Environmental and Social Impact Assessment Draft Report: Annexes

Project Number: 51090-001
August 2017

ARM: ArmPower CJSC

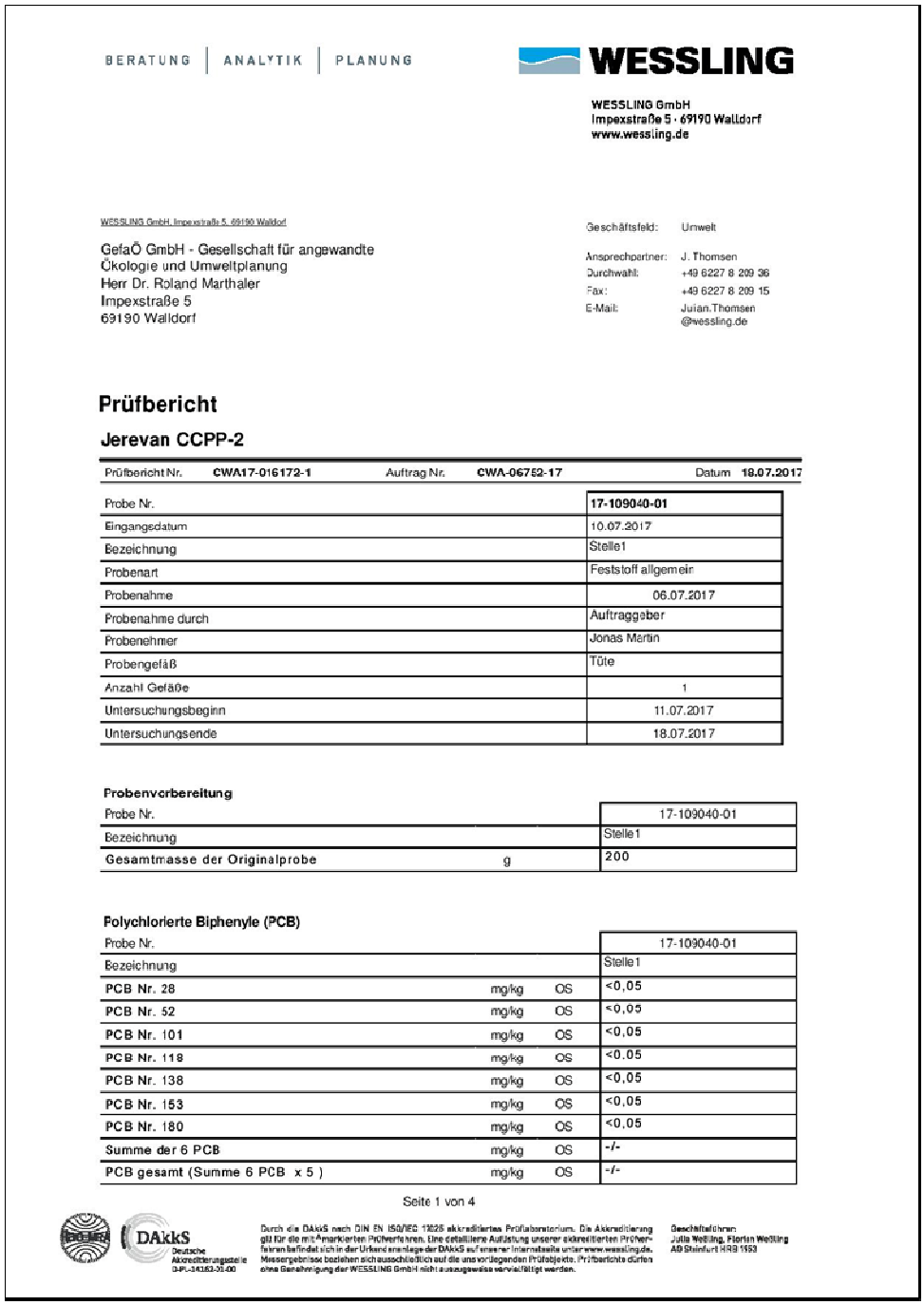
Prepared by Fichtner, Stuttgart, Germany

13. Annexes

13.1 Record of Meetings

Date	Agency/ Institution	Place	Name of Person consulted	Reason for Visit
04.07.2017	RENCO SPA	Yerevan	Gegham Baklachev (RENCO), Vram Tevosyan (Consecoard LLC)	Discussion of technical and environmental issues of construction and operation of YCCPP-2
04.07.2017	Municipality of Kharberd village	Kharberd	Kamo Kakoyan (Mayor of Kharberd), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
04.07.2017	Municipality of Ayntap village	Ayntap	Karen Sargsyan (Mayor of Ayntap), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
05.07.2017	YCCPP-2 site	Yerevan	Gegham Baklachev, Vram Tevosyan	Visit of site and surrounding area
05.07.2017	RENCO SPA	Yerevan	Gabriele Colletta (RENCO engineer), Vram Tevosyan	Discussion of technical issues of construction and operation of YCCPP-2
06.07.2017	Municipality of Yerevan, Staff of Head of Erebuni Administrative District	Yerevan	Edgar Mkrtchyan (Head of Department), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
06.07.2017	Aarhus Center (NGO)	Yerevan	Silva Ayvazyan (Coordinator of Yerevan Aarhus Center), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing environmental and social concerns
06.07.2017	Environmental Monitoring and Information Center	Yerevan	Shahnazaryan Gayane (Deputy Director), Gegham Baklachev, Vram Tevosyan	Discussing monitoring of stack emissions and of ambient air pollution
06.07.2017	YCCPP-1	Yerevan	Arkadi Gevorgyan (Chief Engineer), Gegham Baklachev, Vram Tevosyan	Discussing technical and environmental issues of operation of YCCPP-1
07.07.2017	Municipality of Yerevan, Environmental Department	Yerevan	Avet Martirosyan (Head of Environmental Department), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
07.07.2017	Municipality of Yerevan, Staff of Head of Shengavit Administrative District	Yerevan	Armen Sargsyan (Head of Department), Gegham Baklachev, Vram Tevosyan	Introducing the Project; discussing possible concerns
07.07.2017	RENCO SPA	Yerevan	Avetik Horkannisyan (RENCO Engineer), Gegham Baklachev, Vram Tevosyan	Discussion of technical and environmental issues of construction and operation of YCCPP-2

13.2 Analysis of Oil in the Contaminated Soil from Construction Site



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Prüfbericht

Jerevan CCPP-2

Prüfbericht Nr.	CWA17-016172-1	Auftrag Nr.	CWA-06752-17	Datum	18.07.2017

Probe Nr.	17-109040-01
Eingangsdatum	10.07.2017
Bezeichnung	Stelle1
Probenart	Feststoff allgemein
Probenahme	06.07.2017
Probenahme durch	Auftraggeber
Probenehmer	Jonas Martin
Probengefäß	Tüte
Anzahl Gefäße	1
Untersuchungsbeginn	11.07.2017
Untersuchungsende	18.07.2017

Probenvorbereitung

Probe Nr.			17-109040-01
Bezeichnung			Stelle1
Gesamtmasse der Originalprobe	g		200

Polychlorierte Biphenyle (PCB)

Probe Nr.			17-109040-01
Bezeichnung			Stelle1
PCB Nr. 28	mg/kg	OS	<0,05
PCB Nr. 52	mg/kg	OS	<0,05
PCB Nr. 101	mg/kg	OS	<0,05
PCB Nr. 118	mg/kg	OS	<0,05
PCB Nr. 138	mg/kg	OS	<0,05
PCB Nr. 153	mg/kg	OS	<0,05
PCB Nr. 180	mg/kg	OS	<0,05
Summe der 6 PCB	mg/kg	OS	-/-
PCB gesamt (Summe 6 PCB x 5)	mg/kg	OS	-/-

Seite 1 von 4

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Geschäftsführer: Julia Weßling, Florian Weßling
AG Steinfurt HRB 1193

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Prüfbericht Nr.	CWA17-016172-1	Auftrag Nr.	CWA-06752-17		Datum 18.07.2017
Probe Nr.					17-109040-01
Summe der 7 PCB			mg/kg	OS	-/-

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Prüfbericht Nr.	CWA17-016172-1	Auftrag Nr.	CWA-06752-17	Datum	18.07.2017

Probe Nr.	17-109040-02
Eingangsdatum	10.07.2017
Bezeichnung	Stelle2
Probenart	Feststoff allgemein
Probenahme	06.07.2017
Probenahme durch	Auftraggeber
Probenehmer	Jonas Martin
Probengefäß	Tüte
Anzahl Gefäße	1
Untersuchungsbeginn	11.07.2017
Untersuchungsende	18.07.2017

Probenvorbereitung

Probe Nr.			17-109040-02
Bezeichnung			Stelle2
Gesamtmasse der Originalprobe	g		200

Polychlorierte Biphenyle (PCB)

Probe Nr.			17-109040-02
Bezeichnung			Stelle2
PCB Nr. 28	mg/kg	OS	<0,05
PCB Nr. 52	mg/kg	OS	<0,05
PCB Nr. 101	mg/kg	OS	<0,05
PCB Nr. 118	mg/kg	OS	<0,05
PCB Nr. 138	mg/kg	OS	<0,05
PCB Nr. 153	mg/kg	OS	<0,05
PCB Nr. 180	mg/kg	OS	<0,05
Summe der 6 PCB	mg/kg	OS	-/-
PCB gesamt (Summe 6 PCB x 5)	mg/kg	OS	-/-
Summe der 7 PCB	mg/kg	OS	-/-

Geschäftsführer:
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Prüfbericht Nr.	CWA17-015172-1	Auftrag Nr.	CWA-06752-17	Datum	18.07.2017

Abkürzungen und Methoden

		ausführender Standort
Polychlorierte Biphenyle (PCB)	DIN EN 15308[A]	Umweltanalytik Walldorf
		Umweltanalytik Walldorf
OS	Originalsubstanz	

Julian Thomsen
M. Sc. Biogeowissenschaften
Sachverständiger Umwelt und Wasser

Geschäftsführer
Julia Welling, Florian Welling
AG Steinfurt HRB 1753

13.3 Report on Groundwater Quality and Possible Soil Contamination

Report

On Monitoring Services

Yerevan, August 11, 2017

Based on the contract signed between "Renco Armestate" LLC and "Consecoard" LLC on 14.07.2017, the specialists of "Consecoard" LLC carry out monitoring of Yerevan TPP-2 construction site, which includes:

- topsoil, surface water and groundwater sampling according to the list submitted by the Client,
- organizing the tests in the appropriate licensed laboratory according to the List of Materials and Indicators Provided by the Client,
- analysis of results and comparison with sanitary norms in the Republic of Armenia.

Currently, "Consecoard" LLC specialists have conducted all samplings:

1. Land
   - from the central part of the area allocated for construction,
   - from the roadside,
   - near the pile of barrels of used oils existing in the area
2. Water
   - water leak during drilling of the area. Sampled water taken during drilling of a site for construction. The water was taken from the wells 7.9 m and 2.8 m, dug for sampling near the BH 1 (x – 457072.44, y – 4440369.06) and BH 17 (x – 457316.96, y – 4440491.54) wells for geological survey. Sampling was carried out 3 hours after the drilling works to ensure water simplicity.
   - water running through the pipe in the central part of the construction site,
   - outflow of canal water from the operating Yerevan TPP1

The sampling was conducted by the methodology of the Monitoring Center of the Ministry of Nature Protection of the Republic of Armenia with the participation of the representative of Renco company: Gegham Baklachev.

The collected samples have been moved to the “Laboratory of Environmental Monitoring and Information Center” SNCO of the Ministry of Nature Protection of the Republic of Armenia.

The results and data analysis are presented below.

Table 1. Water, common indicators:

№	Measured indicator	Unit of measurement	The results of analysis			The method of analysis
			Sample 1	Sample 2	Sample 3	
1	Hydrogen indicator (pH)	-	7.25	6.68	8.34	Electrochemical
2	Dissolved oxygen	mgO_2/l	1.34	7.37	6.61	Electrochemical
3	Mineralization	mg/l	1708	111	786	Electrochemical
4	BOD_5	mgO_2/l	1.50	1.19	6.80	Electrochemical
5	COD_5[1]	mgO_2/l	288	136	416	Oxidation by bichromate

[1] The COD value is high since the laboratory test was performed weeks after sampling.

Table 2. Water, Metals and Organic Compounds:

№	Measured indicator	Unit of measurement	The results of analysis			The method of analysis
			Sample 1	Sample 2	Sample 3	
6	Lithium	Mg/l	0.0340	0.0038	0.0212	ICP-MS[2]
7	Beryllium	Mg/l	$<10^{-6}$	$<10^{-6}$	$<10^{-6}$	ICP-MS
8	Boron	Mg/l	0.9258	0.0259	0.2678	ICP-MS
9	Natrium	Mg/l	269.5	6.8	95.5	ICP-MS
10	Magnesium	Mg/l	18.8	5.8	24.0	ICP-MS
11	Aluminum	Mg/l	0.0795	0.0052	0.0097	ICP-MS
12	Total phosphorus	Mg/l	0.0798	0.1148	0.2157	ICP-MS
13	Potassium	Mg/l	2.4	2.4	8.2	ICP-MS
14	Calcium	Mg/l	171.1	14.8	28.8	ICP-MS
15	Titan	Mg/l	0.0110	0.0037	0.0020	ICP-MS
16	Vanadium	Mg/l	0.3475	0.0213	0.0092	ICP-MS
17	Chrome	Mg/l	0.0079	0.0010	0.0063	ICP-MS
18	Iron	Mg/l	0.2262	0.0337	0.0828	ICP-MS
19	Manga	Mg/l	0.0818	0.0009	0.0020	ICP-MS
20	Cobalt	Mg/l	0.0017	0.0007	0.0002	ICP-MS
21	Nickel	Mg/l	0.0029	0.0003	0.0012	ICP-MS
22	Copper	Mg/l	0.0034	0.0006	0.0033	ICP-MS
23	Zinc	Mg/l	3.0628	0.0025	0.0038	ICP-MS
24	Arsen	Mg/l	0.0541	0.0011	0.0059	ICP-MS
25	Selen	Mg/l	0.0054	0.0002	0.0014	ICP-MS
26	Strontium	Mg/l	2.2267	0.0821	0.2446	ICP-MS
27	Molybdenum	Mg/l	0.0588	0.0009	0.0485	ICP-MS

[2] The applied method: Inductively coupled plasma mass spectrometry (ICP-MS)

28	Cadmium	Mg/l	0.00017	0.00001	0.00014	ICP-MS
29	Tuna	Mg/l	0.00109	0.00020	0.00041	ICP-MS
30	Antimony	Mg/l	0.00015	0.00010	0.00008	ICP-MS
31	Barium	Mg/l	0.0268	0.0070	0.0219	ICP-MS
32	Lead	Mg/l	0.0011	0.0002	0.0005	ICP-MS
33	Benzene	Mg/l	<0,0001	-	<0,0001	Gas chromatography
34	Toluene	Mg/l	<0,0001	-	0.001	Gas chromatography
35	Oktan	Mg/l	<0,0001	-	<0,0001	Gas chromatography
36	Ethylbenzene	Mg/l	<0,0001	-	<0,0001	Gas chromatography
37	Xylol	Mg/l	<0,0001	-	<0,0001	Gas chromatography
38	Nona	Mg/l	<0,0001	-	0.00014	Gas chromatography
39	Mixture of alkanes ($C_{10}H_{22}$-$C_{22}H_{46}$)	Mg/l	3.474	-	2.758	Gas chromatography

According to RA Government Decree " On defining water quality norms for each water basin management area taking into consideration the peculiarities of the Locality," (RA Government Decree N 75-N, dated on 27 January 2011,) the surface water quality assessment system in Armenia distinguishes five class statuses for each grade: "excellent" (1st grade), "good" (2nd grade), "mediocre" (3rd class); "Insufficient" (grade 4) and "bad" (5th grade).

The government's decision envisages maximum permissible concentrations for all classes, in case of exceeding them, the flow to water resources is prohibited.

Yerevan Thermal Power Plant territory is located in Hrazdan river basin(watershade) management area. According to "Armecomonitoring"'s reference outcomes on " Ecological Monitoring of the RA Environment" for 2015, the water in the lower stream of the Hrazdan River is "bad" (5th grade).

Below are the 5 th class limits for the Hrazdan River basin management, along with the results of the analysis.

Table 3. Water quality comparative data. General indicators

№	Comparable index	Unit of measurement	Norms by Water Quality Classes					The average result of the analysis
			I	II	III	IV	V	
1	2	3	4	5	6	7	8	9
1	Hydrogen indicator (pH)	-	6.5-9	6.5-9	6.5-9	6.5-9	<6.5 >9	7.25 - 8.34
2	Dissolved oxygen	mgO_2/l	>7	>6	>5	>4	<4	1.34 - 7.37
3	Mineralization	mg/l	74	148	1000	1500	>1500	111 - 1708

4	BOD_5	mgO_2/l	3	5	9	18	>18	1.19 - 6.80
5	Benzene	Mg/l	-	-	-	-	-	<0,0001
6	Toluene	Mg/l	-	-	-	-	-	0.001
7	Octane	Mg/l	-	-	-	-	-	<0,0001
8	Ethylbenzene	Mg/l	-	-	-	-	-	<0,0001
9	Xylol	Mg/l	-	-	-	-	-	<0,0001
10	Nona	Mg/l	-	-	-	-	-	0.00014
11	Mixture of alkanes ($C_{10}H_{22}$-$C_{22}H_{46}$)	Mg/l	-	-	-	-	-	2.758 – 3.474

Table 4. Water quality comparative data. Metals

№	Comparable index	Unit of measure ment	Norms by Water Quality Classes					The average result of the analysis
			I	II	III	IV	V	
1	Lithium	mkg/l	ֆԿ	ֆԿ	ֆԿ	<2500	>2500	3.8 – 34.0
2	Beryllium	mkg/l	0.014	0.028	0.056	100	>100	< 0.001
3	Boron	mkg/l	9	450	700	1000	>2000	25.9 – 925.8
4	Natrium	mg/l	5	10	20	40	>40	6.8 – 269.5
5	Magnesium	mg/l	2,8	50	100	200	>200	5.8 – 24.0
6	Aluminum	mkg/l	65	130	260	5000	>5000	5.2 – 79.5
7	Total phosphorus	mg/l	0,025	0,2	0,4	1	>1	0.08 – 0.2157
8	Potassium	mg/l	1,5	3,0	6,0	12,0	>12,0	2.4 – 8.2
9	Calcium	mg/l	9,7	100	200	300	>300	14.8 – 171.1
10	Titanium	mg/l	-	-	-	-	-	0.002 – 0.011
11	Vanadium	mkg/l	1	2	4	8	>8	9.2 – 34.79
12	Chrome	mkg/l	1.0	11.0	100	250	>250	1.0 – 7.9
13	Iron	mg/l	0,08	0,16	0,5	1	>1	0.0337 – 0.226
14	Manga	mkg/l	5	10	20	40	>40	0.9 – 81.8
15	Cobalt	mkg/l	0,14	0,28	0,56	1,12	>1,12	0.2 – 1.7
16	Nickel	mkg/l	1.0	11.0	50	100	>100	0.3 – 2.9
17	Copper	mkg/l	3.0	23.0	50	100	>100	0.6 – 3.4
18	Zinc	mkg/l	3.0	100	200	500	>500	2.5 – 3063.0
19	Arsen	mkg/l	0,13	20	50	100	>100	1.1 – 54.1
20	Selene	mkg/l	0,5	20	40	80	>80	0.2 – 5.4
21	Strontium	mg/l	-	-	-	-	-	0.081 – 2.2267
22	Molybdenum	mkg/l	7	14	28	56	>56	0.9 – 58.8
23	Cadmium	mkg/l	0,02	1,02	2,02	4,02	>4,02	0.01 – 0.17
24	Tin	mkg/l	0,09	0,18	0,36	0,72	>0,72	0.2 – 1.09
25	Antimony	mkg/l	0,2	0,38	0,76	1,52	>1,52	0.08 – 0.15
26	Barium	mkg/l	9	18	36	1000	>1000	7.0 – 26.8
27	Lead	mkg/l	0,3	10,3	25	50	>50	0.2 – 1.1

As can be seen from the table, the results of all sampling tests are within the limits of this class of water, and consequently, this quality water can be directed to the downstream of Hrazdan River, without additional cleaning.

2. Land

Based on the characteristics of soil analysis, preliminary analysis have been performed for some indicators, the results of which are given below.

External inspection: brown soil and ground, with the average content of rock material.

Vegetal and sub-vegetal layer, 13 -22 cm:

pH- in water extract ` 6.5 – 7.3

The sum of absorbed cations, m/eqv 100g in land: 28.5 – 32.2.

Table 5. Soil quality data. Metals

N	Measured index	Unit	Measured value			Method applied
			Sample 1	Sample 2	Sample 3	
6	Lithium	g/kg	0.0061	0.0175	0.0140	ICP-MS
7	Beryllium	g/kg	0.0004	0.0012	0.0010	ICP-MS
8	Boron	g/kg	0.0373	0.0435	0.0440	ICP-MS
9	Sodium	g/kg	6.0	15.7	10.3	ICP-MS
10	Magnesium	g/kg	2.4	14.8	8.7	ICP-MS
11	Aluminium	g/kg	9.17	73.24	45.77	ICP-MS
12	General Phosphorus	g/kg	0.28	0.84	0.64	ICP-MS
13	Potassium	g/kg	5.8	14.9	10.9	ICP-MS
14	Calcium	g/kg	18.2	83.4	44.4	ICP-MS
15	Titanium	g/kg	1.72	4.40	3.24	ICP-MS
16	Vanadium	g/kg	0.0633	0.1329	0.1010	ICP-MS
17	Chromium	g/kg	0.0174	0.0957	0.0518	ICP-MS
18	Iron	g/kg	5.77	41.04	22.07	ICP-MS
19	Manganese	g/kg	0.1579	0.8231	0.4255	ICP-MS
20	Cobalt	g/kg	0.0077	0.0179	0.0164	ICP-MS
21	Nickel	g/kg	0.0218	0.0549	0.0472	ICP-MS
22	Copper	g/kg	0.0167	0.0691	0.0354	ICP-MS
23	Zinc	g/kg	0.0454	0.1010	0.0588	ICP-MS
24	Arsenic	g/kg	0.0086	0.0118	0.0110	ICP-MS

25	Selenium	g/kg	0.0018	0.0012	0.0043	ICP-MS
26	Strontium	g/kg	0.1022	0.3144	0.1845	ICP-MS
27	Molybdenum	g/kg	0.0101	0.0049	0.0106	ICP-MS
28	Cadmium	g/kg	0.00008	0.00025	0.00016	ICP-MS
29	Tin	g/kg	0.00049	0.00206	0.00098	ICP-MS
30	Antimony	g/kg	0.00027	0.00086	0.00039	ICP-MS
31	Barium	g/kg	0.0779	0.4139	0.2195	ICP-MS
32	Lead	g/kg	0.0065	0.0369	0.0129	ICP-MS

The applied method: Inductively coupled plasma mass spectrometry (ICP-MS)

The results of soil survey and general indicators analysis indicate that soil quality is in line with the general characteristics of the region and is within the limits of permitted norms.

V. Tevosyan, director of "Consecoard" LLC

13.4 Noise Impact Study

Yerevan 2 CCGT Power Plant

Noise Impact Study

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Rev No.	Rev-date	Contents /amendments	Prepared/revised	Checked/released
0	28/07/2017	Draft	E C Consulting /F.Sormani	
1	18/08/2017	First Emisison	E C Consulting /F.Sormani	
2				

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Table of Contents

1. Scope of the Report

This Noise Propagation Study has been produced as part of the ESIA Report Methodology

A Noise Calculation (NC) was produced for this purpose for the new power plant (YCCPP-2) site.

The NC has been done by using the propagation model SoundPLAN (Braunstein + Berndt GmbH). The model determines sound propagation based on the provisions of ISO 9613.
This model is widely usedin EU noise mapping projects.

The application of the model will allow determining whether the noise levels emitted by the new plant will represent a nuisance to the surrounding areas, i.e., if the resulting ambient noise will be above the national and international standards.

2. Brief Project Description

To partially reduce the gap between the offer and demand of electric energy foreseen in the Republic of Armenia for the next years, the MOE has signed for the construction of a new 250 MW Combined Cycle type Power Plant, gas fired (the CCGT), in the surroundings of Yerevan city.
The electrical power shall be generated by means of a gas turbine driven generator and, at the same time, steam shall be produced from heat recovery from the GT exhausts. The steam will be fed to a steam turbine, driving an additional power generation unit.
The technology of the most modern gas turbine improving the overall efficiency of the thermal cycle joined with the low environmental impact makes the natural gas fired combined cycle technology, at present, an ideal solution in power sectors.
The Project is a combined cycle plant in a multi-shaft arrangement. The plant will consist of a Gas Turbine (GT) with generator, a Steam Turbine (ST) with generator, a Heat Recovery Steam Generator (HRSG) and other associated equipment and systems.
The plant will be designed for highly efficient operation and for high reliability and availability.
The multi-shaft arrangement is a proper solution with its high flexibility allowing different modes of operation and easy maintenance.

3. Methodology

The aims of this study are:

- calculation of noise emission contributions at the sensitive receptors determined by the CCGT operation
- predictive definition of the acoustic pressure at the sensitive receptors during CCGT operation
- predictive verification of the compliance to applicable limits at sensitive receptors

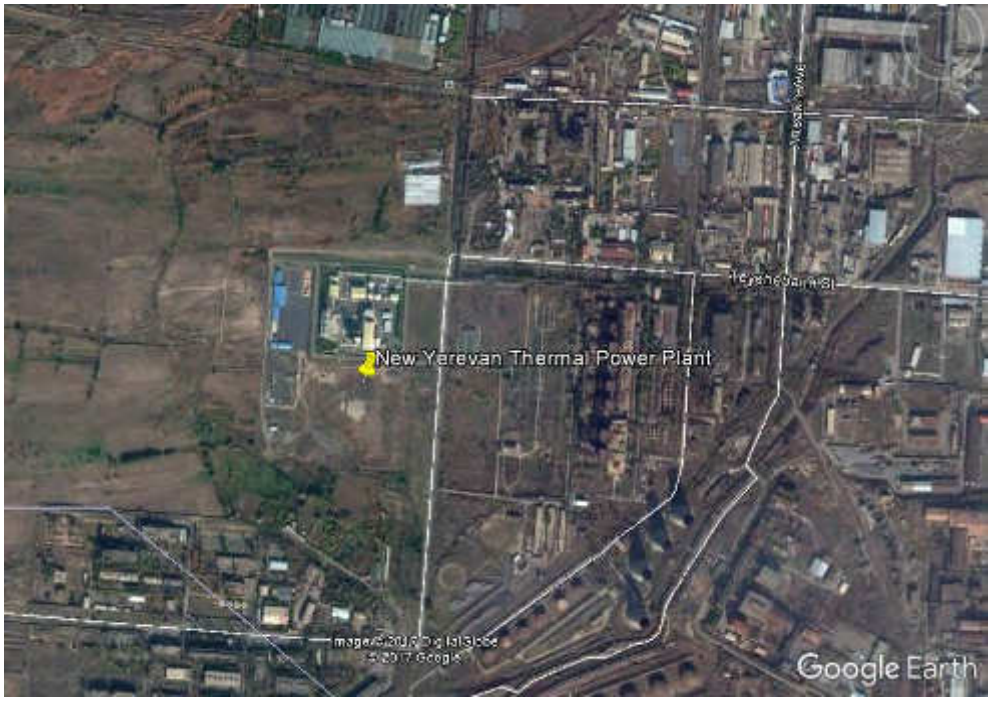
On the basis of the Project data, the sound contribution of the CCGT during operation at the most exposed sensors was calculated.
The values thus obtained were compared to the applicable limits.

The new 250 MW Yerevan Combined Cycle Power Plant ("CCPP") will be located in the vicinity of Yerevan city, in the area adjacent to the existing Yerevan CCPP, currently managed by the Yerevan TPP CJSC.

Figure 3 -1: Geographic overview of the project

The following figure shows the location of the Power Plant.

Figure 3-2: Detailed Geographic overview of the project



The first step of the Noise Calculations has been to state the area potentially most affected by the Project's noise emissions, defined as Assessment area.

4. Noise sources

The whole plant has been designed with particular attention to limit the noise emissions.
The most relevant noise sources will be located inside soundproofed cabin/buildings to minimize noise propagation.

The acoustic enclosure for Gas Turbine and Generator is located over the Gas Turbine thermal block and the generator. It includes the sidewalls for the exhaust gas diffuser area.
The acoustical enclosure is designed and suitable for indoor application, i.e. the thermal block compartment, the generator compartment and the exhaust gas diffuser area compartment are located inside a building.
The main purposes of the acoustic enclosure and the related installations are:

- To reduce the noise emissions generated by the Gas Turbine thermal block, the exhaust gas diffuser and the generator
- To cool down the Gas Turbine set environment during operation.

The acoustical enclosure is completely equipped with structural steel frame, acoustic panels (removable for maintenance), penetration elements for cabling and piping, fully automatic ventilation system, access stairs and ladders, industrial grade/self-closing access doors with panic bars and internal lighting, emergency lighting and small power outlets.

