

Work Package 5: Monitoring and evaluation of outputs

Deliverable 5.7.3 (former 5.4.1): Monitoring of ground water quality at pumps

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About this document:

This deliverable reports on the quality of water from the pilot outputs. More specifically this deliverable focus on physical, chemical and biological parameters of this water.

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Deliverable Contributors:

1. Lykourgos Magafas ;
2. Dimitrios Kaziolas
3. Nikolaos Vordos

Has been reviewed and approved by: Lykourgos Magafas

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1. Introduction

According to World Health Organization (WHO), water is a finite resource, required for human existence, agriculture and industry [1]. The water quality depends on its physical, chemical and biological parameters [1]. WHO drew up the water quality guidelines and standards in 2001 and since then, several research studies have attempted to evaluate those standards [2]–[5]. The water can be classified according to origination (Pipes, bottles, springs, dug well, etc.) and according to water lander as illustrated in Fig. 1. [4].

2. Monitoring of Ground Water Quality at Pumps



Figure 1. Water types classification.

Color, odor, taste, whole solids and dissolved solids and turbidity are the physical tests for water. The water must be colorless, since any presence of color indicates the presence of minerals such as magnesium and iron. Also, water must be tasteless and odorless, since any

taste and odor indicate living microorganisms, algae or ammonia, phenols, hydrocarbons, etc. Turbidity is one of the main parameters which were examined for the water quality and the presence of turbidity can be attributed to solids and colloidal matter.

Highly toxic chemical, biocides PH, hardness, selected chemical parameter are examined for the water quality. PH is the measure of the hydrogen ion concentration and can be categorized as neutral, alkaline or acidic. Drinking water should have a pH between 6.5 and 8.5.

Indicator organisms should be abundant in excrement but absent, or present only in small numbers, in other sources; they should be easily isolated, identified and enumerated and should be unable to grow in water. The presence of organisms or not in water can be certified via a bacteriological test.

Table 1 Sample Water Analysis Report - Port TAP WATER

Parameter	Unit	Test Remarks	Requirement	Methods
Physical & Chemical *):				
· Colour	Pt. Co scale	3	15	Colorimetric
· Odour	Pt. Co scale	negative	odourless	Organoleptic
· pH	Pt. Co scale	6.50	6.5-8.5	Electrometric
· Taste	Pt. Co scale	normal	tasteless	Organoleptic
· Turbidity	FTU	1	5	Turbidity
· Aluminum	mg/l	below 0.20	0.2	AAS
· Copper	mg/l	below 0.03	1.0	AAS
· Iron Total	mg/l	below 0.04	0.3	AAS

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· Manganese	mg/l	0.06	0.1	AAS
· Sodium	mg/l	96.93	200	AAS
· Zinc	mg/l	0.047	5	AAS
· Chloride	mg/l	140.41	250	Argentometric
· Flouride	mg/l	0.09	1.5	Colorimetric
· Nitrate	mg/l	below 0.11	10	Colorimetric
· Nitrite	mg/l	0.96	1	Colorimetric
· Sulphate	mg/l	below 0.94	400	Turbidimetric
· Arsenic	mg/l	below 0.001	0.05	AAS
· Barium	mg/l	below 0.10	1	AAS
· Cadmium	mg/l	below 0.005	0.005	AAS
· Cyanide	mg/l	below 0.01	0.1	Colorimetric
· Chrom Hexavalent	mg/l	below 0.006	0.05	Colorimetric
· Lead	mg/l	below 0.01	0.05	AAS
· Mercury	mg/l	below 0.001	0.001	AAS
· Selenium	mg/l	below 0.007	0.01	AAS
· Organic Matter by KMnO4	mg/l	3.06	10	Permanganantometric
· Dissolved Solid	mg/l	431	1000	Gravimetric
· Hydrogen Sulphide as H2S	mg/l	below 0.01	0.05	Colorimetric

