Tacis

Traceca Corridor

Traffic and Feasibility Studies - TNREG 9803

Module D :

Navigation Channel for Turkmenbashi Port

Determination of the existing situation

November 2000

REPORT COVER PAGE

Project Title	: Traceca Corridor - Traffic and Feasibility Studies
Module D Title	: Navigation Channel for Turkmenbashi Port
Project Number	: TNREG 9803
Module D Country	: Turkmenistan

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1. Project synopsis for module D

Project Title	: Traceca Corridor - Traffic and Feasibility Studies
Module D Title	: Navigation Channel for Turkmenbashi Port
Project Number	: TNREG 9803
Module D Country	: Turkmenistan

Module D overall objective

The overall objective of this module is to ensure the continued accessibility of navigation to the Port of Turkmenbashi.

Planned module D outputs

The project should deliver a detailed periodic maintenance plan, using as far as possible the equipment owned by the port, under a reasonable maintenance budget taking into account the port's projected traffic and revenues. The plan should assure that maritime traffic calling on Turkmenbashi is subject to no unreasonable delay or danger due to the condition of the access channel. The results of the study should indicate clearly:

- the security of future revenues to the port from risks posed by any perceived present or future inadequacies of the navigation channel;
- the costs of dispositions for routine maintenance of the channel;
- investment recommendations, or explanation why no investment is required.

The module should also deliver an investment plan, detailing whatever large or small capital works or equipment procurements are necessary to assure the overall objectives.

Module D activities

1. Determination of the existing situation and the environment

- Review of previous consultants' reports and mission notes.
- Collection of existing charts and maps to describe the geography of the bay and the channel system.
- Collection of existing data to determine natural conditions (hydraulic, meteorological, geophysical).
- Spot checks and surveys to confirm and augment the preceding.
- Survey of channel markings.
- Interviews with vessel operators.
- Identification of current operational guidelines and practices, for vessel operations and for channel maintenance.

- Identification of port services and equipment for assisting vessels during passage of the channel (pilot service, pilot vessels, radio equipment,...).
- Appraisal of past and present dredging practices: available equipment, staff, contractual arrangements, management practice, budget, suitability of locations for disposal of dredged materials, etc.
- Identification of alternatives options for carrying out dredging operations.
- Past, present and forecast traffic and revenues for the port.
- Analysis of the possible impact of fluctuating Caspian sea water levels.
- Assessment of actual situation rates.
- Relevance of international standards in so far as they concern Turkmenbashi port access, including water depth parameters, lighting requirements, etc.

2. Maintenance and improvement recommendations

- Review of the adequacy of the channel system, including layout, navigational aids, buoys, etc.
- Review of operational practices for channel navigation, including the ports services and equipment.
- Recommend and justify possible operational improvement measures with respect to safety and continuity of operations, costs, benefits, environmental aspects.
- Review the port's capacity to correctly maintain and dredge the access channel.
- Recommend and justify a maintenance policy and working maintenance plan, with justifications for any changes from the present situation. Provide budget estimates for such a plan and relate it to expected port revenues and expenditures.
- Recommend and justify any capital works or equipment procurement, if required, including costs, benefits, safety and environmental considerations.
- Provide outline specifications for any equipment procurement, if equipment is required.

Project starting date	Main contract signature	30 August 1999
	Commencement of module D activities	Mid-August 2000

Project duration

The main contract is scheduled to end in August 2001
Module D is to be completed in January 2001

2. Traffic analysis

2.1 General

The port of Turkmenbashi is located at short distance from the western coast of the Caspian sea, and is linked with the railways network irrigating the landlocked countries of Central Asia. This explains the important role this port plays in the transport chain between Central Asia and Caucasian countries. Therefore, the port of Turkmenbashi serves both regional and international sea-borne trade as it is reflected in the traffic analysis.

The objectives of this chapter 2 are:

- to analyse the past port performances,
- to forecast future development of traffic over the 10 coming years,

in order to estimate the numbers and the sizes of ships that will call at the port and thus to help assess the feasibility of the improvements to the navigation channel.

This chapter includes three parts:

- a rough economic assessment,
- an analysis of past and present traffic figures,
- a proposal of traffic projections.

2.2 Economic overview of Turkmenistan

The population of Turkmenistan is about 5 million inhabitants and its Gross Domestic Product was USD 3.3 billion in 1999, which represented a high 16 % increase, compared to the 2.9 billion of 1998.

Main resources are gas, oil and cotton (the tenth world's largest cotton production).

However these resources make Turkmenistan economy mainly oriented towards the export market. That dependency of the national economy from the external trade is very high and increases; the last available information shows that exports of goods and services amounted in 1999 to 41.6 % of the GDP while it was only 29.7 % in 1998.

This dependency makes the national economy very sensitive to any change in the international market. It might be favourable in periods of price increase but might turn into a recession if international prices happen to drop.

From 1993 to 1997 Turkmenistan faced a very severe recession period because of the refusal of Russia to forward gas exports to the western market and because of non-payments of debts by customers. Since cotton and energy account together for over 70 % of economic activity and contribute for 80 % to export revenues, import capacity dramatically declined, national debt increased and GDP fell by over 30 % in real terms.

In 1998 oil production increased and an agreement with Iran gave new opportunities of oil export, whilst an agreement with the Russian Gasprom let the door open for increasing exports of gas through Russia.

In 1998 production of gas was 500 billion cubic feet, down from 2300 billion in 1993, but the new agreement with Gasprom will allow to re-export to Russia and to Ukraine. In 2002 the sole exports to Russia are planned to be 5 times the present ones. If problems of arrears of Ukrainian debt can be solved, this market will develop too.

On the other hand, the construction of a gas pipeline under the Caspian Sea towards Azerbaijan and Turkey would allow to export an additional 600 billion per year.

Cotton production is declining because of lack of water, therefore one cannot expect any significant increase of cotton exports.

Concerning future trends, some factors are favourable whereas others are constraints that might hinder development.

2.2.1 Favourable factors

- The national saving rate (Savings / GDP) is increasing very fast, from 11% in 1998 up to 26 % in 1999.
- Accordingly, the investment ratio (Investments / GDP) amounts to 46 %, which is a good sign of trust of economic players. Energy sectors are the main keys of this effort in investment.
- Due to the increase of exports over the past two years, the balance of payment improved and the deficit has decreased by 50 %. Therefore, the debt declined from 80 to 70 % of the GDP, from 1998 to 1999.
- The economy recovered a positive trend of growth in 1998 and 1999 (+7% and +16%, respectively) after a negative average annual rate of - 7.7 % along the past ten years.
- The perspective of increase in production and prices of oil and gas for the long term is the warrant of long term revenues for the country and increase in capacity to invest in infrastructure, education and industry.

2.2.2 Unfavourable constraints

- For the short term, the debt of the recession period amounts to 145 % of the yearly export value and, even decreasing, the total debt service for 1999 was still 38 % of the export figures.
- The logistical difficulties of exportation, due to geographical features of the country, hinder economy development.
- The variations of prices of raw materials could lead to series of investment "stop and go", exports and imports experiencing ample cycles.

This complex economic situation has direct consequences on the external trade and on the sea-borne trade through the port of Turkmenbashi. The traffic analysis shows the effect of those economic cycles on the port activity.

2.3 Traffic analysis methodology

2.3.1 Methodology for past and present traffic

Following studies, statistics and data have been used or worked out:

- the Scott Wilson's port tariff study,
- the Statistics of the Turkmen Sea Administration produced with the support of Haskoning,
- the Statistics of the Turkmen Maritime Lines produced with the support of Haskoning,
- the available results of Modules A, B and C of the on-going Tacis-Traceca project, by Bceom,
- the ferry statistics of the Baku port,
- the previous Traceca reports.

Reliability of data is of utmost importance. Collected figures have been cross-checked and they proved their consistency since comparisons resulted in discrepancies of more or less:

- 5 % for the ferry terminal throughput,
- 10 % for general cargo,
- 2 % for crude oil and oil products.

2.3.2 Forecasting method

Forecasting port traffic is not easy in the case of a newly independent country because changes are so fast that past trends cannot be used as reliable indicators. Moreover, economic changes in the region may have huge consequences on traffic:

- increase of oil and gas production, that results in a higher demand for sea transport;
- increase of oil prices, that leads to growth of import capacity and then increases inwards port traffic;
- development of new North-South axes of sea-borne trade on the Caspian Sea, that might affect land transport and consequently the port traffic itself;
- development of other regional countries that Turkmenbashi trades with.

Lastly, competition with other ports and routes to collect cargoes from land-locked areas, such as the Uzbek cotton, is an additional element to be taken into account for foreseeing traffic development.
This is the reason why several scenarios are proposed in the following.

2.4 Traffic variations at Turkmenbashi port

The port of Turkmenbashi throughput includes three types of terminals and traffic.

2.4.1 The ferry terminal (PPK 2)

It accommodates the ferries sailing between Turkmenbashi and Baku.

Note: *in the following we first mention the tonnage of cargoes, excluding tares of rail-cars and trucks, because forecasting future traffic is essentially estimating the demand for cargo transport. We then evaluate tonnage of tares. Therefore, the text only mentions tonnage of cargoes but tables also mention tares of rail-cars and trucks, estimating them by extrapolation of past data.*

Ferry traffic evolved from 490 000 tonnes in 1993 to 612 000 tonnes of cargo in 1999 with two peaks of 800 and 850 thousand tonnes in 1997 and 1998, thanks to the development of oil and gas industries.
In 1999, traffic consisted of 260 000 tonnes of import and 352 000 tonnes of export from/to Azerbaijan but also from/to other Caucasian and European countries. Main commodities carried on train and trucks hauled aboard the ferries in 1999 were:

- Export of oil products (40 %)
- Import of raw agricultural products, food and beverages (21 %)
- Export of fertilisers (13 %)
- Export of cotton (9 %)
- Export of equipment and vehicles (5 %)
- Export of construction materials and cement (4 %)

It is worth mentioning that 66% of this traffic is transiting through Azerbaijan from/to other countries:

- 350 thousand tonnes in 1998 and 171 thousand tonnes in 1999, or respectively 85 and 66 % of imports, have been carried from Western Europe, Eastern Europe and Georgia via the Caucasian itinerary. The main transit commodities are soya beans, food and beverages, timber, equipment and chemicals.
- 207 thousand tonnes in 1998 and 312 thousand tonnes in 1999, or respectively 46 and 89 % of exports, have been carried to Georgia and Ukraine via the Caucasian railways network.
- Main commodities are oil products and cotton.
- 64 000 tonnes of alumina were imported by Tajikistan via Turkmenbashi.

The attached table 1 provides with in-depth data.

2.4.2 The general cargo terminal (PPK 1)

It accommodates conventional and multipurpose ships sailing within the Caspian Sea and from/to the Mediterranean Sea via the Volga-Don canal.

Traffic declined from 410 thousand tonnes in 1993 to 110 thousand tonnes in 1996 and then increased to about 150 thousand tonnes in 1999, in correlation with the variations of economic activity.

Inbound traffic of 118 000 tonnes consists of domestic and import cargo:

- The main commodity is salt (58 %) originating from northern Turkmenistan (domestic traffic),
- Import of chemicals (11%),
- Import of equipment and transportation vehicles (11 %),
- Import of sugar (6 %).

The outbound traffic, that amounted to 32 000 tonnes in 1999, mainly consists of construction material.

Over the past seven years the traffic structure has changed:

- Export of cotton disappeared in 1996.
- Export of construction materials drastically declined, which lead to the dramatic decrease of outbound traffic of the port.
- Import of flour disappeared in 1997.

The attached table 2 provides with detailed data.

2.4.3 The Ufra oil terminal

Crude oil originating from Cheleken and Okarem is unloaded in Ufra and forwarded to the Turkmenbashi refinery; then part of refined oil and exported from Ufra.
In 1999, about 235 thousand tonnes of crude oil have been unloaded in Ufra (domestic traffic), which was less than the 710 thousand tonnes recorded in 1998.
As far as oil products are concerned, in 1999 2.5 million tonnes were loaded at Ufra, a bit less than the 2.7 million 1998 figure. Dark and light products were shipped to Mediterranean countries (44 %), Caucasian countries (21 %), Iran/Turkey/Afghanistan (23 %) and the remaining to various countries of Eastern and Northern Europe.
It means that Baku collects 75 % of the sea-borne export of oil products.
244 000 tonnes of oil products have also been carried to Baku by train onboard the ferries for further transportation to other Caucasian countries.
Lastly there is some import of oil products, mainly kerosene: 26 000 tonnes in 1998 and 2 500 tonnes in 1999.

The attached table 3 provides with more detailed data.

2.4.4 Vessel traffic

- Ferries calling at PPK 2

In 1998, 837 moves of ferries were recorded (417 arrivals and 420 departures).
In 1999, 720 moves of ferries were recorded (360 arrivals and 360 departures).
The average shipload was 780 tonnes of cargo inbound and 935 tonnes of cargo outbound.
For the needs of forecasting an average figure of 2000 tonnes of cargo per call is therefore decided.

- Conventional ships calling at PPK 1

In 1999, 220 moves of ships were recorded (110 calls). The average shipload was 1100 tonnes per call. Some ships arrived fully loaded and departed empty (for salt traffic, for example) whilst others arrived partially loaded and left fully loaded.
For the needs of forecasting an average figure of 1100 tonnes per call is selected.

- Tankers

In 1999, the average shipload of tankers carrying crude oil was 4800 tonnes and the average shipload of tankers carrying oil products was 3990 tonnes.
We keep these figures for the projection needs, since average tanker sizes are not likely to vary significantly.

2.5 Traffic forecasts

2.5.1 Forecasts from other studies

Three studies have been reviewed: the Louis Berger's feasibility study, the Corporate Solutions' study and the Update of Traffic Forecasts by the Turkmen Maritime Lines, supported by Haskoning.

- Louis Berger's feasibility study (1997)

Traffic forecasts concern the overall traffic at the "city port"; Ufra oil terminal is not included. This study is pessimistic for year 2000 since it forecasts a total traffic of only 400 000 tonnes (750 thousand tonnes were carried in 1999, 600 thousand tonnes by ferries and 150 thousand by conventional cargo vessels). Their traffic forecast for year 2005 (540 000 tonnes) is also below the present level.

- The Corporate Solutions' study

This traffic forecast concerns the PPK 1 terminal. It has been based on the 1997 traffic (125 thousand tonnes), taking into account the very specific economic situation. Corporate Solutions has foreseen a high rate of growth of the import cargo until 2001 (import of construction cargo, pipelines and food) and a decline along the following four years, to reach in 2005 the same level as in 1999.
On the contrary, as far as export cargo is concerned, the growth is supposed to be regular:

Traffic forecast by Corporate Solutions (at PPK1, in tonnes)

	1998	1999	2000	2001	2002	2003	2004	2005
Import	80 000	120 000	160 000	170 000	160 000	135 000	120 000	115 000
Export	50 000	55000	60 000	75 000	105 000	125 000	130 000	135 000
Total	**130 000**	**175 000**	**220 000**	**245 000**	**265 000**	**260 000**	**250 000**	**250 000**

From this table traffic of general cargo should increase by 43 % from 1999 through 2005.

- Turkmen Maritime Lines' Forecasts

In June 2000 TML updated the forecasts according to the true changes of traffic over the past two years.
TML has estimated the 2005 traffic at about 230 000 tonnes by extrapolation of current trends. This figure is close to the one of CS and is consistent with the growth rate of 7% considered by Louis Berger. Such hypotheses need an increase of revenues from oil industry.

2.5.2 Bceom's scenarios for the next 10 years

Five factors were taken into account.

1. Demographic evolution

Imports of food and beverages are directly correlated to this indicator. Growth rate is estimated at 1.7 %

2. Evolution of the Gross National Product (GNP)

The GNP depends on the evolution of the energy industry, on world oil consumption and on the means which are used to solve transportation problems. According to the experts of the World Bank and the Energy Information Administration, the Turkmen GNP is forecasted to increase by 7.8 % per year up to 2004, due to the development of gas and oil exports. The import of equipment, engines and vehicles is therefore correlated with the GNP.

3. The level of competition between ports and the ability of Turkmenbashi port to catch Uzbek exports. Cotton from Uzbekistan has always been a cargo that all ports of the region wanted to catch because they all consider that it is inside their hinterland. For the time being, cotton is still being exported through the Russian railways network via Riga, and it seems quite difficult to shift the route towards the Caspian ports.

4. As far as imports are concerned, most shippers use the land transport through Europe and Russia. The future trend is difficult to foresee.

5. Lastly, the economic development of other Caspian and Caucasian countries is a determining factor for sea-borne trade. If we exclude oil export, the main countries where Turkmenistan is exporting are Russia, Iran and Caucasian countries. Their imported volume is depending on their GNP and we will have to build scenarios about their development.