5. Noise Propagation Model

The calculation of the predictive noise propagation was performed in accordance with the ISO 9613-2.

The calculation was performed through SoundPlan (open field propagation simulation software) after setting the model parameters:

- contour setting (geomorphological-acoustic parameters of the propagation environment);
- calculation settings;
- characterization of sound emission sources.

5.1 Software used for simulation: Sound Plan

SOUND PLAN is an open-field sound propagation simulation program and is one of the most used software in environmental noise studies. Modeling of sound propagation is done through a numerical calculation model called 'search angle method'. Starting from every single point of reception considered in the simulation of sound propagation, SOUND PLAN simulates a series of search rays that propagate uniformly in all directions and, for each of them, the software analyzes the physical-geometric and acoustic characteristics of the propagation environment, determines the 'path' leading to the sound source by applying known properties on the direction of propagation of the sound rays.

Therefore, for each sound radius that reaches the source, it applies the attenuating factors related to the acoustic phenomena affected by the ray (the attenuating factors are evaluated quantitatively by means of the ISO 9613-2) and then, it sums, at the receiving point considered, all the contributions made by the sound rays that had reached at least one sound source.

For this numeric procedure to be executed in a reasonable time by the computer, using Sound Plan it is possible to make 'settings' on the accuracy of the calculation model and in particular on:

- the incremental value of the angle that identifies two contiguous rays of search;
- the maximum number of reflections to be considered for the search radius before its contribution is considered null;
- the circular width of the field of research.

Sound Plan is basically based on three modules:

- a 'geo-database'
- a calculation module
- a result display module

In the geo-database, the propagation environment is represented in the three dimensions and the surfaces of the same are acoustically characterized. Emission sources are also located, each of which must be associated with acoustic characterization (source spectrum or total source sound pressure level).
By the calculation module it's possible to select the calculation standard to be used and once selected, the standard can be 'set' in the values of the propagation environment conditions.
The result display module renders the calculation results according to the purpose of the calculation.

5.2 Model runs

The model has been set up and launched. The results have been collected and analyzed.
The Set up of the model has implied the input of all basic data into the software. This has included information regarding the location of sensitive receptors, the noise emission and the technical data of the new YCCPP-2 including terrain data, and dimensions of the nearby structures.
The following aspects have been considered

- The soil use and occupation (including sensitive receptors)
- The terrain characteristics:
- The Plant's noise emissions and technical data.

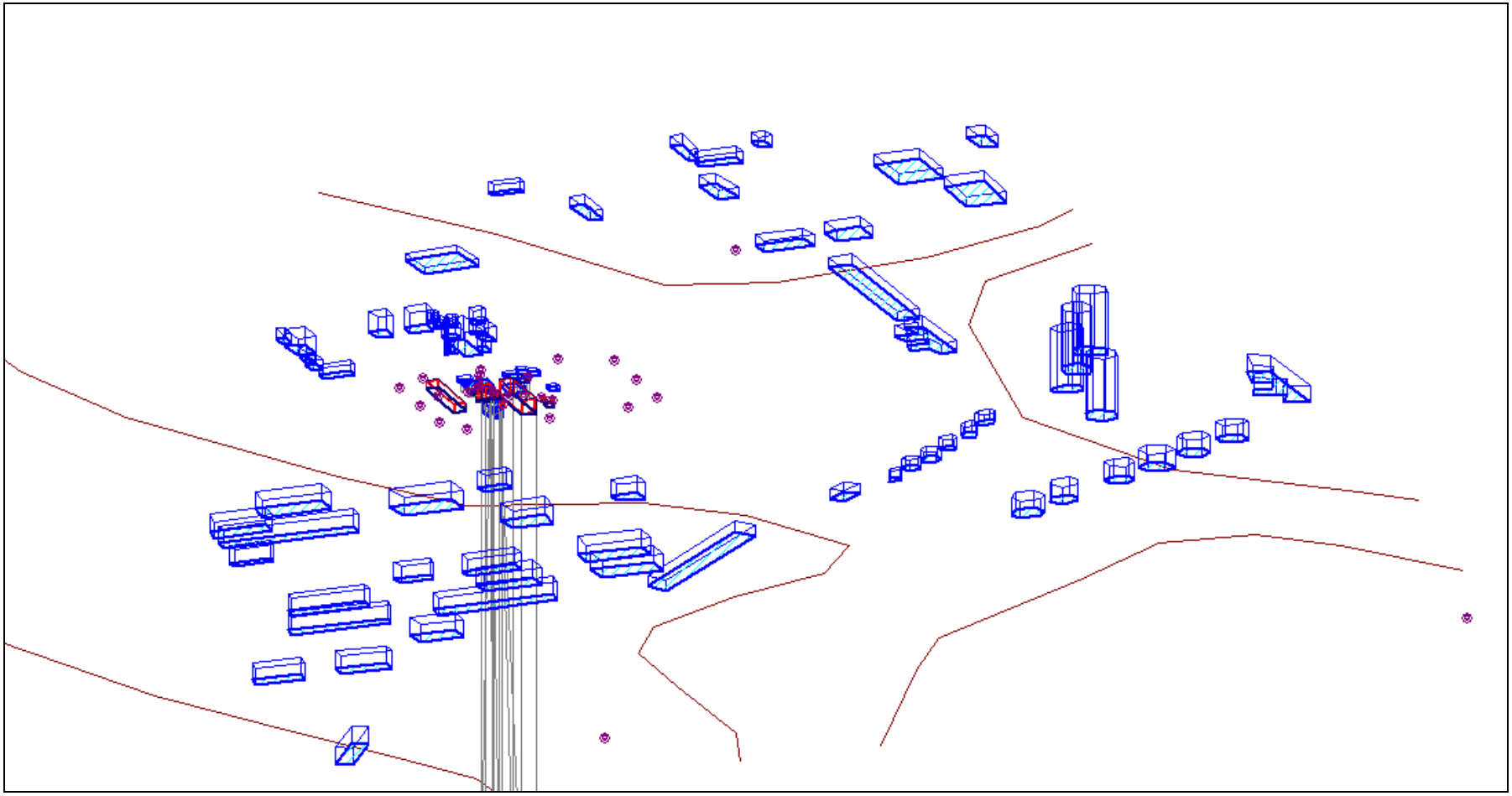
5.2.1 Setting boundary conditions

The propagation area considered is the installation area of the Project Center and its immediate vicinity and is such as to include sensitive receptors identified.
The calculation of the contribution of the sound sources has been carried out on an area of the territory so that the effects of the sound can be considered as null.
In order to cover within the spatial scope of the study the sensitive receptors identified a computational area of about 3 km x 3 km was considered.

The geo-database was built through a detailed plan of the area.

Figure 5.2.1-1 The computational area

Figure 5.2.1.-2 A geodatabase 3D view of the computational area



5.2.2 Setting the sound sources

The allocation of the sound emission to the various components of the plant was made in analogy to the technical specifications for the purchase of the various equipment, according to the designers' instructions according to the values reported in the Table 5.2.2-1

Table 5.2.2-1Sound pressure level of the most relevant sources considered in the model

Item	Source	Lp(A) (@1m) [dB(A)]
HRSG	Lateral Walls	71
	Roof	71
Air Intake GT	Intake	77
HRSG Diffusor	All surfaces	70
Main Machine Building (GT, ST)	All surfaces	60
Stack	External surfaces	75
	Mouth	80
Close cycle heat exchanger	All surfaces	75
Cooling Towers	All surfaces	80
Main Transformer	All surfaces	80
Units Transformer	All surfaces	75
Fuel Gas Booster Compressors Building	All surfaces	80
Auxiliary Boiler	All surfaces	60

Some sound sources have been modeled as areal sources and others as point sources.

The surfaces of buildings are acoustically considered as good reflectors (as is also indicated in ISO 9613-2). This is a typical assumption in the study of environmental noise propagation where 'natural screens' to be considered always have a significant thickness that, following the formulation proposed by ISO 9613-2 for the assessment of the sound pressure level loss at a reflection, is equivalent to the loss of 1 dB at every reflection.

The allocation of the sound power to the different components of the plant was made in analogy to the technical specifications for the purchase of the various equipment, according to the designers' instructions.

The following cautionary assumptions were made in the calculation model parameters setting:

- Continuous operation 24hours / day - 365 days / year (continuous operation both during the diurnal reference period and during the night reference period)
- Operating characteristics characterized by cautionary sound levels if compared to those guaranteed

5.2.3 Calculation settings

In order to obtain good accuracy results, the search angle method through which SOUND PLAN performs the calculation was set by initializing the relevant parameters with the following values:

- Incremental value of the search beam angle = 2º
- Maximum number of reflections (after which the contribution of the search radius is considered null) = 3

The settings made on the parameters of the calculation standard are as follows:

Table 5.2.3-1 Calculation settings

Environmental Conditions	Humidity	70%
	Temperature	10ºC
	Atmospheric pressure	1013,25 mbar
Diffractions Calculations	Contribution limits due to diffractions	Single diffraction=20dB
		Double diffraction=25dB
	Values assumed for the parameters in the formulations of ISO 9613 for calculating the diffractions	C1=3
		C2=20
		C3=0

5.2.4 Sound pressure levels "ante-operam"

Sensitive receptors that could potentially be more impacted by noise were detected through a site survey. They are reported in the Figure 5.2.4-1

Figure 5.2.4-1 Sensitive receptors potentially impacted

According to The Sanitary Norms N2-III-11.3:

- the applicable noise limits In the residential areas are 45 dBA during the Night time and 55 dBA during the Day time

In the industrial areas the limits fluctuate from 50 dBA to 80 dBA depending on the category of works:
The said limits are referred to the total environment noise (the power plant contribution including the current sound pressure (“ante operam” sound pressure).

The applicable limits to the sensitive receptors potentially impacted are shown in the Table 5.2.4-1

Table 5.2.4-1: applicable limits to the sensitive receptors potentially impacted

Point of measurement	Time	TLV (equivalent to sound level), [dB(A)]
(Work-day and Weekend)		
R1	Day-time	55
	Night-time	45
R2	Day-time	55
	Night-time	45
R3	Day-time	55
	Night-time	45
R4	Day-time	70
	Night-time	70
R5	Day-time	55
	Night-time	45

In order to characterize the acoustic climate at the sensitive receptors, noise measurements were performed at each of them during the survey.
For the measurement report, refer to the report “Noise and PM10 Baseline Study” rev.01 dated August 2017.
In the Table 5.2.4-2 the summary of the measurements outcome is reported.

Table 5.2.4-2: Current sound pressure ("ante operam") at the sensitive receptors

Point of measurement	Wind speed (m/s)	Time of measurement	Leq(A) [dB(A)]
Work-day			
R1	<1.7	Day-time	49.8
	<1.8	Night-time	47.1
R2	<1.9	Day-time	72.6
	<2.3	Night-time	62.4
R3	<1.8	Day-time	48.1
	<1.7	Night-time	40.0
R4	<1.6	Day-time	53.6
	<1.9	Night-time	57.3
R5	<1.7	Day-time	36.2
	<2.0	Night-time	39.4
Weekend			
R1	<1.5	Day-time	43.4
	<2.1	Night-time	49.0
R2	<1.8	Day-time	72.8
	<2.5	Night-time	59.2
R3	<1.9	Day-time	43.9
	<2.0	Night-time	33.9
R4	<1.8	Day-time	56.4
	<2.0	Night-time	57.2
R5	<1.5	Day-time	35.6
	<1.8	Night-time	34.2

"Ante operam" Day-time noise evaluation
Based on the noise measurement results conducted during work-days and weekend days, it can be concluded that noise equivalent levels in/near the residential areas were generally within the TLV except the point R2 (located in front of the highway), where the noise level exceeded the 55 dBA normative value. This can be explained by the movement of heavy vehicles and high traffic density along the highway

"Ante operam" Night-time noise evaluation
Equivalent noise levels during work-days and weekend days at measurement points R3 and R5 are within the 45 dBA TLV. Noise levels at point R1 during both work-days and weekend days were slightly exceeding the TLV (2.1 dBA and 4 dBA accordingly). This is due to the availability of background night noise from the facilities located in the vicinities. As a result of night-time measurements, the equivalent noise level at point R 2 (located in front of the highway) is above the 45 dBA TLV (see). The reason is high traffic density along the highway even at night-time.

5.2.5 Calculation of the sound contribution to the most exposed sensitive receptors

The calculation of the sound pressure level generated by the operation of the Power Plant towards the sensitive receptors has been performed by positioning the sensitive receptors in the model geodatabase. The calculation outcomes are reported in the Table 5.2.5-1.

Table 5.2.5-1 Calculation outcomes: Sound Pressure generated by the Plant operation at the sensitive receivers

ID Receptor	Reference period (Work-day and Weekend)	Sensitive receptor applicability	Sound level contribution LAeq [dB(A)]
R1	*Day time*	Yes	32,5
	Night time	Yes	32,5
R2	*Day time*	Yes	38,0
	Night time	Yes	38,0
R3	*Day time*	Yes	34,9
	Night time	Yes	34,9
R4	*Day time*	Yes	42,7
	Night time	Yes	42,7
R5	*Day time*	Yes	31,8
	Night time	Yes	31,8

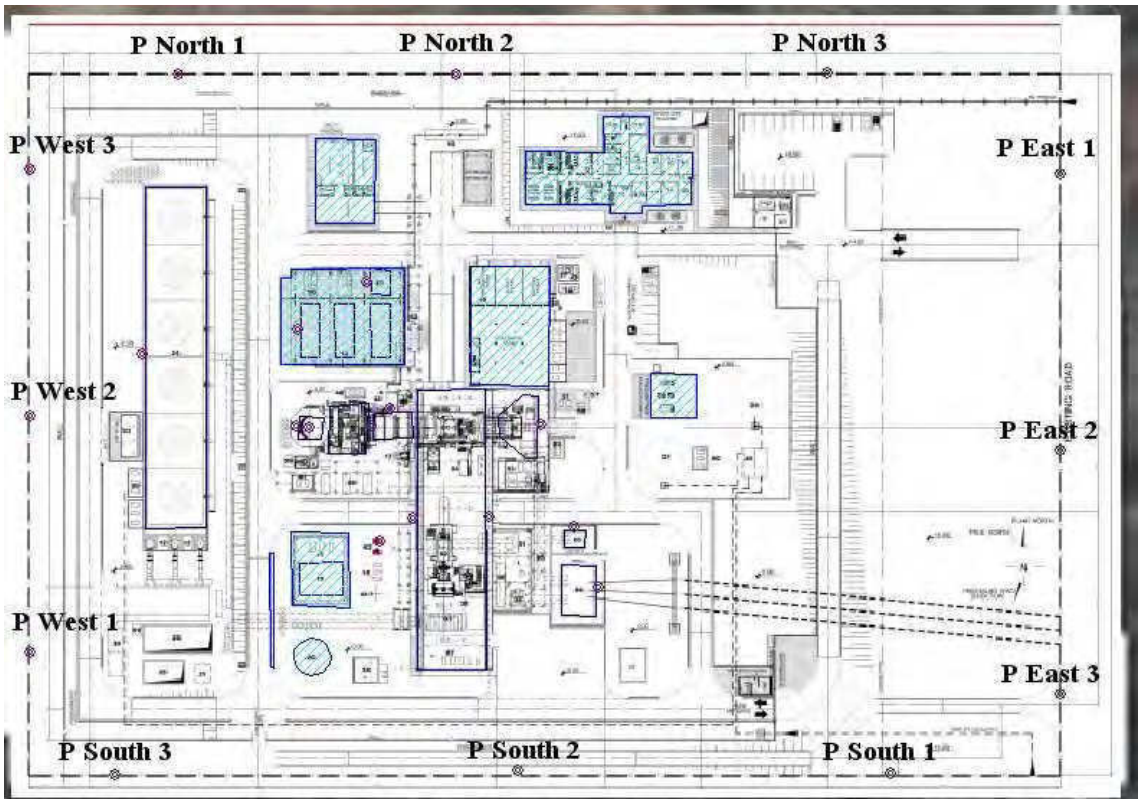
In addition calculation points along the Plant fence have been considered. The calculation outcomes are reported in the Table 5.2.5-2.

Table 5.2.5-2 Calculation outcome: Sound Pressure generated by the Plant operation at the Plant fence.

ID Fence Point	Sound level contribution LAeq [dB(A)]
P East 1	51,3
P East 2	51,6
P East 3	51,5
P North 1	64,0
P North 2	57,3
P North 3	53,1
P South 1	54,2
P South 2	59,6
P South 3	60,2
P West 1	62,6
P West 2	67,9
P West 3	66,2

The calculation point along the fence have been positioned as shown in the Figure 5.2.5-1.

Figure 5.2.5-1. Position of the calculation points along the Plant fence



5.2.6 Calculation of noise maps

Through the calculation model also the noise maps have been generated.

The noise maps represent the sound pressure level curves, generated by the Plant during operation at the quotas of:

- +2 m from the ground level (Annex A)
- +10 m from the ground level (Annex B)

6. Predictive noise limit compliance check

The predictive noise pressure at the sensitive receptors has been calculated by adding the value of the background noise sound pressure to sound level contribution calculated by the model.
The formula used is the following:

$$Lpi_r = 10Log(10^{\frac{Lpe\_r}{10}} + 10^{\frac{Lpf}{10}})$$

Where:

- Lpi_r is the predicted noise pressure value at the 'r' sensitive receptor
- Lpe_r is the Sound level contribution of the Plant at the 'r' sensitive receptor
- Lpf is the current back ground sound level

The calculation outcomes are shown in the Table 6-1

Table 6-1: predicted noise pressure at the sensitive receptors and "post – operam" noise limits compliance check

ID Receptor	Reference period	Applicable limit	"Ante operam" sound pressure LAeq [dB(A)]	"Ante operam" noise limits compliance check	Sound level contribution LAeq [dB(A)]	***Predicted noise ("post operam") pressure value LAeq [dB(A)]***	***Predicted ("post operam") noise limits compliance check***
Work-day							
R1	Day time	55	49.8		32,5	49,88	
	Night time	45	47,1		32,5	47,25	+0,15 dB (A)
R2	Day time	55	72,6		38,0	72,60	+0,00 dB (A)
	Night time	45	62,4		38,0	62,42	+0,02 dB (A)
R3	Day time	55	48,1		34,9	48,30	
	Night time	45	40,0		34,9	41,17	
R4	Day time	70	53,6		42,7	53,94	
	Night time	70	57,3		42,7	57,45	
R5	Day time	55	36,2		31,8	37,55	
	Night time	45	39,4		31,8	40,10	
Weekend							
R1	Day time	55	43,4		32,5	43,74	
	Night time	45	49,0		32,5	49,10	+0,10 dB (A)
R2	Day time	55	72,8		38,0	72,80	+0,00 dB (A)
	Night time	45	59,2		38,0	59,23	+0,03 dB (A)
R3	Day time	55	43,9		34,9	44,41	
	Night time	45	33,9		34,9	37,44	
R4	Day time	70	56,4		42,7	56,58	
	Night time	70	57,2		42,7	57,35	
R5	Day time	55	35,6		31,8	37,11	
	Night time	45	34,2		31,8	36,17	

7 Conclusions

The assessment of the acoustic impact associated with the New CCGT has been carried out applying a predictive mathematic model to the actual project data.
The calculation has been performed in accordance with the calculation models defined in the ISO 9613-2 standard. The calculation was performed through the SoundPlan software after setting the model parameters.

The sensitive receivers that are more exposed to the new Power Plant operation noise have been detected.
The current noise level pressure at the said sensitive receiver have been assessed by an acoustic survey.
The applicable reference noise limit are prescribed by The Sanitary Norms N2-III-11.3.

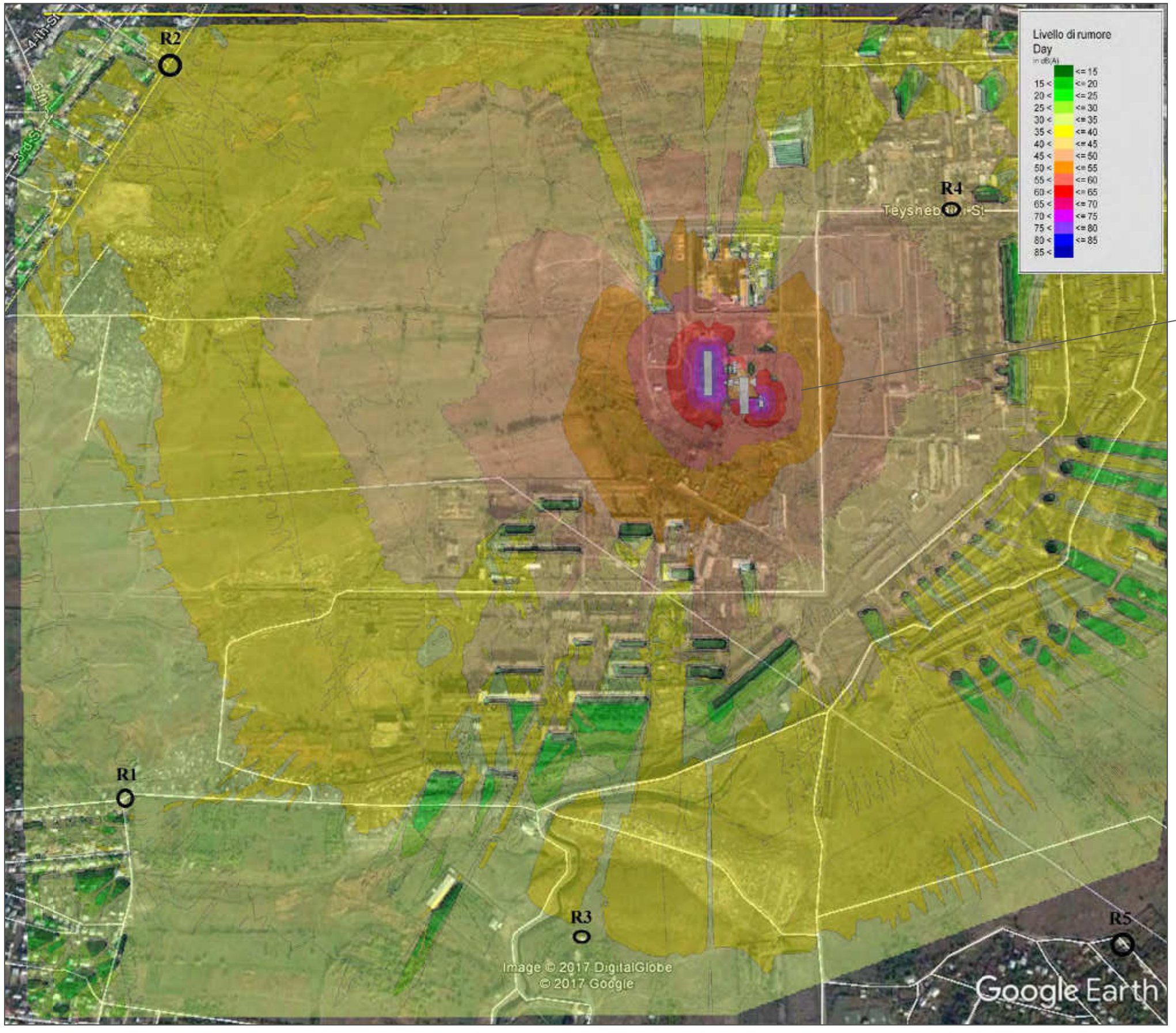
The final calculation outcomes has shown the compatibility of the New CCGT operation with the applicable noise limits.
The New CCGT operation will not produce any significant increase of the noise pressure at the sensitive receptors. In particular:

- where the current noise pressure is under the applicable limits, the New CCGT operation will not produce any exceedance of the said limit either during the daytime or during the night time
- where the current noise pressure is already over the applicable limits, the New CCGT operation will produce a negligible contribution

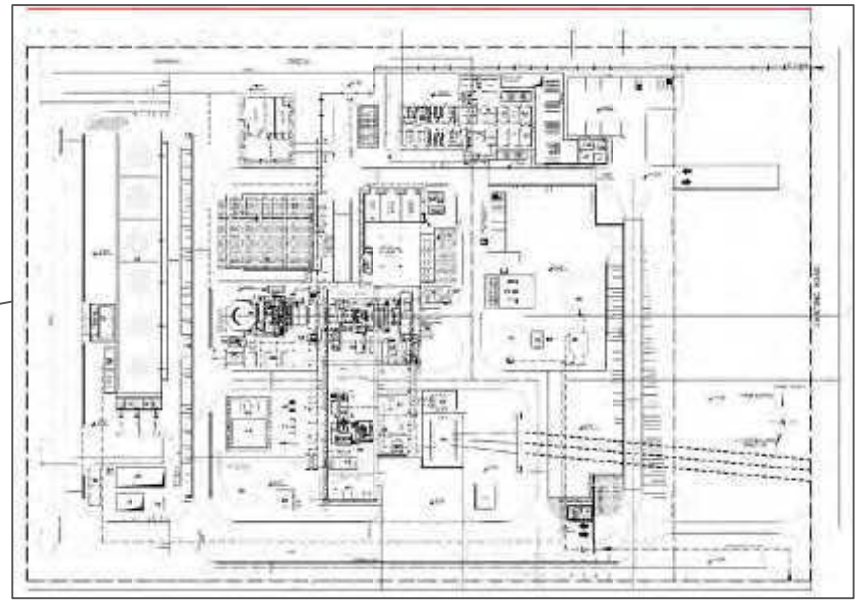
As last consideration, it has to be underlined that, although at the CCGT fence no sensible receivers are present, the Sound level contribution of the New CCGT operation will be significantly below the applicable industrial areas noise limits.

