

International Conference on Environmental Science and Technology
5-7 September 2007, Kos island, Greece

**Towards a Master Plan of Water Resources
Management and Protection in Greece**

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Project identity

- ◆ Commissioned by: Ministry of Environment, Planning and Public Works
- ◆ Contractor: Department of Water Resources and Environment - National Technical University of Athens
- ◆ Duration: February 2007 - May 2007
- ◆ The project updates and expands a previous research project, commissioned by the Ministry of Development and conducted by the same team of NTUA in co-operation with the Ministry of Development, IGME, and KEPE.

Γραπώνηση:
Εθνικό Μετσόβιο
Πολυτεχνείο –
Τμήμα
Υδατικών Πόρων
και
Περιβάλλοντος

ΑΘΗΝΑ

Μάιος 2007

ΥΠΟΥΡΓΕΙΟ ΧΩΡΟΤΑΞΙΑΣ, ΠΕΡΙΒΑΛΛΟΝΤΟΣ
ΚΑΙ ΔΗΜΟΣΙΩΝ ΕΡΓΩΝ

ΕΘΝΙΚΟ ΠΡΟΓΡΑΜΜΑ
ΔΙΑΧΕΙΡΙΣΗΣ ΚΑΙ ΠΡΟΣΤΑΣΙΑΣ
ΤΩΝ ΥΔΑΤΙΚΩΝ ΠΟΡΩΝ



*... υδάτων τε καί νεμάτων μάλιστα μὲν ὑπάρχειν πλῆθος οἰκείων, εἰ
δέ μή, τοῦτό γε εἴρηται διὰ τοῦ κατασκευάζειν ὑποδοχὰς ὀμβρίους
ὕδασι ἀφθόνοους καὶ μεγάλας ...*

