BÜYÜK MENDERES RIVER BASIN

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Büyük Menderes Basin is located in the south-west of Türkiye. In the north of the basin, İzmir, Manisa, Uşak; south of Muğla; the provinces of Afyon and Burdur in the east; To the west is the Aegean Sea. The basin, where Afyon, Uşak, Denizli, Muğla and Aydın provincial centers are located, constitutes 3.2% of the country's surface area, and the total precipitation area is 25,987 km^2.

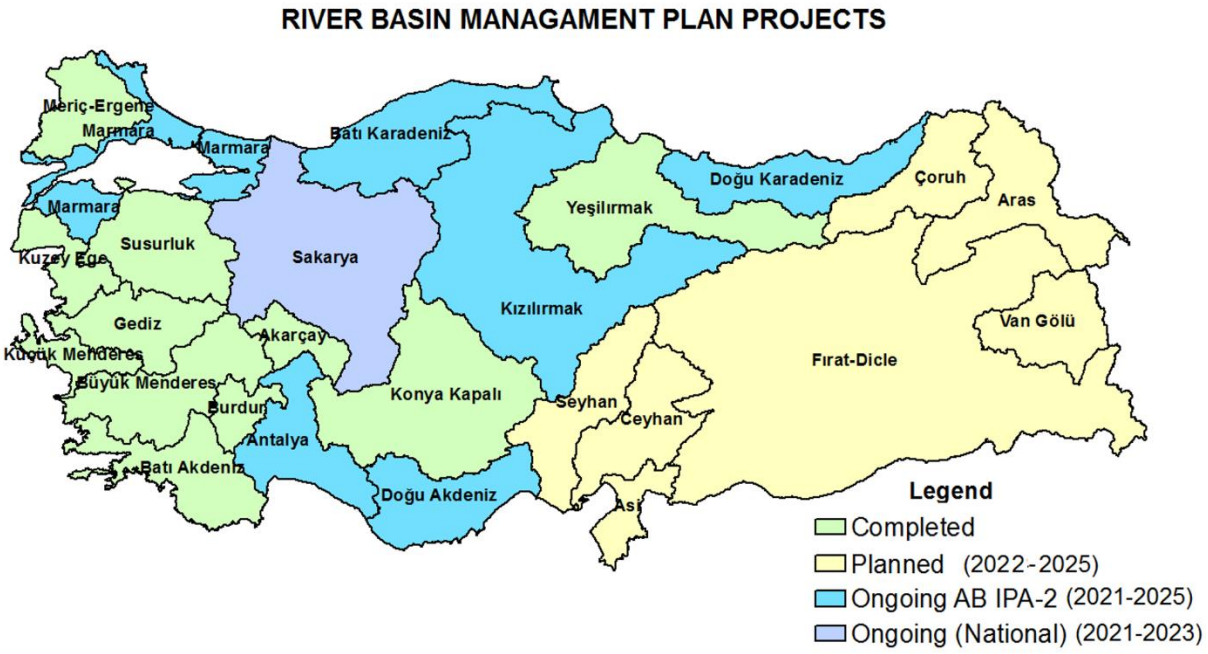
Büyük Menderes Basin Map

Provinces and their areas in the basin

Province	*Area of the Province (ha)*	*Part of the Province in The Basin (ha)*	*Ratio of the Part in The Basin to the Total Province Area (%)*	*Distribution of the Basin to the Provinces (%)*
Afyonkarahisar	1.423.000	327.908	23,04	12,61
Aydın	800.700	761.548	95,11	29,28
Burdur	688.300	4.296	0,62	0,17
Denizli	1.186.800	834.602	70,32	32,09
Isparta	893.300	14.993	1,68	0,58
İzmir	1.201.200	46.453	3,87	1,79
Kütahya	1.187.500	790	0,07	0,03
Manisa	1.381.000	380	0,03	0,01
Muğla	1.253.800	247.118	19,71	9,50
Uşak	534100	362.512	67,87	13,94