· Total Hardness	mg CaCO ₃	95.49	500	AAS
Bacteriological:				
· Total Bacteria	per ml	6.9 x 10 ²	1.0 x 10 ²	Pour Plate
· Coliform	per 100 ml	nil	nil	Filtration
· E. Coli	per 100 ml	nil	nil	Filtration
· Salmonella sp	per 100 ml	negative	negative	Filtration

Table 2. W.H.O. Drinking Water Standards

PARAMETER	UNIT	LIMIT
Aluminium	mg Al/l	0.2
Arsenic	mg As/l	0.05
Barium	mg Ba/l	0.05
Beryllium	ug Be/l	0.2
Cadmium	ug Cd/l	5.0
Calcium	mg Ca/l	200.0
Chromium	mg Cr/l	0.05
Copper	mg Cu/l	1.0
Iron Total	mg Fe/l	0.3
Lead	mg Pb/l	0.01

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Magnesium	mg Mg/l	150.0
Manganese	mg Mn/l	0.1
Mercury	ug Hg/l	1.0
Selenium	mg Se/l	0.01
Sodium	mg Na/l	200.0
Zinc	mg Zn/l	5.0
Chlorides	mg Cl/l	250.0
Cyanide	mg Cn/l	0.1
Fluorides	mg F/l	1.5
Nitrates	mg NO ₃ /l	10.0
Nitrites	mg NO ₂ /l	-
Sulphates	mg SO ₄ /l	400.0
Suphides	mg H ₂ S/l	0
TOTAL "drins"	ug/l	0.03
TOTAL "ddt"	ug/l	1.0
Hydrocarbons	mg/l	0.1
Anionic Detergents	mg/l	0
pH		9.2
Total dissolved solids	mg/l	1500
Total hardness	mg/l	500

Alkalinity	mg/l	500
MICROBIOLOGICAL PARAMETERS		
Total Bacteria	Count/ml	100
Coliform	Count/100ml	0
E. Coli	Count/100ml	0
Salmonella	Count/100ml	0

ug = microgram or ppb

mg = milligram or ppm

Table 3. EU Water Standards

PARAMETER	UNIT	LIMIT
Mercury	ug Hg/l	0.50 (D)
Cadmium	ug Cd/l	5.00 (D)
Arsenic	mg As/l	0.50 (G)
Chromium	mg Cr/l	0.50 (G)
Copper	mg Cu/l	0.50 (G)
Iron	mg Fe/l	3.00 (G)
Lead	mg Pb/l	0.50 (G)
Nickel	mg Ni/l	0.50 (G)
Zinc	mg Zn/l	50.00 (G)
Tributyltin	ug/l	0.002

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Triphenyltin	ug/l	0.008
Aldrin	ug/l	0.01
Dieldrin	ug/l	0.01
Endrin	ug/l	0.005
Isodrin	ug/l	0.005
TOTAL "drins"	ug/l	0.03
TOTAL "ddt" all 4 isomers	ug/l	0.025
para-ddt	ug/l	0.01
Hexachloro-cyclohexane	ug/l	0.02
Carbon tetrachloride	ug/l	12.0
Pentachlorophenol	ug/l	2.0
Hexachlorobenzene	ug/l	0.03
Hexachlorobutadiene	ug/l	0.10
Chloroform	ug/l	12.0
Ethylene Dichloride	ug/l	10.0
Perchloroethylene	ug/l	10.0
Trichlorobenzene	ug/l	0.40
Trichloroethylene	ug/l	10.0
Hydrocarbons	ug/l	300.0 (G)
Phenols	ug/l	50.0

Surfactants	ug/l	300.0 (G)
Dissolved Oxygen	% Saturation	80-120 (G)
pH		6-9
Sulphide	mg/l	0.04 (S)

MICROBIOLOGICAL PARAMETERS

Faecal conforms	per 100ml	2000
Total coliforms	per 100ml	10000
Salmonella		0
Enteroviruses		0

ug = microgram

G = Guideline

mg = milligram

S = Suggested


D = Dissolved

Tables 1, 2 and 3 display examples of indicative water test analyses, corresponding to the WHO water standards and the EU water standards respectively.

