinc (Zn), and copper (Cu), exceed the Maximum Permissible Concentration (MPC) established by the SanPiN № 0191-05 standard. According to national standards, these metals are categorized as moderately hazardous substances. It is important to highlight that the concentrations of these metals, while exceeding national standards, remain below acceptable international values, such as Dutch intervention values. The concentration of manganese in sample S1 is the highest among the samples, reaching 1400 mg/kg, and it is approaching the maximum permissible concentration (MPC).

Table 3: Results of the soil analyses (Samarkand 2)

Name of parameters	Locations				The lower limit of detection	MPC in mg/kg	Dutch intervention Value / Target Value[3]	
	S2	S9	S10	S11				
pH	7.71	7.90	7.91	7.88	1-14	-	-	-
Nitrate (NO_3), mg/dm^3	1.56	2.64	2.60	2.60	0.001 mg/dm^3	130.0 (gross content)	-	-
Sodium (Na), mg/kg	13000	11000	12000	11000	40 mg/kg	-	-	-
Potassium (K), mg/kg	22000	16000	16000	16000	80 mg/kg	-	-	-
Zinc (Zn), mg/kg	72.0	63.0	60.0	59.0	1.0 mg/kg	23,0	720	140
Chromium (Cr), mg/kg	53.0	56.0	60.0	61.0	1.0 mg/kg	6.0	180	-
Cadmium (Cd), mg/kg	0.350	0.200	0.400	0.051	0.005 mg/kg	-	13	0.8
Copper (Cu), mg/kg	34.0	64.0	36.0	160	1.0 mg/kg	3.0	190	36
Manganese (Mn), mg/kg	1400	640	600	580	20 mg/kg	1500.0 (gross content)	-	-
Mercury (Hg), mg/kg	<0.03	0.70	0.20	0.50	0.03 mg/kg	2.1	36	0.3
Iron (Fe), mg/kg	37000	29000	27000	28000	60 mg/kg	-	-	-
Nickel (Ni), mg/kg	51.0	39.0	37.0	38.0	1.0 mg/kg	4.0	100	35
Lead (Pb), mg/kg	27.0	15.0	16.0	17.0	0.1mg/kg	32.0	530	85

[3] Dutch Standards for Soil and groundwater Contamination (2013)

4.2 Groundwater

Analysis of the collected ground water sample revealed concerning levels of salinity. The concentrations of ions such as sulfates (SO42-) and chlorides (Cl-) were found to considerably surpass established maximum permissible concentrations (MPCs). Water samples were found to be alkaline. Addressing the factors causing such excessive salinization is critical for avoiding environmental hazards and rendering the groundwater untenable for drinking or agricultural irrigation without intensive treatment. Despite elevated chloride and sulfate levels, heavy metal concentrations in all samples remain well below the Maximum Permissible Concentration (MPC), indicating minimal risk of heavy metal pollution. The obtained results are evaluated against the MPC criteria established for water use for fishery purposes, as it represents the most stringent standard and is particularly relevant for comparison in the context of river samples.

Table 2: Results of water analysis (Samarkand 1)

	pH	Nitrates (NO_3) mg/l	Chlorides (Cl^-) mg/l	Sulphates (SO_4^{2-}) mg/l	Ammonium NH_4^- mg/l	Cadmium (Cd) mg/l	Chromium (Cr), mg/l	Copper (Cu) mg/l	Lead (Pb) mg/l	Manganese (Mn), mg/l	Mercury (Hg) mg/l	Nickel (Ni) mg/l	Zinc (Zn) mg/l	Arsenic (As) mg/l
The lower limit of detection	1-14	0.001	0.5	25-500	0.01	0.0001	0.002	0.002	0.0002	0.0002	Not specified	0.002	0.0002	0.0001
Sample GW1 (mg/l)	**7.52**	2	674	947	<0.05	0.0001	0.011	0.0018	0.0002	$1.9*10^{-4}$	$1.3*10^{-5}$	0.0022	0.00064	0.012
MPC for Irrigation use (mg/l)	6.5-8.5	-	-	-	1.5	-	-	1	0.2	-	-	-	5	0.1
MPC Fishery water use (mg/l)	6.5-8.5	40	300	100	0.5	0.005	-	0.001	0.03	-	-	0,01	0.01	0.05
Dutch intervention Value (mg/l)[4]	-	-	-	-	-	0.006	0.03	0.075	0.075	-	0.0003	0.075	0.8	0.06

[4] Dutch Standards for Soil and groundwater Contamination (2013)

5 Results of soil analyses for BESS area

All three soil samples have a slightly alkaline pH level, not exceeding 8.05. Nitrate concentration is low in samples ranging from 5.20 to 6.47.

The concentration of heavy metals such as nickel (Ni), chromium (Cr), zinc (Zn) and copper (Cu) in all samples exceeds the maximum permissible concentration established by SanPiN No. 0191-05. However, as in other sites, it should be noted that the concentration of these metals remains below internationally acceptable values such as the Dutch Intervention Values. Regarding lead (Pb), sample S5 shows the highest concentration above the national MPC, but the concentration also remains below international limits.

Table 5.Results of the soil analyses (BESS area)

Name of parameters	Locations			The lower limit of detection	MPC in mg/kg	Dutch intervention Value / Target Value[5]	
	S4	S5	S6				
pH	7.80	7.90	8.05	1-14	-	-	-
Nitrate (NO_3), mg/dm³	5.85	5.20	6.47	0.001 mg/dm3	130.0 (gross content)	-	-
Sodium (Na), mg/kg	12386	14882	11992	40 mg/kg	-	-	-
Potassium (K), mg/kg	13992	14412	16035	80 mg/kg	-	-	-
Zinc (Zn), mg/kg	35.0	273	51.5	1.0 mg/kg	23.0	720	140
Chromium (Cr), mg/kg	53.3	67.4	54.6	1.0 mg/kg	6.0	180	-
Cadmium (Cd), mg/kg	0.075	0.144	0.104	0.005 mg/kg	-	13	0.8
Copper (Cu), mg/kg	19.2	85.0	23.4	1.0 mg/kg	3.0	190	36
Manganese (Mn), mg/kg	422	377	371	20 mg/kg	1500.0 (gross content)	-	-
Mercury (Hg), mg/kg	<0.03	<0.03	<0.03	0.03 mg/kg	2.1	36	0.3
Iron (Fe), mg/kg	19455	19324	21944	60 mg/kg	-	-	-
Nickel (Ni), mg/kg	27.1	24.6	27.3	1.0 mg/kg	4.0	100	35
Lead (Pb), mg/kg	25.0	66.0	18.3	0.1mg/kg	32.0	530	85

