PROJECT:

EastMed Pipeline Project

Document Title:	EastMed Greek Section – Environmental and Social Impact Assessment
Document Subtitle:	Annex 8A.2- Soil and groundwater characteristics report for Achaia Compressor Station
Project Document No:	PERM-GREE-ESIA-A08_0004_0_Annex8A2

Document details	
Document title	EastMed Greek Section – Environmental and Social Impact Assessment
Document subtitle	Annex 8A.2 - Soil and groundwater characteristics report for Achaia Compressor Station
Company	IGI Poseidon
Author	INTERGEO
Project	EastMed Pipeline Project
Project Document No.	PERM-GREE-ESIA-A08_0004_0_Annex8A2
Date	03/06/2022
Version	00

Document history

Revision	Author	Reviewed by	Approved by	Date	Status
00	INTERGEO	ASPROFOS	IGI POSEIDON	03/06/2022	For submission to Authorities

Table of Contents

List of Figures

List of Tables

External cooperation

This document was drafted with the cooperation of:

- INTERGEO, Environmental Technology Ltd

ANNEX 8A.2 SOIL AND GROUNDWATER CHARACTERISTICS

REPORT FOR ACHAIA COMPRESSOR STATION

8A.2.1 SUMMARY

INTERGEO Environmental Technology Ltd, was assigned to perform an Environmental Site Investigation, at the plot where the future Natural Gas Compression Station CS3will be constructed in Achaia-Peloponnese.

This site investigation was performed in order to obtain a representative overview of the type and extent of contamination that might be present at the site and included the collection of seven (7) surface soil samples and one (1) groundwater sample from existing private well.

The plot area and the existing private well are located south of the village of Kato Velitses, in the wider area of the artificial lake of Pinios.

All the fieldwork activities took place on 18/06/2021.

The collected samples were conducted in a series chemical analyses regarding their concentration in several organic, inorganic and microbiological parameters.

According to the overall evaluation of the investigation results, no any significant inorganic, organic and microbiological contamination was detected in the surface soil and the groundwater of the investigated area.

The environmental sensitivity of the investigated plot area in Achaia should be defined generally as medium to low.

This arises from its distance from the coastline (24km) and the presence of shallow underground receptor (relative swallow groundwater < 10 m bgs). Furthermore hydrogeologically, the site is underlain by geological layers with varying permeability at the shallow depth that generally does not allow the easy downward migration of potential contaminants to the groundwater table.

In any case, a periodic and documented monitoring of the groundwater quality in the future is strongly recommended by sampling of the existing private well at least once a year.

The proposed action will detect any possible influence of the future Natural Gas compression Terminal, during construction and operation period, in the groundwater

8A.2.2 PRELIMINARY INVESTIGATION

8A.2.2.1 Site Location

The plot area and the existing private well are located south of the village of Kato Velitses, in the wider area of the artificial lake of Pinios. The distance of the plot area from the sea 24km approximately.

The approximate geographic location and a satellite view of the investigated area are shown in the attached figures 1, 2 (including the existing groundwater well Mw1) and 3 (Appendix 1 - FIGURES). A satellite view of the existing private well is shown in the attached figure 5 (Appendix 1 - FIGURES).

8A.2.2.2 Historic site land use

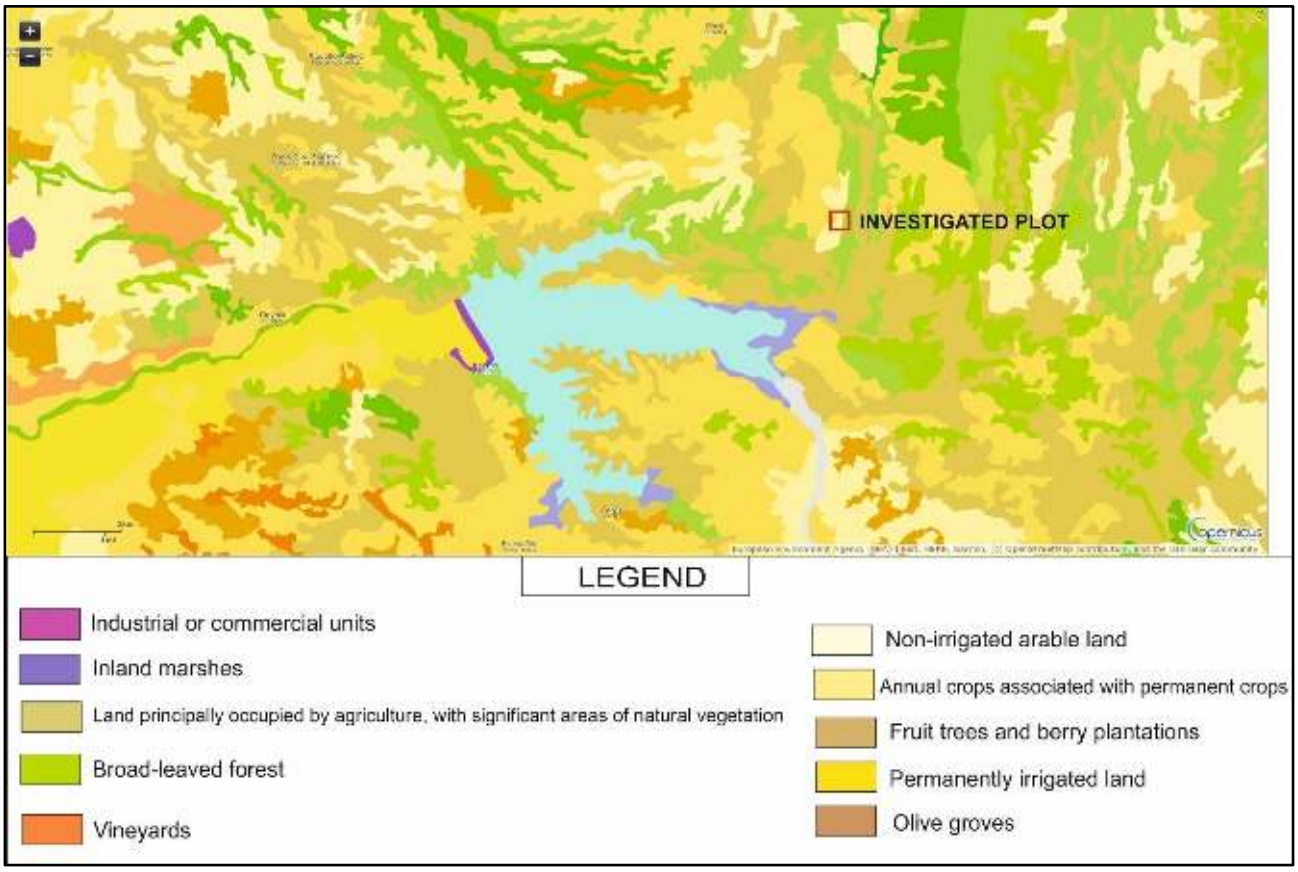
At the investigated area no previous industrial activities took place in the past. Furthermore, not any hazardous or debris materials were encountered at the site during a walk over survey.

8A.2.2.3 Surrounding land use

Generally, the site is located south of the village of Kato Velitses and north of the artificial lake of Pinios. Not any industrial activity was recorded in the vicinity.

Based on the land use map (Corine 2018), the main activities in the vicinity of the investigated area are agricultural.

In Figure A2- 1 below the land use of the wider area of the site is presented (Corine 2018).



Prepared by INTERGEO on behalf ASPROFOS, 2022.

Figure A2- 1 Land use of the wider area.

8A.2.3 INVESTIGATION METHODS

On 18/06/2021 took place the collection of seven (7) soil samples and one (1) groundwater sample by INTERGEO's personnel Mr. Michail Xifaras.

8A.2.3.1 Relevant Legislation

Till today, there is no active legislation in terms of set values for soil and/or groundwater contamination in Greece. In future, the Greek Authorities responsible for environmental legislation and protection will set up specific limit values for different land use sites, based on a range of soil quality parameters.

According to the obligation of Greece to be harmonized with the legislation of the European Union in future, the soil and groundwater conditions have to be assessed for all sites. Moreover, according to proposal EU Direction No 2006/0086 (COD), a soil report is required in cases of selling or buying sites or plots where potential contamination activities may have taken place.

Currently, when the environmental Authorities are involved in a contamination case, usually after an accusation by a third party, they generally refer to international accepted standards for the soil and groundwater. These are for example the New Dutch list standards[1] that are preferred by the local authorities due to the absence of relevant regulatory list in Greece.

If there is a contamination in the soil and/or groundwater when compared to these standards the local Authorities can enforce financial penalties to the polluters and also additionally require the polluter to proceed with remediation actions. The "polluter pays" principle is endorsed by Presidential Decree 148/2009, which was implemented by the Environmental Liability Directive 2004/35/EC. The principle was already present in pre-existing legislation, as introduced by law 1650/1986. The operator of a polluting activity bears the costs for preventive and remedial actions taken pursuant to the law for the prevention and restoration of environmental damage caused. Furthermore, in the event that there is an imminent threat of environmental damage, the operator is obliged to investigate the subject property for contamination and undertake instantly, under its own judgment, any preventive measures and must inform the competent authorities.

Also with reference to groundwater contamination, law 3199/2003 implementing the Water Framework Directive (2000/60/EC) provides for administrative fines and criminal sanctions.

An active legislation in Greece concerning the groundwater quality is: M.D. οικ. 1811/2011 (G.G 3322/B`/30.12.2011) "Maximum allowed concentration in the groundwater, in accordance of paragraph 2 of article 3 of No 39626/2208/E130/2009 ministry decision (2075/B)". Table A2- 1 below shows the quality standards and maximum accepted concentration values of contaminants in the groundwater and contamination indicators according to M.D. 1811/2011.

Table A2- 1 Quality standards and maximum accepted concentration values of contaminants in the groundwater and contamination indicators according to M.D. 1811/2011

PART A	
Contaminant	Quality standards of Groundwater
Nitrates (NO3-)	50 mg/l
Pesticides active substances	0.1 μg/l

[1] Ministerie van Volkshuisvesting (2013). Soil Remediation Circular 2013, version of 1st July 2013.

	0.5 µg/l (total)
PART B	
Parameter	Maximum accepted value
pH	6.50 – 9.50
Electrical Conductivity (EC)	2,500µS/cm
Arsenic (As)	10 µg/l
Cadmium (Cd)	5 µg/l
Lead (Pb)	25 µg/l
Mercury (Hg)	1.0 µg/l
Nickel (Ni)	20 µg/l
Chromium total (Cr)	50 µg/l
Aluminum (Al)	200 µg/l
Ammonium (NH4+)	0.50 mg/l
Nitrite (NO2-)	0.50 mg/l
Chloride (Cl-)	250 mg/l
Sulfates (SO42-)	250 mg/l
Sum of Trichloroethylene (TCE) and Tetrachloroethylene (PCE)	10 µg/l

Prepared by INTERGEO on behalf ASPROFOS, 2022.

There is no specific procedure for the decision of implementation of soil remedial measures in contaminated sites. However, if contamination becomes public, then a special study is required (Remedial Action Plan) by experienced engineers describing the most appropriate decontamination alternatives, taking under consideration the existing environmental and health and safety risk caused by the detected contamination. This study has to be approved by the local environmental authorities. The remedial actions are paid by those deemed responsible for the contamination.

A variety of provincial regulations exist within the European Union, setting limits for contaminants in soil and groundwater. In Germany, for example, each province has its own list for the tolerable concentration of various contaminants.

According to the New Dutch List, the regulatory list, which is valid in many European countries, two different values are given for the concentration of each pollutant.

Target value: determines the average concentration (for groundwater only)

Intervention value: determines the concentration above which the application of decontamination measures is compulsory.

According to the New Dutch List the value limits for heavy metals are shown in the below Table A2-2.

Table A2- 2 Limit Values (New Dutch List) for heavy metals in the groundwater

	Target Value (µg/l)	Intervention Value (µg/l)
Heavy metal Contaminant		
Aluminium (Al)	-	-
Arsenic (As)	10	60
Antimony (Sb)	-	20
Beryllium (Be)	-	15
Lead (Pb)	15	75
Cadmium (Cd)	0.4	6
Chromium (Cr)	1	30
Fluorine (F)	-	-
Iron (Fe)	-	-
Cobalt (Co)	20	100
Copper (Cu)	15	75
Lithium (Li)	-	-
Manganese (Mn)	-	-
Molybdenum (Mo)	5	300
Nickel (Ni)	15	75
Mercury (Hg)	-	-
Selenium (Se)	-	160
Tellurium (Te)	-	70
Vanadium (V)	-	70
Zinc (Zn)	65	800
Boron (B)	-	-
Hexavalent Chromium (CrVI)	-	-

Prepared by INTERGEO on behalf ASPROFOS, 2022.

The corresponding Target and intervention values from ‘‘New Dutch list’’ for Total Petroleum Hydrocarbons (TPH) concentration in groundwater are shown below in Table A2- 3.

