

Development of an Integrated Water Monitoring Programme and development of associated databases supporting the implementation of the Water Framework Directive 2000/60/EC in Cyprus

Contract No. 46/2005

Rationale of WFD monitoring network options
Identification of key issues
Suggestions and recommendations



Nicosia, Monday 16/10/2006



Today's Agenda

Monday 16/10/2006

Scope of 16/10/2006 presentation

1. Review of basic and extended approach as proposed in Activity 2.2 report
2. Review of the issues discussed in the framework of the working groups after the delivery of 2.2 report
3. Role of WFD monitoring in relation to general WFD implementation as well as other water related Directives
4. Identification of key issues for Cyprus
5. Present recommendations to the client
6. Discuss all the above

AIMS

1. Assist in deciding upon the selection of one option
2. Assist in mobilization of forces for future needs and requirements

Programme of the day

◆ Part 1 (8:30-9:15)

◆ WFD Article 8 monitoring programme

- ◆ WFD timetable
- ◆ WFD and other water related directives
- ◆ WFD programme of measures
- ◆ Water related directives incorporated in designing of Cyprus monitoring programme
- ◆ Discussion

◆ Part 2 (9:15-10:15)

◆ GWBs monitoring programme

- ◆ Methodology of designing
- ◆ Overview of the two approaches
- ◆ Cost assessment and provisional personnel demands
- ◆ Key issues
- ◆ Discussion

◆ Part 3 (10:15-10:45)

◆ Coastal WBs monitoring programme

- ◆ Methodology of designing
- ◆ Overview of the two approaches
- ◆ Cost assessment and provisional personnel demands
- ◆ Key issues
- ◆ Discussion

Programme of the day (2)

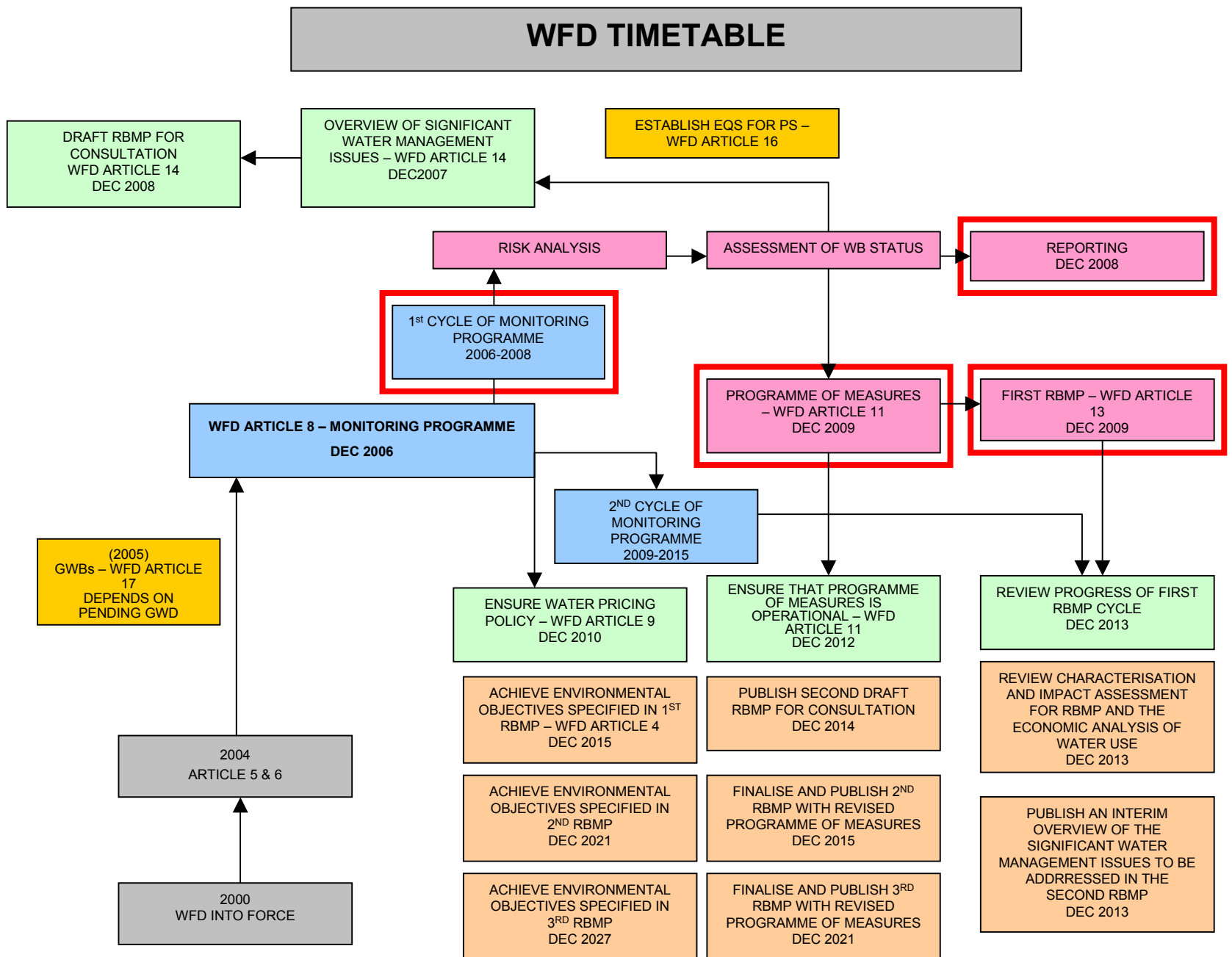
◆ Part 4 (11:00-11:45)

- ◆ River and lake WBs monitoring programme
 - ◆ Methodology of designing
 - ◆ Overview of the two approaches
 - ◆ Cost assessment and provisional personnel demands
 - ◆ Key issues

◆ Part 5 (11:45-13:00)

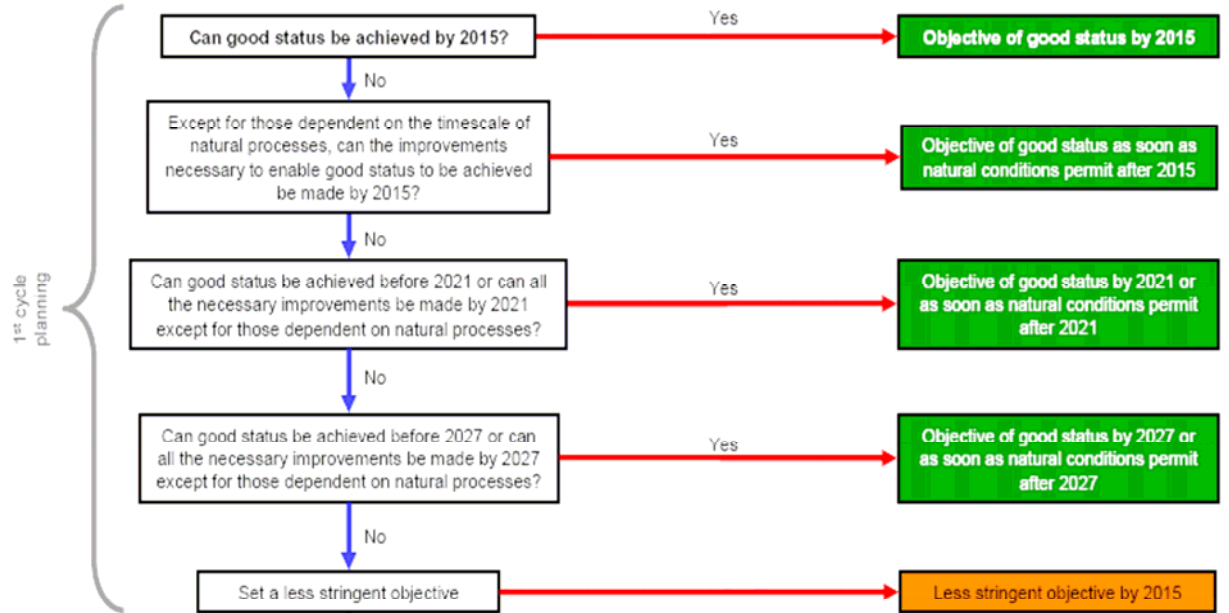
- ◆ Cost and personnel issues
- ◆ Summary of important key issues
- ◆ Recommendations for the client
- ◆ Discussion on parts 4 and 5

WFD TIMETABLE

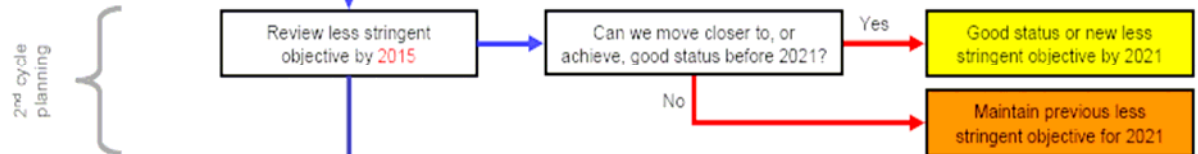


WFD TIMETABLE

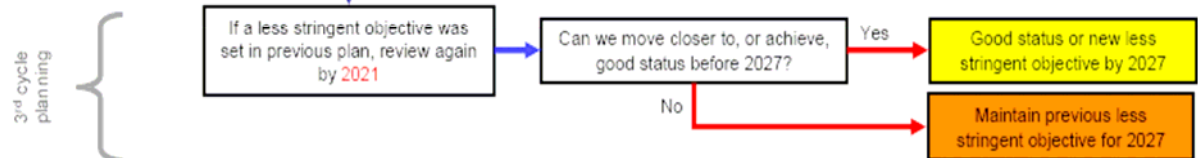
2009-2015



2015-2021



2021-2027



WFD AND OTHER WATER RELATED DIRECTIVES

DIRECTIVES THAT WILL BE REPEALED BY WFD IN PHASES:

UNTIL 2007

- ✓ SURFACE WATER ABSTRACTION DIRECTIVE – 75/440/EEC
- ✓ EXCHANGE OF INFORMATION ON SURFACE WATER DECISION – 77/795/EEC
- ✓ SURFACE WATER ABSTRACTION MEASUREMENT / ANALYSIS DIRECTIVE – 79/869/EEC

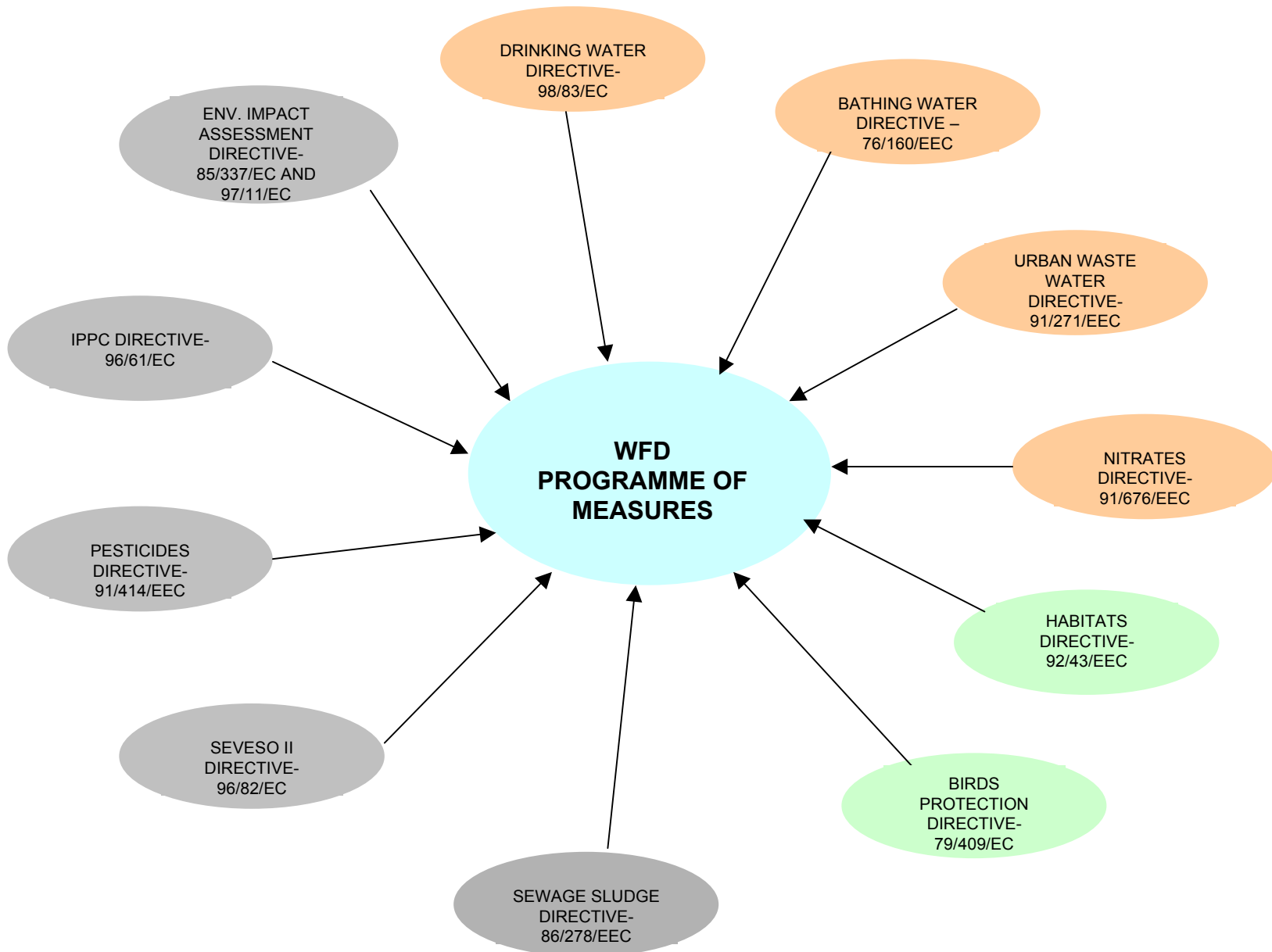
UNTIL 2013

- ✓ FRESHWATER FISH DIRECTIVE – 78/659/EEC
- ✓ SHELLFISH WATERS DIRECTIVE – 79/923/EEC
- ✓ GROUNDWATER DIRECTIVE – 80/68/EEC – TO BE REPLACED BY NEW (NOW IN DRAFT)
- ✓ DANGEROUS SUBSTANCES DIRECTIVE 76/464/EEC

DIRECTIVES THAT WILL REMAIN IN PARALLEL WITH WFD:

- ✓ Bathing waters Directive 76/160/EEC and the new Directive 2006/7/EC
- ✓ Nitrates from agricultural sources 91/676/EEC
- ✓ Urban Waste Water Treatment 91/271/EEC
- ✓ quality of water intended for human consumption 98/83/EC

CONTRIBUTION OF OTHER DIRECTIVES IN WFD PROGRAMME OF MEASURES (1ST RBMP – END 2009)



WATER RELATED DIRECTIVES INCORPORATED IN DESIGNING OF MONITORING PROGRAMME OF CYPRUS

DIRECTIVES		FULLY INCORPORATED	PARTIALLY INCORPORATED	NOT INCORPORATED
SURFACE DRINKING WATER ABSTRACTION DIRECTIVE – 75/440/EEC AS REPLACED BY WFD ANNEX V §1.3.5 FROM 2007		✓ AS SURVEILLANCE - ADDITIONAL MONITORING		
QUALITY OF WATER INTENDED FOR HUMAN CONSUMPTION 98/83/EC				✓ NOT RELEVANT (REFERS TO TAP WATER QUALITY MONITORING)
EXCHANGE OF INFORMATION ON SURFACE WATER DECISION – 77/795/EEC		✓		
FRESHWATER FISH DIRECTIVE – 78/659/EEC			✓	
DANGEROUS SUBSTANCES DIRECTIVE 76/464/EEC		✓		
GROUNDWATER DIRECTIVE – 80/68/EEC – TO BE REPLACED BY NEW (NOW IN DRAFT)		✓		
BATHING WATERS DIRECTIVE 76/160/EEC and DIRECTIVE 2006/7/EC				✓
NITRATES FROM AGRICULTURAL SOURCES 91/676/EEC			✓	
URBAN WASTE WATER TREATMENT 91/271	FOR THE DESIGNATION OF SENSITIVE ZONES		✓	
	NOT RELEVANT (REFERS TO EFFLUENT OF WWTP)			✓

For integration reasons in the action plan (Activity 2.4) every effort will be made to include additional to WFD parameters for other Directives in samples taken in order to avoid double sampling at the same station, at the same period

WFD Groundwater Monitoring

- A “**groundwater level monitoring**” network to assess risks of failing to achieve good groundwater quantitative status (With estimates of recharge and appropriate conceptual model / understanding for quantitative status).
- A “**chemical status monitoring**”:

“ Surveillance ”:	“ Operational ”:
▪ Assess characterization and risks of failing to achieve good chemical status	▪ Status of GWB being “AT RISK”
▪ Status of GWB, not being at risk	▪ Significant / sustained presence of upward trends of any pollutant
▪ Pollutants long term trends (natural and due to human activities)	

WFD (Annex V) Objectives of GWT monitoring

- reliable assessment of quantitative status
- supplement /validate impact assessment procedure
- assess long term trends
- establish chemical status of GWBs “at risk”
- establish trends in pollutants, and,
- assess the reversal of such trends

Key design principles of programmes

- On the basis of the results of the WFD Annex II characterisation and risk assessment procedure.
- Amount of monitoring to be proportional to the difficulty in judging:
 - (a) status of a groundwater body,
 - (b) presence of adverse trends, and
 - (c) the implications of errors in such judgements

Basis of design / operation of monitoring programmes for each GWB

- Objectives applying to it
- Its characteristics
- Existing level of understanding of GWB
- Type, extent and range of the pressures on the GWB
- Confidence in assessment of risk from pressures on GWB, and
- Level of confidence required in the assessment of risk.

