GROUNDWATER MONITORING IN BULGARIA

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Identification and initial characterization of groundwater bodies in Bulgaria

- The borderlines of the groundwater bodies have been outlined with the help of the following maps: the geological map of Bulgaria at scale 1:100 000, another geological map of Bulgaria at scale of 1:500 000, the hydrogeological map at a scale 1:200 000, maps at a scale 1: 25000 for some individual parts.
- GWB definition in the WFD. Because of that a new GWBs have been delineated in high mountains regions with low permeable volcanic and metamorphic rocks.
- Further characterisation and review of the impact of human activity of those groundwater bodies or groups of bodies which have been identified as being at risk
- GWBs are situated in 7 layers in GIS
- The identified water bodies have been distinguished in depth:

  for the East-Aegean Sea River Basin District – GWB are distributed in 6 GIS layers; For the West-Aegean Sea River Basin District - into 5 layers; For the Danube River Basin District - into 5 layers; While for the Black Sea River Basin District – into seven layers.

Further characterization of groundwater bodies

- geological characteristics of the groundwater body including the extent and type of geological units,
- hydrogeological characteristics of the groundwater body including hydraulic conductivity, porosity and confinement,
- characteristics of the superficial deposits and soils in the catchment from which the groundwater body receives its recharge, including the thickness, porosity, hydraulic conductivity, and absorptive properties of the deposits and soils – expert judgment
- stratification characteristics of the groundwater within the groundwater body
- an inventory of associated surface systems, including terrestrial ecosystems and bodies of surface water, with which the groundwater body is dynamically linked,
- estimates of the directions of exchange of water between the groundwater body and associated surface systems, expert judgment have been made – two categories have been distinguished direct and indirect connection with surface water ecosystems,
- Evaluation of the long term annual average rate of overall recharge of GWBs,
- characterisation of the chemical composition of the groundwater,
- the location of points in the groundwater body into which water is directly discharged, only a few cases with permits and in some cases - from waste water in the settlements without of sewage systems.
- land use in the catchment or catchments from which the groundwater body receives its recharge.

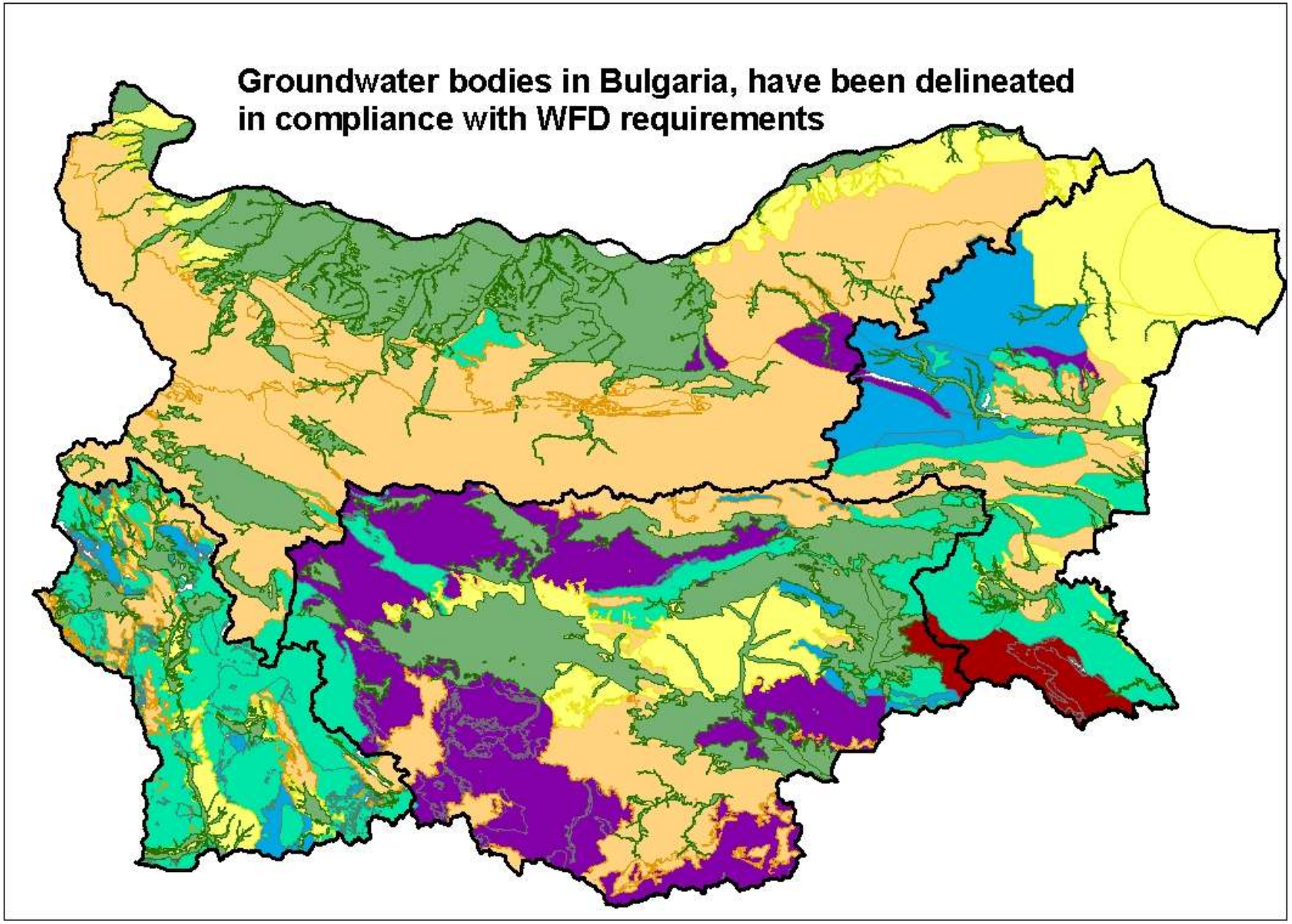
On the basis of the further characterisation – some cahanges of GWBs delineation ended up to be needed