Table A2- 3 Limit Values (New Dutch List) for Total Petroleum Hydrocarbons (TPH) in groundwater

Limit values of the new Dutch List	TPH mg/l
Target value	0.05
Intervention value	0.6

Prepared by INTERGEO on behalf ASPROFOS, 2022.

According to the New Dutch List, the limit values of the Polycyclic Aromatic Hydrocarbons (PAHs) contaminants in the groundwater are given in the following Table A2- 4.

Table A2- 4 Limit Values (New Dutch List) for Polycyclic Aromatic Hydrocarbons (PAHs) concentration in the groundwater

PAHs	Target value µg/l	Intervention value µg/l
Naphthalene	0.1	70
Acenaphthylene	--	--
Acenaphthene	--	--
Fluorene	--	--
Phenanthrene	0.03	5
Anthracene	0.02	5
Fluoranthene	--	--
Pyrene	--	--
Benzo(a)anthracene	0.002	0.5
Chrysene	0.002	0.05
Benzo(b)fluoranthene	--	--
Benzo(k)fluoranthene	0.001	0.05
Benzo(a)pyrene	0.001	0.5
Dibenzo(ghi)perylene	--	--
Benzo(ghi)perylene	0.0002	0.05
Indeno(1,2,3-cd)pyrene	0.0004	0.05

Prepared by INTERGEO on behalf ASPROFOS, 2022.

Table A2- 5 below shows the quality standards and maximum accepted concentration values of some contaminants, related to the chemical analyses results, in the drinking water and contamination indicators according to M.D Γ1(δ)/ ΓΠ οικ.67322/2017.

Table A2- 5 Quality standards and maximum accepted concentration values of some contaminants in the drinking water and contamination indicators according to M.D Γ1(δ)/ ΓΠ οικ.67322/2017

Parameter	Maximum accepted value
Iron (Fe)	200 μg/l
Manganese (Mn)	50 μg/l
Antimony (Sb)	5 μg/l
Boron (B)	1.0 mg/l
Copper (Cu)	2.0 mg/l
Arsenic (As)	10 μg/l
Selenium (Se)	10 μg/l
Cadmium (Cd)	5 μg/l
Lead (Pb)	10 μg/l
Mercury (Hg)	1.0 μg/l
Nickel (Ni)	20 μg/l
Chromium total (Cr)	50 μg/l
Aluminum (Al)	200 μg/l
Chloride (Cl-)	250 mg/l
Sulfates (SO42-)	250 mg/l
Nitrate (NO3-)	50 mg/l
Dissolved Hydrocarbons – Oil grease	10 μg/l
PAHs	0.1 μg/l
Sum of Trichloroethylene and Tetrachloroethylene	10 μg/l
pH	6.50 – 9.50
Electrical Conductivity (EC)	2,500μS/cm
Escherichia coli (E. coli)	0/100ml
Coliform bacteria	0/100ml

Prepared by INTERGEO on behalf ASPROFOS, 2022.

8A.2.3.2 Surface soil sampling

The surface soil sampling was performed by means of hand auger equipment and reached the maximum depth of 30cm below ground surface.

The geographical coordinates of the seven (7) surface soil sampling points are presented in Table A2-6

Table A2- 6 Coordinates of surface soil sampling points from area south of the village of Kato Velitses.

Surface sample	Coordinates	
Ss1	37°55'36.49"N	21°32'14.66"E
Ss2	37°55'35.71"N	21°32'20.20"E
Ss3	37°55'37.80"N	21°32'20.13"E
Ss4	37°55'36.23"N	21°32'18.4"E
Ss5	37°55'33.87"N	21°32'24.15"E
Ss6	37°55'41.15"N	21°32'20.70"E
Ss7	37°55'40.50"N	21°32'16.68"E

Prepared by INTERGEO on behalf ASPROFOS, 2022.

All surface soil sampling locations are indicated in Appendix 1 - FIGURES (see figure 4) and respective photos are given in Appendix 3 - PHOTOS

All soil samples were collected and stored in cool conditions and were analysed in certified laboratory according to EN ISO 17025 international standards.

The soil samples that collected were submitted to a series of chemical analyses, presented in the Table A2- 7 below:

Table A2- 7 Parameters tested in the obtained soil samples

Number of samples	Parameter
7	Heavy metals (Sb, As, Be, Cd, Co, Cr, CrIV, Hg, Ni, Pb, Cu, Se, Sn, Tl, V, Zn) according to EN ISO 11885, DIN EN ISO 12846, DIN EN 15192 and DIN EN ISO 17294-2 (E 29)
7	Total Petroleum Hydrocarbons (TPH) according to EN ISO 16573
7	Polycyclic Aromatic Hydrocarbons (PAH's) according to DIN ISO 18287 : 2006-05
7	PCB's according to DIN EN 15308.

Prepared by INTERGEO on behalf ASPROFOS, 2022.

All chemical analyses results are presented in Appendix 2 - CHEMICAL ANALYSES RESULTS

8A.2.3.2.1 Fraction sieve analysis

Also all soil samples that collected from the plot of interest were submitted to fraction sieve analysis.

The size distribution is often of critical importance to the way the material performs in use. A sieve analysis can be performed on any type of non-organic or organic granular materials including sands, crushed rock, clays, granite, feldspars, coal, soil, a wide range of manufactured powders, grain and seeds, down to a minimum size depending on the exact method. Being such a simple technique of particle sizing, it is probably the most common.

During sieving the sample is subjected to horizontal or vertical movement in accordance with the chosen method. This causes a relative movement between the particles and the sieve, depending on their size the individual particles either pass through the sieve mesh or are retained on the sieve surface. The likelihood of a particle passing through the sieve mesh is determined by the ratio of the particle size to the sieve openings, the orientation of the particle and the number of encounters between the particle and the mesh openings.

8A.2.3.3 Groundwater sampling

8A.2.3.3.1 Groundwater sampling

On 18/06/2021 groundwater sampling was conducted from an existing private well located adjacent and north-west from the plot where the future Natural Gas compression Terminal will be constructed and at a distance of about 1000 m from the plot, in order to control the groundwater condition.

The geographical coordinates of the existing private well are presented in Table A2- 8:

Table A2- 8 Coordinates of groundwater sampling point from area south of the village of Kato Velitses.

Groundwater well	Coordinates	
Mw1	37°56'19.33"N	21°32'02.11"E

Prepared by Intergeo on behalf ASPROFOS, 2022.

The groundwater sample was collected directly from the existing well by means of special groundwater sampler (PVC bailer). The collection, conservation, storage and transport of the samples took place according to EN ISO 5667-3 specifications (General Information for Sample Recovery and Preservation).

The groundwater sample that collected was submitted to a series of chemical analyses, presented in the Table A2- 9 below:

Table A2- 9 Parameters tested in the obtained groundwater sample

Number of samples	Parameter
1	Heavy metals (Al, As, Be, , Cd, Co, Cr, CrIV, Cu,F, Fe, Li, Mn, Mo, Ni, Pb, , Se,V, Tl, Zn, Sb ,B, Hg) according to, DIN EN ISO 12846 and DIN EN ISO 17294-2 (E 29)
1	Total oil (TPH + TOG) according to EN ISO 9377-2 and DIN 38409-H56
1	Polycyclic Aromatic Hydrocarbons (PAH's) according to DIN 38407-39
1	Total coliforms according to

Number of samples	Parameter
1	BOD5, COD, according to ΕΛΟΤ EN ISO 15705 and BOD Sensor
1	TDS, according to ΕΛΟΤ EN 15216
1	Sum TCE+PCE according to DIN EN ISO 10301
1	TOC according to DIN EN 1484
1	Anions according to EPA 325.1, EPA 375.4, DIN 38405 D9, EPA 340.3 and EN 1189

Prepared by INTERGEO on behalf ASPROFOS, 2022.

All chemical analyses results are presented in Appendix 2 - CHEMICAL ANALYSES RESULTS.

8A.2.4 GEOLOGICAL AND HYDROGEOLOGICAL SITUATION

8A.2.4.1 Topography

The plot is located at a great distance (24 km) from the sea (Ionian Sea). The geomorphology of the local area presents geomorphs such as hills and steep slopes. However, in the area of the plot, the relief is milder. The altitude within the plot ranges between 248-254 m and 255-263 m above sea level at its western and eastern limits, respectively.

Figure A2- 2, below, shows the morphology of the territory, in the wider area of the investigated plot.

Prepared by INTERGEO on behalf ASPROFOS, 2022

Figure A2- 2 Morphology of the territory, in the broader area of the investigated plot.

8A.2.4.2 Hydrology

The plot is located at a great distance (24 km) from the Ionian Sea. An important artificial formation near the study area is the artificial lake of Piniou. However, there is no stream that passes through the plot of interest.

Regarding the water basin, both the research area and the groundwater well are located within the same catchment area (Pirou-Verga-Pinios catchment area).

8A.2.4.3 Regional Geology/Hydrogeology

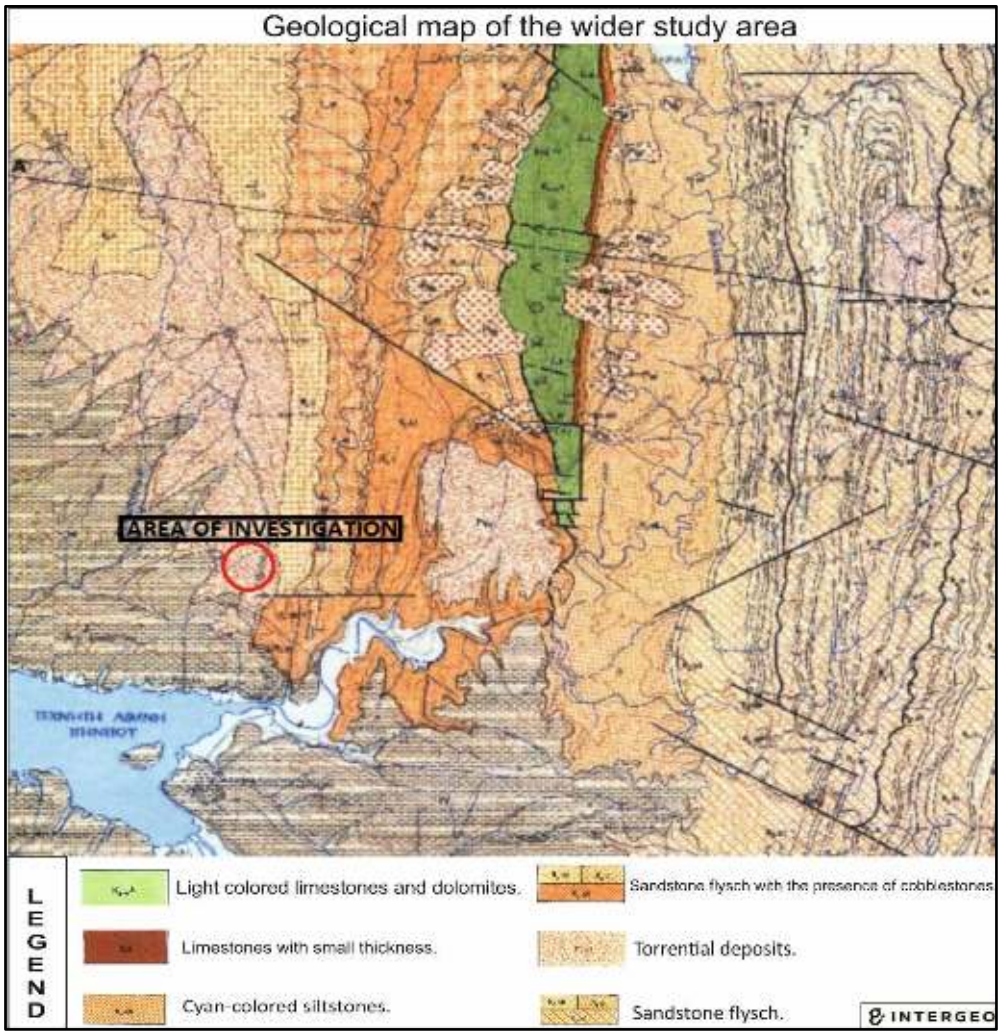
The study area belongs from a geological point of view, to the geotectonic zone of Gavrovo – Tripoli. This consists of a thick-layered flysch with limestone background.

The geology of the wider area consists of four (4) geological formations.

- Sandstone flysch, with a thickness of 0.2 to 2 meters.
- Cyan-colored siltstones, with the presence of cobblestones.
- Thick-layered light-colored limestones and dolomites to the north.
- Biogenic limestones of small thickness up to 1 m.

As far as the plot of interest is concerned, it consists of sedimentary rocks in the forms of torrents. These deposits have reddish-grained sand in their lower layers, while in the upper layers there are cobbles that appear with an angular shape. The thickness of these formations ranges from 1.5 to 3 m.