Design Considerations:

1. QUANTITATIVE monitoring

WHAT: Mainly groundwater level (but also flow of springs, river base-flows, abstraction and precipitation when required for understanding of GWB system).

WHERE: Depends on needs for understanding and predictions it provides. Spatial variability in GWB flow system or the pressures on it, control the density of monitoring points. WFD requires level monitoring effort to be focused on GWBs “at risk”.

WHEN: Monitoring frequency to allow short- and long-term level variations to be detected. Variability of groundwater level or rapid response to pressures requires higher frequency.

Design Considerations:

2. **SURVEILLANCE monitoring** (As per WFD Annex II characterisation and risk assessment)

WHAT: O₂, pH, NO₃, NH₄ and conductivity (Additional per purpose, pressures and risk assessments).

WHEN: Surveillance for each RBM Plan (6 years).

- No minimum duration is specified. For first RBM Plan, MS with extensive GWB networks may only need a short period of surveillance to help design operational monitoring programmes.

Frequency of monitoring as per understanding of GWB system, characteristics and understanding of fate/ behaviour of pollutants.

At least once a year for trend assessment.

Design Considerations:

3. **OPERATIONAL monitoring** (must be on the basis of the **RISK assessment and refinement from surveillance**)

WHERE: Operational monitoring is exclusively on GWBs at risk. Sites based on GWB system, key pressures – at Risk;

WHAT: Indicators of pollutants causing the GWB to be at risk. Generally, both core and selective determinants will be required at each site.

WHEN: Sampling for periods between surveillance to detect impacts, but at a minimum of once per annum (suggested quarterly to annual). To continue until GWB be no longer at poor status or at risk (adequate data demonstrating reversal of trends).

The GWB characterization

Grouped into 20 GWBs (lithology, hydraulic characteristics, pressures and importance).

GWBs at RISK of not meeting WFD quality objectives are 14 + Troodos based on:

- deficient water balance
- pressure due urban population-sewage
- Agricultural activity pressures - pollution due to nutrients (nitrogen and phosphorus), oxygen demanding compounds (BOD, COD) and pesticides.

JUSTIFICATION FOR SELECTION OF SITES, PARAMETERS AND FREQUENCY:

QUANTITATIVE PROGRAMME

SITES: Overpumping, Artificial Recharge, Sea Intrusion, not a well defined aquifer system, Karstification,

PARAMETERS: Overpumping, Artificial Recharge, Sea Intrusion, not a well defined aquifer system, Karstification, ecosystem

FREQUENCY: Type of aquifer (phreatic – semiconfined – confined –karstic) , permeability

SURVEILLANCE AND OPERATIONAL

SITES AND PARAMETERS: Sea Intrusion, Water Supply, degree of Vulnerability, Diffuse pollution, Urbanization, Agriculture, Industrial, Artificial Recharge (treated effluent), Karstification, natural high elements (B, SO₄, Chloride, F, Mg)

FREQUENCY: Type of aquifer (phreatic – semiconfined – confined –karstic) , permeability

GROUNDWATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

	Quantitative	Surveillance	Operational
No of sites	96	96	81
ON AVERAGE EACH SITE CORRESPONDS TO ABOUT 56km ² OF AQUIFER AREA (67 km ² IN OPERATIONAL)			

BASIC MONITORING PROGRAMME

	Quantitative	Surveillance	Operation
No of sites	78	78	63
ON AVERAGE EACH SITE CORRESPONDS TO ABOUT 69km ² OF AQUIFER AREA (86 km ² IN OPERATIONAL)			

GENERAL PRINCIPLES:

WFD REQUIREMENTS

BETTER REPRESENTATION OF GWBs

BETTER REPRESENTATION OF WB TYPES THREE OR MORE

MONITORING SITES PER GWB

FOCUSSED ON AS MANY OF THE EXISTING MONITORING STATIONS

AS POSSIBLE

SITES FOCUSED ON 'LOCAL' MONITORING OF LEVELS AND FLOWS

ECOSYSTEMS.

CHANGE OF GROUNDWATER FLOW DIRECTION (INTRUSION),

RAINFALL, RECHARGE

HIGHER FREQUENCY OF MONITORING

SURVEILLANCE, SAME AS FOR BASIC BUT WITH MORE POINTS FOR

BODIES AT RISK AND THOSE NOT AT RISK. AT LEAST 3 MONITORING

POINTS PER GWB

SUITES OF INORGANIC PARAMETERS TO PROVIDE DATA FOR QA

PURPOSES AND INFORMATION ON THE NATURAL QUALITY

(BASELINE) OF GROUNDWATER AND TEMPERATURE. FURTHER

GENERIC INDICATOR SPECIES ARE ALSO ADDED TO SUPPLEMENT

THE RISK ASSESSMENT PROCESS.

OPERATIONAL SAME AS FOR BASIC

ENOUGH TO OBTAIN ADEQUATE NUMBER OF OBSERVATIONS FOR

RELIABLE STATISTICAL EVALUATIONS AND EVALUATION OF

MEASURES EFFECTIVENESS

✓ WFD REQUIREMENTS

✓ ADEQUATE REPRESENTATION OF GWBs

✓ ADEQUATE REPRESENTATION OF WB TYPES

✓ AT LEAST THREE MONITORING SITES PER GWB

✓ FOCUSED ON AS MANY OF THE EXISTING MONITORING STATIONS

AS POSSIBLE

✓ SITES SUFFICIENT TO VALIDATE THE GWB SYSTEM

✓ WATER LEVELS, SPRING FLOWS, RIVER BASE FLOWS WHEN

GROUNDWATER MAIN SUPPLIER

FREQUENCY SUFFICIENT TO DISTINGUISH SHORT- AND LONG-

TERM VARIATIONS

✓ SURVEILLANCE SITES ON BASIS OF GWB SYSTEM –FATE OF

POLLUTANTS. AT LEAST 3 POINTS IN THE GWB 'NOT AT RISK', WITH

AT LEAST ONE ADDITIONAL IN REMAINING BODIES IN THE GROUP

✓ FOR BODIES 'AT RISK' LOCATIONS SHOULD IDEALLY COINCIDE

WITH OPERATIONAL MONITORING POINTS.

✓ OXYGEN CONTENT, PH VALUE, CONDUCTIVITY, NITRATE,

AMMONIUM, OTHER PARAMETERS INDICATIVE OF THE RISKS TO

AND IMPACTS ON GROUNDWATER FROM PRESSURES IDENTIFIED IN

CHARACTERIZATION PROCESS.

✓ SUFFICIENT POINTS IN BODIES OR GROUPS OF BODIES 'AT RISK'

TO RELIABLY CLASSIFY THE BODIES

✓ FREQUENCY ENOUGH TO OBTAIN ADEQUATE NUMBER OF

OBSERVATIONS FOR RELIABLE STATISTICAL EVALUATIONS AND

EVALUATION OF MEASURES EFFECTIVENESS

GROUNDWATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

QUANTITATIVE (96 sites)	
1: Monthly	43 sites
2: Quarterly	32 sites
3: Biannually	21 sites
Number of visits	686

SURVEILLANCE (96 sites)	
1: Quarterly	13 sites
2: Biannually	68 sites
3: Annually	15 sites
Number of visits	203

OPERATIONAL (81 sites)	
1: Monthly	13 sites
2: Quarterly	62 sites
3: Biannually	6 sites
Number of visits	416

BASIC MONITORING PROGRAMME

QUANTITATIVE (78 sites)	
1: Monthly	24 sites
2: Quarterly	30 sites
3: Biannually	24 sites
Number of visits	456

SURVEILLANCE (78 sites)	
1: Quarterly	7 sites
2: Biannually	34 sites
3: Annually	37 sites
Number of visits	133

OPERATIONAL (63 sites)	
1: Monthly	7 sites
2: Quarterly	31 sites
3: Biannually	25 sites
Number of visits	258

ABOUT 55% MORE VISITS IN EXTENDED MONITORING PROGRAMME

Summary comparison of the two Monitoring Programmes

	Extended Monitoring			Basic Monitoring		
	Quantitative	Surveillance	Operational	Quantitative	Surveillance	Operational
SITES						
Quantitative	96			78		
Qualitative		96	81		78	63
Total	96			78		
GWBs	19	19	15	19	19	15
Total	19			19		
No. OF PARAMETERS						
Quantitative	3			3		
Core		5	5		5	5
Trace elem.		11	11		11	11
Ionic anal.		4	4		4	4
Pesticides		9	9		9	9
Priority sub.+		14	14		14	14
Total 1	3	43	43	3	43	43
No. of data	800	4000	600	600	33000	600
No of samples	203	203	413	137	137	274

DIFFERENCES BETWEEN THE TWO GROUNDWATER PROGRAMS

The Extended approach demands 34% more samplings compared to the Basic one.

Sampling parameters are same for both approaches and are based on pressures exerted on groundwaters.

Sampling frequency is higher in the Extended Program for some of the water bodies, based on the types of pressures they are subject to, their risk status, their protection status and their general importance as aquifers.

Cost factors for the two options of Groundwater monitoring (thousand CY£)

Analysis		Sampling			Hydro-morphology			TOTAL (thousand CY£)
Surv.	Oper.	Surv.	Oper.	Quant.	Surv.	Oper.	Quant.	
EXTENDED								
187.3	407.2	19.8	35.9	56.5	-	-	8.9	715.7
BASIC								
119.8	253.9	13.0	25.2	39.9	-	-	6.1	457.9

GROUNDWATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

INCORPORATION OF EXISTING MONITORING PROGRAMMES

DIRECTIVE OR DECISION	ST	QE	FR
<p>DANGEROUS SUBSTANCES - 76/464/EEC</p> <p>Directive 80.68/EEC – GW Daughter Directive to be finalized end of 2006.</p>	F	F	F
<p>NITRATES – 91/676/EEC</p> <p>Detection (N) (1 year monitoring), (NVZs)</p> <p>CGAP, Action Programs within NVZ,</p> <p>National monitoring and reporting every 4 years when <25 mg/l or 8 years when no pressures.</p> <p>Assessment of Action Programs impact, Revision of NVZs and Action Programs</p>	P	F	P
<p>URBAN WASTE WATER TREATMENT – 91/271/EEC</p> <p>FOR THE DESIGNATION OF SENSITIVE ZONES</p>	P	P	P
<p>Drinking Water Protected Areas</p>	F	F	F

DIRECTIVE OR DECISION	ST	QE	FR
<p>DANGEROUS SUBSTANCES -76/464/EEC</p> <p>In 1980 the protection of groundwater was taken out of 76/464/EEC (pollution by certain dangerous substances) and regulated under the Directive 89/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (disposal of waste substances)</p>	F	F	F
<p>NITRATES – 91/676/EEC</p>	P	F	P
<p>URBAN WASTE WATER TREATMENT – 91/271/EEC</p> <p>FOR THE DESIGNATION OF SENSITIVE ZONES</p>	P	P	P
<p>No additional specific monitoring criteria for GWBs by WFD for Drinking Water Protected Areas. However, Level, Surveillance and Operational networks are to be supplemented by monitoring programmes required for</p>	F	F	F

ADJUSTMENT OF SITES IN GROUNDWATER MONITORING

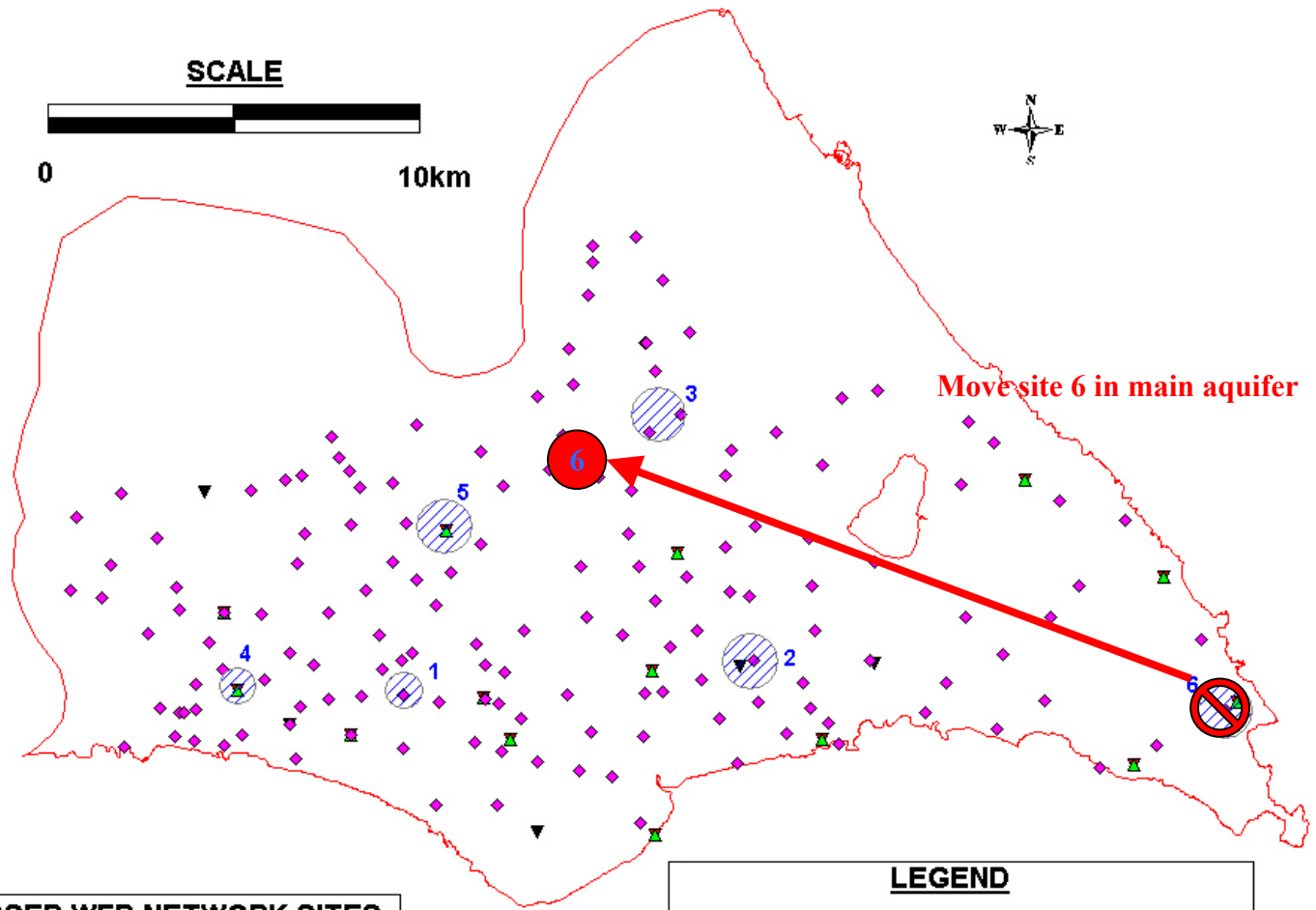
After a series of meetings with the WDD and the GSD, at the presence of PM Team Representative the following most important issues were raised with regards to the GWT monitoring options:

- Preferably and where possible, existing boreholes should be used
- For the case of qualitative monitoring, existing boreholes being pumped on a steady basis (i.e. Government, domestic supply / irrigation) should be selected.
- For the case of quantitative, separate non pumping boreholes, near the ones of the qualitative monitoring but out of their interference area (i.e. GSD Boreholes with automatic recording) should be preferred.
- Where selection of existing boreholes is not possible, install new pumps on government boreholes – use of a portable generator
- Where government boreholes cannot be utilized, drill new boreholes