8. Annexes

Annex A – noise map at +2m
Annex B – noise map at +10m



0 100 500 1000 m

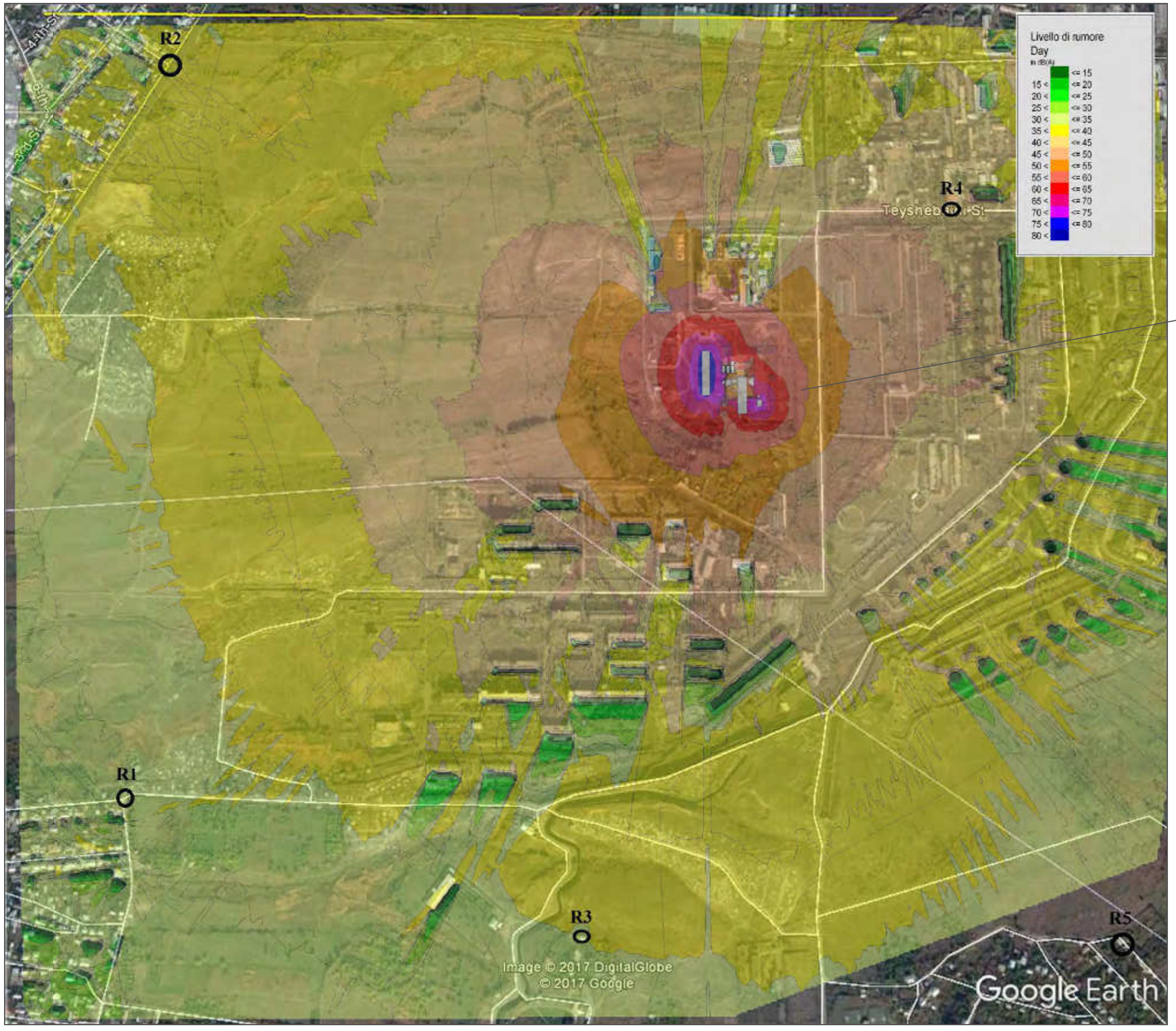


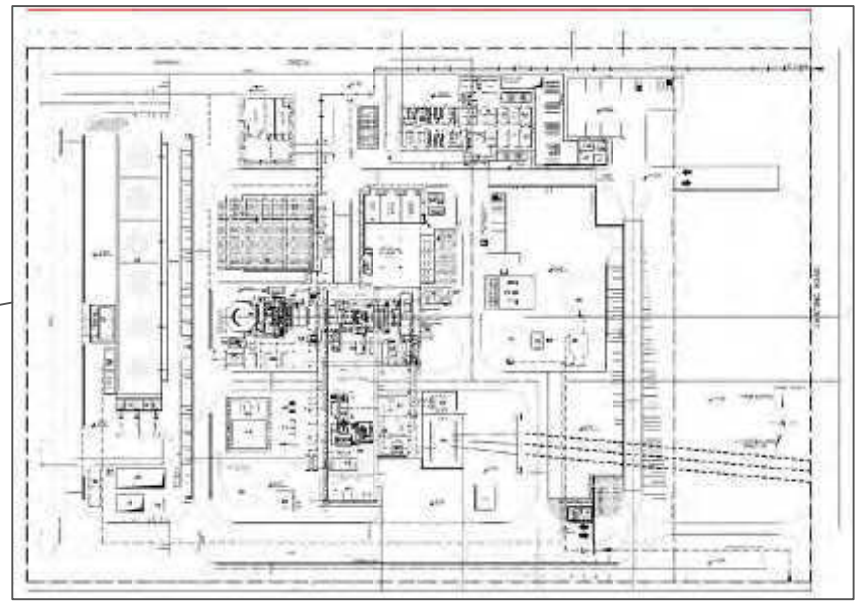
Plant layout

Item	Source	L_{WA} [Octave] [dB(A)]
HRSG	Lateral Walls	71
	Roof	71
Air Intake GT	Intake	77
HRSG Diffusor	All surfaces	70
Main Machine Building (GT, ST)	All surfaces	80
Stack	External surfaces	75
	Mouth	80
Close cycle heat exchanger	All surfaces	75
Cooling Towers	All surfaces	80
Main Transformer	All surfaces	80
Units Transformer	All surfaces	75
Fuel Gas Boostar Compressors Building	All surfaces	80
Auxiliary Boiler	All surfaces	80

Most relevant Noise emission items considered in the Plant project

	Annex A
	Noise emissions - 2 m height noise map





Plant layout

Item	Source	Lp(A) [distance] [dB(A)]
LRSG	Lateral Walls	71
	Roof	71
Air Intake GT	Intake	77
HRSG Diffusor	All surfaces	70
Main Machine Building (GT, ST)	All surfaces	80
Stack	External surfaces	75
	Mouth	80
Close cycle heat exchanger	All surfaces	75
Cooling Towers	All surfaces	80
Main Transformer	All surfaces	80
Units Transformer	All surfaces	75
Fuel Gas Booster Compressors Building	All surfaces	80
Auxiliary Boiler	All surfaces	80

Most relevant Noise emission items considered in the Plant project

0 100 500 1000 m

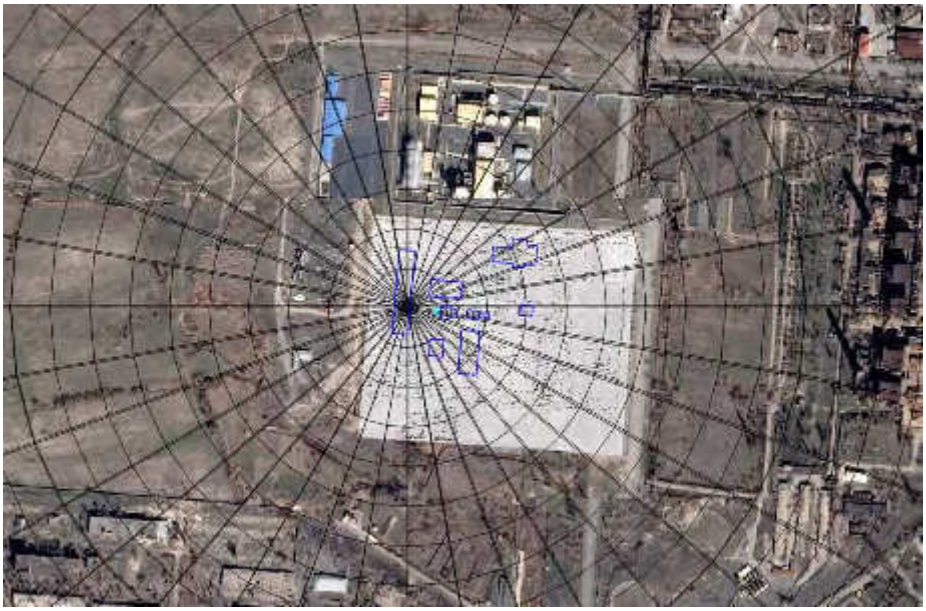
	Annex B
	Noise emissions - 10 m height noise map

13.5 Air Dispersion Calculation

Draft Report
August 2017

Yerevan 2 CC Power Plant
Armpower SJSC

Air Dispersion Calculation



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Rev No.	Rev-date	Contents /amendments	Prepared/revised	Checked/released
0	18.08.2017	Draft Report for incorporation into the Draft ESIA	Sousa	Heinold
1				
2				

Disclaimer

Table of Contents

List of tables

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List of abbreviations and acronyms

AQS = Air Quality Standard(s)
CC = Combined Cycle
CO = Carbon Monoxide
ECD = European Council Directive(s)
ELV = Emission Limit Values
IFC = International Finance Corporation
MAC = Maximum Allowable Concentration
masl = meters above sea level
NG = Natural Gas
NO_2 = Nitrogen Dioxide
PP = Power Plant
WB = World Bank
YCCPP = Yerevan Combined Cycle Power Plant

1. Scope of the Report

The Ministry of Energy (MOE) of the Republic of Armenia plans to improve the total output capacity of its electric energy production, complementing the power units of the existing Yerevan Combined Cycle Power Plant (YCCPP-1) with a more modern and efficient power plant. For this reason a new gas fired Combined Cycle Power Plant of 234 MWe (YCCPP-2) is planned to be built at the site next to the existing YCCPP-1.

To obtain financing from the International Financing Corporation (IFC), a bankable Environmental and Social Impact Assessment (ESIA) Report to the YCCPP-2 ("the Project") on the basis of the relevant World Bank Group's guidelines has to be delivered to IFC for review and approval.

Fichtner is providing Technical Advisory Services to Armpower SJSC ("Project Company"), including the elaboration of the bankable ESIA. The present report presents the Air Dispersion Calculation performed for the Project, and is part of the ESIA.

The objective of the study is to assess the contribution of the air emissions of the YCCPP-2 to the air quality in the area, and to indicate whether the national and international air quality standards are expected to be fulfilled or not. The assessment ultimately leads to the determination of the conditions required to fulfill these standards. The criteria pollutants CO and NO_2 are subject of analysis in this context.

The Air Dispersion Calculation is performed using the dispersion modeling software BREEZE AERMOD (version 7.12.1.0 from 2017), based on a U.S. EPA (United States Environmental Protection Agency) Regulatory Model.

2. Project Site

The YCCPP-2 will be located in the city of Yerevan, Armenia, nearby the existing YCCPP-1 in an industrial area (Figure 2-1 and Figure 2-2). The coordinates of the site center are approximately:

- Northing: 40° 6'48.06"N;
- Easting: 44°29'49.55"E;
- Zone: 38T (WGS 84).

Noragvit (a residential district of Yerevan) is located approx. 1,350 m to the west, Ayntap (a major village in the Ararat Province) is located approx. 1,500 m to the south west, Kharberd (another major village in the Ararat Province) is located 1,200 m to the south, and the nearest residential areas of the Erebuni District are located approx. 1,200 m north east. Right at the vicinity of the site there are some temporary houses, as well as former industrial buildings and the local Fire Service.

Nearby the Project site, there is one non-operational power plant and many other active industrial plants:

- "Plant of Pure Iron" OJSC
- "Armenian Molybdenum Production" LLC
- "Nairit 1" and "Nairit 2" Chemical Plants
- Others

The site is located close to the Erebuni Airport, and the E 117 highway.

Although the present study focus on the impacts of the Yerevan - 2 PP on the air quality, it would be necessary to consider as well the emissions of the existing neighboring plants, road and airport for a complete analysis. Since there is a large number of air emission sources in the area, and it is not possible to obtain data for all of them, a baseline air quality assessment has been undertaken. Please see Section 4.5 for further details.

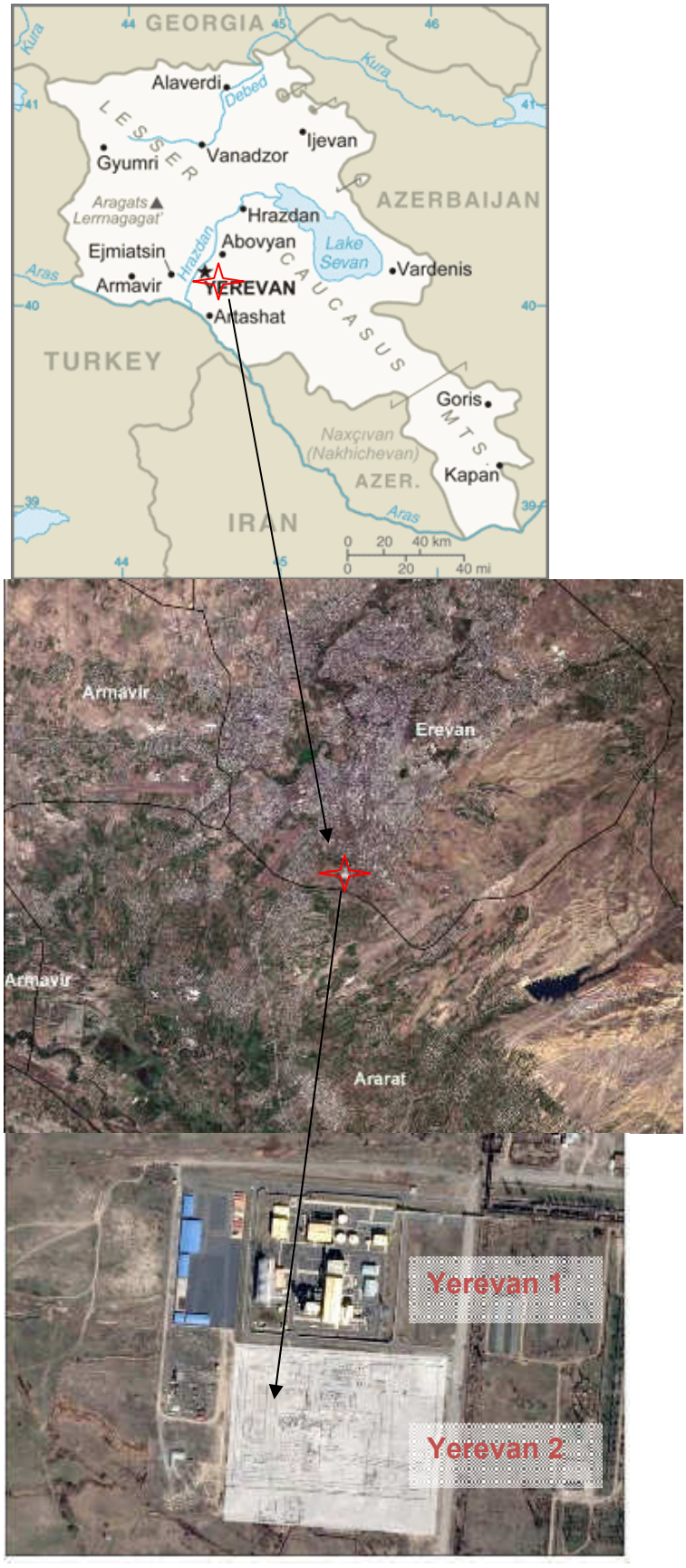


Figure 2-1: Location of the future Yerevan - 2 PP (source of the topographic map: URL 1)

Figure 2-2: Overview of the immediate surroundings of the Yerevan Power Plants 1 and 2

3. Air Emissions and Air Quality Legislation

In order to protect human health, vegetation and/or properties from the negative effects of air pollution, limits are imposed to:

- the concentrations of the pollutants that are emitted from various sources - air emission limits; *and to*
- the concentrations of the pollutants that are present in the atmosphere - air quality standards.

In several countries these limits (or standards) are defined in the national laws/regulations, but there are also internationally accepted values like the ones from the World Bank Group Guidelines or the European Union Directives.

The air emission limits represent the maximum concentrations that are allowed in the flue gas coming out of the source (a stack, in this case) and are given in mg of pollutant per normal m^3 of dry flue gas (mg/Nm^3). The N stands for "Normal conditions": temperature of 0°C and atmospheric pressure of 101.3 kPa.

The air quality standards (AQS) state the maximum concentrations that are allowed in the ambient air, in this case, in the airshed surrounding the power plant. The standards are presented in µg of pollutant per m^3 of ambient (exterior) air ($\mu g/m^3$). For gaseous pollutants, the results of the air quality monitoring shall be standardized at a temperature of 293 K (20°C) and an atmospheric pressure of 101.3 kPa.

This chapter presents the national and international standards for air emissions and for air quality that are applicable to the project.

3.1 Air Emission Limits

The International Finance Corporation (IFC, World Bank Group) defined emission guidelines (EG) for facilities with a power input larger than 50 MW_{th} using gas turbines (Table 3-1).

Pollutant	EG for combustion turbines; facilities > 50 MW_{th}
	Natural Gas
NO_2	51 mg/Nm^3
Dry gas, excess O_2 content	15%
Temperature flue gas	0°C

Table 3-1: IFC emission guidelines for facilities larger than 50 MW with combustion turbines (IFC, 2008)

There are no national air emission limits for thermal power plants. The specifications for Yerevan 2 demand the compliance with the performance guarantee values for CO, NO_2 and Unburned Hydrocarbons (UHC) as shown in Table 3-2.

Pollutant	Performance Guarantees
CO	30 mg/Nm^3
NO_2	50 mg/Nm^3
UHC	10 mg/Nm^3
Dry gas, excess O_2 content	15%
Temperature flue gas	0°C
Load	From 70% to 100%

UHC: Unburned Hydrocarbons

Table 3-2: Performance Guarantees for YCCPP-2 - air emissions

The performance guarantee values for NO_2 comply with the IFC emission guidelines. No emission guidelines are defined by IFC for CO. For the project at hand, and based on the specific natural gas composition, the emissions of UHC may include pollutants such as methane (85 to 96% of the gas us composed of methane), ethane, propane, butane, and pentane. IFC does not define emission guidelines for UHC in general nor for any of the listed chemicals in particular.

3.2 Air Quality Standards

The Air Quality Standards are defined according to the different levels of danger that the pollutants pose depending on the exposition period. This way, the standards are defined for different time frames, allowing the protection against the short term acute impacts, the medium term impacts and the long term impacts.

IFC states that emissions from projects shall not result in pollutant concentrations in the ambient air that reach or exceed the relevant ambient air quality guidelines and standards by applying the national legislated standards or, in their absence, the World Health Organization (WHO) Guidelines or other internationally recognized sources like the U.S. EPA (United States Environmental Protection Agency) or the European Council Directives (ECD).

The IFC recommends, in addition, that the emissions from a single project should not contribute with more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same airshed. This implies that even when a ground level concentration (GLC) of a certain pollutant respects the air quality standard, it shall be evaluated whether it is below or above 25% of that standard. This is also assessed in the present study.

Table 3-3 presents the national ambient air quality standards, or MAC - maximum allowable concentrations (established by Governmental Decree Nr. 160-N of 2 February 2006), and the standards defined by the European Council Directive 2008/50/EC that are applicable to the project.

Pollutant		Averaging period	Air Quality Standards [µg/m³]	
			National MAC	ECD
CO		Short-time	5,000	-
		24 hours	3,000	-
		Max. daily 8 hour mean	-	10,000
NO_2		Short-time	200	-
		1 hour	-	200 *Not to be exceeded more than 18 times per year*
		24 hours	40	-
		1 year	-	40
UHC	Methane	-	-	-
	Ethane	-	-	-
	Propane	-	-	-
	Butane	Short-time	200,000	-
	Pentane	Short-time	100,000	-
		24 hours	25,000	-
PM_{10}		Maximum	300	-
		24 hours	60	50 *Not to be exceeded more than 35 times per year*
		1 year	-	40
SO_2		Maximum	500	-
		1 hour	-	350 *Not to be exceeded more than 24 times per year*
		24 hours	50	125 *Not to be exceeded more than 3 times per year*

Table 3-3: National and ECD Ambient Air Quality Standards

The ECD 2008/50/EC does not set a limit for the type of UHC that are expected from natural gas operation (methane, ethane, propane, butane, and pentane). The limits shown in Table 3-3 for butane and pentane are based on the national legislation, but seem to be overly permissive. In fact, the national air quality monitoring network does not measure hydrocarbons

(WHO, 2003), for what there is not a real experience on the application of the standards for UHC. Given this, these standards will not be used in the present ADC, and **focus will be provided on CO and NO_2**.

Although PM_{10} and SO_2 are not expected to be emitted by the YCCPP - 2, these standards are mentioned as they are of importance for the air quality baseline assessment shown in Section 4.5.

It shall be noted that the national MAC for 24 hr NO_2 of 40 μg/m³ corresponds to the ECD limit for annual averages. This implies that the national MAC is very stringent when compared to the international standards.

4. Baseline Data

4.1 Affected area and receptors

The air quality standards considered in this study are defined for protection of human health. Given this, the study will focus particularly on the analysis of the air quality effects in areas where human presence exists. An area of 314 km^2 around the power plant is defined as the eventually affected area for air pollution impacts. This includes the neighboring settlements up to 10 km in all directions counting from the stack of the YCCPP-2 (Figure 4-1).

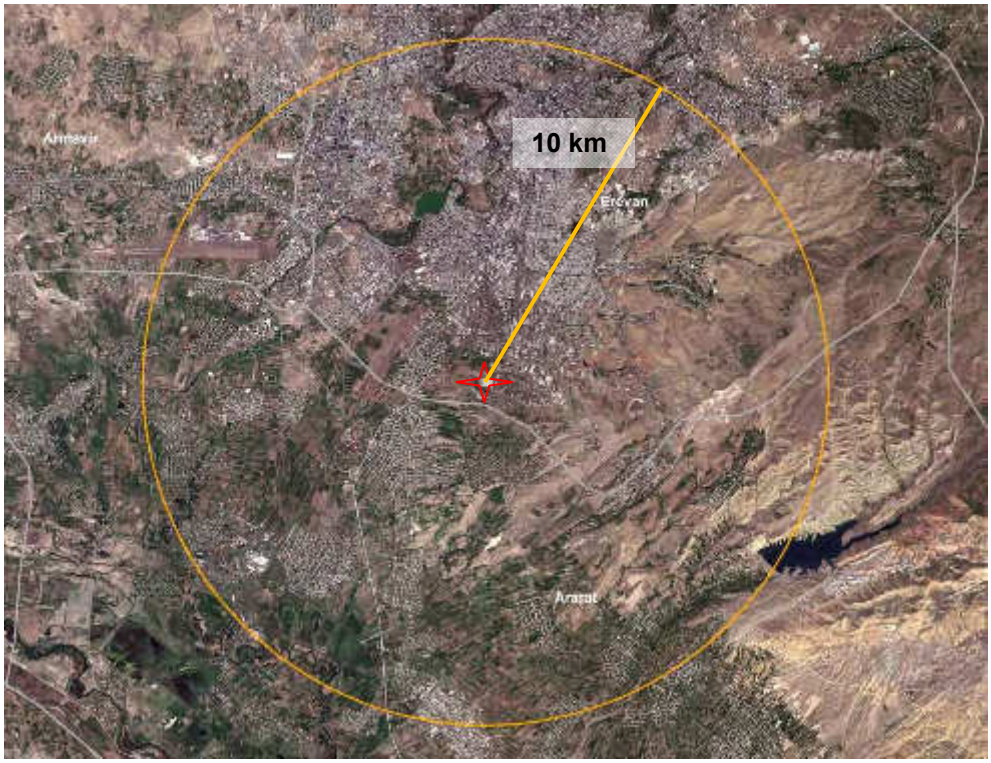


Figure 4-1: Location of the affected area

In the direct proximity of the power plant (up to 1 km), there are some temporary informal houses to the northeast and southeast, deactivated industries and the local Fire Services to the southwest, a non-operational power plant to the east and agricultural fields/pastures to the west and northwest (Figure 4-2).

Figure 4-2: Closer view of the affected area

4.2 Meteorological Data

To conduct the Air Dispersion Calculation, recent meteorological data from a monitoring station located nearby the project site (Zvartnots Airport) have been analyzed. The data set includes information such as wind speed and direction, cloud cover, temperature, sensible heat flux, surface roughness, etc.

Figure 4-2 presents the windrose for the years 2014 to 2016. It shows that the prevailing winds blow from northeast (NE). The windrose also indicates that the more frequent wind speeds are between 1.5 and 3 m/sec, which is equivalent, in the Beaufort scale, to the levels “light air” and “light breeze”.

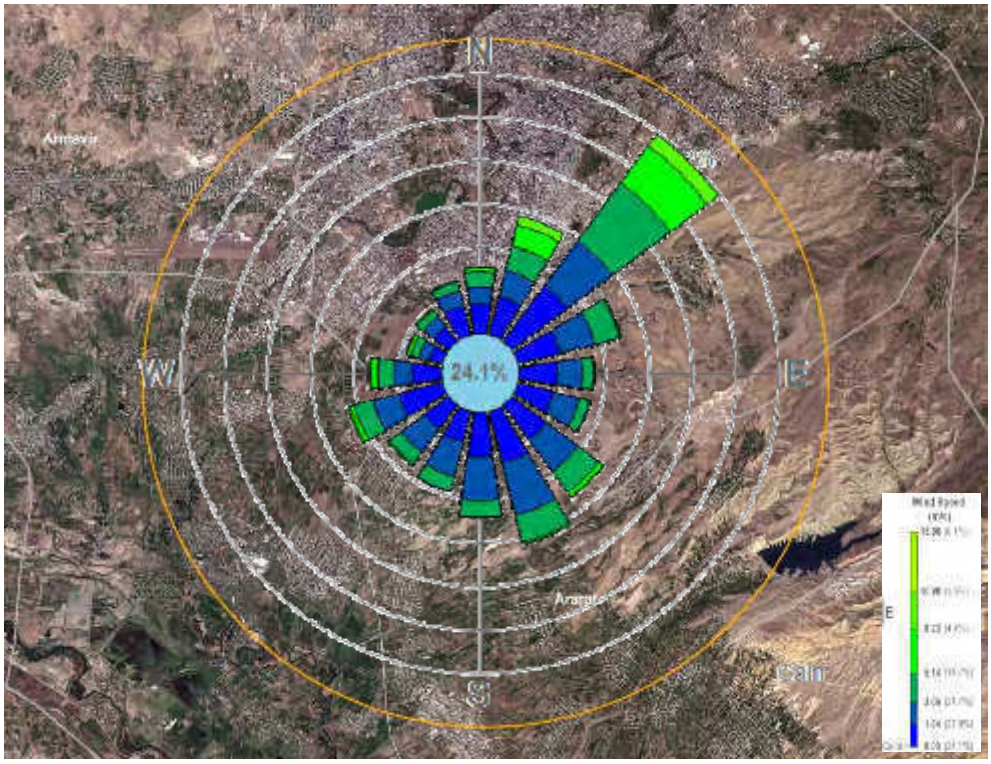


Figure 4-3: Windrose for the years 2014-2016 (wind blowing from)

4.3 Terrain data

To account for the different heights above sea level of the sensitive receptors and the plants, terrain data were acquired. These allow a 3D representation of the terrain of the assessment area and a more accurate simulation of the pollutants' distribution. Figure 4-4 shows a representation of the area's terrain.

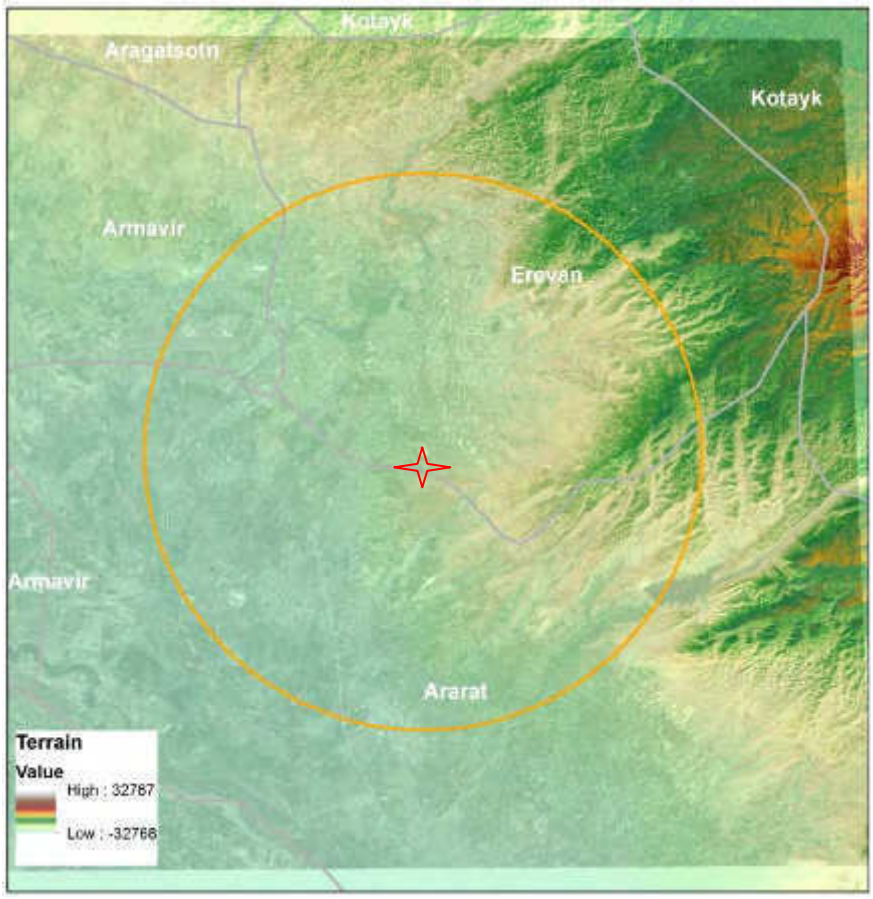


Figure 4-4: Representation of the terrain of the affected area

The project site is located at a height of ca. 930 masl. The terrain and the immediate surroundings are generally flat. Around 3 km to the east of the plant the terrain becomes more elevated where the Gegham mountains begin (Figure 4-5).


YCCPP 1
YCCPP 2
Gegham Mountains
Non-operational PP
Plant of
Pure Iron

Figure 4-5: Landscape/terrain at the site and its surroundings (Fichtner, July 2017)

4.4 Emission Data

To the date of writing this report, emission data of YCCPP-1 and forecast emission data for YCCPP-2 could be obtained (see Table 4-1). Complete data for other neighboring plants could not be obtained. If possible, the remaining plants will be considered in a later version of this ADC.

Parameter	YCCPP 2		YCCPP-1	
	Value	Source	Value	Source
Number of stacks	1	Tender specifications/RENCO	1	Site visit
Location of stacks [m; WGS 84, Zone 38T]	Easting: 457,128		Easting: 457,150	
	Northing: 4,440,461		Northing: 4,440,617	
Height of stacks [m]	35		45	
Diameter of stacks (inner) [m]	6.23		6.7	
Flue gas exit temperature [K]	370		399	
Flue gas exit velocity [m/s]	20		19	
Actual* flue gas exit flow [m^3/s] per stack	606		670	Calculated based on information collected during the site visit
Concentration CO [mg/Nm³] dry, 15% O2	30		0.86	RENCO
Concentration NO_2 [mg/Nm³] dry, 15% O2	50		43.4	
Concentration UHC [mg/Nm³] dry, 15% O2	10		-	-
Emission rate CO [g/s] per stack	12.4	Calculated based on information provided by RENCO	0.4	Calculated based on information provided by RENCO
Emission rate NO_2 [g/s] per stack	20.6		18.0	
Emission rate UHC [g/s] per stack	4.1		NA	-

* Actual means at the actual conditions of temperature, pressure, moisture and O_2 content of the flue gas

Table 4-1: Emission data for YCCPP-2 and YCCPP-1

4.5 Baseline Air Quality Data - Summer

A baseline air quality assessment has been undertaken in the Project area, as well as in the areas where the highest pollution levels resulting from the operation of the YCCPP - 2 are expected.

The primary objective of this assessment was to determine if the Project's airshed is degraded or non-degraded. A degraded airshed is one where the applicable air quality standards are exceeded (IFC, 2007). With this objective, the ground level concentrations (GLC) of PM_{10}, SO_2 and NO_2 have been monitored in 5 different locations as shown in Figure 4-6.