The regional geological features are presented below in Figure A2- 3.



Prepared by INTERGEO on behalf ASPROFOS, 2022.

Figure A2- 3 Simplified geological map of the area under investigation.

8A.2.5 CHEMICAL ANALYSES RESULTS

8A.2.5.1 Surface soil samples

8A.2.5.1.1 Heavy Metals

Seven (7) surface soil samples were tested according to EN ISO 11885, DIN EN ISO 12846, DIN EN 15192 and DIN EN ISO 17294-2 (E 29) Standard Methods to define their concentration in selected Heavy Metals (Sb, As, Be, Cd, Co, Cr, CrVI, Hg, Ni, Pb, Cu, Se, Sn, Tl, V, Zn). The Standard Methods

applied for the determination of each metal are shown in the table of chemical analysis results in Appendix 2 - CHEMICAL ANALYSES RESULTS

The Table A2- 10 below shows the range of the recorded concentrations of heavy metals in the examined soil samples:

Table A2- 10 Range of the recorded concentrations of heavy metals in the examined surface soil samples

Heavy metal	Number of examined samples	Intervention Value (mg/kg)	Range of concentrations (mg/Kg)	Number of samples exceeding action value of NDL
Arsenic (As)	7	76	2.1-5.0	--
Cadmium(Cd)	7	13	n.d.	--
Chromium(Cr)	7	258	54-110	--
Copper (Cu)	7	190	9-27	--
Mercury (Hg)	7	36	n.d.	--
Nickel (Ni)	7	100	41-160	1
Lead (Pb)	7	530	7-21	--
Zinc (Zn)	7	720	18-61	--
Beryllium (Be)	7	30	n.d.	--
Selenium (Se)	7	100	n.d.	--
Vanadium (V)	7	250	29-53	--
Cobalt (Co)	7	190	11-21	--
Thallium (Tl)	7	15	n.d.-0.1	--
Antimony (Sb)	7	22	n.d.	--
Tin (Sn)	7	900	n.d.	--

Prepared by INTERGEO on behalf ASPROFOS, 2022.

Based on the results, no significant inorganic soil contamination was noted in the investigated site. All of Heavy metals concentrations, in the majority of the analyzed surface soil samples, remained below the intervention values of New Dutch List (NDL).

As for Nickel (Ni), the recorded concentration at sampling position SS1 (160mg/kg) exceeded the relative intervention value of New Dutch (100mg/kg). The increased Ni concentration in the obtained soil samples (SS1) is originated from area's geological layers.

All heavy metals analyses results are presented in Appendix 2 - CHEMICAL ANALYSES RESULTS. The distribution of the concentration in eight (8) selected heavy metals (As, Cr, Cu, Ni, Pb, Zn, V and Co) in the surface soil is illustrated in figures 6 to 13 for the investigated plot area.

8A.2.5.1.2 Total Petroleum Hydrocarbons (TPH)

A variety of provincial regulations exist within the European Union, setting limits for contaminants in the soil. In Germany, for example, each province has its own list for the tolerable concentration of (total) mineral oil hydrocarbons. The limit concentration varies between 300 and 1000 mg/kg, with a dominantly accepted maximum tolerable concentration the one of 500 mg/kg.

Recently the Greek Authorities adopted the limit concentration of 500 mg/Kg TPH (Total Petroleum Hydrocarbons) that is mentioned European Community decision 2003/33 (Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to article 16 of and Annex II to Directive 1999/31/EC) and indicates the characterization of inert material / waste.

Table A2- 11 below shows the limit values for the concentration of Total Petroleum Hydrocarbons (TPH) as well as the range of the recorded concentrations in the analyzed soil samples.

Table A2- 11 Limit values of Total Petroleum Hydrocarbons (TPH) and the range of the recorded concentrations in the analyzed soil samples.

Limit values of the soil contamination	TPH mg/kg	Range of the examined soil samples (mg/kg)	Number of samples exceeding intervention value of NDL (> 5000 mg/Kg)	Number of samples exceeding limit value according to European Community decision 2003/33 (>500 mg/Kg)
Intervention value (New Dutch list)	5000	n.d.	-	-
Limit value according to European Community decision 2003/33	500			

Prepared by INTERGEO on behalf ASPROFOS, 2022. n.d. not detected

Totally seven (7) soil samples were analysed for their concentration in TPH according to EN ISO 16703.

Based on the TPH analyses results, not any organic soil contamination, of Total Petroleum Hydrocarbons, was noted in the subject area. All of the TPH concentrations of the analyzed soil samples, remained at non detectable level.

All TPH analyses results are presented in Appendix 2 - CHEMICAL ANALYSES RESULTS.

8A.2.5.1.3 Polycyclic Aromatic Hydrocarbons (PAHs)

All obtained surface soil samples (totally 7) were tested according to DIN ISO 18287 : 2006-05 Standard Method to define the concentration of Polycyclic Aromatic Hydrocarbons (PAHs).

Table A2- 12 below shows the limit values for the concentration of Polycyclic Aromatic Hydrocarbons (PAH) as well as the range of the recorded concentrations in the analyzed soil samples.

Table A2- 12 Limit values of Polycyclic Aromatic Hydrocarbons (PAH) and the range of the recorded concentrations in the analyzed soil samples.

Limit values of the soil contamination	PAH mg/kg	Range of the examined soil samples (mg/kg)	Number of samples exceeding intervention value of NDL (> 40 mg/Kg)
Intervention value (New Dutch list)	40	n.d.	-

Prepared by INTERGEO on behalf ASPROFOS, 2022.

Based on the PAH analyses results, not any organic soil contamination, of Polycyclic Aromatic Hydrocarbons (PAH), was noted in the subject area. All of the PAH concentrations of the analyzed soil samples, remained at non detectable level.

All PAH chemical analyses results are presented in Appendix 2 - CHEMICAL ANALYSES RESULTS

8A.2.5.1.4 PCBs

Totally seven (7) soil samples were analysed for their concentration in PCBs according to DIN EN 15308.

Table A2- 13 below shows the limit values for the concentration of Polycyclic Aromatic Hydrocarbons (PAH) as well as the range of the recorded concentrations in the analysed soil samples.

Table A2- 13 Limit values of Polychlorobiphenyls (PCBs) and the range of the recorded concentrations in the analyzed soil samples.

Limit values of the soil contamination	PCB mg/kg	Range of the examined soil samples (mg/kg)	Number of samples exceeding intervention value of NDL (> 1 mg/Kg)
Intervention value (New Dutch list)	1	n.d.	-

Prepared by INTERGEO on behalf ASPROFOS, 2022.

Based on the PCBs analyses results, not any soil contamination, of Polychlorobiphenyls (PCBs), was noted in the subject area. All of the PCB concentrations of the analysed soil samples, remained at non detectable level.

All PCB's chemical analyses results are presented in Appendix 2 - CHEMICAL ANALYSES RESULTS

8A.2.5.1.5 Fraction sieve analysis

A sieve analysis (or gradation test) is a practice or procedure used (commonly used in civil engineering) to assess the particle size distribution (also called gradation) of a granular material.

The size distribution is often of critical importance to the way the material performs in use. A sieve analysis can be performed on any type of non-organic or organic granular materials including sands, crushed rock, clays, granite, feldspars, coal, soil, a wide range of manufactured powders, grain and seeds, down to a minimum size depending on the exact method. Being such a simple technique of particle sizing, it is probably the most common

During sieving the sample is subjected to horizontal or vertical movement in accordance with the chosen method. This causes a relative movement between the particles and the sieve, depending on their size the individual particles either pass through the sieve mesh or are retained on the sieve surface. The likelihood of a particle passing through the sieve mesh is determined by the ratio of the particle size to the sieve openings, the orientation of the particle and the number of encounters between the particle and the mesh openings.

The sieve analyses results are presented in the following Table A2- 14:

Table A2- 14 Sieve analysis in the surface soil samples.

Surface sample	Cobles (%)	Sand (%)	Silt-Clay (%)	Clay (%)
Ss1	-	21	79	-

Surface sample	Cobles (%)	Sand (%)	Silt-Clay (%)	Clay (%)
Ss2	-	22	78	-
Ss3	-	19	81	-
Ss4	-	20	80	-
Ss5	-	19	81	-
Ss6	-	21	79	-
Ss7	-	18	82	-

Prepared by INTERGEO on behalf ASPROFOS, 2022.

8A.2.5.2 Groundwater samples

8A.2.5.2.1 On site measurements

During the sampling procedure several physico - chemical parameters were measured on site using portable scientific equipment such as:

- Electrical conductivity (EC) (μS/cm or mS/cm)
- pH
- Temperature (°C).
- Piezometric level (m)

All values of the physico - chemical parameters, are shown in the Table A2- 15 below

Table A2- 15 On site Physico – chemical measurements (18/06/2021)

Monitoring well	Groundwater level below ground surface (m)	Electrical Conductivity (μS/cm)	Temperature (oC)	pH	Organoleptical observation
MW1	3.23	825	2.0	7.8	No smell

Prepared by INTERGEO on behalf ASPROFOS, 2022.

Based on the on-site physico – chemical measurements the following can be concluded:

The **EC value (825 μS/cm)** in the examined private groundwater well was measured 825 μS/cm indicating normal condition (decreased salinity) and remained below the limit value of 2,500 μS/cm, set by M.D. 1811/2011.

Temperature (25 oC) was found in normal range expected at the specific time period.

The pH value (7.8) that was determined for the obtained groundwater sample was within the range of the limit values according to the M.D. 1811/2011.

8A.2.5.2.2 Heavy metals

The regulatory limit values of the New Dutch List and the relevant Greek legislation (M.D. 1811/2011) were compared to the findings of the chemical analyses to establish whether the groundwater is impacted by heavy metals. One (1) groundwater sample was tested according DIN EN ISO 17294-2 (E-29) and EN 12846 Standard Methods.

Table A2- 16 shows the limit values for heavy metals analysed in groundwater and the range of recorded concentrations in the obtained groundwater sample:

Table A2- 16 Limit Values (New Dutch List and Greek Legislation) for heavy metals in the groundwater and range of recorded concentrations

Heavy metal	Target Value (NDL) (µg/L) - Shallow	Intervention Value (NDL) (µg/L)	Greek legislation*1 (µg/L)	MW1
Aluminium (Al)	-	-	200	n.d.
Arsenic (As)	10	60	10	n.d.
Antimony (Sb)	-	20	-	n.d.
Beryllium (Be)	-	15	-	n.d.
Lead (Pb)	15	75	25	n.d.
Cadmium (Cd)	0.4	6	5	n.d.
Chromium (Cr)	1	30	50	n.d.
Fluorine (F)	-	-	-	0.11
Iron (Fe)	-	-	-	0.01
Cobalt (Co)	20	100	-	n.d.
Copper (Cu)	15	75	-	n.d.
Lithium (Li)	-	-	-	0.0080
Manganese (Mn)	-	-	-	n.d.
Molybdenum (Mo)	5	300		n.d.
Nickel (Ni)	15	75	20	n.d.
Mercury (Hg)	-	-	1	n.d.
Selenium (Se)	-	160	-	n.d.
Tellurium (Te)	-	70	-	n.d.
Vanadium (V)	-	70	-	n.d.

Heavy metal	Target Value (NDL) (µg/L) - Shallow	Intervention Value (NDL) (µg/L)	Greek legislation*1 (µg/L)	MW1
Zinc (Zn)	65	800	-	n.d.
Boron (B)	-	-	-	0.25
Hexavalent Chromium (CrVI)	-	-	-	n.d.

Prepared by INTERGEO on behalf ASPROFOS, 2022. n.d. not detected

Based on the heavy metal analyses results, the concentrations ranged between low and non-detectable levels and remained below the target and intervention values of NDL (New Dutch List) and the relative Greek legislation (M.D. 1811/2011 (ΦΕΚ 3322/Β`/30.12.2011) and M.D. Γ1(δ)/ ΓΠ οικ. 67322/2017 (G.G 3282/19.09.2017).

Based on the results not any inorganic contamination, from heavy metals, was found on groundwater at the study area.

8A.2.5.2.3 Total Petroleum Hydrocarbons (TPH)

The one (1) groundwater sample that was obtained from groundwater well (MW1) was tested according to EN ISO 9377-2 Standard Method for its concentration in Total Petroleum Hydrocarbons (TPH). According to the organoleptic observation, no smell of any petroleum product was detected in the examined groundwater sample. According to the chemical analyses results groundwater was found in satisfactory condition. Almost all examined parameters remained in very low values and in some cases in not detectable level.

In the Table A2- 17 below, are presented the limit values regarding the TPH concentration, as well as, the recorded concentration that was found in the obtained groundwater sample.

Table A2- 17 Limit Values (New Dutch List) for Total Petroleum Hydrocarbons in the groundwater and recorded concentration.