In the context of the Green Pump project, the Department of Physics of the International University of Greece collaborated with the Municipal Water Supply Company of Drama to test the water quality. Water quality measurements are carried out both at the level of the boreholes, where samples are taken from the groundwater as well as the water supply network. At least 34 samples are taken from the water supply network during the year. Similar measurements are made in groundwater, including but not limited to measurements of temperature, color, taste, odor, turbidity, enterococci, ammonia, etc. Table 4 shows the

total sample points. Table 5 shows an indicative chemical parameters analysis from the underground water sample.

Table 4. Drama Municipality Water Quality Measurement

 <small>ΔΗΜΟΤΙΚΗ ΕΠΙΧΕΙΡΗΣΗ ΥΔΡΕΥΣΗΣ ΑΠΟΧΕΤΕΥΣΗΣ ΔΡΑΜΑΣ</small>	Water Quality Measurements					
	Tap Water					
Drama Municipality						
Sampling Points	Habitants	m ³ / Day	Control Type A	Control Type B	Radiation Control	
Drama Municipality	45832	9166,4		34	4	3
Water Network Points 1: (Agios Tryfonas Reservoir)						
1) Ampelokipi x2, 2) Administration x2, 3) TEI of Drama						
4) OSE area,						
5) Stenimachos- Suburb x2 6) N. Sevastia x2						
Water Network Points 2: (High Reservoir)						
1) N. Kromni x2, 2) Hospital x2 3) area Prof. Elias, 4)						
National Stadium (Men's area), 5) Doxas Stadium (St. Panteleimonas area)						
6) Α΄ Δημ. Paidikos, 7) 3rd Δημ. Children's 8) 5						

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<u>Roads</u>						
<u>Water Network Points 3: (Wellhead Reservoir)</u>						
<u>1) N. Amisos 2) Ampelakia, 3) City Hall, 4) Municipal Garden, 5) area 12 Apostoli, 6) Ortakina, 7) DEYAD, 8) BDDim. Child, 9) Δ'Αημοτ. Children's 10) EEL</u>			10			
<u>Water Network Points 4: (Panorama Reservoir)</u>						
<u>1) Kiosk fountain in the regional Panorama, 2) Church x 2</u>			1			
<i>Total Samples</i>			34			

Table 5. Water Chemical Parameter Analysis.

Parameter	Unit	Value	Limit Reference	Upper Limit	Method
Aluminum (Al)	µg/L	N.D	10	200	ICPMS 3125

					A,B
Nickel (Ni)	µg/L	N.D	1	20	ICPMS 3125 A,B
Selenium (Se)	µg/L	N.D	1	10	ICPMS 3125 A,B
Lead (Pb)	µg/L	N.D	1	10	ICPMS 3125 A,B
Chromium (Cr)	µg/L	N.D	1	50	ICPMS 3125 A,B
Manganese (Mn)	µg/L	N.D	10	50	ICPMS 3125 A,B
Iron (Fe)	µg/L	N.D	10	200	ICPMS 3125 A,B
Copper (Cu)	mg/L	N.D	0,01	2	ICPMS 3125 A,B
Zinc (Zn)	µg/L	<0,11 DL			ICPMS 3125 A,B
Arsenic (As)	µg/L	1,25	1	10	ICPMS 3125 A,B
Cadmium (Cd)	µg/L	N.D	1	5	ICPMS 3125 A,B
Antimony (Sb)	µg/L	N.D	1	5	ICPMS 3125 A,B
Boron (B)	mg/L	N.D	0,05	1	ICPMS 3125 A,B
Mercury (Hg)	µg/L	N.D	0,1	1	ICPMS 3125

					A,B
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