- Joining of the part of the GWBs , had been delineated at 2004 have been done - in case of equal geological structures, hydrogeological conditions, superficial deposits and soil in the cachment from which the GWBs receives its recharge and lack of human impact.

- Spliting in two of these GWBs that consisted of different layers with different petrographic description (stratification is available), hydrogeological conditions, superficial deposits and soil in the cachment from which GWBs receives its recharge and with different results from risk assessment.

- Groundwater bodies must be assigned to a River Basin District - according to Art. 3.1 of the WFD “Where groundwaters do not fully follow a particular river basin, they shall be identified and assigned to the nearest or most appropriate river basin district.”

- As a result: 178 groundwater bodies are delineated – porous, karstic ore fissured


Groundwater bodies in Bulgaria, have been delineated
in compliance with WFD requirements

Groundwater monitoring network

- Is developed in compliance with WFD requirements and National legislation
- And on the basis of had been made GWBs characterisation and risk assessment for failing to meet the objectives under Article 4.
- And as considered cost-effectivity and possibilities for developing the groundwater networks in next years.
- The main monitoring efforts have direrected to the groundwater bodies which have been identified as being at risk in order to establish a more precise assessment of the significance of such risk and identification of any measures to be required under Article 11

Groundwater monitoring programs included:

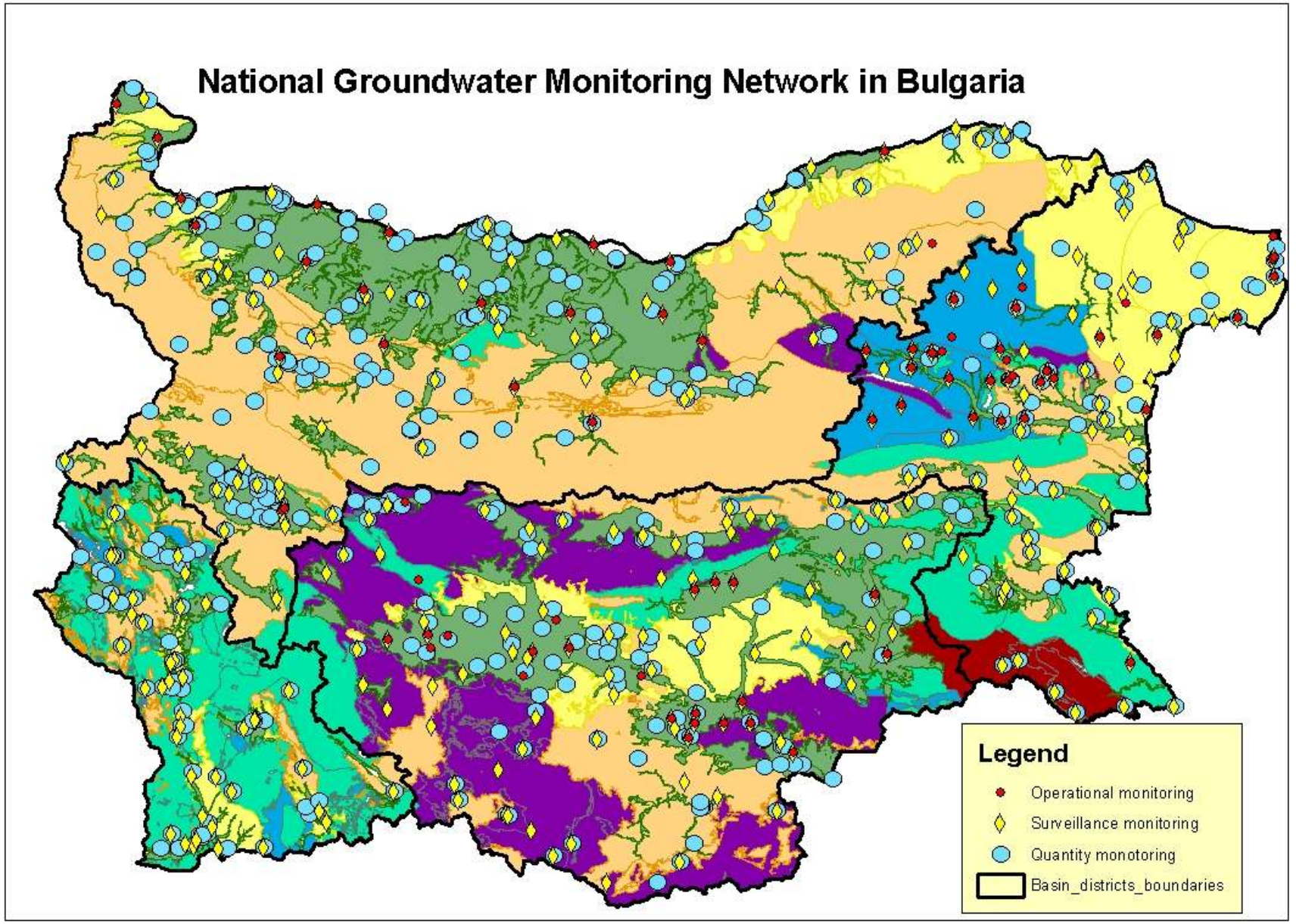
➢Monitoring of groundwater quantitative status, which have to provide a reliable assessment of the quantitative status of all groundwater bodies or groups of bodies including ssessment of the available groundwater resource

➢Monitoring of groundwater chemical status:

• Surveillance monitoring, which have to supplement and validate the impact assessment procedure and provide information for use in the assessment of long term trends both as a result of changes in natural conditions and through anthropogenic activity.

• Operational monitoring, which have to be undertaken in the periods between surveillance monitoring programmes in
order to establish the chemical status of all groundwater bodies or groups of bodies determined as being at risk and establish the presence of any long term anthropogenically induced upward trend in the concentration of any pollutant.

The protected areas' monitoring of the of the groundwater have used for drinking water supply was established by including of drinking water supply points in the networks for surveillance and operational monitoring.