[5] Dutch Standards for Soil and groundwater Contamination (2013)

6 National standards and Maximum Permissible Concentrations (MPC) for soil and water

In accordance with SanPiN № 0191-05 “Maximum permissible concentrations (MPC) and Approximate permittable concentrations of exogenous harmful substances in soil”, the MPC of exogenous chemicals in the soils (in mg/kg) is as follows:

According to the general sanitary limiting indicator of harmfulness in mg/kg:	
1. BENZAPIRENE (gross content)	0.02
2.VANADIUM (gross content)	150.0
3. Manganese + VANADIUM (gross content)	1000.0
4. TUNGSTEN (moving forms)	10.0
5. CELTAN	1.0
6 COBALT (mobile forms)	5.0
7. COPPER (mobile forms)	3.0
8. Molybdenum (mobile forms)	10.0
9. NICKEL (mobile forms)	4.0
10. COAL FLOTATION WASTE (OFU) (gross content)	3000.0
11. LEAD (gross content)	32.0
12. SULFUR ELEMENTARY (gross content)	160.0
13. SULFURIC ACID (gross content)	160.0
14. PHOSPHATES	27.2
15. FURFUROL	3.0
16. CHROME (moving forms)	6.0
by air-migration limiting hazard indicator:	
17. ALFAMETHYLSTYROL	0.5
18. BENZENE	0.3
19. ISOPROTTILBENZENE	0.5
20. HYDROGEN SULFUR (gross content)	0.4

21. STYROL	0.1
22. FORMALDEHYDE	0.7
by water-migration limiting hazard indicator:	
23. LIQUID COMPLEX FERTILIZERS (gross content)	80.0
24. INTEGRATED GRANULATED FERTILIZERS (gross content)	120.0
25. Manganese: (gross content) (mobile forms)	1500.0 60.0
26. NITRATES (gross content)	130.0
27. POTASSIUM CHLORIDE (gross content)	560.0
by trans locational limiting hazard indicator:	
28. ACIDS (ortho, -meta, -pa)	0.3
29. ARROW (gross maintenance)	2.0
30. Mercury (gross content)	2.1
31. LEAD + MERCURY (gross content)	20.0+1.0
32. ANTIMONY (gross content)	4.5
33. TOLUOL	0.3
34. FLUORINE (water soluble forms)	10.0
35. ZINC	23.0

Table 6. Maximum permissible concentrations of pollutants in water of surface water bodies by category of use[6]

Name of parameters	Fishery water use	Cultural and domestic water use.	Domestic Drinking water	Irrigation water use
COD, mgO_2/dm^3	15	40	30	40
BOD, mgO_2/dm^3	3	3-6	3-7	10
pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
Total suspended solids mg/dm^3	15	30	30	50

[6] Source: "Handbook of the Ecologist-Expert". State Committee of the Republic of Uzbekistan on Nature Protection. State Environmental Expertise 2009. Tashkent.

Mineralization mg/dm^3	1000	1000	1000–1500	1000
Sulphates mg/dm^3	100	500	400-500	
Chloride mg/dm^3	300	350	250-350	
Ammonium nitrogen (NH4+N)	0,5	2	0.5	1.5
Nitrite nitrogen (NO2-N)	0.02	0.5	3	0.5
Nitrate nitrogen (NO3-N)	9.1	25	45	25
Nitrites	0.08	3.3	3	
Nitrates	40	45	45	
Phosphates (PO_4^{3-})	0.3	1	3.5	1
Ether - soluble	0.05	0.8	0.8	0.8
Petroleum products	0.05	0.3	0.1	0.3
Surfactants	0.1	0.5	0.5	0.5
Phenol	0.001	0.001	0.001-0.1	0.001
Fluorine (F)	0.05	1.5	0.7	1
Arsenic (As)	0.05	0.05	0.05	0.1
Iron (Fe)	0.05	0.5	0.3-3	5
Chrome (Cr6-)	0.001	0.1	0.05	0.1
Copper (Cu)	0.001	1	1	1
Zinc (Zn)	0.01	1	3	5
Cyanides	0.05	0.1		
Lead (Pb)	0.03	0.1	0.03	0.2
Nickel (Ni)	0.01	0.1	0.1	
Cadmium (Cd)	0.005	0.01		
Cobalt (Co)	0.1	1		
Molybdenum (Mo)	0.0012	0.5	0.25	
Strontium (Sr2+)		2	7	
Selenium (Se)	0.001		0.01	
Rodanids	0.1			
Mercury (Hg)		0.005	0.0005	

Table 7: Dutch Standards for Soil and Groundwater Contamination (2013)

Parameters	Soil (mg/kg dry matter)		Groundwater (µg/l)	
	Target value*	Intervention value	Target value	Intervention value
Heavy Metals				
Arsenic	29	76	10	60
Barium	160	-	50	625
Cadmium	0.8	13	0.4	6
Chromium	100	-	1	30
Chromium III	-	180	-	-
Chromium IV	-	78	-	-
Cobalt	-	190	20	100
Copper	36	190	15	75
Lead	85	530	15	75
Mercury	0.3	36 (inorganic) 4 (organic)	0.05	0.3
Molybdenum	3	190	5	300
Nickel	35	100	15	75
Zinc	140	720	65	800
Aromatic Compounds				
Benzene	0.01	1.1	0.2	30
Ethyl benzene	0.03	110	4	150
Toluene	0.01	32	7	1000
Xylene (sum)	0.1	17	0.2	70
Styrene (vinyilbenzene)	0.3	86	6	300
Phenol	0.05	14	0.2	2000
Cresols (sum)	0.05	13	0.2	200
Chlorinated Hydrocarbons				
Volatile Hydrocarbons				
monochloroethene (vinyl chloride)	0.01	0.1	0.01	5
dichloromethane	0.4	3.9	0.01	1,000
1,1-dichloroethane	0.02	15	7	900