Αριστοτέλης, Πολιτικά 7.1330b

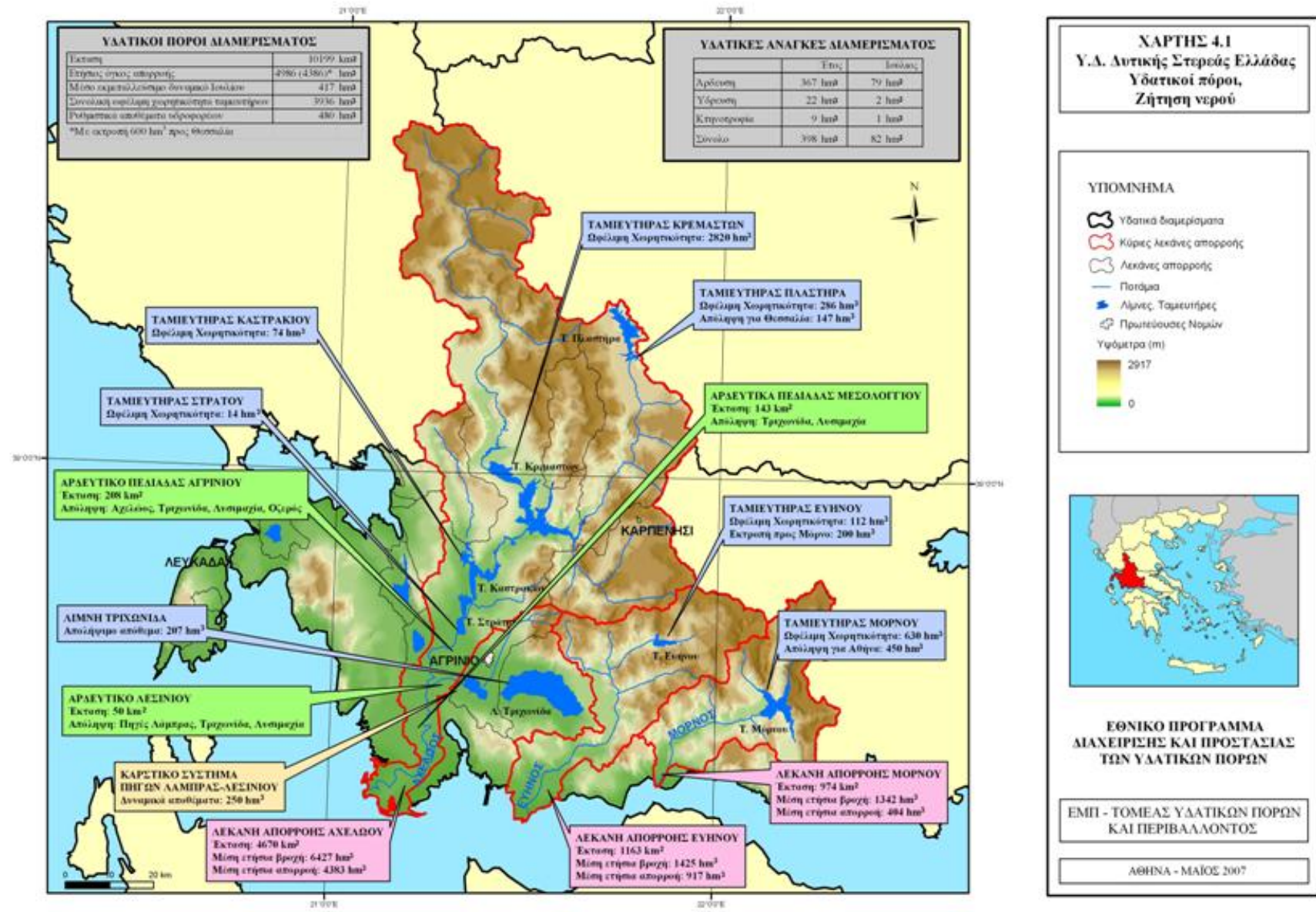
Contents of Master Plan

- I. Introduction
- II. A framework for the water resources management in Greece
- III. Methodology
- IV. Analysis of river basin districts
- V. Relationships between river basin districts
- VI. Integration of the water resources management on a country level
- VII. The National Master Plan of Water Resources Management and Protection in Greece