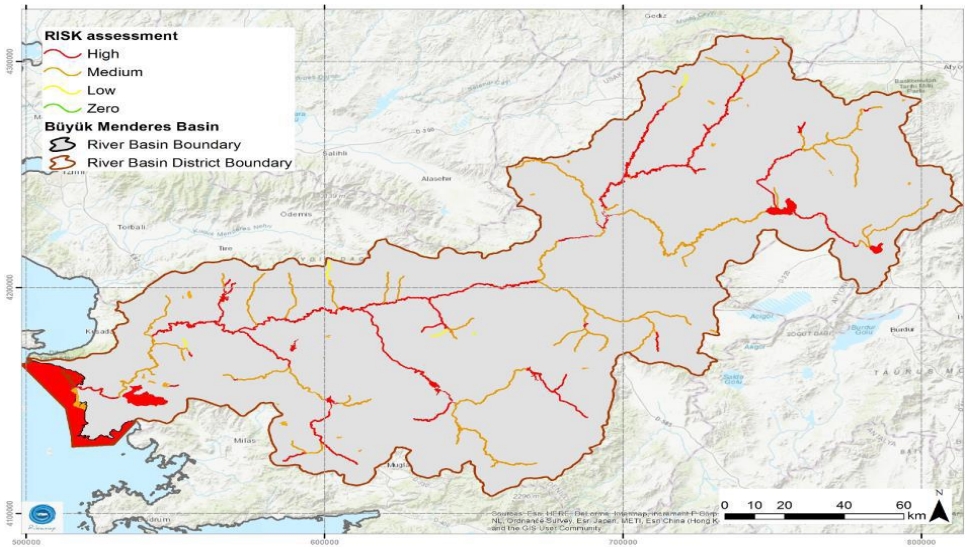
RIVER BASIN MANAGEMENT PLAN

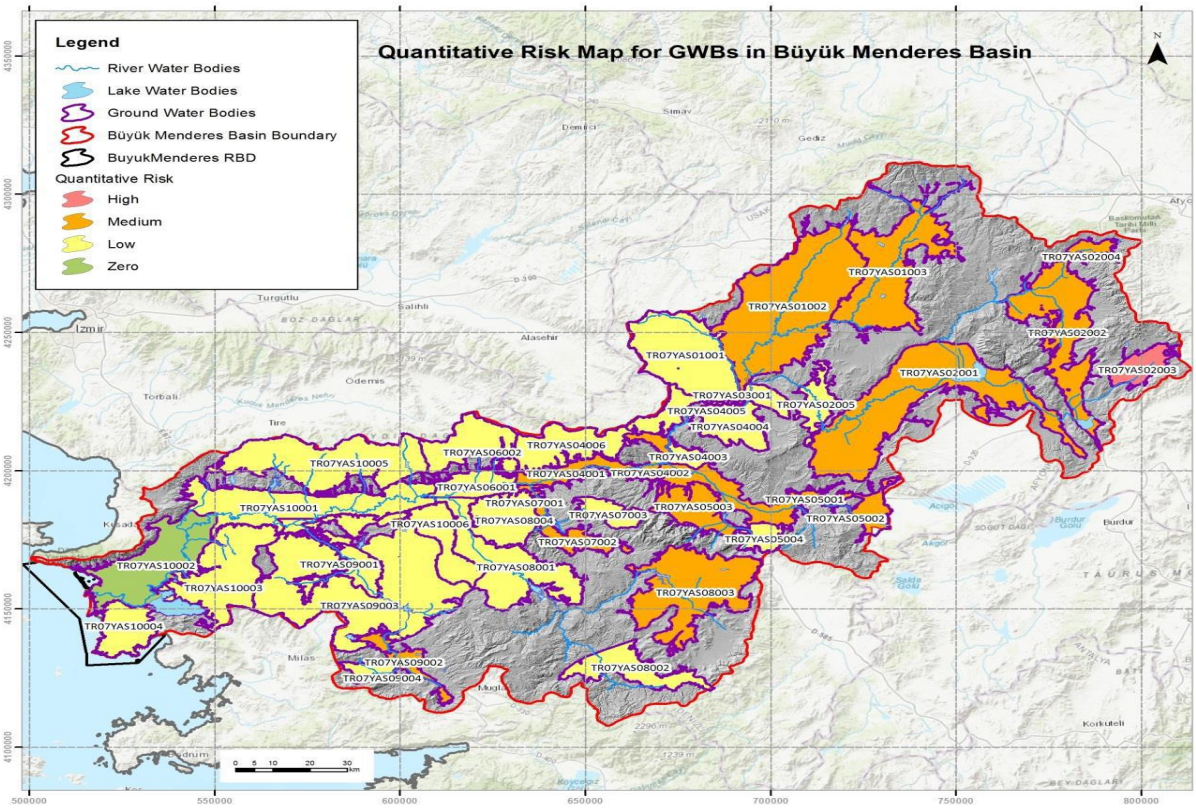
Büyük Menderes River Basin Management Plan (RBMP) was prepared in 2018, and the follow-up studies of implementation have been started in 2019 by National Water Information System.



In Büyük Menderes Basin; there are 81 river waterbodies, 48 lake waterbodies, 3 transitional waterbodies, 2 coastal waterbodies; and in total 134 surface waterbodies. It has been determined that 41 surface waterbodies are at high risk.

There are 38 groudwater bodies in Büyük Menderes Basin. 1 groundwater body is at risk in terms of quantity.





1320 measures have been determined in order to ensure that all water bodies in the Büyük Menderes Basin achieve good status and that the ones that are in good status are protected. The main groups of measures are listed below.

- Measures Addressing Pressures from Urban Discharges
- Measures Addressing Pressures from Industrial Discharges
- Sewage Sludge Control
- Establishment of Fish Passage
- Environmental Flow Management
- Measures Addressing Pressures from Erosion and Desertification (Afforestation, Erosion Control, Pasture Improvement)
- Water Efficiency
- Conservation of Habitat and Species
- Measures related to Drinking Water (Groundwater Protected Areas Delineation-Development and Monitoring)
- Administrative Measures (Determination of Discharge Limits, Sectoral Allocation
- and Drought Management Plans, etc.)
- Good Agricultural Practices (Terracing, Green Belt, Fertilizer Management and Education-Awareness)
- Measures Addressing Pressures from Geothermal Discharges (Reinjection and New WWTP Installation)
- Measures Addressing Pressures from Solid Waste (Removal of Dump Site and Installation of Transfer Station or Establishment of New Landfill)
- Coastline Restoration
- Measures Addressing Pressures from Mining Activities (Rehabilitation, New
- WWTP and Legal Sanctions)

WATER QUALITY

Surface Water Status

As a result of monitoring studies in rivers, lakes, coastal and transitional water bodies, their ecological and chemical status have been evaluated and their final status have been determined.