Parameters	Soil (mg/kg dry matter)		Groundwater (µg/l)	
	Target value*	Intervention value	Target value	Intervention value
1,2-dichloroethane	0.02	6.4	7	400
1,1-dichloroethene	0.1	0.3	0.01	10
1,2-dichloroethene (sum)	-	1	0.01	20
Dichloropropanes (sum)	-	2	0.8	80
Trichloromethane (chloroform)	0.02	5.6	6	400
1,1,1-trichloroethane	0.07	15	0.01	300
1,1,2-trichloroethane	0.4	10	0.01	130
Trichloroethene (Tri)	0.1	2.5	24	500
Tetrachloromethane (Tetra)	0.4	0.7	0.01	10
Tetrachloroethene (Per)	0.002	8.8	0.01	40
Chlorobenzenes				
Monochlorobenzene	-	15	7	180
Dichlorobenzenes (sum)	-	19	3	50
Trichlorobenzenes (sum)	-	11	0.01	10
Tetrachlorobenzenes (sum)	-	2.2	0.01	2.5
Pentachlorobenzene	-	6.7	0.003	1
Hexachlorobenzene	-	2.0	0.00009	0.5
Chlorophenols				
Monochlorophenols (sum)	-	5.4	0.3	100
Dichlorophenols (sum)	-	22	0.2	30
Trichlorophenols (sum)	-	22	0.03	10
Tetrachlorphenols (sum)	-	21	0.01	10
Pentachlorophenol	-	12	0.04	3
Source: Soil Remediation Circular 2013, (*Target values for soil refer to 2000 version as they are not present in the 2013)				

Note: The soil values are calculated for a 'Standard Soil' with 10% organic matter and 25% clay. A case of environmental contamination is defined as 'serious' if >25 m³ soil or >100 m³ groundwater is contaminated above the intervention value. Where contaminants are found to exceed 'intervention' levels, this is considered to be a case of soil contamination, which is dangerous to the health of humans and the natural environment. Such a level of contamination should prompt a need for remediation, appropriate treatment and disposal.

7 Annex 1. Pictures of the soil and water sampling


Soil sample S1


S2


S3

S4

S5

S6


S7

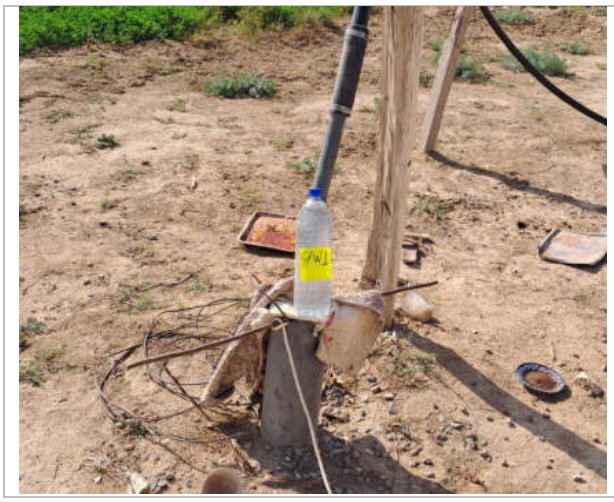

S8


S9


S10


S11

Sampling of groundwater GW1




Sampling of groundwater GW2

1.

Samarkand Solar 1 ESIA

Noise and air monitoring report

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1. Introduction

In order to characterise the sound and air profile of the area of the proposed development to support future monitoring obligations or noise grievances, a continuous environmental noise and air quality (AQ) monitoring was carried out from the 15 September 2023 to 17 September 2023 (NA1, Noise 2, Noise 3) at 3 nearest sensitive receptors (NSRs) for daytime and night-time noise (24hr). In addition wind speed and direction, were also measured.

Three monitoring locations were chosen based on proximity to the proposed Solar PV and BESS area and to provide representative conditions for the NSR that may be affected by the Project. AQ and noise monitoring locations were at the same places (Figure 1).