Before depicting the scenarios, the main conclusions of the past traffic analysis have to be reminded.

a. Ferry traffic

The ferry traffic is essentially depending on the oil products exported to the Caucasian countries and to the Ukraine. In addition, the export of cotton is stable and will probably not increase except if logistics conditions evolve in favour of the southern Traceca route. The import traffic onboard ferries mainly consists of soja beans, food and beverages, as well as alumina.

b. General cargo traffic

Salt is a stable component of inbound traffic (about 50 000 tonnes per year).
Machines, equipment and vehicles are the second group of import cargo.
Chemicals are the third important element and are linked to the oil industry.
Construction material is the only tangible export traffic; it depends on the level of the demand in Azerbaijan and other Caucasian countries.

c. Oil and oil products

Evolution of this trade is depending on the implementation of the future network of pipelines around 2004.

d. The future for trade on the Caspian Sea

Agreements have been or are close to be signed between Iran and Kazakhstan (for metals and wheat) on the one hand, and between Russia and Iran (for oil, metals, equipment and textile) on the other hand, which could result in a significant traffic of about 1.2 million tonnes of North-South sea-borne trade on the Caspian Sea. Such a situation would entail development of new fleets. In order to make scale savings, ship-owners might create new services calling at Aktau, Turkmenbashi, Iranian ports, Baku and Astrakhan on a regular basis. This regularity of sails might influence trade logistics and transport routes.

Scenario n°1 (pessimistic scenario)

This first scenario combines all pessimistic evolutions that may hinder traffic development.
In this hypothesis, it is assumed that Turkmenistan only succeeds to increase export of oil and gas according to the agreements signed with Iran, Russia and Ukraine.
Export of cotton is limited to the present level.
Export of building material increases only by 2 % because of the low development in the Caucasian countries.
Import of food and beverages increases like demography does (1.7 %).
Imports of equipment and vehicles evolve at the same rate as the GDP (+7.8%) for the coming 4 years and only at 2 % after 2004.
Oil products are sea-borne towards Baku and Iran only. The international demand limits the increase rate of demand to 1% a year. The capacity of the refinery limits the export of oil products to 3 million tonnes. Inbound traffic of crude oil is limited accordingly.
In this scenario, it is also assumed that the maximum tonnage that the ferries can carry will be limited to 250 thousand tonnes, which means a full shipload every two days. Limiting factors are security on board, availability of rail-tank cars and costs of transport of empty rail-cars.

Scenario n°2 (optimistic scenario)

This second scenario combines all favourable possible evolutions for each traffic category.
In such a situation, oil and gas exports strongly increase thanks to an assumed high international demand for energy, and to construction of pipelines through neighbouring countries.
At the same time, Uzbek cotton exporters decide in 2005 to export to Mediterranean countries about 500 000 tonnes via the Caspian Sea. If they do not use containers, ferries will carry this tonnage in addition to the 100 thousand tonnes of Turkmen cotton.
The GNP increases at a rate of 7.8% per year, even after 2004, resulting in a growth rate of income per capita of 6%; import of food and beverages increases faster than the demographic evolution, 3 % a year, imports of equipment and vehicles increase very fast (+10%) because the investments in oil industry and in other industries create other activities for maintenance and miscellaneous businesses.
The refinery increases its capacity up to 4 million tonnes (in 2007) and the service for transport of crude oil, as well as export of products to Iran and to Baku, increase at a 5% rate.
We assume that ferries will be able to go on carrying tank-cars to Baku and to increase their capacity up to 350 thousand tonnes.
Moreover, the creation of new shipping lines between Russia and Iran will give opportunities for ship-owners to set up triangular lines serving also the ports of Aktau, Turkmenbashi and Baku. New services will induce new general cargo traffic, currently hindered by the lack of flexibility of the ferries, that can serve only Baku, Aktau and Turkmenbashi.

Scenario n°3 (medium scenario)

This scenario is a combination of medium hypotheses for the various cargoes.
In this scenario, oil and gas industries will be strongly developing after 2004 and the GDP growth rate on the long term will be 5%.
The increasing standard of life, thanks to oil and gas revenues, will allow reduction of poverty and thus create an increase of consumption and import of food and beverages, which is estimated at 3%.
After the import-boom of equipment and vehicles during the first 4 years of oil and gas investigation campaigns, volumes of import will grow at a cruise speed of 5 %.
Oil products exports will be limited to 3 million tonnes, due to the refinery capacity.
Ferries will carry a maximum 250 000 tonnes of oil products per year.

2.5.3 Traffic forecasts

Before evaluating traffic for various milestones, it is necessary to compute basic figures to which growth rates will be applied. Using figures of a previous year as a base may result in wrong estimates because there are often exceptional events that explain a high or a low traffic for a given year. Therefore, we have used the following method to determine base figures:

- when traffic has been irregular in the past, we have adopted as base figure the average value of the last three years;
- when traffic is new or strongly increased over the last three years, we have adopted the last figure as the base.

In spite of the risks of foreseeing beyond 10 years, we have extrapolated the trend for the next 20 years, in order to roughly anticipate the possible problems.
The following tables summarise the projections, whereas detailed tables are attached (table 4 to table 12).

Scenario n°1 (pessimistic scenario)

	BASE TRAFFIC	2005	2010	2020
CARGO (1000 TONNES)				
Ferry terminal	812	875	922	1 032
General cargo terminal	163	180	198	238
Oil and oil products terminal	3 397	3 540	3 720	3 817
TOTAL CARGO	**4 372**	**4 595**	**4 840**	**5 087**
SHIPS (CALLS)				
Ferry terminal	406	437	461	516
General cargo terminal	148	164	180	216
Oil and products terminal	927	850	888	916
TOTAL SHIP CALLS	**1 481**	**1 451**	**1 529**	**1 648**

Scenario n°2 (optimistic scenario)

	BASE TRAFFIC	2005	2010	2020
CARGO (1000 TONNES)				
Ferry terminal	812	1 486	1 734	1 965
General cargo terminal	163	213	270	349
Oil and oil products terminal	3 397	3 753	4 350	5 079
TOTAL CARGO	**4 372**	**7 944**	**9 242**	**10 741**
SHIPS (CALLS)				
Ferry terminal	406	743	867	982
General cargo terminal	148	194	246	317
Oil and products terminal	927	902	1 045	1 220
TOTAL SHIP CALLS	**1 481**	**1 839**	**2 158**	**2 499**

Scenario n°3 (medium scenario)

	BASE TRAFFIC	2005	2010	2020
CARGO (1000 TONNES)				
Ferry terminal	812	1 387	1 503	1 738
General cargo terminal	163	207	246	322
Oil and oil products terminal	3 397	3 645	3 813	3 817
TOTAL CARGO	**4 372**	**5 239**	**5 562**	**5 877**
SHIPS (CALLS)				
Ferry terminal	406	694	752	868
General cargo terminal	148	188	224	292
Oil and products terminal	927	876	916	916
TOTAL SHIP CALLS	**1 481**	**1 758**	**1 892**	**2 076**

From these tables it turns out that the overall traffic should increase by 10 to 45% between 2000 and 2010, depending on the scenario.

Increase rates from 2000 to 2010

	Pessimistic sc.	Optimistic sc.	Medium sc.
Ferry terminal	13.5 %	113.5 %	85.0 %
General Cargo terminal	21.5 %	65.6 %	50.9 %
Oil terminals	9.5 %	28.1 %	12.2 %
All terminals together	10.7 %	45.3 %	27.2 %

Attached tables n°4 to n°12 provide with full details about traffic projections.

3. Port finance assessment

3.1 Purpose

The purpose of this financial analysis is:

- first to review the current financial situation of Turkmenbashi port, which was assessed by financial auditors in 1998 and 1999;
- then to estimate the income share from the navigation channel, to help prepare the evaluation of the financial viability of the channel project.

3.2 Methodology

For the time being TML, which includes the port of Turkmenbashi, has no accounting system which could allow a detailed analysis of costs and revenues from various profit centres. Thus, as far as the navigation channel is concerned, accounts do not enable to clearly estimate incomes from dredging maintenance and from navigation aids maintenance. However, information related to the income from "Navigation Services" is provided in the port logbooks. According to official tariffs Navigation Services include:

	Tariff in USD	Allocation share
Ship services (vessel charges)	0.013 per m3	26 %
Maintenance of the channel	0.024 per m3	48 %
Maintenance of buoys	0.013 per m3	26 %
Total navigation services	0.050 per m3	100 %

Measurement of volume is computed by the use of the following formula:

Volume of ship = overall length x width x moulded depth of ship

Is it possible to deduct that channel dues do represent 48% of the total income from navigation services ? To answer this question we have estimated theoretical incomes, applying the official tariff to the vessels which really called at the Turkmenbashi port, using the above formula for ferries, general cargo vessels and oil tankers:

Income in thousand USD	1998	1999
Total official income from navigation services	1 903	1 886
48 % of above amounts	913	905
Theoretical estimates by direct calculation	914	757
Discrepancies	- 0.1 %	+ 16.3 %

Results of theoretical calculations appear to be rather close to the 48% figures. These latter will be used for forecasting future income from channel maintenance dues.

3.3 Channel maintenance dues

The following can be drawn from TSA accounts:

- income from port services is about 85% of TSA total income;
- income from navigation services is about 30% of port income;
- dues for maintenance channel represent about 10 to 12% of total income of TSA, or 12 to 15% of the port income.

Dues for channel maintenance are therefore one of the major incomes of the port, together with berth dues, significantly over revenues from handling services.

INCOME STATEMENT IN 1998 & 1999

Sources of income	Amounts in 1000 USD		Distribution of income / port income (in %)	
	1998	1999	1998	1999
Navigation services *channel dues share*	1 902.7 *914*	1 886.0 *757*	32.9 *15.8*	29.5 *11.8*
Berth dues	2 828.5	2 991.0	49.0	46.8
Cargo handling	614.6	915.6	10.6	14.3
Ferry services	17.1	13.8	0.3	0.2
Ship charter services	1 476.7	901.0	not included	not included
Other services	411.7	583.3	7.2	9.2
Total income (sum of above items)	7 251.3	7 290.6		
Port services	**5 774.6**	**6 389.6**	**100**	**100**
Port services / Total income	79.6 %	87.6 %		

Initial figures were in Manats
Official exchange rate, used for conversion: 1 USD = 5 200 Manats
Source: TSA Commercial Management

3.4 TSA operating expenses

The following table summarises TSA operating expenses for 1998 and 1999 (in thousand USD):

	1998	1999
Staff costs	1 733	2 641
Port services and equipment costs	996	1 119
Repair and maintenance costs	322	373
Depreciation	146	154
Other operating expenses	607	380
Total cost of sales	**3 804**	**4 667**
Administrative expenses	964	1 241
Selling and marketing expenses	296	189
Total operating expenses	**5 064**	**6 097**

Source: TSA Commercial Management
Initial figures were in Manats
Official exchange rate, used for conversion: 1 USD = 5 200 Manats

Operating expenses have increased by 20.4% from 1998 to 1999, labour cost being the major factor for this increase (in spite of traffic stagnation). However, this statement does not show the share of port activities in the total cost, which makes it difficult to assess the real financial situation of Turkmenbashi port.

3.5 Profit and loss account

The present analysis aims at estimating TML capacity to finance the channel project, it will serve as a base to calculate the impact of any new investment during the next ten years, according to the various traffic scenarios.

PROFIT AND LOSS ACCOUNT

(FIGURES IN THOUSANDS USD)

	1998	1999
Turnover	7 251.3	7 290.6
Operating costs of sales	-3 804.0	-4 667.0
Operating profit	**3 447.3**	**2 623.6**
Administrative expenses *(including doubtful debts)*	-964.0 *(22.7)*	-1 241.0 *(106.7)*
Selling and marketing expenses	-296.0	-189.0
Total operating profit before taxes	**2 187.3**	**1 193.6**
Financial charges	-76.3	-38.1
Other sales and non operational inc. & exp.	303.1	9.4
Profit for activities before taxation	**2 414.1**	**1 164.9**
Taxation on profit	-1 223.5	-1 012.5
Profit after taxation	**1 190.6**	**152.4**

Source: TSA Commercial Management
Initial figures were in Manats
Official exchange rate, used for conversion: 1 USD = 5 200 Manats

The above table shows that the increase in costs and taxes reduced the 1999 profit almost to nil, which leaves very little margin for new project financing.

The next step will consist in estimating income, charges and cash flows along the ten coming years, depending on traffic scenarios, on tariff hypotheses, and taking into account the loans already granted to TML for rehabilitation of port structures and for construction of a tanker vessel.

4. Possible environmental impacts

4.1 General

The proposed dredging of the main shipping lanes in the Turkmenbashi navigation channel may have various environmental impacts, both through the dredging activities and through the intended open sea disposal of dredging spoils. Maintenance dredging has been implemented previously in this area, especially during the period 1991-1999.
Dredging and disposal of spoils may result in direct or indirect environmental impacts on:

- Water quality (through increase of suspended solids and potential release of contaminants during dredging or disposal, as well as through leaching of contaminants from the disposal site)
- Habitats and natural areas (including habitat enhancement or creation, removal or destruction of benthos, smothering of local marine populations)
- Local communities
- Bathymetry or topography
- Physical processes (waves and currents, causing erosion or deposition)
- Recreation
- Economic activities (especially fishing)

A general review of international dredging conventions and guidelines, as well as a preliminary assessment of the possible impacts of dredging at the Turkmenbashi navigation channel are presented below.

4.2 International conventions and guidelines for maritime dredging

A number of international conventions have established guidelines for the disposal of dredged material. They are principally as follows:

- The London Convention of 1972
- The Oslo/Paris Convention (OSPAR)
- The Helsinki Convention

The London Convention is global, and the other two conventions are regional. The conventions were established to regulate the disposal of hazardous substances into the world's oceans to protect the marine environment and other legitimate uses of the sea.

The Dredged Material Assessment Framework (DMAF) replaced the 1986 Dredged Material Guidelines. Both were developed within the context of the Waste Assessment Framework, which technically implements the London Convention. The DMAF contains the following suggested steps for dredging activities:

1. Evaluate the need for dredging and disposal
2. As appropriate, characterise dredged material (chemical, biological, physical)

3. Evaluate disposal options
4. If open sea disposal is chosen, select disposal site
5. Conduct impact assessment
6. Issue permit
7. Conduct monitoring (including specification of baseline conditions and post-dredging monitoring)

The DMAF incorporates a risk-based assessment approach, which supports weighing ocean management of contaminated sediments against land-based and other alternatives. Open-water disposal normally is selected for clean or mildly contaminated dredge spoils.

The OSPAR guidelines, derived from the 1992 OSPAR Convention (which only covers disposal of dredged sediments, and not removal by dredging) are designed to assist in the management of dredged material to prevent and eliminate pollution and thus protect the marine environment. The dredging operators are encouraged to use a Best Environmental Practice (BEP) approach to minimise the quantity of material that has to be dredged, as well as the impact of dredging and disposal activities. The choice of dredging technology (e.g. mechanical, hydraulic, etc.) plays a key role in possible environmental impacts of the dredging operation.

In some cases low-impact dredgers can be applied to a particular dredging activity. This equipment reduces impacts by increasing the precision of the dredging operation, through reduction of over-dredging and minimisation of the suspension of bed material. In some cases existing dredgers can be adopted to this technology. Examples of this technology include encapsulated bucket lines for bucket chain dredgers, closed buckets for backhoes, closed clamshells for grab dredgers, and modification of cutter dredgers (auger dredger, disk cutter, scoop dredger and sweep dredger).

Dredged material characterisation is a critical part of the process. Exemptions from a detailed characterisation are often condoned for dredging of material that is composed of previously undisturbed geological material, or almost exclusively of sand, gravel or rock, or in the absence of appreciable pollution sources. The latter should be supported by existing local information to provide reasonable assurance that the dredged material has not been contaminated. Physical, chemical and/or biological characterisation are usually carried out (in that order) if the dredged material do not meet these criteria.

Characterisation of dredged material is used to support dredged material management decisions through application of criteria for specific substances. Disposing of dredging spoils at sea when one or more characterisation criteria have been exceeded requires mitigation measures to reduce the potential impacts of the dumping operation on the marine environment. The probable fate and effects of the dumped material is a key characteristic of open sea disposal, and are directly influenced by the physical conditions in the vicinity of the sea disposal site.

4.3 Local environment

Most of the Gulf of Turkmenbashi is part of the Khazar Nature Reserve (covering 262,000 hectares, 90 % of which is covered by water), which is frequented by migrating birds (over 10 million animals spend winter in the reserve) and other species, as well as permanent fauna and flora (there are about 500,000 birds living in the reserve throughout the year). The reserve extends to the south and east of the dredged channel for the Port of Turkmenbashi and the Ufra Oil Terminal, and encloses the Turkmenbashi spit. The Port of Turkmenbashi is located outside of the reserve, and is 5 kilometres distant at its closest point. Near the port, along Turkmenbashi spit, there are limited wetlands.

There are about 40 species of fish in the Khazar Nature Reserve. However, sources indicate that no commercial fishing takes place in the Gulf of Turkmenbashi, largely because it is enclosed by the reserve. The waters around the port are not believed to be a major spawning area for fish species. A small fishing fleet is located at the port, mainly for fishing outside the bay.

4.4 Possible local sources of bottom sediment contamination

The bottom of Turkmenbashi bay is characterised by sandy silts. Early investigations of sediment quality included analysis of oily substances in sediment at the port and the oil terminal. These analyses showed about 0.3 mg/g average oil concentration at the port, and 0.64 mg/g at the oil terminal. These were compared to and exceed the Dutch Target Level for mineral oil in water sediments of 0,05 mg/g, but are below the Dutch Reference Level of 1.0 mg/g. Thus, they satisfy the Dutch Government's criteria for disposal within the marine environment after dredging. Sediment studies carried out in the shipping channel by Kaspecocontrol in 1990 (required for the five-year dredging permit for 1991-1995) showed levels of oily substances ranging from 0.242 mg/g in the access to the 'city scoop' to 0.442 mg/g in the Ufrin scoop. These figures are also below the Dutch Reference Level.