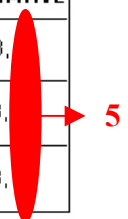
Changes per GWB follow next:

GROUNDWATER BODY CY_1: KOKKINOCHORIA (AT RISK)

EXISTING MONITORING PROGRAMS & OUTLINE OF WFD MONITORING NETWORK OPTIONS



PROPOSED WFD NETWORK SITES		
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3, 4, 5, 6	1, 2, 3,
SURVEILLANCE	1, 2, 3, 4, 5, 6	1, 2, 3,
OPERATIONAL	1, 2, 3, 4, 5, 6	1, 2, 3,

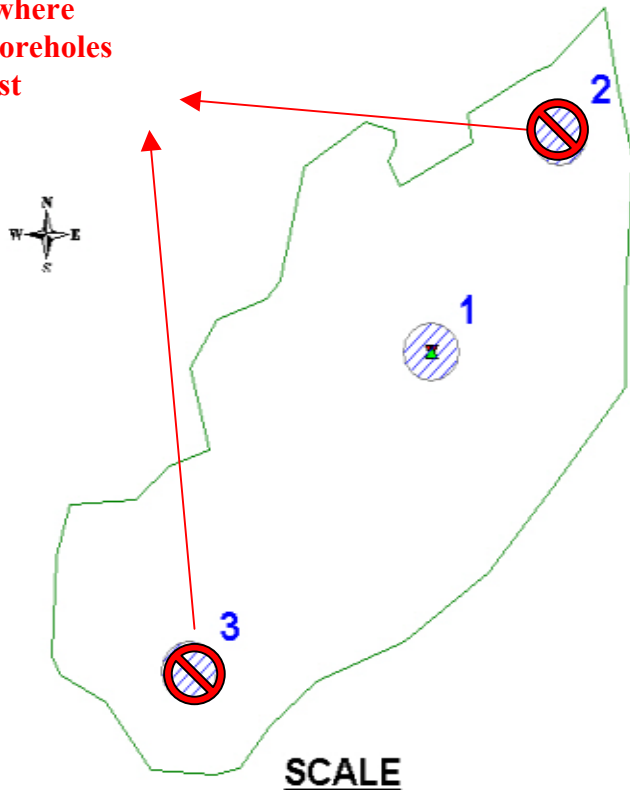


LEGEND	
◆	Water Level and Quality of Groundwater - WDD
◆	Water Flow and Quality of Springs - WDD
▼	Water Level and Quality of Groundwater - GSD
▲	National Quality Monitoring Network - GSD
▼	Directive 91/676/EEC - Nitrates Pollution - GSD
⊘	Proposed WFD Monitoring Network Sites

GROUNDWATER BODY CY_2: ARADIPPOU GYPSUM

EXISTING MONITORING PROGRAMS & OUTLINE OF WFD MONITORING NETWORK OPTIONS

Move where existing boreholes exist



LEGEND

- ◆ Water Level and Quality of Groundwater - WDD
- ◇ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- ⊘ Proposed WFD Monitoring Network Sites

PROPOSED WFD NETWORK SITES

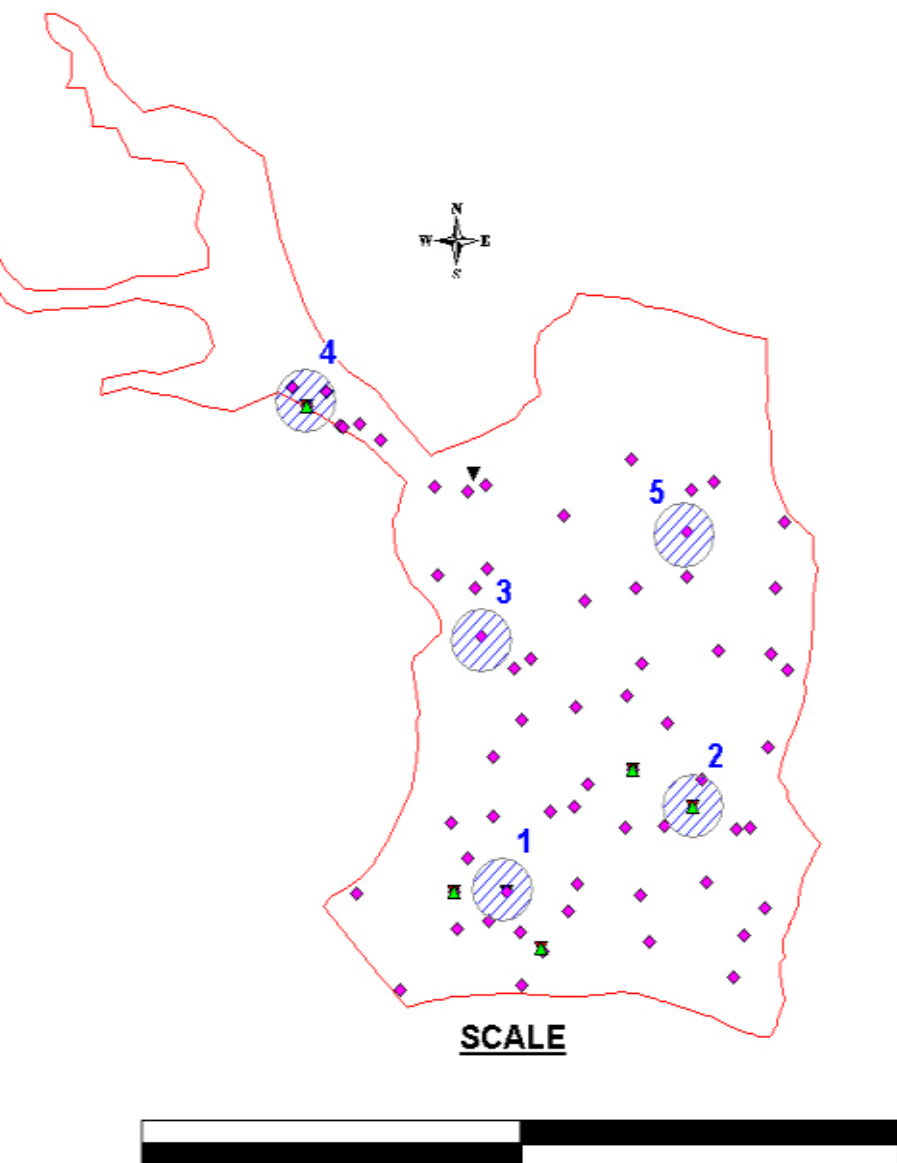
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3	1, 2, 3
SURVEILLANCE	1, 2, 3	1, 2, 3
OPERATIONAL	N/A	N/A

0

10km

KITI - PERVOLIA AND TREMITHIOS RIVERBED (AT RISK)

EXISTING MONITORING PROGRAMS & OUTLINE OF WFD MONITORING NETWORK OPTIONS

LEGEND

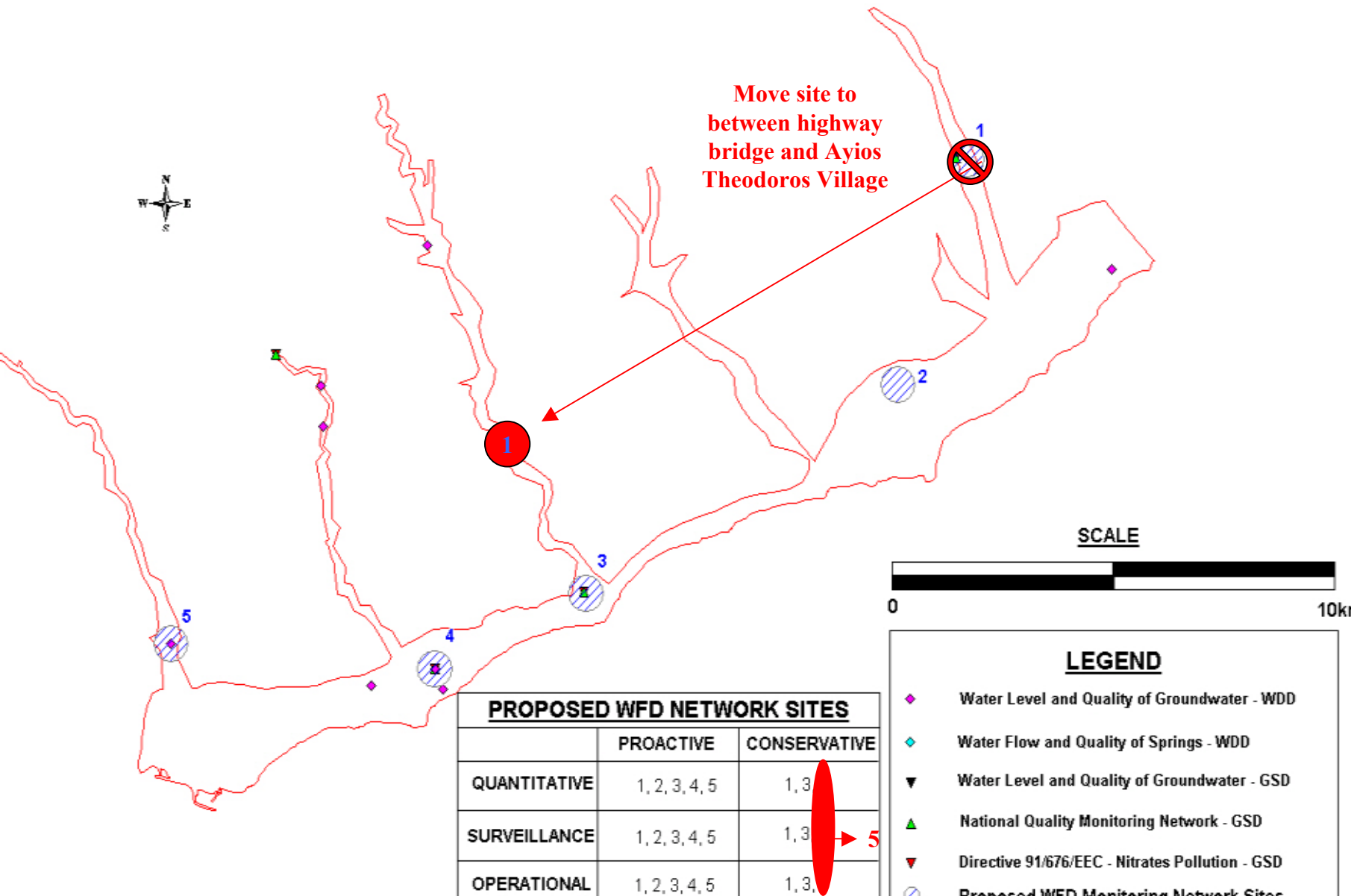
- ◆ Water Level and Quality of Groundwater - WDD
- ◆ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- Proposed WFD Monitoring Network Sites

PROPOSED WFD NETWORK SITES

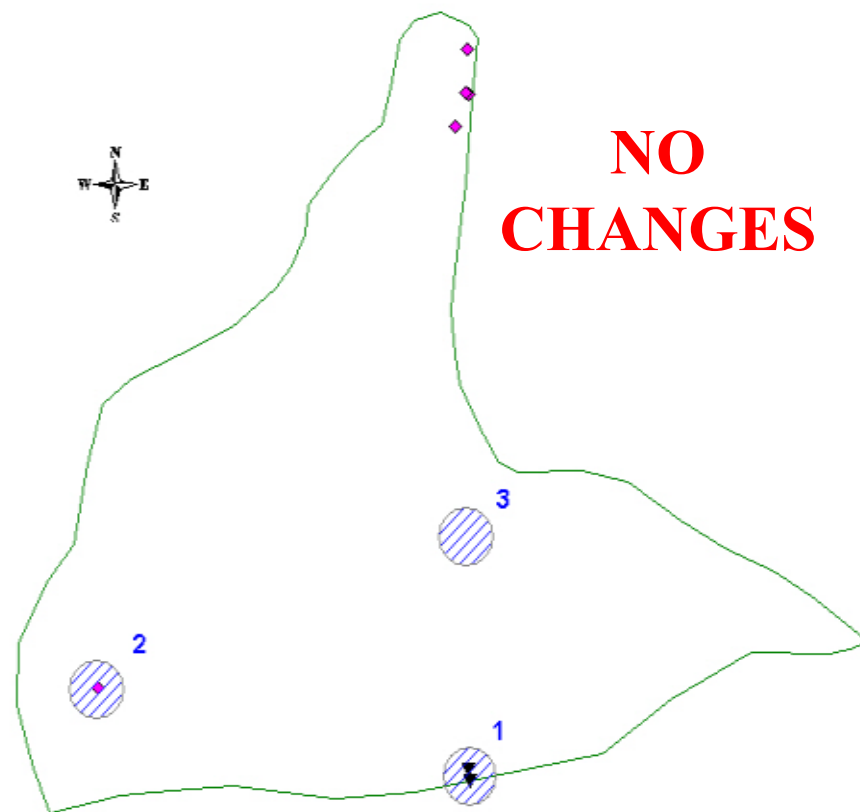
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3, 4, 5	1, 4
SURVEILLANCE	1, 2, 3, 4, 5	1, 4 3 ←
OPERATIONAL	1, 2, 3, 4, 5	1, 4

SOFTADES - ZYGI - COASTAL PLAIN AND RIVERBED (AT RISK)

EXISTING MONITORING PROGRAMS & OUTLINE OF WFD MONITORING NETWORK OPTIONS



**GROUNDWATER BODY CY_5:
MARONI GYPSUM
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**



**NO
CHANGES**

LEGEND

- ◆ Water Level and Quality of Groundwater - WDD
- ◆ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- ⊙ Proposed WFD Monitoring Network Sites

PROPOSED WFD NETWORK SITES

	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3	1, 2, 3
SURVEILLANCE	1, 2, 3	1, 2, 3
OPERATIONAL	N/A	N/A

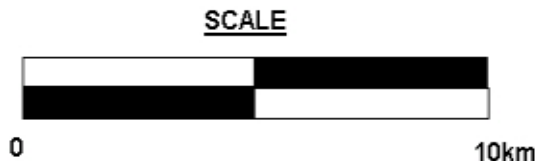
SCALE



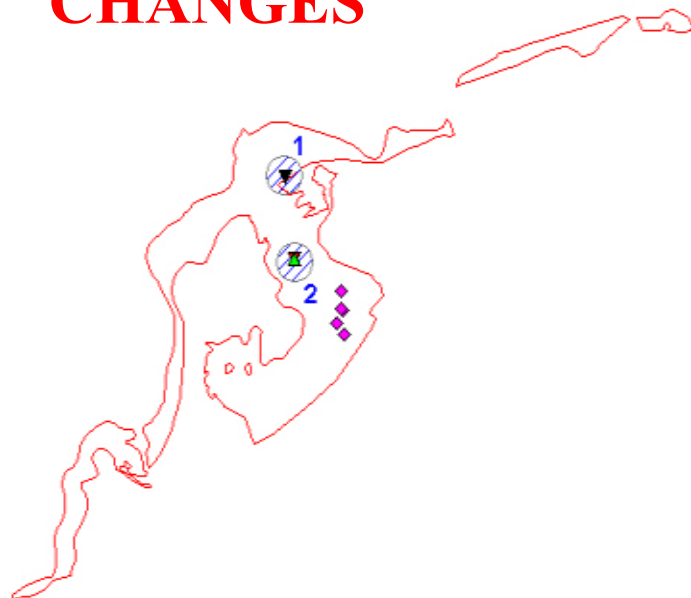
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10km

GROUNDWATER BODY CY_6:
 MARI-KALO CHORIO CHALKS AND CHOIROKOITIA SANDSTONES (AT RISK)
 EXISTING MONITORING PROGRAMS & OUTLINE OF WFD MONITORING NETWORK OPTIONS

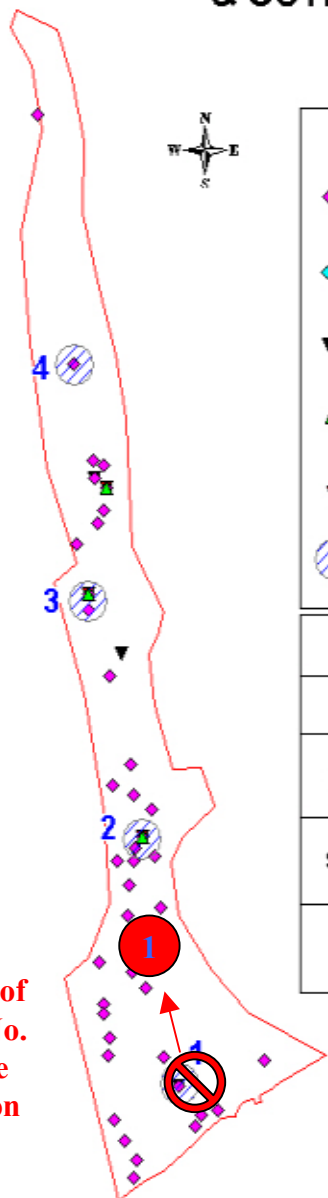


**NO
 CHANGES**



LEGEND		
◆	Water Level and Quality of Groundwater - WDD	
◆	Water Flow and Quality of Springs - WDD	
▼	Water Level and Quality of Groundwater - GSD	
▲	National Quality Monitoring Network - GSD	
▼	Directive 91/676/EEC - Nitrates Pollution - GSD	
⊖	Proposed WFD Monitoring Network Sites	
PROPOSED WFD NETWORK SITES		
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3	1, 2, 3
SURVEILLANCE	1, 2, 3	1, 2, 3
OPERATIONAL	1, 2, 3	1, 2, 3