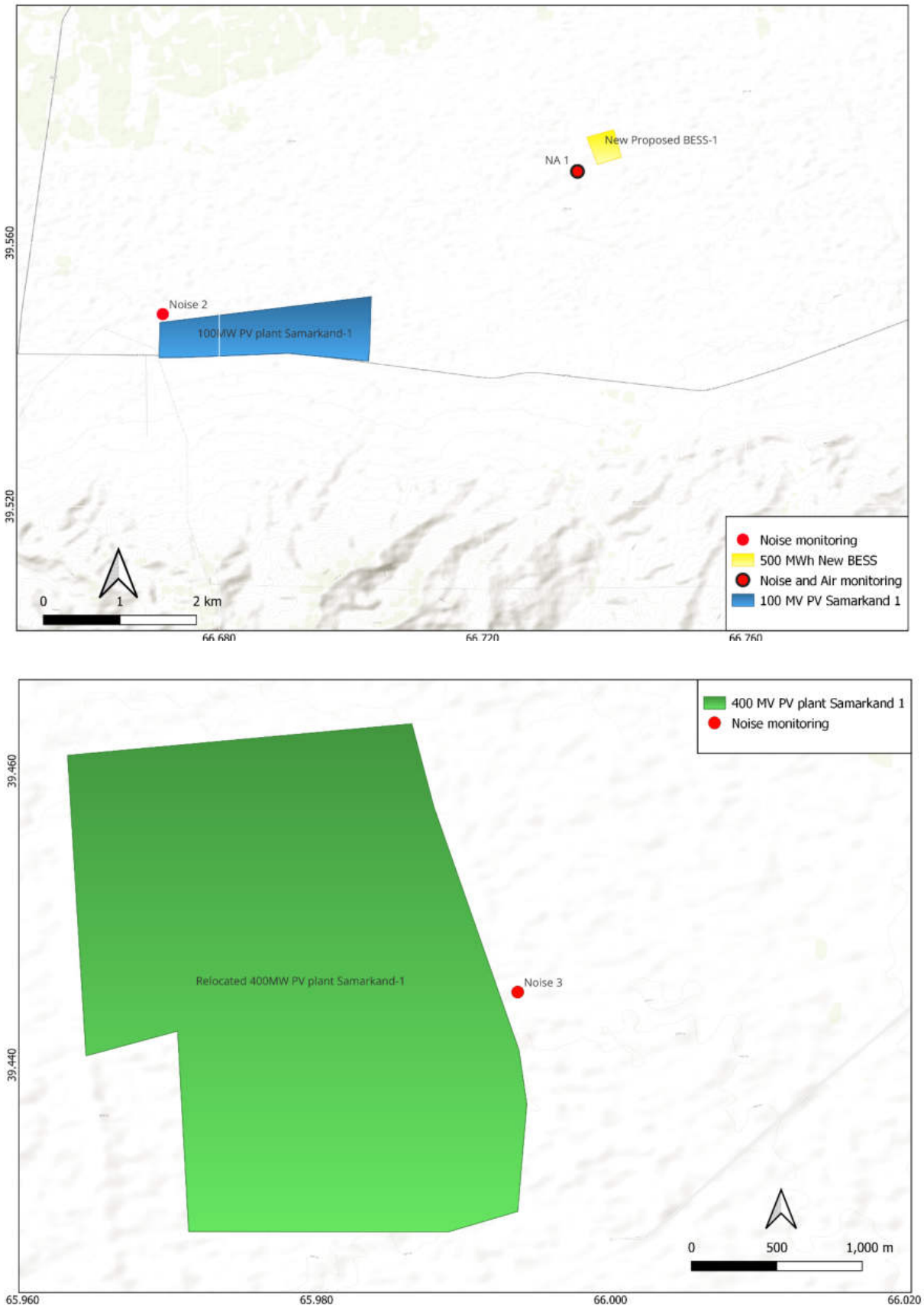


Figure 1: Noise and air monitoring locations

2. Measurement methodology

2.1. Noise

For the noise measurement an unattended noise meter Class 1 (Type 1) per IEC 61672-1. It was placed in the vicinity of NSR's, at 1.7 m above the ground level with no nearby reflective surfaces in minimum 5 m distance. The following parameters were recorded: LAeq, LAmax, LAmin, LA_{10}, LA_{90}. The LAeq level is the equivalent continuous sound pressure level over at the measurement period 10 minutes. LAmax is an indicator of the highest sound level during the measurement period; the LAmin is the lowest level during the measurement period; LA90 is used as a descriptor of background noise levels and LA10 is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise.

2.2. Air quality

For the air measurement AQ Mesh was used. It was placed in the vicinity of NSR's, at 2.5 m above the ground level with no nearby reflective surfaces in minimum 15 m distance. The following parameters were recorded: carbon monoxide (CO), sulphur dioxide (SO2), nitrogen oxide (NO), nitrogen dioxide (NO2), particular matter (PM2.5, PM10). The characteristics of the NSR's are described in Table 1.

Table 1: Location of nearest sensitive receptors

Location	Description	Coordinates Latitude	Coordinates Longitude
NA 1	Farmer's building	39.570837°	66.734426°
Noise 2	Residential building	39.549182°	66.671436°
Noise 3	Residential building	39.444964°	65.993682°

3. Measurement equipment

The following equipment was use for the monitoring exercise.

Table 2: The measurement equipment used for noise monitoring

Item	Meter Model	Serial Number
Sound Level Meter	Rion NL 52	00410152
Calibrator	Calibrator Rion NL 75	34313059
Microphone	All-weather windscreen WS-15	Does not have SN

Table 3: The measurement equipment used for air monitoring

Item	Meter Model
Air quality monitoring system	AQ Mesh
Accumulator	Solar panel pack
Anemometer	Scarlet Tech anemometer

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤0.5 dB. Sound meter fitted with a protective windshield for the entire measurements period. UKAS certificates are attached in Annex.

4. Monitoring results

4.1. Summary table noise

The data provided in Table 4 includes measurements of noise levels at N1, N2, N3 during two-time intervals: 07:00-23:00 (daytime) and 23:00-07:00 (night-time). The measurements were taken at 10-minute intervals and are reported in decibels (dBA).

Table 4: Summary of average noise values for 24 hr measurement per location, dBA

Location	Date	daytime / night-time	Time Period Interval	LAeq, avg	LAmax, average	LAmin (average),	LA10, min	LA10, avg	LA10, max	LA90, min	LA90, avg	LA90, max
NA1	14-15 September	07:00-23:00	10 min	45,19	62,93	33,89	40,40	45,05	57,90	29,40	37,22	46,70
		23:00-07:00		47,38	60,87	39,65	46,10	49,13	55,40	41,30	43,60	46,00
Noise2	15-16 September	07:00-23:00	10 min	41,42	56,45	34,97	32,70	42,74	56,50	29,00	37,53	51,40
		23:00-07:00		45,28	55,21	36,38	41,80	47,72	56,20	36,00	40,37	43,40
Noise3	16-17 September	07:00-23:00	10 min	43,84	58,30	32,75	27,80	45,34	67,10	22,80	36,78	64,20
		23:00-07:00		42,73	53,71	35,56	33,70	44,70	53,30	29,70	38,26	45,60