Previous studies[1] indicated that the water quality in the port is relatively good. Concentrations of phenols and oily substances (measured by the East Caspian Inspectorate, now Kaspecocontrol, which reports to the Ministry of Natural Resources and Environmental Protection of Turkmenistan) were slightly above the regulatory standards. Sources of these substances are likely to be the oil port itself, offshore oil production in the vicinity of the Cheleken Peninsula, or tankers carrying crude oil or petroleum products.[2] Oily substances have been found in the soil and groundwater between Berth n° 16 in the port and the ferry terminal (the groundwater table is close to the ground level of the general cargo terminal). The source of this oil is not known, and the full extent of the contamination has not been determined.

There are very few industries around Turkmenbashi spit, aside from a refinery, a power plant, and the petroleum product depot. The Neftebaza facility at Ufra features two oil jetties, as well as onshore tank storage. Domestic wastewater generated in the port area (Turkmenbashi has a population of about 70,000) enters a holding tank, and then is transferred to the city's sewage treatment lagoon. Although solid waste management is purportedly adequate, disposal of waste oil might be improved. There are three underground storage tanks (USTs) at the port for diesel and gasoline of unknown integrity. There are no reception facilities at the port for bilge and ballast water, sewage and solid waste from ships. However, a service vessel (the *Crab*) picks up these waste streams and transfers them to the appropriate disposal or treatment facilities onshore.

[1] *Environmental Assessment Report, Louis Berger, 1997*

[2] *Tankers carry about 3 million tonnes of crude oil and petroleum products through the Port of Turkmenbashi annually*

4.5 Local legal and institutional framework

The Ministry of Use of Natural resources and Environmental Protection is responsible for implementing environmental legislation in Turkmenistan. Monitoring of coastal environmental conditions (including the port area) is the responsibility of Kaspecocontrol, which operates its own environmental monitoring laboratory and conducts quarterly sampling and analysis of water and sediment along the coast of the Gulf of Krasnovovdsk. The Environmental Protection Law (1991) provides guidelines for conducting environmental assessments in preparation for implementing engineering projects. The State Environmental Expertise Law (1995) requires the compilation of a document (an SEE) that is mandatory for most public and private projects. A permit for the dredging and disposal of dredging spoils will be required.

4.6 Recommendations to be developed next

- The validity of analytical methods and sample points for previous bottom sediment characterisation efforts should be confirmed. If necessary, additional studies should be implemented, and criteria should be established, in conformance with national and international standards.
- Assessment of planned dredging activities should take into account past dredging operations in the shipping channels and the Port of Turkmenbashi and oil terminal. During the Soviet era and till 1994, maintenance dredging at the Port of Turkmenbashi and associated shipping channels have been implemented through "multi-dredging" suction dredges that carry the dredging spoils. Then a new bucket dredger was supplied to the port (full data regarding dredged volumes are included in the chapter dealing with dredging equipment).
- The traditional site for disposal of dredging spoils (to the north of the entrance to the Turkmenbashi spit) should be studied, and new sites proposed and evaluated.
- The possible environmental impacts of the dredging and disposal operations and fate of disposed spoils should be evaluated, especially the possible impacts on the Khazar Nature Reserve.
- Possible sources of contamination (especially from oily substances) should be identified, and if possible the volume of contamination should be estimated.
- The impacts of previous dredging technologies should be assessed, and new technologies considered, within the context of technical and financial feasibility.
- Details of dredging permit requirements should be determined, and support for developing the permit provided.

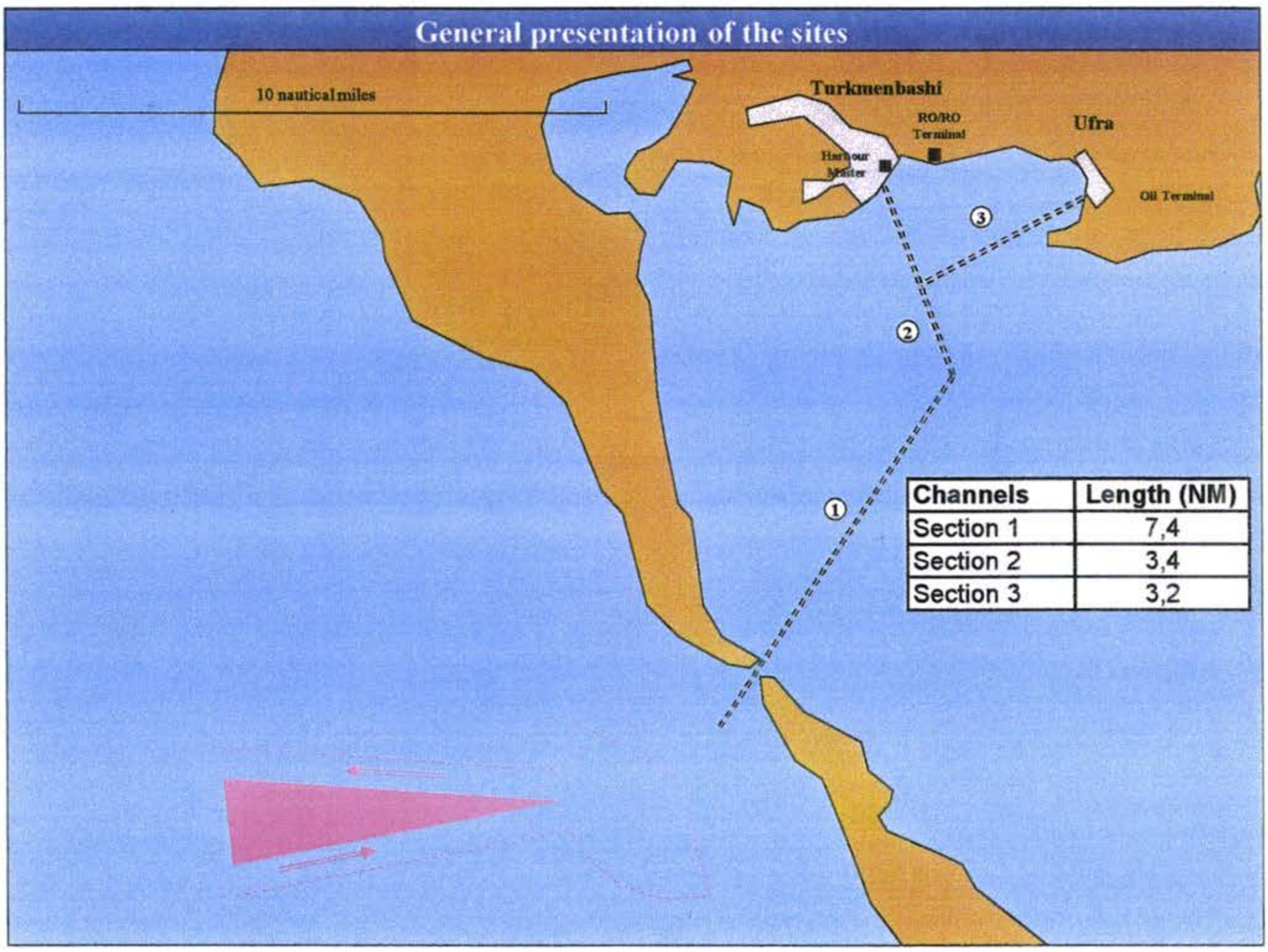
5. Navigation aids

5.1 General

Regarding problems related to navigation aids, from the open sea to the different parts of the Turkmenbashi harbour, mariners successively meet:

- A two lane Traffic Separation Scheme (TSS), situated at about 15 nautical miles from the harbour, which is not visible from the watch-tower;
- The narrow mouth, to enter the lagoon;
- The first section of the navigation channel (length: 7,4 nautical miles);
- The second section of the navigation channel, leading to the port of Turkmenbashi and to the ferry (RO-RO) terminal (length: 3,4 nautical miles);
- The third section, leading to the Ufra Oil Terminal (length: 3,2 nautical miles).

TSS is not marked and there is no true landfall buoy at the mouth entrance.
Mooring areas inside the lagoon are correctly sized for the present traffic and could easily be extended to cope with a larger traffic. These areas are not marked, they are simply reported on the charts.



Channels	Length (NM)
Section 1	7,4
Section 2	3,4
Section 3	3,2

5.2 Aids to Navigation

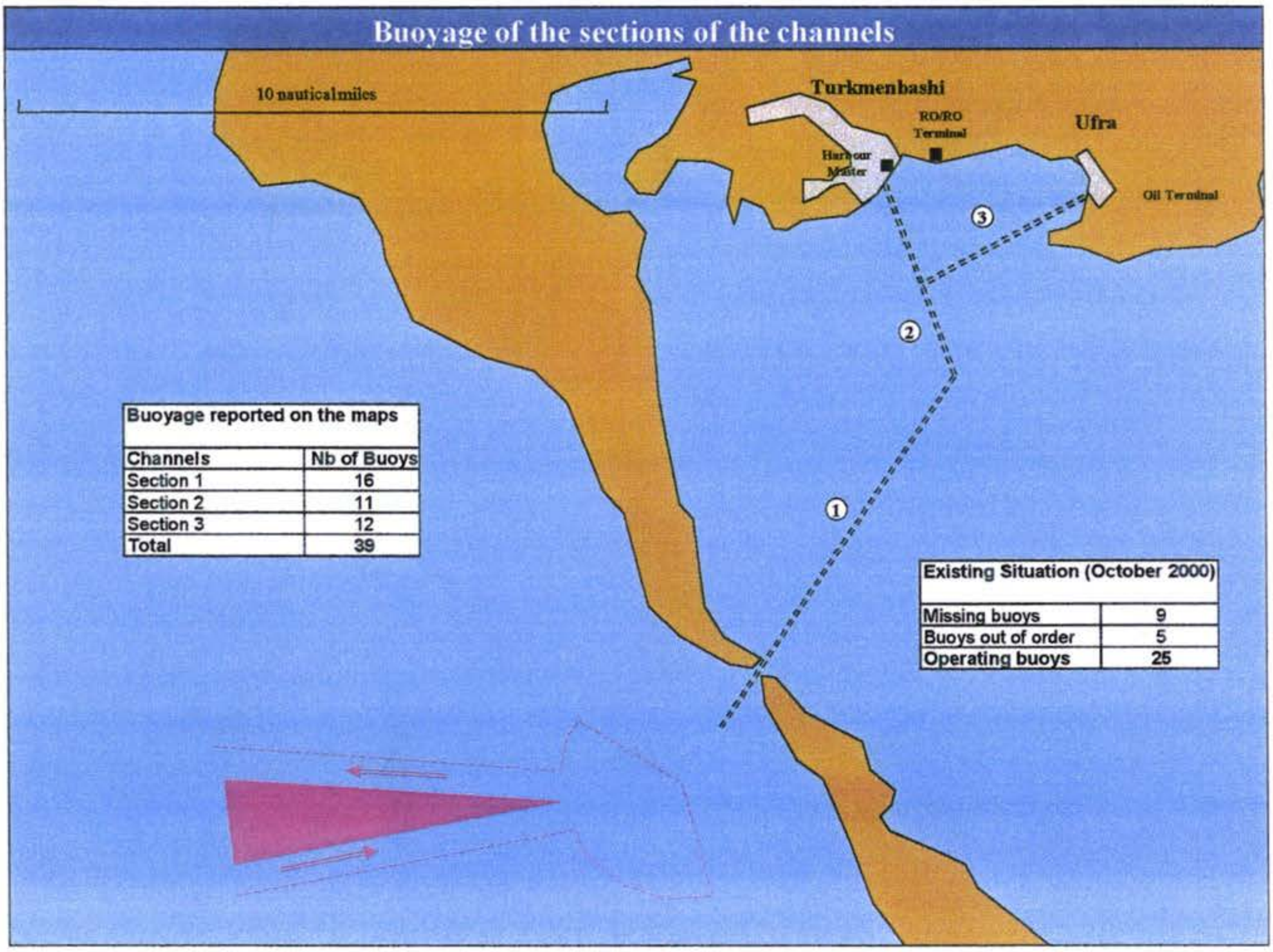
5.2.1 Landfall buoy

As already said there is no true landfall buoy but port buoy n°2, located at the eastern head of the TSS, is used as a landfall buoy:

5.2.2 Lateral buoys

i) Number and position of buoys reported on the charts
A total of 39 buoys are distributed along the 3 sections of the channel. Average distance between buoys is 0.5 nautical mile; most of them are arranged in staggered rows; a few of them form gates.

ii) Present situation
Out of these 39 buoys, 9 buoys are missing and 5 buoys are completely out of order.



iii) Description of the buoys

The buoys were built in the 1940's by USSR manufacturers.

<u>a) Hull, colours, identification, top marks and mooring lines</u>

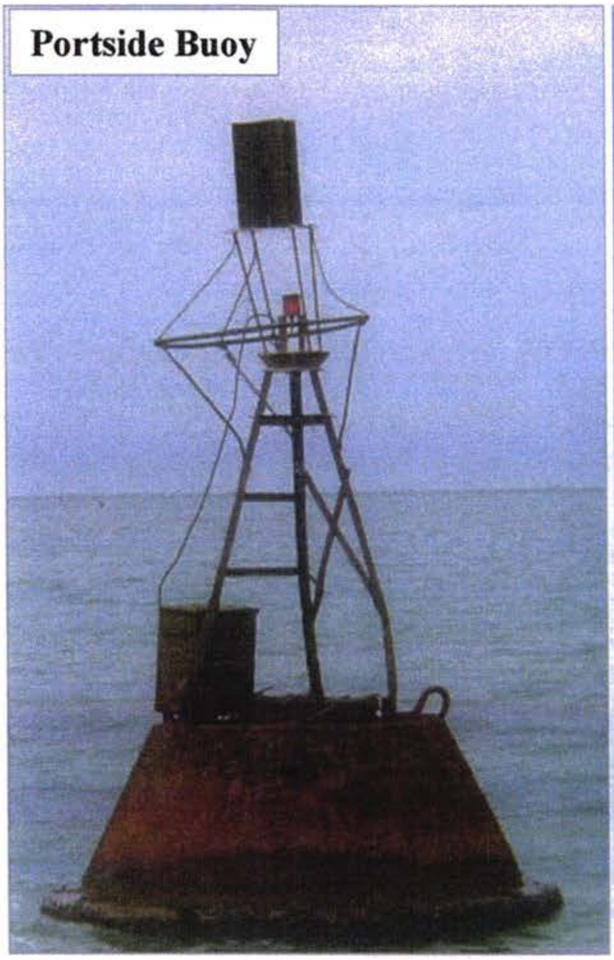
The buoys are made of steel, their volume is about 2.5 m3 and their light focal is about 3.6 m above sea level. Out of the 25 operating buoys, most of them are deeply corroded and have lost their colour, their identification panels and their top mark. Mooring lines are made of steel chains; their length is twice the water depth.

<u>b) Lights</u>

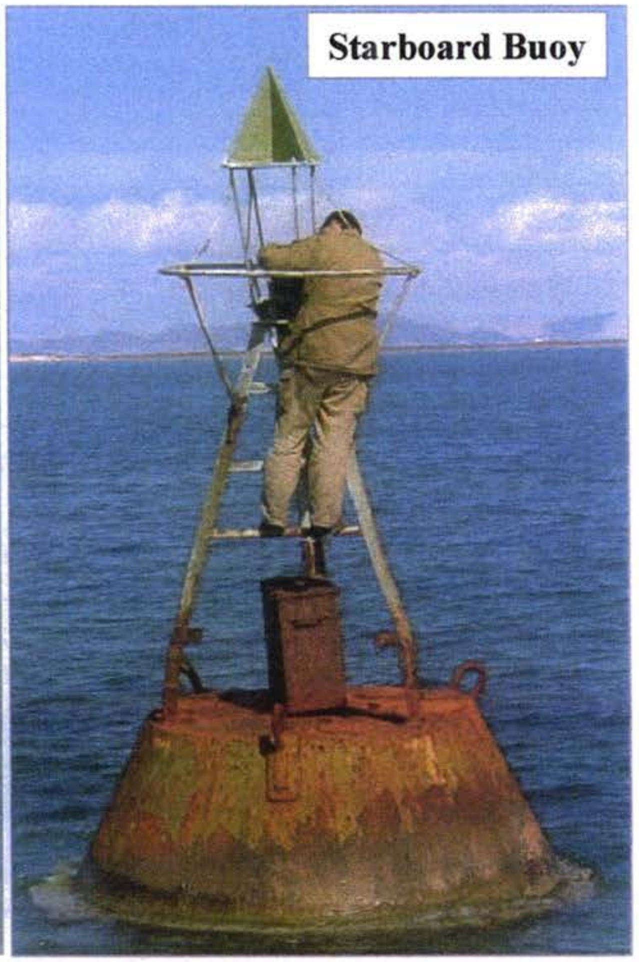
The range identified by the expert on the site is below 500 meters. The lights are fitted with four-position lamp changers. Lights are operated day and night, they are not synchronised.

<u>c) Power supply</u>

Lights are powered by 6 volt batteries.