Water Status	Number of Waterbodies	Percentages of Waterbodies
High	8	6%
Good	4	3%
Moderate	35	26,1%
Poor	14	10,5%
Bad	1	0,7%
No Monitoring	72	53,7%
Total	134	100%

Physicochemical Parameters that Fail to Meet Environmental Objectives in Surface Waterbodies
Biochemical Oxygen Demand, Chemical Oxygen Demand, Amonnium Nitrogen, Total Phosphorus, Dissolved Oxygen, Total Kjeldahl Nitrogen, Elektrical Conductivity, Nitrate + Nitrite
Chemical Parameters that Fail to Meet Environmental Objectives in Surface Waterbodies
4,4'-DDD, Aluminum, Antimony, Arsenic, Beryllium, Boron, Chromium, Cobalt, Copper, Diflubenzuran, Fenpropathrin, Iron, PCB 138, PCB 180, PCB 52, Pyrene, Silicon, Silver, Terbutylazine, Titanium, Vanadium, Zinc, Cadmium, Chloroalkanes C10-13, Cybutryne, Endosulfan, Fluorantene, Lead, Mercury, Nickel, Indeno (1,2,3-cd)pyrene, Benzo(b)floranthene

Biological Quality Indicators

Cladocora

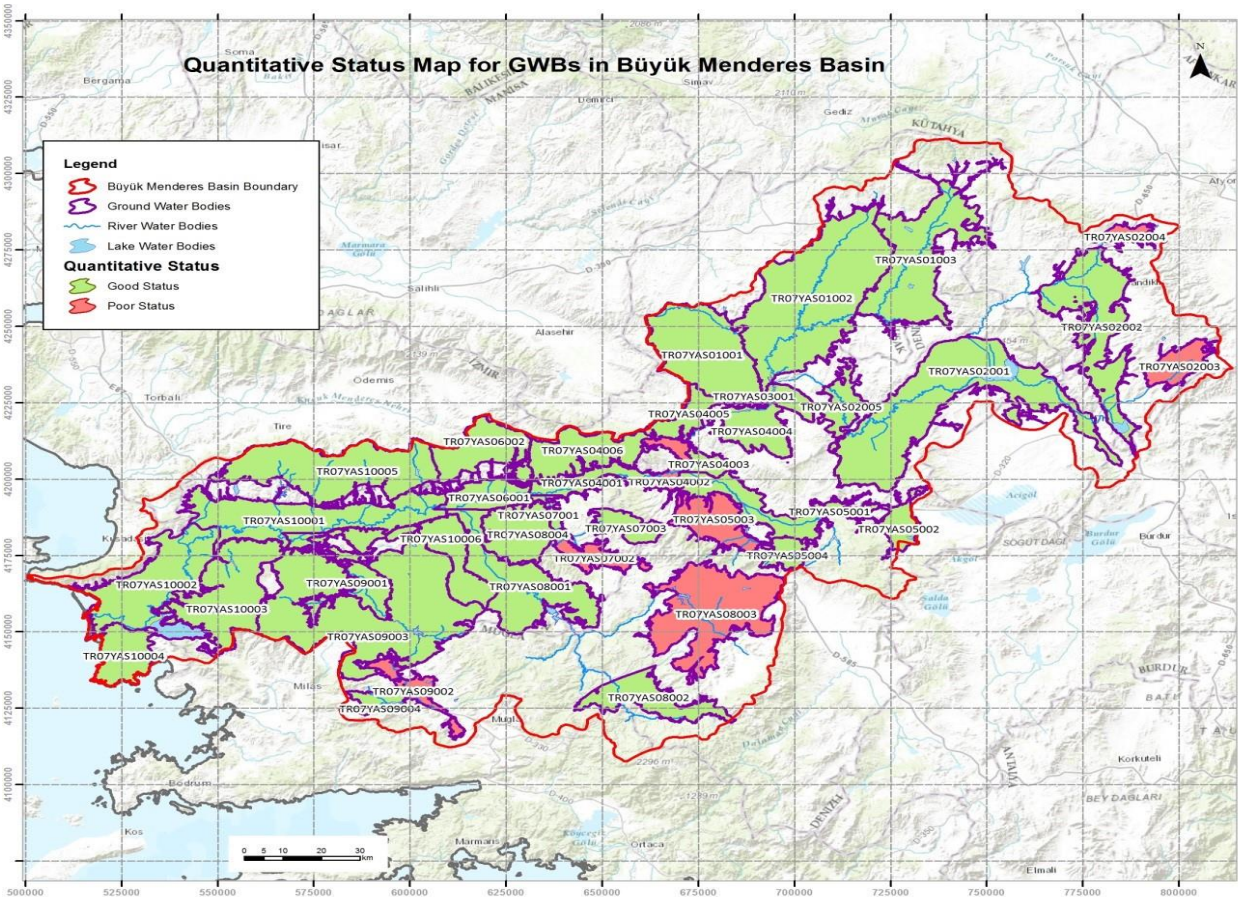
Galathae bolivori

Oxynoemacheilus germencicus

Biological Parameters that Fail to Meet Environmental Objectives in Surface Waterbodies	
River Waterbodies	Lake Waterbodies
Phytobenthos, Macroinvertebrate,	Phytoplankton