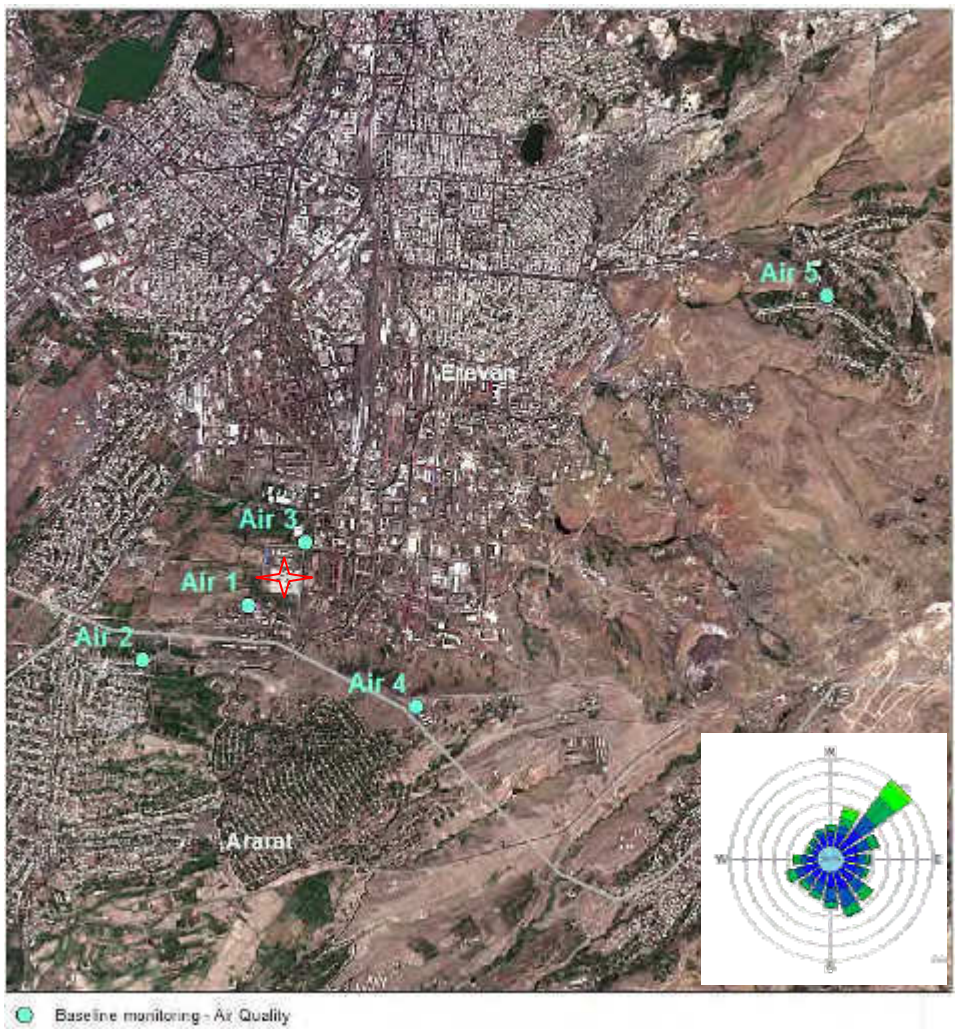


Figure 4-6: Baseline Monitoring Points - Air Quality

The measurement point Air 1 is situated in industrial area near the southeast border of YCCPP - 1, between the fire brigade and an abandoned production facility. The measurement point Air 2 is placed approx. 1,700 m to the south-west of YCCPP - 2; it is located near the northeast border of Ayntap community between the cemetery and private cultivated gardens. Points Air 1 and Air 2 are located downwind the main wind direction. The measurement point Air 3 is placed in an industrial area near the northern border of the YCCPP - 2. In points Air 1, Air 2 and Air 3 all pollutants

(PM_{10}, SO_2 and NOx) have been monitored. Although PM_{10} and SO_2 are not expected to be emitted by the YCCPP - 2, it is important to determine their concentrations to assess whether the airshed is degraded or not.

The points Air 4 and Air 5 have been defined after one test model run, being located in the areas where the highest GLC of NO_2 resulting from the operation of YCCPP - 2 are expected. For this reason, in these points only NO_2 has been measured.

4.5.1 PM_{10}

The complete reports of the measurements of PM_{10} can be find in Annex 1 to this ADC.

The dust concentration was measured by using the dust particle meter DT-96 in accordance with the GOST 17.2.4.05-83 - "Environmental protection. Atmosphere. Gravimetric method for determination of suspended dust particles".

The equipment has collected 5 daily measurements of 5 minutes along 5 days between 27.07.2017 and 05.08.2017 (Summer). The results are presented in Table 4-2. They show that the national and international air quality standards are presently respected in the area.

Point	Temp. [°C]	Relative humidity [%]	PM_{10} [µg/m³] - average 5 mins	Air Quality Standards [µg/m³]			
				National MAC		ECD	
				Max.	24 hr	24 hr	1 yr
31.07.2017							
Air 1	38	20	14	300	60	50	40
	38	21	11				
	38	20	10				
	39	19	10				
	38	19	11				
Air 2	39	22	20				
	39	20	41				
	39	20	21				
	39	21	21				
	38	20	19				
Air 3	38	22	22				
	38	21	17				
	39	21	13				
	39	20	13				
	38	19	16				
01.08.2017							
Air 1	37	22	13	300	60	50	40
	37	21	10				
	38	21	11				

Point	Temp. [°C]	Relative humidity [%]	PM_{10} [µg/m³] - average 5 mins	Air Quality Standards [µg/m³]			
				National MAC		ECD	
				Max.	24 hr	24 hr	1 yr
	38	19	12				
	38	21	14				
Air 2	38	20	20				
	39	19	16				
	39	19	18				
	39	20	19				
	39	21	20				
Air 3	37	23	27				
	38	21	23				
	38	20	11				
	39	20	16				
	38	21	25				
02.08.2017							
Air 1	38	20	14				
	38	21	11				
	39	21	17				
	39	20	10				
	37	22	9				
Air 2	39	20	20				
	40	18	18				
	39	19	17	300	60	50	40
	40	19	17				
	39	21	20				
Air 3	39	21	42				
	39	22	37				
	39	20	31				
	38	19	23				
	38	20	27				
03.08.2017							
Air 1	37	20	13				
	38	21	9				
	38	21	10				
	39	20	11				
	39	19	9				
Air 2	38	23	13				
	39	22	10				
	39	19	11	300	60	50	40
	39	20	12				
	39	20	14				
Air 3	38	19	9				
	38	20	11				
	39	20	12				
	38	19	13				
	38	19	12				

Point	Temp. [°C]	Relative humidity [%]	PM_{10} [µg/m³] - average 5 mins	Air Quality Standards [µg/m³]			
				National MAC		ECD	
				Max.	24 hr	24 hr	1 yr
05.08.2017							
Air 1	38	20	12	300	60	50	40
	39	21	10				
	39	20	12				
	39	18	11				
	38	19	11				
Air 2	37	22	11				
	38	21	19				
	38	22	13				
	39	19	36				
	38	19	10				
Air 3	37	23	9				
	39	22	8				
	39	19	14				
	39	19	12				
	38	20	12				

Table 4-2: Baseline air quality measurement results - PM_{10}

4.5.2 SO_2 and NO_2

The baseline concentration of gases (SO_2 and NO_2) in the project area has been measured with diffusion tubes. The tubes have been placed in monitoring points Air 1 to Air 5 for 7 days. The resulting GLC has been determined in the Laboratory of Environmental Monitoring and Information Center of the Ministry of Nature Protection (* The points Air 4 and Air 5 have been defined after one test model run, being located in the areas where the highest GLC of NO_2 resulting from the operation of YCCPP - 2 are expected Table 4-3 and Table 4-4). They show that the national and international air quality standards are presently respected in the area.

Point	NO_2 [µg/m³] - average 7 days	Air Quality Standards [µg/m³]			
		National MAC		ECD	
		Max.	24 hr	1 hr	1 yr
Air 1	16.0	200	40	200	40
Air 2	11.9				
Air 3	21.3				
Air 4 *	20.1				
Air 5 *	9.2				

* The points Air 4 and Air 5 have been defined after one test model run, being located in the areas where the highest GLC of NO_2 resulting from the operation of YCCPP - 2 are expected

Table 4-3: Baseline air quality measurement results - NO_2

Point	SO_2 [µg/m^3] - average 7 days	Air Quality Standards [µg/m³]			
		National MAC		ECD	
		Max.	24 hr	1 hr	24 hr
Air 1	19.4	500	50	350	125
Air 2	22.1				
Air 3	28.4				

Table 4-4: Baseline air quality measurement results - SO_2

4.5.3 Conclusion and future work

The results show that the airshed surrounding the future YCCPP - 2 can be classified as **non-degraded** regarding the pollutants PM_{10}, SO_2 and NO_2. New monitoring campaigns will be however undertaken in Autumn, Winter and Spring to capture the seasonal variations in the pollutant's GLC, and reinforce or adapt this conclusion. The Air Dispersion Calculation and the ESIA will be updated based on these results.

The results of the baseline monitoring, once completed over an entire year, will be used to accurately assess the "before-the-project" scenario. In a later version of this ADC, the results of the simulation of the impact of YCCPP-2 will be added to the baseline monitoring results to obtain a realistic future scenario.

5. Air Dispersion Calculation

5.1 Air Quality Model

The Air Dispersion Calculation was performed using the dispersion modeling software BREEZE AERMOD, version 7.12 (January 2017), which predicts pollutant concentrations from continuous point, flare, area, line, volume and open pit sources. This steady-state plume model is a US-EPA Regulatory Model.

The simulations performed with BREEZE AERMOD for each of the pollutants CO and NO_2 result in worst case scenarios, that is, the software outputs the maximum concentrations expected to be found in the area due to the operation of the plants.

One of the objectives of the ADC is determining the height that the stacks of the plant shall have so that the national and international air quality standards (AQS) are fulfilled at the next receptor points in every scenario. In a first instance, it is assumed that a height of **35 meters** as planned will be sufficient to assure a proper dispersion of the air pollutants emitted.

5.2 Calculation Scenarios

Altogether 3 scenarios are simulated:

- one where only YCCPP-1 is operating (indicative baseline scenario, or Scenario **A**);
- one where only YCCPP-2 is operating (Scenario **B**),
- and one where both plants are operating (indicative future scenario, indicative cumulative scenario, or Scenario **C**).

Once one complete year of baseline air quality data, and/or data for existing surrounding sources are available (see Sections 4.4 and 4.5), Scenario A will be complemented.

5.3 Buildings and downwash effects

The term „building downwash“ describes the effect that wind flowing over or around buildings has on pollutant plumes released from nearby stacks. Essentially, buildings create a cavity of recirculating winds in the area near the buildings, and these building cavities cause increased vertical dispersion of plumes emitted from stacks on or near the buildings. Building downwash often leads to elevated concentrations downwind of affected stacks (Wanger, A., 2011).

For the present ADC, a 3D model of the main buildings of both power plants YCCPP-1 and YCCPP-2 has been set up and included in the model in order to account for eventual downwash effects.

5.4 ADC Results

This Section contains the results of the simulations performed with BREEZE AERMOD for each of the pollutants CO and NO_2 for all the different averaging periods for which the standards are defined.

The results are presented in the form of:

- Tables showing the **maximum simulated ground level concentrations** (GLC) in the assessment area for all scenarios. The respective comparison with the Air Quality Standards is made. The tables show in addition the percentage of the AQS which the maximum GLC represent.

- **Plot maps** of the maximum simulated GLC for Scenario C.

It is **important to note** that the results shown represent maximum GLC. The maximum GLC are expected in different times and locations for each scenario. This implies that there is not a direct correlation between the maximum GLCs simulated for the three scenarios.

5.4.1 CO - Short-time and 1 hour AQS

The national legislation defines a short-time AQS/MAC for CO of 5,000 µg/m³. There is not a definition of "short-time" in the national legislation, for what in this study the comparison is made with the simulated 1-hour values. The ECD does not define a 1-hour AQS for CO.

The comparison of the model results with the national MAC shows that this is expected to be respected throughout the entire assessment area in all scenarios (Table 5-1). The contribution of YCCPP-2 represents less than 25% of the applicable AQS (i.e., 1.9%), being in line with IFC's recommendation for a future sustainable development in the area.

The concentration plots (Figure 5-1 and Figure 5-2) show that the absolute cumulative maximum of 93.9 µg/m³ is found in the industrial areas to the east and southeast of the power plants' area.

Time period	CO maximum modeled GLC [µg/m³]	Air Quality Standards [µg/m³]	
		National MAC	ECD
SCENARIO A - Only YCCPP-1			
1 hour / Short time	2.0	5,000	-
SCENARIO B - Only YCCPP 2			
1 hour / Short time	92.5 ***% of the AQS:*** *1.9%*	5,000	-
SCENARIO C - YCCPP-1 + YCCPP 2			
1 hour / Short time	93.9	5,000	-

Standard is not exceeded Standard is exceeded

Table 5-1: Maximum simulated 1 hr CO GLC and comparison with the air quality standards

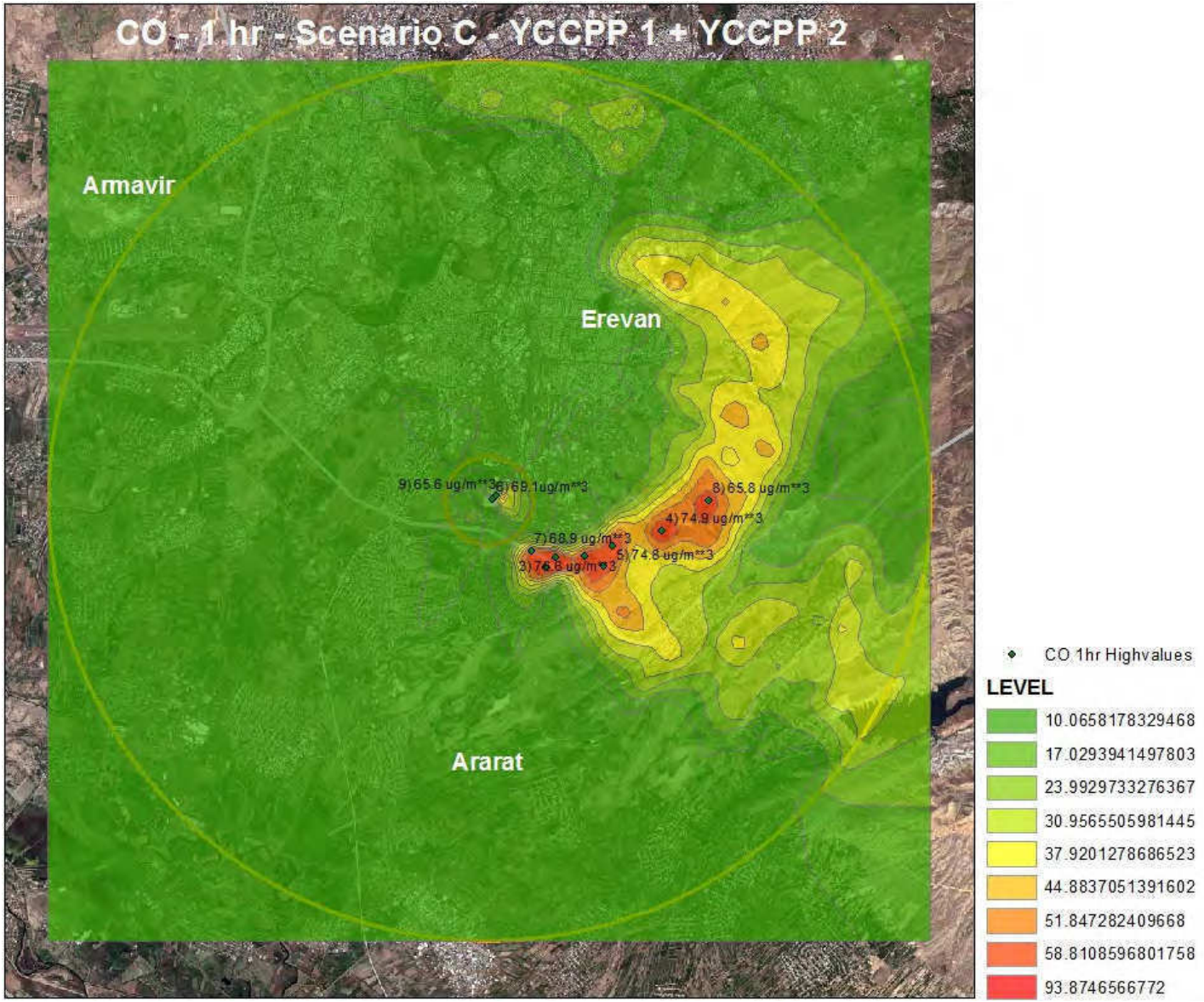


Figure 5-1: Maximum simulated 1 hr CO GLC - cumulative effects - YCCPP-1 + YCCPP 2

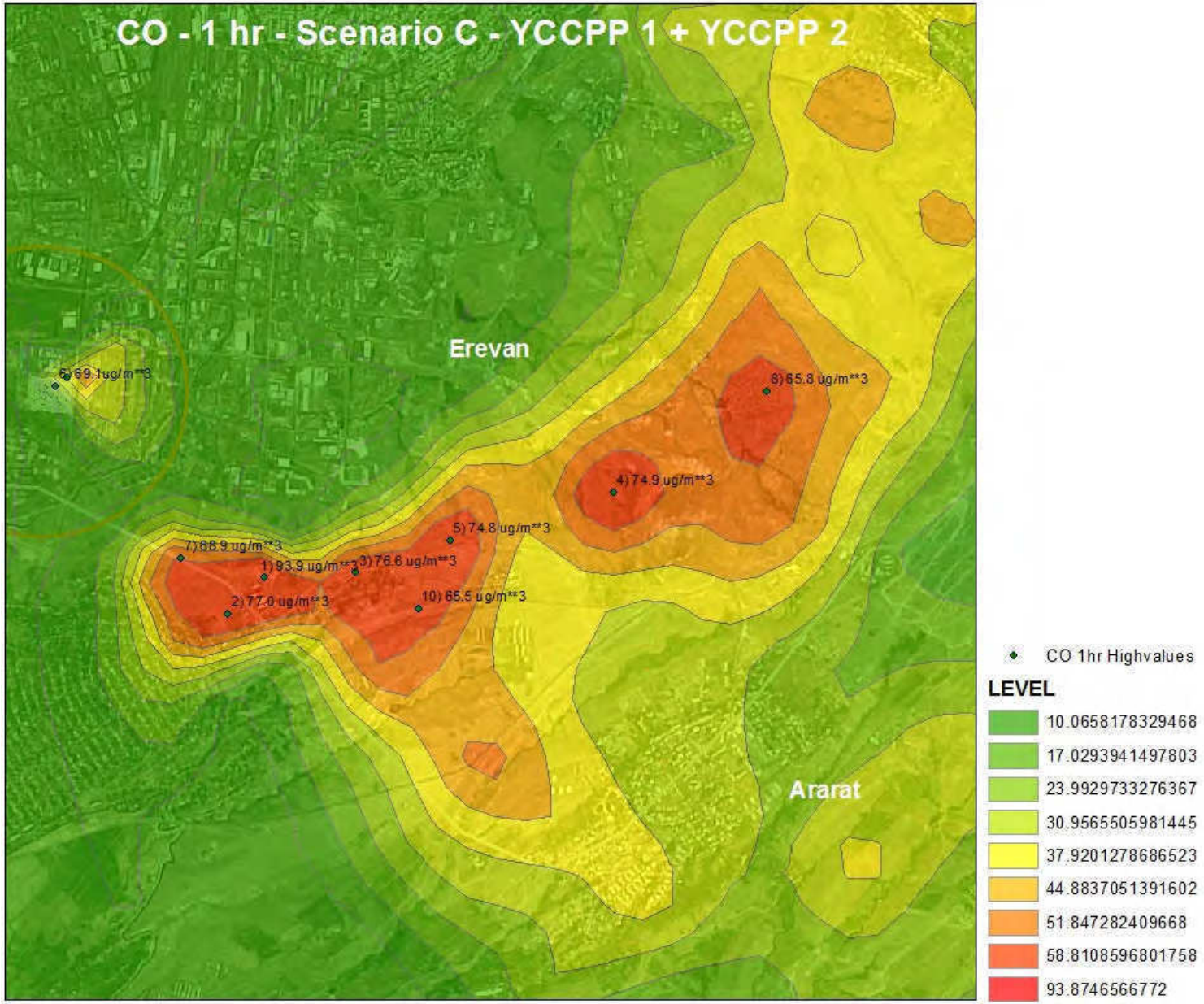


Figure 5-2: Maximum simulated 1 hr CO GLC - cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values

5.4.2 CO - 8 hours AQS

The ECD defines an 8-hours air quality standard for CO, unlike the Armenian legislation. The model results (Table 5-2) show that no difficulties are expected regarding fulfillment of this standard in any of the scenarios.

The contribution of YCCPP-2 represents less than 25% of the applicable AQS (i.e., 0.6%), being in line with IFC's recommendation for a future sustainable development in the area.

Time period	CO maximum modeled GLC [µg/m³]	Air Quality Standards [µg/m³]	
		National MAC	ECD
SCENARIO A - Only YCCPP-1			
8 hours	0.98	-	10,000
SCENARIO B - Only YCCPP 2			
8 hours	59.5 ***% of the AQS:*** *0.6%*	-	10,000
SCENARIO C - YCCPP-1 + YCCPP 2			
8 hours	60.3	-	10,000

Standard is not exceeded Standard is exceeded

Table 5-2: Maximum simulated 8 hr CO GLC and comparison with the air quality standards

The concentration plots (Figure 5-3 and Figure 5-4) show that the absolute cumulative maximum of 60.3 µg/m³ is found in the industrial areas to the east and southeast of the power plants' area.

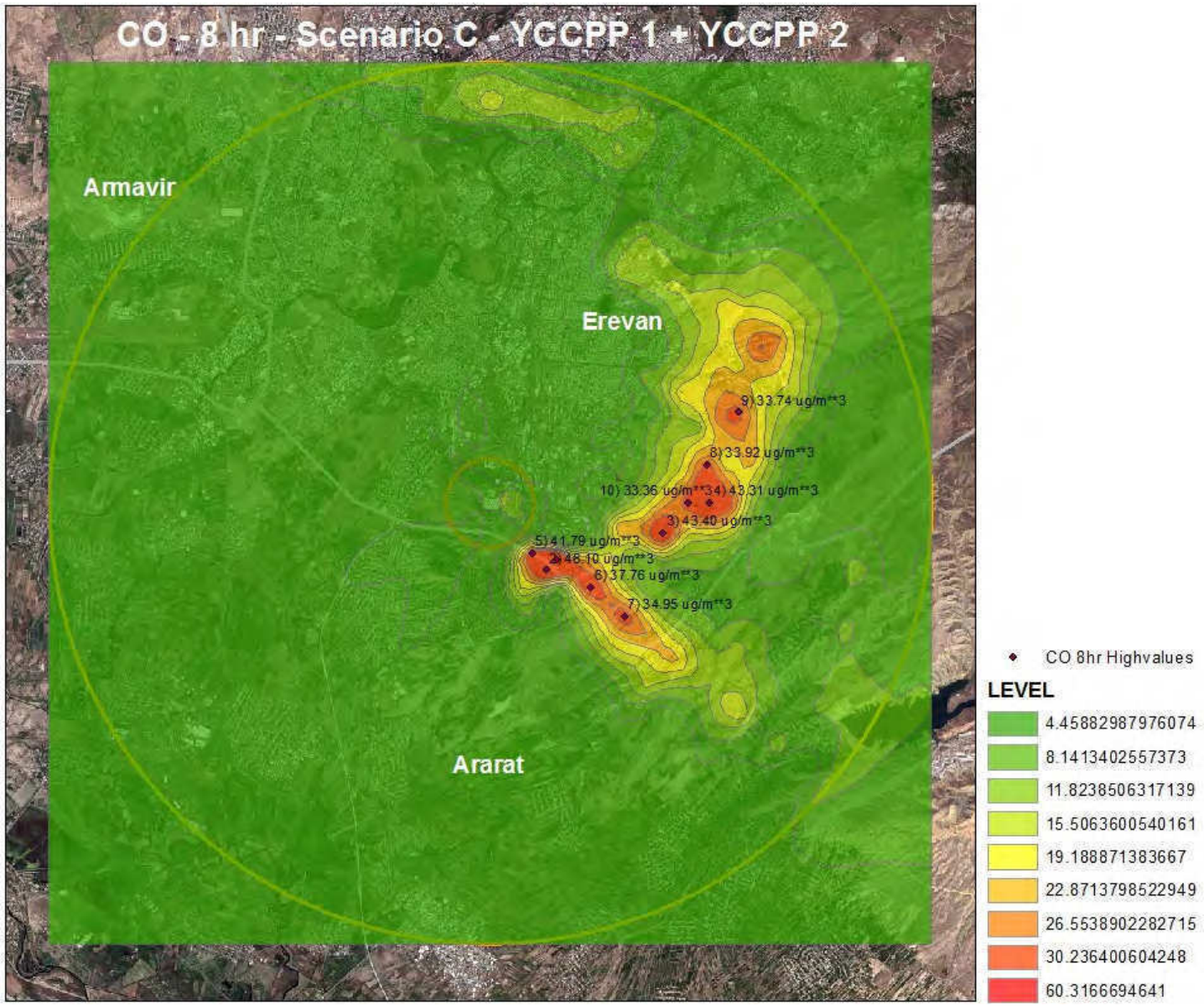


Figure 5-3: Maximum simulated 8 hr CO GLC - cumulative effects - YCCPP-1 + YCCPP 2

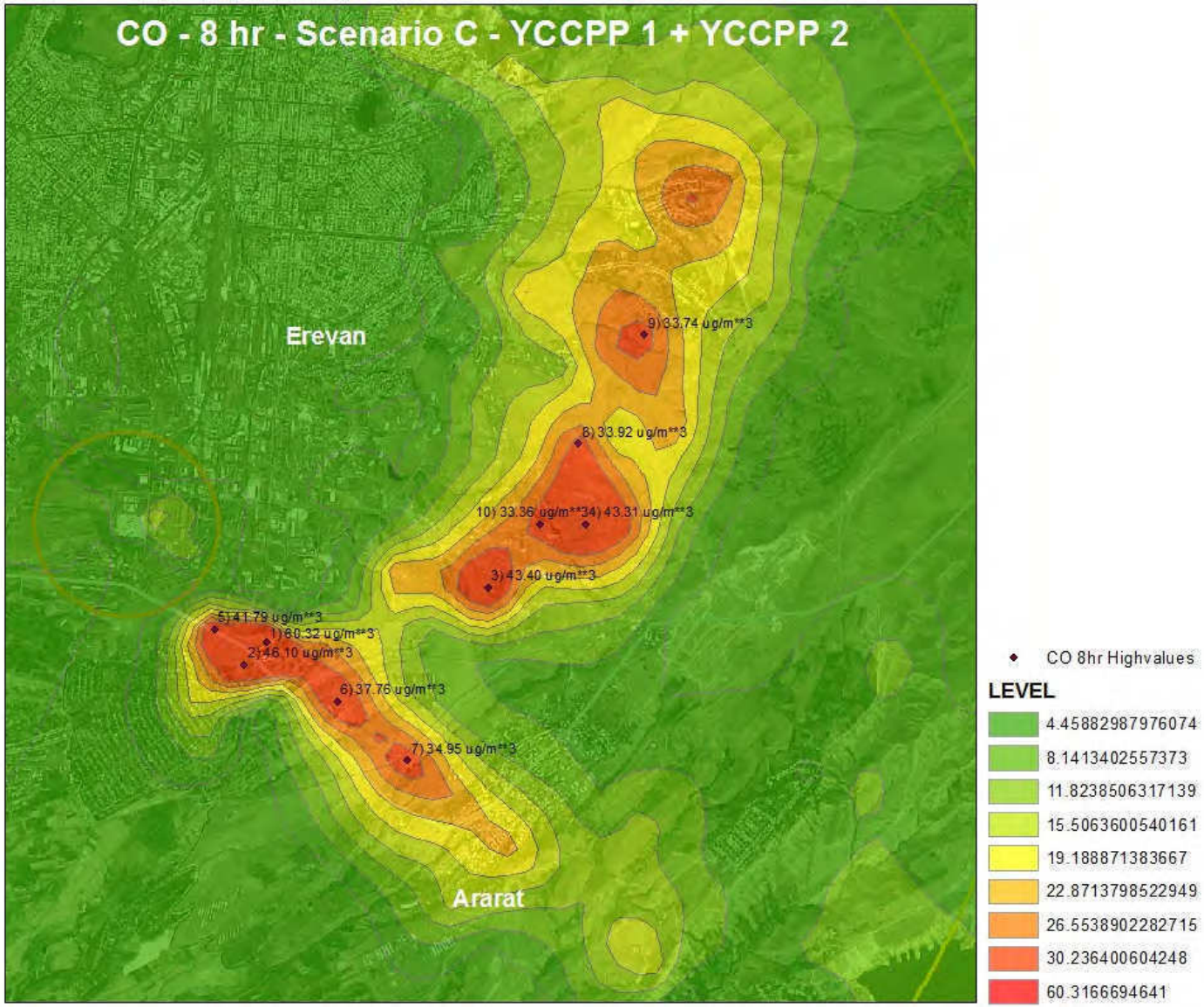


Figure 5-4: Maximum simulated 8 hr CO GLC - cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values

5.4.3 CO - 24 hours AQS

The ECD defined no 24 hours AQS for CO. Regarding the national MAC, the results show that this standard is expected to be respected in the entire assessment area (Table 5-3).