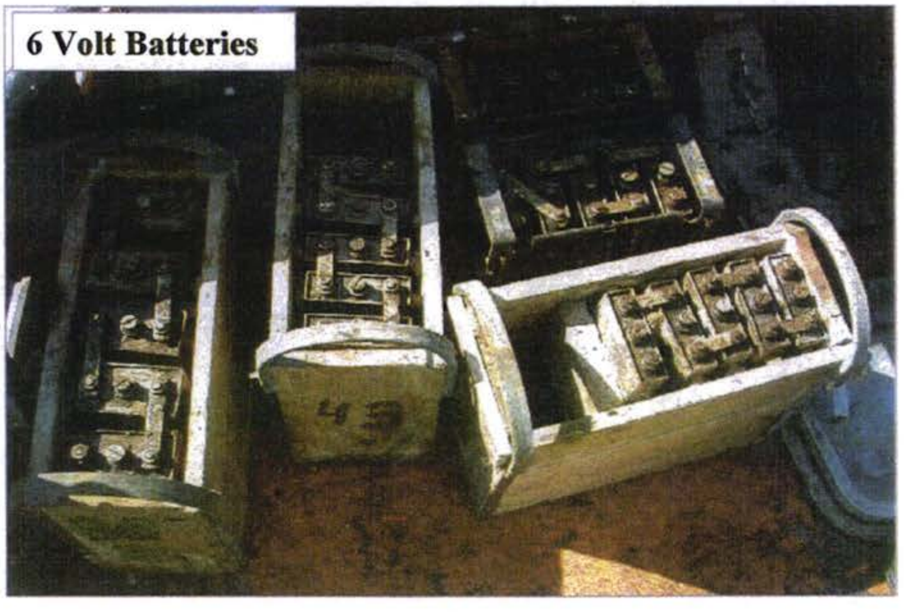


Portside Buoy



Starboard Buoy

Buoy light



6 Volt Batteries

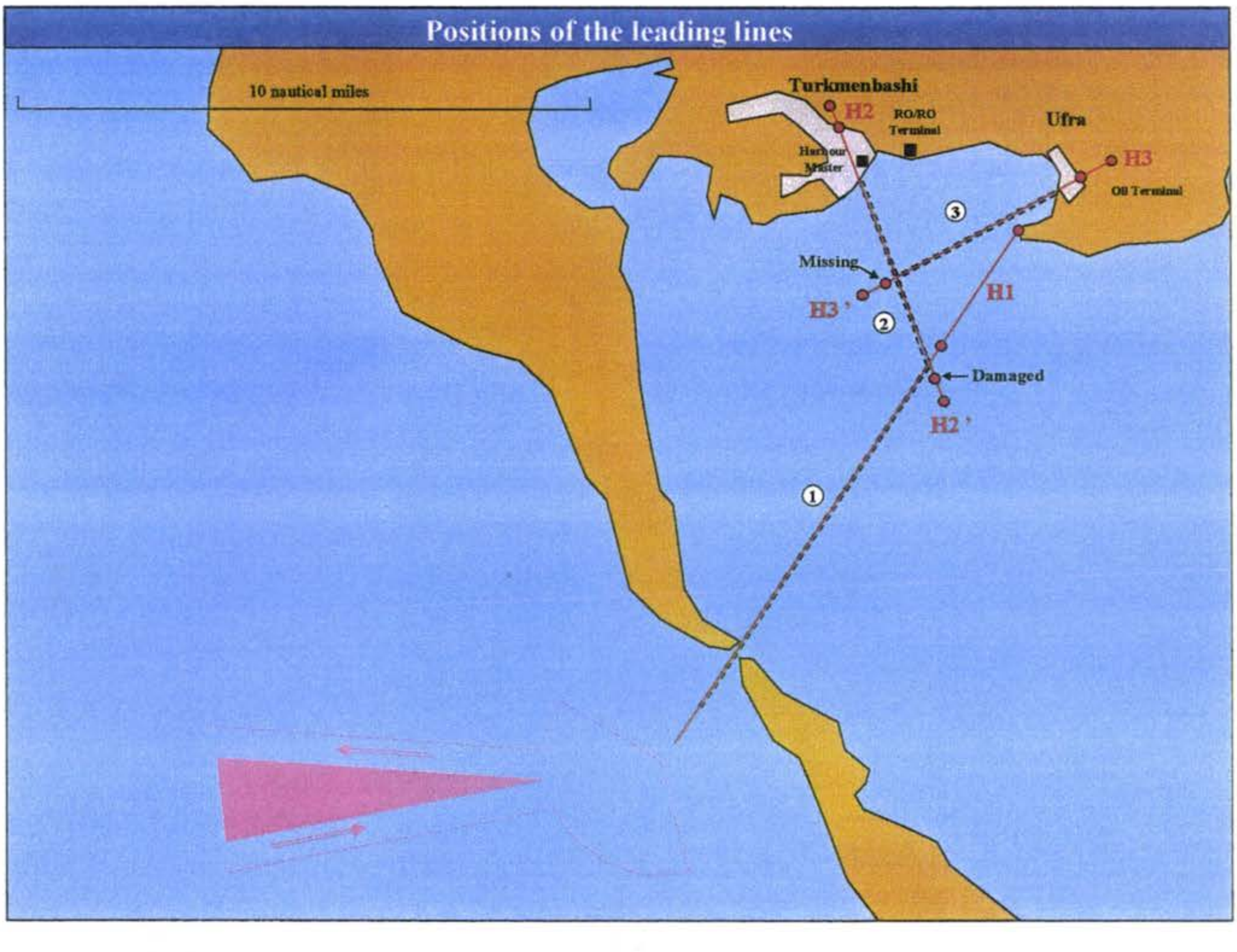
5.2.3 Leading lines

i) Number and position of leading lines reported on the charts

Five leading lines are reported on the charts as follows:

- H1 is used to sail from the sea to the port in section 1; it consists of a rear shore-based tower and a front offshore tower.
- H2 is used to sail from the sea to the port in section 2; it consists of rear and front shore-based towers.
- H3 is used to sail from the sea to the port in section 3; it consists of rear and front shore-based towers.
- H2' is used to sail from the port to the sea in section 2; it consists of rear and front offshore towers.
- H3' is used to sail from the port to the sea in section 3; it consists of rear and front offshore towers.

Shore-based towers are made of lattice steel with wooden identification boards; lights are powered by the mains. Offshore towers are made of cylindrical lattice steel with wooden identification boards; lights are powered by batteries.



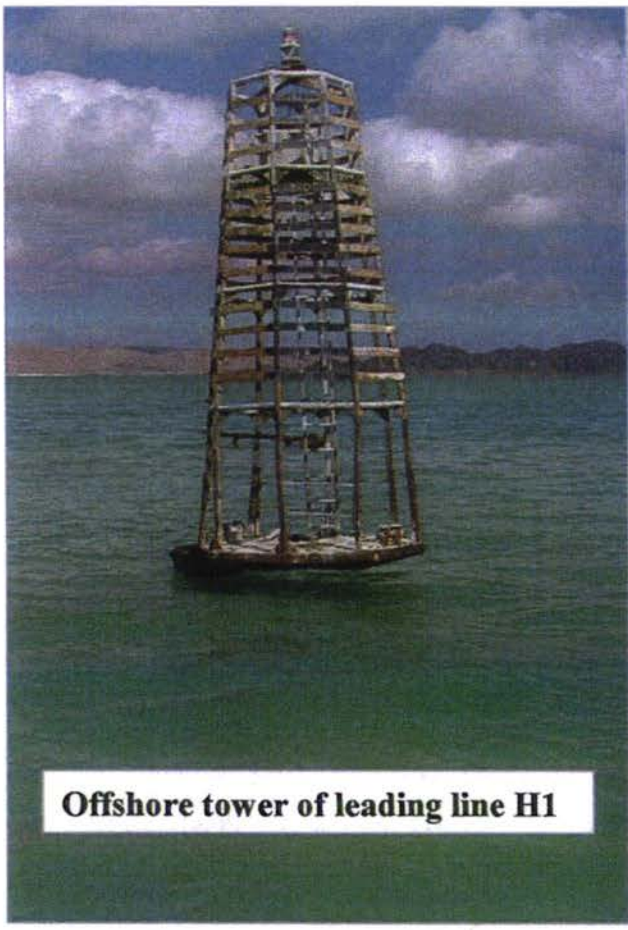
Positions of the leading lines

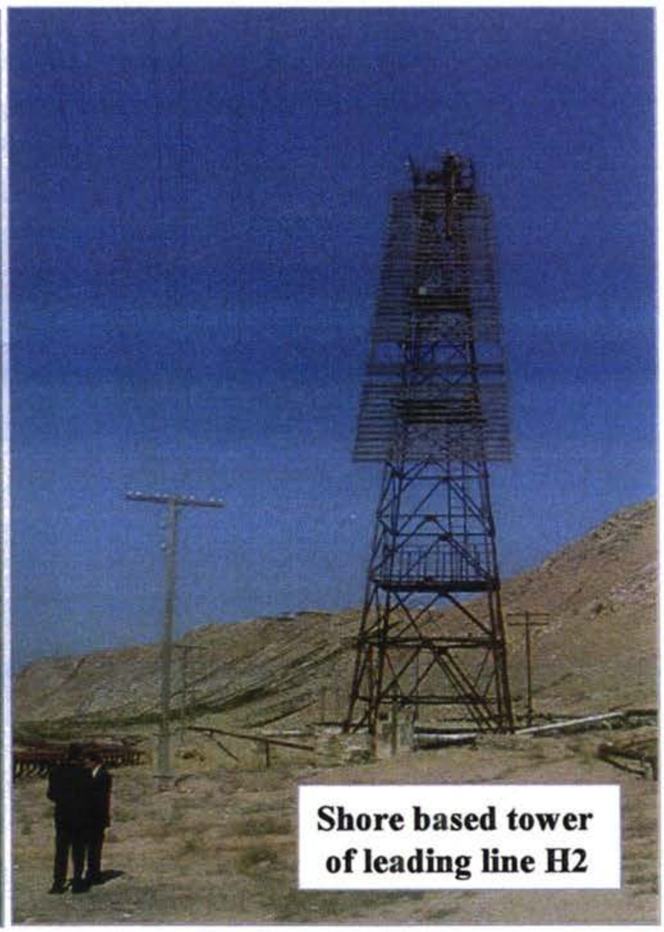
ii) Present situation

Leading line H2' is out of order because the front offshore tower is damaged.
Leading line H3' is out of order because the front offshore tower is missing.

iii) Description of leading lines

Leading lines H1, H2 and H3 are correctly operating at night, with fixed red lights.
All towers are deeply corroded and have lost their colours, consequently their day appearance is poor.





5.2.4 Remote monitoring

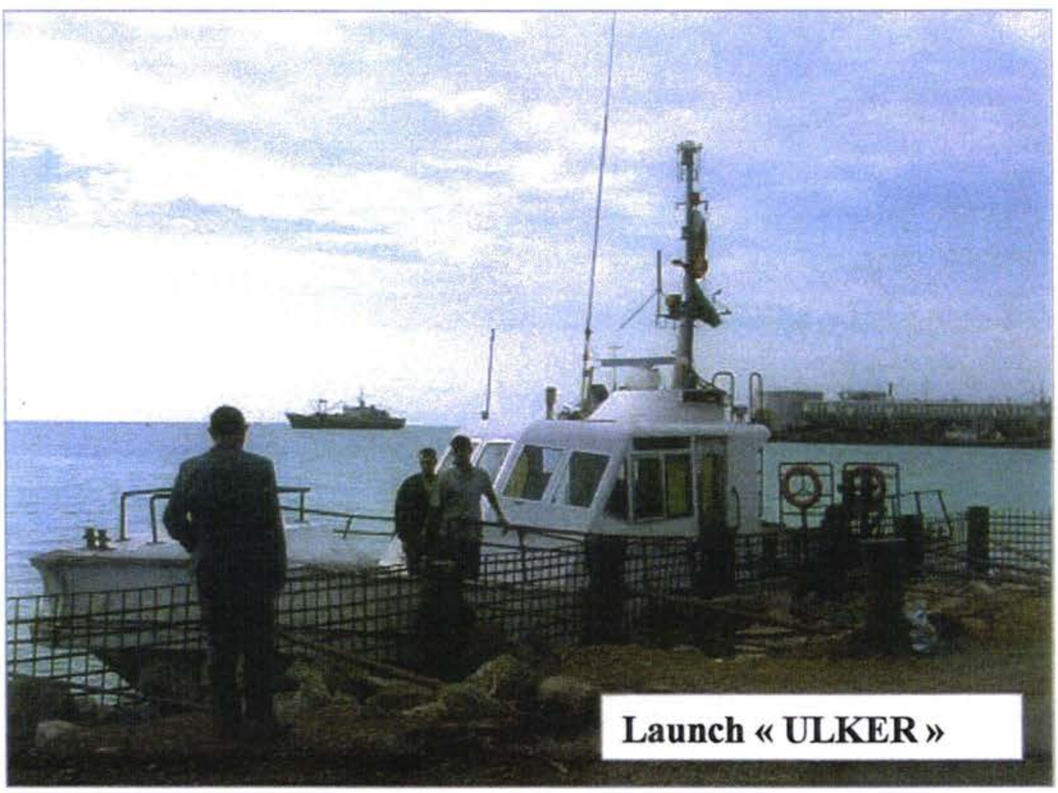
There is no remote monitoring, neither for the buoys nor for the leading lines. Failures can simply be reported to the harbour master by mariners.

5.2.5 Maintenance ships

The port maintenance department operates:

- A buoy tender fitted with a crane, which is in satisfying working condition.

- The "ULKER" launch, built in Norway in 1989, 8 knot cruise speed, in acceptable condition; this launch is used to change batteries and lamps.



Maintenance operation

5.3 Vessel Traffic Service

5.3.1 Missions

Missions of the Turkmenbashi Vessel Traffic Service (VTS) are:

- To enforce regulations inside the Traffic Separation Scheme located West of the channel mouth.
- To improve safety of navigation through the mouth, inside the channel, inside mooring areas and near the berths.
- To ensure a safe and efficient planning of ships movements.

5.3.2 Operators and equipment

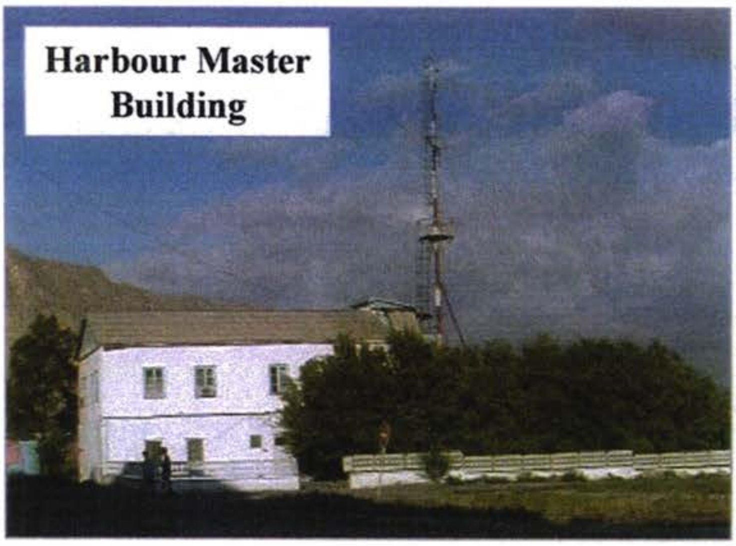
The watch-tower is located on top of the Harbour Master's building; surface of the room is only 3 square meters and, from this place, the operator cannot see the channel mouth.
Only one operator at a time can be present in the watch-tower; they usually work 24 continuous hours then have three-day rests; there are five operators to ensure watch-keeping all the year round.

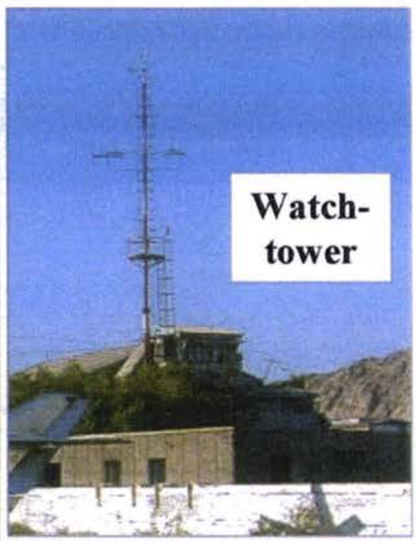
No radar equipment is available, all contacts with ships are made by radio communication by the mean of an old Russian VHF radio set (SEINER type), which does not work very well, luckily complemented by a new MOTOROLA GR 350 type radio operating in a range of 15 nautical miles; this range allows to ensure contact with vessels inside the offshore Traffic Separation Scheme.

There is no computer in the watch-tower, all vessel lists and logs are hand-written and stored on paper sheets showing:

- Ships about to call at the port, with Estimated Time of Arrival
- Ship berthing time and location
- Ship mooring
- Ships which have left
- Weather forecasts

The mast supporting signals and radio antennas is installed on the watch-tower.