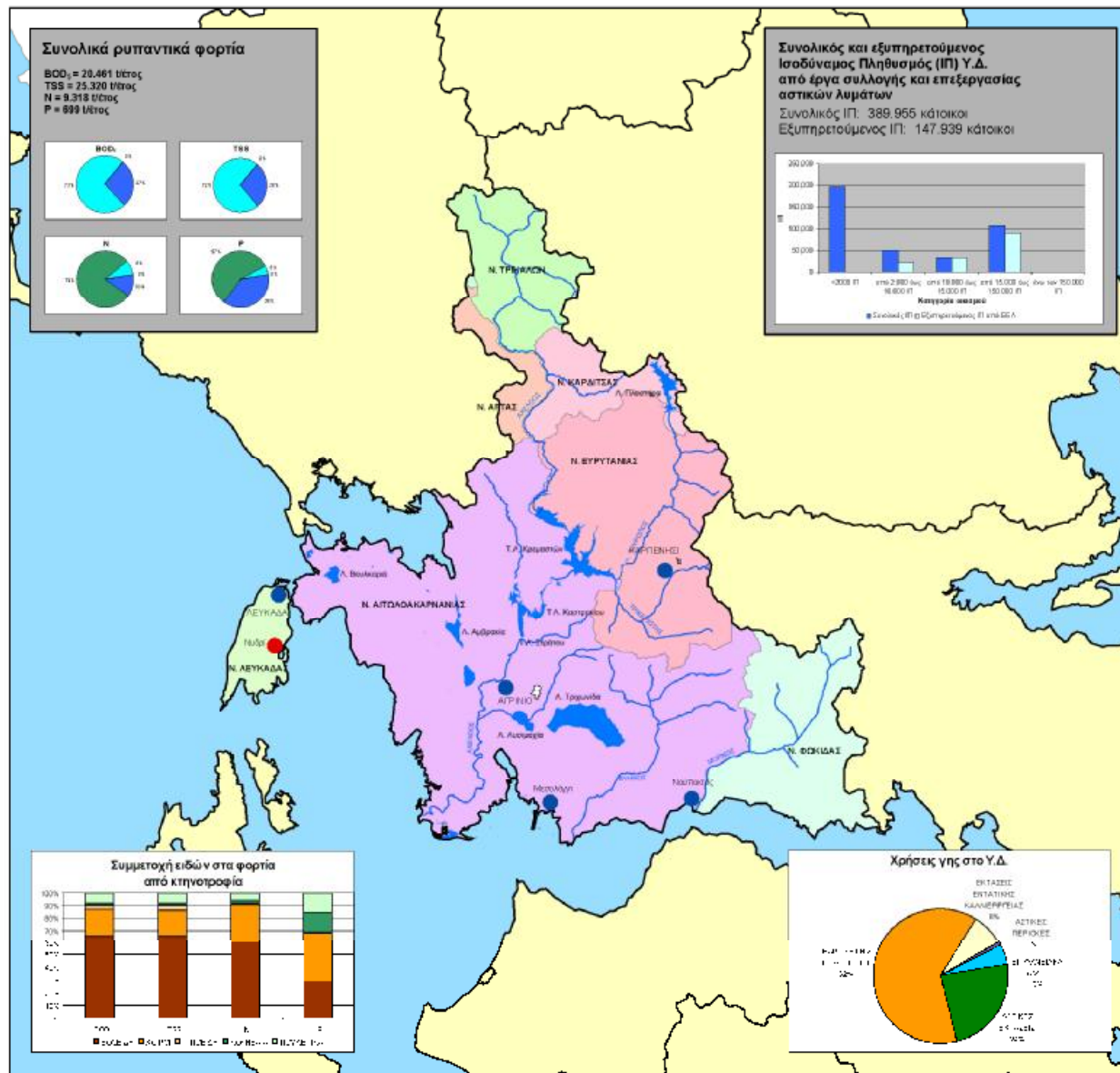
Core of the Master Plan

- ◆ **Analysis of river basin districts (RBD) [scale: 1/500.000]**
 - Hydrological and hydrogeological identity (water quantity and quality)
 - Characteristics of development
 - Water balance – demand vs. supply – present and future
 - Pollution load; protected areas
 - Problems; potential; perspectives; proposals
- ◆ **Relationships between river basin districts**
 - Similarities, relationships and interdependences between RBDs
 - Dependences of water resources from neighbour countries
 - Grouping of RBDs (4 groups)
- ◆ **Integration of the water resources management on a country level [scale 1/1.000.000]**
 - The water resources of Greece
 - Water quality
 - Hydrological balance
 - Water uses and demands
 - Infrastructure works for water resources development
 - Water and agriculture
 - Water and urban development
 - Water and energy
 - Water and environment
 - Water demand and supply balance
 - Water resources research and technology

Water demand vs. supply balance (an example for the Western Sterea Hellas RBD)



Water quality (an example for the Western Sterea Hellas RBD)