The contribution of YCCPP-2 represents less than 25% of the applicable AQS (i.e., 0.7%), being in line with IFC's recommendation for a future sustainable development in the area.

Time period	CO maximum modeled GLC [µg/m³]	Air Quality Standards [µg/m³]	
		National MAC	ECD
SCENARIO A - Only YCCPP-1			
24 hours	0.6	3,000	-
SCENARIO B - Only YCCPP 2			
24 hours	21.2 ***% of the AQS:*** *0.7%*	3,000	-
SCENARIO C - YCCPP-1 + YCCPP 2			
24 hours	21.6	3,000	-

Standard is not exceeded Standard is exceeded

Table 5-3: Maximum simulated 24 hr CO GLC and comparison with the air quality standards

The maximum 24 hr concentration plots (Figure 5-5 and Figure 5-6) show that the absolute cumulative maximum of 21.6 µg/m³ is found in the residential area east of center Yerevan (Verin Jrashen). This value is, as described above, far below the national MAC and is therefore no reason for concern.

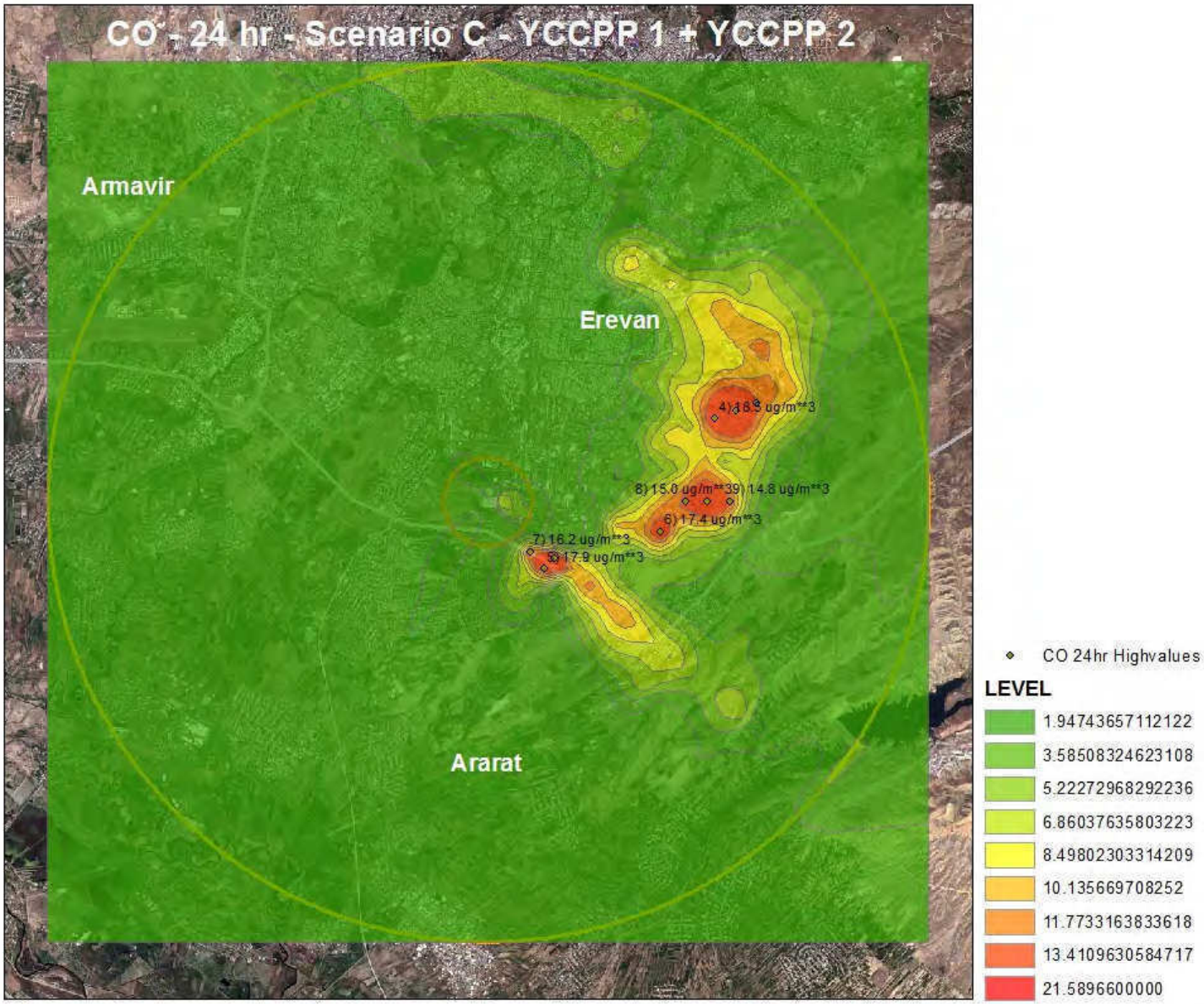


Figure 5-5: Maximum simulated 24 hr CO GLC - cumulative effects - YCCPP-1 + YCCPP 2

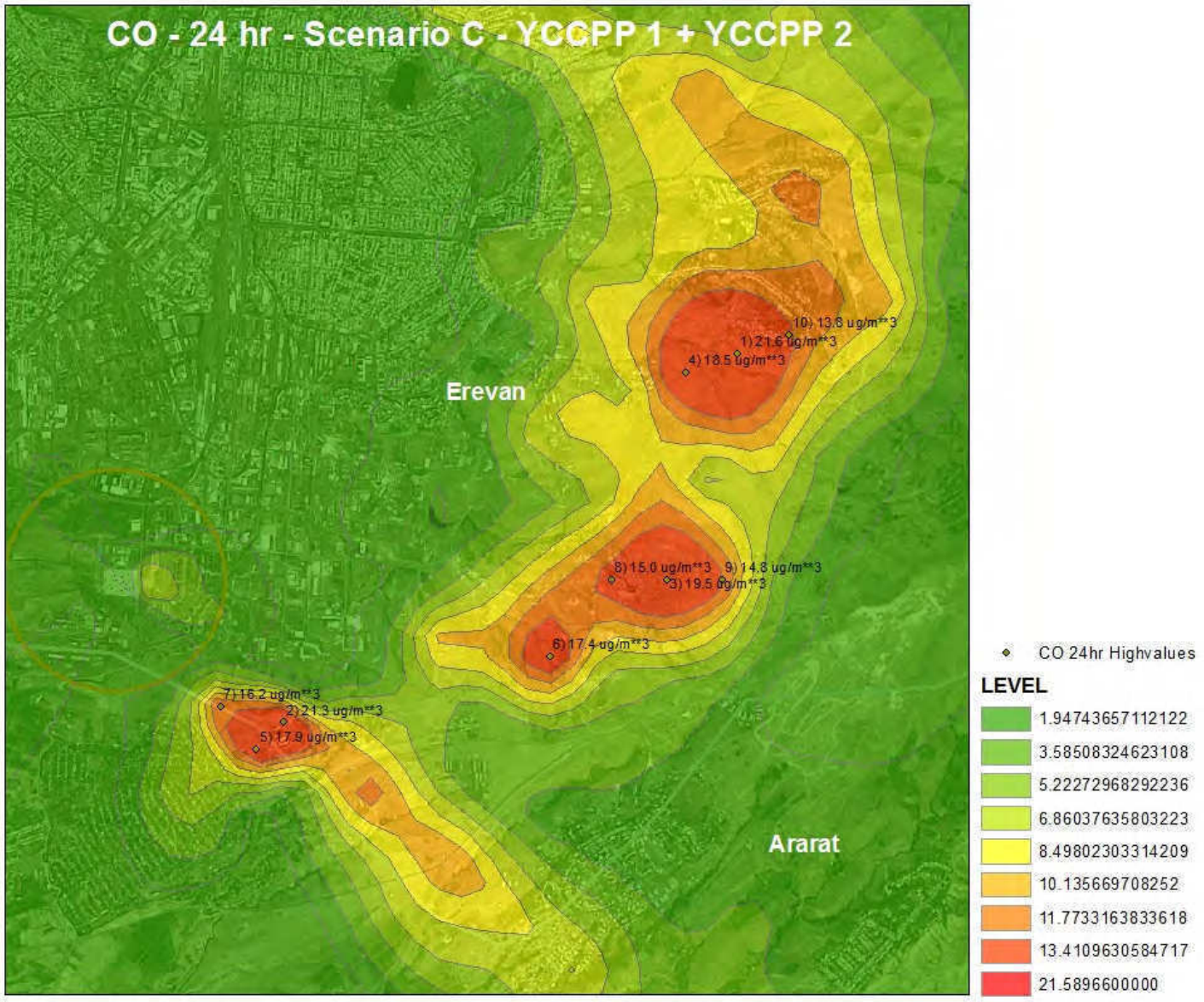


Figure 5-6: Maximum simulated 24 hr CO GLC - cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values

5.4.4 NO_2 - Short-time and 1 hour AQS

The national legislation defines a short-time MAC for NO_2 of 200 µg/m³. There is not a definition of "short-time" in the national legislation, for what in this study the comparison is made with the simulated 1-hour values.

Table 5-4 shows that the maximum modeled 1 hr NO_2 GLCs are expected to be below the national and the international standards throughout the entire assessment area for all scenarios. Specifically regarding Scenario C, the model results show that the cumulative contribution of YCCPP-1 and YCCPP-2 respects the standards.

The results show, however, that the effect of YCCPP-2 is expected to represent more than 25% of the WHO GL (i.e., 61.5%), which goes against the IFC recommendation for a future sustainable development in the area.

Time period	NO_2 maximum modeled GLC [µg/m³]	Air Quality Standards [µg/m³]	
		National MAC	ECD
SCENARIO A - Only YCCPP-1			
1 hour / Short time	71.5	200	200 18 times/year
SCENARIO B - Only YCCPP 2			
1 hour / Short time	123 ***% of the AQS:*** *61.5%*	200	200 18 times/year
SCENARIO C - YCCPP-1 + YCCPP 2			
1 hour / Short time	174	200	200 18 times/year

Standard is not exceeded Standard is exceeded

Table 5-4: Maximum simulated 1 hr NO_2 GLC and comparison with the air quality standards

Figure 5-7 (overview) and Figure 5-8 (close-up) show the maximum cumulative concentration plots (Scenario C). The plots show that the higher values are expected to be found in the industrial areas to the east and to the southeast of the YCCPP-1 and 2. These higher values are, however, below the AQS.

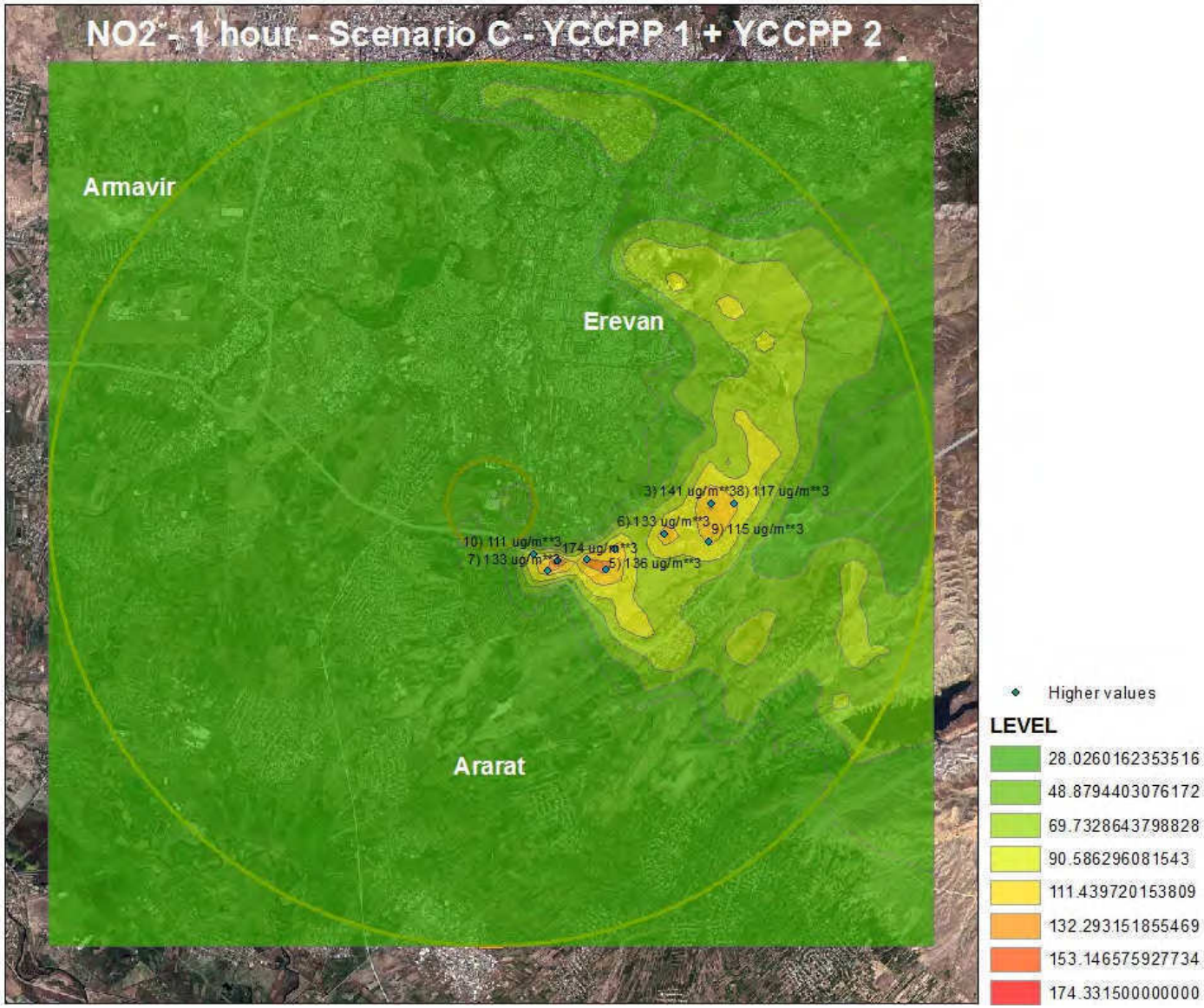


Figure 5-7: Maximum simulated 1 hr NO_2 GLC - cumulative effects - YCCPP-1 + YCCPP 2

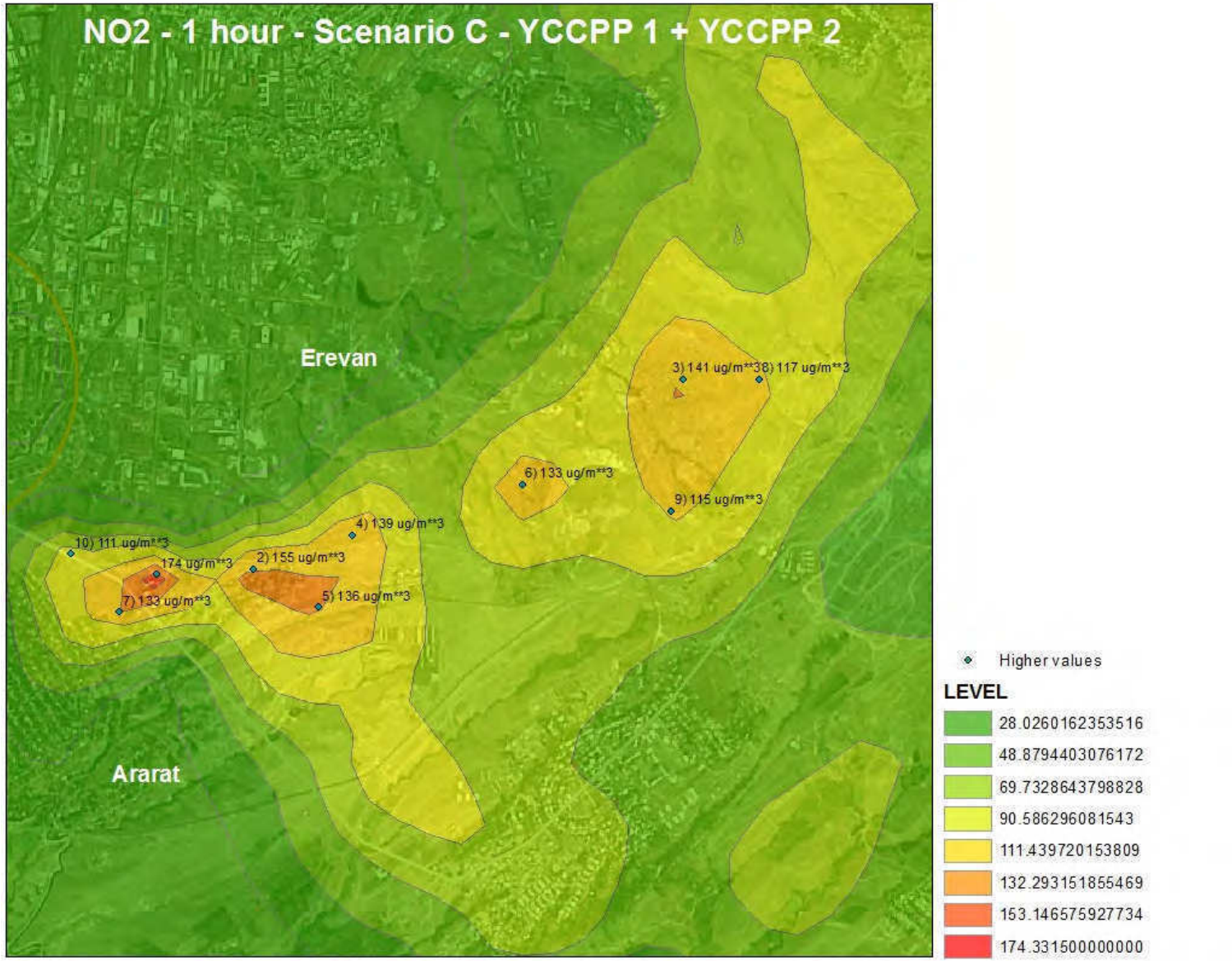


Figure 5-8: Maximum simulated 1 hr NO_2 GLC - cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values

5.4.5 NO_2 - 24 hours AQS

There is no ECD standard for 24 hr NO_2 GLC. The results for the maximum 24 hr NO_2 GLC show that the national MAC is expected to be fulfilled in the area for Scenarios A and B, but not for Scenario C (Table 5-5).

It shall be noted that the national MAC for 24 hr NO_2 of 40 µg/m³ is **very stringent**. When compared to the EU legislation, which was defined based on the guidelines of the World Health Organization (WHO, 2005), the 24 hr national MAC corresponds to the EU's annual limit.

The maximum GLC as a result of the operation of YCCPP-2 (Scenario B) represents more than 25% of the national MAC, which does not allow respecting the IFC recommendation for a future sustainable development in the direct vicinity of the plant.

Time period	NO_2 maximum modeled GLC [µg/m³]	Air Quality Standards [µg/m³]	
		National MAC	ECD
SCENARIO A - Only YCCPP-1			
24 hours	20.1	40	-
SCENARIO B - Only YCCPP-2			
24 hours	28.2 ***% of the AQS:*** *70.5%*	40	-
SCENARIO C - YCCPP-1 + YCCPP-2			
24 hours	42.5	40	-

Standard is not exceeded Standard is exceeded

Table 5-5: Maximum simulated 24 hours NO_2 GLC and comparison with the air quality standards

Figure 5-9 (overview) and Figure 5-10 (close-up) show the maximum GLC plots for cumulative effects (Scenario C). The plots show that the higher values are expected to be found in the areas to the east, to the northeast and to the southeast of the YCCPP-1 and 2. These areas cover industrial sites, but also the residential areas of Verin Jrashen and Mushavan, located to the east of center Yerevan.

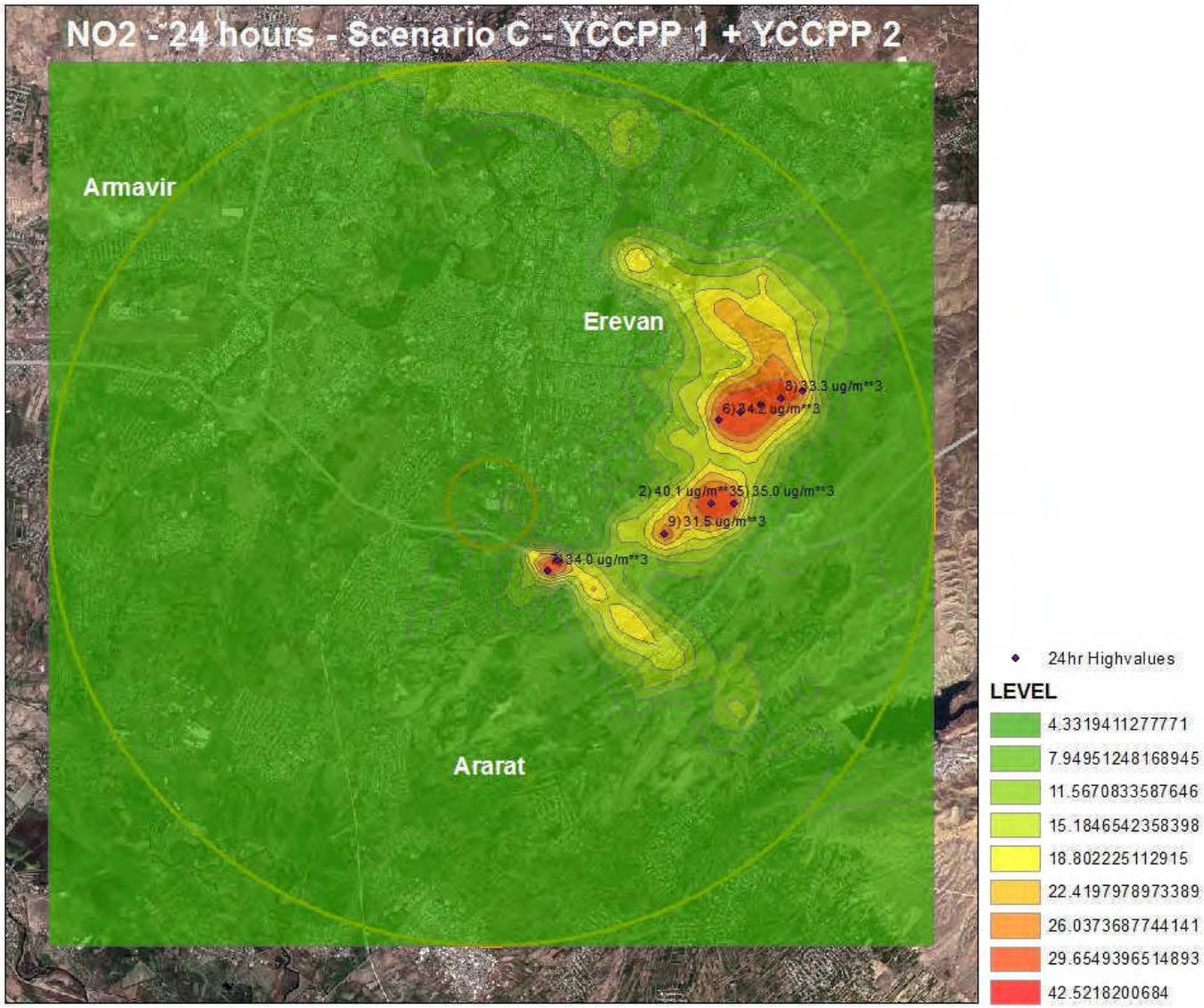


Figure 5-9: Maximum simulated 24 hr NO_2 GLC - cumulative effects - YCCPP-1 + YCCPP 2

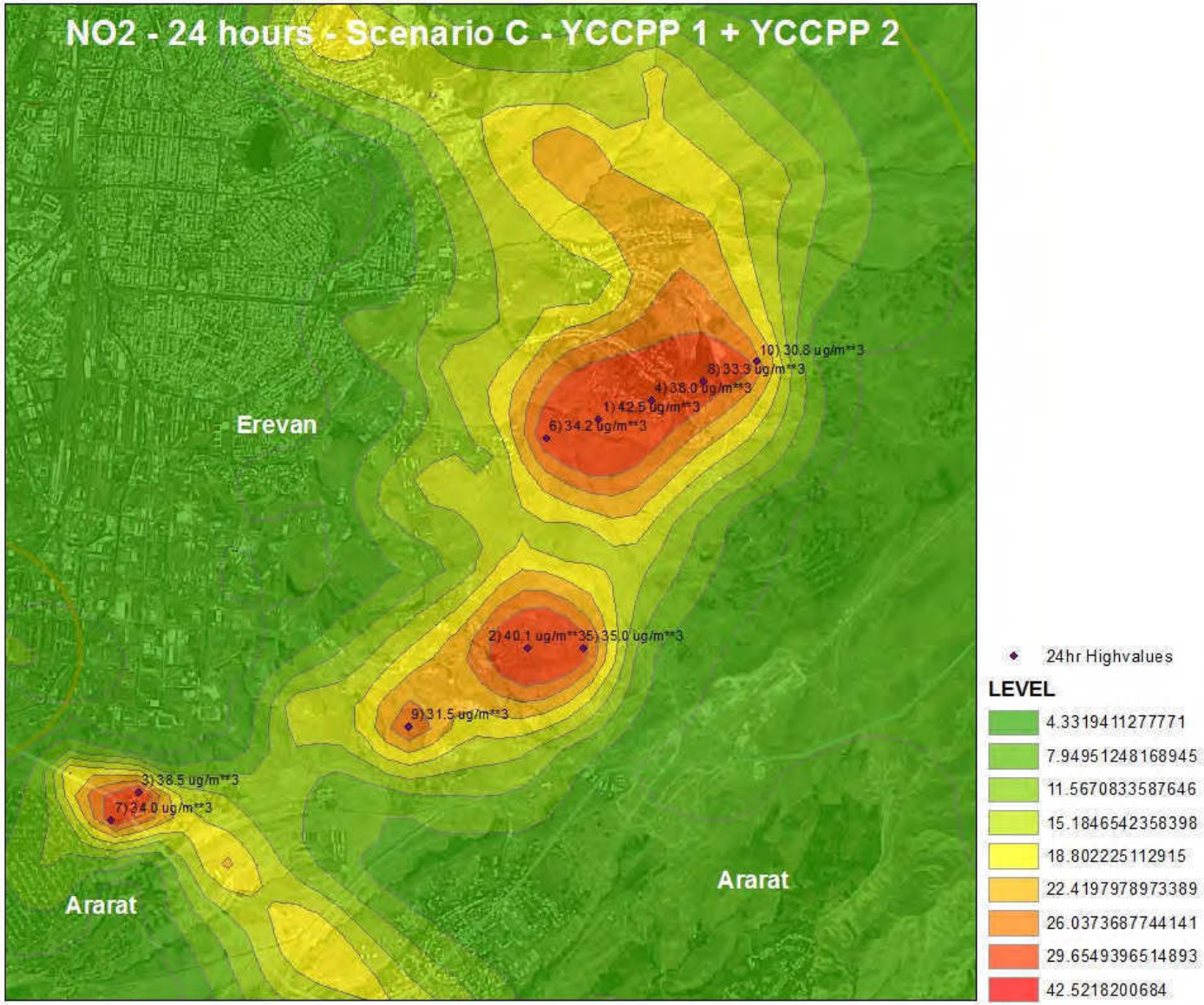


Figure 5-10: Maximum simulated 24 hr NO_2 GLC - cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values

5.4.6 NO_2 - Annual AQS

The predicted annual NO_2 values in the project area are very low. The comparison with the applicable air quality standard (only ECD) reveals that this is not expected to be exceeded (Table 5-6).

The maximum increment in the NO_2 annual mean represents far less than 25% of the ECD AQS, which respects IFC's dispositions regarding future sustainable development in the area.

Time period	NO_2 maximum modeled GLC [µg/m³]	Air Quality Standards [µg/m³]	
		National MAC	ECD
SCENARIO A - Only YCCPP-1			
1 year	0.5	-	40
SCENARIO B - Only YCCPP 2			
1 year	0.8 ***% of the AQS:*** *2%*	-	40
SCENARIO C - YCCPP-1 + YCCPP 2			
1 year	1.2	-	40

Standard is not exceeded Standard is exceeded

Table 5-6: Maximum simulated annual NO_2 GLC and comparison with the air quality standards

Figure 5-11 and Figure 5-12 show the maximum GLC plots for Scenario C (cumulative effects). The plots show that the maximum GLC are expected very close to the power plants.