National Groundwater Monitoring Network in Bulgaria
Legend
Operational monitoring
Surveillance monitoring
Quantity monotoring
Basin_districts_boundaries

Monitoring of groundwater quantitative status

№	River Basin District	Number of GWBs with quantitative monitoring	Number of GWBs with missing quantitative monitoring	Total number of the monitoring points	For groundwater level	For spring flows	For base-flow in the rivers
1	Danube	44	4	215	156	58	1
2	Black sea	40	3	71	51	20	
3	East Aegean Sea	35	13	107	83	22	2
4	West Aegean sea	26	13	61	36	25	

Monitoring of groundwater chemical status status

№	River Basin District	Number of GWBs with surveylance monitoring	Number of GWBs with missing surveylanc e monitoring	Number of the monitoring points for surveylance monitoring	Number of GWBs with operative monitoring	Number of the monitoring points for operative monitoring
1	Danube	48		81	21	21
2	Black sea	40	3	80	10	37
3	East Aegean Sea	40	8	89	6	17
4	West Aegean sea	27	12	40	0	0

I Basic phisico-chemical parameters	II Additional phisico-chemical parameters	III. Heavy metals and etalloids	IV. Organic compaunds
1. Dissolved oxigen	1. Nitrites	1. Lead	1.Trichloroethylene
2. pH	2. Phosphates	2. Cadmium	2.Tetrachloroethene
3. Electrconductivity	3. Total Iron	3. Arsenic	3. Aldrin
4. Nitrates	4. Manganese	4. Mercury	4. Atrazine
5. Amonia		5. Cupper	5. DDT/DDD/DDE
6. Temperature		6. Zinc	6. Dieldrine
7. COD (Mn)		7. Nickel	7. Drines
8. Total hardness		8. Chromium 3+	8. Endosulfan
9.Calcium		9. Chromium 6+	9. Endrine
10. Magnesium		10. Strontium	10. Metoxychlor
11. Chlorides		11. α – activity	11.HCH
12. Sodium, Potassium		12 β – activity	12.Propazine
13. Sulphates			13. Simazine
14. Hydrocarbonates			14. Heptachlore
15. Carbonates			15.Chlordan
16. Total solids			16. 2,4 D
			17.Acetochlor
			18. Pendimetaline
			19. Flutriafol
			20. Thriadimenol
			21.Mancozeb
			22. Tebuconazole
			23. Chlorpyrifos
			24.Trifluralin
			25. Alachlor
			26.Cypermetrin

Groundwater monitoring data – DataBase

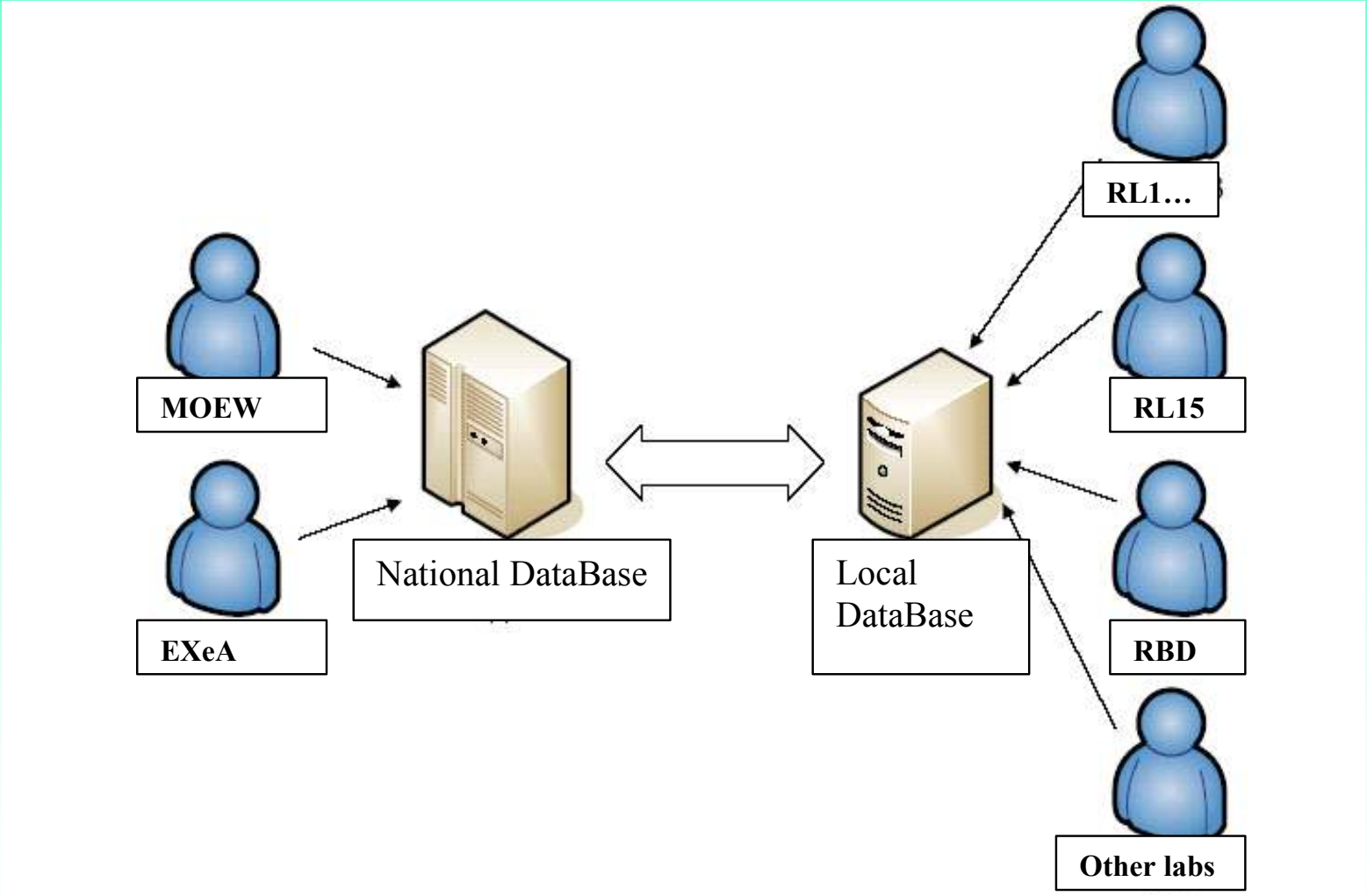
- 15 local databases – in 15 Regional laboratories