Groundwater Status

31 groundwater bodies are in good status and 7 waterbodies are in poor status in terms of quantity.

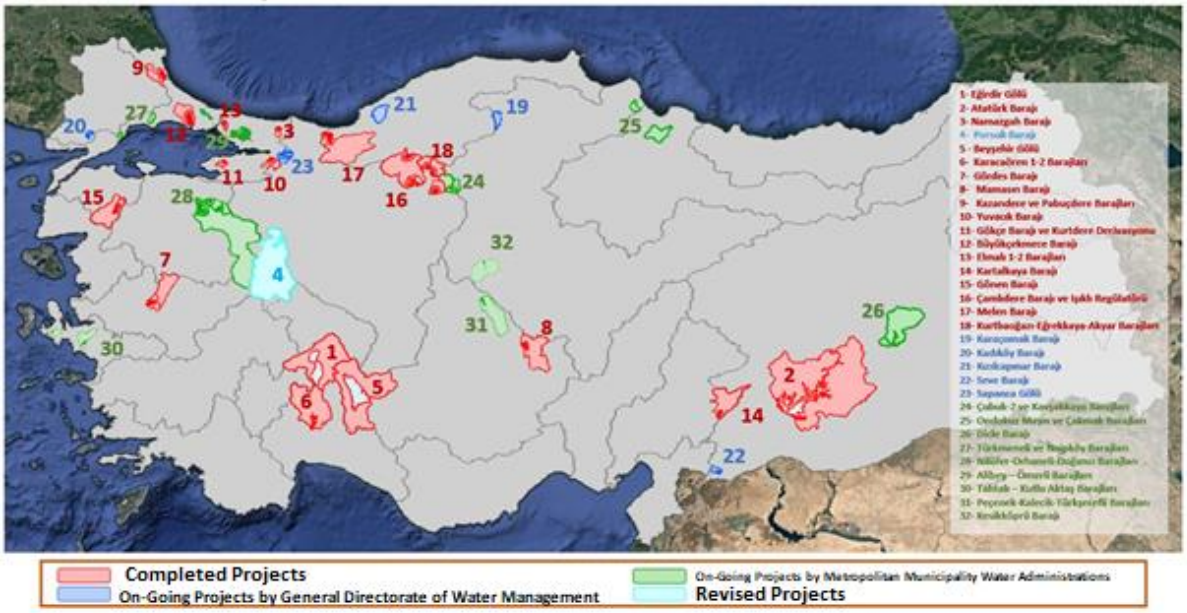


DRINKING WATER PROTECTION PLANS

The purpose of drinking water protection plans is to determine basin-specific protection areas and principles based on scientific data to improve and sustainably manage the quality and quantity of drinking water sources.

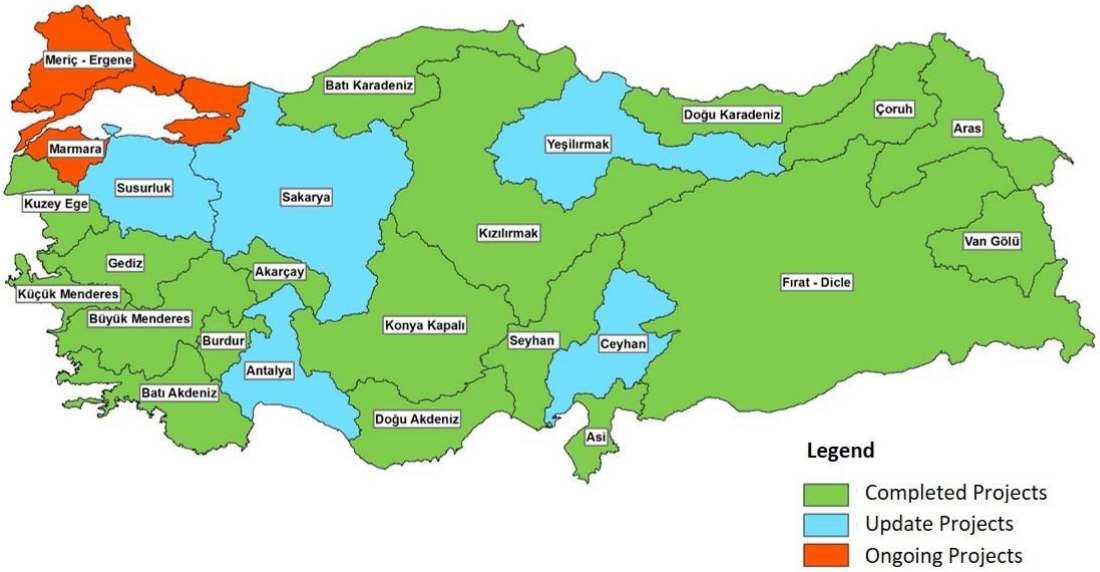
According to the Regulation on the Protection of Drinking-Water Basins:

- Protection plans for surface water sources that provide drinking water to metropolitan municipalities are prepared by the general directorates of water and sewage administrations of metropolitan municipalities in coordination with Ministry;
- Protection plans for surface water sources that provide drinking water to settlements outside of metropolitan municipalities are prepared by Ministry.

