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1. ASSIGNED REGION OF INTEREST – GENERAL INFORMATION

1.1. Geographical position

Between the Danube River and the Black Sea was created a navigable canals system, including the main canal, which crosses Dobrogea from west to east, with a final point at the Maritime Port of Constanta, more precisely the northern branch Poarta Alba - Midia Navodari, which links the Midia Port with the lake Tasaul.

The navigable canal Danube - Black Sea links the Cernavoda Port to the Constanta Port, shortening the route towards the Black Sea with about 400 km.

The canal is a component part of the importance of the European waterways between the Black Sea and the North Sea (through the Rhine–Main–Danube Canal).

The route of the canal, long of 64.410 km, with a hydrographic basin of 870 m^2, is detached from the Danube river bed in the area of the old Cernavoda Port (km 299,3), follows the Carasu Valley, crossing the Medgidia, Basarabi villages and the plateau areas, at Straja-Cumpana and reached the South Constanta Port.

The canal is an exceptional engineering accomplishment which imposed a series of connected works: the build of some big bridges, the correction of some roads, railways and some high tension networks and water supply, irrigation amenities, the heighten of some possible flood lands, draughts, dams, retention barrages, etc.

The Danube - Black Sea Canal and the Poarta Alba - Midia Navodari Canal, called navigable canals are Romania's national waters, which are under the statehood and exclusive jurisdiction of the Romanian state.

The hydro-technical scheme adapted is foreseen with 2 twin locks, which are the Cernavoda lock – for the connection of the waterway with the variable levels of the water in the river, and the Agigea lock – for the connection at the sea level, in the area of the Constanta south Port.

1.2. Economical position

After the opening of the Rhine – Main - Danube Canal, the Rhine and the Danube form now a major trans-European shipping artery, in length of approx. 3500 kilometers, which links the North Sea with the Black Sea and which connects the inland navigation networks of 13 Central and Western European countries.

Connecting the Trans-European Navigation System with a first size sea port like Constanta, on an shorter route with over 400 km than the existing one passing through Sulina, considering that at the end or from the Black Sea an important intermodal transport platform has developed, where the largest vessels transiting the Suez and Bosporus can dock and operate, provide especially favorable economic conditions and a rapid development of the entire corridor that stretches from Rotterdam to Constanta.

Therefore, we can state that both Danube - Black Sea and Poarta Alba - Midia Navodari waterways as well as the Constanta-South port form objectives that bring value to the entire Rhine - Danube Trans-European Navigational System of navigable canals.

Through the opening of the two important waterways, Danube - Black Sea Canal (1984) and Poarta Alba - Midia Navodari Canal (1987), that cross Dobrogea this have become the main source of water used for all purposes, including potable water and the supply for the bordering settlements of the Black Sea seashore.

Ensuring the water quality in the waterways at optimal parameters is an essential condition of which further development of the South Dobrogea and the Black Sea seashore depends.

Completing the existing and future quality requests of water uses represents a key issue. The obligation to water protection against pollution also derives from the current legislation regarding the environment and water protection.

Further more, it is imposed the necessity of ensuring sanitation and water scenery of the Danube - Black Sea and Poarta Alba - Midia Navodari waterways in the purpose of maintaining ecological balance and meeting the aesthetic requests, recreational and hygiene requirements in the area.

The administration, operation and maintenance of the Danube - Black Sea and Poarta Alba - Midia Navodari waterways is done by the National Company "Administration of Navigable Canals" SA.

The Danube - Black Sea Canal is an inland waterway having an important class VI, according to the standards adopted by the European Convention of the transport ministers.

The canal was conceived as a part of the hydro-technical system “The hydro-energetic and transport complex Danube - Black Sea”, whose accomplishment was approved in June 1973 and in its compound the following main objectives can be mentioned:

- The Danube - Black Sea Canal
- The Constanta South Maritime Port
- The hydro-technical nod on the Danube

The Danube - Black Sea Canal was realized between 1975-1984, based on the main general execution project, elaborated by IPTANA and approved through the Decree 300/1978. Once it was given in use, the Danube - Black Sea Canal took over the functions of the magisterial irrigational canal Carasu, as well as new functions, which satisfy the requests of other uses and which takes or downloads waters in the canal.

The Poarta Alba - Midia Navodari Canal is an inland waterway, of V^{th} class, according to the standards adopted by the European Convention of the transport ministers. The profile of this work is “Canal for fluvial navigation, with complex functions of water management, including irrigation, hydro-electric energy, fresh water and industrial supply and evacuation of floods that come from rainfalls”.

1.3. Area presentation

The **Danube - Black Sea Canal** links the Danube (km 64+410) to the Black Sea (km 0) and is composed of 3 characteristic sections, determined by the water level:

- Canal pool I – 4,1 km, between the Danube and the twin locks at Cernavoda; its hydrologic system is directly linked to that of the Danube with which is in direct connection;
- Canal pool II – 58,3 km, between the twin locks at Cernavoda and the twin locks from Agigea, and its hydrologic system has the characteristics of the canal exploiting system;

- Canal pool III – 2 km, between the twin locks at Agigea and the Black Sea its hydrologic system is that of the Black Sea.

The Danube - Black Sea Canal was completed between 1975-1983 based on the general execution project elaborated by MTTc, as the titular of investments and general designer and approved through Decree 300/1978.

Levels, depths, transport capacities, speeds on CDMN:

Specification	**UM**	Canal Pool I	Canal Pool II	Canal Pool III
maximum level	mrMB	12,0	8,50	0,50
normal level	mrMB	7,0	7,50	-0,50
minimum level	mrMB	2,75	7,00	-1,10
channel bottom share	mrMB	-1,50	0,50	-7,50
water depth per level:				
normal	m	8,50	7,00	7,00
minimum	m	4,50	6,50	6,40