- 4 regional databases – in 4 River Basin Directorates – 4 MySQL servers

- National database – in Executive Environment Agency – by Administrative module an extraction is possible from 4 MySQL to National ORACLE Data Base
- 4 program modules are available:

- Groundwater Administrator
- Groundwater Laboratory – for laboratory data
- Groundwater Passports – for monitoring points characteristics
- Groundwater Reports
- Groundwater ORACLE Reports

Groundwater monitoring data flows



One example – part of the report for EEA - data for Ammonia

EWN-Code	Year	NumberOfSites	Drinking_Water_Sites	Industrial_Sites	Surveillance_Sites	Other_Sites	SamplingFrequency	Class_0.1	Class_0.1_0.3	Class_0.3_0.5	Class_0.5	MinValue	MeanValue	MaxValue	Percentile10
BG1001	2007	1	1	0	0	0	1	1	0	0	0	0	0	0	0
BG1013	2007	1	0	0	0	1	1	0	1	0	0	0,15	0,15	0,15	0,15
BG1033	2007	1	0	0	0	1	1	1	0	0	0	0	0	0	0
BG1046	2007	1	0	0	0	1	2	1	0	0	0	0,006	0,006	0,006	0,006
BG1048	2007	1	0	0	0	1	1	0	0	0	1	0,99	0,99	0,99	0,99
BG2003	2007	1	0	0	0	1	1	0	1	0	0	0,149	0,149	0,149	0,149
BG2004	2007	1	0	0	0	1	1	0	1	0	0	0,22	0,22	0,22	0,22
BG2036	2007	1	0	0	0	1	1	0	1	0	0	0,174	0,174	0,174	0,174
BG2037	2007	1	0	0	0	1	1	0	0	0	1	0,92	0,92	0,92	0,92
BG2040	2007	1	0	0	0	1	1	0	0	0	1	0,97	0,97	0,97	0,97
BG2041	2007	2	0	0	0	2	1	0	1	1	0	0,103	0,204	0,305	0,103
BG3009	2007	4	0	0	0	4	1	1	1	2	0	0	0,273	0,418	0
BG3012	2007	2	0	0	0	2	1	1	0	0	1	0,011	0,297	0,583	0,011
BG3014	2007	1	0	0	0	1	1	1	0	0	0	0	0	0	0
BG3015	2007	2	0	0	0	2	1	2	0	0	0	0	0	0	0
BG3017	2007	1	0	0	0	1	1	1	0	0	0	0	0	0	0
BG3026	2007	1	0	0	0	1	1	0	1	0	0	0,268	0,268	0,268	0,268
BG3048	2007	1	0	0	0	1	1	0	1	0	0	0,249	0,249	0,249	0,249
BG4004	2007	1	0	0	0	1	1	1	0	0	0	0,031	0,031	0,031	0,031