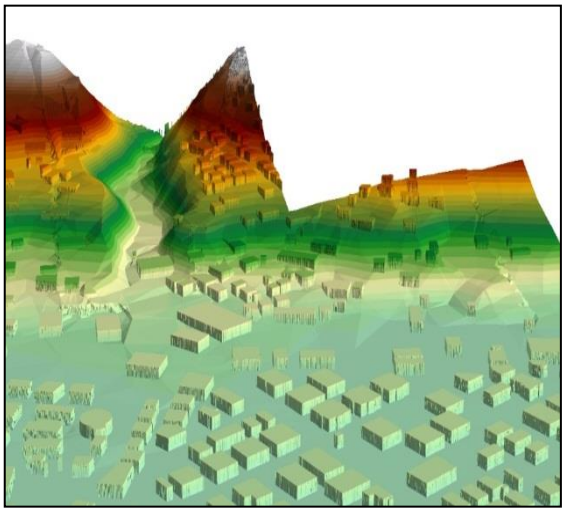


FLOOD MANAGEMENT PLANS

Büyük Menderes River Basin Flood Management Plan (FMP) started in 2016 and the plan was completed in 2019.



Flood Hazard and Flood Risk maps are generated within the scope of Büyük Menderes River Basin Flood Management Plan. The necessary measures to be taken to prevent risks before, during, and after floods have been determined using these maps, as have the responsible institutions and the time of implementation of the measures.



To mitigate the effects of potential flood events in the Yeşilrmak Basin, 267 measures have been identified under the following groups of mitigation measures within the scope of the Flood Management Plan.

- Improvement of bridges
- Cleaning of stream beds
- Improvement of banks well
- Improvement of culverts
- Improvement of walls
- Upper basin measures
- Data-Information Collection/ Production
- Education/ Informing/ Raising Awareness
- Disaster and Emergency Response Capacity
- Dam Failure
- Improving related legislations
- Stream rehabilitation
- Planning
- Crop pattern management
- Insurance System
- Improvement of the performance of regulators
- Agricultural applications
- Flood forecasting and early warning system

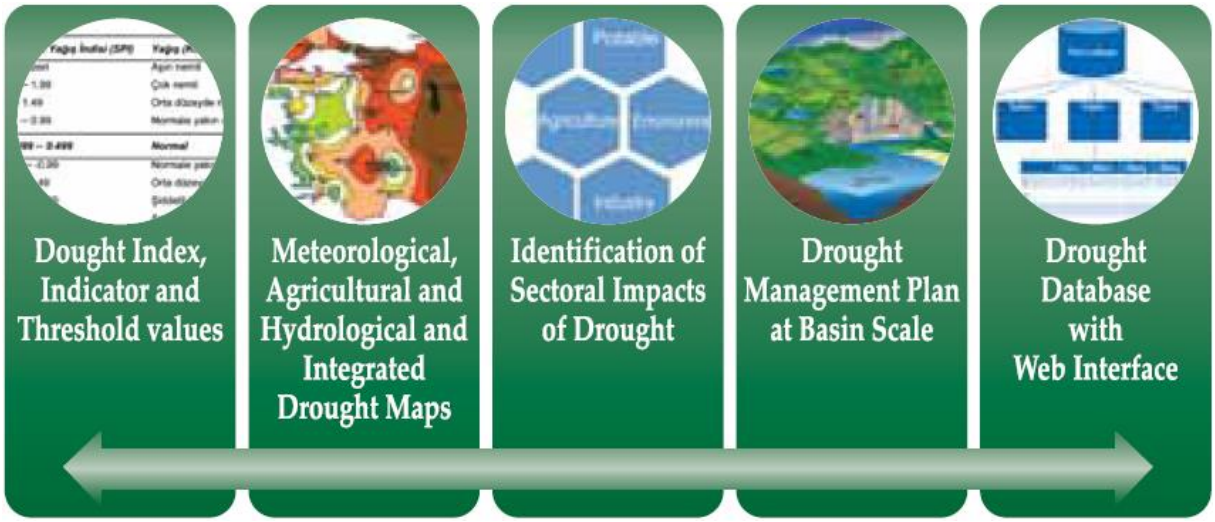
Mitigation measures determined within the scope of the plan are still being tracked via the Flood and Drought Plans Tracking Web Application in 2019 and the National Water Information System (USBS) in 2020.