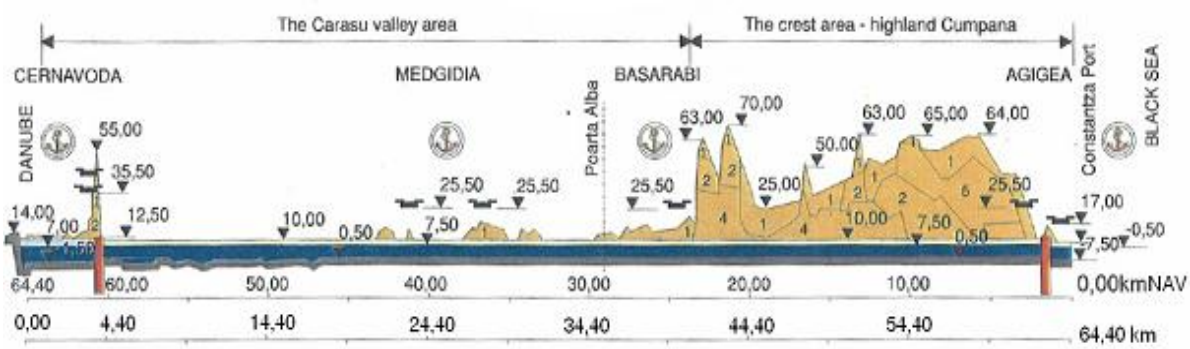
water transport capacity for: maximum levels	mc/s	335	900	900
normal levels	mc/s	320	320	320
minimum levels	mc/s	310	310	200
longitudinal speeds, water limitations	mc/s	0,5	1,4	1,4

Danube attraction area:

1 attraction point Danube – right bank, km 299 + 100 ;
2 normal level opening at the Danube: 0,4 km;
3 free level attraction;
4 trapezoidal section;
5 bottom cote = - 1,50 mrMB;
6 water depth : normal level = 8,50 m
minimum level = 4,50 m;

7 longitudinal speed at – maximum limit in normal terms of exploitation: 0,3 m/s
8 longitudinala speed: - maximum limit in normal terms of flood transit: 0,5 m/s;
9 transit floods : normal level : 335 mc/s;
minimum level : 320 mc/s

LONGITUDINAL PROFILE OF DANUBE – BLACK SEA CANAL



The **Poarta Alba - Midia Navodari Canal** links the Danube - Black Sea Canal to the Luminita Port located on the lake Tasaul.

The length of the canal between the Danube - Black Sea Canal (at Poarta Alba – km 34+669) and the Black Sea at Navodari is of 27,757 km, at which is added the link to the Luminita Port of 5,0 km.

The canal has 3 functional areas:

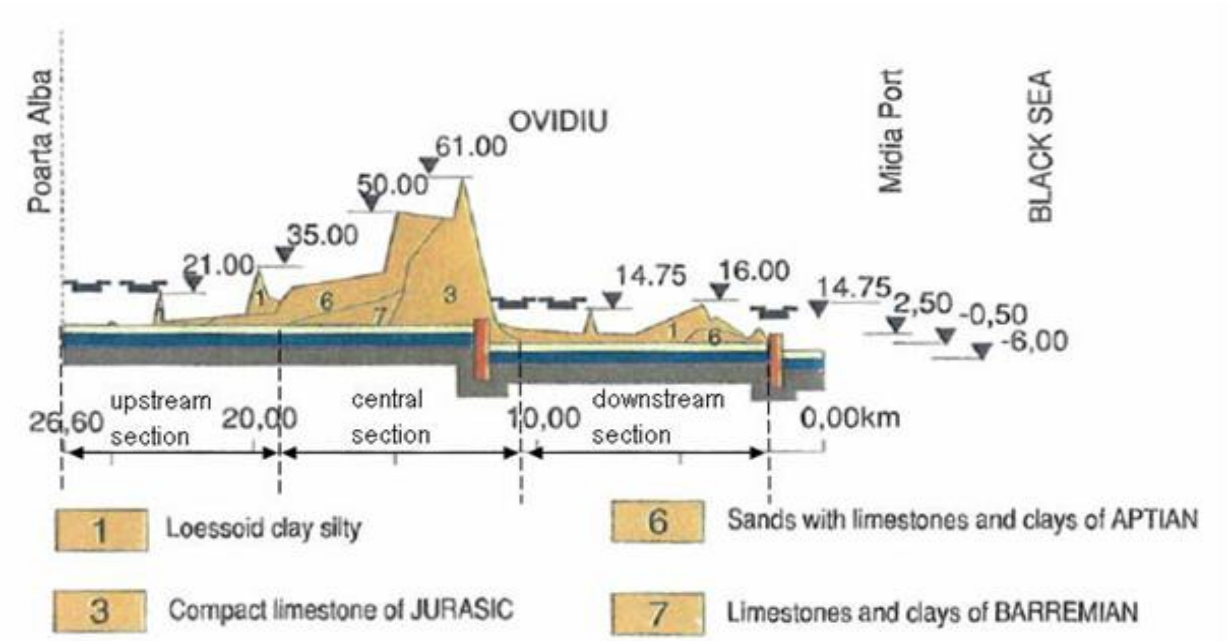
- Canal pool I : length = 15,2 km, between the confluence DBSC and the twin locks Ovidiu;
- Canal pool II : length = 10,3 km, between the twin locks Ovidiu and Navodari locks, plus 5,0 km, the connection with Tasaul lake (Luminita port) ;
- Canal pool III: length = 1,1 km, between the twin locks Navodari and Black Sea.

Levels, depths, transport capacities, speeds on Poarta Alba-Midia Navodari Canal:

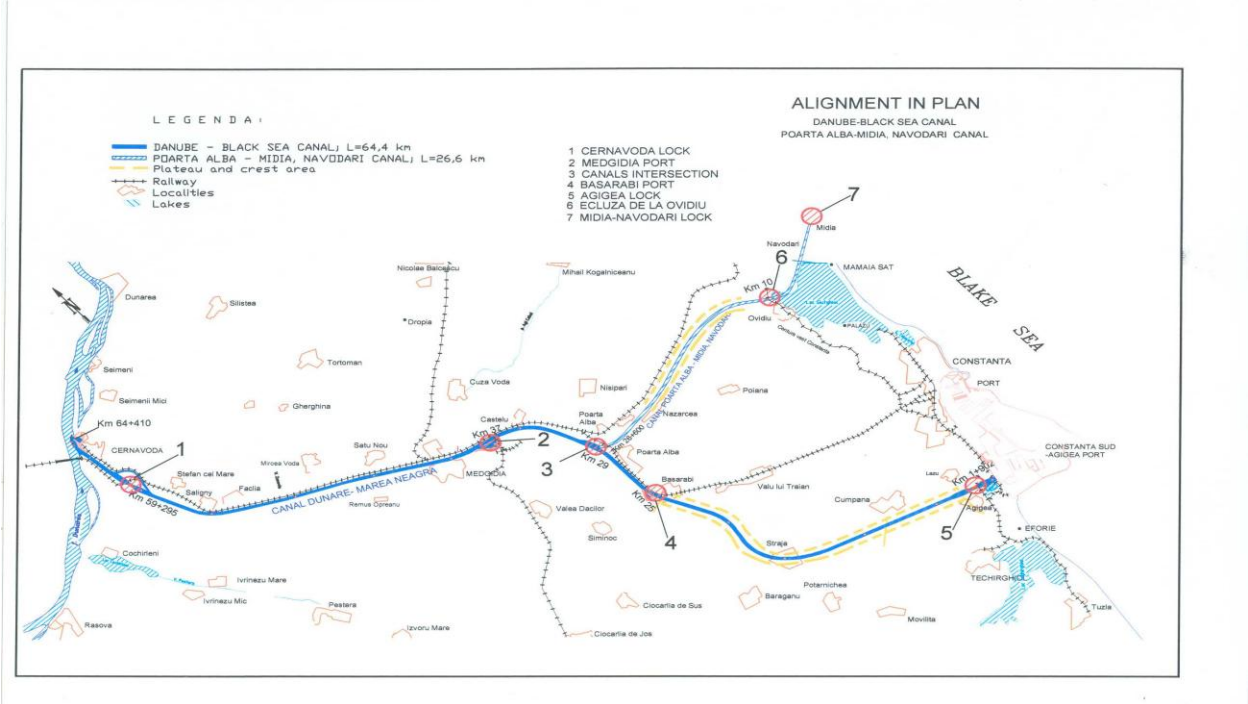
Specification	**UM**	Canal Pool I	Canal Pool II	Canal Pool III
maximum level	mrMB	8,50	2,25	0,50
normal level	mrMB	7,50	1,25	-0,50
minimum level	mrMB	7,00	1,00	-1,10
channel bottom share	mrMB	2,00	-4,25	-6,00
water depth per level:				
normal	m	550	5,50	5,50
minimum	m	5,00	5,25	4,90
water transport capacity for:				
normal levels	mc/s	42 - 51,6	38,2 - 51,0	38,2 - 51,0
minimum levels	mc/s	42	38,2	38,2
longitudinal speeds, water limitations	mc/s	0,13 - 0,19	0,17 - 0,23	0,17 - 0,23

Poarta Alba Midia Navodari Canal is dimensioned for a maximum capacity of transport of up to 24-25 millions tones/year, for navigation both ways with a convoy composed of a 3000 tones barge and a pusher of approximately 800 HP.

LONGITUDINAL PROFILE OF POARTA ALBA-MIDIA NAVODARI CANAL



The sketch of the Danube-Black Sea and Poarta Alba-Midia Navodari canals route



1.4. Water river network – main basins and sub - basins

The Hydro-technical scheme of the Danube - Black Sea and the Poarta Alba - Midia Navodari navigable canals has a complex character being sized to serve the following purposes:

- navigation;
- supplying water for irrigation, drinking and industrial purposes, for producing hydroelectric energy and nuclear power;
- receiver for evacuation of cleared wastewater and water that comes from draining;
- the adjustment of leakage from its own hydrographic basin, the defense against flood.

The hydro - technical scheme provides qualitative and quantitative management of water from the navigable canals in normal operating conditions and in accidental evacuation conditions caused by generalized or partially generalized rainfalls in the hydrographic basin.

At the basis of the complex hydro-technical scheme of the canal and the quantitative water management, lay the following principles:

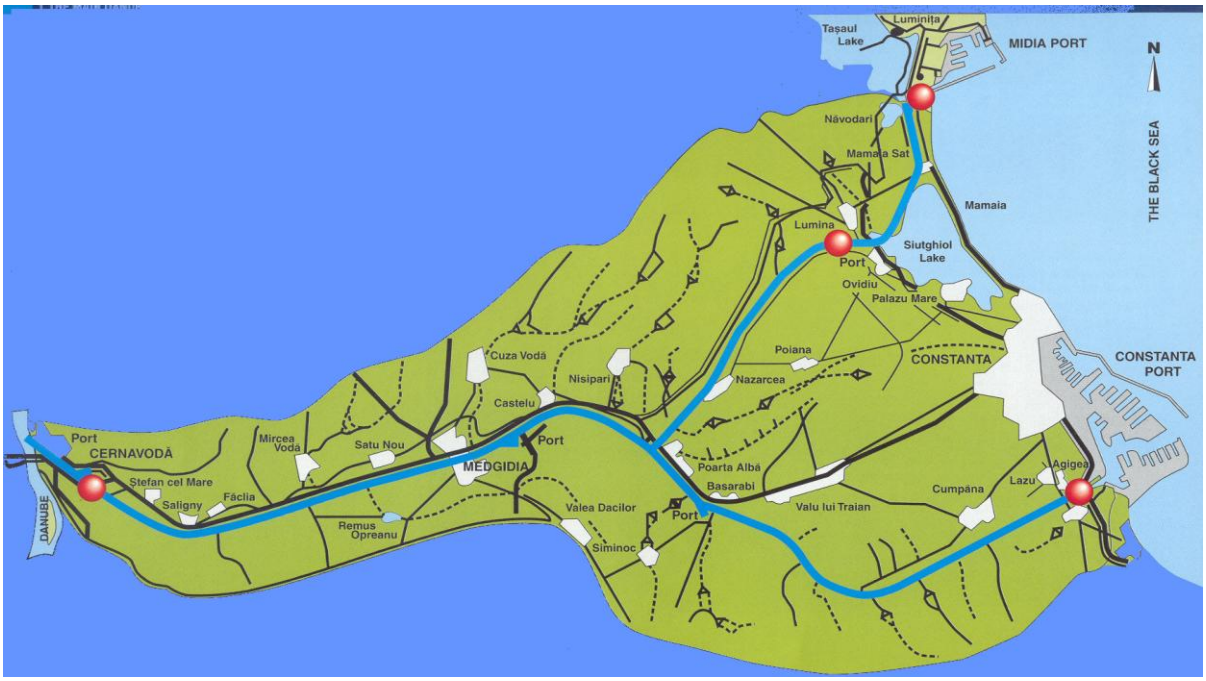
I. The beneficiaries of the services provided by the complex hydro-technical scheme, specifically the ones that sample water from the canal, don't have normal conditions of functioning assured, if the levels at the Danube and in bief I have reached equal or smaller levels than +2,75 mrMB, corresponding to an insurance level of 97% or if this levels have reached equal or bigger than +12 mrMB, corresponding an insurance level of 1%.

II. The beneficiaries of the services provided by the complex hydro-technical scheme which sample water in bief II no longer have insured normal working conditions, if the levels in this bief have reached levels lower than the cote of +7mrMB. The beneficiaries which discharge water in bief II have no longer assured normal working conditions if these levels have reached higher levels than +8,50 mrMB, corresponding to the evacuation of a flood with an insurance degree of 1%.