Second example – part of the report for ICPDR
- data groundwater monitoring points

MSCD_GWST	OLD_CODE	NAME	EUCD_BODY	QUANTUM	OPERAT	SURVEIL	SCREENDEPTMIN	SCREENDEPTMAX	WELL_O_SPR	USE	LONGITUDE GK	LATITUDE GK
1G0000J3KMP282	8750	Русе	BG1G0000J3K048	Y	N	N			well	OTH	43.84208333	25.96613889
1G0000J3KMP283	8746	Руйно	BG1G0000J3K048	Y	N	N			well	OTH	43.82466667	27.03316667
1G0000J3KMP284	0156	Попово	BG1G0000J3K048	N	N	Y			well	OTH	43.34864167	26.21785278
2G000000NMP049	0206	Добрич	BG2G000000N016	N	N	Y			well	OTH	43.705	27.88
2G000000NMP053	8726	Полковник Дяково	BG2G000000N017	Y	N	N			well	OTH	43.83454444	27.78861944
2G000000NMP055	8393	Богдан	BG2G000000N017	N	N	Y			spring	OTH	43.51343611	27.78461389
2G000K1J3MP114	8553	Горичане	BG2G000J3K1040	Y	N	N			well	OTH	42.31583333	26.66888889
2G000K1J3MP115	8519	Васил Друмев	BG2G000J3K1040	Y	N	N			well	OTH	43.25333333	27.01361111
2G000K1J3MP116	8394	Варна	BG2G000J3K1040	N	N	Y			well	OTH	42.49025	27.47833333
2G000K1J3MP117	8389	Тополи	BG2G000J3K1040	N	N	Y			well	OTH	43.40833333	28.23811111
2G000K1J3MP118	0212	Търговище	BG2G000J3K1040	N	N	Y			well	OTH	43.2375	26.58055556
2G000K1J3MP121	0094	Карапелит	BG2G000J3K1041	N	N	Y			well	OTH	43.65194444	27.55888889
2G000K1J3MP122	8744	Росица	BG2G000J3K1041	Y	N	N			well	OTH	43.954775	27.90560833
2G000K1J3MP123	0224	Цани Гинчево	BG2G000J3K1041	N	N	Y	130	150	well	OTH	43.605	27.27333333
2G000K1J3MP124	0084	Изгрев	BG2G000J3K1041	N	N	Y			well	OTH	43.59527778	26.98138889
2G000K1J3MP125	8387	Росица	BG2G000J3K1041	N	N	Y			well	OTH	43.95361111	27.90527778
2G000K1J3MP126	8381	Кардам	BG2G000J3K1041	N	N	Y			well	OTH	43.59527778	26.98138889
2G000K1J3MP127	8654	Крушари	BG2G000J3K1041	Y	N	N			well	OTH	43.80951944	27.76277778
2G000K1J3MP128	8487	Балканци	BG2G000J3K1041	Y	N	N			well	OTH	43.60055556	28.16333333
2G000K1J3MP129	8718	Плиска	BG2G000J3K1041	Y	N	N			well	OTH	43.34038056	27.10262778

Groundwater models and case studies

- **A PHARE project BG 2004/016-783.01.02.01** "Integrated Management of Transboundary Groundwater between Bulgaria and Romania in Dobrudja/Dobrogea Area - Technical Assistance to ensure transboundary groundwater management using the WFD and Groundwater Directive" was carried out in Bulgaria
- **There are six (6) main components were covered by the project:**