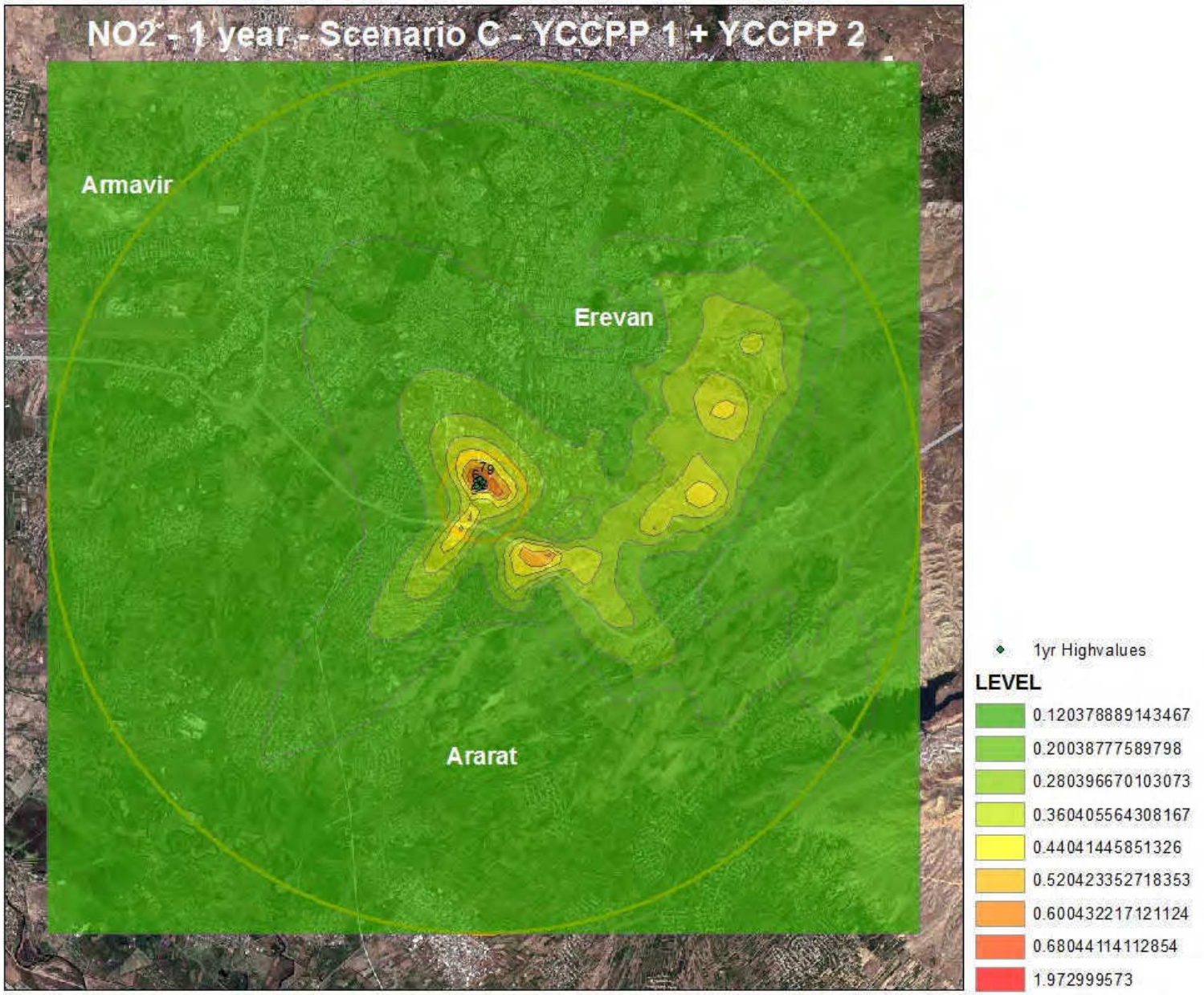


Figure 5-11: Maximum simulated 1 yr NO_2 GLC - cumulative effects - YCCPP-1 + YCCPP 2

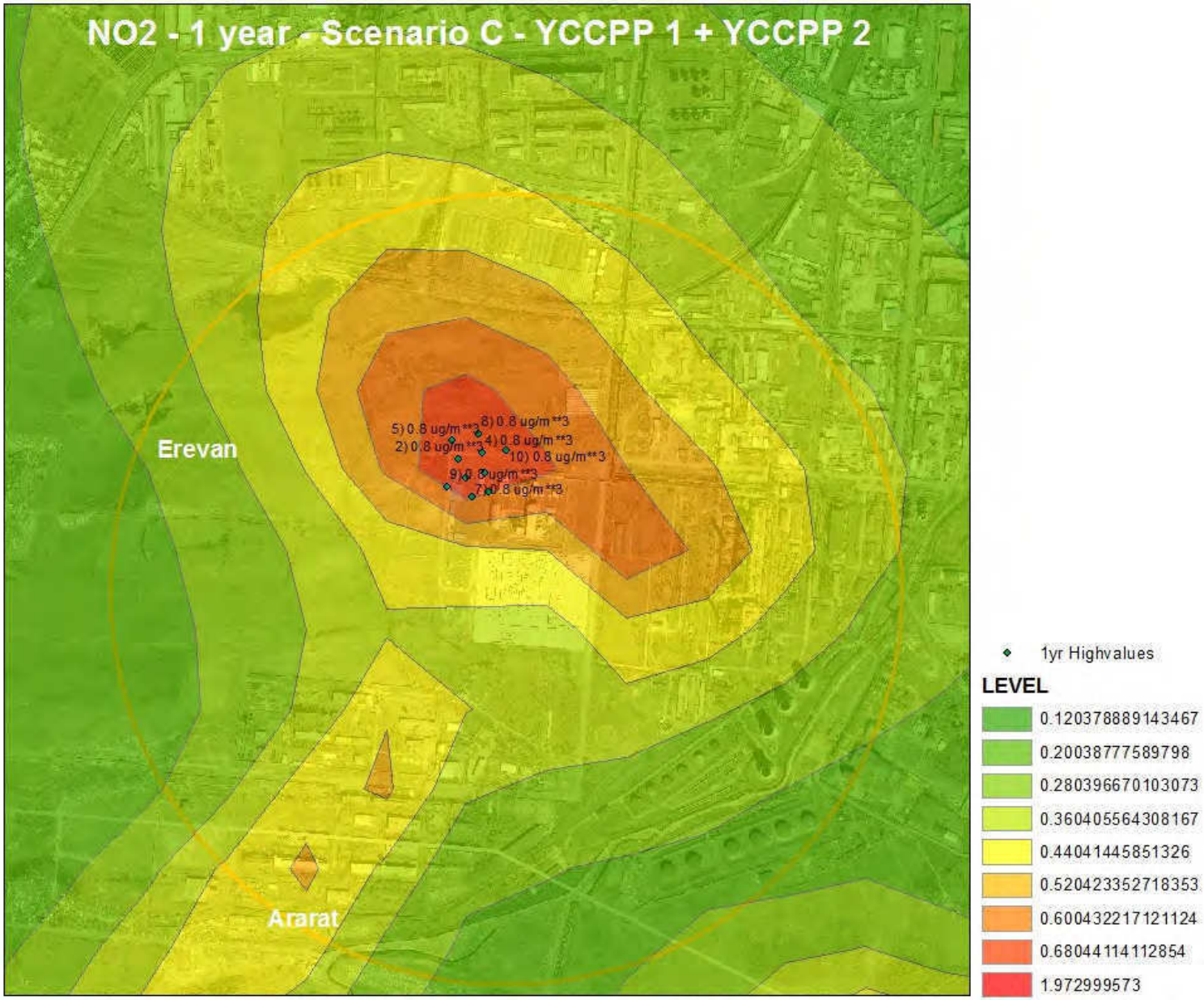


Figure 5-12: Maximum simulated 1 yr NO_2 GLC - cumulative effects - YCCPP-1 + YCCPP-2 - closer view of the higher values

6. Summary of the results

The present ADC allows understanding what is the expected impact of the YCCPP-2 in the airshed of Yerevan.

In respect for international requirements, it is important to understand as well the quality of the airshed before the project is implemented, i.e., the **baseline**. Only this way it is possible to understand the **cumulative impact** of the project. The baseline can be determined in two alternative ways:

a) Data regarding all surrounding industries is made available, and given as an input to the model; the model will then simulate the impacts of the existing industries in the air quality in the area; *or*
b) An air quality monitoring campaign is undertaken at site.

The contribution of other surrounding industries (option a) could not be considered at this stage, due to a lack of important technical and emission data - only data for YCCPP-1 was made available. For this reason, Fichtner undertook a baseline air monitoring in Summer 2017 (option b). However, additional data must be collected in other seasons to complete the set of data and define a "before-the-project" scenario.

To obtain **one first indication about the cumulative effects** of the Project, this ADC considered the contribution of the neighboring YCCPP-1 in the model. For this reason, the present ADC is only considered to be indicative.

Altogether **3 scenarios** were simulated:

- one where only YCCPP-1 is operating (baseline scenario, or Scenario A);
- one where only YCCPP-2 is operating (Scenario B),
- and one where both plants are operating (future scenario, or Scenario C).

The simulation of the 1 hour, 8 hour and 24 hours GLCs for **CO** shows that these are expected to be very low in all scenarios. All CO international and national air quality standards are foreseen to be fulfilled in the area.

The maximum 1 hr, 8 hr and 24 hr GLCs of CO derived from the operation of YCCPP-2 represent less than 25% of all applicable air quality standards.

The maximum modeled 1 hr and annual **NO_2** GLCs are expected to be below the national and the international AQS throughout the entire assessment area for all scenarios.

The maximum modeled 24 hr NO_2 GLC is expected to be above the national MAC for Scenario C, i.e., the scenario that considers the cumulative effects of YCCPP-1 and YCCPP 2. It shall be noted that the national MAC for 24 hr NO_2 of 40 µg/m³ is very stringent, and corresponds to the ECD annual limit.

The maximum modeled 1 hr and 24 hr GLC as a result of the operation of YCCPP-2 only (Scenario B) represent more than 25% of the applicable standards.

7. Conclusion

The ADC presents indicative results of the simulation of the cumulative impact of the YCCPP-2 on the surrounding airshed. These indicative results show that the **national air quality standard for 24hr NO_2 may not be fulfilled** in the area, when considering cumulative impacts. However, **the applicable international standards are expected to be respected.**

A baseline air quality monitoring was undertaken at the surroundings of the power plants' site, and will be complemented in the upcoming seasons. The results will be used as an input for an updated report. Based on the results of the updated report, suggestions for **mitigation measures** to reduce the emissions of NO_2 and fulfill the national 24 ht MAC will be proposed.

8. References

IFC, 2007: *Environmental, Health, and Safety Guidelines - General EHS Guidelines: Air Emissions and Ambient Air Quality*, International Finance Corporation, April 2007

IFC, 2008: *Environmental, Health, and Safety Guidelines for Thermal Power Plants*, International Finance Corporation, December 2008

Wanger, A., 2011: *Dispersion Modeling: new downwash calculations change the playing field, November 2011.* Available at http://www.trinityconsultants.com/Templates/TrinityConsultants/News/Article.aspx?id=3670

9. Annexes

9.1 Annex 1: Noise and PM_{10} Baseline Study

Project: **Environmental and Social Impact Assessment for a Combined Cycle Power Plant - Yerevan 2**

Project №: **8559P01**

Noise and PM10 Baseline Study

Report

Rev01

Prepared for

Fichtner GmbH & Co. KG

Prepared by

"ATMS Solutions" Ltd.

August, 2017

Contents

1. Introduction

Within the Main Contract between ARMPOWER SJSC (hereinafter - Client) and Fichtner GmbH & Co. KG (hereinafter - Employer) the latter has signed a subcontractor agreement with ATMS Solutions Ltd. (hereinafter - Contractor) to conduct the following tasks:

- Task I. Noise measurements
- Task II. PM10[1] measurements
- Reporting.

Noise and PM10 measurement points have been selected by the Employer and presented in Annex 1. Quantities, durations and times (day-time / night-time) of noise and PM10 measurements were also defined by the Employer and presented below in Table 1.

Table 1. Measurement pre-conditions

Measurement point	Measuring parameters	Time of measurement	Quantity, measurements	Duration	Total quantity, measurements
Noise measurements					**20**
Work-day					**10**
Noise 1	Noise, wind speed	Day-time/	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 2	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 3	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 4	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 5	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Weekend					**10**
Noise 1	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 2	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 3	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 4	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
Noise 5	Noise, wind speed	Day-time	1	1 hour	2
	Noise, wind speed	Night-time	1	1 hour	
PM10 measurements					**75**
Air 1	PM10, temperature, RH[2]	Day-time	5 x 5[3]	5 min[4]	25
Air 2	PM10, temperature, RH	Day-time	5 x 5	5 min	25
Air 3	PM10, temperature, RH	Day-time	5 x 5	5 min	25

[1] Particle matters with 10 μm size
[2] Relative humidity
[3] 5 measurements per day during the 5 days
[4] 5 minutes for each measurement

2. Objective of the Study

The objective of the Study is to conduct instrumental measurements of noise levels and PM10 concentrations at the points around the Yerevan 2 Power Plant, which are expected to be impacted during the construction and operation stages. The measurement points have been selected by the Employer (see Annex 1). The study results should be reported to the Employer.

This Noise and PM10 Baseline Study Report (hereinafter - Study Report) provides an overview of the measurement process and equipment, description of the measurement (sensitive) points, noise and dust (PM10) national sanitary standards, a quantitative analysis, assessment of measurement results and main conclusions. The instrumental measurements were conducted between the 27.07.2017-05.08.2017 at five 5 noise and 3 air sensitive points.

3. Measurement Methodology and Equipment

3.1 Measuring Equipment and Software

3.1.1 Noise Measurement

Instrumental measurements of noise levels are performed using a Sound Level Meter (SLM) "WS1361". The SLM consists of a microphone, electronic circuits and a readout display. The microphone detects the small air pressure variations associated with sound and transforms them into electrical signals. Afterwards, these signals are processed by the electronic circuitry of the instrument. The readout displays the sound level in decibels. The duration of each noise measurement is 1 hour.

The SLM has SLOW and FAST response options. The response rate is the time period over which the instrument averages the sound level before displaying it on the readout. Usually measurements of background noise are taken in the SLOW response mode.

Data on the State verification, as well as technical characteristics of the Sound level meter are listed in Verification certificate that presented in Annex 2. The verification date of the device is 16.05.2017. It is valid until 16.05.2018.

The SLM has the following technical characteristics:

- Measurement range: 30÷130 dB (sub-ranges: 30÷80, 40÷90, 50÷100, 60÷110, 70÷120, 80÷130, 30÷130),
- Frequency Range: 31.5÷8500 Hz,
- Accuracy: ±1.5 dB.

In order to ensure continuous measurements over a certain period of time and further analysis of the results, the SLM WS1361 is connected to a tablet. The special software installed in the tablet allows to record noise levels with one second frequency and provides complete information on the noise level (both in digital imaging and as a graph), including the minimum, maximum and average values of the sound level.

The wind speed during the noise measurements have been determined by the Microclimate parameters measuring device "Meteoscop". Data on the State verification, as well as technical characteristics of "Meteoscop" are listed in Verification certificate (see Annex 2) and summarized below:

- Measurement range of wind speed: 0.1~20 m/sec,
  Accuracy: ±(0.05+0.05V), if wind speed is up to 1m/sec and ±(0.1+0.05V), if wind speed is between 1÷20m/sec,

- Measurement range of temperature: between -10 and +50°C,
  Accuracy: ±0.2,
- Measurement range of relative humidity: between 3 and 97%,
  Accuracy: ±3,
- The verification date of the device is 16.05.2017. It is valid until 16.05.2018.

3.1.2 PM10 Measurement

Dust concentration is measured by using of Dust particle meter DT-96. This device is equipped with 2.5um and 10um size channels to measure PM2.5 and PM10 simultaneously as well as air temperature and relative humidity. The duration of each PM10 measurement is 5 minutes. The obtained data is analyzed and compared with corresponding threshold limit value.

Technical parameters of the device are listed below:

- Concentration measurement: 0~2000 ug/m^3, resolution: 1 ug/m^3,
- Temperature range: 0~50°C, resolution: 1°C, accuracy: ±0.1°C,
- Humidity Range: 0 to 100%RH, accuracy: ±5%RH, 0~20%RH, 80~100%RH; ±3.5%RH, 20~80%RH.

The verification of Dust particle meter is conducted by manufacturer on 08.08.2016 and valid till 08.08.2017 (Annex 2).

4. Normative Framework

4.1 Sanitary Norms for Noise

Noise instrumental measurements, analysis and evaluation of results were carried out in accordance with the following regulations/standards:

- RoA Sanitary Norms №2-III-11.3 "Noise in the workplaces, in residential and public buildings and in residential construction areas" adopted by the order of RoA[5] Minister of Health №138 on 06.03.2002,
- Guidelines for Community Noise, World Health Organization (WHO), 1999.

As criteria for determination of the conformity level of the actual noise in identified measurement points, the normative value of the equivalent (average) sound level is used, according to the RoA Sanitary Norms №2-III-11.3 "Noise in the workplaces, in residential and public buildings and housing in construction areas" as well as WHO's Guidelines for Community Noise (see Table 2).

Table 2. Threshold limit value (TLV) for noise

№	Premises and territories	Time	TLV (equivalent to sound level), dBA
1	Industrial and commercial areas[6]	07:00-22:00 Day-time	70
		22:00-07:00 Night-time	70
2	Territories adjacent to residential buildings, clinics, ambulatories, rest houses, care homes, disabled persons homes, libraries,	06:00-22:00 Day-time	55

[5] Republic of Armenia
[6] Source: WHO's Guidelines for Community Noise

№	Premises and territories	Time	TLV (equivalent to sound level), dBA
	kinder gardens, schools and other educational facilities[7]	22:00-06:00 Night-time	45

4.2 Environmental Norms for Dust

The PM10 measurements were conducted and evaluated in accordance with the following normative documentation acting in the Republic of Armenia:

- GOST 17.2.4.05-83. "Environmental protection. Atmosphere. Gravimetric method for determination of suspended dust particles",
- RoA Government Decree №160-N. "Norms of maximum permissible concentrations (MPC) of atmospheric air pollutants in residential areas".

The maximum permissible concentrations of PM10, including daily average values are defined by the RoA Government Decree №160-N and summarized below in Table 3.

Table 3. Daily average and maximum permissible concentrations (MPC) for PM10

№	Name of substance	MPC (mg/ m^3)	
		Max	Daily average
1	PM10	0.3	0.06

5. Description of Measurement Points

The given Study Report presents results of noise levels and PM10 concentration measurements for the points defined by the Employer (see Annex 1) and described below. Totally, 20 noise instrumental measurements were conducted at 5 points and 75 PM10 measurements were carried out at 3 points.

Noise 1, Air 2

Measurement points Noise 1 and Air 2 are placed approx. 1700m to the south-west from the CCPP Yerevan-2 site. These points are located near the northeast border of Ayntap community between the cemetery and private cultivated garden (see Figures 1, 2).

Noise 2

Measurement point Noise 2 is situated at the distance of approx. 1750m to the west from the CCPP Yerevan-2 site. The point Noise 2 is located on the eastern border of Noragavit settlement in front of the highway, connecting the capital Yerevan with the M2 roadway (see Figure 3).

Noise 3 and Noise 5

Measurement points Noise 3 and Noise 5 are located in Kharberd horticultural settlement. Both points are situated along the northern border of the settlement. Noise 5 is the closest point to the CCPP Yerevan-2 site, at the distance of approx. 1100m, while the distance between the point Noise 3 and Project site is 1500m (see Figures 4, 5).

Noise 4, Air 3

[7] Source: Sanitary Norms № 2-III-11.3 "Noise in the workplaces, in residential and public buildings and in residential construction areas"

Measurement points Noise 4 and Air 3 are placed in industrial area near the northern border of the CCPP Yerevan-2 site (see Figures 6, 7).

Air 1

Measurement point Air 1 is situated in industrial area near the southeast border of current Yerevan-1 thermal power plant, between the fire brigade and abandoned production facility (see Figure 8).

Figure 1. Measurement process at point Noise 1

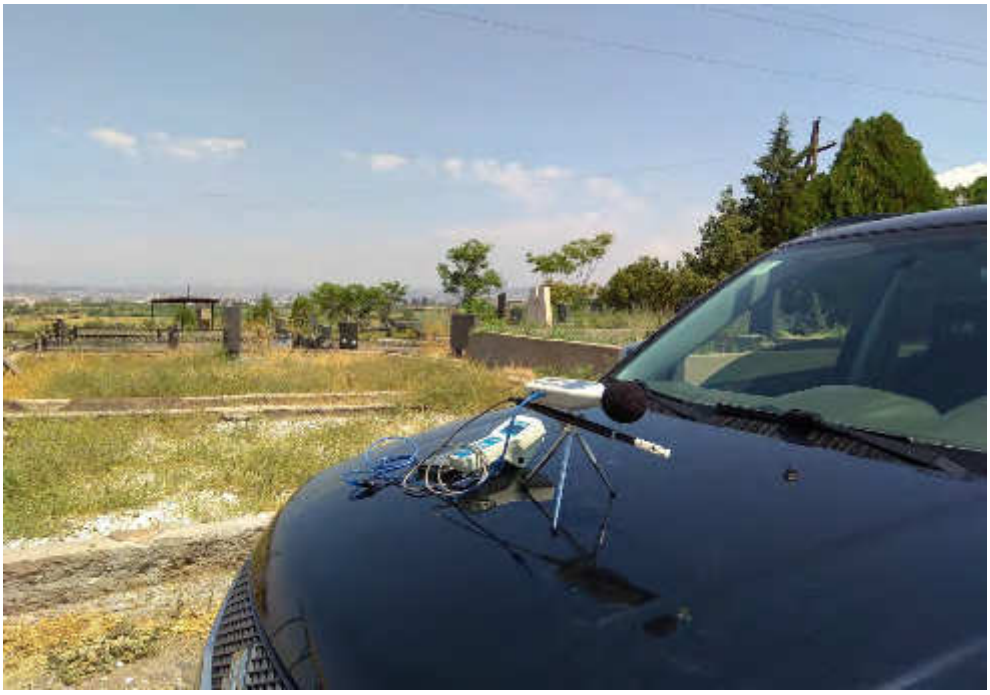


Figure 2. Measurement process at point Air 2

Figure 3. Measurement process at point Noise 2

Figure 4. Measurement process at point Noise 3

Figure 5. Measurement process at point Noise 5

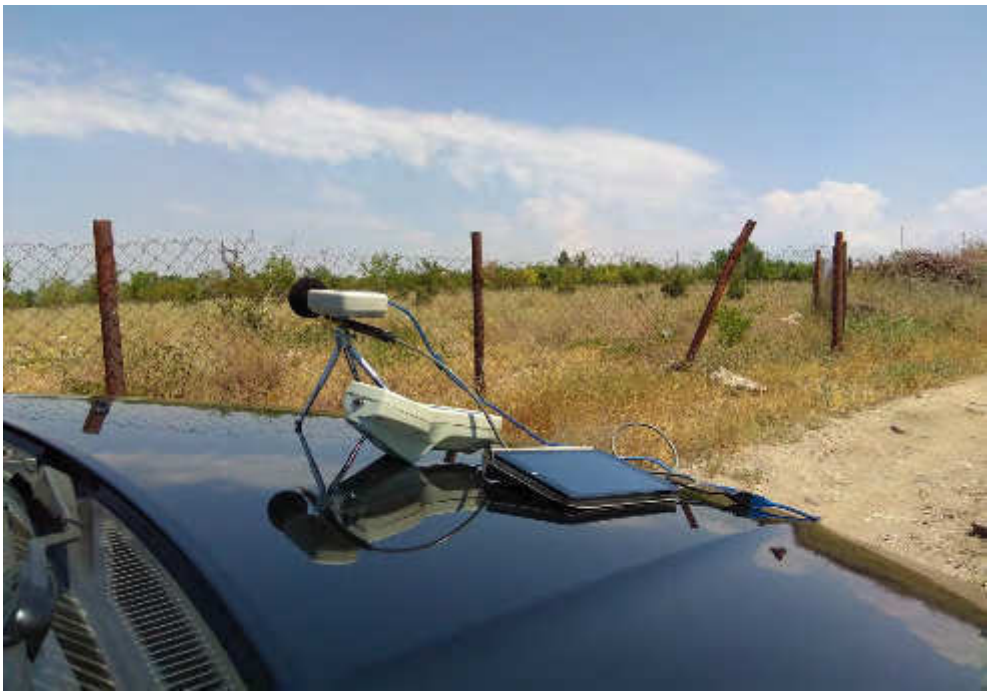


Figure 6. Measurement process at point Noise 4

Figure 7. Measurement process at point Air 3

Figure 8. Measurement process at point Air 2

6. Measurement Results and Evaluation

Noise and PM10 measuring results are summarized in Table 4 (for noise) and Table 5 (for PM10) correspondingly. Diagrams, demonstrating equivalent noise levels at measurement points compared with the TLV are shown in Figures 9-11. Diagrams of PM10 actual concentrations in comparison with the MPCs (maximum and daily average) are presented in Figures 12-14.

