

# Interreg Greece-Bulgaria

European Regional Development Fund



The Project is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.



## INTERREG V-A "GREECE - BULGARIA 2014 – 2020" COOPERATION PROGRAMME

<b>PROJECT BENEFICIARY:</b>	Municipality of Pilea - Hortiatis
<b>PROJECT:</b>	Management of underground water resources for the needs of non-portable water, heating and underground areas protection (GREEN PUMP) within the framework of INTERREG V-A "Greece-Bulgaria 2014-2020.
<b>OBJECTIVE:</b>	Preparation & supervision of initial tests' good performance, technical reports, improvement proposals & trial operation of installations
<b>OPERATION:</b>	3.5.2 Installation of procured equipment/technical works 3.5.3 Functionality test report of installation
<b>BUDGET :</b>	«TOTAL BUDGET FOR THE OPERATION (CONTRACTED BUDGET in €) (ERDF: 766.194,23 € / National Funds: 135.210,75 €)»



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## **1. GENERAL**

The present report refers to the services of the package WP3/3.2 under the title: "Preparation & supervision of initial tests' good performance, technical reports, improvement proposals & trial operation of installations". This package of services refers to the contract between ALTEREN S.A. and the Municipality of Pylaia – Hortiatis which participates in the project *Management of underground water resources for the needs of non-portable water, heating and underground areas protection (GREEN PUMP)* within the framework of INTERREG V-A "Greece-Bulgaria 2014-2020. This report includes the following subjects:

- Description of Installations
- Project Implementation
- Operation tests
- Improvement Proposals



## **2. DESCRIPTION OF INSTALLATIONS**

### **2.1. General**

The installations of drilling water for irrigation purposes and in hygiene areas in schools are consisted of various subsystems. These subsystems are:

- The drilling
- Water storage tanks
- Network connecting drilling with tanks
- Supply network connecting hygiene installations and tanks
- Irrigation networks

In order to have a clear view of the layout of these installations, a technical description designed for the 1<sup>st</sup> high School Complex of Pylaia - Hortiatis is provided.

### **2.2. Technical Description of the 1<sup>st</sup> High School of Pylaia**

A drilling was executed in the 1<sup>st</sup> High School of Pylaia with a pump which supplies through tanks the irrigation networks of the school's trees and also the toilets of the ground floor, according to the project drawings.

The drilling pump supplies 4 tanks of 500 lit (L) each, which are installed in the basement area of the school as it is stated in the drawings. Then these tanks supplies the irrigation system and the toilets of the ground floor through pipe network via two different pumps.

The electrical connection of the drilling pump is installed on an underground ditch of 70cm depth outside of the building. The pumps are connected with cables on the wall in the area of the tanks.

A volume flow meter is installed in the hydraulic network before of the tanks supply.



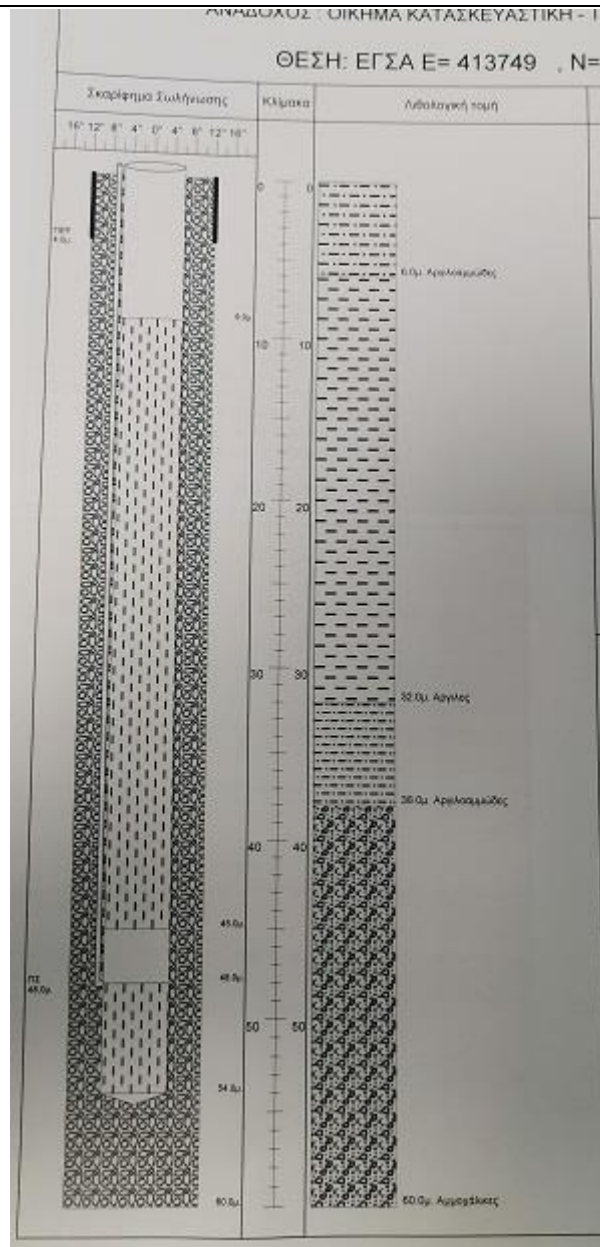
### 2.2.1. Drilling

The position of the drilling is shown in the picture below:



The drilling will have the following characteristics:

- Drilling depth 60m
- Water supply 5 m<sup>3</sup>/h
- Tube diameter 12in
- Casing tube diameter 12in, width 6mm and depth 4m
- Piezometric tube diameter 1½ in and length of 48 m
- Copper filter 4-8 mm, quantity 8 m<sup>3</sup>
- Precited concrete plates for the drilling protection dimensions 1X1X0,2 with the lid



**Image 2.1** Drilling section

### 2.2.2. Storage tanks

There are 4 plastic tanks of 500L each which are installed in the basement and operate under atmospheric pressure.

For the determination of the tank positioning the following parameters were taken under consideration:

- The altitude and regional position of the drilling
- The altitude and regional distribution of the irrigative fields

Additionally, except from tanks and valves more equipment is included:

- Discharge apparatus
- Pipe connections



- Filters
- Non return valves
- Interconnection of the tanks for simultaneous filling
- Control system of tanks filling

### 2.2.3. Irrigation Installation

The irrigation network is supplied from the storage tanks through a horizontal multilevel pump with a continuous connection motor to pump of standard revolutions conventional motor and mechanical connector axis and one phase asynchronous motor.

The network includes:

- Irrigation network for the water distribution to bushes and trees, which are scattered in the nearby field. For the above-mentioned area and due to the topography of the region, the irrigation system is provided with small static sprinklers of special types which were installed inside of the tree ditches around their roots.
- The pipe network for water distribution is constructed from polyethylenium tube (PE) of low density (LD) 2<sup>nd</sup> generation, according to standard 8074/8075, with 10 atm strength to internal pressure and the pipes are installed underground in depth of 50cm. The nominal diameter of the tubes in the most of the irrigation network, was calculated to DN20 tubes. The backfilling material is free of stones and other sharp stones which might damage the pipes. On the tube there is a layer of 3A gravel type, which is compacted from both sides of the tube, while the final backfilling material is constructed with excavation materials which are compacted in layers up to the ground level. Inside the buildings the use of special fasteners are suggested for the support of the tube network. Openings in the masonry are constructed in such way that does not affected by deformation stresses.
- The tube connections are welded and the connections with other instruments are also welded or self-welded in order o avoid leakages to the environment.
- The central irrigation network inside the control room has an electric valve with automatic control, closed normally. The activation is initiated with a central irrigation programmer unit.



- The system provides operation even if a power cut occurs. The system provides rain sensor in order to stop when rain starts. The rain sensor was installed outside and in a certain distance from the programmer unit.

#### 2.2.4. Water network

The water network is fed by the storage tanks via a horizontal multilevel pump. Before the installation of toilet furniture, the network of all the water washing points is completed and connected to tanks. Non return valves are also installed to avoid opposite flow.



### 3. PROJECT EXECUTION

#### 3.1. Drilling construction

The drilling works were completed using hydraulic drilling machine with an air compressor unit of 850 ft/min with working pressure of 24 atms.

The initial drilling was executed with a diameter of  $\Phi$  146 mm and in depth of 60m. The sampling of the drilling material was taken every 2 meters. Samples maintained in plastic bags with labels stating the depth level.

During the drilling process the following geological formations were found:

- Series of red silver (M<sub>4</sub>.Pli.l)
- red silver sludges
- limestone grains

An increased drilling was initiated up to a diameter of 148 mm or 12in with a 4m depth. Casing of the drill walls was applied with 12 in tubes up to a depth of 4 meters. Additionally, up to 60m wall casing with tubes was installed.

The permanent drilling tube network has a depth of 54m. From this depth the 42 meters are with steel filter tubes of 6<sup>5/8</sup> in and thickness 6mm the tubes are continuous, galvanized, seamless according to standard EN 10208-1. The fastening parts are of the same characteristics and according to standard DIN 4922. Moreover, all the above materials are in accordance with the Greek legislation law (Greek Government Gazette 292/12-3-2003). The filters are bridge type and paled 30cm from the coupler Also a piezometric tube of diameter 1<sup>1/2</sup> in which is situated to the 6<sup>5/8</sup> in tubes in 48 m depth. The final tube network is blocked with a threaded cap.

After the completion of the drilling tube network the inside area of the tube was filled with gravel which will work as filter by having gravel sizes 4-8 mm.

The filter consists of silicon gravels and aims to:

- Stop the sand wash from the water levels

- Remain the tube filters open in order to avoid the water drop level of the drilling.

The granulometry of the gravel was chosen in such a way to avoid gaps. The total quantity of the gravel filter was up to 8m<sup>3</sup>.