**GROUNDWATER BODY CY_7:
GERMASOGEIA RIVERBED (AT RISK)
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**



LEGEND	
◆	Water Level and Quality of Groundwater - WDD
◆	Water Flow and Quality of Springs - WDD
▼	Water Level and Quality of Groundwater - GSD
▲	National Quality Monitoring Network - GSD
▼	Directive 91/676/EEC - Nitrates Pollution - GSD
⊘	Proposed WFD Monitoring Network Sites

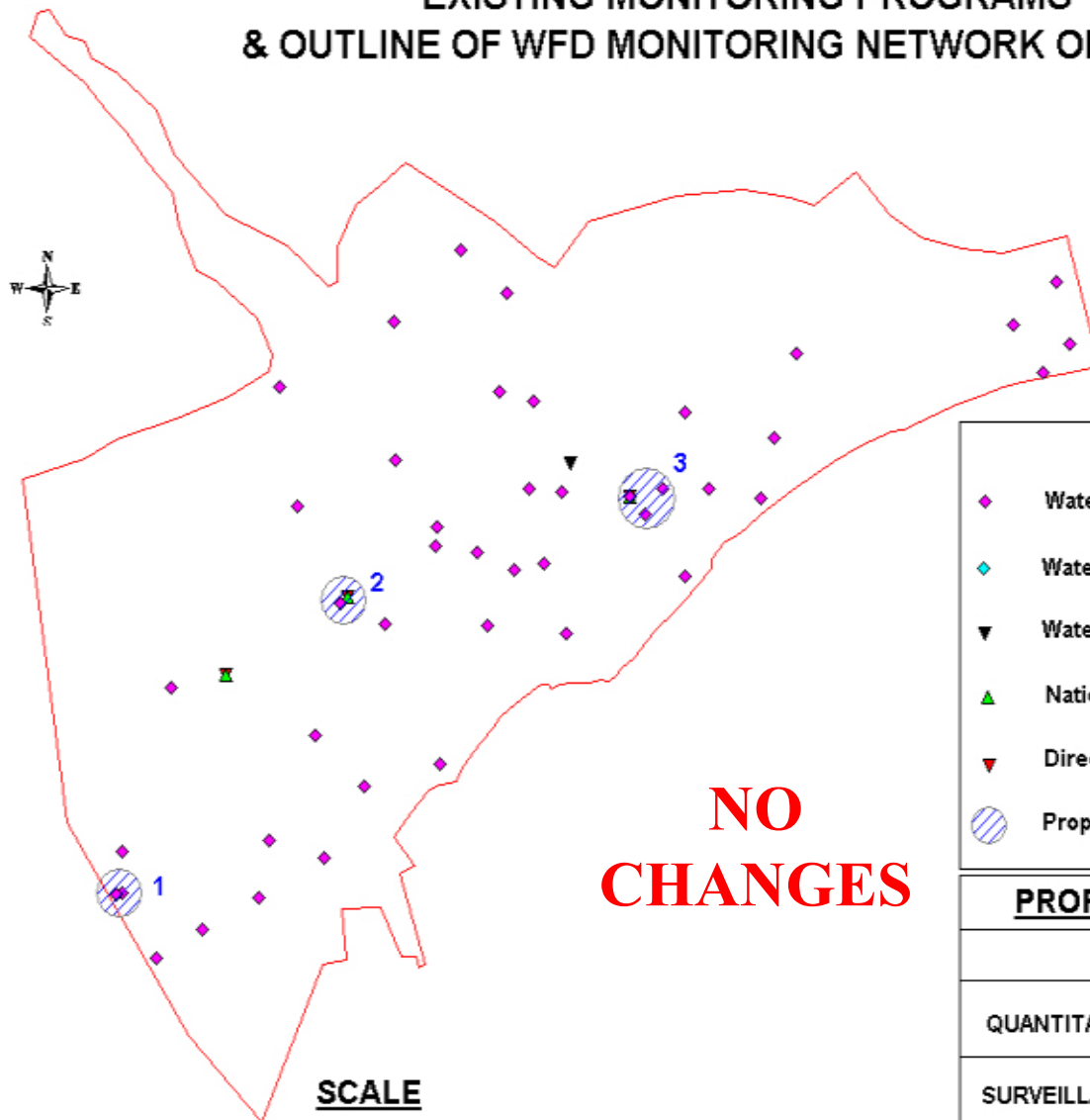
PROPOSED WFD NETWORK SITES		
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3, 4	1, 3, 4
SURVEILLANCE	1, 2, 3, 4	1, 3, 4
OPERATIONAL	1, 2, 3, 4	1, 3, 4

Move site to beginning of Delta (possibly Hydr. No. 861?) to avoid possible permanent sea intrusion

SCALE



**GROUNDWATER BODY CY_8:
LEMESOS (AT RISK)
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**



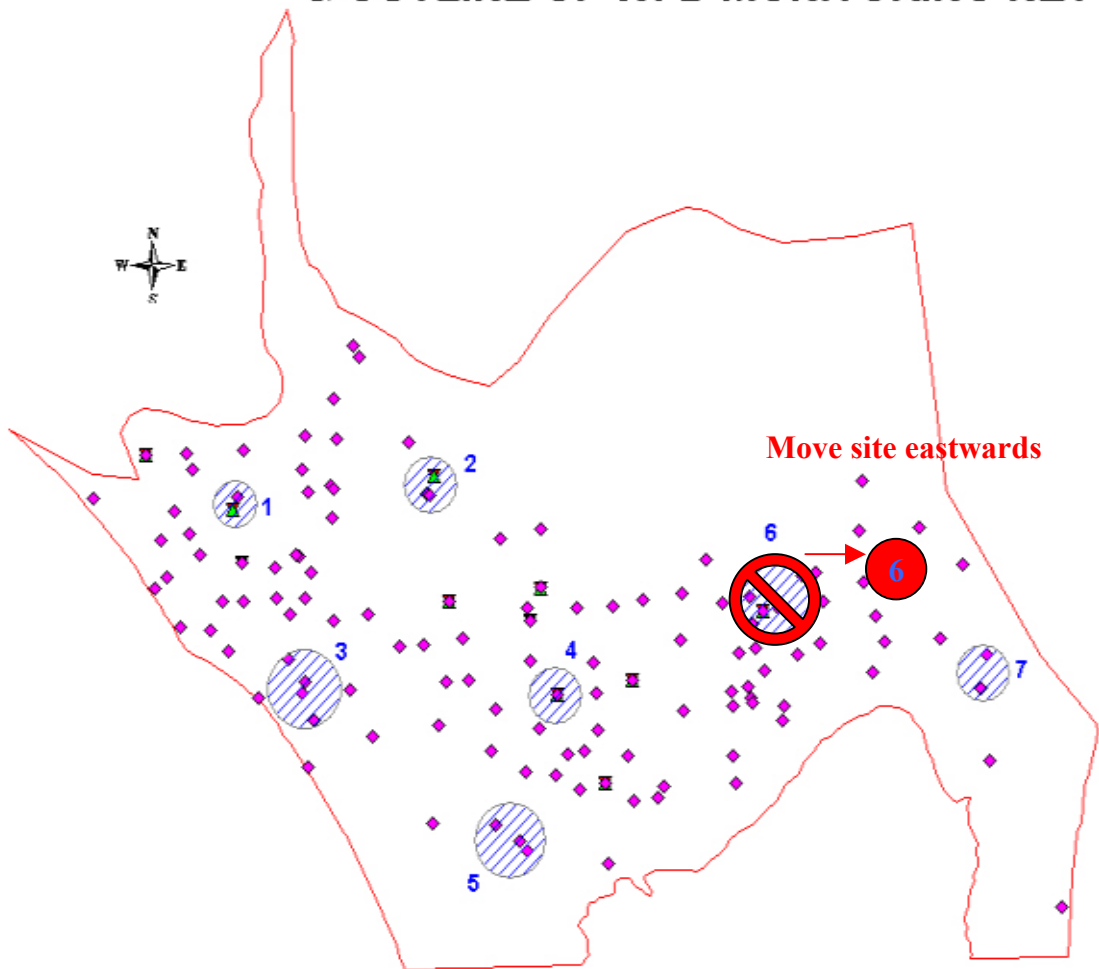
LEGEND

- ◆ Water Level and Quality of Groundwater - WDD
- ◆ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- ⊘ Proposed WFD Monitoring Network Sites

PROPOSED WFD NETWORK SITES

	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3	1, 2, 3
SURVEILLANCE	1, 2, 3	1, 2, 3
OPERATIONAL	1, 2, 3	1, 2, 3

GROUNDWATER BODY CY_9: AKROTIRI (AT RISK) EXISTING MONITORING PROGRAMS & OUTLINE OF WFD MONITORING NETWORK OPTIONS



LEGEND

- ◆ Water Level and Quality of Groundwater - WDD
- ◆ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- ⊘ Proposed WFD Monitoring Network Sites

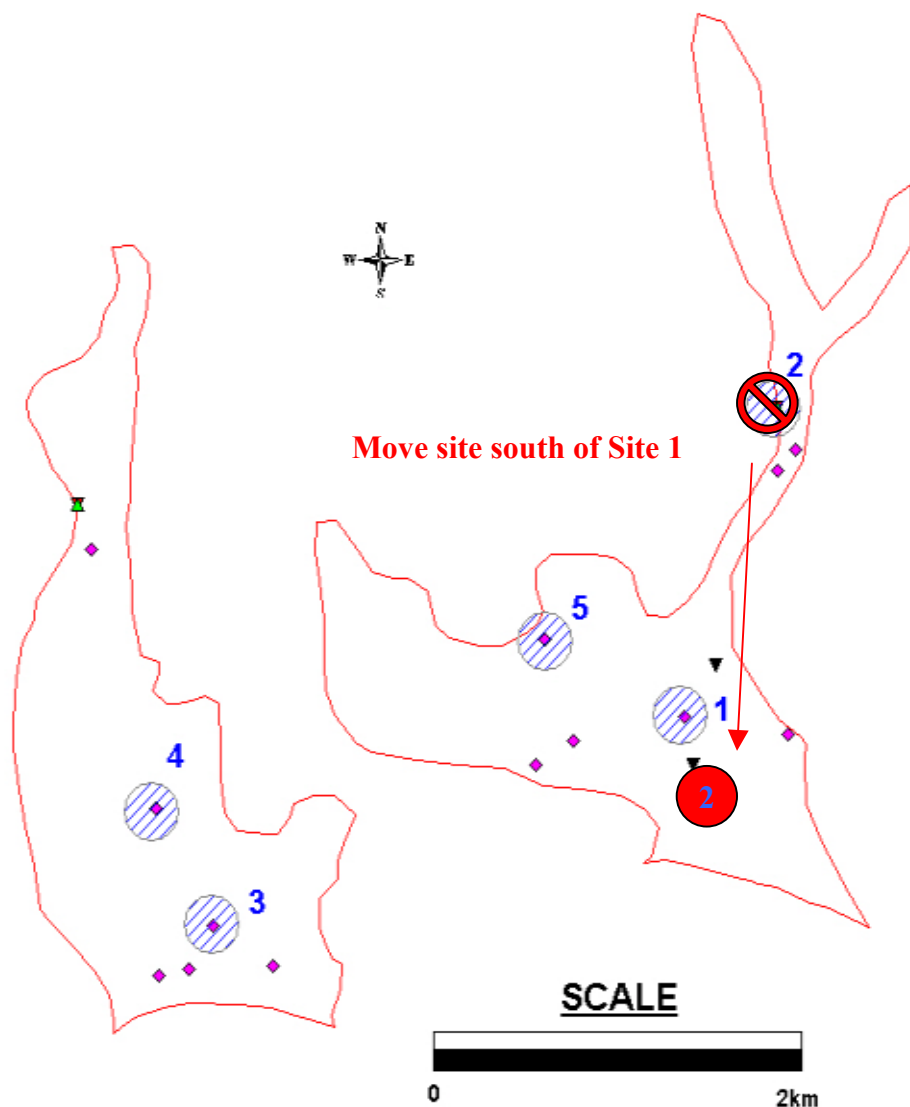
PROPOSED WFD NETWORK SITES

	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 5, 6
SURVEILLANCE	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 5, 6
OPERATIONAL	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 5, 6

SCALE



**GROUNDWATER BODY CY_10:
PARAMALI AND AVDIMOU (AT RISK)
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**



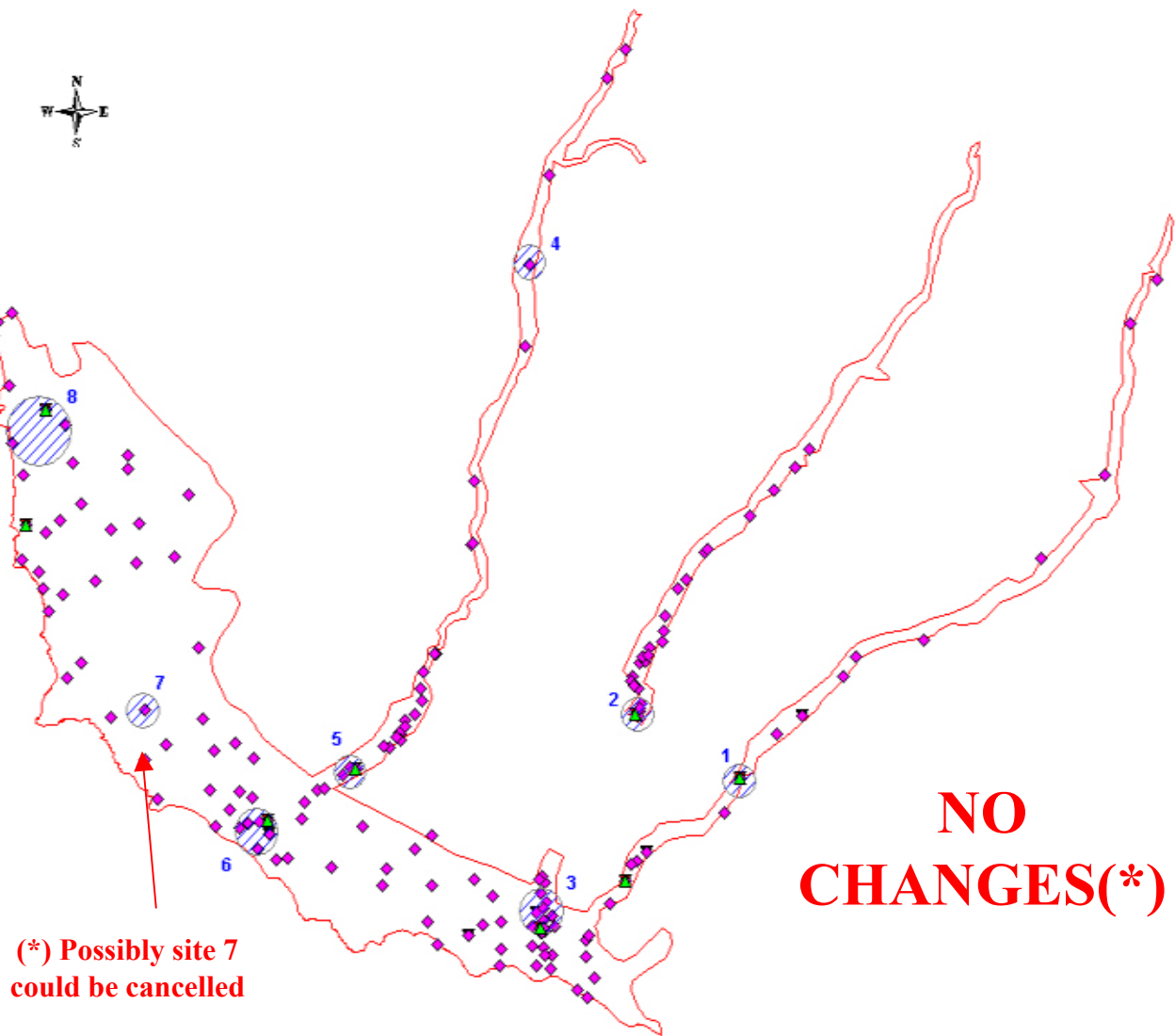
LEGEND

- ◆ Water Level and Quality of Groundwater - WDD
- ◆ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- ⊘ Proposed WFD Monitoring Network Sites