DROUGHT MANAGEMENT PLAN

Drought Management Plans (DMPs) are being prepared at the basin level for all of the water user sectors, including agriculture, in order to minimize the negative effects of possible drought risks and be prepared for drought. The aim of DMPs is to mitigate and prevent the negative impacts of possible droughts by determining the measures to be taken during water scarcity and the measures to be taken before, during, and after the drought periods in order to solve the drought problem as quickly as possible. Drought analyses, climatic and hydrological studies, sectoral vulnerability analyses, and drought maps are used to plan and direct studies such as recovery and intervention.

Büyük Menderes Basin DMP was started at 2017 and completed at 2019.

Studies During the Preparation of Drought Management Plans:



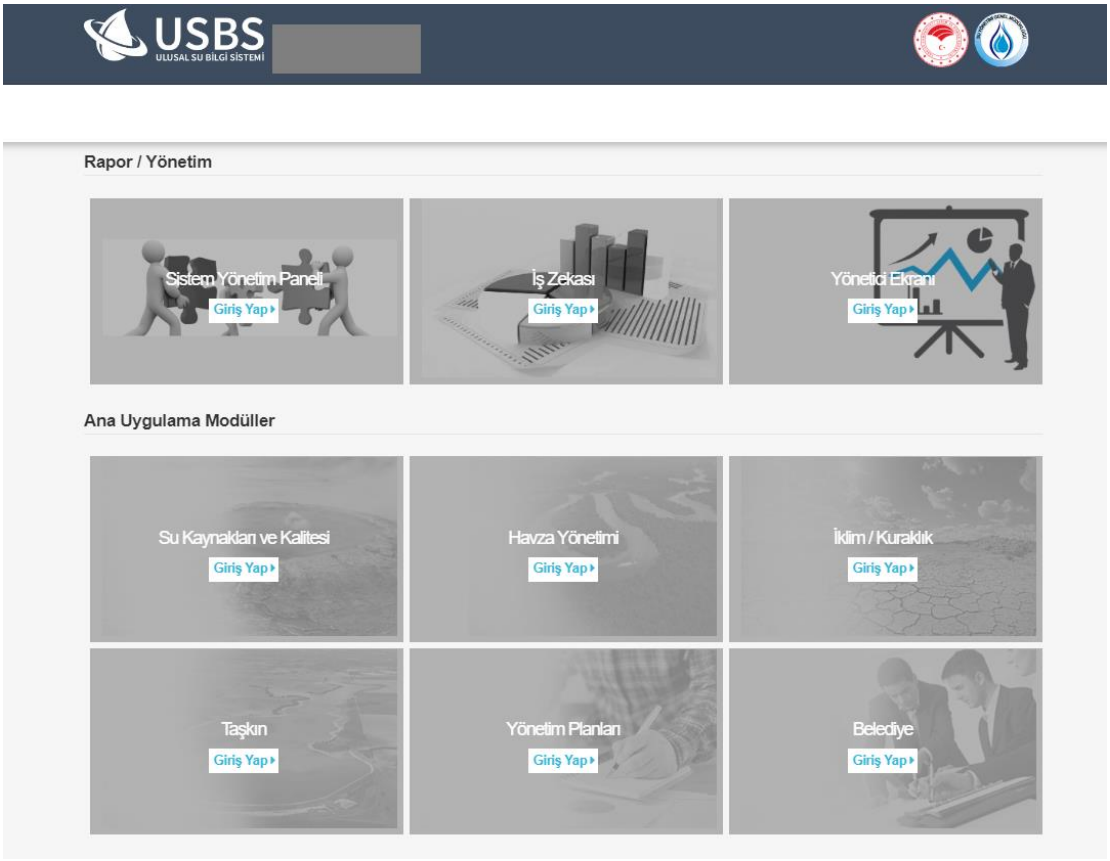
In order to prevent damage caused by possible droughts in the Büyük Menderes Basin, 27 measures have been determined under the measure groups of reducing water use/loss and Improving the Monitoring and Measurement Network within the scope of the Drought Management Plan.

Measures determined within the scope of the plan started to be followed via the Flood and Drought Plans Tracking Web Application as of 2019, and the National Water Information System (USBS) as of 2020.

MONITORING, INVENTORY and WATER INFORMATION SYSTEM

Actions that are taken about water quality and quantity as follows:

- To acquire the data that has been produced for various purposes by different organizations,
- To enhance the quality of data,
- To prevent the repetitive production of data,
- To enhance the accessibility of data,
- To determine and complete the missing/incomplete data,
- To set and apply a watershed-scale and sustainable monitoring system.