After the completion of the gravel filling, pressurized air was applied in order to provide:



- cleaning of the drilling from sand
- color less and clear water
- smooth distribution of granule gravel of the filter with respect to hydrodynamic flow of the water
- collection of initial hydrological elements which are useful for the installation depth of the pump

The column of 3 in steel tubes was installed in depth of 54 meters. During this process the level, the flow and the sand content were measured. The process lasted for 6 hours.

The trial drilling with submerged pump of 1,5 HP was installed in 43 m depth and was executed in three phases:

1. **Predrilling**, which was helped cleaning of the system and provided data for the drilling capacity
2. Afterwards a program of **two level** of constant flow. This phase of the levels lasted 6 hours
3. After the completion of the system operating in its maximum flow a **continuous drilling** lasted for 24 hours

All measurements were performed volumetrically. The drilling works where executed from 13/08/2020 to 14/08/2020.

For the determination of the available flow rate, the level of drilling and the installation depth of the drilling unit the measurements and diagrams of the Geologist G. Delveniotis were used. For the drilling level, the following formula was applied:

$$\Sigma.A. = Y.\Sigma.\max + \Delta S_{3000} + A\lambda,$$

where

**Y.Σ.max** = maximum hydrostatic level

**ΔS<sub>3000</sub>** = drop of the level after 3000 h of continuous pumping

**Aλ** = inter reaction of drillings

**Y.Σ.max** = Y.Σ. seasonal variation factor + Level drop dry year, ie:

$$Y.\Sigma.\max = 12,80 + 1,5 + 3 = \mathbf{17,30\ m}$$



$$\Delta S_{3000} = \Delta S_3 + 3 * C,$$

where:

$\Delta S_3$  = the level drop after 3 hours of continuous pumping in the suggested region

$C$  = the drop pressure drops in a time interval of a logarithmic cycle for pumping with the suggested volumetric flow rate

$$\Delta S_{3000} = 10,94 + 3 * 4,21 = \mathbf{23,57 \text{ m}}$$

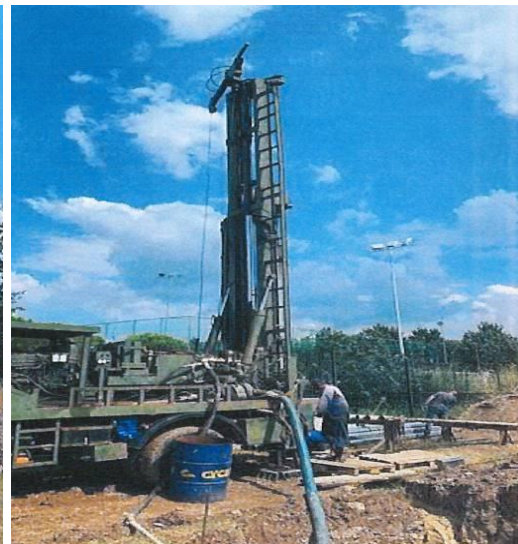
$$A\lambda = \mathbf{0 \text{ m}},$$

therefore:

$$\Sigma.A. = \mathbf{17,30 + 23,57 = 40,87 \text{ m}}$$

According to the above a) the available volumetric flow rate of the drilling is **5 m<sup>3</sup>/h**, b) the drilling level is 41 meters and C) the installation depth of the drilling unit is 47 meters







**Image 3.1** Photos during construction



**Image 3.2** Drilling area after installation process

### **3.2. Construction of hydraulic installation**

The construction of the hydraulic installation was taken place under study's standards.



**Image 3.3** Connection with WC



**Image 3.4** Storage tanks



**Image 3.5** Switchboard and flowmeter



**Image 3.6** Irrigation network and well



### **3.2. Problems during the construction**

After the completion of the drilling works and during the connection of the cabling, there was a delay due to cut of the cables connecting the pumps. The cabling was fixed and works continued.

Also, during the installation of the water tube network (for toilets) the existing local valves, almost all of them, were leaking and this had set the network's testing procedure impossible.



## 4. TESTS AND SUPERVISION OF INSTALLATION PERFORMANCE

### 4.1. Drilling

The trial drilling with submerged pump of 1,5 HP was installed in 43 m depth and executed in three phases:

- **Predrilling was** helped the cleaning of the system for the capacity of drilling. The phase of predrilling lasted 4 hours
- Afterwards a program of **two level** of constant flow. This phase of the levels lasted 6 hours
- After the completion of the system operating in its maximum flow a **continuous drilling** lasted for 24 hours

All measurements were performed volumetrically. The drilling works were executed from 13/08/2020 to 14/08/2020.

### 4.2. Data collection

Data collection is performed with special monitoring equipment which is installed in the system and has access to internet in the "log in" form. Data being collected are:

- Temperature of drilling water
- Flow
- Energy consumption of irrigation and drilling system

The monitoring equipment is UNICOcoder ®MP, Singlejet consumption meter, diameter of DN 15, with M-Bus interface according to EN 13757-2, suitable for temperature measurement until the value of 50 °C.



**Image 4.1** Monitoring equipment



### 4.3 Results of the installation's operation

During the period 26/10/2020 – 24/10/2021 the installation was monitored in order to control its operation and collect data.

	Consump. Start	Consump. End	Daily Consump. (m3)	Energy consump. Start	Energy consump. End	Daily Energy Consump. (kWh)	Energy Consump./m3	Mean Temperature 1 (°C)	Mean Temperature 2 (°C)
28/10/2020	4,76	4,8	0,04	354,6	361,5	6,90	172,50	18,2	20,60
29/10/2020	4,8	4,88	0,08	361,53	374,43	12,90	161,25	17,95	20,65
30/10/2020	4,88	4,92	0,04	374,46	381,39	6,93	173,25	18,65	20,70
31/10/2020	4,92	5,01	0,09	381,42	394,87	13,45	149,44	18,70	20,50
1/11/2020	5,01	5,05	0,04	394,89	401,83	6,94	173,50	17,95	20,55
2/11/2020	5,05	5,08	0,03	401,85	408,67	6,82	227,33	17,50	20,50
3/11/2020	5,08	5,18	0,1	408,7	422,07	13,37	133,70	18,3	20,45
4/11/2020	5,18	5,19	0,01	422,09	428,4	6,31	631,00	17,95	20,45
5/11/2020	5,19	5,29	0,1	428,42	441,77	13,35	133,50	17,95	20,45
6/11/2020	5,29	5,32	0,03	441,8	448,71	6,91	230,33	18,40	20,30
7/11/2020	5,32	5,42	0,1	448,73	462,12	13,39	133,90	18,4	20,10
8/11/2020	5,42	5,46	0,04	462,15	469,04	6,89	172,25	17,80	20,00
9/11/2020	5,46	5,49	0,03	469,07	476	6,93	231,00	17,1	19,85
10/11/2020	5,49	5,58	0,09	476,03	489,12	13,09	145,44	18,30	19,80
11/11/2020	5,58	5,62	0,04	489,57	496,53	6,96	174,00	18,35	19,75
12/11/2020	5,62	5,71	0,09	496,56	510,08	13,52	150,22	18,45	19,65
13/11/2020	5,71	5,74	0,03	510,1	516,99	6,89	229,67	18,85	19,65
14/11/2020	5,74	5,84	0,1	517,02	530,47	13,45	134,50	18,55	19,50
15/11/2020	5,84	5,87	0,03	530,49	537,29	6,80	226,67	17,55	19,40
16/11/2020	5,87	5,9	0,03	537,32	544,13	6,81	227,00	16,85	19,35
17/11/2020	5,9	6	0,1	544,16	557,59	13,43	134,30	17,6	19,35
18/11/2020	6	6,03	0,03	557,61	564,51	6,90	230,00	18,10	19,35
19/11/2020	6,03	6,12	0,09	564,53	577,76	13,23	147,00	17,65	19,30
20/11/2020	6,12	6,15	0,03	577,79	584,65	6,86	228,67	18,30	19,05
21/11/2020	6,15	6,24	0,09	584,68	597,99	13,31	147,89	17,9	18,85
22/11/2020	6,24	6,25	0,01	598,02	603,71	5,69	569,00	18,25	18,65
23/11/2020	6,25	6,29	0,04	603,74	610,68	6,94	173,50	18,1	18,55
24/11/2020	6,29	6,38	0,09	610,7	624,15	13,45	149,44	18,20	18,75
25/11/2020	6,38	6,41	0,03	624,18	631,08	6,90	230,00	17,95	18,50
26/11/2020	6,41	6,51	0,1	631,11	644,57	13,46	134,60	18,65	18,95
27/11/2020	6,51	6,52	0,01	644,59	650,92	6,33	633,00	18,7	19,00
28/11/2020	6,52	6,61	0,09	650,95	664,3	13,35	148,33	17,95	18,60
29/11/2020	6,61	6,65	0,04	664,33	671,19	6,86	171,50	17,5	18,25
30/11/2020	6,65	6,68	0,03	671,22	678,09	6,87	229,00	18,30	18,90
1/12/2020	6,68	6,87	0,19	678,12	691,36	13,24	69,68	17,95	18,50
2/12/2020	6,87	6,88	0,01	691,39	697,76	6,37	637,00	17,95	18,50
3/12/2020	6,88	7,1	0,22	697,78	711,28	13,50	61,36	18,4	18,95
4/12/2020	7,1	7,13	0,03	711,31	718,15	6,84	228,00	18,40	19,05



Installation of procured equipment/technical works - Functionality test report of installation