6. Evaluation of existing port dredging equipment

6.1 Dredging fleet

Bucket chain dredger (one unit):

- Name: SAGADAM
- Built in 1993 in the Leninskaya Kuznyia shipyard, Kiev, Ukraine
- Delivered to the Port of Turkmenbashi in 1994
- Overall length: 66,4 m
- Width: 12,2 m
- Draft: 3,6 m
- 34 buckets: 900 kg capacity each (~ 750 litres)
- Main generator: 500 kW (propulsion and dredging)
- Total power: 700 kW
- Cruise speed: 6 knots
- Accommodation : max. 40 crew members
- Maximum dredging depth: 10 m
- Classification: none (neither Lloyd nor Veritas nor any other)

Barges (two self-propelled barges):

- Names: GYYANLY and AWAZA
- Built in: 1984 and 1994
- Length: 47,34 m
- Width: 8 m
- Draft: empty: 0,82 m
  loaded: 1,94 m
- Capacity: 250 m3
- Speed: unloaded ~ 4 knots
  loaded ~ 3 knots
- Condition: good, but need to be sent to the floating dock
- Power of engine: 165 kW
- Careened in: 1997, in Turkmenbashi
- Classification: none (neither Lloyd nor Veritas nor any other)

Anchor boat (used for shifting dredger anchors):

- Power of engine: 150 kW
- Lifting capacity: 3 tonnes

Survey boats:

Actually there is no real survey boat for hydrographic purposes.
The ARZOV boat (450 kW, built in 1959, length = 28,6 m, width = 5,2 m, draft = 1,74 m, speed = 12 knots) is equipped with an echo-sounder which is currently out of order.
The GAYRAT tug boat (330 kW, built in 1993, length = 26,75 m, width = 6,5 m, draft = 3,2 m) is equipped with a recording echo-sounder which is working but which cannot record because of lack of paper. This tug boat needs to be dry-docked for regular maintenance.
Besides, these two launches are far too big for survey purposes. Hydrographic surveys are made from time to time with a smaller boat, using a hand operated probe.

6.2 Remarks on the bucket dredger

- This dredger is not old at all (7 years old only).
- Its staff is 28 crew members (14 members x 2 shifts).
- Each shift lasts 12 hours when the dredger is in operation and 8 hours when the dredger is idle.
- At present the dredger has almost no activity, partly because the Caspian sea level is high.
- It operated in January, February and March 1998, also in February 1999. Dredging was only in the offshore part of the channel and in the mouth.
- Before 1998 all dredging works were made by a dredger coming from Baku.
- The dredger is in good condition, well maintained by its permanent staff; all engines are working a few hours every week.
- However, there are some problems with electrical panels, but the crew said that they should be fixed soon.
- There is also a lack of positioning system.
- Since its arrival in 1994 in Turkmenbashi, the dredger was never dry-docked.

6.3 Dredger productivity

The dredger productivity is weak. In Western Europe capital costs and running costs for such dredgers are usually high, in terms of costs per dredged cubic meter. Such dredgers are almost no longer used in Western Europe, except for very specific purposes.
The equipment is heavy, taking into account its low production. It is necessary to use two barges (the dredger and the barges are all self-propelled).
It is quite suitable for soft and consolidated mud, also for rather hard material.
The main advantage is that this kind of dredger minimises mixing of dredged material with sea water. As far as environmental issues are concerned, it is therefore a good dredger, particularly for mud dredging inside the bay.

According to the dredger master the production capacity is 70 m^3/h x 24 x 0,6 = 1000 m^3/day
or 1000 m^3 x 26 days / month = 26 000 m^3 / month,
which is much lower than the manufacturer's figures:

- 900 m^3 / h , average difficulties, optimal depth, speed of claim: 20 buckets / minute;
- 600 m^3/ h, heavy soil, optimal depth, speed of claim; 14 buckets / minute.

When considering 600 m^3/ h and 60% efficiency, the theoretical monthly rate reaches 225 000 m^3/ month, i.e. 225 000 m^3/ month x 10 month / year = 2 250 000 m^3/ year.
Some tests were made in the Turkmenbashi bay with soft material, outside the channel, including plenty sea grass. A barge was filled in about 30 minutes, i.e. approximately 500 m^3/ hour.

6.4 Dredging records

Information collected at the port in August 2000 shows the following dredging records, till 1990 (global annual dredged volumes in the whole channel):

1978	840 000 m^3
1979	925 000 m^3
1980	1 130 000 m^3
1984	895 000 m^3
1985	912 000 m^3
1986	1 110 000 m^3
1987	707 000 m^3
1988	1 019 000 m^3
1989	746 000 m^3
1990	728 000 m^3

These figures are on the high side. The main reason is that between 1975 and 1985 the water level in the Caspian sea was low. After 1990 dredging quantities were very small; operations only happened in the channel mouth and in the two elbows.
No dredging operation happened from 1991 to 1994.
There was some dredging at the end of 1997 and at the beginning of 1998. 117 barges were filled. Approximately 30 000 m^3 of sand was dredged in the entrance area. There were no major problem with the anchors (which have stability problems in muddy areas).
Some dredgings were also made in February 1999. 73 barges were filled. Dredging works were interrupted before end.

6.5 Equipment prices

Some data was provided by the port, showing theoretical values supposed to be valid in 2000:

Dredger *	2 813 000 000 Manats
Barge 32	170 000 000 Manats
Barge 65	240 000 000 Manats
Anchor boat	77 000 000 Manats
Total	3 300 000 000 Manats

** It was said to the consultant that the dredger was paid to the Ukrainians with fuel oil (or with gas)*

7. Sedimentation regime in the navigation channel

7.1 Introduction

To ensure the continued accessibility of navigation to the port of Turkmenbashi, a survey of sedimentary dynamics along the access channel was programmed in order to review all existing data and perform some field investigations. The aim of this survey is (1) to give a synthetic view of sedimentation problems along the channel and in the adjacent areas, as well as of the evolution of the shore equilibrium, and (2) to propose some solutions to alleviate the maintenance cost of the channel within a reasonable budget.

The present report deals with the first objective and describes the geographic environment, the dynamics and the evolution of the Turkmenbashi channel area.

The port of Turkmenbashi is situated in the inner part of a shallow bay along the eastern shore of the Caspian Sea and is linked to the open sea by a 8 mile long channel, initially dug to a depth of about six meters through the natural muddy bottom of the bay, for the inner part, and through a major spit of sand towards the sea. The cut through the sand spit allows a significant reduction of the length of trans-Caspian journeys in comparison with the route of the natural southern exit of the bay. Most sedimentation problems arise in the area of the cut, the channel in the bay being almost stable.

The idea to cut through the spit arose at the beginning of the XX° century, but detailed studies were only made in 1941 and the actual work in 1956. The canal through the spit was subsequently enlarged from 70 to 140 m with depth up to 7 meters. Detailed surveys of the evolution of the channel in the spit area were carried out in 1963, 1969 and 1989. They show a large variation of natural conditions along the shore and in the channel. No recent field survey seems available, out of a 1999 channel bathymetry and our own observations.

7.2 Main features of the coastal regime

7.2.1 Geo-morphological setting

The eastern coast of the Caspian Sea is characterised by the development of desert and steppe areas and by the existence of very large valleys which join the sea level without any slope on the coast: such is the case in the north-eastern part of the Turkmenbashi bay, as well as in the whole of the Karabogaz-Turkmenbashi lowland area.

The Kudabag mountain, which rises just beneath the Turkmenbashi bay and the port, belongs to older geological series, often covered by the Oktumkum sands. To the west, lagoon and saline formations represent the final part of geological deposits, underlining a general evolution of the Caspian basin towards continentalisation.

In the south of the Kudabag and its western termination at Cape Tartar, lowlands form a long sand spit stretching towards Cheleken and bordering the Turkmenbashi bay, which is also partly closed from the south by an other major sand system, the Cheleken spit. Between the heads of both spits lies the natural entrance of the Turkmenbashi bay, only 18 km wide.

The development of those two major sand formations is obviously linked to wave action, and specifically to the obliquity of the most important of them along the shore, coming from north-west. It is through the medium part of the Turkmenbashi spit, where the width of the spit was reduced to about 700 m, that the new channel of Turkmenbashi port was opened, cutting the spit in two parts and isolating the southern part from the main source of drifting sediments.

Turkmenbashi and Cheleken spits are not recent accumulations and a geo-morphological analysis put an evidence of a progressive growth of the Turkmenbashi spit where four successive sandy or lagoon formations marked its extension to the south and the increase of its width, following stages of decreasing sea levels (at a geological rate).

From Cape Tartar, the Turkmenbashi spit stretches from north-west to south-east along 45 km. It forms a huge reserve of sand, of which a small part only is still active along the sea coast. Small rocky islands adjoin the main sand body and are themselves at the origin of small secondary spits.

The sea bottom west of the spit is covered by middle-grained sand gently sloping and deposited mainly by waves but bottom shapes are irregular because of the resurgence of water springs and the presence of basaltic outcrops.

On the contrary, depths in the bay are very small. The maximum is 4 m along the eastern shore of the spit, but northern and eastern parts of the bay are shallow areas with depths smaller than 2 m at 1 km away from the coast. The sediment is there a muddy silt often covered with sea grass.

7.2.2 Meteorological and climatic data

The climate of Turkmenbashi bay is characterised by a hot summer, a mild winter and a very small amount of rain. The average annual quantity of rain is 89 mm, but can vary from 33 to 166 mm, the number of rainy days being on average 34. Rough rains in the plains allow transport of fine sediments up to the sea coast and especially to the shallow bays.

Wind regime of the bay is very seasonal: in winter, winds from eastern and south-eastern directions are prevailing. During spring and summer, north-western and northern winds are blowing with an occurrence of 24 % for velocities from 6 to 9 m/s. In autumn, north-western and eastern winds prevail. Annual occurrence of storm winds (speed >14 m/s) is 2,3 %, they are observed mainly from north; the maximum observed speed was 34 m/s and the duration of storms is generally 6 to 12 hours.

Finally, it is the occurrence of winds of the northern quadrant which is the main factor for the evolution of the sea coast along the Turkmenbashi spit.

7.2.3 Hydrology and sea-level variations

In winter, from November to March inclusively, short period level fluctuations and strong waves can be generated by rapidly developing wind fluctuations over the Caspian Sea area. On the contrary, main periods of still water occur from May to July. An outcome of such fluctuations is the existence of currents through the Turkmenbashi spit, between the bay and the open sea, and variations in the wave drift regime.

a. Wave regime

In the bay, only short period waves are produced by the winds, because of the very limited depths, and, at least in the channel area, because of the short fetch under which north-western winds blow. The average height of waves is 0,3 m with a 2,9 s period, the maximum observed height being of 1,8 m with a period of 4,8 s, over 3 m depths.

On the sea side, the situation is different in the open sea and in the neighbourhood of the channel entrance, due to refraction of waves around two rocky outcrops forming a screen and transforming incoming north-western waves into west and south-western waves at a distance of 500 m from the shore.
The most important waves in the open sea come from the south with a significant height of 1,6 m on 5,0 m depths, with a period of 7,7 s, but maximum height can reach 2 m. Waves from the northern quadrant reach the maximum height of 2,6 m in storm conditions and are prevailing all over the year.

In less important depths and particularly at the entrance of the channel in the spit area, the average height of waves is only 0,4 m with a 4,4 s period. But the widening to 350 m of the outer channel has allowed a significant increase of penetration of storm waves up to the shoreline, damaging the beach slopes and increasing erosion of the shoreline.

b. Sea-level variations

Without any connection with the world ocean, the Caspian Sea level is practically insensible to the astronomical tide, but shows short term variations linked to meteorological and climatic influences, as well as long term general and non-periodical disturbances which have been precisely recorded since 1830. The reference level is fixed at 28,00 m below the Baltic Sea level as measured in Kronstadt harbour.

During the period comprised between 1830 and 1930, the level kept a relatively stable value close to an average of 26 m BSL, water balance of the Caspian Sea depending upon natural climatic conditions. Beginning from 1930, the level fell permanently despite some irregularities, up to an extreme low of -29,12 m BSL in 1977: agricultural developments in the Volga basin and other basins are considered to be the main cause of such a change.

Since 1977, the Caspian level has increased, trespassing the reference level in 1985. It is currently situated at 0,80 m above it, due to more favourable climatic conditions, but it seems that we are still lacking a general theory of such a phenomenon. From the highest level, observed in 1869 (-25,51 m), to the lowest in 1977 (-29,12 m BSL) the amplitude of the fluctuation of sea level reaches 3,61 m.

The annual amplitude of the variation of sea level is extremely changing (e.g. +31 cm in 1979 and +2 cm in 1984), potential changes in the trend cannot been written out.

Following some projections by the Danish Hydraulic Institute (ref. 6), the lowest possible level could be close to -30 m BSL with all the consequences for the navigability of the Turkmenbashi channel and of the harbour installations (max. might reach -25 m BSL). Previous Russian models gave the prediction of a large increase of the sea level, in relation with some major climatic changes in Eurasia around 2000.

Out of the general trend of annual variation of the sea level, annual climatic conditions have also an influence, an increase of the level being recorded from April to July with an average of 20 cm above annual level, and a decrease from July to February (minus 11 cm).

c. Sea-levels and currents in the channel

Temporary fluctuations of sea level are also connected with water flows, itself linked to wind currents. If wind effect can be sensible in the open sea as a whole, it is almost negligible within the Turkmenbashi bay, also in the access channel through the sand spit.

More precisely, the level regime of the access channel and the bay reflects the fluctuations of the bay level and on the other side those of the open sea. At the seasonal level, the minimum is in winter and the maximum in summer on both sides and the main disparities between bay and sea are linked to the movement of prevailing winds; short term variations of level during strong storm winds of NW reach 50 cm on the seaside entrance of the spit, 40 cm bay-side. During storms of SE direction, level fluctuation can reach 49 cm on bay-side entrance and 41 cm on sea-side.

Within the part of the channel through the spit, strong currents may be related to those level fluctuations, the type of fluctuation being obviously of different direction (plus or minus) on each side of the spit, thus allowing level differences of up to 80 cm between sea and bay. *Velocity of currents related to such a situation have been measured up to 2,6 m/s in the mouth area. Furthermore, current directions in the mouth are usually not parallel to the channel axis, which makes navigation very risky.*

Under the prevalence of north-western winds, higher levels and related incoming currents are observed on the sea-side with a 46% occurrence. Currents coming from the bay-side represent 38% of the cases. Duration of level fluctuations is limited to 6-8 hours in general with an average of level variation of 4,5 cm/hour.

Direction and velocity of currents in the canal are not constant and can change within a short period of time (about one hour) depending on the change of the difference of levels between bay and sea. Almost 40% of the currents which velocity is more than 0,1 m/s are in the sea-to-bay direction, 30% come from the bay. The former are related to NW, W and N winds, the latter to E, NE and SE winds.

Currents in the channel are of the same direction from bottom to the surface, their maximum velocity is in the axis of the canal and the speed diminishes closer to the shore. On the sea bottom, maximum recorded speeds reach 1,6 to 2 m/s and are measured not only in the channel through the spit but also in the bay and in the open sea at a distance of 200 to 400 m of the spit, depending on the importance of the wind. Beyond that zone, velocities suddenly decrease and this can be at the origin of intense sedimentation of sand in the channel.

7.3 Hydrodynamics and sediment transport around the Turkmenbashi spit

Most navigation problems in the Turkmenbashi access channel occur in the vicinity of the cut dug out at the narrowest part of the sand spit, mainly because such an artificial cut in the medium part of the length of a powerfully developed sand spit strongly perturbes a previous natural sedimentary equilibrium on the shoreline itself, but also within the shallow areas of both sides of the channel cut.

7.3.1 Sedimentary equilibrium on the spit shoreline prior to channel digging

As usual on world shorelines, it is under the influence of prevailing waves that the development of the sea coast of the Turkmenbashi spit went on during the quaternary period, with the formation of large sand deposits along the coast and in the neighbouring shallow areas.

The progressive closing up of the bay behind the sand spit, where wave development is very limited, allowed the accumulation of fine muddy and silt material on the bay side of the spit and inside secondary lagoons.

As previously seen, winds in that part of the Caspian Sea are mainly blowing from the north-western quadrant and generate waves which direction reaches the shore with a very significant obliquity, responsible for sand drift and for general accretion of length and width of the spit.

Each irregularity in the bathymetry of the coastal waters, namely the presence of rocky outcrops or shallow banks, introduces a fluctuation in the pattern of the propagation of waves and changes the intensity and/or the direction of drift. The limited width of the spit at the location of the future channel, compared with the importance of northern and southern parts of the spit, is linked with such particularity. That does not mean that sand transit is less important in this area, but that agitation regime is strong enough to reduce the natural trend to beach deposit.

A very specific pattern of sedimentary dynamics in the Caspian Sea is linked with the relatively short term fluctuations of sea level, especially the constant decrease observed from 1930 to 1977, which amounted for instance to a variation of -2,40 m between 1930 and 1955. Such a rapid regression brought the drainage of big parts of underwater sediments towards deeper areas and, on the other hand, to the accumulation of more sand deposits on the beach. All these moving sands are prone to nourish the intensity of sand drift: the length of the new southern claw of the spit increased by 4300 m from 1935 to 1956.

Constructed in 1957, the new channel stopped the flow of drifts. This led to a deficit of sand on the south of the cut and introduced a trend to erosion along the southern sea coast.