PROPOSED WFD NETWORK SITES

	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3, 4, 5	1, 2, 3
SURVEILLANCE	1, 2, 3, 4, 5	1, 2, 3
OPERATIONAL	1, 2, 3, 4, 5	1, 2, 3

**GROUNDWATER BODY CY_11:
PAFOS COASTAL PLAIN AND RIVERBEDS (AT RISK)
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**



SCALE



0 10km

LEGEND

- ◆ Water Level and Quality of Groundwater - WDD
- ◆ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- Proposed WFD Monitoring Network Sites

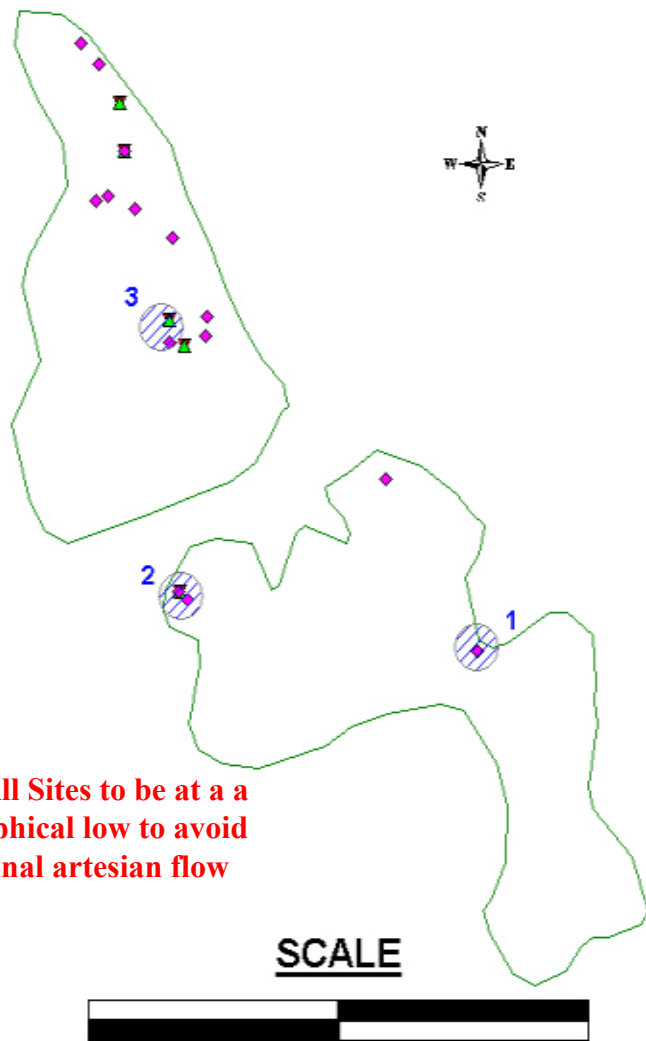
PROPOSED WFD NETWORK SITES

	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 5, 6,
SURVEILLANCE	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 5, 6,
OPERATIONAL	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 5, 6,

**NO
CHANGES(*)**

(*) Possibly site 7 could be cancelled

**GROUNDWATER BODY CY_12:
LETYMOVU - GIOLOU GYPSUM
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**



Check All Sites to be at a a topographical low to avoid occasional artesian flow

<u>LEGEND</u>	
◆	Water Level and Quality of Groundwater - WDD
◆	Water Flow and Quality of Springs - WDD
▼	Water Level and Quality of Groundwater - GSD
▲	National Quality Monitoring Network - GSD
▼	Directive 91/676/EEC - Nitrates Pollution - GSD
⊘	Proposed WFD Monitoring Network Sites

<u>PROPOSED WFD NETWORK SITES</u>		
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3	1, 2, 3
SURVEILLANCE	1, 2, 3	1, 2, 3
OPERATIONAL	N/A	N/A

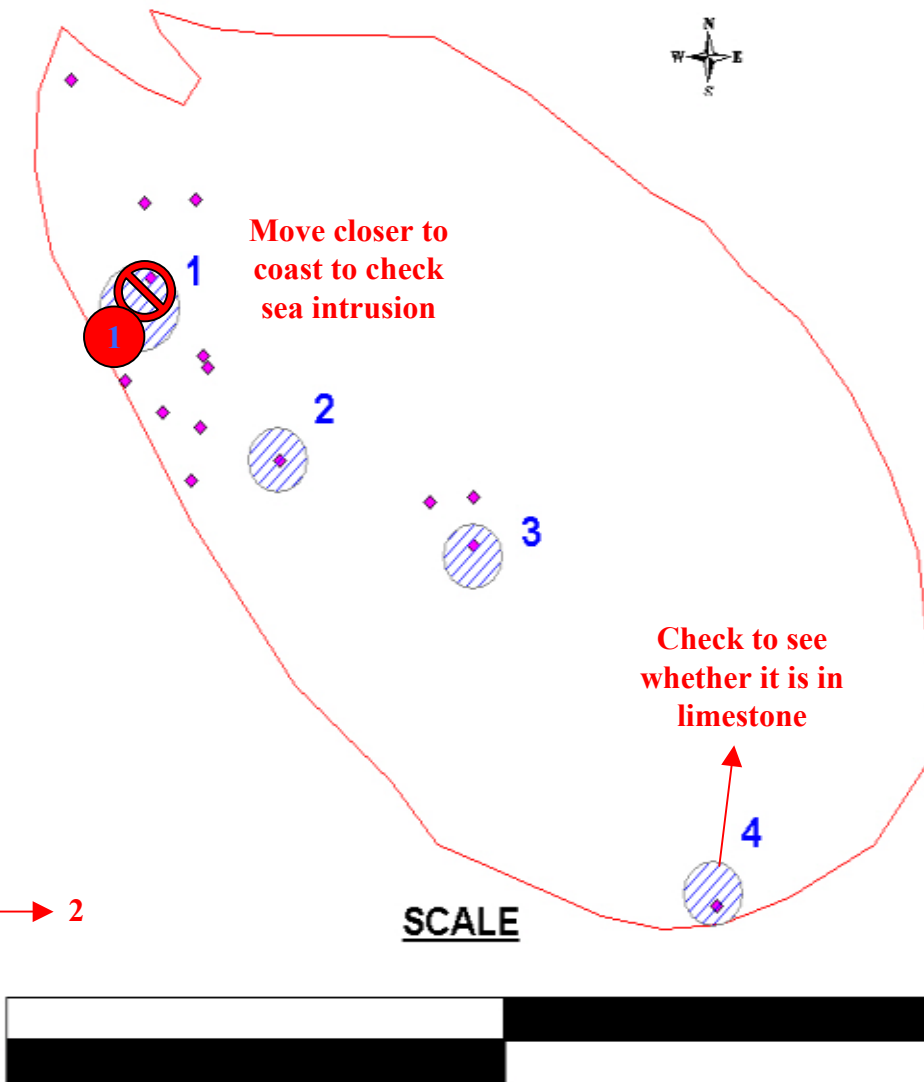
**GROUNDWATER BODY CT_13:
PEGEIA LIMESTONE (AT RISK)
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**

LEGEND

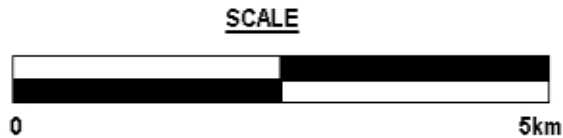
- ◆ Water Level and Quality of Groundwater - WDD
- ◆ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- ⊘ Proposed WFD Monitoring Network Sites

PROPOSED WFD NETWORK SITES

	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3, 4	1, 3,
SURVEILLANCE	1, 2, 3, 4	1, 3,
OPERATIONAL	1, 2, 3, 4	1, 3,



**GROUNDWATER BODY CY_14:
ANDROLIKOU LIMESTONES (AT RISK)
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**

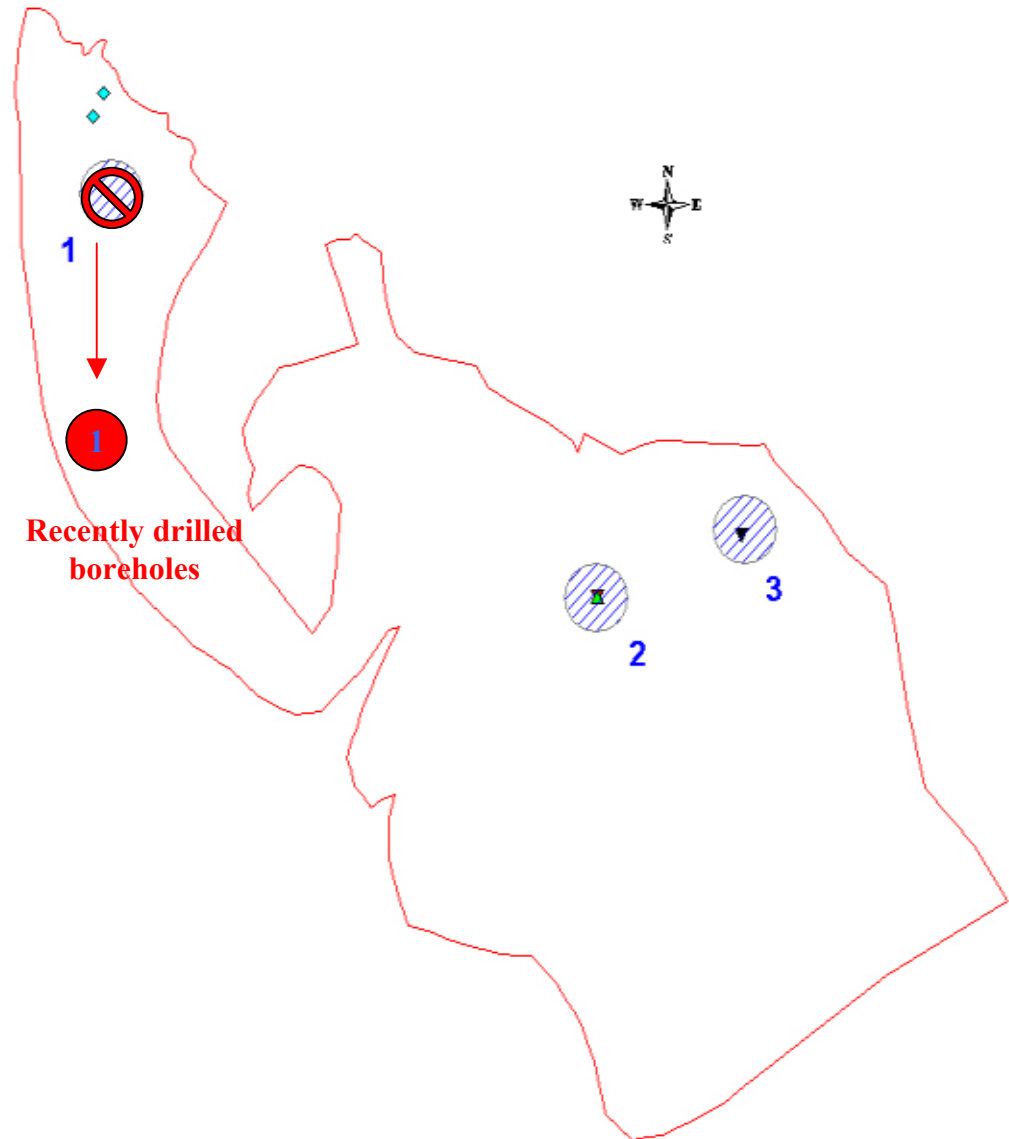


LEGEND

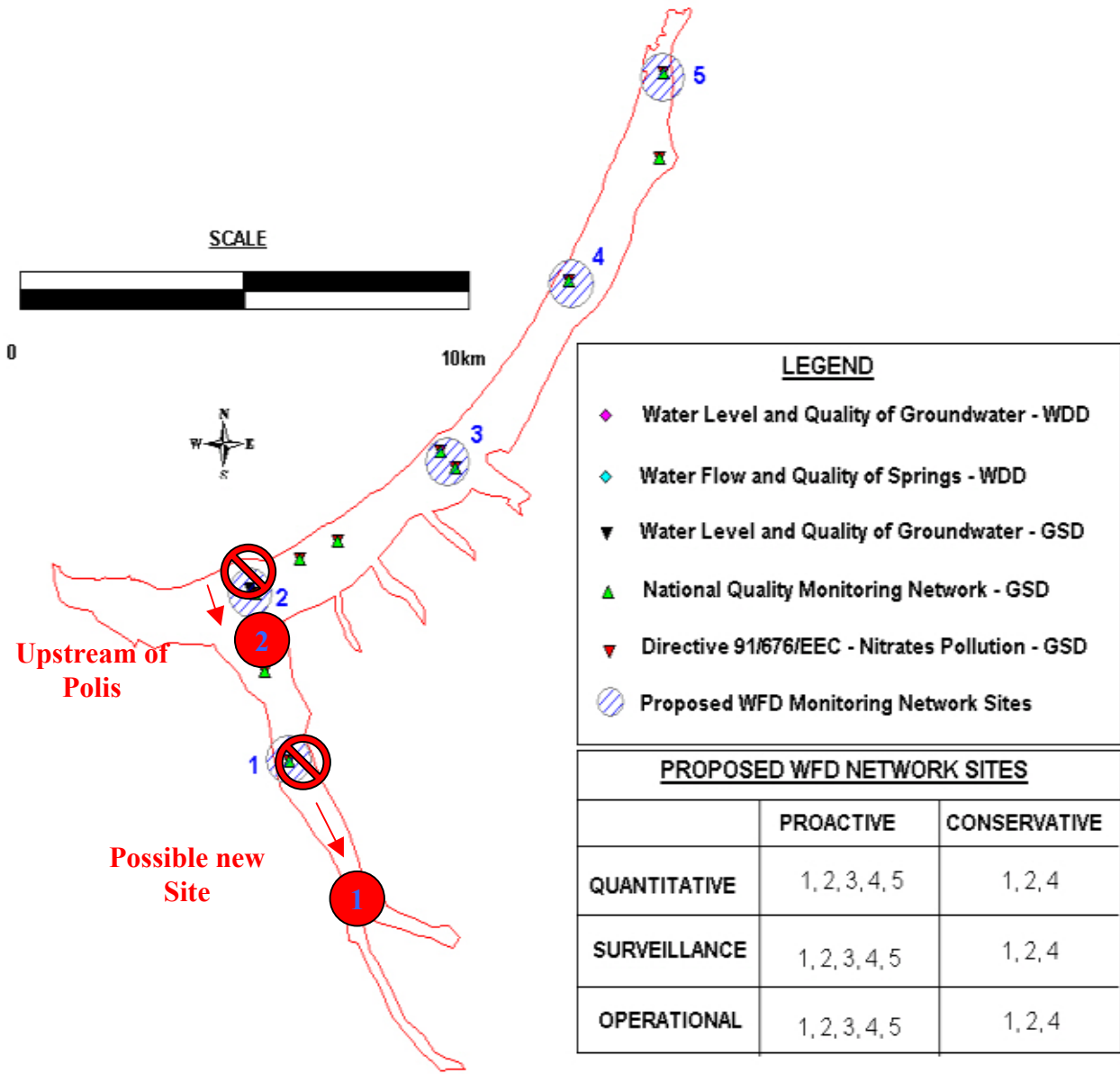
- ◆ Water Level and Quality of Groundwater - WDD
- ◆ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- ⊘ Proposed WFD Monitoring Network Sites