Consump. Start	Consump. End	Daily Consump. (m3)	Energy consump. Start	Energy consump. End	Daily Energy Consump. (kWh)	Eenergy Consump./m3	Mean Temperature 1 (°C)	Mean Temperature 2 (°C)	Consump. Start
5/12/2020	7,13	7,32	0,19	718,18	731,21	13,03	68,58	17,8	18,40
6/12/2020	7,32	7,33	0,01	731,23	737,37	6,14	614,00	17,10	17,85
7/12/2020	7,33	7,36	0,03	737,4	744,02	6,62	220,67	18,3	18,85
8/12/2020	7,36	7,57	0,21	744,05	757,17	13,12	62,48	18,35	18,85
9/12/2020	7,57	7,59	0,02	757,19	763,82	6,63	331,50	18,45	19,05
10/12/2020	7,59	7,76	0,17	763,85	776,42	12,57	73,94	18,85	19,60
11/12/2020	7,76	7,9	0,14	776,45	783,34	6,89	49,21	18,55	19,25
12/12/2020	7,9	8,11	0,21	783,37	796,47	13,10	62,38	17,55	18,25
13/12/2020	8,11	8,12	0,01	796,5	802,62	6,12	612,00	16,85	17,60
14/12/2020	8,12	8,15	0,03	802,65	809,33	6,68	222,67	17,60	18,30
15/12/2020	8,15	8,35	0,2	809,36	822,36	13,00	65,00	18,1	18,60
16/12/2020	8,35	8,49	0,14	822,39	829	6,61	47,21	17,65	18,50
17/12/2020	8,49	8,66	0,17	829,03	841,55	12,52	73,65	18,3	19,00
18/12/2020	8,66	8,69	0,03	841,58	848,35	6,77	225,67	17,90	18,55
19/12/2020	8,69	8,78	0,09	848,37	861,57	13,20	146,67	17	17,85
20/12/2020	8,78	8,79	0,01	861,59	867,93	6,34	634,00	16,30	17,35
21/12/2020	8,79	8,82	0,03	867,96	874,82	6,86	228,67	17,5	18,10
22/12/2020	8,82	8,9	0,08	874,85	888,08	13,23	165,38	17,70	18,25
23/12/2020	8,9	8,91	0,01	888,11	894,36	6,25	625,00	17,45	18,00
24/12/2020	8,91	9,11	0,2	894,39	907,57	13,18	65,90	17,10	17,90
25/12/2020	9,11	9,14	0,03	907,59	914,33	6,74	224,67	16,8	17,65
26/12/2020	9,14	9,31	0,17	914,36	927,06	12,70	74,71	16,60	17,35
27/12/2020	9,31	9,34	0,03	927,09	933,8	6,71	223,67	16,6	17,50
28/12/2020	9,34	9,35	0,01	933,83	939,97	6,14	614,00	16,40	17,35
29/12/2020	9,35	9,41	0,06	939,99	952,72	12,73	212,17	16,85	17,55
30/12/2020	9,41	9,44	0,03	<b>952,75</b>	<b>959,55</b>	6,80	226,67	16,85	17,60
31/12/2020	9,44	9,64	0,2	959,58	972,63	13,05	65,25	17,2	17,75
1/1/2021	9,64	9,64	0	972,66	978,98	6,32	#ΔIAIP/0!	16,65	17,45
2/1/2021	9,64	9,95	0,31	979,01	992,08	13,07	42,16	16,8	17,55
3/1/2021	9,95	9,95	0	992,1	998,21	6,11	#ΔIAIP/0!	16,50	17,40
4/1/2021	9,95	9,98	0,03	998,24	1004,87	6,63	221,00	17,6	18,00
5/1/2021	9,98	10,04	0,06	1004,9	1017,31	12,41	206,83	17,50	18,10
6/1/2021	10,04	10,05	0,01	1017,33	1023,51	6,18	618,00	16,25	17,25
7/1/2021	10,05	10,23	0,18	1023,54	1036,23	12,69	70,50	17,75	18,20
8/1/2021	10,23	10,26	0,03	1036,26	1043,1	6,84	228,00	17,95	18,50
9/1/2021	10,26	10,32	0,06	1043,13	1055,74	12,61	210,17	17,40	18,00
10/1/2021	10,32	10,35	0,03	1055,77	1062,43	6,66	222,00	16,85	17,65
11/1/2021	10,35	10,36	0,01	1062,46	1068,51	6,05	605,00	17,15	17,60
12/1/2021	10,36	10,36	0	1068,54	1069,84	1,30	#ΔIAIP/0!	17,1	17,00
13/1/2021	10,43	10,44	0,01	1081,1	1087,41	6,31	631,00	16,35	17,20
14/1/2021	10,44	10,5	0,06	1087,44	1100,18	12,74	212,33	16,1	17,05
15/1/2021	10,5	10,54	0,04	1100,2	1107,09	6,89	172,25	15,50	16,60
16/1/2021	10,54	10,59	0,05	1107,12	1119,23	12,11	242,20	13,5	15,2
17/1/2021	10,59	10,6	0,01	1119,26	1125,54	6,28	628,00	13,20	14,75
18/1/2021	10,6	10,63	0,03	1125,57	1132,43	6,86	228,67	13,25	14,25
19/1/2021	10,63	10,7	0,07	1132,46	1145,07	12,61	180,14	14,40	15,30
20/1/2021	10,7	10,71	0,01	1145,1	1151,37	6,27	627,00	14,3	15,7



Installation of procured equipment/technical works - Functionality test report of installation

Consump. Start	Consump. End	Daily Consump. (m3)	Energy consump. Start	Energy consump. End	Daily Energy Consump. (kWh)	Energy Consump./m3	Mean Temperature 1 (°C)	Mean Temperature 2 (°C)	Consump. Start
21/1/2021	10,71	10,89	0,18	1151,4	1163,96	12,56	69,78	15,45	15,80
22/1/2021	10,89	10,91	0,02	1163,99	1170,27	6,28	314,00	16,7	17
23/1/2021	10,91	10,97	0,06	1170,3	1182,92	12,62	210,33	15,90	17,05
24/1/2021	10,97	10,98	0,01	1182,95	1189,21	6,26	626,00	15,1	16,45
25/1/2021	10,98	11	0,02	1189,23	1196,05	6,82	341,00	17,35	17,20
26/1/2021	11	11,18	0,18	1196,08	1208,63	12,55	69,72	18,15	18,3
27/1/2021	11,18	11,19	0,01	1208,66	1214,92	6,26	626,00	17,00	17,80
28/1/2021	11,19	11,26	0,07	1214,95	1227,5	12,55	179,29	16,75	17,1
29/1/2021	11,26	11,27	0,01	1227,53	1233,81	6,28	628,00	18,45	19,15
30/1/2021	11,27	11,34	0,07	1233,84	1246,33	12,49	178,43	16,9	17,55
31/1/2021	11,34	11,37	0,03	1246,36	1253,11	6,75	225,00	15,95	17,15
1/2/2021	11,37	11,38	0,01	1253,13	1259,34	6,21	621,00	19,75	19,75
2/2/2021	11,38	11,44	0,06	1259,37	1271,97	12,60	210,00	20,75	21,00
3/2/2021	11,44	11,44	0	1272	1278,22	6,22	#ΔIAIP/0!	20,8	21,2
4/2/2021	11,44	11,62	0,18	1278,25	1290,84	12,59	69,94	21,50	21,20
5/2/2021	11,62	11,65	0,03	1290,87	1297,66	6,79	226,33	21,3	21,7
6/2/2021	11,65	11,71	0,06	1297,68	1310,26	12,58	209,67	19,25	19,75
7/2/2021	11,71	11,71	0	1310,29	1316,47	6,18	#ΔIAIP/0!	17,55	18,15
8/2/2021	11,71	11,73	0,02	1316,49	1323,25	6,76	338,00	19,65	20,10
9/2/2021	11,73	11,79	0,06	1323,28	1335,68	12,40	206,67	19,55	20,05
10/2/2021	11,79	11,79	0	1335,7	1341,94	6,24	#ΔIAIP/0!	19,35	19,95
11/2/2021	11,79	11,96	0,17	1341,97	1354,46	12,49	73,47	19,65	20,1
12/2/2021	11,96	11,99	0,03	1354,48	1361,31	6,83	227,67	17,45	18,15
13/2/2021	11,99	12,05	0,06	1361,34	1373,94	12,60	210,00	15,8	17,05
14/2/2021	12,05	12,05	0	1373,97	1379,43	5,46	#ΔIAIP/0!	15,15	15,45
15/2/2021	12,05	12,07	0,02	1379,46	1386,32	6,86	343,00	16,5	16,85
16/2/2021	12,07	12,13	0,06	1386,34	1399,03	12,69	211,50	18,00	18,35
17/2/2021	12,13	12,13	0	1399,06	1405,3	6,24	#ΔIAIP/0!	18,25	19,15
18/2/2021	12,13	12,32	0,19	1405,33	1418,48	13,15	69,21	19,80	20,25
19/2/2021	12,32	12,33	0,01	1418,51	1424,75	6,24	624,00	19,4	20,3
20/2/2021	12,33	12,4	0,07	1424,78	1437,86	13,08	186,86	17,55	18,30
21/2/2021	12,4	12,41	0,01	1437,89	1444,14	6,25	625,00	16,5	17,45
22/2/2021	12,41	12,43	0,02	1444,17	1450,96	6,79	339,50	19,90	19,80
23/2/2021	12,43	12,6	0,17	1450,99	1463,67	12,68	74,59	20,3	20,6
24/2/2021	12,6	12,61	0,01	1463,7	1469,93	6,23	623,00	18,35	18,90
25/2/2021	12,61	12,66	0,05	1469,96	1482,67	12,71	254,20	18,6	18,75
26/2/2021	12,66	12,8	0,14	1482,7	1489,54	6,84	48,86	18,80	19,15
27/2/2021	12,8	12,97	0,17	1489,56	1502,2	12,64	74,35	18,3	18,65
28/2/2021	12,97	12,98	0,01	1502,23	1508,46	6,23	623,00	17,40	18,05
1/3/2021	12,98	13	0,02	1508,49	1515,32	6,83	341,50	17,8	18,4
2/3/2021	13	13,06	0,06	1515,35	1528,05	12,70	211,67	18,40	18,85
3/3/2021	13,06	13,2	0,14	1528,07	1534,93	6,86	49,00	18,5	18,85
4/3/2021	13,2	13,49	0,29	1534,95	1547,56	12,61	43,48	18,55	18,50
5/3/2021	13,49	13,49	0	1547,59	1553,79	6,20	#ΔIAIP/0!	18,4	18,8
6/3/2021	13,49	13,79	0,3	1553,82	1566,97	13,15	43,83	17,65	18,25
7/3/2021	13,79	13,79	0	1567	1573,22	6,22	#ΔIAIP/0!	16,55	17,5
8/3/2021	13,79	13,82	0,03	1573,25	1580,11	6,86	228,67	17,50	18,20