In the limit situations presented above, the hydro-technical scheme of the canal enter in alert state, the main task regarding the water management being the monitoring of the works in the hydro-technical scheme located between the limits of calculus and of check. The further insurance of some sampling or discharging of water from and in the canal, for some beneficiaries can be made in correlation with the restriction plans and the use of water in the incondite period.

a) The hydrographic basins

of the two navigable canals Danube - Black Sea and Poarta Alba - Midia Navodari, have a total surface of 939,8 km2 (including the Hydrographic Basin Siutghiol = 12 km^2).



The navigable canals have the function of receivers and evacuators of the waters, caused by the rainfalls in the afferent hydrographical basins.

This are taken over and assigned as follows:

- Out of 36,6 km^2 it is downloaded through canal pool I of DBSC, in the Danube;
- Out of 663 km^2 it is downloaded in the canal pool II of the DBSC;
- Out of 32,2 km^2 it is downloaded through canal pool III of DBSC, in the Black Sea;
- Out of 154 km^2 it is downloaded in the canal pool I of PAMNC;
- Out of 42 km^2 it is downloaded in the canal pool II of PAMNC;
- Out of 12 km^2 it is downloaded in BH Siutghiol.

b) Sub-basins

The affluent valleys of the waterways have a non-permanent drainage system and a torrential character, fact which made necessary the defense against floods of the canal pool II of the Danube-Black Sea Canal and canal pool I of the Poarta Alba-Midia Navodari Canal, to achieve a number of 24 non-permanent accumulations, of attenuation and 10 accumulations for the retention of the wash.

The equipment beneficiary – N.A. “Romanian Waters” Bucharest - Dobrogea Seashore Water Directorate Constanta ensures the operating.

The floods in the affluent valleys and the direct slopes affect the canal pool II of the Danube-Black Sea Canal and the canal pool I of the Poarta Alba-Midia Navodari Canal located between the twin locks of Cernavoda, Agigea and Ovidiu. For the draining of the floods the Navigable Canals accomplish the function of receiver and evacuator of big waters. Under these circumstances level growths are produced, with partial and temporary water accumulations in the canals section. Canal pool III through which it will be transited the same flows of water that originates from floods in the canal pool II doesn’t undergo special influences, because this being connected to the sea, allows the transit of floods without significant level modifications.

2. CLIMATOLOGICALLY CONDITIONS

From a geographic point of view the navigable canals Danube – Black Sea and Poarta Alba – Midia Navodari are located at the Northern extremity of Southern Dobrogea, which, although situated in the neighborhood of the Black Sea has the most arid climate in the country.

2.1. Precipitation

The precipitations in summer have a pouring character, alternating with long periods of drought, long periods of sunstroke, reduced cloudiness. The average rainfall is low, under 400 mm/year, but irregularly distributed along year.

2.2. Temperature

All this has imposed the introduction of the irrigation systems in order to obtain a safer harvest. The climate in the area is called “continental steppe” climate. The air temperature, annual average and on more than one year is of 11,2^{o}C, defining Dobrogea as one of the warmest areas in the country. In winter the multi-annual average is close to 0^{o}C, and in July and August the multi-annual average is of more than 22^{o}C. Extreme temperatures, although considerably lower than other areas in the country (Baragan plain), still remain fairly high or low (+42,2^{o}C and - 33^{o}C).

2.3. The winds from the North – West are frequent, reaching to speeds of up to 70m/s.

The climate from Dobrogea as a whole is influenced by the presence of the water basins which surround this natural unit (Black Sea, the Delta and the Danube’s ponds), influence which is reflected in the climatic particularities which makes it different from the other natural units of the country.

In general, between the atmosphere from above the sea and that from above the land is a permanent interaction, which has as a result the reciprocal influence on the climate of the nearby regions. This is why the climate from the land regions from the neighborhood of the water pools from the West Dobrogea and of the Black Sea is characterized of the moderate thermal system, the diurnal and annual thermal amplitudes are also lower than in the central areas of Dobrogea, but there are still bigger than in the West and those from the seashore.

2.4. The perspiration evaporation**,** almost inexistent in the winter months, grows in the summer months, when it surpasses the water quantity fallen from precipitations and trains in circuit not only the water situated deep in the ground but also the water that comes from the condensing at the ground level of the water vapors from the air.

2.5. Geomorphology

The area of potential influence of the navigable canals in morphologic terms the area of South Dobrogea, is characterized by younger geological formations (compared to the area at the North of the Hirsova-Midia line). In the geological

structure, the sedimentary rocks predominate, and especially the loess ones which cover the biggest part of the basic rocks. The layers of the rocks can reach up to 40 m thick. Among the useful mineral resources which can be found along the navigable canals, the kaolin clay from the Medgidia area and a one of a kind deposit of high purity chalk on a surface of about 1000 ha nearby Murfatlar are worth mentioned.

The relief of the area of potential influence of the navigable canals presents two distinct axes:

- The North-South axes, of the Black Sea seashore;
- The East-West, following the route of the navigable canals.

On a strip of 10-15 km along the seashore the characteristics of a maritime microclimate appear (temperature, breeze and humidity), the unique touristic area, characterized by spas qualities, with the special particularities of the Black Sea (absence of the tides, lower salinity than in the Mediterranean Sea), as well as the presence of therapeutic lakes known for their efficacy in the cure of certain diseases.

The relief in the east-west axes presents in front of the Carasu valley a lower area bordered in the North-South directions by gentle hills; the coast canal pool crosses an area of higher altitudes. Along the whole route, the territory is drained of valleys, with periodic debit, a consequence of the rainfall regime.

3. MAIN BASINS DESCRIPTION

3.1. Orographic, geomorphologic and morphological conditions

3.1.1. Geographical position – natural environment

Situated in the south – east extremity of the country, Constanta County forms on its Eastern side a part of the Romanian territory of the Black Sea. It occupies about 2/3 from the Dobrogea plateau, having a total surface of 7.055 km^2 (3% of the country's territory). The population of the county is of 746.988 inhabitants. The county's territory is intersected by the 44^0 latitude North parallel (at the South of Dobromir, South of Topraisar, Tuzla) and by the 28^0 longitude East meridian (East of Rasova, West of Deleni).

The territory of the Constanta County is formed of a suspended plateau compared to the Black Sea and the Danube, with altitudes of 160-200 m at the North and at the South by the transversal chute, the lower one of the Carasu Valley (50-100 m). The lowest altitudes are registered along the seashore (0 m) and in the lower meadow of the Danube (8-10 m).