Pollutant	Target Value (NDL) (mg/L	Intervention Value (NDL) (mg/L	MW1
Total Petroleum Hydrocarbons (TPH)	0.05	0.6	n.d.

Prepared by INTERGEO on behalf ASPROFOS, 2022. n.d. not detected

According to the results no organic contamination from TPH was found on the groundwater at the study area.

The concentration of TPH remained at non-detectable levels.

8A.2.5.2.4 Total oil and grease

The one (1) groundwater sample that was obtained from groundwater well (MW1) was tested according to DIN 38409-H56 Standard Method for its concentration in Total oil and grease (TOG). According to the chemical analyses results groundwater was found in satisfactory condition. The examined parameter remained in not detectable level.

In the Table A2- 18 below, are presented the limit values regarding the TOG concentration, as well as, the recorded concentration that was found in the obtained groundwater sample.

Table A2- 18 Limit Values (M.D Γ1(δ)/ ΓΠ οικ.67322/2017) for Total Oil and Grease in drinking water and recorded concentration in the obtained groundwater sample.

Pollutant	M.D Γ1(δ)/ ΓΠ οικ.67322/2017 (μg/L)	MW1
Total Oil and Grease (TOG)	10	n.d.

Prepared by INTERGEO on behalf ASPROFOS, 2022. n.d. not detected

8A.2.5.2.5 Polycyclic Aromatic Hydrocarbons (PAH)

The one (1) groundwater sample that was obtained from groundwater well (MW1) was tested according to DIN 38407-39 Standard Method for its concentration in Polycyclic Aromatic Hydrocarbons (PAH).

According to the chemical analyses results the concentration in sum PAH's remained at non-detectable levels.

Table A2- 19 below shows the limit values for the concentration of Polycyclic Aromatic Hydrocarbons (PAH) as well as the range of the recorded concentrations in the analysed soil samples.

Table A2- 19 Limit values of Polycyclic Aromatic Hydrocarbons (PAH) and the range of the recorded concentrations in the analyzed groundwater sample.

Parameter	New Dutch List Target value (NDL) (μg/l)	New Dutch List Intervention value (NDL) (μg/l)	MW1 (μg/l)
Naphthalene	0.1	70	n.d.
Acenaphthylene	--	-	n.d.

Parameter	New Dutch List Target value (NDL) (µg/l)	New Dutch List Intervention value (NDL) (µg/l)	MW1 (µg/l)
Acenaphthene	--	-	n.d.
Fluorene	--	-	n.d.
Phenanthrene	0.03	5	n.d.
Anthracene	0.02	5	n.d.
Fluoranthene	--	1	n.d.
Pyrene	--	-	n.d.
Benz(a)anthracene	0.002	0.5	n.d.
Chrysene	0.002	0.2	n.d.
Benzo(b)fluoranthene	--	-	n.d.
Benzo(k)fluoranthene	0.001	0.05	n.d.
Benzo(a)pyrene	0.001	-	n.d.
Dibenzo(a,h)anthracene	--	-	n.d.
Benzo(g,h,i)perylene	0.0002	0.05	n.d.
Indeno(1,2,3-cd)pyrene	0.0004	0.05	n.d.
Sum PAH (16 EPA)	-	-	n.d.

Prepared by INTERGEO on behalf ASPROFOS, 2022). n.d. not detected

Based on the PAH analyses results, not any organic groundwater contamination, of Polycyclic Aromatic Hydrocarbons (PAH), was noted in the subject area.

All PAH chemical analyses results are presented in Appendix 2 - CHEMICAL ANALYSES RESULTS

8A.2.5.2.6 Volatile Organic Compounds (VOCs) – Sum TCE and PCE

A total of one (1) groundwater samples was obtained from groundwater well MW1 and was analysed for its concentration as sum of Trichloroethylene and Tetrachloroethylene.

In the Table A2- 20 below are presented the concentrations that have been found according to the chemical analyses results.

Table A2- 20 Recorded concentrations of sum TCE and PCE in groundwater.

Parameter	M.D. 1811/2011 (μg/L)	New Dutch List Target value (NDL) (μg/L)	New Dutch List Intervention value (NDL) (μg/L)	MW1 (μg/L)
Trichloroethene	-	24	500	n.d.
Tetrachloroethene	-	0.01	40	n.d.
Sum TCE + PCE	10	-	-	n.d.

Prepared by INTERGEO on behalf ASPROFOS, 2022. n.d. not detected

Based on the results of the chemical analyses regarding the concentration on TCE and PCE, not any groundwater contamination of Volatile Organic Compounds (VOC's) was detected on groundwater at the subject area.

All concentrations remained at non-detectable levels.

8A.2.5.2.7 Anions – Microbiological

All examined anions and cations concentrations, remained in the normal range according to M.D. 1811/2011 and M.D Γ1(δ)/ ΓΠ οικ.67322/2017.

In the Table A2- 21 below are presented the concentrations that have been found according to the chemical analyses results.

Table A2- 21 Recorded concentrations of anions in groundwater.

Parameter	Maximum accepted value M.D. 1811/2011	MW1
Chloride (Cl-)	250 mg/l	46 mg/l
Sulfates (SO42-)	250 mg/l	60 mg/l
Phosphates (PO43)	-	174 mg/l
Nitrate (NO3-)	50 mg/l	12 mg/l
Total Coliforms	0/100ml	n.d.
Escherichia coli (E. coli)	0/100ml	n.d.

Prepared by INTERGEO on behalf ASPROFOS, 2022. n.d. not detected

Regarding the microbiological analyses results, the coliform bacteria and Escherichia coli were found in non-detectable levels and did not exceed the maximum accepted concentration value

(0cfu/100ml) of some contaminants in the drinking water according to M.D Γ1(δ)/ ΓΠ οικ.67322/2017.

8A.2.5.2.8 Quality parameters

In the Table A2- 22 below are presented the concentrations regarding the quality parameters that have been found according to the groundwater chemical analyses results.

Table A2- 22 Recorded concentrations of quality parameters in groundwater.

Parameter	MW1 (mg/L)
Chemical Oxygen demand (COD)	n.d.
Biochemical Oxygen demand (BOD5)	n.d.
Total dissolved solids (TDS)	466
Total organic carbon (TOC)	0.8

Prepared by INTERGEO on behalf ASPROFOS, 2022.(n.d.:not detected)

8A.2.6 INTERPRETATION OF THE RESULTS

The purpose of the investigation was to collect all necessary environmental information available as well as the relevant environmental legislation, concerning the current environmental conditions of the soil and groundwater for the particular study area.

For the purposes of the specific study, INTERGEO performed specific field work at the site in order to obtain a representative overview of the soil and groundwater condition at the specific area.

According to the overall evaluation of the investigation results, **not any significant inorganic, organic and microbiological contamination was detected in the surface soil and the groundwater of the investigated plot area.**

No contamination inflow was recorded at the site from activities irrelevant to the plot area. The absence of any contamination load in the surface soil makes the plot suitable for the implementation of any further future use (industrial, residential, commercial etc.). Moreover, groundwater was found in satisfactory condition taking in account the chemical analyses results of the obtained groundwater sample from existing private well

Based on the investigation results, **the environmental sensitivity of the investigated plot area in Achaia should** be defined generally **as medium to low**.

This arises from its distance from the coastline (24km) and the presence of shallow underground receptor (relative swallow groundwater < 10 m bgs). Furthermore hydrogeologically, the site is underlain by geological layers with varying permeability at the shallow depth that generally does not allow the easy downward migration of potential contaminants to the groundwater table.

More specifically regarding soil and groundwater quality based on the results of the environmental assessment, the following synoptic conclusions could be drawn:

Surface soil

According to the chemical analyses results surface soil was found in satisfactory condition.

No organic contamination was detected at the investigated area, as all organic parameters (TPH, PAH, PCBs) were found in not detectable values.

Based on the results, no significant inorganic soil contamination was noted in the investigated site. All Heavy metal's concentrations, in the majority of the analysed surface soil samples, remained below the intervention values of New Dutch List (NDL).

As far as Nickel (Ni) is concerned the recorded concentration at sampling position SS1 (160mg/kg) exceeded the relative intervention value of New Dutch (100mg/kg). The increased Ni concentration is not originating from human activities, as high Nickel concentration is a common phenomenon in Greece originated from the local geological characteristics.[2].

Groundwater

According to the chemical analyses results the groundwater sample was found in satisfactory condition.

No organic contamination was detected in the groundwater sample, as all organic parameters (TPH, PAH, PCBs) were found in not detectable values.

Based on the results not any inorganic contamination, from heavy metals, was found on groundwater at the study area.

Heavy metal's concentrations ranged between low and non-detectable levels and remained below the target and intervention values of NDL (New Dutch List) as well as the threshold limits set by the relative Greek legislation (M.D. 1811/2011 (ΦΕΚ 3322/Β`/30.12.2011 and M.D. Γ1(δ)/ ΓΠ οικ. 67322/2017 G.G 3282/19.09.2017).

[2] http://weppi.gtk.fi/publ/foregsatlas/

Additionally, all examined anions and cations concentrations remained below the threshold limits set by the relative Greek legislation (M.D. 1811/2011 (ΦΕΚ 3322/Β`/30.12.2011 and M.D. Γ1(δ)/ ΓΠ οικ. 67322/2017 G.G 3282/19.09.2017).

Regarding the microbiological analyses results the coliform bacteria and Escherichia coli were remained in non-detectable levels and did not exceed the maximum accepted concentration value (0cfu/100ml) of some contaminants in the drinking water according to M.D Γ1(δ)/ ΓΠ οικ.67322/2017

8A.2.7 SUGGESTED FURTHER ACTIONS

Taking under consideration that:

- Coastline is located at a distance of approximately 24 km from the plot;
- no previous industrial activities took place within the investigated plot;
- the broader area of investigation is mainly covered by Agricultural land (Olive groves and annual crops areas) as well as semi-forest natural areas (Broad – leaved forest);
- no water streams are located in the vicinity of the investigated area;

the environmental sensitivity of the study area is estimated as medium to low.

Both current environmental sensitivity of the study area and absence of any contamination load in the surface soil render the plot suitable for the implementation of any future industrial use.

In any case, a periodic and documented monitoring of the groundwater quality in the future is strongly recommended by sampling of the existing private well at least once a year.

I N T E R G E O

Environmental Technology

Dr. Stylianos A. Papadopoulos Dr. Christos Vatseris

Michael Xifaras

Appendix 1 FIGURES

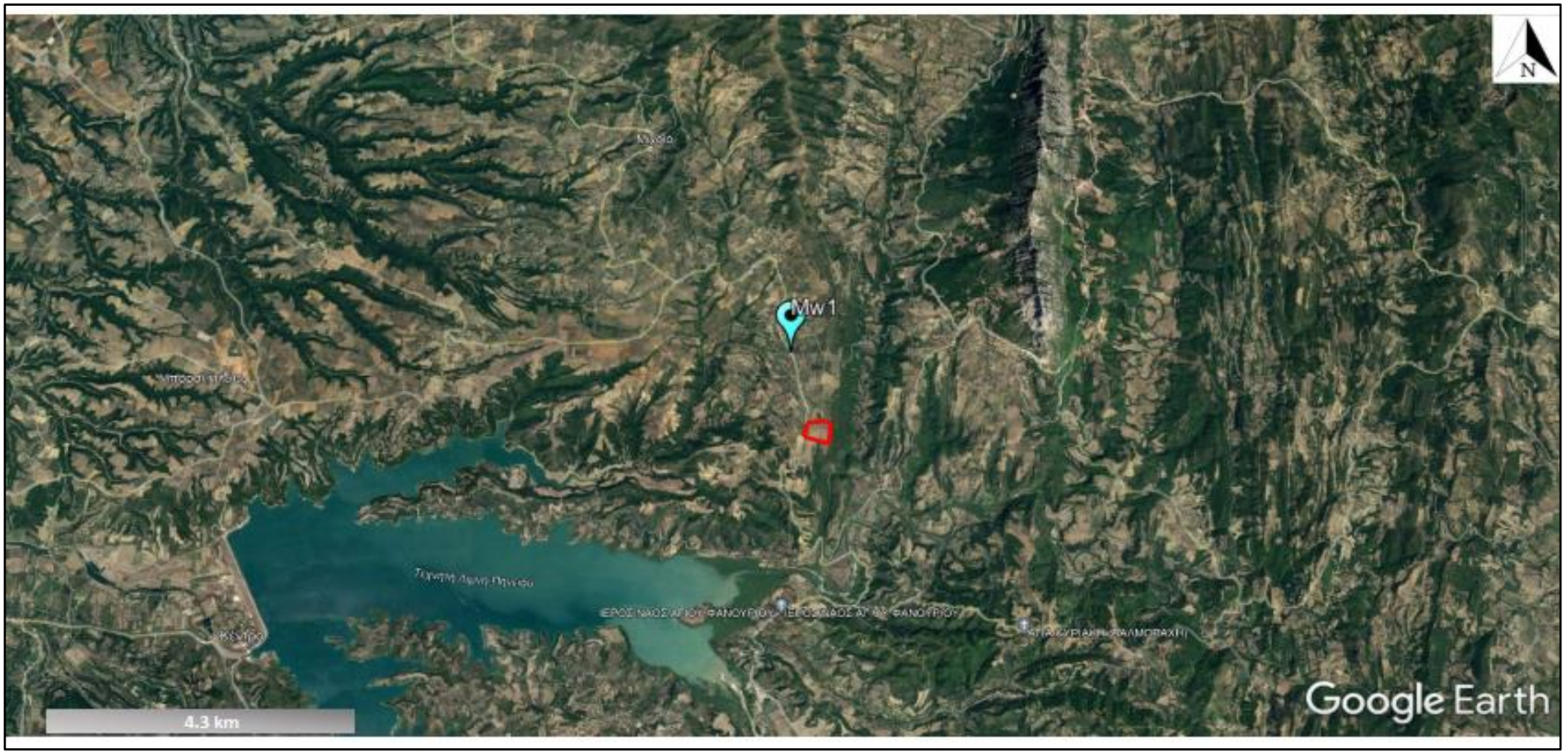


Figure 1 Geographic location of the plot and of the existing groundwater well (MW1) at Achaia, Greece.