Installation of procured equipment/technical works - Functionality test report of installation

Consump. Start	Consump. End	Daily Consump. (m3)	Energy consump. Start	Energy consump. End	Daily Energy Consump. (kWh)	Eenergy Consump./m3	Mean Temperature 1 (°C)	Mean Temperature 2 (°C)	Consump. Start
9/3/2021	13,82	13,88	0,06	1580,13	1592,79	12,66	211,00	17,55	18,3
10/3/2021	13,88	14,01	0,13	1592,82	1599,59	6,77	52,08	17,50	18,25
11/3/2021	14,01	14,07	0,06	1599,62	1612,22	12,60	210,00	17,15	18,1
12/3/2021	14,07	14,07	0	1612,24	1618,51	6,27	#ΔIAIP/0!	17,20	17,95
13/3/2021	14,07	14,13	0,06	1618,54	1631,12	12,58	209,67	17,35	18,05
14/3/2021	14,13	14,27	0,14	1631,15	1638,01	6,86	49,00	17,45	18,00
15/3/2021	14,27	14,39	0,12	1638,03	1644,82	6,79	56,58	17,85	18
16/3/2021	14,39	14,69	0,3	1644,85	1657,52	12,67	42,23	17,15	18,00
17/3/2021	14,69	14,69	0	1657,55	1663,8	6,25	#ΔIAIP/0!	17,05	17,7
18/3/2021	14,69	14,76	0,07	1663,83	1676,52	12,69	181,29	17,40	18,05
19/3/2021	14,76	14,76	0	1676,55	1678,17	1,62	#ΔIAIP/0!	9,15	17,9
20/3/2021	14,78	14,96	0,18	1683,44	1696,09	12,65	70,28	16,90	17,80
21/3/2021	14,96	14,98	0,02	1696,12	1702,99	6,87	343,50	16,15	17,35
22/3/2021	14,98	14,99	0,01	1703,02	1709,34	6,32	632,00	16,70	17,75
23/3/2021	14,99	15,3	0,31	1709,37	1722,54	13,17	42,48	16,7	17,7
24/3/2021	15,3	15,3	0	1722,57	1728,86	6,29	#ΔIAIP/0!	16,40	17,45
25/3/2021	15,3	15,38	0,08	1728,89	1742,11	13,22	165,25	17,05	17,7
26/3/2021	15,38	15,38	0	1742,14	1748,37	6,23	#ΔIAIP/0!	16,95	17,50
27/3/2021	15,38	15,57	0,19	1748,4	1761,59	13,19	69,42	17,35	17,7
28/3/2021	15,57	15,57	0	1761,62	1767,76	6,14	#ΔIAIP/0!	16,95	17,35
29/3/2021	15,57	15,6	0,03	1767,79	1774,65	6,86	228,67	17,45	17,55
30/3/2021	15,6	15,88	0,28	1774,68	1787,29	12,61	45,04	17,85	17,80
31/3/2021	15,88	15,9	0,02	1787,32	1794,23	6,91	345,50	17,95	18
1/4/2021	15,9	16,19	0,29	1794,25	1806,85	12,60	43,45	18,10	18,05
2/4/2021	16,19	16,21	0,02	1806,88	1813,66	6,78	339,00	17,95	18,1
3/4/2021	16,21	16,39	0,18	1813,69	1826,36	12,67	70,39	18,10	18,15
4/4/2021	16,39	16,53	0,14	1826,39	1833,22	6,83	48,79	17,8	18,1
5/4/2021	16,53	16,53	0	1833,25	1839,51	6,26	#ΔIAIP/0!	17,55	17,90
6/4/2021	16,53	16,61	0,08	1839,54	1852,76	13,22	165,25	18,1	18,35
7/4/2021	16,61	16,61	0	1852,79	1853,78	0,99	#ΔIAIP/0!	18,10	18,05
8/4/2021	16,61	16,91	0,3	1859,08	1871,72	12,64	42,13	17,9	18,4
9/4/2021	16,91	17,05	0,14	1871,75	1878,55	6,80	48,57	18,05	18,30
10/4/2021	17,05	17,22	0,17	1878,58	1891,09	12,51	73,59	17,8	18,2
11/4/2021	17,22	17,36	0,14	1891,12	1897,95	6,83	48,79	17,85	18,05
12/4/2021	17,36	17,36	0	1897,98	1904,24	6,26	#ΔIAIP/0!	18,35	18,15
13/4/2021	17,36	17,54	0,18	1904,27	1916,94	12,67	70,39	18,80	18,65
14/4/2021	17,54	17,67	0,13	1916,97	1923,77	6,80	52,31	19,45	19,05
15/4/2021	17,67	17,85	0,18	1923,8	1936,48	12,68	70,44	19,45	19,25
16/4/2021	17,85	17,87	0,02	1936,5	1943,37	6,87	343,50	19,05	19,25
17/4/2021	17,87	17,93	0,06	1943,4	1956,03	12,63	210,50	18,40	18,75
18/4/2021	17,93	17,95	0,02	1956,05	1962,83	6,78	339,00	18,15	18,5
19/4/2021	17,95	17,95	0	1962,86	1969,14	6,28	#ΔIAIP/0!	19,05	18,90
20/4/2021	17,95	18,13	0,18	1969,17	1981,86	12,69	70,50	19,85	19,5
21/4/2021	18,13	18,15	0,02	1981,89	1988,82	6,93	346,50	20,20	19,80
22/4/2021	18,15	18,21	0,06	1988,85	2001,68	12,83	213,83	20,1	19,8
23/4/2021	18,21	18,21	0	2001,7	2008	6,30	#ΔIAIP/0!	21,40	21,15
24/4/2021	18,21	18,75	0,54	2008,03	2021,3	13,27	24,57	19,5	19,6



Installation of procured equipment/technical works - Functionality test report of installation

Consump. Start	Consump. End	Daily Consump. (m3)	Energy consump. Start	Energy consump. End	Daily Energy Consump. (kWh)	Energy Consump./m3	Mean Temperature 1 (°C)	Mean Temperature 2 (°C)	Consump. Start
25/4/2021	18,75	18,75	0	2021,33	2027,6	6,27	#ΔIAIP/0!	19,35	19,10
26/4/2021	18,75	18,9	0,15	2027,63	2034,52	6,89	45,93	19,25	19,15
27/4/2021	18,9	19,17	0,27	2034,55	2047,2	12,65	46,85	19,00	18,90
28/4/2021	19,17	19,31	0,14	2047,23	2054,05	6,82	48,71	18,95	19
29/4/2021	19,31	19,37	0,06	2054,08	2066,7	12,62	210,33	19,40	19,30
30/4/2021	19,37	19,39	0,02	2066,73	2073,53	6,80	340,00	19,7	19,45
1/5/2021	19,39	19,93	0,54	2073,56	2086,73	13,17	24,39	19,55	19,45
2/5/2021	19,93	19,93	0	2086,76	2093,01	6,25	#ΔIAIP/0!	19,8	19,55
3/5/2021	19,93	19,96	0,03	2093,04	2099,85	6,81	227,00	19,95	19,75
4/5/2021	19,96	20,24	0,28	2099,88	2112,45	12,57	44,89	19,7	19,6
5/5/2021	20,24	20,37	0,13	2112,48	2119,34	6,86	52,77	19,95	19,75
6/5/2021	20,37	22,4	2,03	2119,37	2140,98	21,61	10,65	20,45	20,45
7/5/2021	22,4	23,14	0,74	2141,01	2151,26	10,25	13,85	20,30	20,20
8/5/2021	23,14	25,14	2	2151,29	2172,61	21,32	10,66	20,7	20,7
9/5/2021	25,14	25,75	0,61	2172,64	2182,28	9,64	15,80	20,35	20,10
10/5/2021	25,75	26,52	0,77	2182,31	2192,68	10,37	13,47	20,55	20,4
11/5/2021	26,52	28,48	1,96	2192,71	2213,86	21,15	10,79	20,45	20,40
12/5/2021	28,48	29,23	0,75	2213,88	2224,12	10,24	13,65	20,6	20,25
13/5/2021	29,23	31,17	1,94	2224,15	2245,33	21,18	10,92	20,55	20,30
14/5/2021	31,17	31,93	0,76	2245,36	2255,62	10,26	13,50	20,65	20,5
15/5/2021	31,93	33,88	1,95	2255,64	2276,5	20,86	10,70	20,15	20,00
16/5/2021	33,88	34,63	0,75	2276,53	2286,79	10,26	13,68	20,75	20,5
17/5/2021	34,63	35,24	0,61	2286,82	2296,36	9,54	15,64	20,50	20,35
18/5/2021	35,24	37,28	2,04	2296,39	2317,7	21,31	10,45	20,95	20,75
19/5/2021	37,28	38,04	0,76	2317,72	2328,02	10,30	13,55	21,05	20,65
20/5/2021	38,04	40,01	1,97	2328,04	2348,81	20,77	10,54	20,8	20,6
21/5/2021	40,01	40,01	0	2348,84	2348,91	0,07	#ΔIAIP/0!	21,10	20,95
31/5/2021	40,01	40,79	0,78	2348,92	2358,15	9,23	11,83	20,95	20,65
1/6/2021	40,79	42,77	1,98	2368,5	2379,23	9,82	4,96	20,95	20,70
2/6/2021	42,77	43,53	0,76	2379,26	2389,43	10,17	13,38	21,2	20,8
3/6/2021	43,53	45,65	2,12	2389,46	2410,32	20,86	9,84	21,30	21,10
4/6/2021	45,65	46,4	0,75	2410,35	2420,52	10,17	13,56	21,2	21,05
5/6/2021	46,4	48,37	1,97	2420,55	2441,52	20,97	10,64	21,40	21,05
6/6/2021	48,37	49,13	0,76	2441,55	2451,78	10,23	13,46	21,6	21,25
7/6/2021	49,13	49,73	0,6	2451,8	2461,31	9,51	15,85	21,55	21,25
8/6/2021	49,73	51,86	2,13	2461,34	2482,88	21,54	10,11	21,45	21,2
9/6/2021	51,86	52,59	0,73	2482,9	2492,89	9,99	13,68	21,25	21,00
10/6/2021	52,59	54,53	1,94	2492,92	2513,76	20,84	10,74	21,45	21,15
11/6/2021	54,53	55,3	0,77	2513,79	2524,03	10,24	13,30	21,65	21,30
12/6/2021	55,3	57,26	1,96	2524,06	2545,06	21	10,71	21,35	21
13/6/2021	57,26	58,03	0,77	2545,09	2555,28	10,19	13,23	21,35	21,05
14/6/2021	58,03	58,75	0,72	2555,3	2565,29	9,99	13,87	21,15	20,9
15/6/2021	58,75	60,7	1,95	2565,32	2586,05	20,73	10,63	21,15	20,85
16/6/2021	60,7	61,45	0,75	2586,08	2596,28	10,2	13,60	21,6	21,3
17/6/2021	61,45	63,44	1,99	2596,31	2617,22	20,91	10,51	21,75	21,35
18/6/2021	63,44	64,21	0,77	2617,25	2627,48	10,23	13,29	22,15	21,8
19/6/2021	64,21	66,3	2,09	2627,51	2649,03	21,52	10,30	22,15	21,70