7.3.2 Evolution of the channel area since mouth opening

The construction of the canal through the spit caused an intensive erosion of the body of the spit, mainly along the seaside coast and at the entrance of the canal. Huge quantities of sediment were also washed away through the canal, inducing sand depositions seaside or bay-side, following the prevailing currents.

a. Data from 1957 to 1989

Two main surveys of the evolution of the channel in its part through the spit were undertaken in 1970 and in 1989. Using data from bathymetry and dredging, they provide a picture of the general frame of dynamics in the area, as well as details of fluctuations in the morphology of the bottom of this part of the channel. The major part of the material used here comes from the very comprehensive 1990 report (ref. 3).

Three different periods of evolution are to be considered, depending on the way and the magnitude of the variations of sea level: 1957-70, 1970-77 and 1978-89.

1) The period 1957-70 is considered to be one of a relative stabilisation of the level of the Caspian Sea, with a variation of less than 20 cm from the average level for 13 years: -28,41 m. The erosion of the body of the spit reached 50 m on a length of more than 1km on each side of the axis of the channel. Along the canal itself, the shoreline recessed on 100 to 150 m.
On figures n°5 and n°6, the direction of the drifts and the deposition trend areas are sketched for both prevailing waves directions, NW and SE.
A tentative to alleviate the sedimentation problem in the channel was undertaken in 1963 with the building of a kind of groin north of the channel entrance. The groin was meant to retain sands drifting from the north towards the channel. Unfortunately, the construction made of three sunk vessels and dredged material was not anchored enough in the sea bottom and the root of the groin disappeared in the sand, allowing the drift to go on southward, like before construction.
During all the period, the dynamic axis of the flow at the sea entrance was displaced by the growth of a sand body forming a kind of jut or hook on the north-western end of the spit (Fig. n°7), thus eroding the south-eastern shore of the cut. In 1969, the axis of the canal was 30-40 m south-east of its primitive location. The new beach constructed at the NW entrance of the channel was dislocated during NW storms and contributed to the narrowing of the width of the channel.
In the part of the bay adjoining the canal, the bottom was washed away at a rate of 0,1 to 0,3 m/year and along the banks of the canal vast shallows were formed. Far south, the growth of the southern claw of the spit decreased from 240 m/year to 10 m/year only.
Considering such stable level conditions, and despite the importance of observed sedimentary movements, the 1969 survey concluded that a balanced profile could be maintained for navigation purposes with a dredging programme limited to an operation every two or three years.

2) In the period 1970-77 happens a sharp decrease of the Caspian Sea level: 0,65 m down to the mark -29,12 m. Such a decrease activates the accumulating process on the shore and strengthens its growth. In the meantime, the intensity of drift is reduced along-shore by lack of available material from the sea bottom and finally accumulative forms on the shore down-drift can be again washed away, the profile of underwater

slopes becoming sharper than the equilibrium profile. A huge quantity of sandy material which was stabilised at higher level periods is remobilized, following this wash away of the coast.
The evidence of such an evolution in the spit area is found in the increase of volumes of annual dredging: +10,6% over six years up to 1977, where 1 040 000 m3 were extracted (spit area and sea part of the channel).
The lowering of sea level had a considerable outcome in the bay channel also, with an amount of more than two million cubic meters extracted in 1977. Three millions cubic meters were forecasted for the following dredging campaign in 1980, but the inversion in the trend of sea level variations strongly alleviated the burden.

3) The period 1978-89 sees a huge increase of the sea level: 158 cm in 13 years, from -29,12 (1977) to -27,54 (1989), coming back to the 1939 level. During the sole 1978 year, the increase reached 31 cm. In such conditions, depths and wave energy at the shoreline grow significantly and erosion of beaches also increases, at least in the northern part of the spit, near Cape Tartar. Southwards, the sand drift is also growing and compensates the erosion trend: more material is carried towards the channel entrance and what was left of the 1963 groin disappears completely under the water level (Fig. n°7bis).
All previously described dynamic factors control the evolution of the channel banks and depths, with the growth and the gradual displacement of the hook in the north-west slope of the canal (100 to 120 m in the direction of the bay between 1983 and 1989). In the meantime, beaches on both sides of the channel retreat under the influence of the increase of the level; the distance between the two beaches grows from 200 to 260 m. But the dynamic axis of the canal is also displaced towards SE with a projection of the northern side and a recession of the southern one (Fig. n°8). In the width of the (theoretical) project channel, not less than 36% of the bottom cut is invaded by sands in 1984 on the northern side, the southern bank has significantly recessed and maximum depth has increased up to 14 m in the channel axis.
The importance of the drift is varying, according to the yearly increase of sea level. Part of the moving sand is deposited on the shore, but it also penetrates in the channel and is deposited mainly in the bay at a distance of 200 to 700 m from the cut. A part of the moving material (less than 30%) is also deposited along the south-east bank of the cut and contributes to a regular accretion of the south-east body of the spit on the bay side.
According to bathymetric measurements and dredging data, *the average sand drifting represented during the period 2475 m3/month and the average annual dredging in the body of the spit (700 m length) was 29700 m3*, but increased rather regularly (1.9 to 2.8% per year) in proportion to sea level change.
Total amount of dredging realised in the channel (bay and spit together) during these years was close to 1 million m3 with a maximum in 1986 with 1 100 400 m3 and a minimum of 707 000 m3 in 1987. A forecast of a 2.3% increase in annual dredging works was based on existing data and sea level change previsions.

b. Current situation

Since 1990, no global survey of the sedimentation problem in the channel seems to have been undertaken. That period is characterised first by the following in the increase of sea level (up to -26.6 m in 1995) and afterwards by a light recess and an approximate stabilisation: the yearly average level for 1999 is 27.2 m, 0.8 m over the reference mark and did not vary much since 1997.

The last available bathymetric survey (February 1999) of the channel through the spit area shows a pattern which is not different from the morphology previously described: a central deep trough (>14 m) between the two lips of the spit cut, the northern shoreline encroaching upon the border of the channel and the southern shore thrusted aside.

Field observations during our mission (September 2000) confirm the already described evolution with an important recess of the seaside shore of the northern spit, the ruins of the lighthouse invaded by the sea, and an accretion of the hook towards the bay side, with a sunk boat entirely in the sands. On the southern shore, the lighthouse is also ruined and partly invaded by waters. Maximum depth in the channel entrance is still close to 14 m. Due to the stability of the sea level, equilibrium profiles on the beaches and in adjacent shallow waters are stabilised and the intensity of drift is reduced despite the presence of sharp slopes on the north side of the channel.

Those observations mean that all significant evolution of the channel equilibrium is to take place under stormy conditions, during which the channel area and the sea shore are more than previously exposed to north-western waves because of the increased sea level. Sunk boats which were previously meant to protect the northern side of the channel entrance are by now buried in the sand bottom and far away from the retreated shoreline: they do not play any part in the control of the shore sand drift.

Bottom samples were taken in and around the channel and were subsequently analysed in laboratory. The position of these samples is indicated on Fig. n°9 and detailed results of analyses given in Annex n°3. Out of the total of sixteen samples, ten were sands taken in what is to be considered as the spit area, the six others are muddy sediments and characterise the bay area.

The sieve analysis of sands shows the following results:

- On the sea side of the spit, the beach sand (sample 1) is a medium size and well sorted sediment, but on the bay side, north of the channel (sample 2), the same sand is richer in fine particles but not muddy, at least on the shoreline.
- In shallow depths north of the channel, sands are much finer with a 0,1mm mode (sample 5 at -5 m, sample 6 at -1 m) due to the wash away of the slopes in front of the shoreline.
- Along the coast south of the channel (sample 3, -1 m) one finds a medium sorted sand, a little finer than on the north. It is the same type of sediment which is found in the channel entrance (sample 4 at -7 m), washed by currents.
- In the channel through the spit, the sand mode is still close to 0.2 mm (sample 7 at -12 m) but currents have washed away part of the sediment which is enriched in coarse material, namely shell debris.

- On the bay side of the channel, 200 m from the spit, finer sands are found again (sample 8), deposited by slowing currents. Closer to the shore and out of the channel (sample 9 at -1 m), sands are coarser in relation with the development and the displacement of the sand hook at the end of the northern shoreline.
- Further north in the channel (sample 10) the bottom is still sandy and shelly but sorting is poor. There is no significant trace of fine material associated, despite the location well inside the bay.

The extension of sands drifting along the sea coast of the spit through the channel and well inside the bay was already established, and the analyses confirm that all bottom sands belong to the same mobile body and do not really mix with the fine material which is found in the whole of the bay.

7.4 Siltation regime inside the Turkmenbashi bay

7.4.1 General deposit conditions

In the major part of the Turkmenbashi channel within the bay, namely out of the vicinity of the spit - as previously described -, bottom sediments are made of fine silt and mud, often rich in organic matter. Such sediments have a particular behaviour linked to physical properties of cohesive material when it is mixed with water.

From the main harbour as well as from the oil terminal, the channel has been dug out of the very flat and shallow bottom of the bay: natural depths on both sides of the main channel are always around 2 meters below the reference level, depths of some 4 meters being found along the track of the southern channel only, towards the natural entrance of the Turkmenbashi bay.

Sediments in such a flat area are deposited in calm conditions out of suspended fine material which is able to be transported in the whole water body even under very weak currents. Short waves generated in shallow waters maintain fine sediment in suspension and can retrieve it from the bottom under stormy conditions: sediments are dispersed more or less equally in the whole bay area and re-deposited at random at the end of the storm.

The Turkmenbashi bay represents the final deposit area of sediments washed away from the steppe plains which lay on the east of the Caspian Sea. Soils eroded from the adjacent mountains are transported by temporary rivers after heavy rains and the material is gradually sorted, up to its arrival on the bay eastern shore where the major part stays in sandy and marshy areas. Only fine material is able to travel in suspension through the whole water body of the bay, the finest one the most to the west.

The navigation channel, dug out in the middle of that flat deposition area, constitutes an obvious trap for suspended material and is prone to preferential deposit, tending to re-establish the natural equilibrium of depths on the sea bottom.

7.4.2 Properties of bay sediments

From the port installations to the south of the buoys marking the bend of the channel towards the southern route (and along this one also) the bottom is capped with a very fine and water-rich sediment, of the same type and quality that can be found out of the waterway, on both sides: the decanting process, which is the way of depositing fine sediment in calm waters, is working everywhere in this western part of the bay and even more quietly in the deeper zone of the channel.

In order to precise the properties of those so called "silts", surface bottom samples were taken out (samples 11 to 16, see localisation on fig. n°9).

Laboratory tests were conducted in order to define the percentage of cohesive material (as percentage of particle diameter smaller than 40 micrometers), the grain size distribution of sandy material, the percentage of organic material as related to the whole sediment, and, for sample 16 coming from the first bend of the channel, the rheological properties.

Detailed results of analyses are given in Annex 3. Main data can be summarised as follows:

- Percentage of fine material (< 40 micro-metre) is very high in all samples, even more important along the channel (samples 11, 14, 15 and 16 with values reaching 80 to 90%) than in its vicinity (samples 12 and 13, close to the beginning of the southern channel): around 50%, which a sufficient value to define a fully cohesive material.

- The "sandy" part of the sediment is poorly sorted and often made of shell fragments, which means that there is no sand transport at all in the bay area.

- Organic material content in the sediment, as calculated after measurement of organic carbon by the Blackley method, varies more or less between 4 and 6%, which would represent an average value for coastal tropical muds but can be considered here as rather high. Development of sea grass on the bay bottom and probable oil pollution can explain the importance of this parameter which influence on physical properties (yield value) is to be taken in account.

- Sample 16 (north bend of the channel) was submitted to rheological analysis by means of a Beckman viscosity-meter and the relation between yield value (in Newton/m2) and mixture concentration was determined:

1) In natural conditions on the channel bottom, concentration is very low (<100 g per litre) and the sediment acts as a suspension in water: there is no hindrance to navigation provided no concentration increase linked to settlement takes place.

2) Over 300 g/l concentrations (soft mud), yield value is climbing: at a restrained rate up to 500 g/l, but much strongly onwards. Stiff concentrated muds are much more difficult to be remobilize by waves and currents, and need more energetic ways to be dredged.

3) Liquid suspensions and even soft muds are unstable on slopes and tend to reach the base of the slope, in this case the bottom of the channel, contributing to a growth of the sedimentation rate with a material which is not always of low concentration, like the direct decanting products. The accretion rate in the channel represents the sum of those two different processes, the former being constant but the contribution of the latter becoming more dominant when relative depths between banks and channel increase.

In the end, the muddy material on the bottom of the major part of the bay appears to be easily mobilised, even if its primordial source is to be found far away from this area. It can be assumed that there is no direct link between the bay sedimentation process and the Caspian Sea level fluctuations. The increase in dredging volumes indicated previously can be related to the decrease of the sea level but not to a change in the sedimentation pattern.

7.5 Conclusion

The long Turkmenbashi navigation channel spans through two different types of sea bottom: the flat muddy area of the bay and the sandy environment of the spit and its sea and bay slopes.

Sediment dynamics are not to be compared in both areas, the former characterised by calm decanting processes, the latter by sand drift along the sea shore and within the artificial cut through the spit, as well as by deposits in the neighbourhood of the way out of the channel inside the bay.

An historic review of previous surveys shows that channel problems can be very different following long term fluctuations of the Caspian sea level and namely following the rate of those fluctuations. During present time and since 1996, only tiny or seasonal changes happen.

1) Such short term ("meteorological") level variations in the sea generate currents in both directions through the spit and are responsible for the large spreading of sands in the bay, but also for the collapse of slopes on the seaside, where they compete with the thrust of drifting coming mainly from the north under the influence of north-western waves. The northern bank of the channel through the spit is submitted to a constant accretion and deformation towards south-east, and the southern bank is retreating.
There is some kind of equilibrium between all these actions and the maintenance of the channel mouth can be obtained through sand dredging works averaging 30,000 m3 a year. The dredged sands have been disposed up to now in an area situated on the northern slopes of the spit, which location offers perhaps the possibility of recycling the disposed material by the drift.
The water-rich character of the muddy bottom of the channel inside the bay underlines the minor rate of direct decanting process which can allow some navigation without too frequent interventions of dredging, but soft muds are easily dragged on slopes due to the narrowness of the channel bottom.

2) Other problems arise during long term and high rate fluctuations of the sea level.
During low level periods, the maintenance of navigable conditions in the bay imposed a high dredging rate at an average of more or less 1 million m3 a year. The sand drift along the coast was reduced during a first period but increased after some time with a accentuated dismantling of the slopes, on shore as well as in front of the shore.
With the rapid accretion of sea level observed between 1979 and 1995, sand drift along-shore and through the channel entrance increased, but the outcome on navigability was alleviated despite the frequent intervention of dredging in the spit area. In the bay, there should not have been a need of important dredging works and those which were undertaken certainly had very positive impacts.

In the course of the next phase, actions likely to improve the sedimentation condition of the channel will be proposed.

8. Conclusions and executive summary

Following an inception report issued in September 2000, the present report covers the first part of the Turkmenbashi navigation channel study, which consists in depicting and evaluating the current situation and environment of the channel. It includes a traffic analysis, an assessment of port finances, environmental considerations, an evaluation of existing navigation aids, a description of available dredging equipment and a sediment transport analysis.

The second part will provide with recommendations aiming at improving and maintaining the channel.

Before summarising the contents of the document, it is not useless to remind the three major deficiencies the Turkmenbashi navigation channel suffers from:

- Navigation aids are in poor condition and urgently require additional equipment. Several lighthouses, towers and buoys are missing, most lights are out of order, no radar system is available. Therefore, sailing during night time is almost impossible, cargo vessels cannot cross in the channel and the port has no efficient control on channel traffic.

- The channel mouth is narrow and subject to oblique and strong currents, up to 5 knot velocity. Therefore vessels cannot sail through the mouth under bad weather conditions, such circumstances happen 60 to 80 days per year. In these cases vessels wait or sail around the southern end of the peninsula. Some vessels also ground, from time to time.

- The channel is subject to siltation, with higher intensity in the mouth area. Although very little maintenance dredging was carried out in the past years, water depths are luckily sufficient since the Caspian sea sharply rose till 1995 and is still on the high side. As proved by the measurements carried out in September 2000, water depths in the channel axis range from 12 m to 7 m (current sea level is 0.7 m above the Caspian sea reference). However the channel is narrow, water depths quickly decrease near most of lateral buoys. Available width is much less than the theoretical 140 meters.

8.1 Traffic analysis

The Turkmenbashi navigation channel mainly serves three port terminals: the ferry terminal, the general cargo terminal and the Ufra oil terminal. Below are the characteristics of the largest vessels calling or likely to call at these terminals, which make up controlling parameters for the navigation channel:

	Length Over All	Beam	Maximum Draught	Dead Weight Tonnage
Ferry vessels	154.47 m	18.30 m	4.50 m	3,950 tonnes
Oil tankers	168.88 m	17.40 m	5.30 m	7,410 tonnes
Future TML oil tanker	113.80 m	16.40 m	4.57 m	7,500 tonnes

The following table outlines the traffic density in the channel, showing the result of the consultant's analyses in terms of cargo turnover and ship calls, projections being those of a medium scenario situated between an optimistic one and a pessimistic scenario.

	Average recent figures	2005 projections	2010 projections	2020 projections
		Cargo (in thousand tonnes)		
Ferry terminal	812	1 387	1 503	1 738
General cargo terminal	163	207	246	322
Ufra oil terminal	3 397	3 645	3 813	3 817
Total cargo	4 372	5 239	5 562	5 877
		Ship calls		
Ferry terminal	406	694	752	868
General cargo terminal	148	188	224	292
Ufra oil terminal	927	876	916	916
Total ship calls	1 481	1 758	1 892	2 076

The current 1,481 calls/year figure means that the average daily number of vessels sailing along the channel is close to eight, whilst long-term projected figure (2,076) means eleven vessel moves per day.