PROPOSED WFD NETWORK SITES

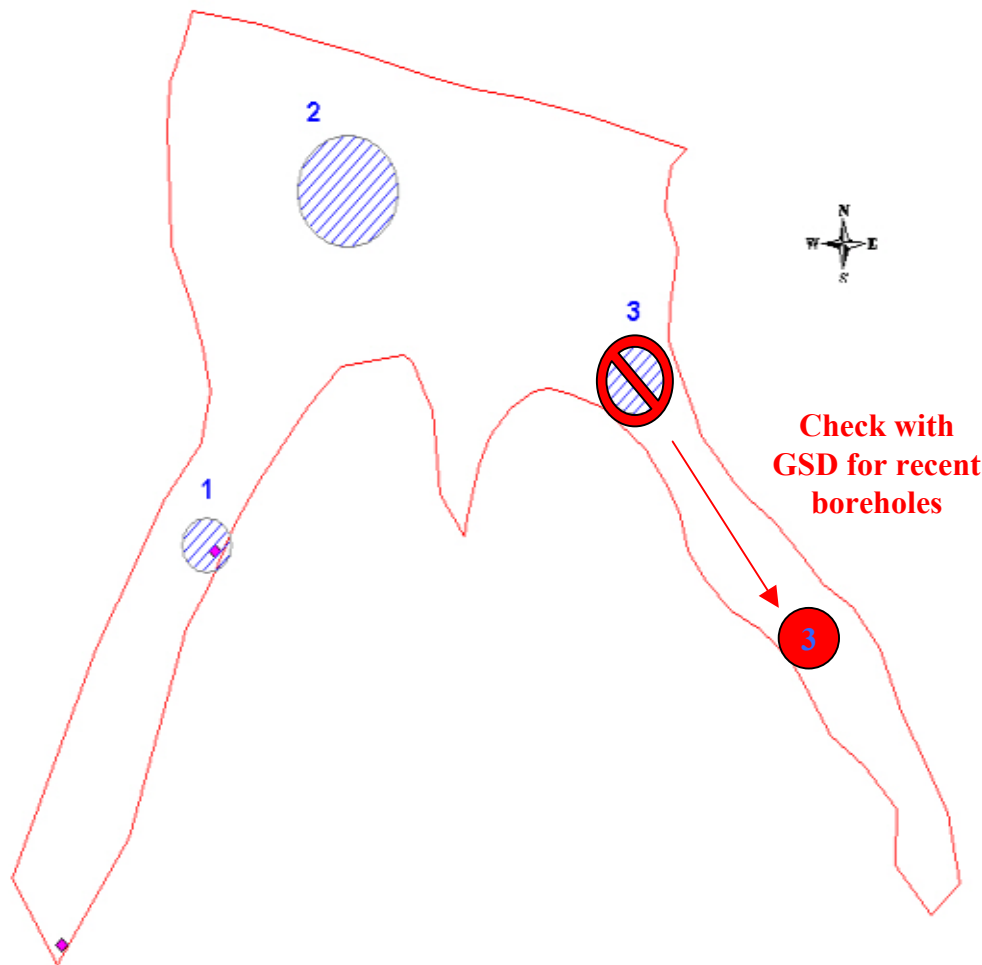
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3	1, 2, 3
SURVEILLANCE	1, 2, 3	1, 2, 3
OPERATIONAL	1, 2, 3	1, 2, 3



**GROUNDWATER BODY CY_15:
CHRYSOCHOU - GIALIA COASTAL PLAIN AND RIVERBEDS (AT RISK)
EXISTING MONITORING PROGRAMS & OUTLINE OF WFD MONITORING NETWORK OPTIONS**



**GROUNDWATER BODY CY_16:
PYRGOS (AT RISK)
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**



LEGEND

- ◆ Water Level and Quality of Groundwater - WDD
- ◆ Water Flow and Quality of Springs - WDD
- ▼ Water Level and Quality of Groundwater - GSD
- ▲ National Quality Monitoring Network - GSD
- ▼ Directive 91/676/EEC - Nitrates Pollution - GSD
- ⊘ Proposed WFD Monitoring Network Sites

PROPOSED WFD NETWORK SITES

	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3	1, 2, 3
SURVEILLANCE	1, 2, 3	1, 2, 3
OPERATIONAL	1, 2, 3	1, 2, 3

SCALE



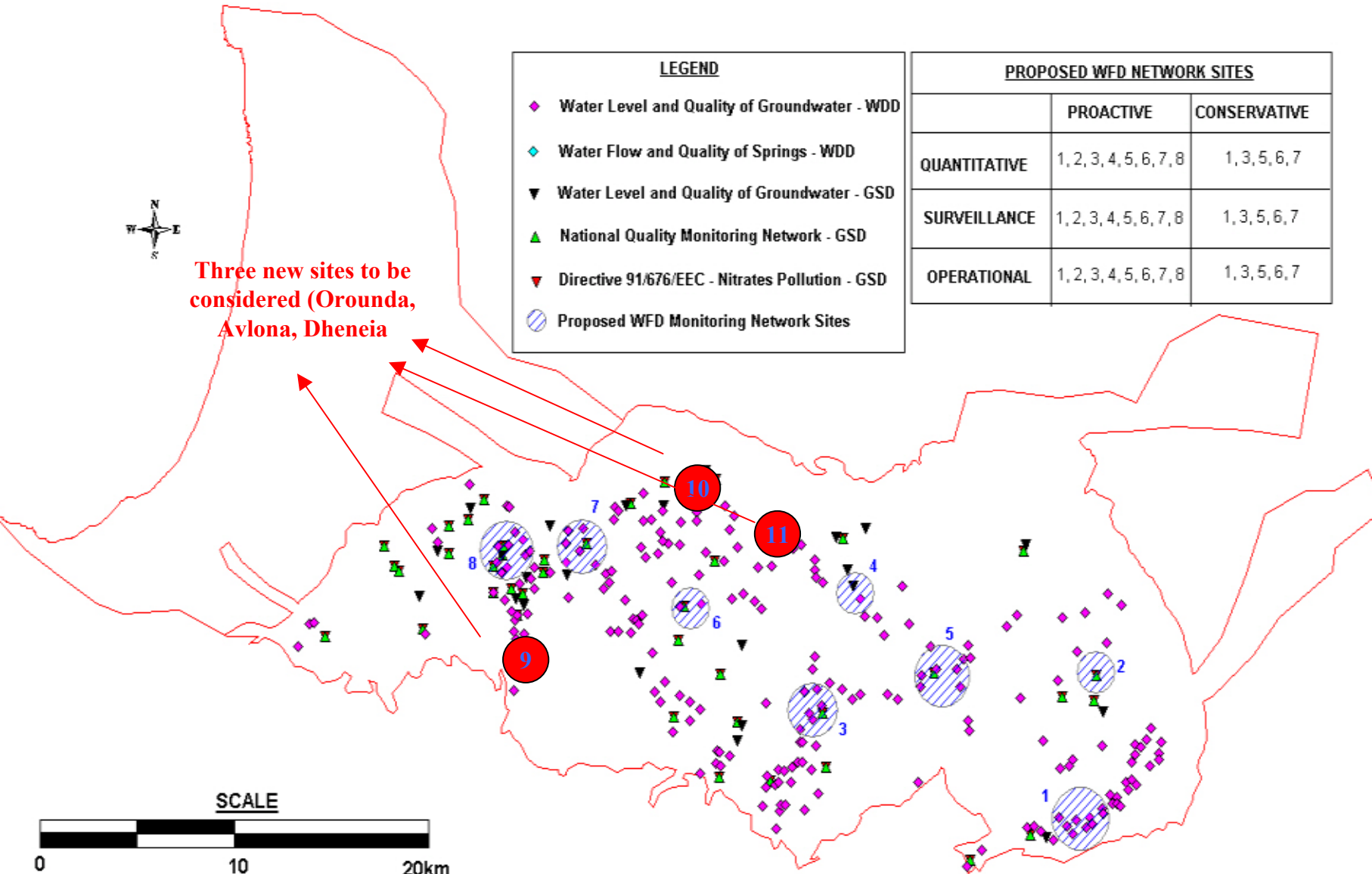
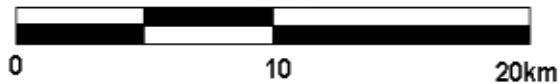
**GROUNDWATER BODY CY_17:
CENTRAL AND EASTERN MESAORIA (AT RISK)
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**



Three new sites to be considered (Orounda, Avlona, Dheneia)







LEGEND	
◆	Water Level and Quality of Groundwater - WDD
◊	Water Flow and Quality of Springs - WDD
▼	Water Level and Quality of Groundwater - GSD
▲	National Quality Monitoring Network - GSD
▼	Directive 91/676/EEC - Nitrates Pollution - GSD
⊘	Proposed WFD Monitoring Network Sites

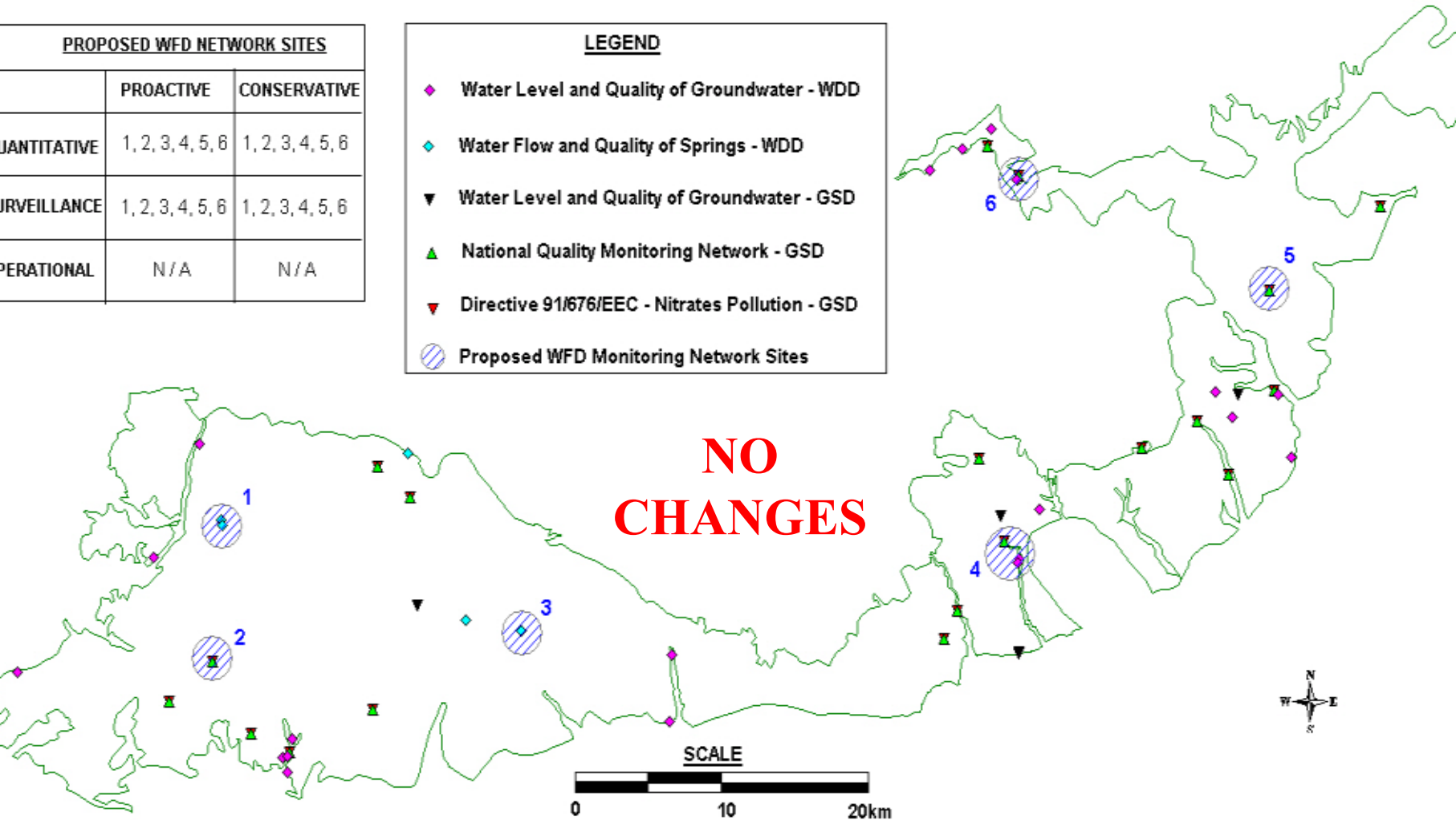
PROPOSED WFD NETWORK SITES		
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3, 4, 5, 6, 7, 8	1, 3, 5, 6, 7
SURVEILLANCE	1, 2, 3, 4, 5, 6, 7, 8	1, 3, 5, 6, 7
OPERATIONAL	1, 2, 3, 4, 5, 6, 7, 8	1, 3, 5, 6, 7



**GROUNDWATER BODY CY_18:
LEFKARA-PACHNA FORMATIONS
EXISTING MONITORING PROGRAMS
& OUTLINE OF WFD MONITORING NETWORK OPTIONS**

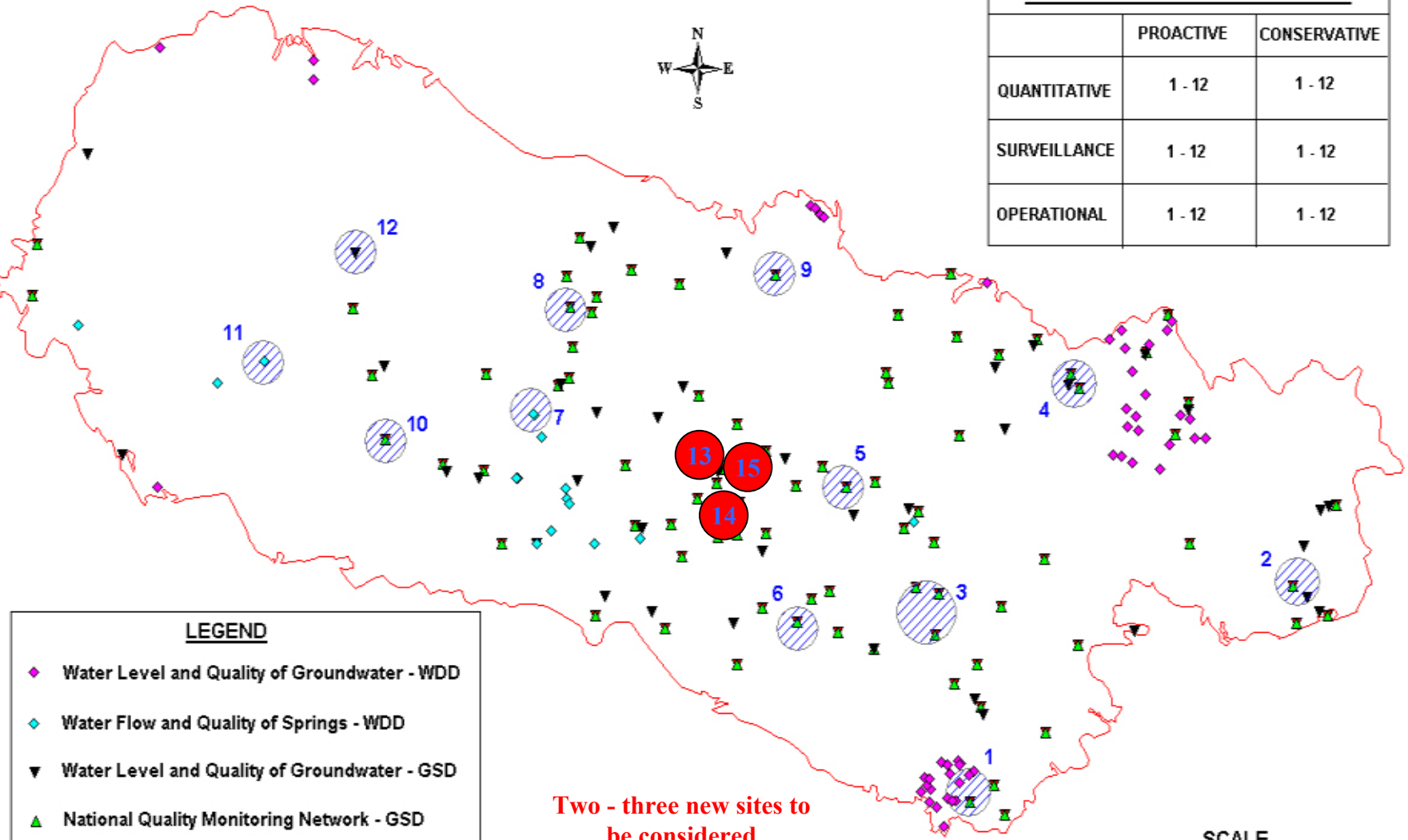
PROPOSED WFD NETWORK SITES		
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6
SURVEILLANCE	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6
OPERATIONAL	N/A	N/A

LEGEND	
	Water Level and Quality of Groundwater - WDD
	Water Flow and Quality of Springs - WDD
	Water Level and Quality of Groundwater - GSD
	National Quality Monitoring Network - GSD
	Directive 91/676/EEC - Nitrates Pollution - GSD
	Proposed WFD Monitoring Network Sites



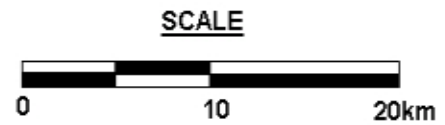
**GROUNDWATER BODY CY_19:
TROODOS AREA (TROODOS IGNEOUS MASSIF AQUIFERS) (AT RISK)
EXISTING MONITORING PROGRAMS & OUTLINE OF WFD MONITORING NETWORK OPTIONS**

<u>PROPOSED WFD NETWORK SITES</u>		
	PROACTIVE	CONSERVATIVE
QUANTITATIVE	1 - 12	1 - 12
SURVEILLANCE	1 - 12	1 - 12
OPERATIONAL	1 - 12	1 - 12



<u>LEGEND</u>	
◆	Water Level and Quality of Groundwater - WDD
◆	Water Flow and Quality of Springs - WDD
▼	Water Level and Quality of Groundwater - GSD
▲	National Quality Monitoring Network - GSD
▼	Directive 91/676/EEC - Nitrates Pollution - GSD
⊘	Proposed WFD Monitoring Network Sites

**Two - three new sites to
be considered
(Amiantos, Kyperounda,
Chandria – Agros)**



SOME FINAL REMARKS

Samples obtained under the WFD monitoring programs and coinciding both in location and timing with any other requirement of any other Directive then these samples should serve the other Directives as well.