The navigable canal Danube - Black Sea links the Cernavoda Port to the Constanta Port, shortening the route towards the Black Sea with about 400 km. The canal is a component part of the importance of the European waterways between the Black Sea and the North Sea (through the Rhine – Main – Danube Canal).

The idea of a navigable canal between the Danube and the Black Sea dates back to 1837 and was given by a group of British experts.

The first modern project of the navigational system in this area was developed by the Romanian engineer Jean Stoenescu – Dunare, in 1927. The works at a waterway between Cernavoda and Constanta began in 1949, but the Romanian economy of the time could not support the high costs involved and could not produce

the necessary equipment. Thus, in 1953 the works were stopped. In 1975 the works to the building of the Danube - Black Sea Canal began once again.

At the end of the investment (1984), between the Danube River and the Black Sea it was completed a system of navigable canals, including the main canal which crosses Dobrogea from east to West, with a final point at the Maritime Port of Constanta and the Northern branch Poarta Alba - Midia Navodari, which links the main Midia Port to the Tasaul Lake.

Once with the inauguration of the canal for traffic in 1992 of the Main – Danube Canal of the German territory it was realized a direct link between the Black Sea and the North Sea, the Constanta Port being linked to the Pan European Corridor VII – the Danube, which links the two European commercial poles (Rotterdam and Constanta), thus forming an inland waterway, from the North Sea to the Black Sea.

The Constanta County forms one of the most representative touristic bases from Romania. Through its geographical location, the climate, the relief, archeological remnants, natural reserves, the accommodation, recreation and treatment resort, the possibility of organizing trips and cruises, the county's territory offers a wide range of touristic activities. The Romanian seashore of the Black Sea represents one of the most important Romanian touristic areas compared to other touristic areas of the country.

3.1.2. Geomorphologic considerations

Located between the $27^0$15'15" and $29^0$30'10" eastern longitude and $43^0$40'04" and $49^0$25'03" northern latitude, the Dobrogea region presents itself as a unique unit in the Romanian territory. The specificity of the place is given by the geomorphology of the area, the whole relief reached the peneplain stage, and the river erosion stopped being a special shaping factor.

Based on the physical-geographical, petrography and the hydrological characteristics, Dobrogea can be divided in the northern Dobrogea and the southern Dobrogea, the limits of the areas was realized through the Topalu line (left bank of the Danube) – Sibioara (Village of the Western bank of the Tasaul lake).

From a geomorphologic point of view the hydrographic basin and the hydro-geological area of influence of the Danube - Black Sea Canal and the Poarta Alba - Midia Navodari Canal are situated in the countryside of the east European platform (the countryside of extra-Carpathian planes and plateaus), sub-countryside Prebalcanic Platform (Moesica) characterized through a plate foundation in Precambrian, river shaped and covered by quasi-horizontal deposits, crossing borders starting with the Silurian and continuing in the Triasic – Jurasic, Cretacic, Paleogen and Neogen.

The epirogenic tilting movements from Neogen and Cuatemar have determined in the geomorphologic land of south Dobrogea Plateau, part of the Moesic Platform, the large undulation and its rise.

Correlated with its the geological structure, the south Dobrogea Plateau is characterized through a tubular relief with large inter-rivers, easily waved or plane, with medium heights which vary between 100-200 m.

The margins of the plateau are abrupt towards the Danube and the Black Sea. In the south Dobrogea Plateau we can identify 3 geomorphologic units:

- The Danube Dobrogea Plateau District
- The Maritime Dobrogea Plateau District
- The Negru Voda Plateau District

Some researchers separate the Capidava – Ovidiu fault at the north and a line that crosses through Cernavoda – Medgidia – Basarabi – south Constanta, a northern unit of the Meridional Dobrogea – Dorobanti Plateau.

The Danube - Black Sea Canal and its branch Poarta Alba - Midia Navodari crosses from east to west the Danube Dobrogea Plateau (in the west) and the Maritime Dobrogea (in the east) being bordered by the Dorobantu Plateau in the North.

The Danube Dobrogea Plateau District has a tubular structural character, with large inter-rivers, segmented by relatively deep valleys (canyon type). Starting with its northern limit (with the Casimcea Unit) and until the south of the Danube - Black Sea Canal (Carasu valley), the Danube Dobrogea Plateau has a homocline character with structural homocline inter-rivers, asymmetric valleys (Monographic Geography of Romania – Petre Cotet 1960).

The altitudes do not surpass 100m. From the south of the Danube - Black Sea Canal and until the border with Bulgaria the plateau rises in height (150-200m) and is formed of structurally vast surfaces, with deep valleys with an ascendant and epigenetic character.

The Maritime Dobrogea Plateau District, with medium altitudes of 100 m, occupy the sector from the Danube - Black Sea and the plateau, expanding from the south of Tasaul lake until the Bulgarian frontier. The plateau has a structural character with vast inter-river surfaces, covered by loess.

There are two steps of storied relief:

- The structural plateau itself with altitudes of about 100 m
- The firth step with altitudes of 20-40m.

The shore is generally high with separate sea front in the Sarmatian deposits, covered with loess.

The recent epirogenetic movements determined the depth of the valleys with suspended firth holes, closed by lidos.

The coast line is formed of sea front lines developed on the sedimentary formations of the third and Cenozoic. Still, at the mouths of some rivers at shore, lagoons and beaches were formed. Some of these lagoons are: Tasaul lake, Siutghiol lake, Techirghiol lake, etc.

3.2. General hydrogeological considerations

The shore construction, the structural-tectonic arrangement and the geomorphology are determined elements for the hydrology of South Dobrogea.

The processed and summarized field investigation results of the scientists led to the highlighting of some main hydro-geological aspects:

- **The fundament, Paleozoic and triasic deposits** formed of crystalline schists and green schists, shales, argillite, quartz sandstone, quartiles, have been less studied under hydro-geological aspect, being considered to be aquifer formations;
- **Sedimentary coverlets**, in the interval Jurasic – Pleistocen, forms more multilayered aquiferous.

The aquifers from the two units are grouped in two complexes:

- Complex I Neogen
- Complex II superior Jurasic – Creatic

Researches made due to the study of the Danube - Black Sea Canal route (1978) highlighted the aquiferous complexes quaternary formed in the alluviation of the main valleys, characterized by a lithological inhomogeneity grading and of thickness. In the plateau areas, the aquiferous formed generally at the basis of the loess often have a suspended and discontinuous character.

The hydro-geological parameters of these aquifers are extremely variable and depend of the space repartition of the deposits which forms them.