Figure 2 Satellite view of the plot and of the existing groundwater well (MW1) at Achaia, Greece

Figure 3: Satellite view of the plot at Achaia, Greece.

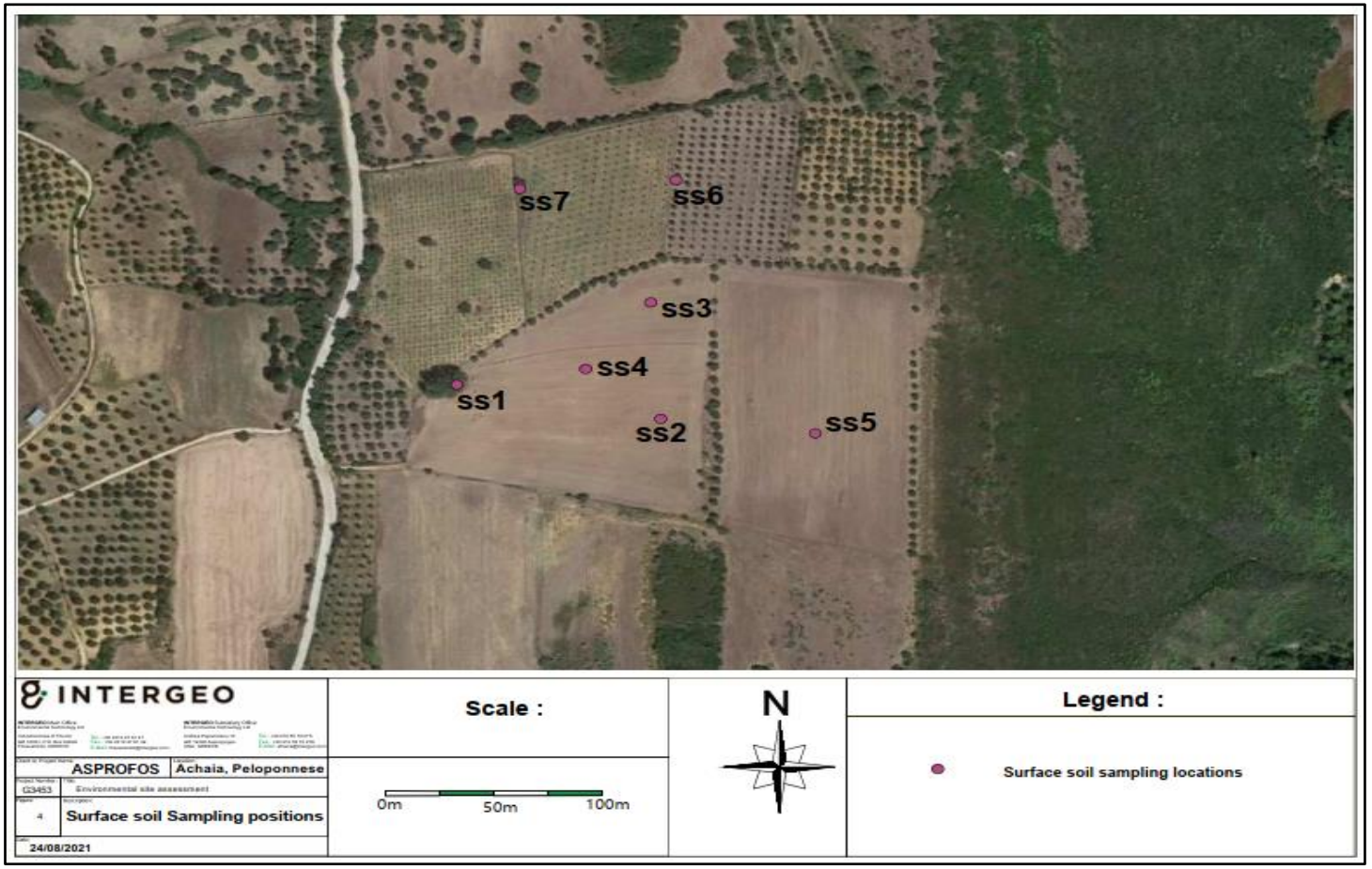


Figure 4 Surface soil Sampling positions

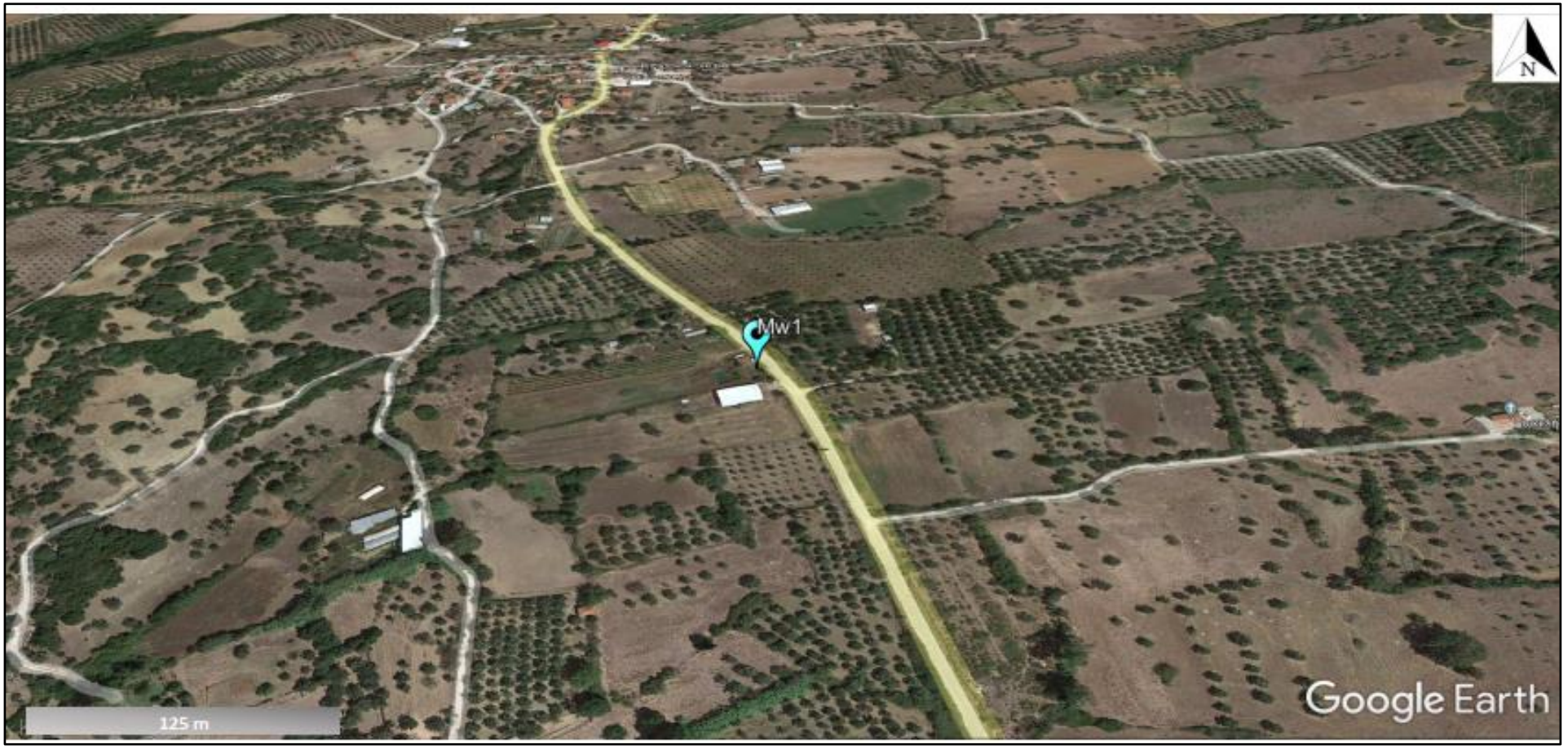


Figure 5 Satellite view of the existing groundwater well (MW1) at Achaia, Greece.