8.2 Port finance assessment

Income statements of years 1998 and 1999 show that dues paid to TML for navigation services are among the highest sources of income, close to USD 2 million per annum and amounting to 30% of Turkmenbashi port income:

Sources of income	Amounts in thousand USD		Distribution of income / port income (in %)	
	1998	1999	1998	1999
Navigation services	1 902.7	1 886.0	32.9	29.5
Berth dues	2 828.5	2 991.0	49.0	46.8
Cargo handling	614.6	915.6	10.6	14.3
Ferry services	17.1	13.8	0.3	0.2
Ship charter services	1 476.7	901.0	not included	not included
Other services	411.7	583.3	7.2	9.2
Total income (sum of above items)	7 251.3	7 290.6		
Sole port services	**5 774.6**	**6 389.6**	**100**	**100**
Port services / Total income	79.6 %	87.6 %		

However, profit and loss accounts reveal that small margins are available for new project financing:

(figures in thousands USD)

	1998	1999
Turnover	7 251.3	7 290.6
Operating costs of sales	-3 804.0	-4 667.0
Operating profit	**3 447.3**	**2 623.6**
Administrative expenses	-964.0	-1 241.0
Selling and marketing expenses	-296.0	-189.0
Total operating profit before taxes	**2 187.3**	**1 193.6**
Financial charges	-76.3	-38.1
Other sales and non operational inc. & exp.	303.1	9.4
Profit for activities before taxation	**2 414.1**	**1 164.9**
Taxation on profit	-1 223.5	-1 012.5
Profit after taxation	**1 190.6**	**152.4**

Considering the loans which will soon have to be paid back, regarding the new tanker and the general cargo facilities, very little will be left for improving the channel.

8.3 Environmental considerations

Dredging operations in the navigation channel affect the sea water quality through increase of suspended solids and potential release of contaminants during dredging and disposal, as well as through leaching of contaminants from the disposal site.

Most of the Turkmenbashi bay is part of the Khazar Nature Reserve (covering 262,000 hectares, 90% of which are covered by water), which is frequented by migrating birds (over 10 million animals spend winter in the reserve) and other species, as well as permanent fauna and flora (there are about 500,000 birds living in the reserve throughout the year). The reserve extends to the south and east of the navigation channel, and encloses the Turkmenbashi spit. The port of Turkmenbashi itself is located outside of the reserve, and is 5 kilometres distant at its closest point. Near the port, along Turkmenbashi spit, there are limited wetlands.

There are about 40 species of fish in the Khazar Nature Reserve. However, sources indicate that no commercial fishing takes place in the Turkmenbashi bay, largely because it is enclosed by the reserve. The waters around the port are not believed to be a major spawning area for fish species. A small fishing fleet is located at the port, mainly for fishing outside the bay.

Early investigations of bay sediment included analysis of oily substances at the port and the oil terminal. These analyses showed about 0.3 mg/g average oil concentration at the port, and 0.64 mg/g at the oil terminal, which are rather high figures. Sediment studies that were carried out along the navigation channel in 1990, required for the five-year dredging permit for 1991-1995, showed levels of oily substances ranging from

0.242 mg/g in the city stretch to 0.442 mg/g in the Ufra stretch. Although these figures are lower than those of the port areas, they are still worrying.

The Ministry of Use of Natural Resources and Environmental Protection is responsible for implementing environmental legislation in Turkmenistan. Monitoring of coastal environmental conditions, including the port area, is the responsibility of Kaspecocontrol, which operates its own environmental monitoring laboratory and conducts quarterly sampling and analysis of water and sediment along the coast of the Turkmenbashi bay. The State Environmental Expertise Law of 1995 requires the compilation of a document that is mandatory for most public and private projects; permits for dredging and disposal of dredging spoils are required.

At the following step some important factors therefore ought to be considered:

- The validity of analytical methods and sample points for previous bottom sediment characterisation efforts should be confirmed. If necessary, additional studies should be implemented, and criteria should be established, in conformance with national and international standards.
- The traditional site for disposal of dredging spoils, to the north of the bay entrance, should be studied, and new sites proposed and evaluated.
- The possible environmental impacts of the dredging and disposal operations and fate of disposed spoils should be evaluated, especially the possible impacts on the Khazar Nature Reserve.
- Possible sources of contamination (especially from oily substances) should be identified, and volumes of contamination should be estimated.
- Details of dredging permit requirements should be determined, and support for developing the permit provided.

8.4 Navigation aids

As summarised below, navigation aids are very limited and the existing facilities are in poor condition.

In the outer part of the channel, the sea-lanes which form the Traffic Separation Scheme, off the channel mouth, are not marked; they are simply drawn on the chart. Besides, there is not real landfall buoy at the channel entrance, the small and corroded buoy n°2 is the only mark which helps locate the entrance.

There used to be lighthouses on each side of the mouth; both are out of order.

Within the bay, the channel was initially marked with 39 lateral buoys. Out of this amount, 9 buoys are missing, 5 others are completely out of use whilst most of the remaining ones are so altered and so corroded that their colours and top marks disappeared. Moreover, light ranges are extremely weak.

To guide the vessels sailing in the various sections of the channel, five leading alignments were marked with ten lighted towers. Today one tower is missing, another one is severely damaged and all remaining towers are deeply corroded and hardly visible from the sea.

Two launches are available for maintenance of navigation aids, a buoy tender and an ordinary launch used to fix buoy lights. They don't have any positioning equipment.

Lastly, the harbour master's staff is based in a very small watch tower from where it is only possible to control navigation within the port basins and in the nearest channel section. No radar is available, the only way to control channel traffic is to use VHF radio sets.

8.5 Existing port dredging equipment

The port dredging fleet consists of a self-propelled bucket dredger, two self-propelled dump barges and an anchor boat used to place and to lift the dredger anchors. Its current total value is estimated around USD 630,000.

No vessel is capable of carrying out reliable hydrographic surveys, which makes it very tough to plan and to monitor dredging operations.

The dredger was supplied to the port in 1994 and was used very few times, in 1998, 1999 and 2000; before 1998 dredging works were performed by Azeri equipment based in Baku. Although the equipment is not very handy, since four units are required, and though its productivity is rather low (from 100 m3 to 500 m3 per hour), it should be able to cope with dredging needs.

8.6 Sedimentation regime in the navigation channel

The long Turkmenbashi navigation channel spans through two different types of sea bottom: the flat and shallow muddy area of the bay and the sandy environment of the spit and its sea and bay slopes.

Sediment dynamics are very different in these two areas, the former being characterised by calm decanting processes, the latter by sand drift along the sea shore and within the artificial cut through the spit, as well as by deposits in the neighbourhood of the mouth exit, inside the bay.

An historic review of previous surveys shows that channel problems can be very different following long term fluctuations of the Caspian sea level and according to the rate of those fluctuations. Since 1996, only tiny and seasonal changes happened.

1) Such short term sea level variations generate currents in both directions through the mouth and are responsible for large spreading of sands in the bay, also for the collapse of slopes on the seaside, where they compete with the thrust of sand drift mainly coming from the north under the influence of north-western

waves. The northern bank of the channel through the spit is subject to a constant accretion and deformation towards south-east, whereas the southern bank is retreating.

There is some kind of equilibrium between these actions and the maintenance of the channel mouth can be obtained through sand dredging works averaging 30,000 m3 a year. Up to now dredged sands were disposed in an area situated on the northern slopes of the spit, which location may offer the possibility of recycling the disposed material, due to the drift.

Inside the bay, the water-rich character of the muddy bed underlines the minor rate of direct decanting process, which allows navigation without frequent dredging interventions. However, soft muds are easily dragged on slopes, due to the narrowness of the channel bottom.

2) Other problems arise during long term and high rate fluctuations of the sea level.

During low level periods, maintenance of navigable conditions in the bay imposed high dredging rates at an average of approximately 1 million cubic meters a year. Sand drift along the coast was reduced during a first period but increased after some time with an accentuated dismantling of slopes, on shore as well as in front of the shore.

With the fast accretion of sea level observed from 1979 to 1995, sand drift along-shore and through the channel entrance increased, but the effect on navigability was alleviated thanks to frequent intervention of dredging in the spit area. In the bay, there should not have been a need of important dredging works and those which were undertaken certainly had very positive impacts.

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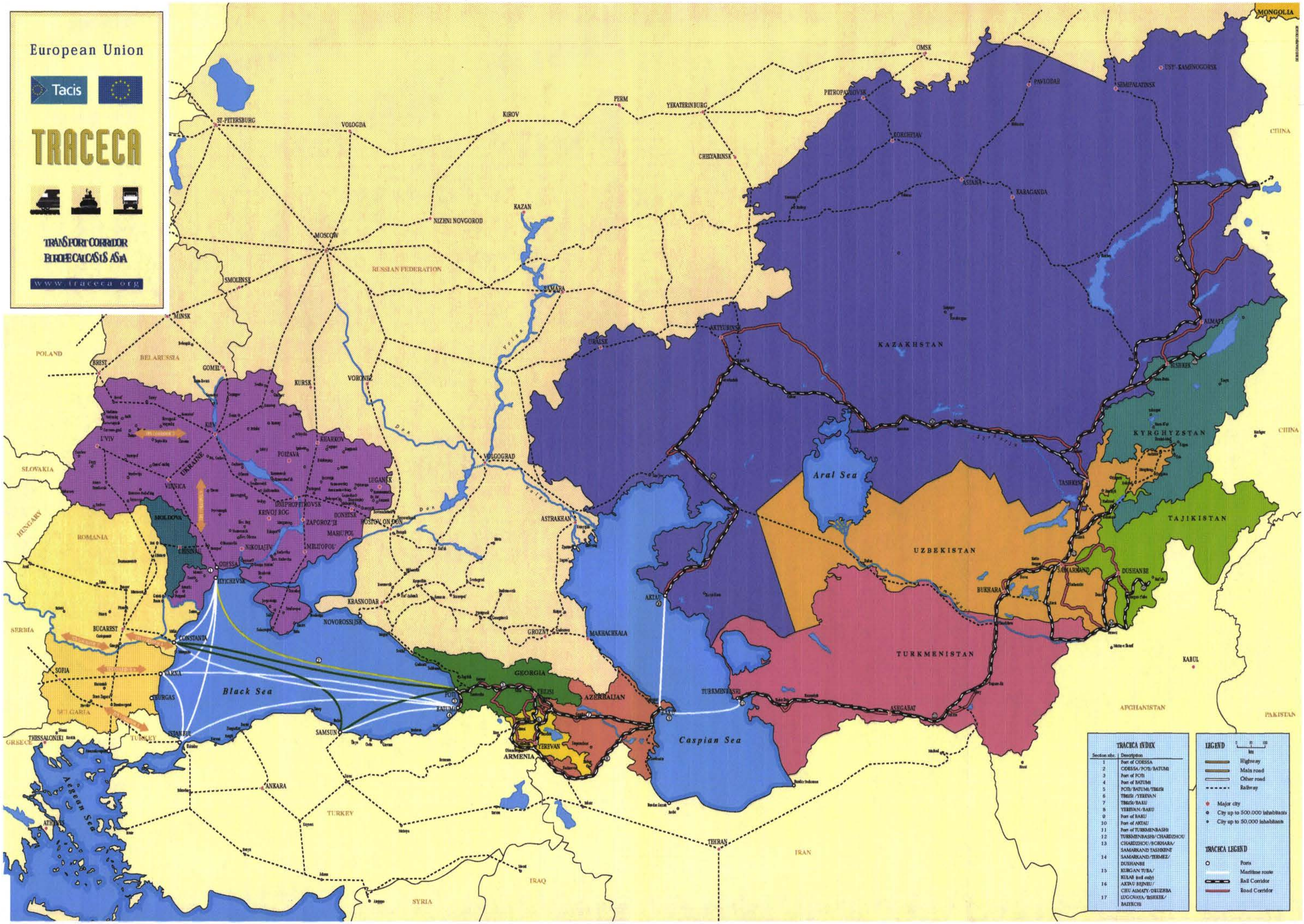
Enclosures: Annex 1 to Annex 4

Annex 1

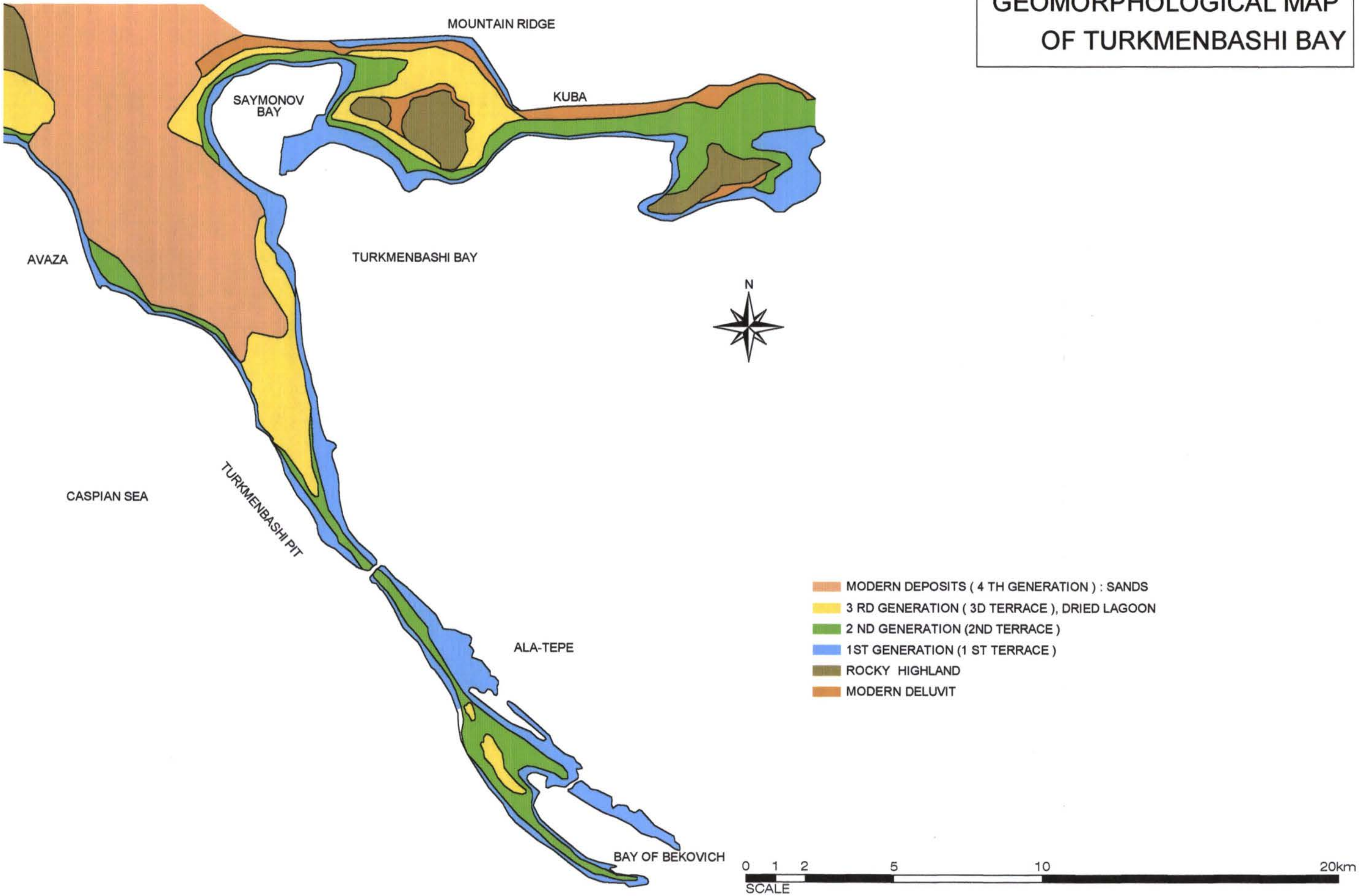
13 maps and figures



European Union
Tacis
TRACECA
TRANSPORT CORRIDOR
EUROPE CAUCASUS ASIA
www.traceca.org
TRACECA INDEX
Section nbr. | Description
1 Port of ODESSA
2 ODESSA/POTI/BATUMI
3 Port of POTI
4 Port of BATUMI
5 POTI/BATUMI/TBILISI
6 TBILISI /YEREVAN
7 TBILISI/BAKU
8 YEREVAN/BAKU
9 Port of BAKU
10 Port of AKTAU
11 Port of TURKMENBASHI
12 TURKMENBASHI/CHARDZHOU
13 CHARDZHOU/BOKHARA/ SAMARKAND TASHKENT
14 SAMARKAND/TERMEZ/ DUSHANBE
15 KURGAN TUBA/ KULAB (rail only)
16 AKTAU BEJNEU/ CHU ALMATY/DRUZHBA
17 LUGOVAYA/BISHKEK/ BALYKCHI
LEGEND
km
Highway
Main road
Other road
Railway
Major city
City up to 500,000 inhabitants
City up to 50,000 inhabitants
TRACECA LEGEND
Ports
Maritime route
Rail Corridor
Road Corridor
RUSSIAN FEDERATION
KAZAKHSTAN
UZBEKISTAN
TURKMENISTAN
KYRGHYZSTAN
TAJIKISTAN
GEORGIA
AZERBAIJAN
ARMENIA
UKRAINE
MOLDOVA
ROMANIA
BULGARIA
TURKEY
IRAN
IRAQ
SYRIA
AFGHANISTAN
PAKISTAN
CHINA
MONGOLIA
POLAND
BELARUSSIA
SLOVAKIA
HUNGARY
SERBIA
GREECE
Black Sea
Caspian Sea
Aral Sea
Aegean Sea
MOSCOW
ST-PETERSBURG
VOLOGDA
KIROV
PERM
YEKATERINBURG
OMSK
PETROPAVLOVSK
PAVLODAR
SEMIPALATINSK
UST'-KAMENOGORSK
CHELYABINSK
KOKCHETAV
ASTANA
KARAGANDA
NIZHNI NOVGOROD
KAZAN
SAMARA
SMOLENSK
MINSK
GOMEL
BREST
KURSK
VORONEZ
KIEV
L'VIV
KHARKOV
POLTAVA
LUGANSK
VINNICA
DNEPROPETROVSK
DONETSK
KRIVOJ ROG
ZAPOROZ'JE
MARIUPOL
MELITOPOL
NIKOLAJEV
ROSTOV ON DON
VOLGOGRAD
ASTRAKHAN
CHISINAU
ODESSA
ILYICHEVSK
KRASNODAR
NOVOROSSIJSK
GROZNY
MAKHACHKALA
AKTYUBINSK
URALSK
AKTAU
ALMATY
BISHKEK
TASHKENT
SAMARKAND
BUKHARA
DUSHANBE
ASHGABAT
TURKMENBASHI
BAKU
TBILISI
YEREVAN
POTI
BATUMI
SAMSUN
ANKARA
ISTANBUL
BUCAREST
CONSTANTA
VARNA
BURGAS
SOFIA
THESSALONIKI
ATHENS
TEHRAN
KABUL