Graphical User Interface of National Water Information System (TRNWIS)

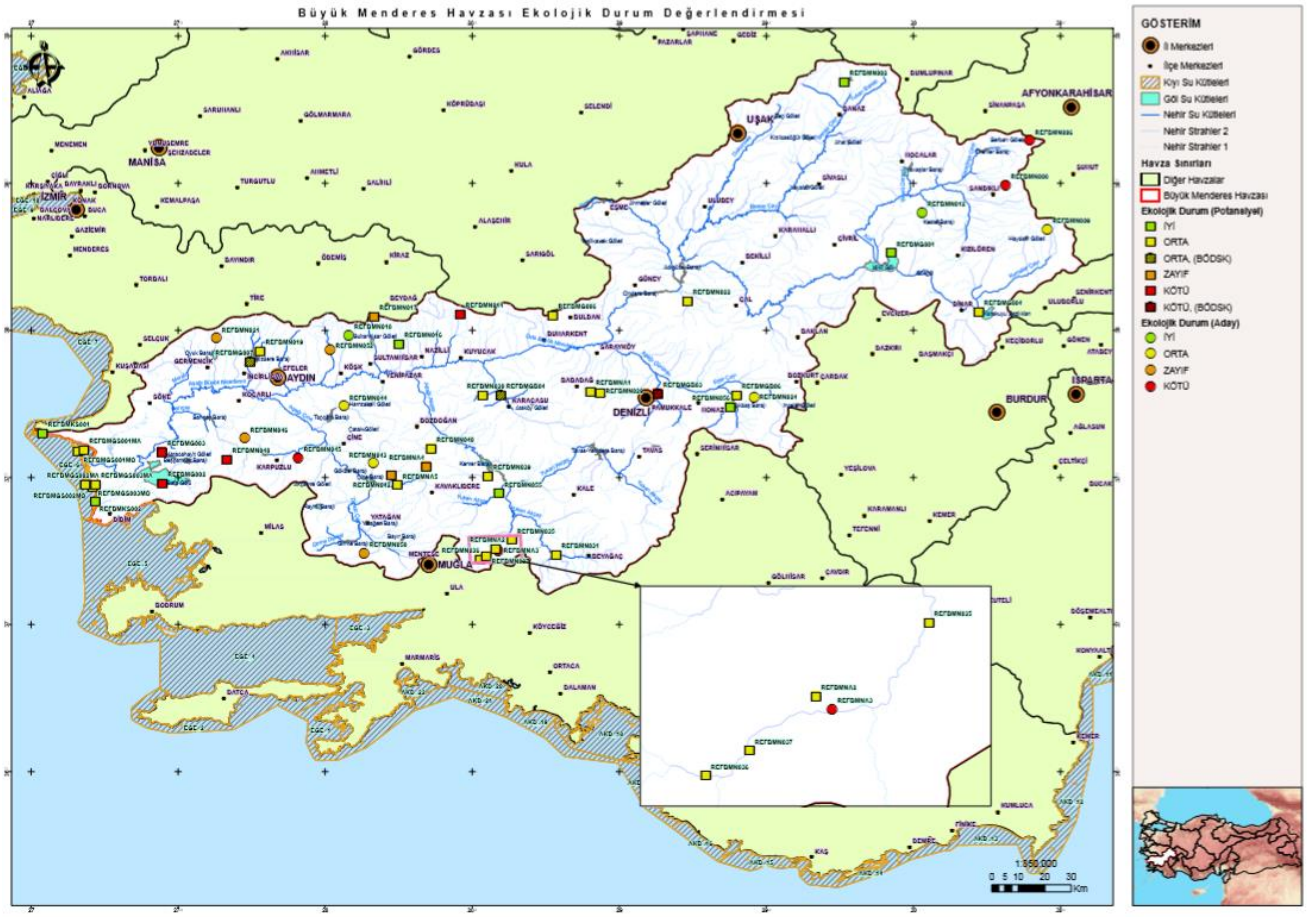
For the purpose of ecological-based assessment of water quality; biological, physicochemical, and hydromorphological monitoring studies were conducted in 25 basins across the country as part of the Project for the Establishment of a Reference Monitoring Network in Türkiye to identify natural

and/or near-natural reference (unpolluted) sites that were not or minimally impacted by anthropogenic activities, and pristine water sources were identified.

Within the scope of the study, monitoring studies were carried out in a total of 60 locations in the Büyük Menderes River Basin, including 39 rivers, 13 lakes (10 natural, 3 heavily modified), 6 transitional waters, and 2 coastal waters, and 40 reference (unpolluted) water sources were identified. In addition, the ecological status of the monitored water bodies in the Büyük Menderes River Basin was determined as a result of the monitoring activities.

In the scope of monitoring activities, the smallest possible taxonomic level of all biological quality elements was identified and in this context 31 fish, 239 phytobenthos, 139 phytoplankton, 441 macroinvertebrate, 42 macroalgae/angiosperm and 24 macrophyte species were identified in the Büyük Menderes River Basin.

Additionally, for each biological quality element, the Reference Monitoring Network and Reference Monitoring Programs have been established, which include the monitoring stations determined in the reference sites, the parameters to be monitored at these stations, and the monitoring frequencies. In line with these monitoring programs, monitoring activities will be carried out regularly.