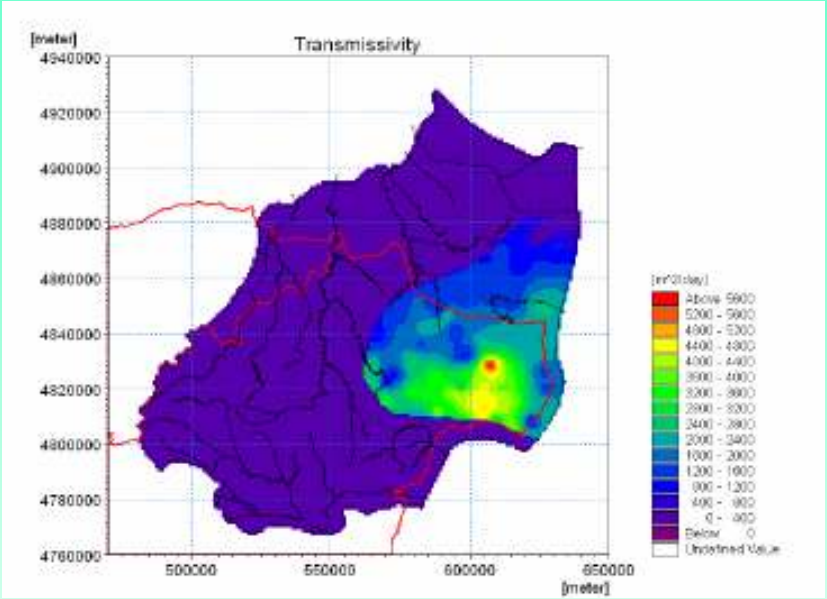
- Inception Phase
- Data collection and assessment for elaboration of the Joint Monitoring Programme
- Development of Joint Transboundary Groundwater Monitoring Programme
- Selection and validation of a Groundwater Model
- Establishment of Joint Bulgarian and Romanian Groundwater Information System
- Institutional Capacity Building

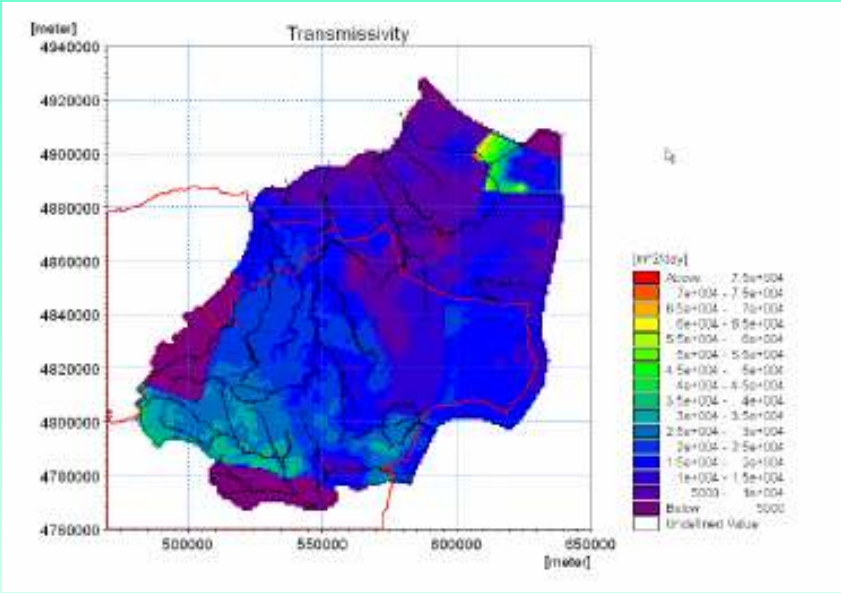
Groundwater model of Dobrudja (1)

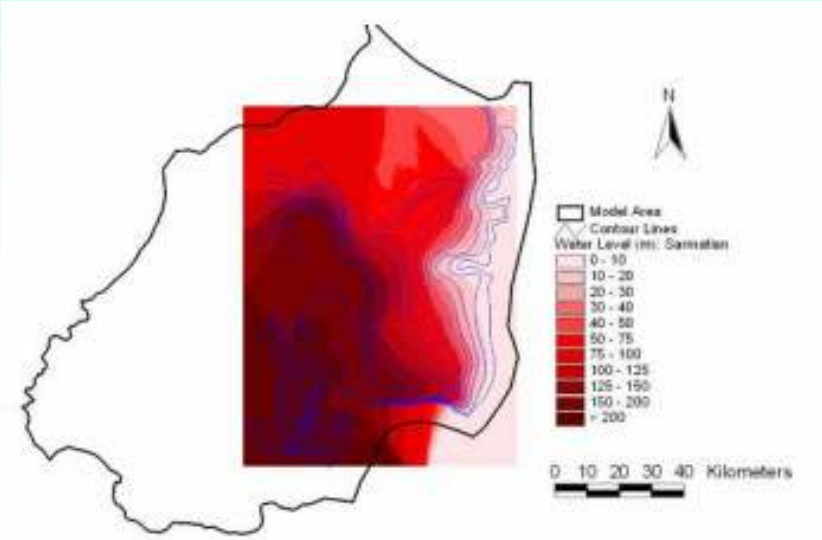
- **The modelling tool** selected in this project to accomplish the requirements of an operational groundwater model is **the MIKE SHE software program.** The software program is an integrated surface water and groundwater modelling tool. The mathematical (numerical) model describes the overall water balance (land phase of the hydrological cycle) for the Dobrudja/Dobrogea area in NE Bulgaria and SE Romania.
- **The main purposes of the model were:**