ΧΑΡΤΗΣ 4.2
Υ.Δ. Δυτικής Στερεάς Ελλάδας
Ρυπαντικά φορτία

ΥΠΟΜΝΗΜΑ

- Ποταμός
- Λίμνες
- Πρωτεύουσες Νομών

Ρυπαντικά φορτία

- Αστικά
- Κτηνοτροφία
- Βιομηχανία
- Επιφανειακές απορροές

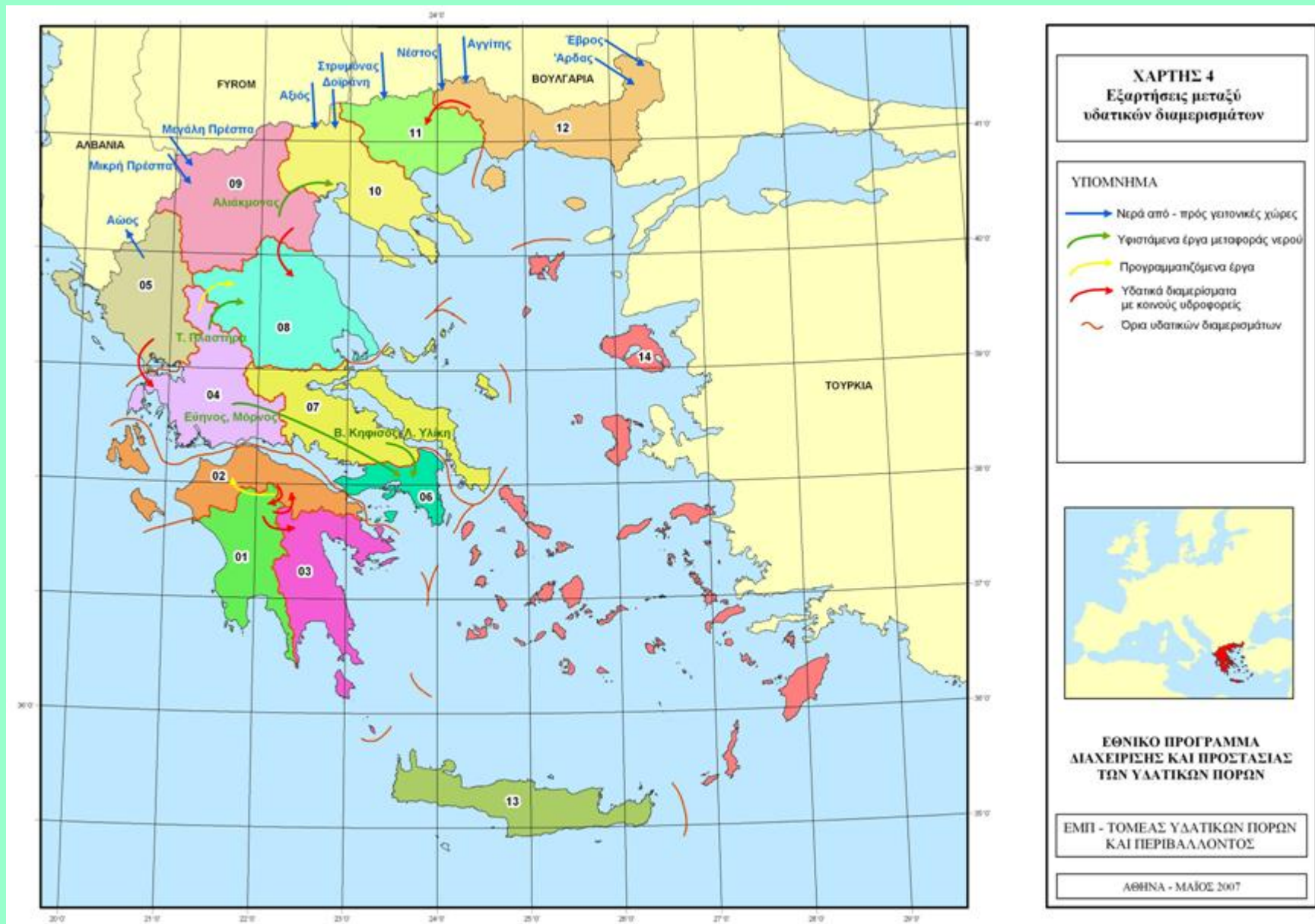
● Πόλεις με ΙΠ > 15000 (ή ΙΠ > 10000 σε ευαίσθητο αποδέκτη) που εξυπηρετούνται από ΕΕ/Α
● Πόλεις με ΙΠ > 15000 (ή ΙΠ > 10000 σε ευαίσθητο αποδέκτη) που δεν εξυπηρετούνται από ΕΕ/Α