Table 4. Results of noise measurement

Point of measurement	Wind speed (m/s)	Time of measurement	Leq(A), dB(A)	TLV (equivalent to sound level), dB(A)	Compliance
Work-day					
Noise 1	<1.7	Day-time	49.8	55	
	<1.8	Night-time	47.1	45	
Noise 2	<1.9	Day-time	72.6	55	
	<2.3	Night-time	62.4	45	
Noise 3	<1.8	Day-time	48.1	55	
	<1.7	Night-time	40.0	45	
Noise 4	<1.6	Day-time	53.6	70	
	<1.9	Night-time	57.3	70	
Noise 5	<1.7	Day-time	36.2	55	
	<2.0	Night-time	39.4	45	
Weekend					
Noise 1	<1.5	Day-time	43.4	55	
	<2.1	Night-time	49.0	45	
Noise 2	<1.8	Day-time	72.8	55	
	<2.5	Night-time	59.2	45	
Noise 3	<1.9	Day-time	43.9	55	
	<2.0	Night-time	33.9	45	
Noise 4	<1.8	Day-time	56.4	70	
	<2.0	Night-time	57.2	70	
Noise 5	<1.5	Day-time	35.6	55	
	<1.8	Night-time	34.2	45	

Table 5. Results of PM10 measurement

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/m^3	MPC max, mg/m^3	MPC daily average, mg/m^3	Compliance
30.07.2017						
Air 1	38	20	0.014	0.3	0.06	
	38	21	0.011			
	38	20	0.01			
	39	19	0.01			
	38	19	0.011			
Air 2	39	22	0.02	0.3	0.06	
	39	20	0.041			
	39	20	0.021			
	39	21	0.021			
	38	20	0.019			
Air 3	38	22	0.022	0.3	0.06	
	38	21	0.017			
	39	21	0.013			
	39	20	0.013			
	38	19	0.016			
01.08.2017						
Air 1	37	22	0.013	0.3	0.06	
	37	21	0.01			
	38	21	0.011			
	38	19	0.012			
	38	21	0.014			

Point of measurement	Temperature, °C	Relative humidity, %	PM10, mg/ m^3	MPC max, mg/ m^3	MPC daily average, mg/ m^3	Compliance
	38	20	0.02			
	39	19	0.016			
Air 2	39	19	0.018	0.3	0.06	
	39	20	0.019			
	39	21	0.02			
	37	23	0.027			
	38	21	0.023			
Air 3	38	20	0.011	0.3	0.06	
	39	20	0.016			
	38	21	0.025			
02.08.2017						
	38	20	0.014			
	38	21	0.011			
Air 1	39	21	0.017	0.3	0.06	
	39	20	0.01			
	37	22	0.009			
	39	20	0.02			
	40	18	0.018			
Air 2	39	19	0.017	0.3	0.06	
	40	19	0.017			
	39	21	0.02			
	39	21	0.042			
	39	22	0.037			
Air 3	39	20	0.031	0.3	0.06	
	38	19	0.023			
	38	20	0.027			
03.08.2017						
	37	20	0.013			
	38	21	0.009			
Air 1	38	21	0.01	0.3	0.06	
	39	20	0.011			
	39	19	0.009			
	38	23	0.013			
	39	22	0.01			
Air 2	39	19	0.011	0.3	0.06	
	39	20	0.012			
	39	20	0.014			
	38	19	0.009			
	38	20	0.011			
Air 3	39	20	0.012	0.3	0.06	
	38	19	0.013			
	38	19	0.012			
05.08.2017						
	38	20	0.012			
	39	21	0.01			
Air 1	39	20	0.012	0.3	0.06	
	39	18	0.011			
	38	19	0.011			
	37	22	0.011			
	38	21	0.019			
Air 2	38	22	0.013	0.3	0.06	
	39	19	0.036			
	38	19	0.01			
	37	23	0.009			
	39	22	0.008			
Air 3	39	19	0.014	0.3	0.06	
	39	19	0.012			
	38	20	0.012			

Figure 9. Diagram of noise equivalent levels at measurement points located in/ near the residential areas compared with the TLV in day-time

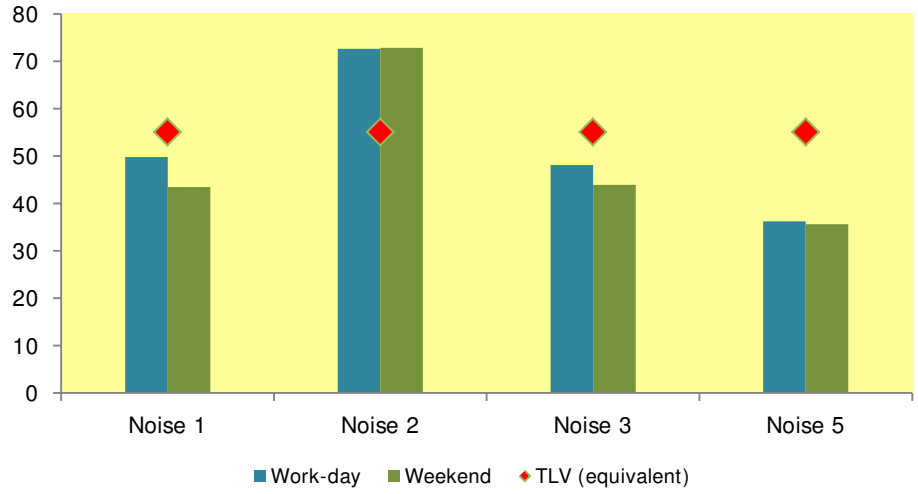


Figure 10. Diagram of noise equivalent levels at measurement points located in/ near the residential areas compared with the TLV in night-time

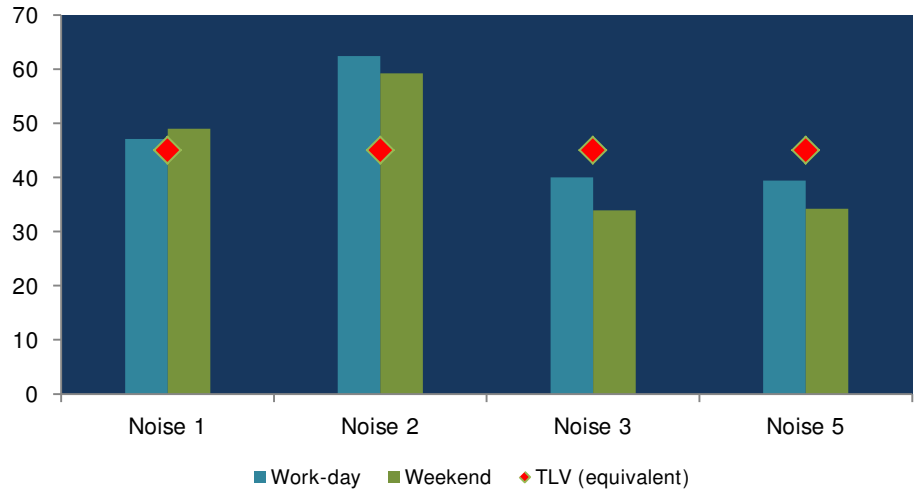


Figure 11. Diagram of noise equivalent level at measurement point Noise 4 (located in industrial area) compared with the TLV

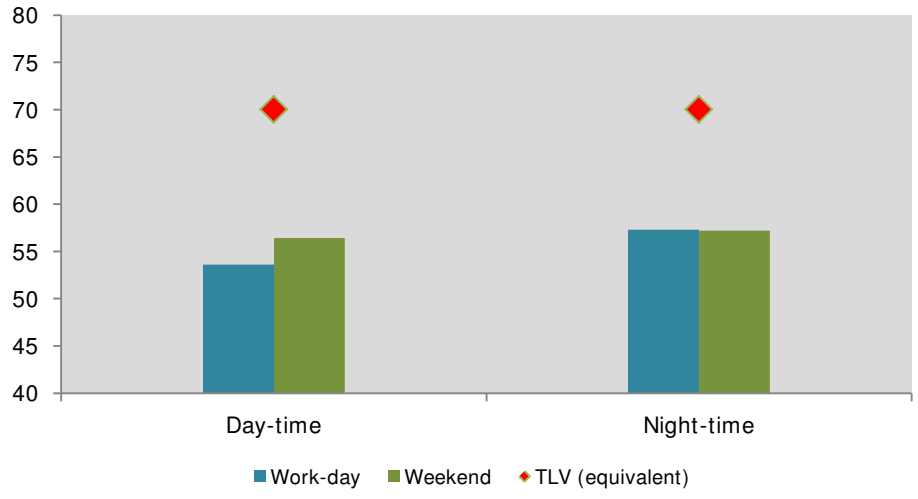


Figure 12. Diagrams of PM10 actual concentrations at point Air 1 compared with the MPC (max and daily average)

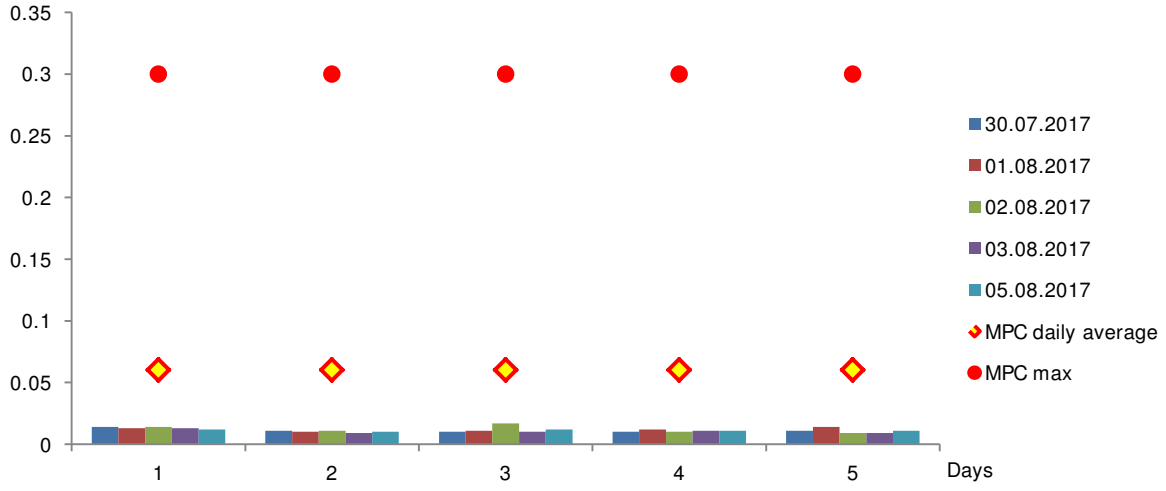


Figure 13. Diagrams of PM10 actual concentrations at point Air 2 compared with the MPC (max and daily average)

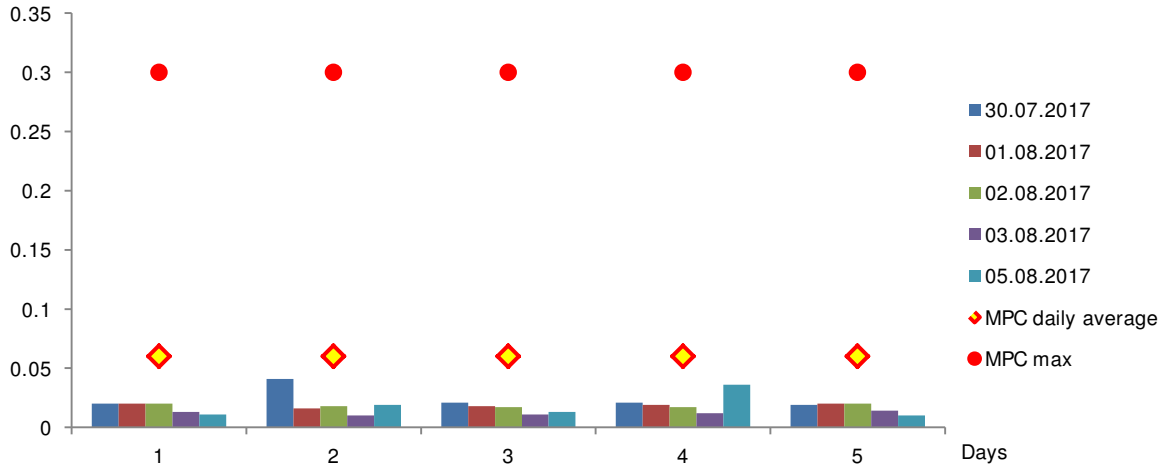
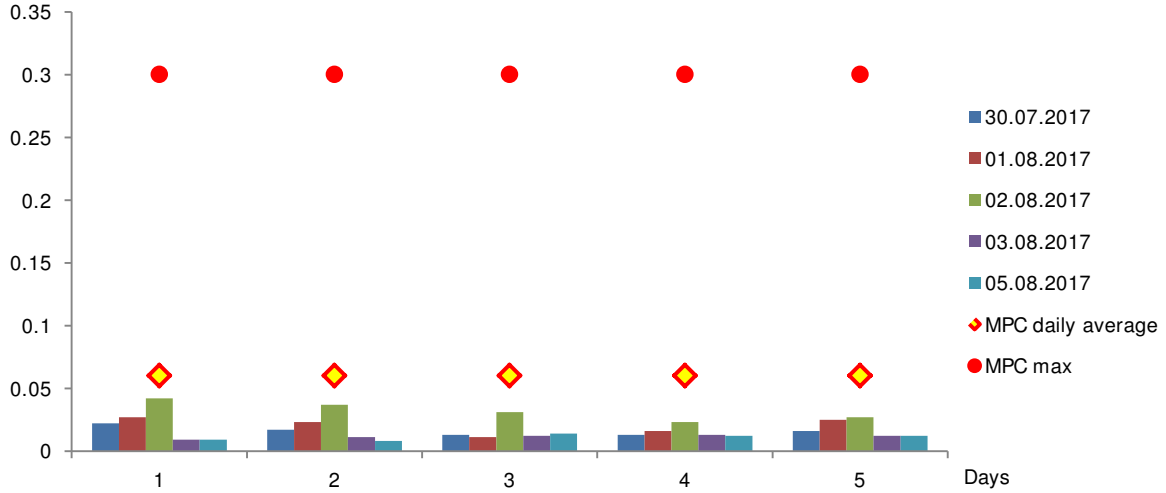


Figure 14. Diagrams of PM10 actual concentrations at point Air 3 compared with the MPC (max and daily average)



Main Conclusions

1) During the study totally 20 noise measurements were conducted at 5 selected points, which means that 4 measurements were carried out at each point, including work-day and weekend day measurements at day-time and night-time.

2) As TLVs for evaluation of noise actual levels at measurement points in/near the residential areas (points: Noise 1, Noise 2, Noise 3 and Noise 5) 55 dBA and 45 dBA as equivalent noise levels for day-time and night-time correspondingly have been applied. For the measurement point Noise 4 (located in industrial area) 70 dBA TLV is applied.

3) Day-time noise evaluation

   Based on the noise measurement results conducted during work-days and weekend days, it can be concluded that noise equivalent levels in/near the residential areas were generally within the TLV (Noise 1, Noise 3 and Noise 5), except the point Noise 2 (located in front of the highway), where the noise level exceeded the 55 dBA normative value (see Figure 9). This can be explained by the movement of heavy vehicles and high traffic density along the highway (see Figure 3).

4) Night-time noise evaluation

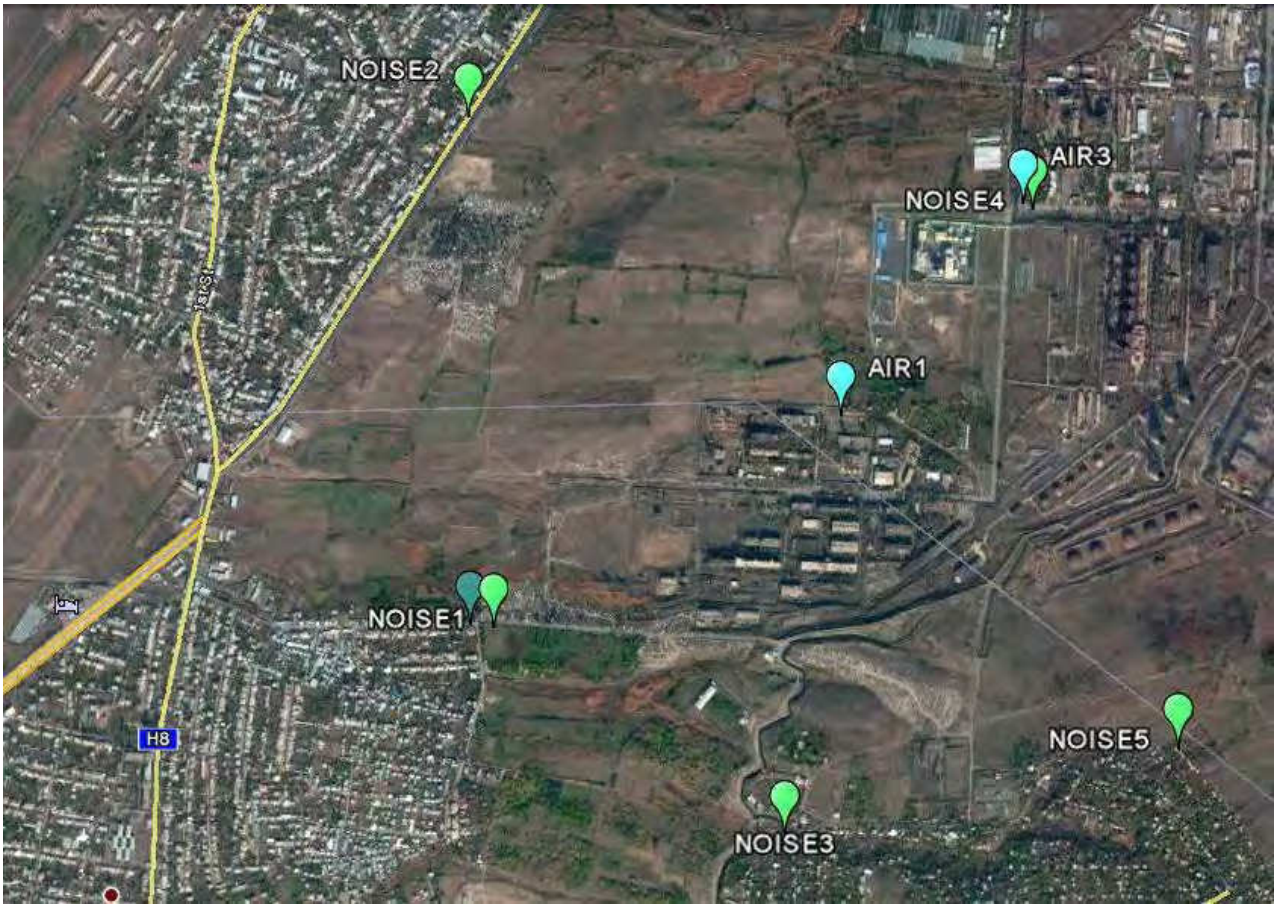
   Equivalent noise levels during work-days and weekend days at measurement points Noise 3 and Noise 5 are within the 45 dBA TLV. Noise levels at point Noise 1 during both work-days and weekend days were slightly exceeding the TLV (2.1 dBA and 4 dBA accordingly). This is due to the availability of background night noise from the facilities located in the vicinities, probably from the industrial area near the CCPP site. As a result of night-time measurements, the equivalent noise level at point Noise 2 (located in front of the highway) is above the 45 dBA TLV (see Figure 10). The reason is high traffic density along the highway even at night-time.

5) Noise equivalent levels in industrial area near the CCPP site during work-days and weekend days, measured at day-time and night-time, are below the 70 dBA TLV (see Figure 11).

6) 75 instrumental measurements were conducted in 3 sensitive points (Air 1, Air 2 and Air 3) during 5 days to determine the PM10 actual concentration. 5 measurements were conducted at each point per day, which means that totally 25 PM10 measurements were carried out at each point. The results of the study were compared with PM permissible concentrations (maximal is 0.3 mg/m^3 and daily average is 0.06 mg/m^3).

7) PM10 (dust particles of 10um size) actual concentrations at all sensitive points (Air 1, Air 2 and Air 3) in different daytime periods don't exceed the daily average and maximum permissible concentrations for residential areas set by the RoA Government Decree №160-N "Norms of maximum permissible concentrations of atmospheric air pollutants in residential areas" (see Figures 12-14).

ANNEX 1. Map of measurement points



ANNEX 2. Verification documents of measuring devices

ՎԿԱՅԱԿԱՆ № 017243

ՍՏՈՒԳԱՉԱՓՄԱՆ ՄԱՍԻՆ

Ստուգաչափման թվականը 2017թ. 01 «18»

Ուժի մեջ է մինչև 2018թ. 01 «18»

БВЕК 431110.02 СБ

Գործարանային հմ. 39610

Չափման տիրույթը

Ճշտության դասը, կարգը (սխալանքը)

Արտադրողը

Պատկանում է

Ստուգաչափման արդյունքների հիման վրա չափման միջոցը ճանաչվել է պիտանի և թույլատրվում է կիրառման:

Ստուգաչափումը կատարվել է համաձայն

Ստուգաչափող

Բաժնի (լաբորատորիայի) ղեկավար

ՎԿԱՅԱԿԱՆ № 015617

ՍՏՈՒԳԱՉԱՓՄԱՆ ՄԱՍԻՆ

Ստուգաչափման թվականը 2017թ. 05 «16»

Ուժի մեջ է մինչև 2018թ. 05 «16»

ա/հ 1361

Գործարանային հմ. ա/հ

Չափման տիրույթը (30÷130)դԲ; (31,5Հց÷8,5կՀց)

Ճշտության դասը, կարգը (սխալանքը) ±1,5դԲ

Արտադրողը

Պատկանում է—

Ստուգաչափման արդյունքների հիման վրա չափման միջոցը ճանաչվել է պիտանի և թույլատրվում է կիրառման:

Ստուգաչափումը կատարվել է համաձայն

Ստուգաչափող

Բաժնի (լաբորատորիայի) ղեկավար

13.6 Stakeholder Engagement Plan

Draft Report
August 2017

Yerevan 2 CC Power Plant
Armpower SJSC

Stakeholder Engagement Plan

Source: Fichtner (July 2017)

FICHTNER

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Rev No.	Rev-date	Contents /amendments	Prepared/revised	Checked/released
0	18.08.2017	Stakeholder Engagement Plan - Draft Report	Sousa/Paulsch/ Martin	Héigold
1				
2				
3				

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1. Introduction

The present draft **Stakeholder Engagement Plan** (SEP) is prepared within the context of the draft Environmental and Social Impact Assessment (ESIA) of the Yerevan CCPP - 2 project.

The SEP describes the strategy and program to be implemented for engaging with the stakeholders of the Project in a culturally and timely appropriate manner. The goal is to ensure the timely provision of relevant and understandable information and to create a process that provides opportunities for stakeholders to express their opinions, aspirations and suggestions about environmental measures, eventual land acquisition and social impacts of the project, and that allows the Project Developer to consider and respond to them.

It is important to note that the Project has been in the past subject to a process of public consultation and that an Environmental Permit has been granted. The public engagement activities defined in the present SEP have as an objective to engage the public once more in a process that assures as well compliance with the requirements of the IFIs (International Financing Institutions) ADB and IFC.

1.1 Brief Project description

The Ministry of Energy (MOE) of the Republic of Armenia plans to improve the total output capacity of its electric energy production, complementing the power units of the existing Yerevan Combined Cycle Thermal Power Plant (YCCPP-1) with a modern and efficient power plant. For this reason a new gas fired Combined Cycle Power Plant of 254 MWe (YCCPP-2) is planned to be built at the site next to the existing YCCPP-1, in an already industrialized region in the south of Yerevan.

The foreseen site location allows co-utilizing the existing auxiliary systems of YCCPP-1 such as water intake and discharge structures, fuel gas regulators, adjacent substation and devices. Possible alternative locations for the proposed new YCCPP-2 had been considered prior to opting for the foreseen site. On account to minimize the additional costs for newly developing such a site and modifying the transmission network to accommodate the new power plant, the foreseen site was selected together with MOE as a final option.

The Project has already been given national approval, which is documented in the following Conclusion: RA Minister of Nature Protection (11.01.2017): State Expert Examination Conclusion on Expert Examination of Influence on the Environment BP 02. Report of evaluation of influence on environment of the new power station in Yerevan with combined cycle of steam and gas.

The new CCPP will include a Gas Turbine (GT), a Steam Turbine (ST), and a Heat Recovery Steam Generator (HRSG) and all auxiliary equipment and

systems that, at local condition with an ambient temperature of 15°C, will produce 254 MW. Interconnections to gas, water and electrical grid are already in place (the new CCPP will use interconnections of existing YCCPP-1).

RENCO SPA will be the EPC Contractor for this Project, which will be operated by ArmPower CJSC, a subsidiary company of RENCO SPA.

2. Public Consultation Regulations and Requirements

This Section provides a brief description of the national regulation of Armenia concerning the public participation in the process of ESIA. Also the IFIs' requirements in these matters are summarized.

The Project has been in the past subject to a process of public consultation and obtained the necessary environmental license. For this reason, the present SEP and the corresponding procedures are/will be undertaken with the main focus of respecting the standards of the IFIs.

2.1 National framework

The notification of stakeholders in the Republic of Armenia and the implementation of public hearings are regulated by the Law on Environmental Impact Assessment and Examination (Article 26).

The public hearings organization is carried out according to the procedure defined by the Decree N 1325-N dated 19.11.2014. Depending on the impact of the planned activity, 2 or 4 hearings are conducted. The first and third hearings are organized by the affected community and the customer, the second and fourth hearings by the affected community and the Expertise Center of the Ministry of Nature Protection with the participation of the client.

2.2 International framework

The SEP follows the IFIs requirements for public engagement, namely the ones depicted in the following documents:

- **ADB, 2012**: *Strengthening participation for development results - an Asian Development Bank guide to Participation*, ADB, Philippines, 2012
- **IFC, 1998:** *Doing Better Business through Effective Public Consultation and Disclosure - A Good Practice Manual*, IFC, Washington, D.C., October 1998
- **IFC, 2007:** *Stakeholder Engagement: a good practice handbook for companies doing business in emerging markets*, IFC, Washington, D.C., May 2007
- **IFC, 2012:** *Performance Standard 1 - Assessment and Management of Environmental and Social Risks and Impacts*, IFC, Washington, D.C., January 2012

The requirements of importance for the Project are summarized in the following sections.

2.2.1 Stakeholders

Stakeholders are those who will be or are likely to be directly or indirectly affected, positively or negatively, by a project (commonly referred to as project-affected people or project-affected communities), as well as those who might have an interest in, or may influence, the project (the "interested parties").

Generally, stakeholders can be distributed in the following three groups (adapted from ADB, 2012 and IFC, 1998):

a) Civil society:

- General public: directly or indirectly affected population groups and subgroups (e.g., youth, girls, and women's groups), and ethnic minority groups:
  - People owning land or assets impacted by the project, both on- and off-site.
  - People using agricultural land or natural resources, such as forests or rivers.
  - Squatters already on-site.
  - Immigrants attracted to the project and its potential labor benefits prior to implementation.
  - People's organizations and institutions affected by the project, such as village development associations, recreational groups, women's groups, farming and fishing cooperatives, and religious groups.
  - Locally disadvantaged and voiceless groups, such as the poor and women.
  - Indigenous or tribal peoples with special ties to land, or who have specific land, resource, and cultural rights that may be protected by national or international law.
  - People from surrounding villages who may be potential sources of labor.
- Civil society organizations: national and international NGOs, community-based organizations, foundations, labor unions, and independent research institutes.
- Informal representatives: scientific community, school teachers, religious leaders.

b) Government:

- Central Government: civil servants in ministries, cabinets, etc.
- Representative assemblies: elected government bodies (e.g., parliament, national and local assemblies, and elected community leaders)
- Bilateral and multilateral government institutions: international financial institutions, bilateral government donors, etc.

c) Private Sector:

- Private companies (including suppliers, customers, and contractors), umbrella groups representing groups in the private sector, and chambers of commerce.
- The media.

According to IFC PS 1 (2012), the stakeholders of the Project, including Affected Communities, shall be identified and a tailored SEP shall be prepared.

2.2.2 Information Disclosure

Disclosure is a formal-sounding term for making information accessible to stakeholders. Information is critical to the effective participation of affected citizens near the project. An informed public will better understand the trade-offs between project benefits and disadvantages; be able to contribute meaningfully to project design; and have greater trust in its new corporate neighbors. Communicating such information in a manner that is understandable to the stakeholders is an important first (and ongoing) step in the process of stakeholder engagement (IFC 2007; IFC 1998). Good practice principles in what concerns information disclosure are:

- Early disclosure: in order for the engagement process to be efficient, the disclosure of information about the project shall be undertaken early in the planning schedule, that is, before the decision-making has been finally undertaken and any impacts have been delivered. Only this way it is possible to include the stakeholders' visions and opinions on the decisions concerning the project.

- Disclose objective information: as far as possible, inform the stakeholders about numbers and facts (even if preliminary), so to avoid the creation of false expectations or unnecessary alarm.

- Design disclosure to support consultation: crucially, leave sufficient time between the provision of information about the benefits and disadvantages of the project (or changes to project operations and their implications) and the start of consultations.

- Provide meaningful information: transmit the information in a matter that is culturally adequate to the targeted public. Consider the local language, the access to information media, the literacy levels, etc.

- Ensure the accessibility of information - adapt the disclosure techniques to the targeted public.

2.2.3 Public Consultation

Consultation is a process of deliberation, discussion and dialogue. It is more than just disclosing information, although clear, transparent and timely information is the basis for any consultation process. The objective of the consultation is also to seek feedback, advice and opinion of the stakeholders in order to shape the project, to the extent possible, to their needs and concerns. In this sense, the vulnerable groups shall be given a particular chance of having their voice heard.

The IFIs require that the client undertakes a process of meaningful consultation in a manner that provides the interested and affected parties with opportunities to express their views on project risks, impacts, and mitigation measures, and allows the client to consider and respond to them. Meaningful consultation is the one that (based on IFC, 2012):

- is based on the disclosure of relevant and adequate information including, where appropriate and relevant, draft documents and plans, prior to decisions being taken when options are still open;
- is undertaken early in the environmental and social appraisal process;
- focus on the social and environmental risks and adverse impacts, and the proposed measures and actions to address these;
- is carried out on an ongoing basis as the nature of issues, impacts and opportunities evolves;
- is undertaken in a manner that is inclusive and culturally appropriate, i.e., tailored to the language preferences of the affected parties, their decision-making process, and the needs of any disadvantaged or vulnerable groups;
- is free of external manipulation, interference, coercion or intimidation;
- reports back in a timely way to those consulted.

There is a vast amount of reference literature and tool kits detailing the variety of participatory techniques and methodologies that can be employed as part of the stakeholder engagement process. However, as is the case with most aspects of the process, the choice of methods will depend on the aim of the consultation, the nature of those being consulted (language, literacy, location, exposure to issues), and the timescale/resources available. Using more than one method yields better responses - in quality and quantity. Different methods can also produce different results (IFC, 2007; ADB, 2012).

Table 3-1 presents some of the techniques that are commonly used for undertaking Public Consultation during an ESIA process.

Table 2-1: Different techniques for undertaking Public Consultation (ADB, 2012)

Tecnique	Description
Online and Written Consultation	This typically involves using a specific consultation web page to introduce the policy, strategy, or project and the aim of the consultation. The consultation structure varies. A draft document, broad topics, or open-ended questions can be used to guide comments or a survey style with closed questions. Public comments allow discussion between stakeholders. Social media can be used. Online consultation enables open public consultation, but it only reaches those who are literate and with internet access, and therefore not the most disadvantaged. Written feedback posted or e-mailed is also common.
Public Meeting	Meetings are an open accessible method of consulting with the public. They take place at any level (community, regional, national, etc.). Ensure they are fully accessible and give adequate notice to interested bodies. Also the meeting size affects participation. Groups of fewer than 20 people ensure everyone can speak. Breakout sessions and participatory methodologies (e.g., ranking, diagrams) can help capture all viewpoints.
Workshop	Workshops involve gathering a group to gain their feedback in a structured format. The face-to-face format allows for brainstorming and testing ideas. Preferable to a single workshop, a series produces greater output. Try different workshop types (e.g., open space, write shop, participatory methods). Facilitation is important, and a skilled neutral individual can help ensure group rules are clear, views are taken seriously, and no participant dominates.
Focus Group Discussion (FGD)	Semi-structured qualitative discussions with a small homogenous group (generally 5–12 participants plus 1–2 skilled facilitators). Open discussion explores people's attitudes, concerns, and preferences toward a specific issue, with the range of viewpoints collated at the end. The mix of people depends on the purpose but numbers are typically restricted to 15 or fewer. Community members not used to formal meetings may feel more comfortable expressing themselves in a FGD (e.g., women, ethnic minorities, or disadvantaged groups; the disabled; or poor individuals and households).
In-Depth Interview	Qualitative phone or face-to-face interviews with individuals (e.g., community members, key informants, or civil society leaders) can get a sense of stakeholders' perspectives. They can be structured (formal, and closely following a written interview guide), semi-structured (partially directed by an interview guide, but open and conversational to allow interviewees to introduce other topics of interest), or unstructured (organized around a few general questions or topics, but informal and open-ended) depending on the context. Structured interviews are likely to yield information that can be compared and generalized, while less structured ones can explore an issue in depth and permit related issues to be raised. Interviews with key informants possessing particular knowledge of an issue are especially useful.
Survey	Surveys provide specific responses on certain issues. They can rapidly show who is interested and why and provide quantitative data. They indicate the weight of different views. Conduct surveys by post, online, or face to face.