4.2. Summary table results - AQ

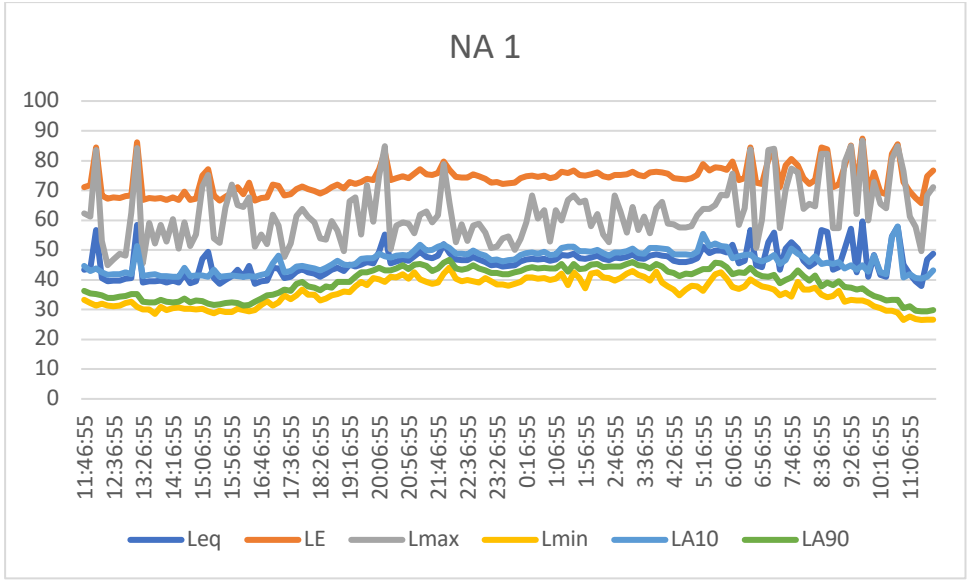
The data provided in Table 5 summarises the average and maximum concentrations at AQ1 for each parameter CO, CO_2, SO_2, NO, NO_2, $PM_{2.5}$, PM_{10}. measured in µg/m^3 over a 24 hours period at 15-minute intervals and displayed for daytime and night-time (07:00-23:00 and 23:00-07:00),

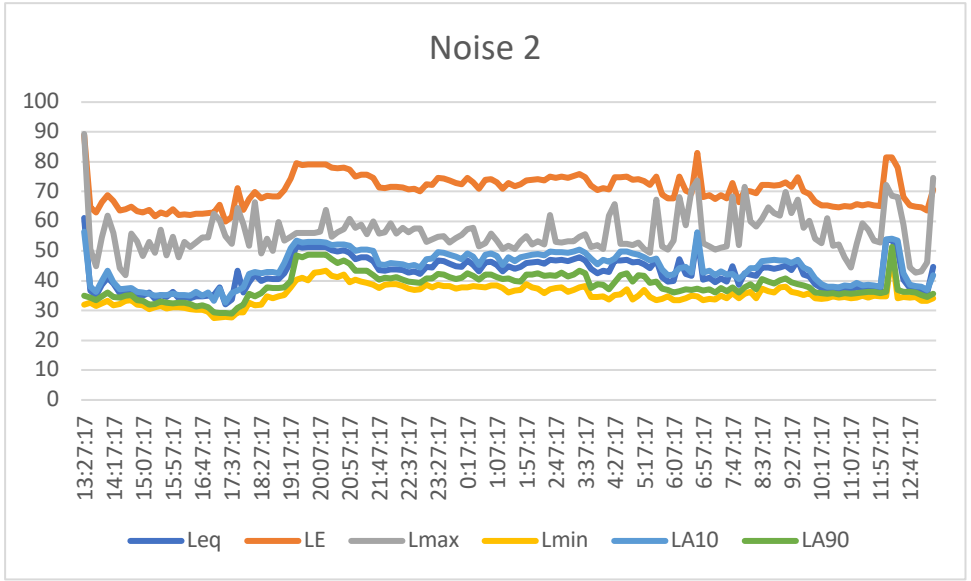
Table 5: 15-minute average concentrations for 24 hr measurement per location (*in µg/m3*)

Location	Date	Time Period	CO	CO_2	NO	NO_2	NO_x	SO_2	$PM_{2.5}$	PM_{10}
			avg	avg	avg	avg	avg	avg	avg	avg
NA 1	14-15 September	15 min	7,50	709,72	0	20,52	0	0	9,42	47,00

4.3. Summary graph results

The following figure provide a graphical representation of results over 24 hour period.


NA 1
100
90
80
70
60
50
40
30
20
10
0
11:46:55
12:36:55
13:26:55
14:16:55
15:06:55
15:56:55
16:46:55
17:36:55
18:26:55
19:16:55
20:06:55
20:56:55
21:46:55
22:36:55
23:26:55
0:16:55
1:06:55
1:56:55
2:46:55
3:36:55
4:26:55
5:16:55
6:06:55
6:56:55
7:46:55
8:36:55
9:26:55
10:16:55
11:06:55
Leq
LE
Lmax
Lmin
LA10
LA90


Noise 2
100
90
80
70
60
50
40
30
20
10
0
13:27:17
14:17:17
15:07:17
15:57:17
16:47:17
17:37:17
18:27:17
19:17:17
20:07:17
20:57:17
21:47:17
22:37:17
23:27:17
0:17:17
1:07:17
1:57:17
2:47:17
3:37:17
4:27:17
5:17:17
6:07:17
6:57:17
7:47:17
8:37:17
9:27:17
10:17:17
11:07:17
11:57:17
12:47:17
Leq
LE
Lmax
Lmin
LA10
LA90