ΕΘΝΙΚΟ ΠΡΟΓΡΑΜΜΑ ΔΙΑΧΕΙΡΙΣΗΣ ΚΑΙ ΠΡΟΣΤΑΣΙΑΣ ΤΩΝ ΥΔΑΤΙΚΩΝ ΠΟΡΩΝ

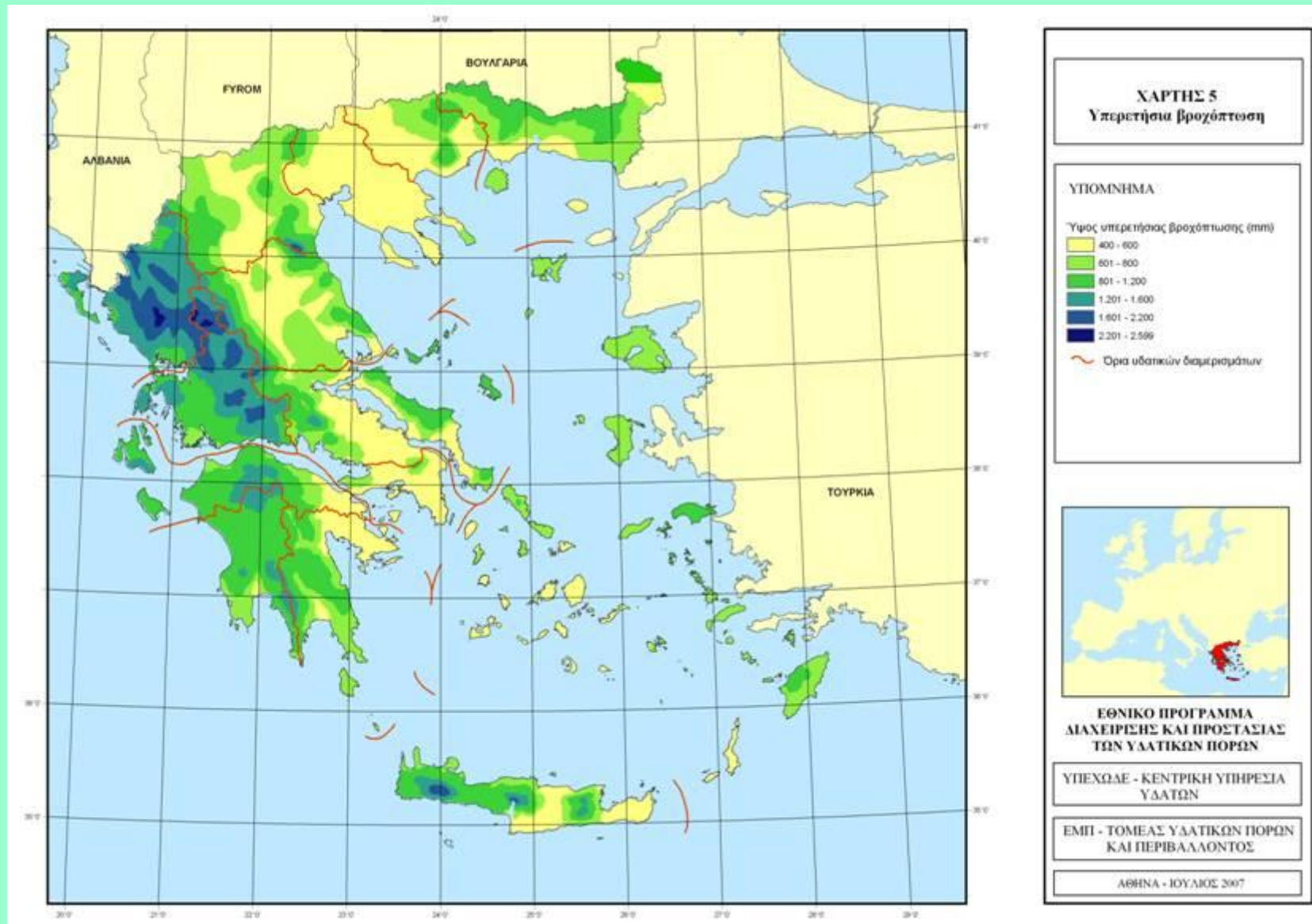
ΕΜΠ - ΤΟΜΕΑΣ ΥΔΑΤΙΚΩΝ ΠΟΡΩΝ ΚΑΙ ΠΕΡΙΒΑΛΛΟΝΤΟΣ