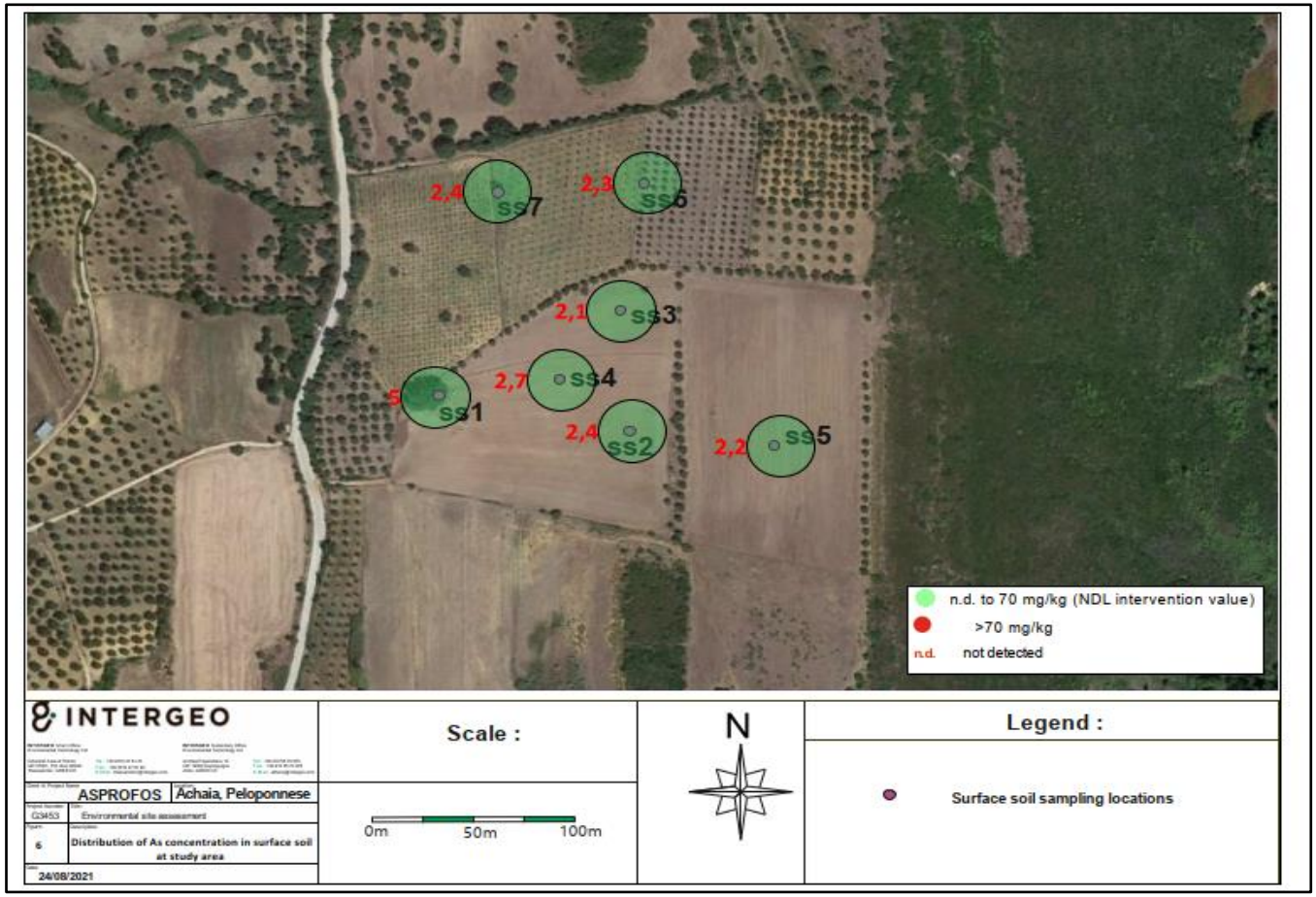


Figure 6 Distribution of As concentration in surface soil at study area

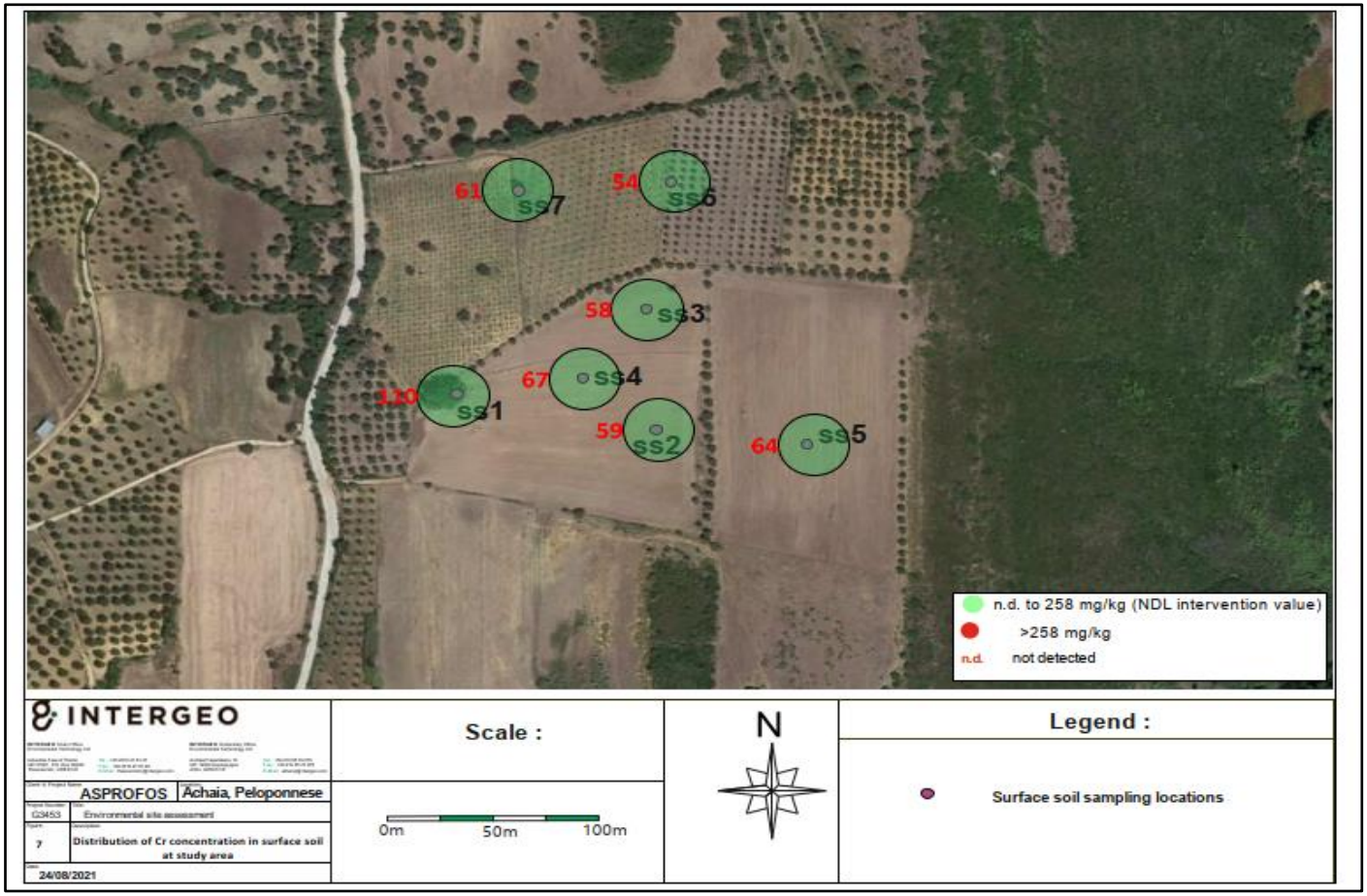


Figure 7 Distribution of Cr concentration in surface soil at study area

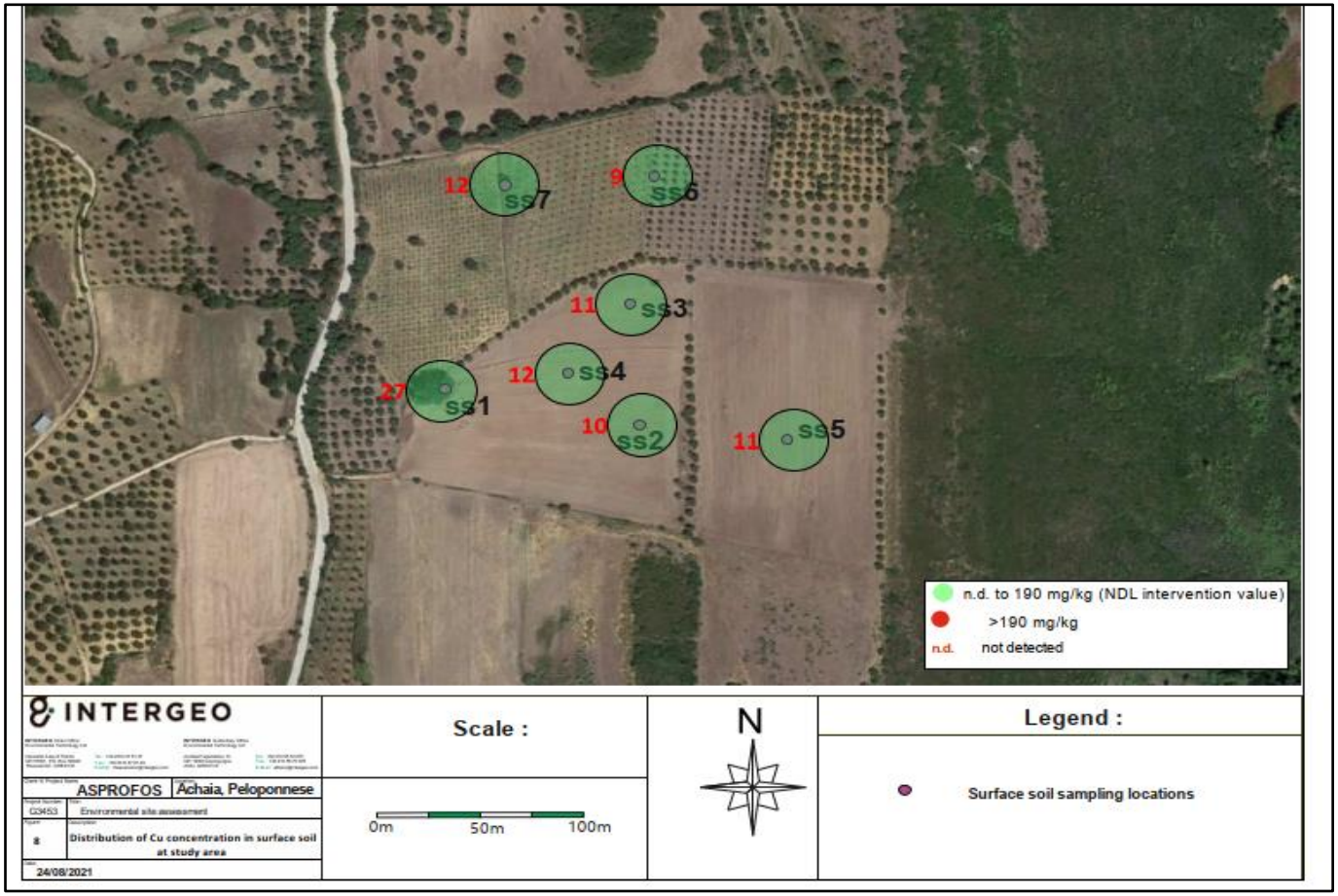


Figure 8 Distribution of Cu concentration in surface soil at study area

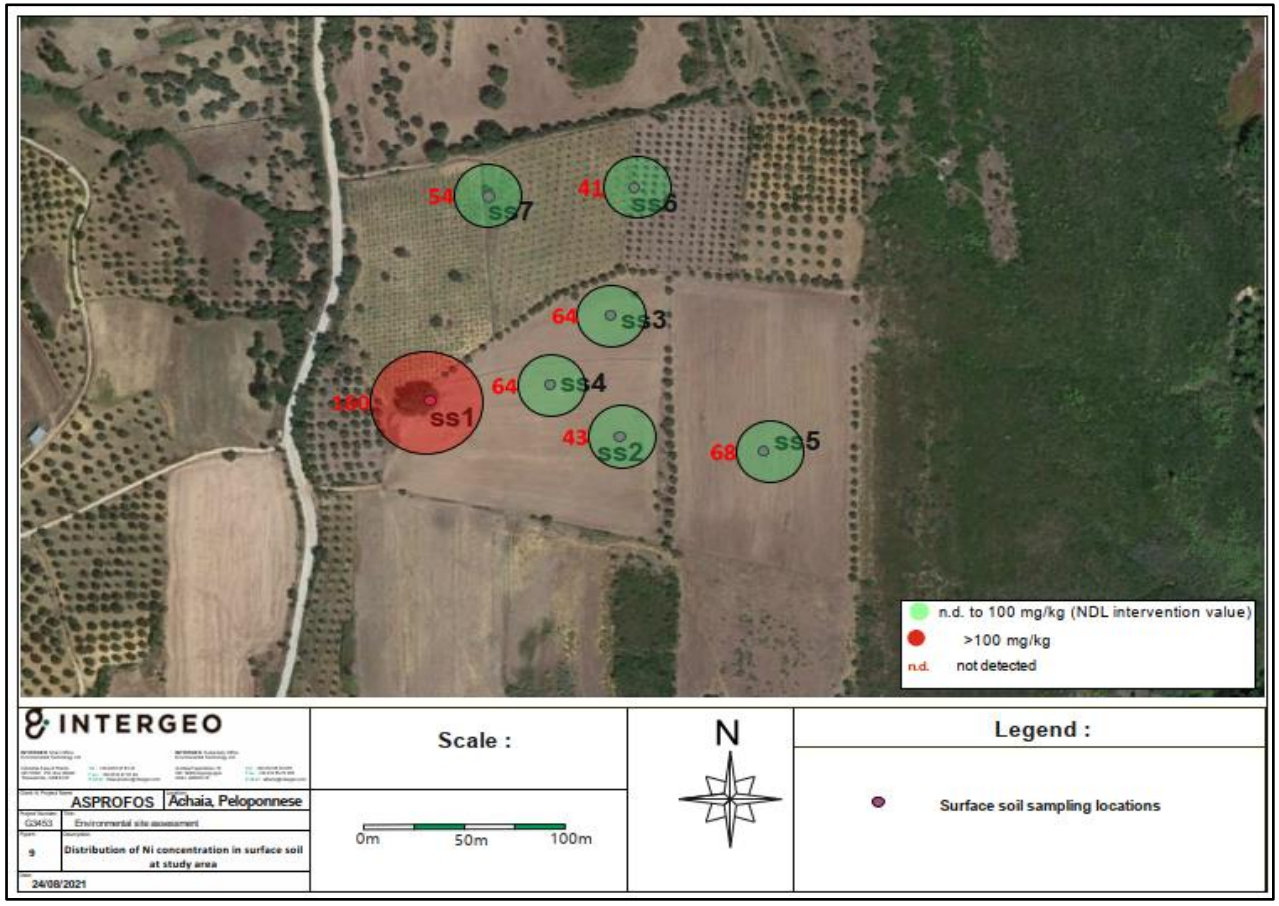


Figure 9 Distribution of Ni concentration in surface soil at study area

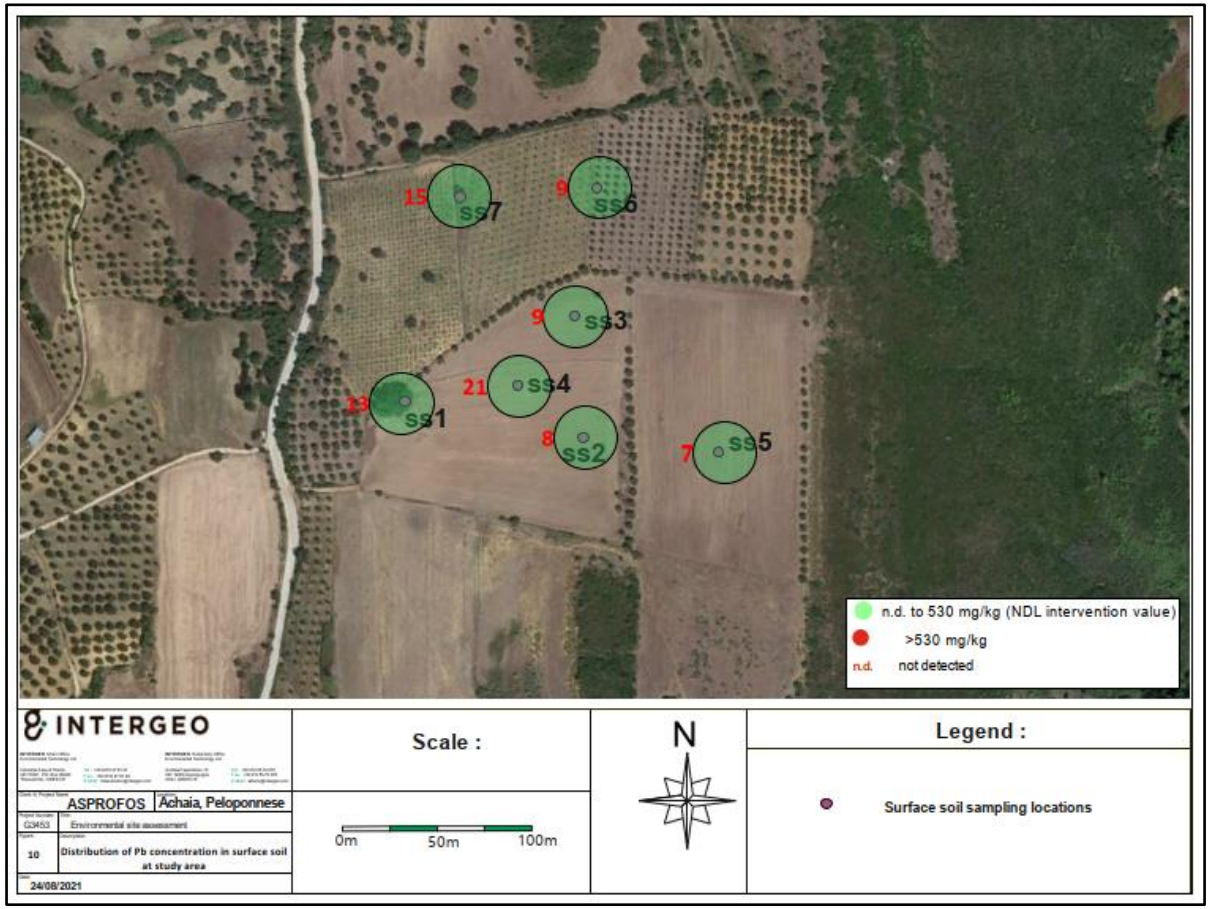


Figure 10 Distribution of Pb concentration in surface soil at study area