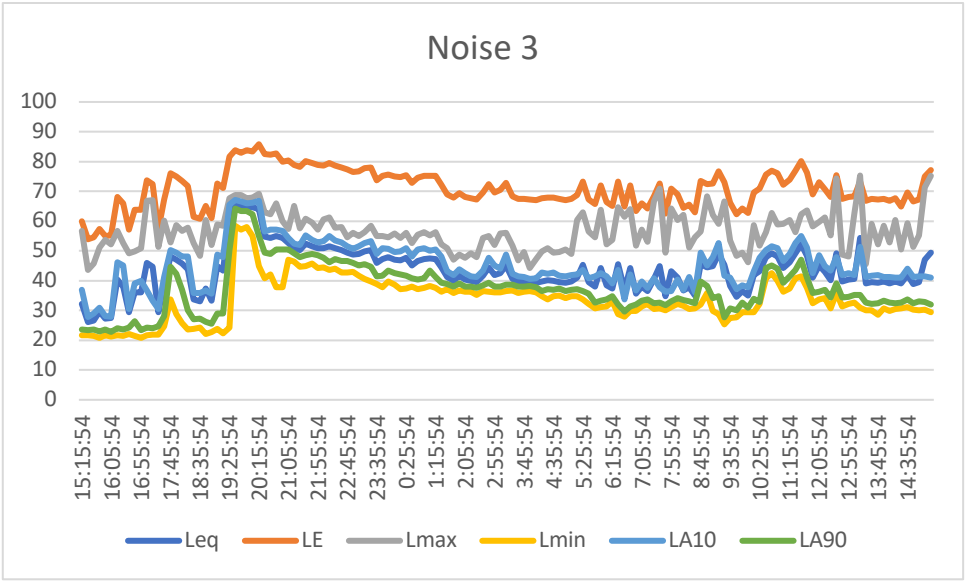
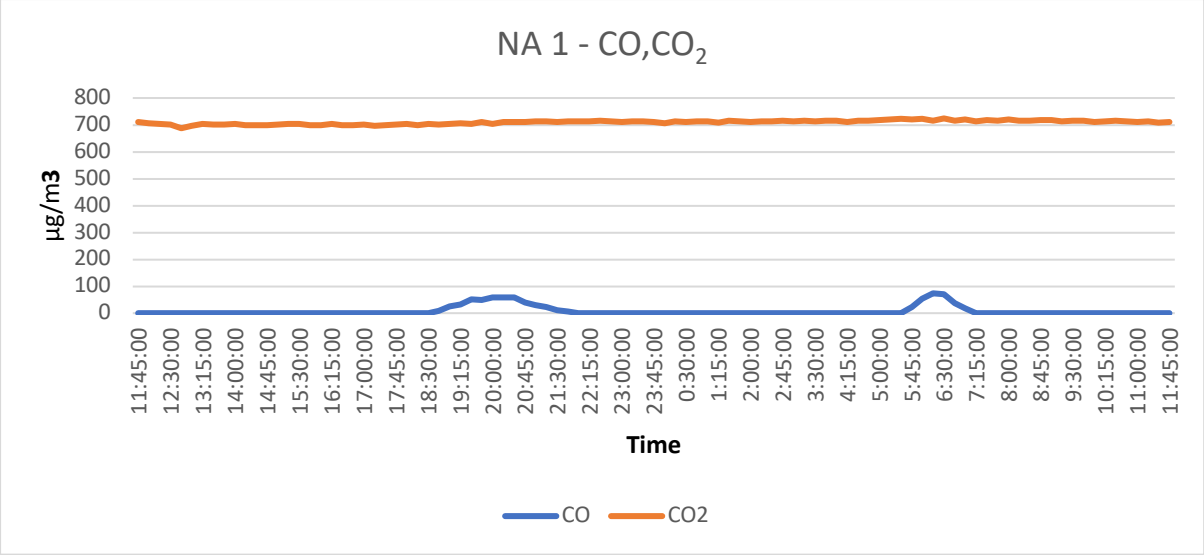
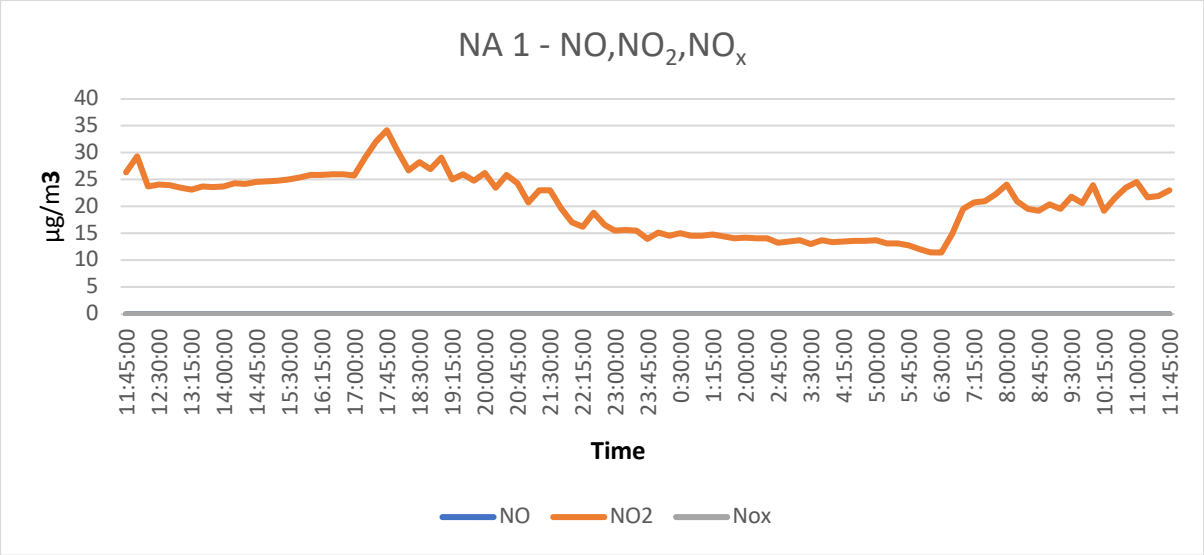
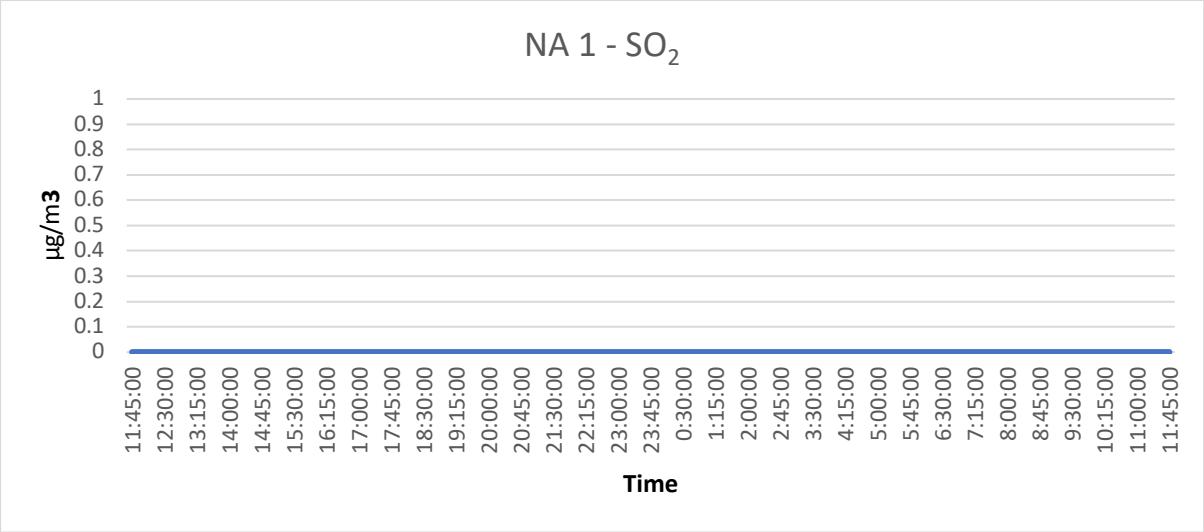