ΑΘ-ΝΑ - ΜΑ-02-2007

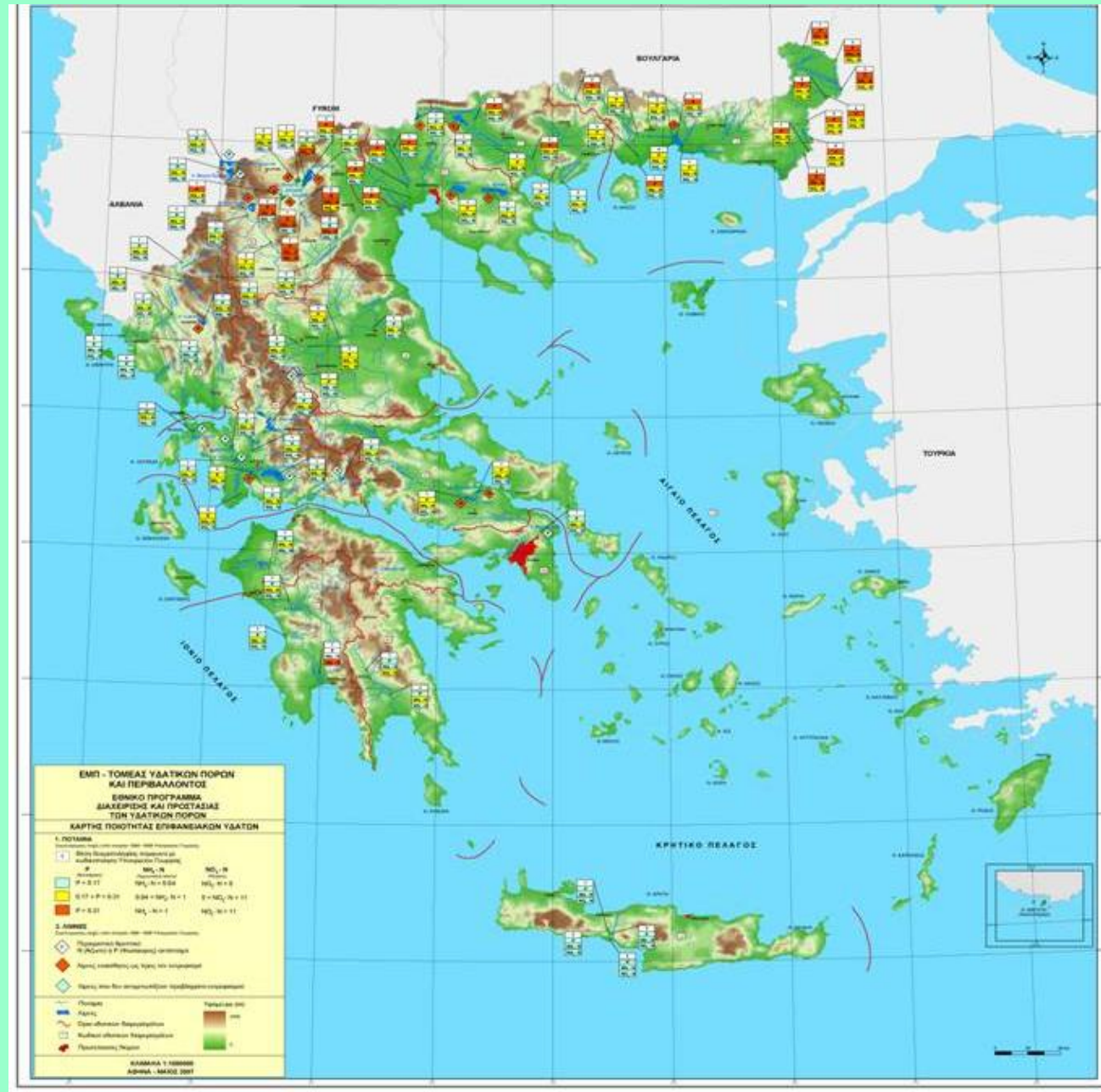
Interdependences between RBDs



Thematic maps of water resources in Greece (Geographical distribution of rainfall)



Thematic maps of water resources in Greece (surface water quality)



Thematic maps of water resources in Greece (groundwater quality)



Water resources status – Key issues

- ◆ **Groundwater:** Overexploitation → Need for protection and recovery
- ◆ **Surface water:** Potential for further development → Need for infrastructure works of medium and large scale
- ◆ **Peculiarities:**
 - Dominance of problems of water quantity over water quality → Need for incorporation of quantity problems into the implementation of the Water Framework Directive
 - Nonuniform temporal water availability distribution, much different from the demand distribution → Results in significant water deficit in summer (July the worst month)
 - Nonuniform spatial water availability distribution, much different from the high demand locations → Results in significant water deficit in specific regions
 - Complex and fragmented topographical relief → Results in small scale of river basins and numerous water bodies that demand monitoring and protection
 - Dependences of water resources availability in Northern Greece from neighbour countries – Need for international cooperation
 - Numerous dry islands with high tourist development → Need for seeking integrated solutions using all available technologies