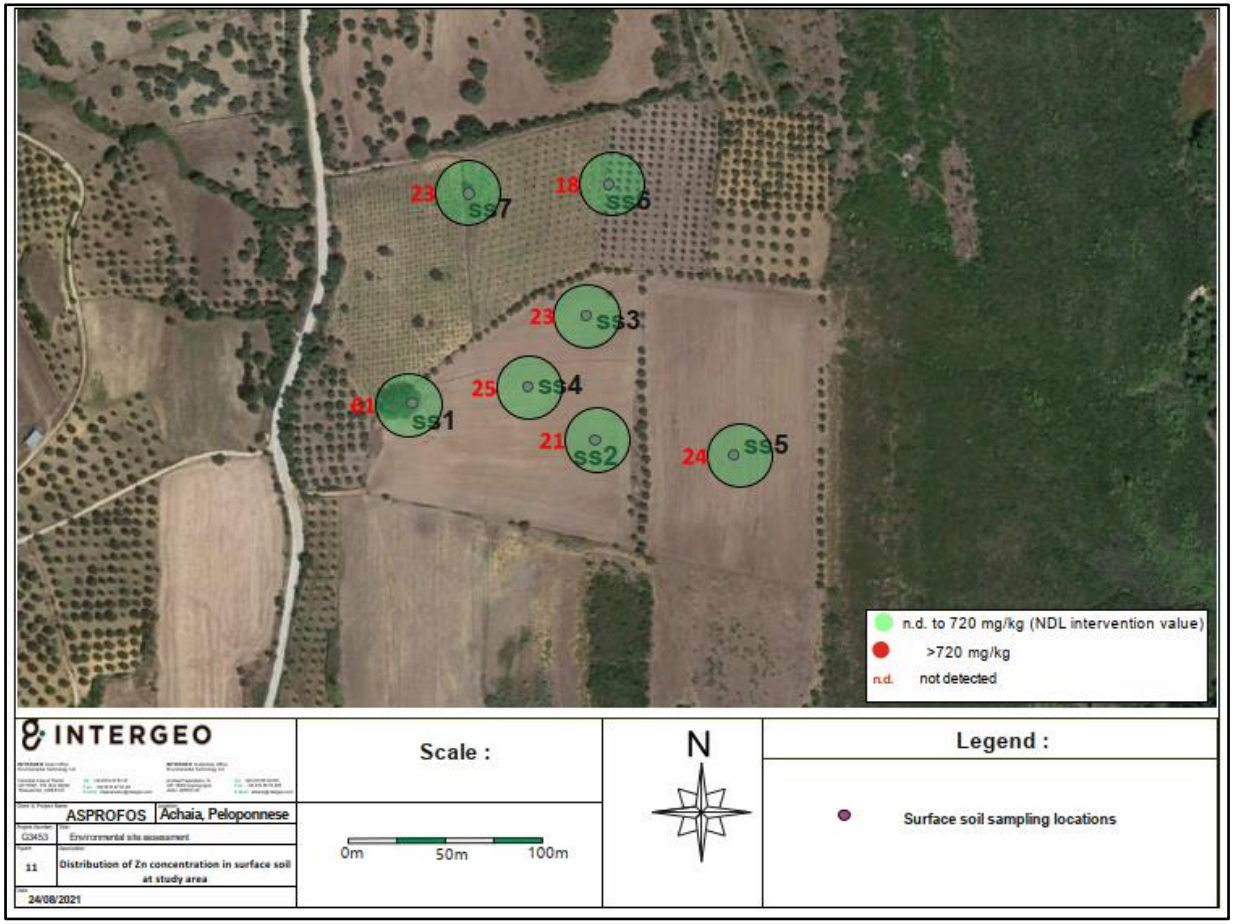


Figure 11 Distribution of Zn concentration in surface soil at study area

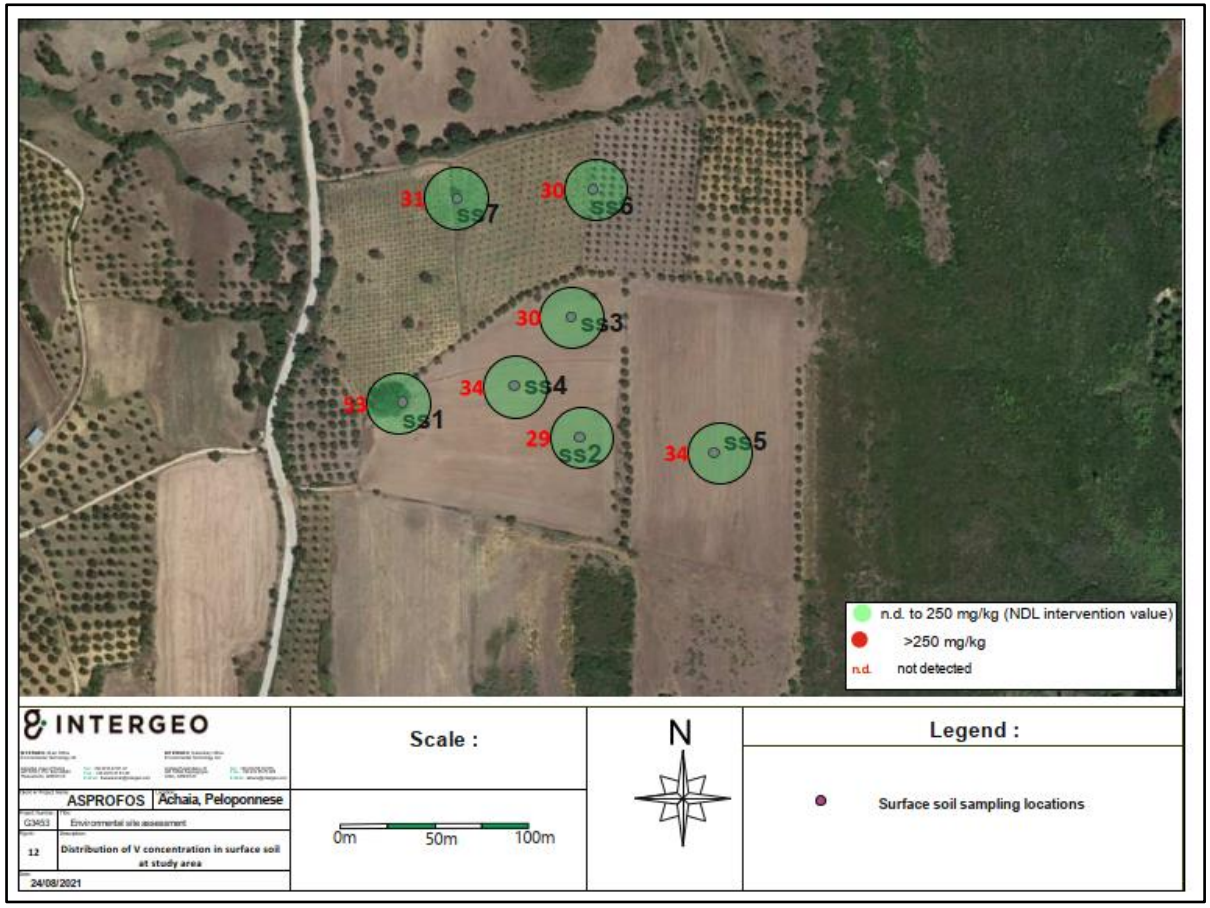


Figure 12 Distribution of V concentration in surface soil at study area

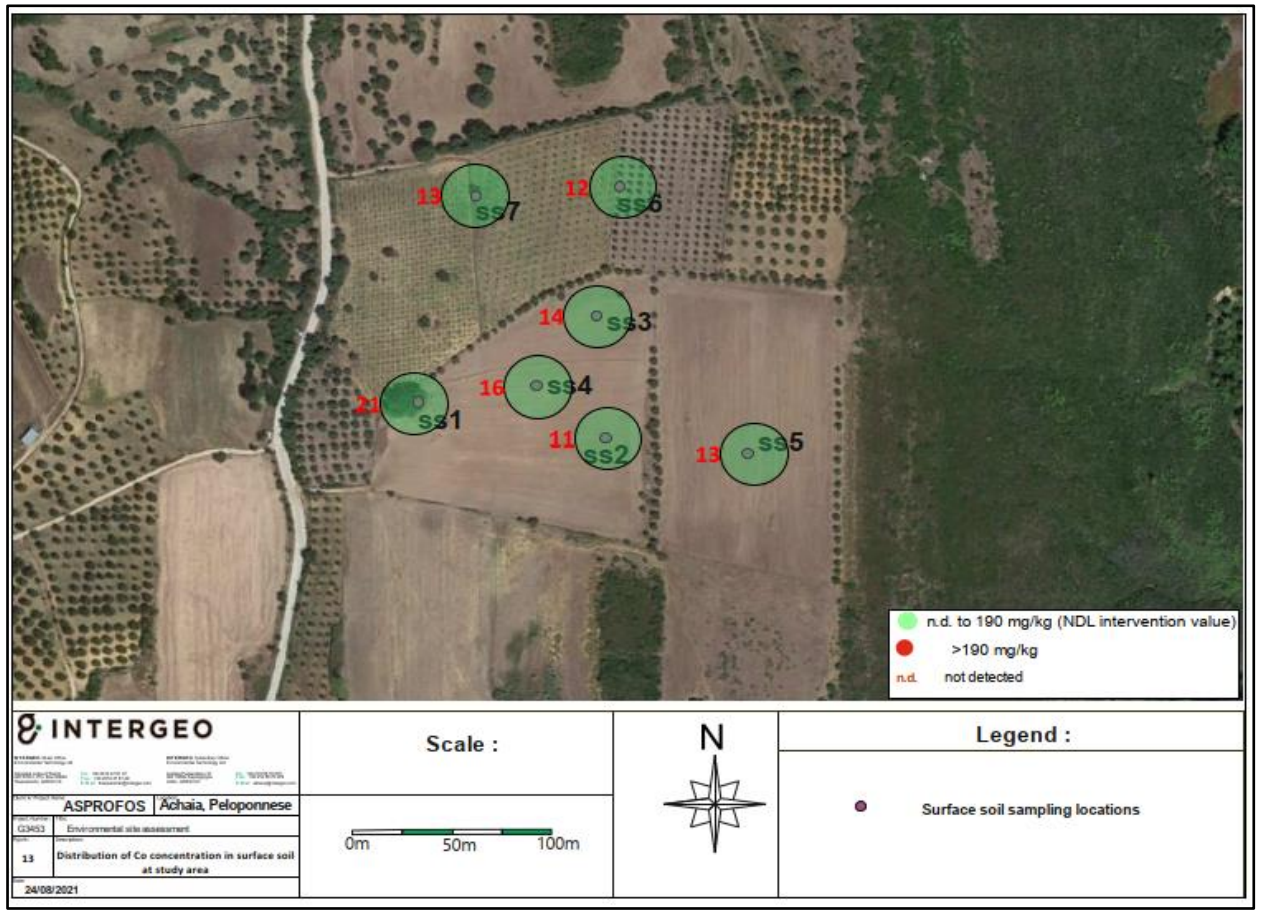


Figure 13 Distribution of Co concentration in surface soil at study area

Appendix 2 CHEMICAL ANALYSES RESULTS

INTERGEO
Industrial Area of Thermi, GR-57001, Thessaloniki, GREECE
Tel. ++302310478147, Fax: ++302310478149
e-mail: thessaloniki@intergeo.com