2.2.4 Grievance Mechanism

A Grievance Mechanism constitutes the process by which people affected by the project can bring their grievances to the sponsor, in a culturally appropriate manner for consideration and redress (IFC, 1998). It is good international practice to ensure access to grievance and remedy to both the workers and the public by means of separate grievance mechanisms.

Ideally, grievance procedures should be in place from the beginning of the social and environmental assessment process and exist throughout construction and operation until the end of the project life. The promoter will duly inform workers and community members of the existence of the grievance mechanism.

The same way as for the information disclosure and consultation procedures, also the grievance procedures shall be readily understandable, accessible and culturally appropriate for the local population. It shall not be overly complicated to use nor should it require legal counsel to complete. The following are desired characteristics of the grievance mechanism:

- legitimate and trusted;
- scaled to the risks and potential adverse impacts of the project;
- publicized and accessible, appropriately tailored to all potentially-affected persons and communities and other interested parties, irrespectively of their literacy and administrative capacity;
- free of cost for the stakeholders;
- includes the anonymity option, where feasible, and guarantee confidential handling of requests, if so requested by the complainant;
- fair, transparent and inclusive;
- guided by engagement and dialogue;
- predictable in terms of process;
- timely appropriate;
- not impeding access to grievance and resolution on grounds of one's financial ability to seek judicial remedy; and,
- a source of continuous learning for the promoter and the lending operation at large.

3. Summary of previous stakeholder engagement activities

During the preparation of the National ESIA (Ecobarik-Audit LLC 2016), consulting and information disclosure activities with some stakeholder groups have been undertaken.

Being nationally classified as a Category A Project, the YCCPP - 2 was subject to 4 public hearings in 2016. All hearings were held at RENCO Armenia's office.

The records of the hearings, the participants' lists with the signatures and the video clips were submitted to the Ministry of Nature Protection of the Republic of Armenia. They are not available for disclosure in this report.

4. Project Stakeholders

As stakeholders are identified, it is necessary to understand their level of interest and influence over the project, as well as the extent to which they are impacted (directly or indirectly).

The information obtained so far shows that there are some temporary informal houses nearby the project site (several families to the northeast and one woman to the south west). The land occupied by these temporary informal houses is not affected by the Project. All these residents are Armenian.

Table 4-1 lists these and other stakeholders identified so far for this project.

Table 4-1: Stakeholder Analysis List

Stakeholders	Stakeholder Interest	Perception of the problem/Issues to be discussed	Resources	Mandate in the project's context	Contact data
Civil Society					
Aarhus Center, NGO	Assist the public in exercising their rights granted by the international and national legislation	Environmental and social impacts of the project; Environmental and Social Management Plan	Internal budget and staff	The Centre's task is to promote the principles of the Aarhus Convention and work towards its implementation.	Silva Ayvazyan Head of Yerevan Aarhus Centre info@aarhus.am (+374) 91 81-60-55
Informal Residents	They can be directly affected by environmental and social issues	Environmental and social impacts of the project; Environmental and Social Management Plan	Public resources (air, water, soil)	Not applicable	Not applicable. People are involved through the local governments.
Inhabitants of surrounding areas	They can be directly affected by environmental and social issues; They can be potential sources of labor	Environmental and social impacts of the project; Environmental and Social Management Plan; Job opportunities	Work force Public resources (air, water, soil)	Not applicable	Not applicable. People are involved through the local governments.
Private Sector					
Media	Publication of information about the EIA process Publication of mandatory advertisements related to the project (e.g. public consultations)	Disclosure of project's information	Communication platforms (TV, radio, internet, newspapers)	The national, regional and local media fulfill the communication needs of the project.	Not applicable
Government					
Ayntap Village	Located in the Project Area; Residents can be directly	ESIA, Environmental and Social Management Plan,	Internal budget and staff	Governments give orders in accordance with the law on implementation of public consultations on the projects of	+(374 094) 722-222
Kharberd Village					+(374 093) 400-122
Shengavit District					+(374 11) 518-808

Stakeholders	Stakeholder Interest	Perception of the problem/Issues to be discussed	Resources	Mandate in the project's context	Contact data
Erebuni District	affected by environmental and social issues	SEP; Disclosure of project's information; Public consultation in order to collect comments and questions		local importance, which can have economic, environmental and social consequences (for life of the people, for culture, health and social protection for local communities and public services), as well as on other issues which are of interest for all population of the administrative/ territory unit or its part.	+(374 11) 518-388
Nature Protection Department of the Municipality of Yerevan	Monitoring of noise/ air emissions and effluents; Waste Management	ESIA, Environmental and Social Management Plan, SEP	Internal budget and staff	The Nature Protection Department participates in the development of state programs for the nature protection and environmental management and ensure their implementation in the territory of Yerevan	Avet Martirosyan +(374 11) 514-264
Environmental Monitoring Center at Ministry of Nature Protection	Monitoring of noise/ air emissions and effluents	ESIA, Environmental and Social Management Plan, SEP	Internal budget and staff	The "Environmental Monitoring and Information Center" SNCO (Ecomonitoring) of the Ministry of Nature Protection of the RA monitors the atmospheric air, surface and groundwater, atmospheric precipitation, soil and sediment quality.	http://www.armmonitoring.am

Stakeholders	Stakeholder Interest	Perception of the problem/Issues to be discussed	Resources	Mandate in the project's context	Contact data
Ministry of Nature Protection	Its permission or agreement is necessary in order to construct YCCPP-2. This permission was already given (RA Minister of Nature Protection (11.01.2017): State Expert Examination Conclusion on Expert Examination of Influence on the Environment)	ESIA, Environmental and Social Management Plan, SEP Approvals: Application, ESIA Program/ToR, ESIA Documentation/ Report	Ministry's internal budget and staff	The Ministry of Nature Protection coordinated the process of national environmental impact assessment of the planned power plant.	min_ecology@ mnp.am

5. Information disclosure and consultation methods

The present Section describes the following main points:

- what information will be disclosed;
- in which formats will the information be presented;
- which methods will be used to communicate this information to each of the stakeholder groups;
- which methods will be used to consult with each of the stakeholder groups;
- how the results of the process will be captured, recorded, tracked, and disseminated.

The requirements of the Armenian law on Environmental Impact Assessment and Examination and of the international financing institutions (IFC and ADB) in respect to public engagement principles and scheduling are considered for the present SEP. Three phases are considered for the planning of the engagement activities:

1. ESIA preparation;
2. Construction;
3. Operation.

5.1 Engagement during the ESIA preparation

The engagement of the stakeholders during the preparation of the ESIA consists of the following actions:

1. Notification of the Project to the local authorities;
2. Disclosure of the draft ESIA Report and respective Executive Summary:
   a) One Public Consultation Session
   b) Online and written consultation

5.1.1 Notification of the project to the local authorities

During the site visit in July 2017, FICHTNER's environmental and social specialists performed stakeholder meetings with mayors of the adjacent villages Kharberd and Ayntap, with the Heads of Departments of Erebuni and Shengavit Administrative Districts, with the Environmental Monitoring and Information Center, and with the NGO Aarhus Center. The purpose of the meetings was to introduce the Project and to discuss issues concerning the presence of houses/ sensitive receptors in the vicinity of the Project area, environmental monitoring, concerns about the Project and the public consultation process.

5.1.2 Disclosure of the draft ESIA and respective Executive Summary

A national process of engagement has been undertaken during the elaboration of the previous ESIA.

For the present ESIA, which aims at covering the gaps with the IFIs' requirements, this process will be complemented by making the new draft ESIA and Non-Technical Executive Summary publicly available and open to comments during a public consultation session. In addition, online and written consultation will be planned as described in the following sections.

a) Public Consultation Session

One Public Consultation Session will be planned and undertaken by RENCO/ARMPOWER with the support of Fichtner to present the ongoing results of the ESIA process and obtain feedback from the stakeholders concerning its content and the areas which may require more attention.

The Public Consultation Session will be conducted in Yerevan. All villages affected by the project will be invited to participate in the session. The following residential complexes are in the proximity of the site (Figure 5-1):

- the nearest residential area of Shengavit District (Noragvit village) is located approx. 1,350 m to the west;
- Ayntap, a major village in the Ararat Province is located approx. 1,500 m to the south west
- Kharberd, another major village in the Ararat Province is located approx. 1,200 m to the south
- the nearest residential area of Erebuni District is located approx. 1,200 m to the north east.

Figure 5-1: Project site and its vicinity

Theoretically, the Public Session could be organized at the YCCPP-1's building or at RENCO Armenia's office. However, since the YCCPP -1 is located far from the city and is difficult to reach, and the RENCO Armenia's office is small, it is more advisable to organize the Session in Yerevan's Aarhus Center, submitting a preliminary application to the center coordinator.

Before the Session
Before the Session takes place, publicity of the time and place will be made by the project's developer by putting out adverts in the mass-media or posting them on its official web-page. Local authorities (Ayntap and Kharberd villages; Shengavit and Erebuni districts) shall put up notices along with a copy of the Draft ESIA accessible for the public in their respective governmental buildings. The local governments may also post the advert regarding the conduct of the Session on their web-pages. The Aarhus Centre Yerevan agreed to assist with promoting the Public Consultation Session and with making the Draft ESIA available to the public.

During the Session
The meetings will be structured in two parts: presentation and Q&A (questions and answers).

The first part will consist of a presentation of the Project and the ESIA process. This will be supported with audiovisual resources (slides, pictures, videos) and will use straightforward, non-technical language. The second part of the meetings will consist of an open Q&A session and will be coordinated in order to allow all stakeholders present to manifest their opinion.

A written record of all stakeholder grievances, criticisms and/or suggestions will be undertaken. Further to voiced manifestations, stakeholders will have the option to register their written opinion in a book to be made available until the end of the meeting. The language of the session will be Armenian.

After the Session
The findings of the public session will be entered in a minute, with the indication of the total number of participants, the list of questions and the objections and proposals put forth. The minutes will be drawn up within 1 week following the date of the conduct of the Session.

Should no answers be provided to the questions put forth during the conduct of the public session, the developer will deliver the answers within 15 days following the date of the conduct of the public session to the authors on the postal or email addresses indicated during registration.

b) Online and written consultation

The Draft ESIA will be made available for public access, with the possibility to deliver written comments in the following platforms:

- Hard copies of the draft ESIA placed in the Aarhus Center, and the local governmental buildings (Noragavit, Ayntap, Kharberd, and Erebuni District).
- Soft copy at the official web-page of the developer;
- Soft copy at the web-page of the IFIs;
- Soft copy at the web-page of Yerevan's municipality;
- Soft copy at the web-page of the Aarhus Center.

In each of the physical or online platforms where the Draft ESIA will be placed, forms will be made available to allow the persons to write their comments, if desired anonymously. See **Annex 1** for a model of the comments form.

The physical and online platforms for consultation will be disclosed during the Public Consultation Session.

5.2 Engagement during construction

For the communities located near the project site the effects of noise, dust, vibration, traffic, and lighting associated with construction, as well as the presence of the sites themselves, can cause disturbances and stress, as well as pose a physical or health hazard. In addition, social conflicts with the workers may also arise in these villages. To avoid such situations, whether for large capital works or minor construction activities, it is advised to give the public notification of:

- the purpose and nature of the construction activities;
- the start date and duration of the overall construction works and of specific operations (blasting, terrain clearing, transport of heavy components, etc.);
- potential impacts;
- information on whom to contact if there are concerns/complaints related to the contractor.

Also recommended is the regular disclosure of information related to the management of the environmental and social matters (application of measures, monitoring efforts and results).

In the construction phase, it is not a common procedure to undertake public debates and discussions. Instead, the construction contractor shall keep functioning grievance mechanisms. This way it is possible for the interested and affected parties to make complaints or suggestions in relation to the project's activities (the mechanism shall be open for the public and for the workers). This is the project's phase where more grievances are expected to be received and the contractor and the Project Developer shall be ready to answer to them on time and efficiently. Please refer to Section 6 for guidance on the preparation of a grievance mechanism.

5.3 Engagement during operation

Typically during operation the number of grievances and frequency of engagement with stakeholders may decrease, along with a reduction in the overall employee and contractor workforce. The following shall be undertaken in this phase for the project:

a) In case the operator prepares an Emergency Preparedness and Response Plan, this shall be disclosed to the employees and communities so that all stakeholders likely to be affected have a basic understanding of the risks involved and what the key elements of the plan are; and that individuals from within and outside the project know what their allocated roles and responsibilities are during an emergency. Disclose any important changes made to the Plan.

b) Undertake a regular communication of the company's environmental and social performance;

c) Maintain the grievance mechanism - there should always be a well functioning procedure for answering public concerns whenever they may arise throughout the life of the project.

In the operational phase, it is not a common procedure to undertake public debates and discussions. Instead, the operator shall keep functioning grievance mechanisms for the public and the workers. This way it is possible for the interested and affected parties to make complaints or suggestions in relation to the project's activities.

5.4 Documentation

Keeping track of the "who, what, when, and where" of consultation is key to effective implementation of the process. Any commitments made to stakeholders should also be recorded. Careful documentation can help to demonstrate to stakeholders that their views have been incorporated into the project strategies, and is a useful resource for reporting back to stakeholders on how their concerns have been addressed. For this, a Stakeholder Log needs to be developed and shall be maintained throughout the project's life cycle. The Log records:

- stakeholder organization;
- contact details;
- issues and concerns raised;
- actions for follow-up;
- responsibilities and deadline;
- confirmation of close-out.

Please refer to **Annex 2** for the model of the Stakeholder Log for this project. At present, no comment or grievance has been received.

Stakeholder consultation carried out during the course of the early stages of the ESIA studies will be recorded in the final ESIA report. This will include:

- The location and dates of meetings;
- A description of the project-affected parties and other stakeholders consulted;
- Presentations and communications;
- The minute of the sessions including:
  - Number of participants;
  - An overview of the issues raised (questions, objections and proposals);
  - How the project sponsor responded to the issues raised;
  - How these responses were conveyed back to those consulted;
- Project variations and impacts on the ESIA process;
- Details of outstanding issues and any planned follow-up.

6. Grievance Mechanism

This Section presents the grievance mechanism for the general public and the workers planned for the Project.

6.1 General public grievance mechanism

In the course of the construction process, Project Affected People (PAP) may feel treated unjustly. This might happen for various reasons such as: the contractor does not adhere to sound construction principles, misunderstandings have arisen, or disagreement with procedures of consultation or notification. If this happens people shall be encouraged to lodge their complaints in a timely and effective manner without directly addressing the court, i.e., through a grievance mechanism.

All PAP will be notified about the Grievance Redress Mechanism (GRM) of the YCCPP -2 Project during the Public Consultation meetings, as well as through the disclosed project information leaflets. Contact data of the **ArmPower's Grievance Coordinator (GC)**, part of the **Grievance Committee**, will be disclosed.

During consultation the PAP shall be notified orally or in a written form about their rights and the procedure of filing complaints. Local NGOs, e.g. the local Aarhus Centre, can inform communities about the possibility to raise complaints and how and where to address them. The grievance mechanism has to be locally implemented at the level of village institutions and local self-government, as well as bundled on national level at ArmPower.

Grievances can be addressed at the local community level ('marzpet'), where the grievance will be recorded and forwarded to ArmPower's GC. Grievances that are addressed to the EPC Contractor during the execution of civil works shall also be forwarded to ArmPower's GC. Even if the constructor decides to settle the grievance on the spot, the documentation of the grievance settlement procedure needs to be prepared by ArmPower's GC.

All project related complaints can in addition be directly addressed to ArmPower's GC via phone, e-mail or grievance form (the SEP presents an example of the public grievances form). A project grievance hotline shall be made available by ArmPower for direct complaints (at national level), and all received grievances shall be recorded in a grievance log-book.

The ArmPower GC then decides whether to settle directly, to arrange a meeting with the Grievance Committee, or go to court. The decision has to be taken within 15 days. In case of major grievances that cannot be directly settled, permanent and non-permanent members of the Grievance Committee will be called for a meeting.

In case of failure of the grievance redress system, the PAP can submit their case to the appropriate court of law.

The EPC Contractor is obliged to carry out the work in accordance with the contractual requirements that include:

a) Nominate a person of staff responsible for the reception and handling of grievances;
b) Preparation of regular monitoring reports including details of any complaints that arose and how they were handled;
c) If vulnerable affected people are identified, then the contractor will appoint professional advocates (social workers/legal experts) to assist those people during the entire process, and to act as independent advocates for them should any grievances arise;
d) Arbitration of grievances with ArmPower and PAP.

ArmPower will carry out works that include:

a) Nominate a person of staff responsible for grievance procedure coordination, hereby referred to as Grievance Coordinator (including first contact, periodical site visiting of mitigation measure to be implemented by contractor);
b) A telephone line, e-mail address and contact name on project boards;
c) Arbitration of grievances with contractor and PAP.
d) Liaison with court.

The PAP have the option to choose a different representative, or directly liaison with ArmPower' staff responsible for grievance redress. Vulnerable households will have the support of their individual social worker and legal support, if applicable.

NGOs, e.g. Aarhus Centre or local member organizations will monitor grievance redress negotiations, assist with grievance arbitration, and raise public awareness. PAP need to be informed that in case of conflict with the community leader they can address NGO staff to follow up their complaint. NGOs will monitor the relationship between PAP and the community leader.

The aggrieved person (PAP) is encouraged to proceed in the following way:

a) Contact contractor's designated grievance staff in the following way: in person via the designated telephone number, via email, via regular mail. Alternatively, the PAP can contact their community leader, who would convey their grievance to the contractor's designated grievance staff.
b) Lodge a complaint and provide information on the case. Each complaint will be registered and a tracking number will be assigned to it. Responses to all complaints should be provided within 15 days (or 25 days in cases where complaint resolution requires special efforts).

c) Agree with the contractor on a mitigation measure.
d) Agree with the contractor on time limit for grievance settlement. Grievances have to be settled within two weeks, or otherwise specified in scheduled agreement.
e) Sign if the mitigation measure has been implemented as agreed
f) Seek redress from ArmPower if not satisfied with the above mentioned procedure though the designated telephone numbers, in person, or via email or regular mail. ArmPower should register all grievances and provide response within 15 days.
g) Involve appropriate NGOs
h) Seek redress from court if all else fails.

Although the grievance mechanism is designed to avoid lengthy court procedures, it does not limit the citizen's right to submit the case straight to the court of law.

ADB/ IFC are not directly a part of the Grievance procedure but shall receive reports about which complaints were received and how they have been followed up/ mitigated.

Special consideration has to be taken for vulnerable people as complaint mechanisms may be unusual and contact with legal procedures let alone courts of law may appear uninviting. This would prevent the most disadvantaged persons from addressing their grievance. A close monitoring on a village level by an independent social expert during the implementation of the project and a personal contact with PAP is therefore recommended.

Vulnerable PAP (all households below the poverty line) will be entitled to a legal aid/ social worker to support them with complaints procedures.

Annex 3 presents an example of the public grievances form that shall be made available in the developer's webpage.

6.2 Workers grievance mechanism

The EPC Contractor RENCO and the future operator of YCCPP-2 ArmPower are requested to implement an independent grievance management system to enable the workers (and their organizations, where they exist) to raise reasonable workplace concerns. This includes complaints related to non-compliance with Health & Safety matters, discrimination cases and non-consideration of equal opportunities.

The workers grievance mechanism shall follow the same principles as the one created for the general public: complaints must be answered in a timely and effective manner without fear of retribution; the access to the grievance mechanism shall not replace or impede the subsequent access to other redress mechanisms; the promoter will inform workers of the grievance mechanism at the time of hire and make it accessible to them.

The grievance management system shall consider the possibility to contact directly a member of the Site Management Staff. The contacted staff members must take a note of the reported complaint or non-compliance and must report it to the Site Manager.

The Site Manager is requested to solve the complaint or non-compliance within 3 working days. In case the problem cannot be solved an action procedure specifying the needed activities together with a predicted deadline for resolution of the problem must be prepared and submitted to the general manager.

The EPC Contractor and ArmPower are requested to provide as well the possibility for the workers to notify a complaint or non-compliance in a confidential way.

According to RENCO SPA a grievance mechanism for workers will be established for this Project, as it has been done in other international projects before. The system will allow staff and contractors to provide feedback on any element of the work via email or by hand delivery to a box placed on site. Grievances will be logged into a spreadsheet where they will be then delegated to the appropriate person for close out. Grievances will be confidential and staff and contractors will be in no way penalized for providing their feedback.

7. Timetable

Table 7-1 presents a preliminary schedule for the engagement of stakeholders during the ESIA Process. This schedule shall be continuously updated. **Error! Reference source not found.** shows the schedule for the takeholder engagement activities to be undertaken during construction and operation.

Table 7-1: Stakeholder Engagement and ESIA Schedule

Activity	Deliverables	Date
Disclosure of the Project to the local authorities	--	04.- 07.07.2017
Fichtner prepares the Draft ESIA Report in English	Draft ESIA Report in English Non-Technical Executive Summary in English	20.08.2017
RENCO/ARMPOWER and the IFIs review the Draft ESIA Report	--	27.08.2017
Fichtner prepares the Draft Final ESIA according to the review in English	Draft Final ESIA Report in English Non-Technical Executive Summary in English	10.09.2017
The Draft Final ESIA is translated into Armenian	Draft Final ESIA Report in Armenian Non-Technical Executive Summary in Armenian	24.09.2017
RENCO/ARMPOWER posts adverts in the mass-media and on its official web-page informing about the Public Consultation Session.	Adverts: brief summary of the project and invitation for the public consultation session	01.10.2017
The local governments post the advert regarding the conduct of the Session on their web-page, at their offices and in other public places.	Adverts: brief summary of the project and invitation for the public consultation session	01.10.2017
Public Consultation Session in Yerevan	--	28.10.2017 (Saturday)
The IFIs publicly disclose the Draft Final EIA Report	Draft Final ESIA Report in English Non-Technical Executive Summary in English Draft Final ESIA Report in Armenian Non-Technical Executive Summary in Armenian	12.09.2017 - 22.01.2018

Table 7-2: Stakeholder Engagement Schedule during construction and operation

Activity	Platforms	Content	Date
CONSTRUCTION			
The developer notifies the public of the construction works or a specific construction activity	Official web page of the developer	The purpose and nature of the construction activities The start date and duration of the overall construction works and of specific operations The potential environmental and social impacts Information on whom to contact if there are concerns/complaints related to the contractor	One month before construction works start
		Information related to the management of the environmental and social matters (application of measures, monitoring efforts and results). The results of the grievance mechanism	During construction works
The contractor and developer keep a functioning grievance mechanism	Nomination of community liaison personnel Suggestion boxes in public locations Visible billboards Official web-page of the developer	Contact information for sending of grievances Time frame in which all recorded complaints will be responded to	During construction works
OPERATION			

Activity	Platforms	Content	Date
Inform the public of operation related issues (community and occupational health and safety; grievance mechanism; environmental and social monitoring)	Official web-page of the developer	Emergency Preparedness and Response Plan, if existent The project's environmental and social performance reports The results of the grievance mechanism	Every 6 months during the life-time of the project
Keep a functioning grievance mechanism	Official web-page of the Project Operator Visible billboards	Contact information for sending of grievances Time frame in which all recorded complaints will be responded to	During the life-time of the project

8. Responsibilities

The implementation of the SEP will be the responsibility of:

- During the ESIA stage: ArmPower/RENCO;
- During Construction: RENCO SPA as EPC Contractor;
- During Operation: ArmPower/RENCO as Project Operator.

The responsibility to monitor the implementation of the SEP belongs to the IFIs until financial closure of the project.

This Section presents a review of the responsibilities and allocated resources for implementation of the SEP.

8.1 Developer - ArmPower/RENCO

The following is the summary of the responsibilities of ArmPower/RENCO as the Project's Developer.

- During the ESIA preparation:

a) Plan and undertake one Public Consultation Session (see Section 5.1);
b) Disclose the Draft ESIA Report (hard and soft copies) (see Section 5.1);
c) Create and maintain a grievance mechanism for the public (see Section 6.1);
d) Keep and update the Stakeholder Log (see **Annex 2**);
e) Nominate a Community Liaison Officer (CLO) (see Section 6.1).

8.2 EPC Contractor - RENCO SPA.

Within the SEP, RENCO SPA as EPC Contractor has the following summarized responsibilities:

- During construction:

a) Keep the public informed about the construction activities, environmental and social management at site, and contact persons (see Section 5.2);
b) Create and maintain a grievance mechanism for workers and the public (see Section 6);
c) Keep and update the Stakeholder Log (see **Annex 2**);
d) Nominate a Community Liaison Officer (CLO) (see Section 6.1).

8.3 Project Operator - ArmPower/RENCO

The Project Operator (ArmPower/RENCO) will have the following SEP-related responsibilities:

- During operation:

a) Keep the public informed about the environmental and social management at the plant (see Section 5.3);
b) Disclose the Emergency Preparedness and Response Plan (see Section 5.3);
c) Create and maintain a grievance mechanism for workers and the public (see Section 6):
d) Keep and update the Stakeholder Log (see **Annex 2**);
e) Nominate a Community Liaison Officer (CLO) (see Section 6.1).

9. Final remarks

The Draft SEP presents the suggested methodologies, timing, and responsibilities for engaging the public and the workers during the implementation of the YCCPP 2 Project. The main focus of the SEP is to assure conformity with the requirements of IFC and ADB. It includes activities during the ESIA preparation, during construction, and during operation.

The present SEP does not necessarily include a strict engagement with the national authorities because such process has been undertaken in the past. However, it is recommended that RENCO keeps an open door for colaboration with local and national agencies, when necessary and if required by these.

In order for the SEP to be sucessfully implemented, it is necessary to include its dispositions into the Developer's, EPC Contractor's and Operator's own Environmental and Social Management Systems (ESMS). In case such systems are not presently implemented in any of the companies, at least one team shall be nominated in each case that will handle the E&S management at the different stages, and implement and monitor the SEP.

Transparency is important to assure an acceptance of the project by the general public, for what the information disclosure activities suggested in the SEP will play an important role. Engaging the public from the beginning of the implementation of the project and continuously thgroughout its life cycle is expected to bring benefits and reduce eventual unfounded reasons for grievances.

10. References

ADB, 2012: *Strengthening participation for development results - an Asian Development Bank guide to Participation*, ADB, Philippines, 2012

IFC, 1998: *Doing Better Business through Effective Public Consultation and Disclosure - A Good Practice Manual*, IFC, Washington, D.C., October 1998

IFC, 2007: *Stakeholder Engagement: a good practice handbook for companies doing business in emerging markets*, IFC, Washington, D.C., May 2007

IFC, 2012: *Performance Standard 1 - Assessment and Management of Environmental and Social Risks and Impacts*, IFC, Washington, D.C., January 2012

11. Annexes

11.1 Annex 1 - Form for comments

<table>
<tr><td colspan="5">Gender:</td></tr>
<tr><td colspan="5">Title:</td></tr>
<tr><td colspan="5">Name: (Please do not fill this field if you would like to remain anonymous)</td></tr>
<tr><td rowspan="2">Please mark how you wish to be contacted</td><td>☐ Post</td><td>☐ Telephone</td><td>☐ E-mail</td><td>☐ Others</td></tr>
<tr><td>Address:</td><td>Contact number:</td><td>E-mail address:</td><td>Please specify:</td></tr>
<tr><td rowspan="2">Preferred language for communication</td><td>☐ Armenian</td><td>☐ Russian</td><td>☐ English</td><td>☐ Others
Please specify:</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="5">Comments to the draft ESIA Report</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">☐ I request you not to disclose my identity to third parties without my previous written consent</td></tr>
<tr><td colspan="5">Signature: (Please do not fill this field if you would like to remain anonymous)</td></tr>
<tr><td colspan="5">Local:</td></tr>
<tr><td colspan="5">Date:</td></tr>
</table>

11.2 Annex 2 - Model for the Stakeholder Log

Entity	Representative	Communication media	Comment	Answer and Action for follow-up	Responsibility	Deadline	Confirmation of close-out

11.3 Annnex 3 - Public Grievances Form

Gender:				
Title:				
Name: *(Please do not fill this field if you would like to remain anonymous)*				
Please mark how you wish to be contacted	☐ Post	☐ Telephone	☐ E-mail	☐ Others
	Address:	Contact number:	E-mail address:	Please specify:
Preferred language for communication	☐ Armenian	☐ Russian	☐ English	☐ Others Please specify:
Description of Incident or Grievance (What happened? Where did it happen? Who did it happen to? What is the result of the problem?)				
Date of Incident/Grievance:				
☐ One time incident/grievance?		Date:		
☐ Happened more than once?		How many times?		
☐ On-going (currently experiencing problem)				
Do you have suggestions on how to solve the problem?				
☐ I request you not to disclose my identity to third parties without my previous written consent				
Signature: *(Please do not fill this field if you would like to remain anonymous)*				
Local:				
Date:				