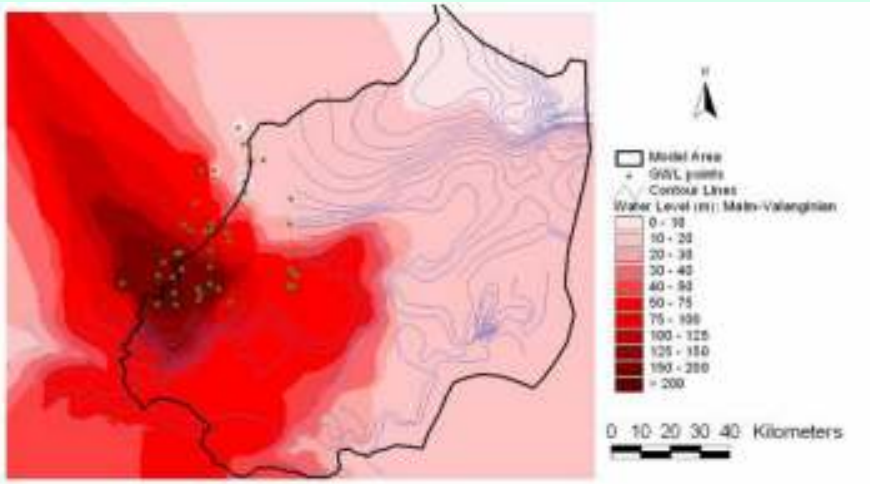
- To be able to calculate the overall water balance for the area
- To run water management scenarios

Groundwater model of Dobrudja – some results(2)









Documentation sources: ministies, institutions, websites (1)

- **Ministry of Environment and Water – responcible for the reporting under WFD and other water directives in EC**
- http://www.moew.government.bg/index_e.html
- National Report on Water Management at River-Basin Level in the Republic of Bulgaria – Review of the implementation of the requirements of articles 5 and 6 from the Water Framework Directive 2000/60/EC
- National Report on Water Management at River-Basin Level in the Republic of Bulgaria - Review of the implementation of the requirements of articles 5 and 6 from the Water Framework Directive 2000/60/EC

- **Executive Environment Agency**
- http://nfp-bg.eionet.eu.int/ncesd/eng/index.html
- Annual report for the state of environment in Bulgaria (Green book)
- Three-month bulletin for the state of environment in Bulgaria

Documentation sources: ministies, institutions, websites (2)

- **Danube River Basin Directorate**
  - http://www.dunavbd.org/
- **Black Sea Basin Directorate**
  - http://www.bsbd.org/v2/uk/index.html
- **East Aegean Sea River Basin Directorate**
  - http://bd-ibr.org/details.php?p_id=107&id=153&cl_lang=EN&PHPSESSID=a5c891df0029ec1c0c30f747f91a6fb8
- **West Aegean Sea River Basin Directorate**
  - http://www.wabd.bg/bg/

Documentation sources: ministies, institutions, websites (3)

- **National Institute of Hydrology and Meteorology – responsible for part of the groundwater quantitative monitoring and surface water hydrological monitoring**
  - http://www.meteo.bg/main.php?page=main&lang=en
- **NIMH Issues:**
  | **Monthly Bulletin (Only in Bulgarian!)** |
  | **Bulgarian Journal of Meteorology and Hydrology** |

Thank you for your attention