The WFD requires the establishment of monitoring programmes covering groundwater quantitative status, chemical status and the assessment of significant, long-term pollutant trends resulting from human activity.

These programmes do not and should not be thought as replacing any other National Water Resources Monitoring Programmes. The WFD monitoring programmes are indicative of trends and serve to evaluate the status of groundwater bodies. Day to day management plans and water resource assessment that would enable their sustained use require specialized monitoring programmes far denser and far more comprehensive. These should be designed and implemented on the basis of other National Objectives.

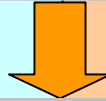
COASTAL WATER BODIES MONITORING PROGRAMME

No of CWBs	No of WBs at risk	No of WBs Need further assessment	No of WB types
25	1	3	3

Methodology of Design

INPUT

WFD requirements, Guidance document no. 7 “Monitoring under the Water Framework Directive”, Existing monitoring networks, Special conditions of Cyprus, Article 5&6 reports (Typology, Pressures), information collected for the FCR report



WFD Article 8 Monitoring Programme

GENERAL PRINCIPLES:

- ✓ WFD REQUIREMENTS
- ✓ REPRESENTATION OF WBs (size, distribution, geografy, etc.)
- ✓ REPRESENTATION OF WB TYPES
- ✓ REPRESENTATION OF WB PRESSURES
- ✓ QE SELECTION ACCORDING TO THE PROVISIONS OF THE DIRECTIVE
- ✓ PS THAT ARE DISCHARGED AND OTHER DANGEROUS SUBSTANCES IN SIGNIFICANT PRESENCE
- ✓ FREQUENCY AS DEFINED BY WFD AND GUIDANCE DOCUMENT

COASTAL WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

Extended representation of WBs (size, distribution, geografy, c.)

c.)

Extended representation of WBs types – adequate grouping coding to typology for type CW1

BASIC MONITORING PROGRAMME

• **Adequate representation of WBs** (size, distribution, geografy etc.)

• **Adequate representation of WBs types – extended grouping for type CW1**

- Full representation of “at risk” WBs
- Full representation of “need further assessment” WBs
- All biological, hydromorphological & general physicochemical QE
- All PS discharged & other pollutants discharged in significant quantities
- Frequency enough to obtain adequate number of observations for reliable statistical evaluations and evaluation of measures effectiveness



	Total	Surveillance	Operational
No of sites	12/25 WBs	11/25 WBs	1/25 WBs

	Total	Surveillance	Operational
No of sites	9/25 WBs	8/25 WBs	1/25 WBs

COASTAL WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

REPRESENTATION OF WB TYPES

SURVEILLANCE MONITORING PROGRAMME

TYPES OF WBs

CW1- Hard intermediate moderately exposed	3/8
CW2- Sand-gravel intermediate moderately exposed	2/13
CW3-Hard shallow moderately exposed	1/4

TYPES OF WBs

CW1- Hard intermediate moderately exposed	1/8
CW2- Sand-gravel intermediate moderately exposed	2/13
CW3-Hard shallow moderately exposed	1/4

Need further assessment coverage

3 OUT OF 3

Natural trends – reference conditions

CW1- Hard intermediate moderately exposed	3/8
CW2- Sand-gravel intermediate moderately exposed	2/13
CW3-Hard shallow moderately exposed	1/4

Natural trends – reference conditions

CW1- Hard intermediate moderately exposed	1/8
CW2- Sand-gravel intermediate moderately exposed	2/13
CW3-Hard shallow moderately exposed	1/4

COASTAL WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

REPRESENTATION OF WB TYPES

OPERATIONAL MONITORING PROGRAMME

TYPES OF WBs AT RISK

CW1- Hard intermediate moderately exposed	-
CW2- Sand-gravel intermediate moderately exposed	1/1
CW3- Hard shallow moderately exposed	-

COASTAL WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

DIRECTIVE OR INTERNATIONAL CONVENTION	Site	Quality Elements	Frequency
BATHING WATERS 76/160/EEC AND 2006/7/EC	No	No	No
DANGEROUS SUBSTANCES -76/464/EEC	Full	Full	Full
MEDPOL – Phase III	No	No	No

COASTAL WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

PROVISIONAL COST IN CP

	SURVEILLANCE	OPERATIONAL
ANALYSIS	85.752	10.014
SAMPLING	17.840	1.868
TOTAL	103.592	11.882

	SURVEILLANCE	OPERATIONAL
ANALYSIS	59.070	10.014
SAMPLING	12.236	1.868
TOTAL	71.306	11.882

NOTE

COST DOES NOT INCLUDE THE COST OF VESSEL CREW

OPERATIONAL MONITORING IS REQUIRED EVERY YEAR OF THE 6 YEAR RBMP MONITORING CYCLE

SURVEILLANCE IS REQUIRED ONCE EVERY 6 YEARS OF THE RBMP MONITORING CYCLE

INDICATIVE PERSONNEL NEEDED

SAMPLING	2-4*
ANALYSIS – INITIAL EVALUATION	1 CHEM – 2 BIOL**
SENIOR (FINAL ASSESSMENT MANAGEMENT)	1-2

IT IS ESTIMATED THAT COMPARED TO THE EXTENDED AN OVERALL REDUCTION RANGING FROM 15-30% COULD BE ACHIEVED DEPENDING MAINLY ON THE POSSIBILITY OF MANAGING EFFICIENTLY “PEAK DEMAND” PERIODS

**VESSEL CREW IS NOT INCLUDED*

***BIOL MIGHT BE REQUIRED TO BE PRESENT IN SAMPLING AT LEAST AT THE EARLY STAGES OF PROGRAMME*

COASTAL WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

BQEs

Invertebrate fauna: Proposed – Intercalibration Exercise

Angiosperms: Proposed – To be tried (*Posidonia oceanica*)

Macroalgae : Proposed – To be tried

Phytoplankton (Chlorophyll-a) : Proposed

1. Invertebrate fauna: Proposed – Intercalibration Exercise
2. Angiosperms: Proposed – To be tried (*Posidonia oceanica*)
3. Macroalgae : Proposed – To be tried
4. Phytoplankton (Chlorophyll-a) : Proposed

COASTAL WATER BODIES MONITORING PROGRAMME

Main Working Group results

- ✓ Agreement on the followed methodology
- ✓ Possible change in the proposed sampling site for heavy metals, it might lead to an additional site
- ✓ Possible change in the proposed sampling site for *Posidonia oceanica*
- ✓ DFMR willing to adopt the basic approach

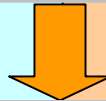
RIVER WATER BODIES MONITORING PROGRAMME

No of Catchments	No of RWBs	No of WBs at risk	No of WBs Need further assessment	No of WB types
47 (under governmental control)	216	46	13	3

Methodology of Design

INPUT

WFD requirements, Guidance document no. 7 “Monitoring under the Water Framework Directive”, Existing monitoring networks, Special conditions of Cyprus, Article 5&6 reports (Typology, Pressures), information collected for the FCR report



WFD Article 8 Monitoring Programme

GENERAL PRINCIPLES:

- ✓ WFD REQUIREMENTS
- ✓ REPRESENTATION OF WBs (size, distribution, geografy, etc.)
- ✓ REPRESENTATION OF WB TYPES
- ✓ REPRESENTATION OF WB PRESSURES
- ✓ QE SELECTION ACCORDING TO THE PROVISIONS OF THE DIRECTIVE
- ✓ PS THAT ARE DISCHARGED AND OTHER DANGEROUS SUBSTANCES IN SIGNIFICANT PRESENCE
- ✓ FREQUENCY AS DEFINED BY WFD AND GUIDANCE DOCUMENT

RIVER WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

- EXTENDED REPRESENTATION OF WBs(size, distribution, geograpy, etc.)
- EXTENDED REPRESENTATION OF WB TYPES, LIMITED GROUPING FOR TYPES 1 AND 3
- LIMITED GROUPING OF “NEED FURTHER ASSESSMENT” AND “AT RISK” WBs
- AT LEAST ONE MONITORING SITE IN EACH OF THE 47 CATCHMENTS – SUB-BASINS
- 3 BQEs EXPECTED TO BE APPLICABLE IN CYPRUS CONDITIONS ARE CHOSEN TO BE MONITORED

BASIC MONITORING PROGRAMME

- ADEQUATE REPRESENTATION OF WBs (size, distribution, geograpy, etc.)
- ADEQUATE REPRESENTATION OF WB TYPES, EXTENDED GROUPING FOR TYPES 1 AND 3
- EXTENDED GROUPING OF “NEED FURTHER ASSESSMENT” AND “AT RISK” WBs
- AT LEAST ONE MONITORING SITE IN CATCHMENTS BIGGER THAN 100km² (=24Monitoring Stations)
- 1 BQE IMPLEMENTED IN INTERCALIBRATION EXERCISE IS CHOSEN TO BE MONITORED

- ✓ FOCUSED ON AS MANY OF THE EXISTING MONITORING STATIONS AS POSSIBLE
- ✓ DUE TO LACK OF BQEs DATA SERIES ALL INTERCALIBRATION SITES WERE ADOPTED (to be discussed)
- ✓ QE SELECTION ACCORDING TO THE PROVISIONS OF THE DIRECTIVE EXCEPT THE BQEs
- ✓ ALL PS THAT ARE DISCHARGED AND OTHER DANGEROUS SUBSTANCES IN SIGNIFICANT PRESENCE
- ✓ FREQUENCY ENOUGH TO OBTAIN ADEQUATE NUMBER OF OBSERVATIONS FOR RELIABLE STATISTICAL EVALUATIONS AND EVALUATION OF MEASURES EFFECTIVENESS



	Total	Surveillance	Operational
No of sites	88	59	32
ON AVERAGE EACH STATION CORRESPONDS TO ABOUT 33km OF RIVER LENGTH			

	Total	Surveillance	Operational
No of sites	70	44	26
ON AVERAGE EACH STATION CORRESPONDS TO ABOUT 43km OF RIVER LENGTH			

RIVER WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

REPRESENTATION OF WB TYPES

SURVEILLANCE MONITORING PROGRAMME

TYPES OF WBs

1: small rain volume with non-continuous flow	25%
2: large rain volume with continuous flow	29%
3: large rain volume with non-continuous flow	23%
Need further assessment coverage	62%

TYPES OF WBs

1: small rain volume with non-continuous flow	15%
2: large rain volume with continuous flow	29%
3: large rain volume with non-continuous flow	19%
Need further assessment coverage	54%

Natural trends – Reference Conditions

1: small rain volume with non-continuous flow	4
2: large rain volume with continuous flow	4
3: large rain volume with non-continuous flow	4

RIVER WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

REPRESENTATION OF WB TYPES

OPERATIONAL MONITORING PROGRAMME

TYPES OF WBs AT RISK

1: small rain volume with non-continuous flow	2/3
2: large rain volume with continuous flow	1/1
3: large rain volume with non-continuous flow	29/55
WBs AT RISK COVERAGE	57%

TYPES OF WBs AT RISK

1: small rain volume with non-continuous flow	2/3
2: large rain volume with continuous flow	0/1
3: large rain volume with non-continuous flow	24/55
WBs AT RISK COVERAGE	52%

RIVER WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

INCORPORATION OF EXISTING MONITORING PROGRAMMES

DIRECTIVE OR DECISION	Site	QE	Frequency
DRINKING WATER – 75/440/EEC AS REPLACED BY WFD ANNEX V §1.3.5 FROM 2007 (SURVEILLANCE – ADDITIONAL MONITORING PROGRAMME)	Full	Full	Full
EXCHANGE OF INFO – 77/795/EEC	Full	Full	Full
DANGEROUS SUBSTANCES - 76/464/EEC	Full	Full	Full
NITRATES – 91/676/EEC	Full	Full	Partial Proposed 3-4 times per year instead of monthly required
URBAN WASTE WATER TREATMENT – 91/271/EEC FOR THE DESIGNATION OF SENSITIVE ZONES	Full	Full	Full

DIRECTIVE OR DECISION	Site	QE	Frequency
DRINKING WATER – 75/440/EEC AS REPLACED BY WFD ANNEX V §1.3.5 FROM 2007 (SURVEILLANCE – ADDITIONAL MONITORING PROGRAMME)	Full	Full	Full
EXCHANGE OF INFO – 77/795/EEC	Full	Full	Full
DANGEROUS SUBSTANCES -76/464/EEC	Full	Full	Full
NITRATES – 91/676/EEC	Partial 8 out of 9 MS	Full	Partial Proposed 3-4 times per year instead of monthly required
URBAN WASTE WATER TREATMENT – 91/271/EEC FOR THE DESIGNATION OF SENSITIVE ZONES	Full	Full	Full

RIVER WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

PROVISIONAL COST IN CP

	SURVEILLANCE	OPERATIONAL
ANALYSIS	135.514	115.302
SAMPLING	88.658	35.651
TOTAL	224.172	150.953
	375.125	

	SURVEILLANCE	OPERATIONAL
ANALYSIS	68.664	87.268
SAMPLING	52.773	26.269
TOTAL	121.437	113.537
	234.974	

NOTE

COST DOES NOT INCLUDE THE BUDGET NEEDED FOR NEW INFRASTRUCTURE, WHICH MIGHT BE REQUIRED, SUCH AS NEW FLOWMETER STATIONS

OPERATIONAL MONITORING IS REQUIRED EVERY YEAR OF THE MONITORING CYCLE

SURVEILLANCE IS REQUIRED ONCE EVERY 6 YEARS OF THE RBMP MONITORING CYCLE

INDICATIVE PERSONNEL NEEDED

SAMPLING	15-20
ANALYSIS – INITIAL EVALUATION	2-3 CHEM – 1-2 BIOL**
SENIOR (FINAL ASSESSMENT MANAGEMENT)	2

IT IS ESTIMATED THAT COMPARED TO THE EXTENDED AN OVERALL REDUCTION RANGING FROM 15-30% COULD BE ACHIEVED DEPENDING MAINLY ON THE POSSIBILITY OF MANAGING EFFICIENTLY “PEAK DEMAND” PERIODS

*****BIOL MIGHT BE REQUIRED TO BE PRESENT IN SAMPLING AT LEAST AT THE EARLY STAGES OF PROGRAMME***

RIVER WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

BQEs

1. MACROINVERTEBRATES: Proposed – Intercalibration Exercise
2. **PHYTOPLANKTON (Chlorophyll – a): Proposed for rivers with lentic character, according to literature and intercalibration results**
3. **PHYTOBENTHOS (Diatoms): Proposed according to literature**
4. **MACROPHYTES: Not proposed for WFD monitoring – Research project proposed instead**
5. FISH : Not applicable

1. MACROINVERTEBRATES: Proposed – Intercalibration Exercise
2. **PHYTOPLANKTON (Chlorophyll – a): Not proposed– Research project proposed instead**
3. **PHYTOBENTHOS (Diatoms): Not proposed– Research project proposed instead**
4. **MACROPHYTES: Not proposed– Research project proposed instead**
5. FISH : Not applicable

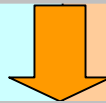
LAKE WATER BODIES MONITORING PROGRAMME

No of LWBs	No of WBs at risk	No of WBs Need further assessment	No of WB types
18	1	4	4

Methodology of Design

INPUT

WFD requirements, Guidance document no. 7 “Monitoring under the Water Framework Directive”, Existing monitoring networks, Special conditions of Cyprus, Article 5&6 reports (Typology, Pressures), information collected for the FCR report



WFD Article 8 Monitoring Programme

GENERAL PRINCIPLES:

- ✓ WFD REQUIREMENTS
- ✓ REPRESENTATION OF WBs (size, distribution, geografy, etc.)
- ✓ REPRESENTATION OF WB TYPES
- ✓ REPRESENTATION OF WB PRESSURES
- ✓ QE SELECTION ACCORDING TO THE PROVISIONS OF THE DIRECTIVE
- ✓ PS THAT ARE DISCHARGED AND OTHER DANGEROUS SUBSTANCES IN SIGNIFICANT PRESENCE
- ✓ FREQUENCY AS DEFINED BY WFD AND GUIDANCE DOCUMENT

LAKE WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

- FULL REPRESENTATION OF WBs (size, distribution, geograpy, etc.)
- FULL REPRESENTATION OF WB TYPES FOR BRACKISH LAKES AND CONNECTED DEEP RESERVOIRS

BASIC MONITORING PROGRAMME

- ADEQUATE REPRESENTATION OF WBs(size, distribution, geograpy, etc.)
- ADEQUATE REPRESENTATION OF WB TYPES FOR BRACKISH LAKES AND CONNECTED DEEP RESERVOIRS

- ✓ FULL REPRESENTATION OF “NEED FURTHER ASSESSMENT” AND “AT RISK” WBs
- ✓ FOCUSED ON AS MANY OF THE EXISTING MONITORING STATIONS AS POSSIBLE
- ✓ DUE TO LACK OF BQEs DATA SERIES INTERCALIBRATION SITES WERE ADOPTED
- ✓ QE SELECTION ACCORDING TO THE PROVISIONS OF THE DIRECTIVE EXCEPT THE BQEs
- ✓ 1 BQE EXPECTED TO BE APPLICABLE IN CYPRUS CONDITIONS IS CHOSEN TO BE MONITORED IN FRESH WATER RESERVOIRS AND 2 BQEs IN SALT AND BRACKISH LAKES
- ✓ ALL PS THAT ARE DISCHARGED AND OTHER DANGEROUS SUBSTANCES IN SIGNIFICANT PRESENCE
- ✓ FREQUENCY ENOUGH TO OBTAIN ADEQUATE NUMBER OF OBSERVATIONS FOR RELIABLE STATISTICAL EVALUATIONS AND EVALUATION OF MEASURES EFFECTIVENESS



	Total	Surveillance	Operational
No of sites	18 /18 WBs	17 /18 WBs	1 /18 WBs

	Total	Surveillance	Operational
No of sites	13 /18 WBs	12 /18 WBs	1 /18 WBs

LAKE WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

REPRESENTATION OF WB TYPES

SURVEILLANCE MONITORING PROGRAMME

TYPES OF WBs

salt lake	1/1
brackish lake	5/5
connected deep reservoir	10/11
shallow storage basin	1/1

TYPES OF WBs

salt lake	1/1
brackish lake	1/5
connected deep reservoir	9/11
shallow storage basin	1/1

Need further assessment coverage

4 OUT OF 4

OPERATIONAL MONITORING PROGRAMME

TYPES OF WBs AT RISK

salt lake		-
brackish lake		-
connected deep reservoir		1/1
shallow storage basin		-

LAKE WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

INCORPORATION OF EXISTING MONITORING PROGRAMMES

DIRECTIVE OR DECISION	Site	Quality Element	Frequency
DRINKING WATER – 75/440/EEC AS REPLACED BY WFD ANNEX V §1.3.5 FROM 2007 (SURVEILLANCE – ADDITIONAL MONITORING PROGRAMME)	Full	Full	Full
FRESHWATER FISH DIRECTIVE – 78/659/EEC	Full For LWBs. There are 12 more reservoirs not characterised as LWBs, where monitoring is currently applied	Partial Not all parameters included in Annex of Fish Directive are included	Partial Proposed 3-4 times per year instead of monthly required by Fish Directive
DANGEROUS SUBSTANCES -76/464/EEC	Full	Full	Full

LAKE WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

PROVISIONAL COST IN CP

	SURVEILLANCE	OPERATIONAL
ANALYSIS	85.752	13.128
SAMPLING	17.840	2.815
TOTAL	103.592	15.943
	119.535	

BASIC MONITORING PROGRAMME

	SURVEILLANCE	OPERATIONAL
ANALYSIS	59.070	13.128
SAMPLING	12.236	2.815
TOTAL	71.306	15.943
	87.249	

NOTE

*OPERATIONAL MONITORING IS REQUIRED EVERY YEAR OF THE MONITORING CYCLE
SURVEILLANCE IS REQUIRED ONCE EVERY 6 YEARS OF THE RBMP MONITORING CYCLE*

INDICATIVE PERSONNEL

SAMPLING	2-3
ANALYSIS – INITIAL EVALUATION	1 CHEM – 1-2 BIOL**
SENIOR (FINAL ASSESSMENT MANAGEMENT)	1

IT IS ESTIMATED THAT AN OVERALL REDUCTION RANGING FROM 15-30% COULD BE ACHIEVED DEPENDING MAINLY ON THE POSSIBILITY OF MANAGING EFFICIENTLY “PEAK DEMAND” PERIODS

***BIOL MIGHT BE REQUIRED TO BE PRESENT IN SAMPLING AT LEAST AT THE EARLY STAGES OF PROGRAMME*

LAKE WATER BODIES MONITORING PROGRAMME

EXTENDED MONITORING PROGRAMME

BASIC MONITORING PROGRAMME

BQEs – Fresh Water Reservoirs

1. PHYTOPLANKTON (Chlorophyll – a): Proposed – Intercalibration Exercise
2. BENTHIC MACROINVERTEBRATES: Not proposed– Research project proposed instead
3. PHYTOBENTHOS: Not proposed– Research project proposed instead
4. MACROPHYTES: Not applicable due to great seasonal variation – Future research project proposed instead
5. FISH : Not applicable

1. PHYTOPLANKTON (Chlorophyll – a): Proposed – Intercalibration Exercise
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4. MACROPHYTES: Not applicable due to great seasonal variation – Future research project proposed instead
5. FISH : Not applicable

BQEs – Salt and brackish natural lakes

- I. PHYTOPLANKTON (Chlorophyll – a): Proposed
- II. BENTHIC MACROINVERTEBRATES: Not proposed– Research project proposed instead
- III. PHYTOBENTHOS: Not proposed– Research project proposed instead
- IV. MACROPHYTES: Proposed for the second monitoring cycle
- V. FISH : Not applicable
- VI. Zooplankton: Proposed, not mandatory by WFD – valuable pollution indicator (to be discussed)

- I. PHYTOPLANKTON (Chlorophyll – a): Proposed
- II. BENTHIC MACROINVERTEBRATES: Not proposed– Research project proposed instead
- III. PHYTOBENTHOS: Not proposed– Research project proposed instead
- IV. MACROPHYTES: Proposed for the second monitoring cycle
- V. FISH : Not applicable
- VI. Zooplankton: Proposed, not mandatory by WFD – valuable pollution indicator(to be discussed)



Issues raised in WG discussions

Rivers Key Issues

I. Sites in RWBs of surveillance monitoring network with “no flows” because of natural reasons, i.e. western Cyprus (Akamas area)

Alternative solutions

1. Install flowmeters in order to collect data
2. Move sites in adjacent RWBs (same or different basin) and regroup
3. Remove sites

Analysis:

Solution 2: might lead to a small reduction in sites

Solution 1: safer but more costly

Related policy action

- ◆ Review of RWBs network and communicate changes to EU
- ◆ Case strengthened by alternative solution 1

WHEN:

- | | | |
|-------------------------------|---|----------------------------------|
| • Summary report (March 2007) | → | • If no data support is intended |
| • End 2008 or | → | • If flow data will be available |
| • End 2009 | | |

II. Sites in RWBs downstream of dams with “no existing flows”

◆ Surveillance sites

Alternative solutions

1. Maintain sites, install flowmeters and collect quality data by sampling when and if water is available

Advantage: Support case of HMWBs final designation in 2009 (status lower than GOOD is required)

2. Remove and replace with upstream (before the dam) sites

Risk: Possible good or high status  no HMWB designation

3. Remove sites completely and combine it with review of river and lake WBs – communicate changes to EU

Analysis

- ◆ Solution 1: more consistent with the spirit of WFD
- ◆ Solutions 1 and 2: might lead to the necessity of establishing “ecological flow” downstream of the lakes as a measure in the relevant RBMP
- ◆ Solution 3: may not be accepted by EU

II. Sites in RWBs downstream of dams with “no existing flows” (2)

◆ Operational sites

Alternative solutions

1. Maintain sites, install flowmeters and collect quality data by sampling when and if water is available

Advantage: Support case of HMWBs final designation in 2009 (status lower than GOOD is required)

2. Remove RWB monitoring sites and add adequate GWB monitoring sites and combine it with review of river and lake WBs – communicate changes to EU
3. Replace sites with upstream (before the dam) sites - grouping

Analysis

Solution 1:

- ◆ more consistent with the spirit of WFD
- ◆ BQEs unlikely to function .Will most likely lead to lower than GOOD Ecological Quality
- ◆ More costly
- ◆ Inclusion in programme of measures and / or less stringent objectives → Possible requirement of “ecological flow”

Solution 2: may not be accepted by EU

Solution 3: inconsistent with existing risk characterisation, grouping possibly not accepted by EU – not suggested

III. Operational sites in RWBs with “no flows” downstream of pollution sources (especially point sources)

Alternative solutions

1. Maintain sites, install flowmeters and collect quality data by sampling when and if water is available
2. Remove RWB monitoring sites completely and add adequate GWB monitoring site and combine it with with review of RWBs designation – communicate changes to EU
3. Replace sites with upstream (before pressures) sites - grouping

Analysis

Solution 1:

- ◆ more consistent with the spirit of WFD
- ◆ can substantiate the “no flows”
- ◆ Can strengthen the case review of RWBs designation

Solution 2: may not be accepted by EU because of no data support

Solution 3: inconsistent with existing risk characterisation grouping possibly not accepted by EU – not suggested

IV. Monitoring sites in occupied territories

They will be removed

V. Request for monitoring sites to be placed close to existing flowmeters

Surveillance monitoring sites:

Many will be accommodated

Limiting factor: Typology

Operational monitoring sites:

Under examination

Limiting factor: Location of pressures (especially point sources)

Issues raised in WG discussions

BQEs – Typology

I. Steps of BQE application (to be repeated for every BQE)

1. Sampling

- ◆ Physicochemical (same to BQE frequency)
- ◆ Hydromorphological (1 in six years)
- ◆ Biological

2. Data analysis for

- ◆ BQE
- ◆ Hydromorphological
- ◆ physicochemical

3. Measurement assessment – grading for

- ◆ BQE
- ◆ Hydromorphological
- ◆ Physicochemical

4. Assessment of WB EQS for the specific BQE

(Combination of biological, hydromorphological and physicochemical metrics and indices)

The lowest EQS grade is adopted for the Ecological Quality grade of the WB
- Application of “one out all out” WFD principle -

Analytical example:

BQE in River Water Bodies

1. Selection of adequate sampling location(s) for each WFD-RWB sampling station (Takes place once)
 - ◆ Depends on the BQE dispersal and habitat characteristics
2. Collection of data on different hydromorphological parameters for each RWB sampling station
3. Identification of hydromorphological “reference conditions” for each RWB type (Takes place once)
4. Assessment of hydromorphological quality according to an integrated quality classification system adapted to local conditions (not available yet)

Steps 2,3 and 4 are to be carried out by experienced personnel having specialist knowledge of plant identification and / or fluvial geomorphology

Source of info: European Standard EN 14614:2004

Situation in Cyprus

Hydromorphological assessment is being carried out only in 1 type of RWBs (continuous flow), according to British methodology adapted for Italy, Intercalibration programme

- ◆ Possible need of further adaptation to Cyprus conditions
- ◆ Need of further expansion to other RWB types (RWBs with high and low volume intermittent flow)

5. Take BQE sample and water sample (physicochemical parameters)
6. Lab analysis of samples's BQE parameters
 - ◆ Specialised personnel (biologist with training / experience in the specific BQE) is required

Analytical example:

BQE use in River Water Bodies (2)

7. Identification of BQE “reference conditions” for each RWB type
8. Assessment of BQE’s parameters metrics
 - ◆ Assessment BQE method developed for Cyprus conditions required
 - ◆ Highly specialised and experienced personnel required
9. Assessment of the physicochemical quality
10. Combine 4,8,9, as above in order to assess the Ecological Quality Status for this BQE

Situation in Cyprus rivers

- ◆ **Ecological Quality assessment is being carried out only in one type of RWBs (continuous flow), based on only BQE (benthic invertebrates), Intercalibration Programme**
 - ◆ Possible need of further adaptation – development of BQE quality assessment methods to Cyprus conditions
 - ◆ Need of further expansion to other RWB types
- ◆ **At least one research programme has been proposed on the applicability of two or more BQEs in Cyprus:**
 - ◆ Macrophytes
 - ◆ Phytobenthos (Diatoms)
- ◆ **Phytoplankton (chlorophyll-a), has been sampled in the framework of the Intercalibration programme, and seems to be applicable in some cases of RWBs (lentic character, pressure: eutrophication)**
- ◆ **Phytobenthos (Diatom) samples have been collected in the framework of the Intercalibration programme**

BQE – Typology – RWBs of Cyprus

Conclusions

- 1. Cyprus has no significant existing data on its river BQEs**
- 2. EQS assessment requires the existence of**
 - Hydromorphological quality measurement – assessment system**
 - BQE measurement – assessment system**
- 3. Both assessment system require the identification of relevant “reference conditions” for each type of RWBs**
- 4. The current Intercalibration programme in rivers covers at present 1 BQE and 1 of the 3 types of RWBs**
- 5. Further work might be needed for better adaptation of assessment systems and type reference conditions to the hydrological, geomorphological and ecological conditions of Cyprus (consultation with intercalibration experts)**
- 6. Dissemination of intercalibration experience is limited due to lack of personnel**



Cost and Personnel issues

Cost assessment

Extended approach

	EXTENDED APPROACH								
	Analysis		Sampling			Hydro-Morphology			
	Surveill	Operat	Surveill	Operat	Quant	Surveill	Operat	Quant	
rivers	135.514	115.302	88.658	35.651	-	127.400	68.250	-	570.775
lakes	123.366	13.128	36.589	2.815	-	34.850	400	-	211.148
groundwater	187.314	407.184	19.844	35.974	56.502	-	-	8.910	715.728
coastal	85.752	10.014	17.840	1.868	-	3.520	320	-	119.314
Total	531.946	545.628	162.932	76.307	56.502	165.770	68.970	8.910	1.616.965

Total cost of surveillance programme: 860.648 CP

Total cost of operational programme: 756.317 CP

Basic approach

	BASIC APPROACH								
	Analysis		Sampling			Hydro-Morphology			
	Surveill	Operat	Surveill	Operat	Quant	Surveill	Operat	Quant	
rivers	68.664	87.268	52.773	26.269	-	97.825	56.875	-	389.674
lakes	110.256	13.128	29.553	2.815	-	24.600	400	-	180.751
groundwater	119.781	253.898	13.001	25.221	39.884	-	-	6.110	457.895
coastal	59.070	10.014	12.236	1.868	-	2.560	0	-	85.748
Total	357.771	364.308	107.563	56.172	39.884	124.985	57.275	6.110	1.114.069

Total cost of surveillance programme: 590.319 CP

Total cost of operational programme: 523.749 CP

What is not included in the cost assessment ...

- 1. The cost of additional required infrastructure (e.g. flowmeter, stations, boreholes, etc)**
- 2. The cost of intercalibration and other research programmes required for the development of relevant assessment methods for BQEs**
- 3. Additional required sampling equipment (not significant)**
- 4. The cost of vessel crew participating in coastal monitoring programme**

Personnel

Extended approach

	Rivers – Lakes	Coastal	Groundwater
Sampling	15-20	2-4*	6-10
Analysis - initial evaluation	4-5 Chem – 2-3 Biol**	1 Chem – 2 Biol**	2 Chem
Senior (final assessment managemant)	2-3	1-2	1-2

*VESSEL CREW IS NOT INCLUDED

**BIOL MIGHT BE REQUIRED TO BE PRESENT IN SAMPLING AT LEAST AT THE EARLY STAGES OF PROGRAMME

	Chemists	Biologists	Senior staff	Support staff
Total	7-8	4-5	5-7	23-34

Basic approach

FOR BASIC APPROACH IS ESTIMATED THAT COMPARED TO THE EXTENDED AN OVERALL REDUCTION RANGING FROM 15-30% COULD BE ACHIEVED DEPENDING MAINLY ON THE POSSIBILITY OF MANAGING EFFICIENTLY “PEAK DEMAND” PERIODS

Note 1: The personnel required depends on the number of BQEs to be included as well as the knowledge and experience disseminated from Intercalibration and other research programmes

Note 1: Finally the personnel required depends on the institutional organisation of WFD monitoring