PROJECT CODE:	G3453
OWNER OF PROJECT:	
AREA:	ACHAIA, PELOPONNESE
TITLE OF PROJECT:	SOIL AND GROUNDWATER INVESTIGATION
SAMPLING DATE:	18/6/2021
DATE OF ANALYSES:	9/7/2021
SAMPLE:	SOIL SAMPLES

Parameter	Unit	Detection limit	Method	G3453_Ss1	G3453_Ss2	G3453_Ss3	G3453_Ss4	G3453_Ss5	G3453_Ss6	G3453_Ss7
Dry matter	%	0,1	DIN EN 14346 : 2007-03, Procedure A	87,9	94	90,3	93	88,4	93,8	93,4
TPH										
Hydrocarbons C10- C40			EN ISO 16703	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Heavy metals										
Arsenic (As)	mg/kg	0,8	DIN EN ISO 17294 - 2 : 2017-01	5	2,4	2,1	2,7	2,2	2,3	2,4
Lead (Pb)	mg/kg	2	DIN EN ISO 17294 - 2 : 2017-01	13	8	9	21	7	9	15
Cadmium (Cd)	mg/kg	0,2	DIN EN ISO 17294 - 2 : 2017-01	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Hexavalent Chromium (CrVI)	mg/kg	0,1	DIN EN 15192 : 2007-02	0,66	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Chromium (Cr)	mg/kg	1	DIN EN ISO 17294 - 2 : 2017-01	110	59	58	67	64	54	61
Copper (Cu)	mg/kg	1	DIN EN ISO 17294 - 2 : 2017-01	27	10	11	12	11	9	12
Nickel (Ni)	mg/kg	1	DIN EN ISO 17294 - 2 : 2017-01	160	43	64	64	68	41	54
Mercury (Hg)	mg/kg	0,1	DIN EN ISO 12846 : 2012-08	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Selenium (Se)	mg/kg	2	DIN EN ISO 17294 - 2 : 2017-01	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Thallium (Tl)	mg/kg	0,1	DIN EN ISO 17294 - 2 : 2017-01	0,1	n.d.	0,1	0,1	n.d.	n.d.	0,1
Tin (Sn)	mg/kg	1	DIN EN ISO 17294 - 2 : 2017-01	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Vanadium (V)	mg/kg	3	DIN EN ISO 11885 : 2009-09	53	29	30	34	34	30	31
Cobalt (Co)	mg/kg	3	DIN EN ISO 11885 : 2009-09	21	11	14	16	13	54	13
Beryllium (Be)	mg/kg	1	DIN EN ISO 11885 : 2009-09	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Antimony (Sb)	mg/kg	2	DIN EN ISO 17294 - 2 : 2017-01	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Zinc (Zn)	mg/kg	2	DIN EN ISO 11885 : 2009-09	61	21	23	25	24	18	23
PAH's										
Naphthalene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Acenaphthylene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Acenaphthene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Fluorene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Phenanthrene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Anthracene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Fluoranthene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Pyrene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Benz(a)anthracene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Chrysene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(b)fluoranthene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.q.	n.q.	n.q.	n.q.	n.q.	n.q.	n.d.
Benzo(k)fluoranthene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(a)pyrene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Dibenz(ah)anthracene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Benzo(g,h,i)perylene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Indeno(1,2,3-cd)pyrene	mg/kg	0,05	DIN ISO 18287 : 2006-05	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum PAHs	mg/kg		Calculation from measured values of individual parameters	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
PCB's										
2,4,4'-TrCB (PCB-28)	mg/kg	0,01	DIN EN 15308 : 2016-12	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,2',5,5'-TeCB (PCB-52)	mg/kg	0,01	DIN EN 15308 : 2016-12	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,2',4,5,5'-PeCB (PCB-101)	mg/kg	0,01	DIN EN 15308 : 2016-12	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,3',4,4',5-PeCB (PCB-118)	mg/kg	0,01	DIN EN 15308 : 2016-12	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,2',3,4,4',5'-HxCB (PCB-138)	mg/kg	0,01	DIN EN 15308 : 2016-12	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,2',4,4',5,5'-HxCB (PCB-153)	mg/kg	0,01	DIN EN 15308 : 2016-12	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
2,2',3,4,4',5,5'-HpCB (PCB-180)	mg/kg	0,01	DIN EN 15308 : 2016-12	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Sum PCB (STI-table)	mg/kg		Calculation from measured values of individual parameters	n.q.	n.q.	n.q.	n.q.	n.d.	n.q.	n.q.

Explanation: "<" or "n.d." or "n.q." represent the fact that the concentration of the analyte is below the limit of quantification (LOQ).

INTERGEO

Annex 8A.2 - Soil and groundwater characteristics report for Achaia Compressor Station

INTERGEO
Industrial Area of Thermi, GR-57001, Thessaloniki, GREECE
Tel. ++302310478147, Fax: ++302310478149
e-mail: thessaloniki@intergeo.com

PROJECT CODE:	G3453
OWNER OF PROJECT:	
AREA:	ACHAIA, PELOPONNESE
TITLE OF PROJECT:	SOIL AND GROUNDWATER INVESTIGATION
SAMPLING DATE:	18/6/2021
DATE OF ANALYSES:	9/7/2021
SAMPLE:	GROUNDWATER SAMPLE

Parameter	Unit	Detection limit	Method	G3453_MW1
pH			APHA 4500 B	7,9
Electrical conductivity (EC)	µS/cm	0,1	APHA 2510 B	882
Total oil				
Total organic Carbon (TOC)	mg/L	0,5	DIN EN 1484 : 1997-08	0,8
Total oil and grease (TOG)	mg/L	0,1	EN ISO 9377-2	n.d.
Hydrocarbons C10- C40	mg/L	0,1	EN ISO 9377-2	n.d.
Heavy metals				
Aluminium (Al)	mg/l	0,02	DIN EN ISO 17294-2 : 2005-02	n.d.
Arsenic (As)	mg/l	0,001	DIN EN ISO 17294-2 : 2005-02	n.d.
Antimony (Sb)	mg/l	0,0005	DIN EN ISO 17294-2 : 2005-02	n.d.
Beryllium (Be)	mg/l	0,005	DIN EN ISO 17294-2 : 2005-02	n.d.
Lead (Pb)	mg/l	0,001	DIN EN ISO 17294-2 : 2005-02	n.d.
Cadmium (Cd)	mg/l	0,0001	DIN EN ISO 17294-2 : 2005-02	n.d.
Hexavalent Chromium (CrVI)	mg/l	0,01	APHA 3500-Cr D	n.d.
Chromium (Cr)	mg/l	0,001	DIN EN ISO 17294-2 : 2005-02	n.d.
Iron (Fe)	mg/l	0,01	DIN EN ISO 17294-2 : 2005-02	0,01
Cobalt (Co)	mg/l	0,005	DIN EN ISO 17294-2 : 2005-02	n.d.
Copper (Cu)	mg/l	0,005	DIN EN ISO 17294-2 : 2005-02	n.d.
Lithium (Li)	mg/l	0,005	DIN EN ISO 17294-2 : 2005-02	0,008
Manganese (Mn)	mg/l	0,005	DIN EN ISO 17294-2 : 2005-02	n.d.
Molybdenum (Mo)	mg/l	0,005	DIN EN ISO 17294-2 : 2005-02	n.d.
Nickel (Ni)	mg/l	0,005	DIN EN ISO 17294-2 : 2005-02	n.d.
Mercury (Hg)	µg/l	0,1	DIN EN ISO 12846 : 2012-08	n.d.
Selenium (Se)	mg/l	0,001	DIN EN ISO 17294-2 : 2005-02	n.d.
Tellurium (Te)	mg/l	0,01	DIN EN ISO 17294-2 : 2005-02	n.d.
Vanadium (V)	mg/l	0,004	DIN EN ISO 17294-2 : 2005-02	n.d.
Fluorine (F)	mg/l	0,1	EPA 340.3	0,11
Boron (B)	mg/l	0,1	EN ISO 17294-2	0,25
Zinc (Zn)	mg/l	0,01	DIN EN ISO 17294-2 : 2005-02	n.d.
PAH's				
Naphthalene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Acenaphthylene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Acenaphthene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Fluorene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Phenanthrene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Anthracene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Fluoranthene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Pyrene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Benz(a)anthracene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Chrysene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Benzo(b)fluoranthene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Benzo(k)fluoranthene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Benzo(a)pyrene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Dibenzo(a,h)anthracene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Benzo(g,h,i)perylene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Indeno(1,2,3-cd)pyrene	µg/L	0,01	DIN 38407-39 : 2011-09	n.d.
Sum PAH (16 EPA)	µg/L		Calculation from measured values of individual parameters	n.d.
ANIONS				
Chloride (Cl^-)	mg/L	5	EPA 325.1 (MERCK KIT114730)	46
Sulfate (SO_4^{2-})	mg/L	5	EPA 375.4*(MERCK KIT114548)	60
Nitrates (NO_3^-)	mg/L	0,5	DIN38405 D9 *(MERCK KIT114563)	12
Phosphates (PO_4^{3-})	mg/L	0,05	DIN EN 15308 : 2016-12	174
VOC's				
TCE - Trichloroethene	µg/l	0,5	DIN EN ISO 10301 : 1997-08	n.d.
PCE - Tetrachloroethene	µg/l	0,5	DIN EN ISO 10301 : 1997-08	n.d.
Vinyl chloride	µg/l	0,5	DIN EN ISO 10301 : 1997-09	n.d.
1,1-Dichloroethene	µg/l	0,5	DIN EN ISO 10301 : 1997-10	n.d.
1,1-Dichloroethane	µg/l	0,5	DIN EN ISO 10301 : 1997-11	n.d.
Dichloromethane	µg/l	0,5	DIN EN ISO 10301 : 1997-12	n.d.
1,2-Dichloroethane	µg/l	0,5	DIN EN ISO 10301 : 1997-13	n.d.
Cis-1,2-dichloroethene	µg/l	0,5	DIN EN ISO 10301 : 1997-14	n.d.
Trans-1,2-dichloroethene	µg/l	0,5	DIN EN ISO 10301 : 1997-15	n.d.
Trichloromethane	µg/l	0,5	DIN EN ISO 10301 : 1997-16	n.d.
Tetrachloromethane	µg/l	0,5	DIN EN ISO 10301 : 1997-17	n.d.
1,1,1-Trichloroethane	µg/l	0,5	DIN EN ISO 10301 : 1997-18	n.d.
Chemical oxygen demand (COD)	mg/l	10	BOD SENSOR	n.d.
Biochemical oxygen demand (BOD5)	mg/l	2	EAOT EN ISO 15705	n.d.
Total dissolved solids (TDS)	mg/l	10	EAOT EN15216	466
total coliforms	cfu/100ml		ISO 9308-1:2014 & Amd1:2016	n.d.
E. coli	cfu/100ml		ISO 9308-1:2014 & Amd1:2017	n.d.

Explanation: "<" or "n.d." or "n.q." represent the fact that the concentration of the analyte is below the limit of quantification (LOQ).

INTERGEO

Appendix 3 PHOTOS

PHOTOS

LOCATION: Achaia, Greece

INDEX

No of photo	Description
1	Surface soil sampling point Ss1
2	Surface soil sampling point Ss2
3	Surface soil sampling point Ss3
4	Surface soil sampling point Ss4
5	Surface soil sampling point Ss5
6	Surface soil sampling point Ss6
7	Surface soil sampling point Ss7
8	View of the existing groundwater well

PHOTO 1 - Surface soil possition Ss1

PHOTO 2 - Surface soil position Ss2

PHOTO 3 - Surface soil possition Ss3

PHOTO 4 - Surface soil possition Ss4

PHOTO 5 - Surface soil possition Ss5

PHOTO 6 - Surface soil possition Ss6

PHOTO 7 - Surface soil possition Ss7

PHOTO 8 - Existing groundwater well, Mw1