Installation of procured equipment/technical works - Functionality test report of installation

Consump. Start	Consump. End	Daily Consump. (m3)	Energy consump. Start	Energy consump. End	Daily Energy Consump. (kWh)	Energy Consump./m3	Mean Temperature 1 (°C)	Mean Temperature 2 (°C)	Consump. Start
20/6/2021	66,3	66,88	0,58	2649,05	2658,45	9,4	16,21	22,4	21,9
21/6/2021	66,88	67,65	0,77	2658,47	2668,72	10,25	13,31	22,65	22,20
22/6/2021	67,65	69,63	1,98	2668,75	2689,63	20,88	10,55	22,75	22,25
23/6/2021	69,63	70,42	0,79	2689,66	2700	10,34	13,09	23,30	22,75
24/6/2021	70,42	72,41	1,99	2700,03	2721,07	21,04	10,57	22,95	22,45
25/6/2021	72,41	73,17	0,76	2721,1	2731,36	10,26	13,50	23,35	22,80
26/6/2021	73,17	75,16	1,99	2731,39	2752,23	20,84	10,47	23,75	23,1
27/6/2021	75,16	75,92	0,76	2752,25	2762,43	10,18	13,39	23,70	22,95
28/6/2021	75,92	76,52	0,6	2762,46	2771,85	9,39	15,65	23,9	23,15
29/6/2021	76,52	78,68	2,16	2771,88	2793,8	21,92	10,15	24,20	23,30
30/6/2021	78,68	79,27	0,59	2793,83	2803,28	9,45	16,02	24,25	23,55
1/7/2021	79,27	81,44	2,17	2803,31	2825,26	21,95	10,12	24,45	23,70
2/7/2021	81,44	82,05	0,61	2825,29	2834,87	9,58	15,70	24	23,15
3/7/2021	82,05	84,09	2,04	2834,9	2856,26	21,36	10,47	23,85	23,00
4/7/2021	84,09	84,86	0,77	2856,29	2866,52	10,23	13,29	24,15	23,2
5/7/2021	84,86	85,58	0,72	2866,55	2876,63	10,08	14,00	24,40	23,30
6/7/2021	85,58	87,54	1,96	2876,66	2897,6	20,94	10,68	24,1	23,05
7/7/2021	87,54	88,31	0,77	2897,63	2907,92	10,29	13,36	24,50	23,50
8/7/2021	88,31	90,29	1,98	2907,95	2928,96	21,01	10,61	24,5	23,65
9/7/2021	90,29	91,05	0,76	2928,99	2939,11	10,12	13,32	24,40	23,45
10/7/2021	91,05	93,05	2	2939,14	2960,11	20,97	10,49	24,15	23,3
11/7/2021	93,05	93,8	0,75	2960,13	2970,34	10,21	13,61	24,65	23,55
12/7/2021	93,8	94,52	0,72	2970,36	2980,45	10,09	14,01	24,7	23,55
13/7/2021	94,52	96,49	1,97	2980,47	3001,52	21,05	10,69	24,65	23,75
14/7/2021	96,49	97,25	0,76	3001,55	3011,78	10,23	13,46	24,6	23,6
15/7/2021	97,25	99,33	2,08	3011,81	3033,35	21,54	10,36	24,65	23,70
16/7/2021	99,33	100,04	0,71	3033,38	3043,32	9,94	14,00	24,65	23,65
17/7/2021	100,04	102,07	2,03	3043,34	3064,39	21,05	10,37	24,65	23,60
18/7/2021	102,07	102,79	0,72	3064,42	3074,37	9,95	13,82	24,2	23,25
19/7/2021	102,79	103,51	0,72	3074,4	3084,39	9,99	13,87	24,30	23,25
20/7/2021	103,51	105,61	2,1	3084,41	3106,07	21,66	10,31	24,5	23,55
21/7/2021	105,61	106,31	0,7	3106,09	3116	9,91	14,16	24,45	23,40
22/7/2021	106,31	108,3	1,99	3116,03	3137,28	21,25	10,68	24,35	23,35
23/7/2021	108,3	109,02	0,72	3137,31	3147,27	9,96	13,83	24,40	23,35
24/7/2021	109,02	111,14	2,12	3147,3	3168,91	21,61	10,19	24,25	23,4
25/7/2021	111,14	111,83	0,69	3168,94	3178,78	9,84	14,26	24,45	23,40
26/7/2021	111,83	112,54	0,71	3178,81	3188,71	9,9	13,94	24,35	23,4
27/7/2021	112,54	114,68	2,14	3188,74	3210,46	21,72	10,15	24,75	23,85
28/7/2021	114,68	115,36	0,68	3210,49	3220,28	9,79	14,40	24,5	23,5
29/7/2021	115,36	117,51	2,15	3220,3	3242,01	21,71	10,10	24,55	23,60
30/7/2021	117,51	118,17	0,66	3242,04	3251,77	9,73	14,74	24,7	23,55
31/7/2021	118,17	120,3	2,13	3251,8	3273,38	21,58	10,13	25,10	24,05
1/8/2021	120,3	120,97	0,67	3273,41	3283,07	9,66	14,42	25,4	24,25
2/8/2021	120,97	121,67	0,7	3283,1	3292,96	9,86	14,09	25,50	24,50
3/8/2021	121,67	123,69	2,02	3292,99	3314,09	21,1	10,45	25,2	24,1
4/8/2021	123,69	124,44	0,75	3314,12	3324,18	10,06	13,41	25,35	24,15
5/8/2021	124,44	126,59	2,15	3324,2	3345,86	21,66	10,07	25,4	24,4



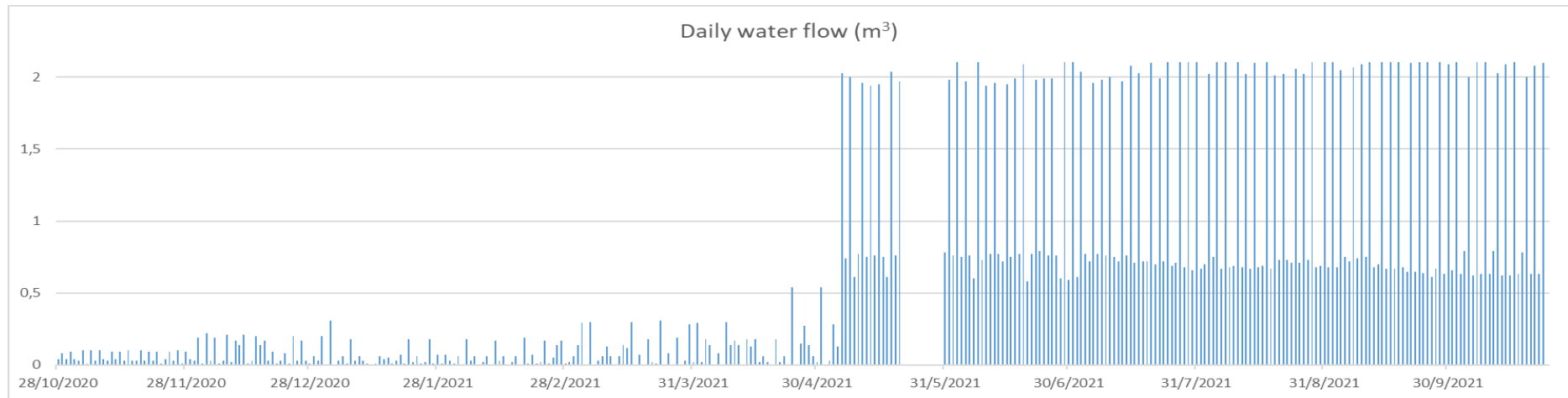
Installation of procured equipment/technical works - Functionality test report of installation