General assessment of water quality

- ◆ With respect to non conventional pollutants the water quality does not present particular problems, with the exception of specific areas.
- ◆ The presence of conventional pollutants, related to urban and agricultural activities, is significant, resulting to the deterioration of the quality of surface waters and groundwaters, as well as coastal areas and aquifers.
- ◆ Significant pressure is related to the agricultural activities, which as non-point sources of pollution are difficult to collect and treat. Emphasis must be given to prevention measures with the adoption of good agricultural practices.
- ◆ Industrial wastewater treatment is mainly provided for large industries, whereas lack of treatment is observed in smaller units. In any case monitoring and control of industrial discharges is not adequate. Grouping of industries in industrial estates, where appropriate wastewater treatment and emission control will be provided, may be part of the solution.
- ◆ The absence of inventory and control of industrial discharges disposal in the urban wastewater sewerage system is related to the lack of appropriate sewerage ordinances, as well as the illegal industrial connections.

Classification of lakes and rivers according to the EU directive 75/440

- ◆ From the evaluation of the available monitoring data the water quality characteristics of most rivers and lakes are appropriate for abstraction and followed by appropriate treatment the production of potable water, with the exception of
 - Lakes Lagada, Vistonida, Chimaditida
 - Soulou stream and Asopos River, Pineios of Ileia, Loudias River and part of Alfeios River
- ◆ The water quality of the following rivers appears problematic
 - Pineios of Thessaly
 - Axios
 - Titarisios
 - Kosynthos
 - Evros

Eutrophication sensitive lakes

Eutrophication sensitive lakes

Vegoritida
Vistonida
Volvi
Doirani
Zazari
Kastorias
Lagada
Lysimachia
Kerkini
Pamvotida
Paralimni
Petron
Yliki
Cheimaditida

Lakes identified as sensitive by national legislation

Marathon
Mornos
Mitrikou

Lakes proposed for identification as sensitive

Vegoritida
Doirani
Zazari
Kastorias
Lysimachia
Kerkini
Pamvotida
Cheimaditida

Vulnerable zones

Zones identified as vulnerable according to the 91/676 Directive

Kopaida
Field of Argoliko
Pineios Ileias
Plain of Thessaly
Plain of Preveza-Arta
Plain Thessaloniki- Kilkis-
Pella-Imathia

Cathcment area of the lakes
Volvi
Lagada

Cathcment area of the rivers
Strymonas
Aliakmonas
Loudias
Axios
Gallikos

Zones proposed for identification as vulnerable according to the 91/676 Directive

Gargalianoi - Kyparissia
Astros-Leonidio
Cathment area of Messologi-Aitoliko salt lake
South of Amvrakikos gulf (Vonitsa-Amphilochia)

Cathcment area of the lakes
Vegoritida
Cheimaditida
Zazari
Kastoria
Doirani
Kerkini
Vistonida
Lysimachia

Cathcment area of the rivers
Evros
Erythropotamos Evrou
Kompsatos
Dytikos Parapotamos

Water uses

Consumptive

- Irrigation
- Urban water supply
- Animal needs
- Industry
- Cooling of industrial units (including thermal energy units)
- ◆ Not rigid – can be managed
- ◆ It is essential to prioritize

Non consumptive

- Hydropower production
- Environmental preservation
- Recreation
- Navigation
- Fish farming
- ◆ Their importance and social acceptance has been increased recently

Present water demand per consumptive use (hm³/year)

WBD		Irrigation	Animal needs	Water supply	Industry	Other	Total
01	Δυτικής Πελοποννήσου	201.0	5.0	23.0	3.0	20.0	252.0
02	Βόρειας Πελοποννήσου	401.5	6.6	41.7	3.0		452.8
03	Ανατολικής Πελοποννήσου	324.9	4.7	22.1			351.7
04	Δυτικής Στερεάς Ελλάδας	366.5	9.0	22.4			397.9
05	Ηπείρου	153.5	10.3	33.9	4.3		202.0
06	Αττικής	99.0	2.5	420.0	17.5		539.0
07	Ανατ. Στερεάς Ελλάδας	773.7	9.9	41.6	12.6		837.8
08	Θεσσαλίας	1 550.0	13.0	69.0			1 632.0
09	Δυτικής Μακεδονίας	609.4	7.9	43.7	30.0	80.0	771.0
10	Κεντρικής Μακεδονίας	527.6	8.0	99.8	80.0		715.4
11	Ανατολικής Μακεδονίας	627.0	5.8	32.0			664.8
12	Θράκης	825.2	7.1	27.9	11.0		871.2
13	Κρήτης	320.0	10.2	42.3			372.5
14	Νήσων Αιγαίου	80.2	6.8	37.2			124.2
Country total		6 859.5	106.8	956.6	161.4	100.0	8184.3