From a hydro-geological point of view, the area of the navigable canals is characterized by the presence of the underground water at a depth of 0,5 – 0,3 m in the first part of the Carasu Valley and of 5….10 m on the sector Poarta Alba – Basarabi. In the pre-quaternary formations found on the Carasu Valley, the underwater layer is of 15 – 30 m depth, sometimes being under pressure, locally, even artesian. The underwater flow from the plane of the valley is conditioned by the water level in the canal.

In the following table there are shown the soils from the quaternary aged covering beds,distributed on types and propagation area.

Symbol	*Description*	*Distribution*
A	*Clayey silts, yellowish (reshuffled loess)*	*Carasu Valley, Siutghiol Peninsula, outlet at Navodari*
C	*Grey Clays and silty clays (swamp deposits)*	*Siutghiol area, outlet at Navodari*
D	*Darkish brown silty clays, sometimes grey (deluvial and alluvial deposits)*	*Siutghiol Peninsula*
E	*Medium and harsh sands, with gravel, in thin beds above the base rocks*	*Carasu Valley*
F	*Marine sands*	*Outlet at Navodari*
H	*Clayey – sandy –silts, grey - greenish*	*Siutghiol Lake area*
K+L	*Loess with 1-2 intercalations of yellowbrown fossil soils.* *Yellow-brown flooded loess.* *Clayey silts and brown silty clays (solidified loess).*	*Valea Adanca* *The crest sector, Siutghiol Peninsula, Mamaia Village, Navodari*
M	*Heavy red sands, finely fissured with slickenside and Fe and Mn oxides*	*The crest area towards Siutghiol.* *On the high shore between Mamaia Village and Navodari*
N	*Heavy red clays, finely fissured with slickensides and Fe and Mn oxides*	*On the Northern shore of the peninsula and on the high coastline, Mamaia Village and Navodari*
X	*Limy and chalky gravels in the red clay volume*	*- at the confluence between Carasu Valley and Valea Adanca* *- the base of the Northern escarpment in the crest area*
Z	*Fillings of earthy materials realized through hydro-mechanization*	

Soil and ground types met on the route of the Danube - Black Sea and Poarta Alba - Midia Navodari Canals

On the Danube - Black Sea Canal there are 3 main groups of fine soils:

1. Alluvium and argillaceous soils characterized by medium plasticity. In general this type of soil has medium mechanic properties and is a little sensitive to water. **They are powerful but sensitive at the erosion when they are situated on unprotected surfaces.**

2. Plastic argils.

These argillaceous soils are sensitive to water. When they are not saturated they present a good mechanical endurance and can be very compact; when they are saturated their endurance diminishes. The water infiltrations must be limited and the drainage must be surveyed.

3. Very plastic argils.

These argillaceous soils are truly sensitive to water and are often characterized by high compressibility and low mechanical endurance, especially when they are saturated.

3.3. Prevailing soil condition

In the rock layers there can be identified 2 main geological formations: limestone and chalk. The chalk layers are present in the section located between km 23 and km 9+400, their height varies between 0 m above the canal level in the central area and 20 m near and downstream from Basarabi. The chalk layers are in general white, saturated, sometimes slightly broken.

In some sectors, over the chalk there are limestones juxtaposed.

These limestones are often degraded, sometimes mixed with sand. In the argillaceous superior layers the intercalation of degraded limestones are frequent. At the inferior part, right above the chalk layers or at the canal level there were identified tough limestones.

On the Danube - Black Sea Canal, according to the geological section of the drillings made between km 21 and km 1, the soils from the superior banks are layers of argil and sand.

Between km 19 and km 16+500 the banks are built mainly from loess. Among the loess layers there are intercalated argil layers and degraded blocks of limestone.

Between km 11 up to km 15 the layers of loess and argil cover the banks composed of limestones. Limestones have been identified at about 40 m high, which means that rock cliffs are about 30 m high. At the superior part the limestone is easy to break and between them there are intercalated argil layers.

To conclude, on the Danube - Black Sea Canal the light soil layers are composed mainly from loess. These soils are often mellow and inclined to erosion and favor easily the water infiltration.

3.4. Land use

The territory that belongs to the Danube - Black Sea and Poarta Alba - Midia Navodari Canals is the one identified by expropriation documents and is part of the

public and private field of the state, administrated by the National Company Administration of Navigable Canals S.H.. The cadastral documentation was created on the basis of expropriation according to the current legal stipulations.

The safety area is composed of the 10 m high land strip located on one side and on the other side of the canal territory, measured from the superior edge of the inclined slope realized in the excavating, more precisely 1 m from the exterior edge of the drainage ditch in the dam areas.

The bordering territory, located on one side and the other of the canal territory on a length of 90 m, measured from the exterior limit of the safety area, forms – according to Law 55/2002 – protection area of the canal, no matter what was the form of these lands.

The location of any new building or installation in the protection area, according to Law 55/2002 can be made only with the approval of the Administration and the Public Works Ministry, Transport and Home.

The exploitation and maintenance of the navigable canals is made by the National Company Administration of Navigable Canals S.H. Constanta – on the basis of the legal dispositions and is obliged to ensure:

- Navigation
- A quality and quantity management of the waters, for satisfying the take and download of the water for all the approved beneficiaries in use.
- The exploitation and maintenance of the works and opening of the canals.

The prejudices brought to the constructions and installations of the navigable canals are considered to be prejudices brought to the Administration and the ship/convoy commanders that have caused them will incur all damages that come from it. The damages brought by individuals or legal persons to the works or installations of the canal, including the water quality can be treated according to the current laws.

3.5. Vegetation

As a consequence of the research made from august 2005 to march 2006 on the navigable canals Danube - Black Sea and Poarta Alba - Midia Navodari were identified the following vegetation types:

1. **Paludous tough vegetation** formed of rush (Phragmites australis), bulrush (Tipha laxmanii), small acacia (Amorphia fruticosa) and scouring rush (Schoenoplectus lacustes).

2. **Land wood vegetation** formed of willow (Salix alba), poplar (Populus alba), alder (Alnus glutinosa), blackthorn (Prunus spinosa), underbrush (Cotinus coggygria), elm (Ulmus minor), sumac (Ailantus altisima), dog rose (Rosa canina), walnut (Juglans regia), Nitraria schoberi, hawthorn (Crataegus monogyma).

3. **Submerged vegetation** formed of vallisneria (Valisneria spiralis), rigid hornwort (Ceratophyllum demersum), sago pondweed (Potamogeton pectinatus), hair weed (Spirogyra sp.), and whorled water milfoil (Myriophylum vercillatum).