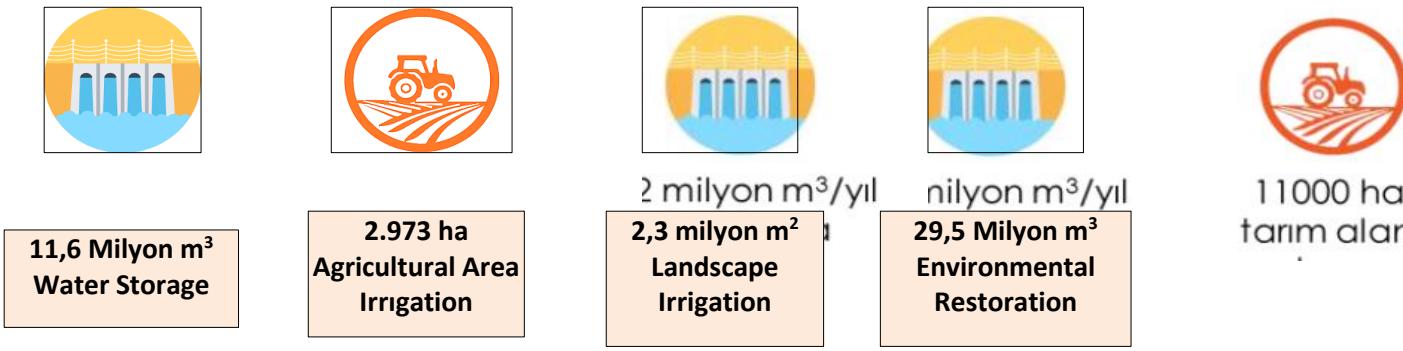


Ecological Status Assessment Results in the Büyük Menderes River Basin

WATER REUSE

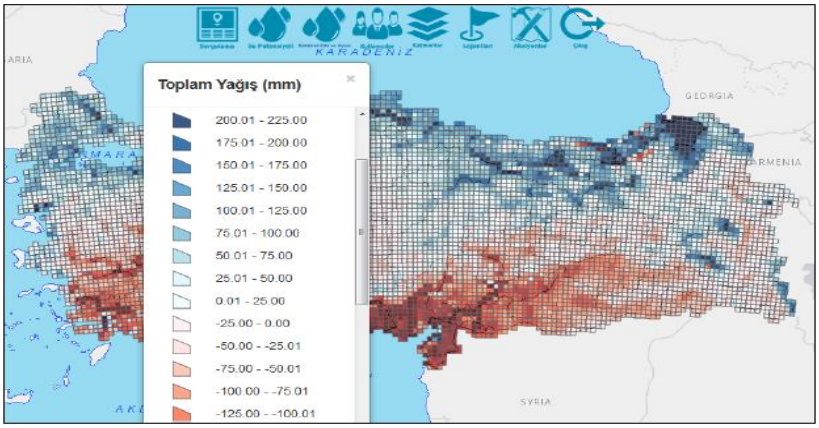
In the fight against possible water scarcity in our country in the future, it is necessary to develop practices related to the economical and planned use of existing water resources. One of these strategies, the option of reusing used water, is one of the most important methods of using water sparingly. With the recovery and use of used water, it is planned to reduce the need for existing water resources and to provide significant water savings. In the "Project for the Evaluation of Reuse Alternatives of Used Water", which was prepared specifically for 25 river basins in our country, both the reuse of wastewater treated in wastewater treatment plants and the water returned from agriculture were evaluated. With the evaluation, used water resources and reuse alternatives were determined. Used water resources was determined as waste water treated in wastewater treatment plants, drainage water returning from agriculture, cooling water and rain water. In the light of all this information, in the evaluation made specifically for the Büyük Menderes basin, the wastewater treated in the wastewater treatment plants and the water returned from the agriculture were determined as used water resources.

As a result of the calculations, the reuse potential, usage areas and gains of the used waters in the Büyük Menderes basin are given in the following figure.



IMPACTS OF CLIMATE CHANGE

The project on impacts of climate change on water resources was finalized in 2016.



According to the climate change projections made for 2015-2100 period:

It is expected that there will be a continuous increase in average temperatures. It is expected that the average temperature of the basin, which was **14,4ºC** according to 1971-2000 observations, will **increase** by **at least** 1,8°C, **maximum 5ºC** in 2071-2100 period. It is expected that temperature increases for this period will predominate in the eastern parts of the basin.

According to the observations of 1971-2000, the average annual precipitation amount of the reference period of the basin was determined to be **592,4 mm.** According to the results of the projection carried out, there is a **decrease tendency** in the total precipitation compared to the reference period (1971-2000), and it is predicted that the basin will receive **25% less** rainfall compared to the reference period in **2071-2100**. It is expected that rainfall decreases for this period will predominate in the **western** parts of the basin.

DSİ (Directorate General for State Hydraulic Works) data were used for hydrological model studies and the mean gross water potential of the basin for the reference period was determined to be **4.028 million ^{3}/year.** With the effect of climate change, it is predicted that inthe period **2041-2070**, the gross water potential of the basin could **decrease up to 65%.** However, in the period **2071-2100**, it is expected that the annual amount of water available willnot meet the total water need, and the **water deficit** will be around **2.480 million m^3/year**.

As a result of the hydrogeological studies carried out, the hydrogeological reserve of groundwater of the basin was determined to be **228 km^3**. The technically and economically usable amount of this reserve, the possible reserve is calculated to be **138 km^3**. It is estimatedthat at the end of the century under the effects of the climate change, the hydrogeological reserve of the basin will decrease by **4%** and possible reserve by **7%.**