Consump. Start	Consump. End	Daily Consump. (m3)	Energy consump. Start	Energy consump. End	Daily Energy Consump. (kWh)	Energy Consump./m3	Mean Temperature 1 (°C)	Mean Temperature 2 (°C)	Consump. Start
6/8/2021	126,59	127,26	0,67	3345,89	3355,64	9,75	14,55	25,65	24,40
7/8/2021	127,26	129,37	2,11	3355,67	3377,34	21,67	10,27	25,5	24,25
8/8/2021	129,37	130,05	0,68	3377,37	3387,08	9,71	14,28	25,45	24,35
9/8/2021	130,05	130,74	0,69	3387,11	3396,89	9,78	14,17	25,75	24,5
10/8/2021	130,74	132,88	2,14	3396,92	3418,73	21,81	10,19	25,50	24,45
11/8/2021	132,88	133,56	0,68	3418,76	3428,53	9,77	14,37	25,1	24,05
12/8/2021	133,56	135,58	2,02	3428,56	3450,11	21,55	10,67	25,00	23,95
13/8/2021	135,58	136,25	0,67	3450,14	3459,93	9,79	14,61	25,15	24,05
14/8/2021	136,25	138,35	2,1	3459,96	3481,47	21,51	10,24	25,05	24,00
15/8/2021	138,35	139,03	0,68	3481,5	3491,22	9,72	14,29	25,25	24,15
16/8/2021	139,03	139,72	0,69	3491,25	3501,1	9,85	14,28	25,35	24,25
17/8/2021	139,72	141,85	2,13	3501,13	3522,79	21,66	10,17	24,95	23,9
18/8/2021	141,85	142,52	0,67	3522,82	3532,54	9,72	14,51	25,45	24,35
19/8/2021	142,52	144,53	2,01	3532,57	3553,65	21,08	10,49	24,65	23,75
20/8/2021	144,53	145,26	0,73	3553,68	3563,76	10,08	13,81	24,90	23,95
21/8/2021	145,26	147,28	2,02	3563,79	3585,12	21,33	10,56	24,4	23,65
22/8/2021	147,28	148,01	0,73	3585,15	3595,26	10,11	13,85	24,55	23,60
23/8/2021	148,01	148,72	0,71	3595,28	3605,29	10,01	14,10	24,6	23,6
24/8/2021	148,72	150,78	2,06	3605,32	3626,77	21,45	10,41	24,40	23,55
25/8/2021	150,78	151,49	0,71	3626,8	3636,83	10,03	14,13	24,5	23,6
26/8/2021	151,49	153,51	2,02	3636,86	3658,19	21,33	10,56	24,25	23,50
27/8/2021	153,51	154,24	0,73	3658,22	3668,25	10,03	13,74	24,75	23,75
28/8/2021	154,24	156,38	2,14	3668,28	3690,11	21,83	10,20	24,65	23,70
29/8/2021	156,38	157,06	0,68	3690,14	3699,88	9,74	14,32	25	23,95
30/8/2021	157,06	157,75	0,69	3699,9	3709,76	9,86	14,29	24,95	23,95
31/8/2021	157,75	159,88	2,13	3709,79	3731,43	21,64	10,16	24,55	23,65
1/9/2021	159,88	160,56	0,68	3731,45	3741,19	9,74	14,32	24,60	23,55
2/9/2021	160,56	162,68	2,12	3741,22	3762,78	21,56	10,17	24,05	23,25
3/9/2021	162,68	163,36	0,68	3762,81	3772,57	9,76	14,35	24,30	23,40
4/9/2021	163,36	165,41	2,05	3772,59	3793,78	21,19	10,34	23,9	23,2
5/9/2021	165,41	166,16	0,75	3793,81	3803,89	10,08	13,44	23,80	23,10
6/9/2021	166,16	166,88	0,72	3803,91	3813,85	9,94	13,81	23,65	22,95
7/9/2021	166,88	168,95	2,07	3813,88	3835,39	21,51	10,39	23,55	22,90
8/9/2021	168,95	169,69	0,74	3835,42	3845,54	10,12	13,68	23,35	22,75
9/9/2021	169,69	171,78	2,09	3845,57	3867,17	21,60	10,33	23,15	22,50
10/9/2021	171,78	172,53	0,75	3867,2	3877,32	10,12	13,49	23,1	22,5
11/9/2021	172,53	174,69	2,16	3877,35	3899,3	21,95	10,16	22,85	22,40
12/9/2021	174,69	175,37	0,68	3899,33	3909,23	9,9	14,56	23,25	22,55
13/9/2021	175,37	176,07	0,7	3909,26	3922,87	13,61	19,44	22,90	22,40
14/9/2021	175,94	178,11	2,17	3922,9	3944,9	22	10,14	23	22,4
15/9/2021	178,11	178,78	0,67	3944,93	3954,79	9,86	14,72	23,55	22,80
16/9/2021	178,78	180,93	2,15	3954,82	3976,63	21,81	10,14	23,15	22,5
17/9/2021	180,93	181,6	0,67	3976,66	3986,45	9,79	14,61	23,30	22,65
18/9/2021	181,6	183,74	2,14	3986,48	4008,32	21,84	10,21	23,15	22,5
19/9/2021	183,74	184,42	0,68	4008,35	4018,14	9,79	14,40	23,35	22,55
20/9/2021	184,42	185,07	0,65	4018,16	4028,12	9,96	15,32	23,8	23,05
21/9/2021	185,07	187,17	2,1	4028,15	4049,9	21,75	10,36	23,35	22,75

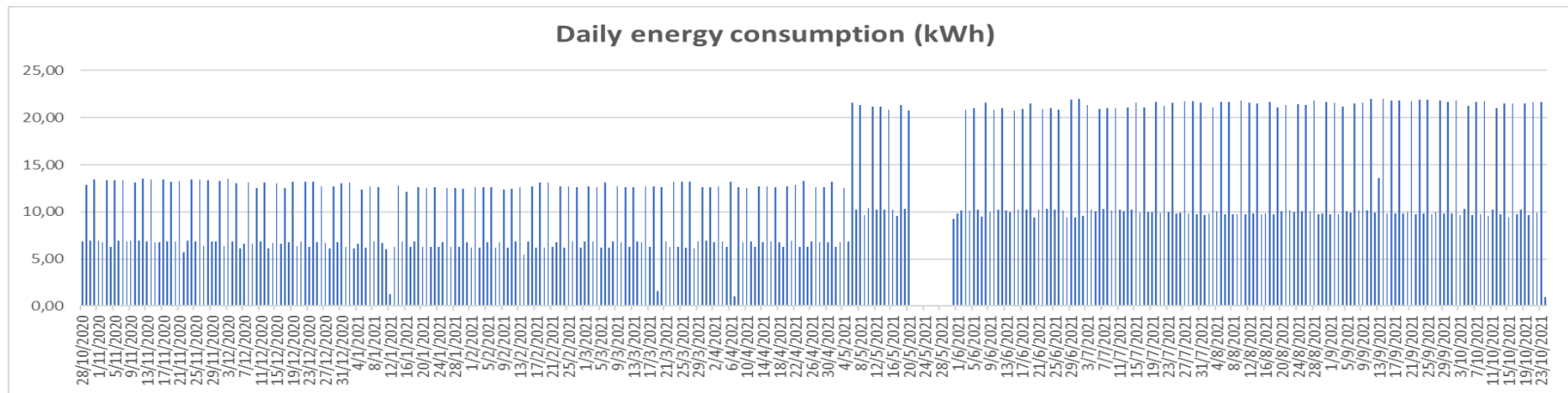


Installation of procured equipment/technical works - Functionality test report of installation