The Danube - Black Sea Canal

- The **rush** is present in the water of the canal on both banks, taking the form of bands, very well developed between km 56+410 (8+000) – 53+410 (11+000) –

left bank, km 50+410 (14+000) – km 44+410 (20+000), km 36+410 (28+000) – km 29+410 (35+000).

- On certain sectors, the **land wood vegetation** (willow, blackthorn, underbrush, etc) developed roots and bodies in the protection of the banks, among the raw stone blocks covered with bituminous mortar (see the annexed photo). The bodies of the trees have the thickness between 2 – 15 cm. between km 62+410 (2+000) – km 61+410 (3+000), left bank, the bank protection is covered in red willow. The land wooden vegetation was identified also behind the supporting walls (a more rare presence, the bodies do not surpass 10 cm in diameter).
- In the control sections from km 40+000 (24+410) and km 28+700 (35+700), the identified **underwater vegetation** is characterized by the biggest specific diversity, being identified 2-3 species (rigid hornwort and vallisneria at km 40+000 and vallisneria, sago pondweed and rigid hornwort at km 28+700). In the section km 40+000, the biomass determined varies in the period august 2005 – march 2006 between 2,1 and 16,8 kg/mp. In the section from km 28+700 the biomass varies between 2,1 and 9,8 kg/mp .

Poarta Alba - Midia Navodari Canal

- The **rush** is present in the water of the canal on both banks, under the form of bands, very well developed between km 10+500 (17+500) – km 6+500 (21+500) – left bank and right bank, km 5+000 (22+500) – km 3+000 (24+500)
- Between the km 5+500 (22+000) – km 2+500 (25+000) left bank, bank defense and access roads with grass are covered by small hawthorn trees with the body thickness of up to 18 cm. The trees are well developed, in some areas, the landscape being one of the edge of the forest. The **land wood vegetation** was identified also behind the support walls (a rare presence, the bodies do not surpass 10 cm in diameter).

- In the control sections from km 20+800 (6+700) and km 2+000 (25+500), the identified **underwater vegetation** is characterized by the biggest specific diversity, being identified 2-3 species (vallisneria, sago pondweed, and whorled water milfoil at km 20+800 and rigid hornwort, sago pondweed and whorled water milfoil at km 2+000). In the section km 20+800, the biomass determined in the period august 2005 – march 2006 varies between 3,15 and 6,40 kg/mp. In the section from km 2+000 the biomass varies between 2,1 and 5,6 kg/mp
- The underwater vegetation (vallisneria, rigid hornwort, and whorled water milfoil) is very much present between the km 27+500 and 20+800, occupying a water length of about 2,0 m on both banks.

3.6. Sensitivity of basinsto creation the flood extreme

The quantity management of the waters

The quantity and quality management of the waters from the Navigable Canals Danube - Black Sea and Poarta Alba - Midia Navodari is insured by the Administration through the proper exploitation of the complex hydro-technical scheme of the canals, after a calculus program which answers to all hypotheses characteristic to low waters, normal and big, coordinated with the needs of taking and downloading of the waters of the rightful beneficiaries of use.

At the settlement of the quantity system management, in big waters conditions at the Danube, the following must be considered:

1. The quantity management system of the waters in the Danube - Black Sea and Poarta Alba - Midia Navodari navigational canals in the evacuation periods of the floods caused by the rainfalls in the hydrographic basin of the canal, and will take into consideration the following special measures which are taken in an interval of maximum 2 hours from the forecast of the general calculus and check rainfall:

2. At the occurrence of the generalized of partially generalized rainfall in the hydrographic basin of the canals with an insurance of calculus of 1%, which needs the insurance of the evacuation towards the sea of a flow of 300 m^3/sec, the complex hydro-technical scheme of the navigable canals begins the alert stage and the satisfaction of the water download of the beneficiaries of use stops.

The access is completely stopped in the canal pool II of the water taken from the Danube, in this canal pool it will be downloaded through the affluent passages of the valleys only the waters that come from rainfalls.

3. The flood which transits through the canals towards the sea where they are downloaded by the functioning of the siphon batteries, of the evacuation galleries of the big waters and if the case, of the hydro-energetic stations and downloads with clamshells.

4. In the case in which in the hydrographical basin was produced a generalized or partially generalized rainfall with the insurance of 0,1% which needs the insurance of evacuation towards the sea of a flow of 600 m^3/sec, there are taken the same measures presented at points 1 and 3 and in addition to this there are added to the ways used for the download of the water in the sea, filling and evacuating galleries of the twin locks from Agigea whose function for navigation has stopped even from reaching the calculus insurance of 1%.

5. The alert state in the big water management of the navigable canals, that come from the generalized or partially generalized rainfall of calculus and check in the hydrographical basin of the canals stops in the moment of the automatic defusing or, upon request of the siphoning batteries which have functioned for the evacuation of the big waters – in which case the water comes to the quantity system management of the waters of the canals, which correspond to the exploitation normal conditions.

6. The water supply of canal pool 2 Poarta Alba - Midia Navodari Canal has remained a an unresolved problem because the works are not finished at the micro-hydro-stations Ovidiu. Up until the present moment the water supply for canal pool 2 of the Poarta Alba - Midia Navodari Canal was succeeded through:

- the small number of lockage from the Navodari lock;
- the water request from the canal pool 2 were lower than the foreseen ones;
- the water brought due to the lockage at Ovidiu lock managed to cover the necessary water for the beneficiaries of use of the canal pool II of the Poarta Alba - Midia Navodari Canal.

It is imposed the realization of an installation to insure the transit from canal pool 2 of the Danube - Black Sea Canal in canal pool 2 of the Poarta Alba - Midia Navodari Canal of a water flow of at least 50 mc/sec.

To solve this issue there is a technical solution that can be applied:

- the transformation of the existing micro-hydro-stations in the evacuating galleries of the big waters, a work that implies the following:
  - the repair of the buildings of the two micro-hydro-stations;
  - the finishing of the works of installing and functioning of the quick valves.

4. HYDROGRAPHICAL MEASUREMENTS

4.1. River bed measurements

The maintenance of fairway suppose to maintain the wet section of the canals in limits of the designed parameters through periodic dredging of alluvial material deposits by water taken from the Danube and rising from hidrographic basin.

In The Rules of operation and maintenance of navigable canals are included articles regarding dredging works, which will be executed in order to maintain the wet section of canals between the designed parameters.

Dredging periods will be established so that solid deposits on the bottom of canals does not exceed thickness of 1 m ... max 1.25 m for the Danube Black Sea Canal and 0,75 m ... max 1 m for Poarta Alba-Midia Navodari Canal.