Figure 2: Variations of noise levels during daytime


NA 1 - CO,CO2
800
700
600
500
400
300
200
100
0
µg/m3
11:45:00
12:30:00
13:15:00
14:00:00
14:45:00
15:30:00
16:15:00
17:00:00
17:45:00
18:30:00
19:15:00
20:00:00
20:45:00
21:30:00
22:15:00
23:00:00
23:45:00
0:30:00
1:15:00
2:00:00
2:45:00
3:30:00
4:15:00
5:00:00
5:45:00
6:30:00
7:15:00
8:00:00
8:45:00
9:30:00
10:15:00
11:00:00
11:45:00
Time
CO
CO2


NA 1 - NO,NO2,NOx
40
35
30
25
20
15
10
5
0
µg/m3
11:45:00
12:30:00
13:15:00
14:00:00
14:45:00
15:30:00
16:15:00
17:00:00
17:45:00
18:30:00
19:15:00
20:00:00
20:45:00
21:30:00
22:15:00
23:00:00
23:45:00
0:30:00
1:15:00
2:00:00
2:45:00
3:30:00
4:15:00
5:00:00
5:45:00
6:30:00
7:15:00
8:00:00
8:45:00
9:30:00
10:15:00
11:00:00
11:45:00
Time
NO
NO2
Nox


NA 1 - SO2
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
µg/m3
11:45:00
12:30:00
13:15:00
14:00:00
14:45:00
15:30:00
16:15:00
17:00:00
17:45:00
18:30:00
19:15:00
20:00:00
20:45:00
21:30:00
22:15:00
23:00:00
23:45:00
0:30:00
1:15:00
2:00:00
2:45:00
3:30:00
4:15:00
5:00:00
5:45:00
6:30:00
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8:00:00
8:45:00
9:30:00
10:15:00
11:00:00
11:45:00
Time

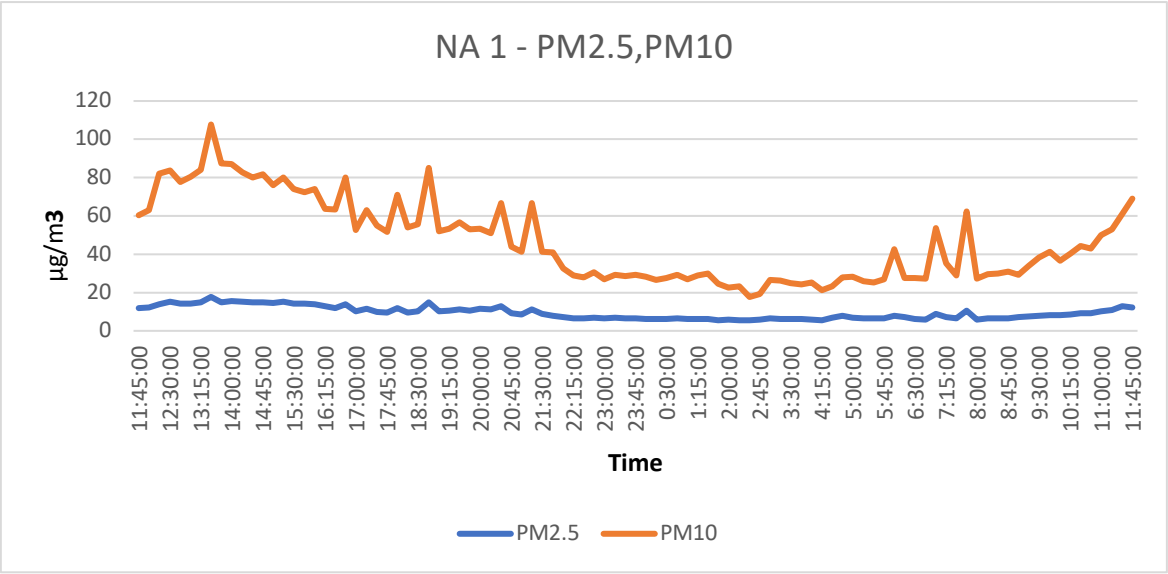

Figure 3: Air quality data NA 1

Figure 4: Noise equipment at NA 1

Figure 5: Additional sources of noise at NA 1

Figure 6: Installed noise equipment at Noise 2

Figure 7: Background noise sources at Noise 2

Figure 8: Installed noise equipment at Noise 3

Figure 9: Background noise sources at Noise 3

Figure 10: Air monitoring system at NA 1

Figure 11: Background (chemical factory)

39.552794°	66.795432°

5. Conclusion

5.1. Noise

The table presents noise measurements captured at different times of the day (daytime and nighttime) in 10-minute intervals for three locations: NA1, Noise2, and Noise3, during the dates of September 14th to 17th.

During the daytime (07:00-23:00), the average equivalent continuous sound level (LAeq) varied across the locations: NA1 ranged from 41.42 dB to 45.19 dB, Noise2 from 41.42 dB to 43.84 dB, and Noise3 from 43.84 dB to 45.19 dB. Comparatively, during the nighttime (23:00-07:00), the LAeq values showed slightly higher readings across all locations, reaching a range from 42.73 dB to 47.38 dB for NA1, 45.28 dB to 47.72 dB for Noise2, and 42.73 dB to 47.38 dB for Noise3.

The maximum sound levels (LAmax) also varied across these time periods and locations. NA1 experienced LAmax ranging from 53.71 dB to 62.93 dB during daytime and from 53.71 dB to 60.87 dB at night. For Noise2, LAmax ranged from 55.21 dB to 56.45 dB in the day and from 53.71 dB to 55.21 dB at night. Meanwhile, Noise3 recorded LAmax values between 58.30 dB and 67.10 dB in the day and between 53.71 dB and 56.45 dB at night.