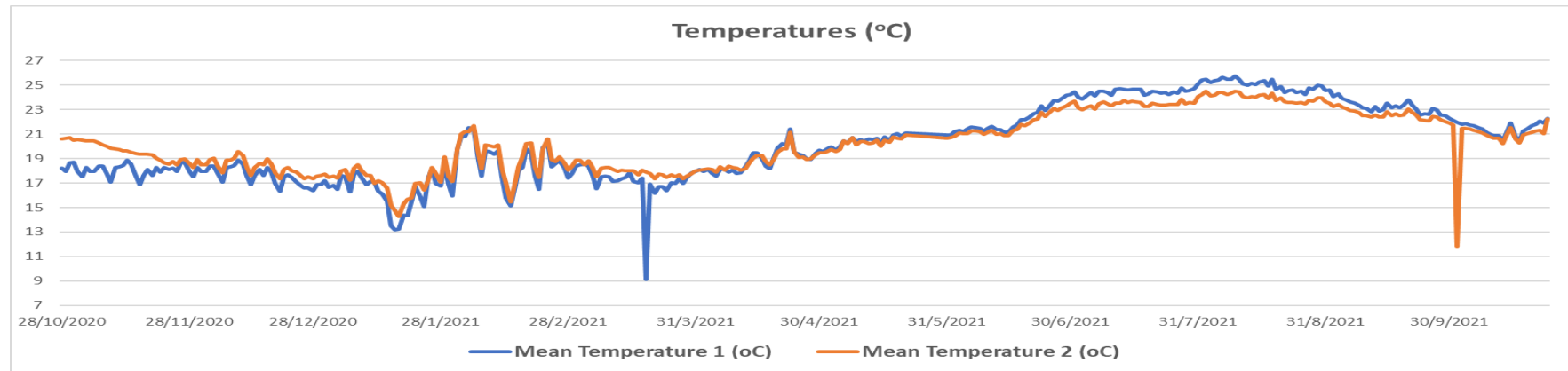
Consump. Start	Consump. End	Daily Consump. (m3)	Energy consump. Start	Energy consump. End	Daily Energy Consump. (kWh)	Energy Consump./m3	Mean Temperature 1 (°C)	Mean Temperature 2 (°C)	Consump. Start
22/9/2021	187,17	187,82	0,65	4049,93	4059,71	9,78	15,05	23,05	22,55
23/9/2021	187,82	189,93	2,11	4059,74	4081,61	21,87	10,36	22,55	22,15
24/9/2021	189,93	190,57	0,64	4081,64	4091,45	9,81	15,33	22,65	22,1
25/9/2021	190,57	192,71	2,14	4091,47	4113,34	21,87	10,22	22,60	22,05
26/9/2021	192,71	193,32	0,61	4113,36	4123,06	9,7	15,90	23,1	22,45
27/9/2021	193,32	193,99	0,67	4123,09	4133,05	9,96	14,87	23,00	22,40
28/9/2021	193,99	196,13	2,14	4133,08	4154,93	21,85	10,21	22,55	22,15
29/9/2021	196,13	196,76	0,63	4154,96	4164,75	9,79	15,54	22,50	22,00
30/9/2021	196,76	198,85	2,09	4164,78	4186,44	21,66	10,36	22,3	21,9
1/10/2021	198,85	199,51	0,66	4186,47	4196,3	9,83	14,89	22,10	21,75
2/10/2021	199,51	201,62	2,11	4196,33	4218,12	21,79	10,33	21,95	11,85
3/10/2021	201,62	202,25	0,63	4218,15	4227,84	9,69	15,38	21,80	21,45
4/10/2021	202,25	203,04	0,79	4227,86	4238,21	10,35	13,10	21,85	21,45
5/10/2021	203,04	205,04	2	4238,23	4259,46	21,23	10,62	21,75	21,40
6/10/2021	205,04	205,66	0,62	4259,48	4269,13	9,65	15,56	21,7	21,3
7/10/2021	205,66	207,78	2,12	4269,15	4290,82	21,67	10,22	21,55	21,20
8/10/2021	207,78	208,41	0,63	4290,85	4300,63	9,78	15,52	21,4	21,1
9/10/2021	208,41	210,53	2,12	4300,66	4322,44	21,78	10,27	21,15	20,95
10/10/2021	210,53	211,16	0,63	4322,47	4332,04	9,57	15,19	21	20,75
11/10/2021	211,16	211,95	0,79	4332,07	4342,28	10,21	12,92	20,90	20,65
12/10/2021	211,95	213,98	2,03	4342,3	4363,34	21,04	10,36	20,85	20,65
13/10/2021	213,98	214,6	0,62	4363,36	4373,11	9,75	15,73	20,45	20,20
14/10/2021	214,6	216,69	2,09	4373,14	4394,61	21,47	10,27	21,15	20,95
15/10/2021	216,69	217,31	0,62	4394,64	4404,08	9,44	15,23	21,90	21,55
16/10/2021	217,31	219,43	2,12	4404,11	4425,62	21,51	10,15	20,8	20,6
17/10/2021	219,43	220,06	0,63	4425,65	4435,39	9,74	15,46	20,40	20,30
18/10/2021	220,06	220,84	0,78	4435,42	4445,69	10,27	13,17	21,25	20,95
19/10/2021	220,84	222,84	2	4445,72	4467,19	21,47	10,73	21,40	21,05
20/10/2021	222,84	223,47	0,63	4467,21	4476,88	9,67	15,35	21,7	21,15
21/10/2021	223,47	225,55	2,08	4476,91	4498,55	21,64	10,40	21,80	21,25
22/10/2021	225,55	226,18	0,63	4498,58	4508,45	9,87	15,67	22,05	21,3
23/10/2021	226,18	228,28	2,1	4508,48	4530,12	21,64	10,30	21,90	21,05
24/10/2021	228,28	228,28	0	4530,14	4531,08	0,94	#ΔΙΑΙΡ/0!	22,3	22,25



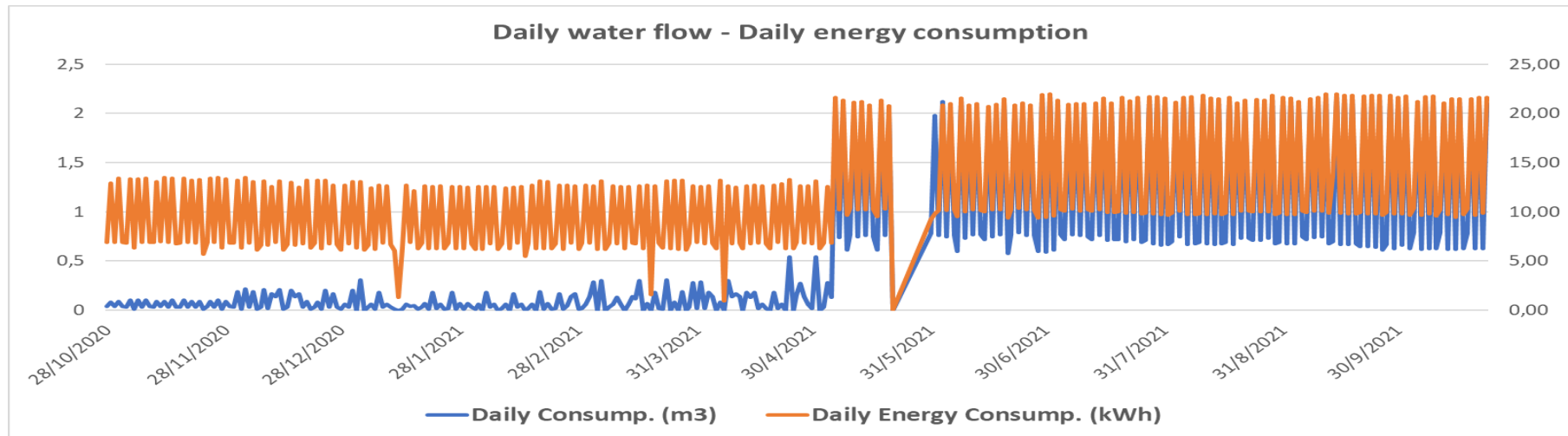
**Image 4.2** Daily water flow for the period 28/10/20-24/10/21



**Image 4.3** Daily energy consumption for the period 28/10/20-24/10/21



**Image 4.4** Daily temperature for the period 28/10/20-24/10/21



**Image 4.5** Daily water flow – Daily energy consumption for the period 26/10/20-24/10/21



#### **4.4. Water quality**

The results of the water analysis (x3) are presented in the following table. A comparison between them and the parametrical limits is also conducted.

The red values concern the parameters above limits of drinking water. These are the following:

- Total plate count 36 °C, with an above-limit value
- Coliforms, with intense presence
- Escherichia coli, its presence doesn't suits with standards
- Enterococcus, same occasion as Escherichia coli
- Total dissolved salts (TDS), above limits
- Total hardness (TH), above limits
- Chlorides ( $\text{Cl}^-$ ), above limits
- Sulfates ( $\text{SO}_4^{-2}$ ), above but close to limits
- Natrium (Na), above limits

According to the above results, the drilling water is non-drinking and not suitable for use in the hygiene installations (WC) of the school.



**Table 2: Comparison of Water Analysis Results – Drinking water limits**

Parameter	Units	Result			Limits <sup>1</sup>
<b>Microbiological Test</b>					
		<b>Analysis</b>			
		1st	2nd	3rd	
<b>Total Plate Count 36°C</b>	CFU/ml	680	220	250	20
<b>Coliforms</b>	CFU/100 ml	280	4	6	0
<b>Escherichia coli</b>	CFU/100 ml	1	<1	1	0
Enterococcus	CFU/100 ml	1	<1	7	0
<b>Physicochemical Tests</b>					
<b>pH</b>	pH units	7,74	7,7	7,52	≤6,5 and ≥9,5
<b>Electrical Conductivity 20°C</b>	µS/cm	2260	2316	1922	2500
<b>Total dissolved salts (TDS)</b>	mg/L	1684,3	1726,1	1432,4	250
<b>Total hardness (TH)</b>	°F	25	26,2	24,9	6
<b>Ionic chromatography</b>					
<b>F<sup>-</sup></b>	mg/L	0,75	<0,45	0,44	1,5
<b>Cl<sup>-</sup></b>	mg/L	340,08	314,67	302,56	250
<b>NO<sub>2</sub><sup>-</sup></b>	mg/L	<0,45	<0,45	<0,30	0,5
<b>NO<sub>3</sub><sup>-</sup></b>	mg/L	16,2	19,32	18,88	50
<b>PO<sub>4</sub><sup>-3</sup></b>	mg/L	<0,45	<0,45	<0,30	5
<b>SO<sub>4</sub><sup>-2</sup></b>	mg/L	267,93	288,57	253,54	250
<b>Metals</b>					
<b>Ca</b>	mg/L	45,94	47,75	46,23	100
<b>K</b>	mg/L	1,4	1,63	1,70	12
<b>Mg</b>	mg/L	32,85	34,79	32,52	50
<b>Na</b>	mg/L	330,6	359,27	337,13	200
<b>As</b>	µg/L	<3,3	<3,3	<3,3	10
<b>Cd</b>	µg/L	<1,65	<1,65	<1,65	5
<b>Cr</b>	µg/L	<3,3	4,5	<3,3	50
<b>Fe</b>	µg/L	33	56,7	34,1	200
<b>Mn</b>	µg/L	31,2	14,8	7,3	50
<b>Ni</b>	µg/L	<3,3	<3,3	<3,3	20
<b>Pb</b>	µg/L	<3,3	<3,3	<3,3	10

<sup>1</sup> Source: GG 3282/B/19-9-2017 and European Union Legislation 2020/2184/16-12-2020)



## **5. IMPROVEMENT PROPOSALS**

The improvement proposals lead to the protection of the present installations as long as to its capability of usage in other applications too. The following could take place:

- Replacement of the existing valves in the toilets with new ones in order for the leakages to disappear and tests of WC fed by drilling water could take place. Nevertheless, according to the water analysis results this is forbidden.
- Construction of a protective structure of the drilling installation system in order to avoid people entering the area. Although it has been noticed that no damages occurred from human intervention, it's proposed for the area to be secured from non valid person.
- In the future the drilling water could be sent via a pipe network to the neighboring fields for irrigation purposes. This could be done if the water flow is stable and for this reason, the system has to be monitored for a long period.