In these line, ACN performs regulary hidrographical measurements , check the channel section, especially the fairway in junction area of the canal wih Danube River and the entire route, including the attachament areas of the tributary valleys to the canals.

Hydrographic measurements is essential to be realised at least once a year, completely on both canals, and in critical points, where are solid deposits, whenever is necessary.

During the dredging period the measurements has to be realised every month.
Responsible for this activity is ACN through Measurement-UCC office.
Data from hydrographic measurements are used to:

- Determining the volume of water
- Determine the necessary volume for dredging /dredging reported in report with a project level
- By comparison with previous measurements (systematic measurements) we can track deposits areas and areas with erosion and can be estimated volume and length of them

- If a statistical set of successive measurements is available it can be adopt different models of prediction

Acquisition and data processing

The coordinate system used is ellipsoidal geographic coordinate system WGS 84. The advantages by using this sistem is:

- Portability of geographic data (import-export facilities in various GIS platforms, exchange information with hydrographic autorities, design and research institutes from the country and from abroad
- Possibility of making repeated measurements on the same routes for systematic tracking of the evolution of land covered by water
- Minimum error in processing
- Low costs of production (does not require network support are local-global coordinates)

Defining of the land line breaks

In order to carry out hydrographic measurements and digital maps it is necessary to be determined ,first,the line of land and main constructions (the quays corners, the limits of dams, buildings, signs and others)

Sailing Routes

On the digital map containing land line it is indicated: navigation routes (the limits of proposed dredging area) for collecting hydrographic datas.

Navigation routes have to form a rectangular grid with constant step.
In the network nodes it will be verified the accuracy of the depth measured by ultrasound.
Density routes will be chosen depending on future design needs. For a detailed edification the recommended equidistance is between 5-10 m and for a large areas

edification with relatively linear bottom configuration is recommended an equidistance between 25-100 m.

In present, in ACN hydrographic measurements are runing by a motor boat equipped with the following equipment:

- ecosounder transducer mount on the boat, sank at least 30 cm into the water;
- WADGPS antenna mounted on the vertical transducer;
- Ecosonda and WADGPS receiver for real time transmission of the position / depth to a PC unit ;
-Portable computer whereupon is coupled the transducer and GPS;
-Navigation and online data acquisition program;

ACN is developing a project of implementation for a complete hydrographic measurements system on navigable canals.
The system includes two components:

- A relatively small vessel size (length 15 to 16 m, width 5m, 1 m maximum depth, autonomy for 10 hours). On the main deck of the ship it will be located a control cabin and a cabin for measuring work activity;
- A group of equipments and softwares necessary to manage the informations submitted by the equipments, the processing of them , the calculation of water and dredged materials volums, processing the datas.

The set contains the following components:

-hydroacoustic system for depth measuring ;
-hydroacoustic system for profiling the layers of sediments;
- accurately positioning system;
- motion sensors;
- processing unit with the necessary programs, software programs necessary for the preparation and execution of hydroacoustic research;
-programs required for final processing.

4.2. Discharge and current measurements

The main bottleneck on the waterways administrated by ACN is the confluence of the Danube river with Danube - Black Sea Canal, because of solid deposits accumulated on bottom of the canal, in this area.

In accordance with the existing studies, solid flow considered initially that will be seek on the bottom is about 340.000 cubic meters per year wherefrom 200.000 cubic meters per year is coming from suspension in water taken from the Danube and filed the first part of the canals and 140.000 cubic meters per year is coming from the tributary valleys and deposited into the canal,in connection area with these valleys.

Due to the hydrological state of the Danube, the carrying silt and inclusiv of morphological characteristics of the Danube at the confluence with the canal was

changed, so that in the area has been a continuous process of accumulation of deposits, including on the I stream .

At this moment the only solution is dredging.

Dredging works are realised by keeping traffic open at least one way of navigation with corresponding signalization. The navigation dispatcher of ACN has the responsability to comunicate to each skipper, the existing dredging works and its position. Performer is announced by radio, for the ship or convoy departure time and about the time it arrives in the area.

The navigation dispatcher of ACN has the responsability to notify the seafarers, by notification, all changes on sailing conditions.

Taking into acount the hidrographic measurements that was realised last years by ACN , for the next 3 years are estimated to be dredged about 500,000 cubic meters per year.

For the sediments dredging from the inland waterways can be used in on acceptable economic terms, the following :

-ladder dredger

-absorbent dredger

-dredger with cranes or floating cranes equipped with claw

-Mobile cranes equipped with claw, located on the pontoon crane

-ballast dredger

The executor can use any other equipments, by keeping the conditions imposed by „Dredging technology on the navigable canals“. In the water,oil or gas pipes area and the related slopes area will be not use absorbent dredger. The executor can do the dredging works with other types of equipments, only with the approval of the general designer of the waterways.

We present below some of the characteristics of dredging machines built in Romania.

Ladder dredger features:

- Productivity: 750mc
- Dimensions: length-65 m, width = 11.50 m
- Maximum depth of dredging-22 m
- Minimum depth of dredging-8m
- Dredging-capacity of 750 m³ / h

Floating crane features:

Length-27.40 M

width- 16, 00 m

The hook-loading - maximum 10 tonnes

Lifting height from water level-20 m

Underwater immersion level -8 m

Maximum opening of arm -27 m

Minimum opening arm -8m

Absorbent dredger

a) Lungime- 25- 30 m,
b) width = 17.00 m
c) Maximum depth of dredging-8, 00 m
d) Minimum depth of dredging-2, 50 m

5. LEGAL MEASURES

5.1. For the monitoring network

The right to use, as well as the obligations that correspond to the results from the protection and conservation of water resources are made according to the Water Laws no. 107/1996, with subsequent modifications and additions.

The banks and their river beds are submitted to the current law, as well as the stipulations from the international conventions at which Romania is part of.

There are also submitted to the present law the works that are built on waters or which have a connection to the waters and through which, directly or indirectly, produce temporary or definitive changes on the water quality or flow system.

The conservation, protection and development of the aquatic environment, in the conditions of its durable use of water resources have at the basis the principles of precaution, preventing and avoiding the damages at the source and the polluter pays and has to take into consideration the vulnerability of the aquatic ecosystems located in the Delta of the Danube and in the Black Sea because their equilibrium is strongly influenced by the water quality of the inland waters which flow into it.

5.2. Avertisment and alarm systems

The alarm and advertisement system is incondite and it is based only on level measurement. There are no automatic systems of measurement and adaptation of the rainfall volume from the hydrographic basin and on the flows from the affluent valleys.