The values for LAmin (average) were observed at lower levels. NA1 exhibited LAmin values ranging from 32.75 dB to 39.65 dB in the daytime and from 32.75 dB to 35.56 dB at night. Noise2 reported LAmin values between 32.75 dB and 36.38 dB in the day and from 32.75 dB to 35.56 dB at night. Noise3 displayed LAmin values ranging from 32.75 dB to 36.38 dB in the day and between 32.75 dB and 35.56 dB at night.

The LA10 values (minimum noise levels exceeded for 10% of the period) showcased fluctuations. For instance, NA1 displayed daytime LA10 ranging from 27.80 dB to 46.10 dB and nighttime values from 29.70 dB to 46.00 dB. Noise2 had daytime LA10 ranging from 27.80 dB to 41.80 dB and nighttime values from 29.70 dB to 43.40 dB. Meanwhile, Noise3 demonstrated daytime LA10 ranging from 27.80 dB to 46.10 dB and nighttime values from 29.70 dB to 46.00 dB.

5.2. Air quality

The air measurement data gathered at location NA 1 between September 14th and 15th provides an insight into various pollutant levels. The measurements are taken at 15-minute intervals, averaging different air pollutants.

Carbon monoxide (CO) levels were recorded at an average of 7.50 µg/m³ during this period. Carbon dioxide (CO2) levels stood at an average of 709.72 µg/m³. Nitric oxide (NO) levels were not detected during this time frame, indicating its absence in the monitored air. Nitrogen dioxide (NO2) levels averaged at 20.52 µg/m³, contributing to the overall nitrogen oxides (NOx) level in the atmosphere. Sulfur dioxide (SO2) was not observed, indicating a lack of its presence in the air samples.

Particulate matter (PM) levels were measured as PM2.5 and PM10, both in micrograms per cubic meter. PM2.5 levels, representing fine particles, averaged at 9.42 µg/m³. Meanwhile, PM10, encompassing coarser particles, stood at an average of 47.00 µg/m³.

The data indicates relatively low levels of some pollutants such as NO and SO2, while CO2 and PM levels are within a moderate range. However, the presence of CO and NO2 might warrant further investigation or monitoring to understand their sources and potential implications for air quality and public health in the area

6. Annex 1 Certificates of equipment

ANV MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

ilac-MRA UKAS CALIBRATION 0653

Date of Issue: 21 February 2023

Certificate Number: UCRT23/1245

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Page 1 of 2 Pages

Approved Signatory

K. Mistry

Customer	Juru Energy Ltd Suite 1 One George Yard London United Kingdom EC3V 9DF
Order No.	JE1
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification

Manufacturer	*Instrument*	*Type*	*Serial No. / Version*
Rion	Sound Level Meter	NL-52	00410151
Rion	Firmware		2.0
Rion	Pre Amplifier	NH-25	10591
Rion	Microphone	UC-59	19220
Rion	Calibrator	NC-74	34536109
	Calibrator adaptor type if applicable		NC-74-002

Performance Class	1
Test Procedure	TP 10. SLM 61672-3:2013 *Procedures from IEC 61672-3:2013 were used to perform the periodic tests.*
Type Approved to IEC 61672-1:2013	Yes *If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2013*
Date Received	20 February 2023 ANV Job No. UKAS23/02116
Date Calibrated	21 February 2023

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 specifications of IEC 61672-1:2013.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	29 June 2021	UCRT21/1801	0653

CERTIFICATE OF CALIBRATION	Certificate Number UCRT23/1245
UKAS Accredited Calibration Laboratory No. 0653	Page 2 of 2 Pages

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	NL-52/NL-42 Description for IEC 61672-1		
SLM instruction manual ref / issue	No. 56034 21-03	Source	Rion
Date provided or internet download date	19 March 2021		

	Case Corrections	Wind Shield Corrections	Mic Pressure to Free Field Corrections
Uncertainties provided	Yes	Yes	Yes

Total expanded uncertainties within the requirements of IEC 61672-1:2013	YES		
Specified or equivalent Calibrator	Specified		
Customer or Lab Calibrator	Lab Calibrator		
Calibrator adaptor type if applicable	NC-74-002		
Calibrator cal. date	16 February 2023		
Calibrator cert. number	UCRT23/1227		
Calibrator cal cert issued by Lab	0653		
Calibrator SPL @ STP	94.04	dB	Calibration reference sound pressure level
Calibrator frequency	1001.97	Hz	Calibration check frequency
Reference level range	Single	dB	

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
Note - The Extension Cable was used between the SLM and the pre-amp for this calibration.

Environmental conditions during tests	Start	End	
Temperature	23.64	22.59	± 0.30 °C
Humidity	39.9	40.0	± 3.00 %RH
Ambient Pressure	100.84	100.84	± 0.03 kPa

Indication at the Calibration Check Frequency				
Initial indicated level	94.0 dB	Adjusted indicated level	94.0	dB
Uncertainty of calibrator used for Indication at the Calibration Check Frequency ±			0.10	dB

Self Generated Noise				
Microphone installed -	Less Than	16.9	dB	A Weighting
Microphone replaced with electrical input device -				UR = Under Range indicated

Weighting	A			C			Z		
	11.9	dB	UR	15.8	dB	UR	21.4	dB	UR

Self Generated Noise reported for information only and not used to assess conformance to a requirement

Certificate of calibrated air monitoring system

ENVIRONMENTAL Instruments

Tel. +44 (0)1789 207459
Email. info@aqmesh.com
www.aqmesh.com

AQMesh

Certificate of calibration

This is to certify that the sensors:

NO: 160410106

NO2: 202761658

CO2: 0330FF15

SO2: 164041109

CO: 162941352

AQMesh pod 2450963 have been calibrated against certified reference equipment for the following measurements:

NO, NO2	Thermo Scientific 42i
CO2	Comparison to AQMesh Gold pod, created via co-location with Licor CO2 analyser
SO2	Thermo Scientific 43i
CO	Ecotech Serinus 30

This is to certify that the AQMesh pod 2450963 has passed end of line testing for the following measurements:

PM 10, PM 2.5, PM 1, Particle count	Fidas 200

Date of manufacture: 25th August 2022

Richard Handy
Operations Manager