## **APPENDIX I – WEEKLY MONITORING SYSTEM FAULTS REPORT**



## Εβδομαδιαία Αναφορά

**Δευτέρα, 16/11/2020**

09/11/2020, 00:00:00 - 15/11/2020, 23:59:59

### ΟΙΚΗΜΑ

#### Καταγραφικό σύστημα

Συμβάντα Συστήματος	Συμβάντα κανόνων ορθής λειτουργίας	Σε σύνδεση
0	0	N/A

#### Σημεία μέτρησης

Ενσωματωμένα Αισθητήρια

Σημείο	Συμβάντα	Ποσοστό Κανονικής Λειτουργίας	Μέση Τιμή
Temperature 1	0	N/A	20.04oC
Temperature 2	0	N/A	20.09oC
Τροφοδοσία Συστήματος	0	100%	N/A

#### OR-WE-504

Σημείο	Συμβάντα	Ποσοστό Κανονικής Λειτουργίας	Μέση Τιμή
Ενέργεια	0	N/A	N/A

#### GWF UnicoCoder MP

Σημείο	Συμβάντα	Ποσοστό Κανονικής Λειτουργίας	Μέση Τιμή
Υδρομετρητής	0	N/A	N/A

### Συγκεντρωτικά Στοιχεία

Συγκεντρωτικά Στοιχεία Συμβάντων	Συνολικός Αριθμός	Ποσοστό αποστολής ειδοποίησης
Καταγραφικό Σύστημα	0	N/A
Κανόνες Ορθής Λειτουργίας Σημείων Μέτρησης	0	N/A



## Εβδομαδιαία Αναφορά

**Δευτέρα, 11/01/2021**

04/01/2021, 00:00:00 - 10/01/2021, 23:59:59

### ΟΙΚΗΜΑ

#### Καταγραφικό σύστημα

Συμβάντα Συστήματος	Συμβάντα κανόνων ορθής λειτουργίας	Σε σύνδεση
0	0	N/A

#### Σημεία μέτρησης

##### Ενσωματωμένα Αισθητήρια

Σημείο	Συμβάντα	Ποσοστό Κανονικής Λειτουργίας	Μέση Τιμή
Temperature 1	0	N/A	17.42oC
Temperature 2	0	N/A	17.53oC
Τροφοδοσία Συστήματος	0	100%	N/A

##### OR-WE-504

Σημείο	Συμβάντα	Ποσοστό Κανονικής Λειτουργίας	Μέση Τιμή
Ενέργεια	0	N/A	N/A

##### GWF UnicoCoder MP

Σημείο	Συμβάντα	Ποσοστό Κανονικής Λειτουργίας	Μέση Τιμή
Υδρομετρητής	0	N/A	N/A

### Συγκεντρωτικά Στοιχεία

Συγκεντρωτικά Στοιχεία Συμβάντων	Συνολικός Αριθμός	Ποσοστό αποστολής ειδοποίησης
Καταγραφικό Σύστημα	0	N/A
Κανόνες Ορθής Λειτουργίας Σημείων Μέτρησης	0	N/A



## APPENDIX II – WATER ANALYSIS

### 1<sup>st</sup> Water Analysis (23/10/2020)

Parameter	Units	Result	Method
<b>Microbiological Tests</b>			
Total plate count 36 °C	CFU/ml	680	ISO 6222:1999
Coliforms	CFU/100 ml	280	ISO 9308-1:2014
Escherichia coli	CFU/100 ml	1	ISO 9308-1:2014
Enterococcus	CFU/100 ml	1	ISO 7899-2:2000
<b>Physicochemical Tests</b>			
pH	Μονάδες pH	7,74	APHA 4500-H*B
Electrical Conductivity (EC) 20°C	μS/cm	2260	APHA 2510 B
Total dissolved salts (TDS)	mg/L	1684,3	Numerical
Total hardness (TH)	°F	25	APHA 2340 B
<b>Ionic chromatography</b>			
F-	mg/L	0,75	APHA 4110 C
Cl-	mg/L	340,08	APHA 4110 C
NO <sub>2</sub> -	mg/L	<0,45	APHA 4110 C
NO <sub>3</sub> -	mg/L	16,2	APHA 4110 C
PO <sub>4</sub> -3	mg/L	<0,45	APHA 4110 C
SO <sub>4</sub> -2	mg/L	267,93	APHA 4110 C
<b>Metals</b>			
Ca	mg/L	45,94	ICP-OES intern. Based on APHA 3120B
K	mg/L	1,4	ICP-OES intern. Based on APHA 3120B
Mg	mg/L	32,85	ICP-OES intern. Based on APHA 3120B
Na	mg/L	330,6	ICP-OES intern. Based on APHA 3120B
As	μg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B
Cd	μg/L	<1,65	USN-ICP-OES intern. Based on APHA 3120B
Cr	μg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B
Fe	μg/L	33	USN-ICP-OES intern. Based on APHA 3120B
Mn	μg/L	31,2	USN-ICP-OES intern. Based on APHA 3120B
Ni	μg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B
Pb	μg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B



## 2nd WATER ANALYSIS (25/2/2021)

Parameter	Units	Result	Method
<b>Microbiological Tests</b>			
Total plate count 36 °C	CFU/ml	220	ISO 6222:1999
Coliforms	CFU/100 ml	4	ISO 9308-1:2014
Escherichia coli	CFU/100 ml	<1	ISO 9308-1:2014
Enterococcus	CFU/100 ml	<1	ISO 7899-2:2000
<b>Physicochemical Tests</b>			
pH	Μονάδες pH	7,7	APHA 4500-H*B
Electrical Conductivity (EC) 20°C	µS/cm	2316	APHA 2510 B
Total dissolved salts (TDS)	mg/L	1726,1	Numerical
Total hardness (TH)	°F	26,2	APHA 2340 B
<b>Ionic chromatography</b>			
F-	mg/L	<0,45	APHA 4110 C
Cl-	mg/L	314,67	APHA 4110 C
NO <sub>2</sub> -	mg/L	<0,45	APHA 4110 C
NO <sub>3</sub> -	mg/L	19,32	APHA 4110 C
PO <sub>4</sub> -3	mg/L	<0,45	APHA 4110 C
SO <sub>4</sub> -2	mg/L	288,57	APHA 4110 C
<b>Metals</b>			
Ca	mg/L	47,75	ICP-OES intern. Based on APHA 3120B
K	mg/L	1,63	ICP-OES intern. Based on APHA 3120B
Mg	mg/L	34,79	ICP-OES intern. Based on APHA 3120B
Na	mg/L	359,27	ICP-OES intern. Based on APHA 3120B
As	µg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B
Cd	µg/L	<1,65	USN-ICP-OES intern. Based on APHA 3120B
Cr	µg/L	4,5	USN-ICP-OES intern. Based on APHA 3120B
Fe	µg/L	56,7	USN-ICP-OES intern. Based on APHA 3120B
Mn	µg/L	14,8	USN-ICP-OES intern. Based on APHA 3120B
Ni	µg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B
Pb	µg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B



### 3rd WATER ANALYSIS (23/4/2021)

Parameter	Units	Result	Method
<b>Microbiological Tests</b>			
Total plate count 36 °C	CFU/ml	250	ISO 6222:1999
Coliforms	CFU/100 ml	6	ISO 9308-1:2014
Escherichia coli	CFU/100 ml	1	ISO 9308-1:2014
Enterococcus	CFU/100 ml	7	ISO 7899-2:2000
<b>Physicochemical Tests</b>			
pH	Μονάδες pH	7,52	APHA 4500-H*B
Electrical Conductivity (EC) 20°C	μS/cm	1922	APHA 2510 B
Total dissolved salts (TDS)	mg/L	1432,4	Numerical
Total hardness (TH)	°F	24,9	APHA 2340 B
<b>Ionic chromatography</b>			
F-	mg/L	0,44	APHA 4110 C
Cl-	mg/L	302,56	APHA 4110 C
NO <sub>2</sub> -	mg/L	<0,30	APHA 4110 C
NO <sub>3</sub> -	mg/L	18,88	APHA 4110 C
PO <sub>4</sub> -3	mg/L	<0,30	APHA 4110 C
SO <sub>4</sub> -2	mg/L	253,54	APHA 4110 C
<b>Metals</b>			
Ca	mg/L	46,23	ICP-OES intern. Based on APHA 3120B
K	mg/L	1,70	ICP-OES intern. Based on APHA 3120B
Mg	mg/L	32,52	ICP-OES intern. Based on APHA 3120B
Na	mg/L	337,13	ICP-OES intern. Based on APHA 3120B
As	μg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B
Cd	μg/L	<1,65	USN-ICP-OES intern. Based on APHA 3120B
Cr	μg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B
Fe	μg/L	34,1	USN-ICP-OES intern. Based on APHA 3120B
Mn	μg/L	7,3	USN-ICP-OES intern. Based on APHA 3120B
Ni	μg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B
Pb	μg/L	<3,3	USN-ICP-OES intern. Based on APHA 3120B