General balance of RBDs

WBD	Supply	Demand	Remark
01 Δυτικής Πελοποννήσου	73	55	Surplus
02 Βόρειας Πελοποννήσου	122	104	Surplus
03 Ανατολικής Πελοποννήσου	56	67	Deficit
04 Δυτικής Στερεάς Ελλάδας	417	82	Surplus
05 Ηπείρου	206	39	Surplus
06 Αττικής	64	64	Surplus (marginal)
07 Ανατ. Στερεάς Ελλάδας	128	176	Deficit
08 Θεσσαλίας	223	337	Deficit
09 Δυτικής Μακεδονίας	159	136	Surplus
10 Κεντρικής Μακεδονίας	137	130	Surplus (marginal)
11 Ανατολικής Μακεδονίας	354	132	Surplus
12 Θράκης	424	253	Surplus
13 Κρήτης	130	133	Deficit
14 Νήσων Αιγαίου	7	25	Deficit (marginal)
Country total	2 500	1 733	

Supply and demand in hm³/July

Infrastructure works for water resources development

- ◆ There is need for further development of surface water resources by building new reservoirs
- ◆ Because of the geographical variation of water resources, water conveyance to different water basins or different WBD has proved to be a good practice and should not be excluded from future plans
- ◆ Water resources development does not contravene the Water Framework Directive; however new projects should be well justified and studied so as to minimize the negative environmental impacts
- ◆ Keeping the society well informed and ensuring participatory procedures in decision making can help in better planning and public acceptance of the new projects.
- ◆ Existing infrastructure works need maintenance, reassessment and re-programming of their operation

Water and agriculture

- ◆ Irrigation is the major water use in Greece (84% of the total uses); this has objective reasons (climate)
- ◆ Water saving is a strong desideratum – but it demands investments
- ◆ Agriculture has created big problems in aquifers (quantitative and qualitative degradation due to overexploitation; qualitative deterioration due to pollution)
- ◆ The present status does not harmonize with the sustainability principle
- ◆ Restructuring of cultivated crops and cultivation methods are strongly needed
- ◆ A new organizational model of farmers is needed, which should give emphasis in the economic sustainability and should provide steering and training services to farmers

Water and urban development

- ◆ The increase of urban water needs and the quantitative and qualitative deterioration of groundwater call for development of surface water resources for the major urban complexes
- ◆ Sewerage and wastewater management are in a satisfactory level but still there exist several problems
- ◆ Flood protection and stormwater management in cities are significantly delayed; strategic planning in country and city level are strongly needed
- ◆ Legislative arrangements are needed to enforce stormwater source control methods
- ◆ Urban streams are in bad situation and need rehabilitation

Water and energy

- ◆ The energy management is strongly related to water resources management
- ◆ Groundwater pumping from large depths should be discouraged
- ◆ There is significant potential for further development of hydropower projects
- ◆ Justification of such projects should be done on the basis of the complete spectrum of their benefits
- ◆ The development of small hydropower plants is well on the way but their contribution is small (250 small plants are equivalent to the Kremasta large hydropower plant)
- ◆ Reversible (pumped storage) hydropower plants for temporary energy storage are extremely important and their importance will increase in the future – for balancing the varying and unpredictable power of alternative renewable energy sources

Final remarks

- ◆ Management and protection of water resources is closely related to the sustainability of the society and the environment as well as to the economical development and prosperity
- ◆ A Master Plan of Water Resources Management and Protection is necessary as a basis for decision making concerning
 - New infrastructure works
 - Institutional and organizational restructuring of the country
 - Water management in regional and central level
 - Full implementation of the Water Framework Directive
- ◆ The Master Plan cannot be completed by a single work group or a single organization but needs the widest possible participation

- ◆ The current version of the draft masterplan is available online at:
<http://www.itia.ntua.gr/e/docinfo/782/>
Comments and contributions are appreciated