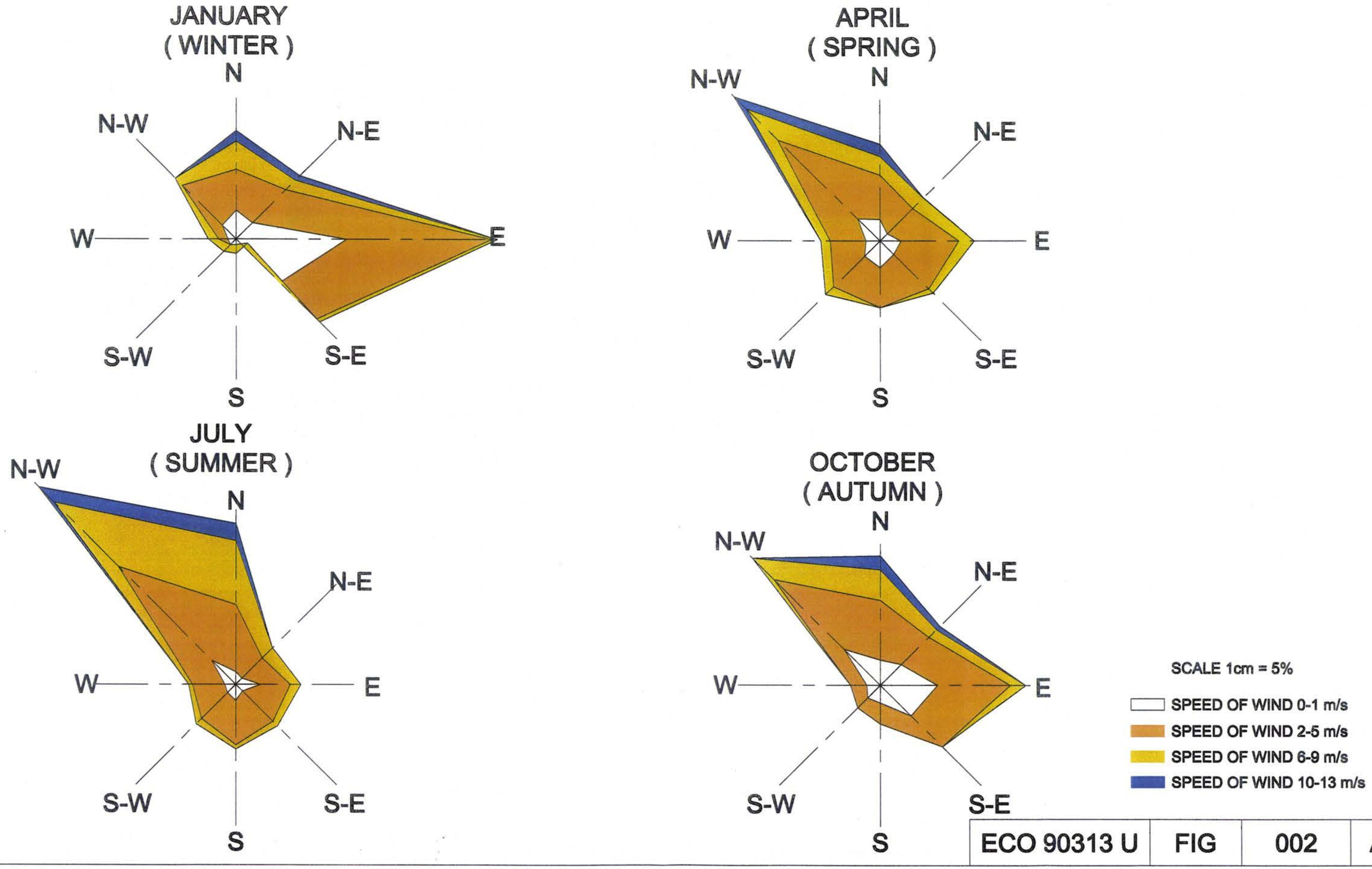

TARTAR CAPE
TURKMENBASHI
UFRA
TURKMENBASHI SPIT
NAVIGATION CHANNEL
DISPOSAL AREA
FOR DREDGED SEDIMENTS
BEKOVICH
CHELEKEN SPIT
CHELEKEN
N
SOURCE = MARINE CHART 32015
DEPTHS IN METRES BELOW CASPIAN SEA REFERENCE
0 1 2 5 10 20Km
SCALE
APPROACHES OF TURKMENBASHI

GEOMORPHOLOGICAL MAP OF TURKMENBASHI BAY



ECO 90313 U	FIG	001	A

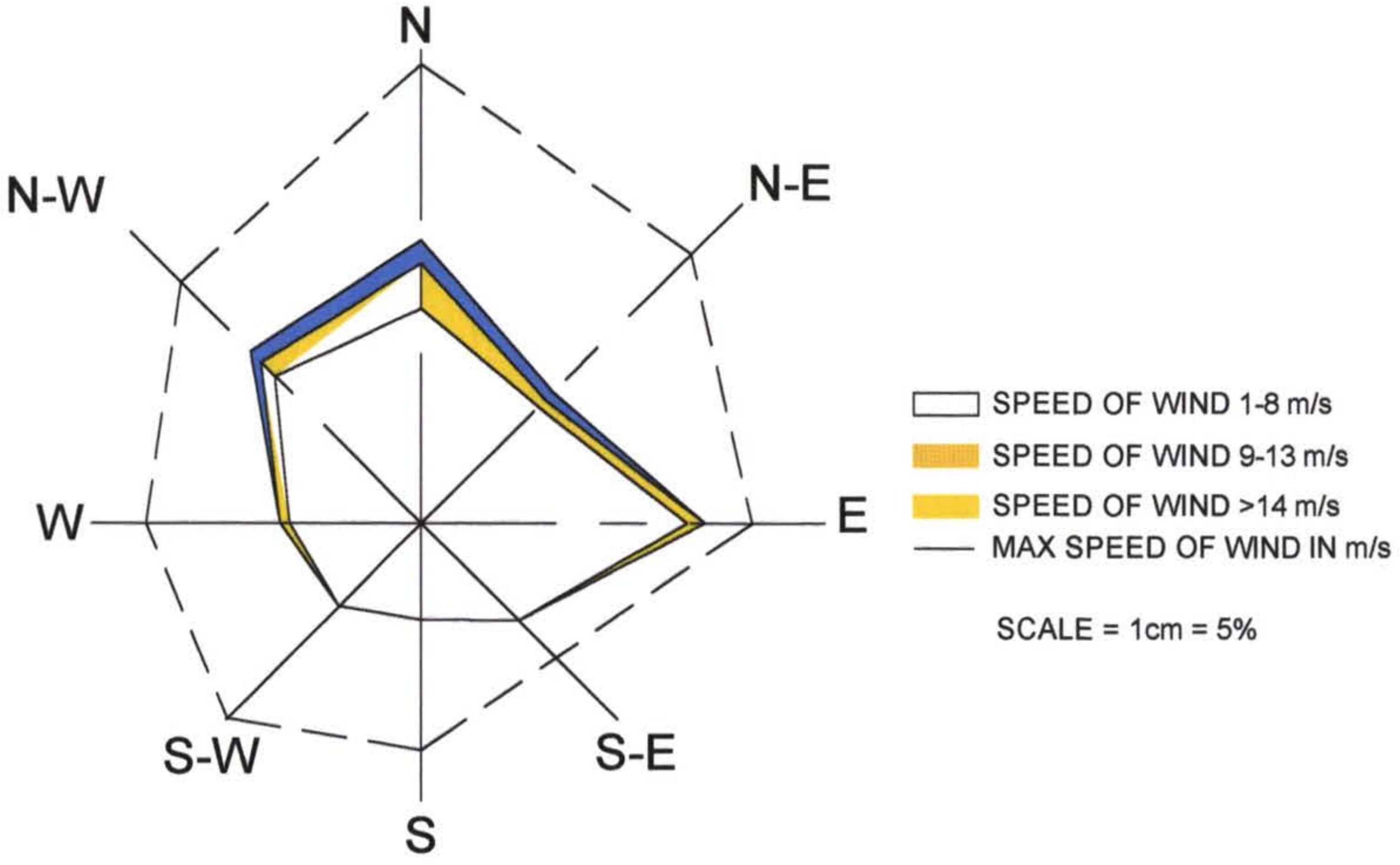
ROSE OF WIND FREQUENCIES IN TURKMENBASHI
(OBSERVATIONS MADE FROM 1965 TO 1986)



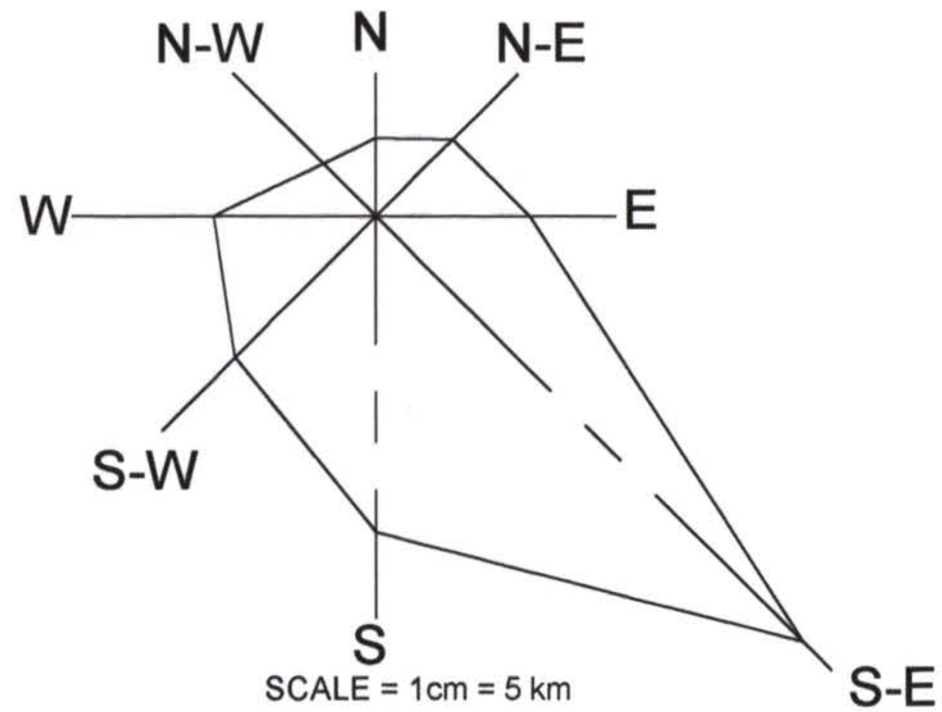
ECO 90313 U	FIG	002	A

WINDS, WAVES, LEVEL FLUCTUATIONS AND CURRENTS AT THE CHANNEL ENTRANCE

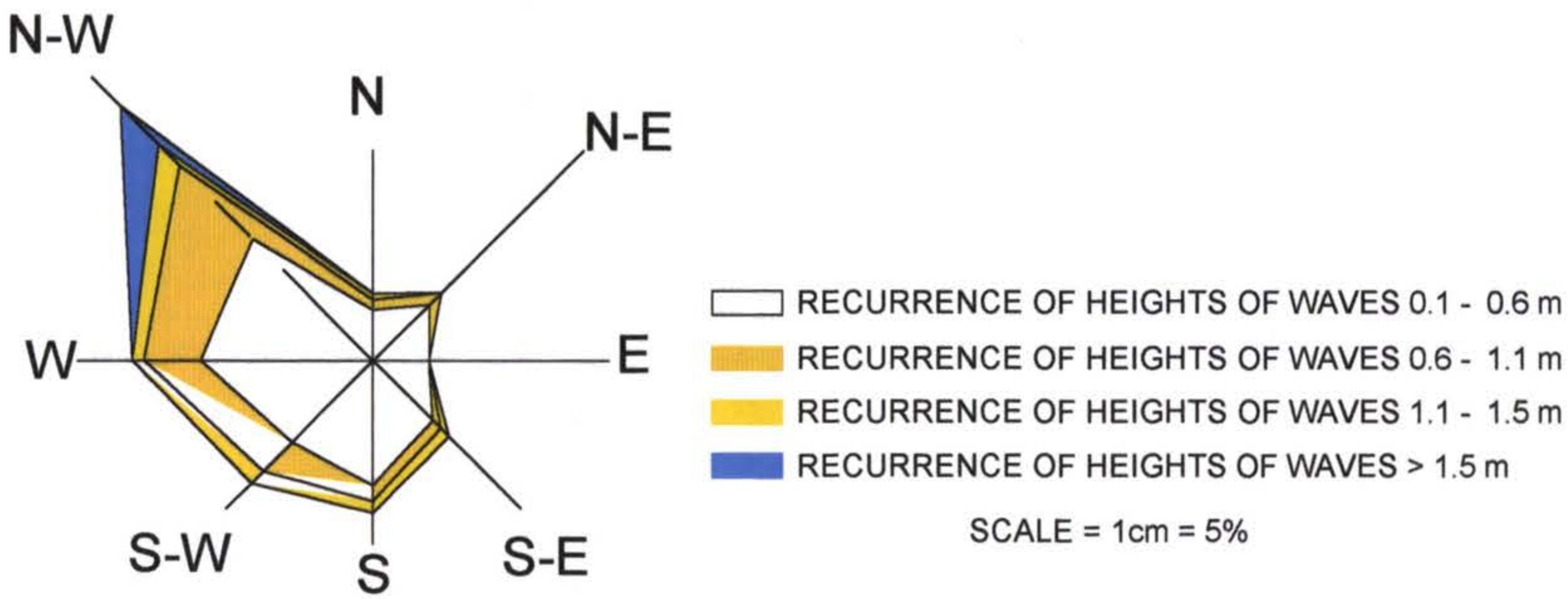
ROSE OF WIND ANNUAL FREQUENCIES



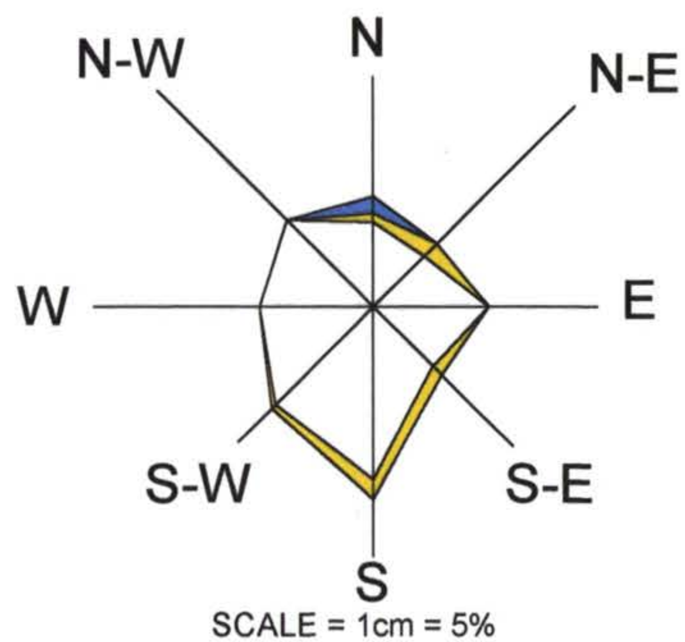
ROSE OF WAVES AT THE INNER PART OF THE CHANNEL MOUTH



ROSE OF WAVES AT OUTER PART OF THE CHANNEL MOUTH

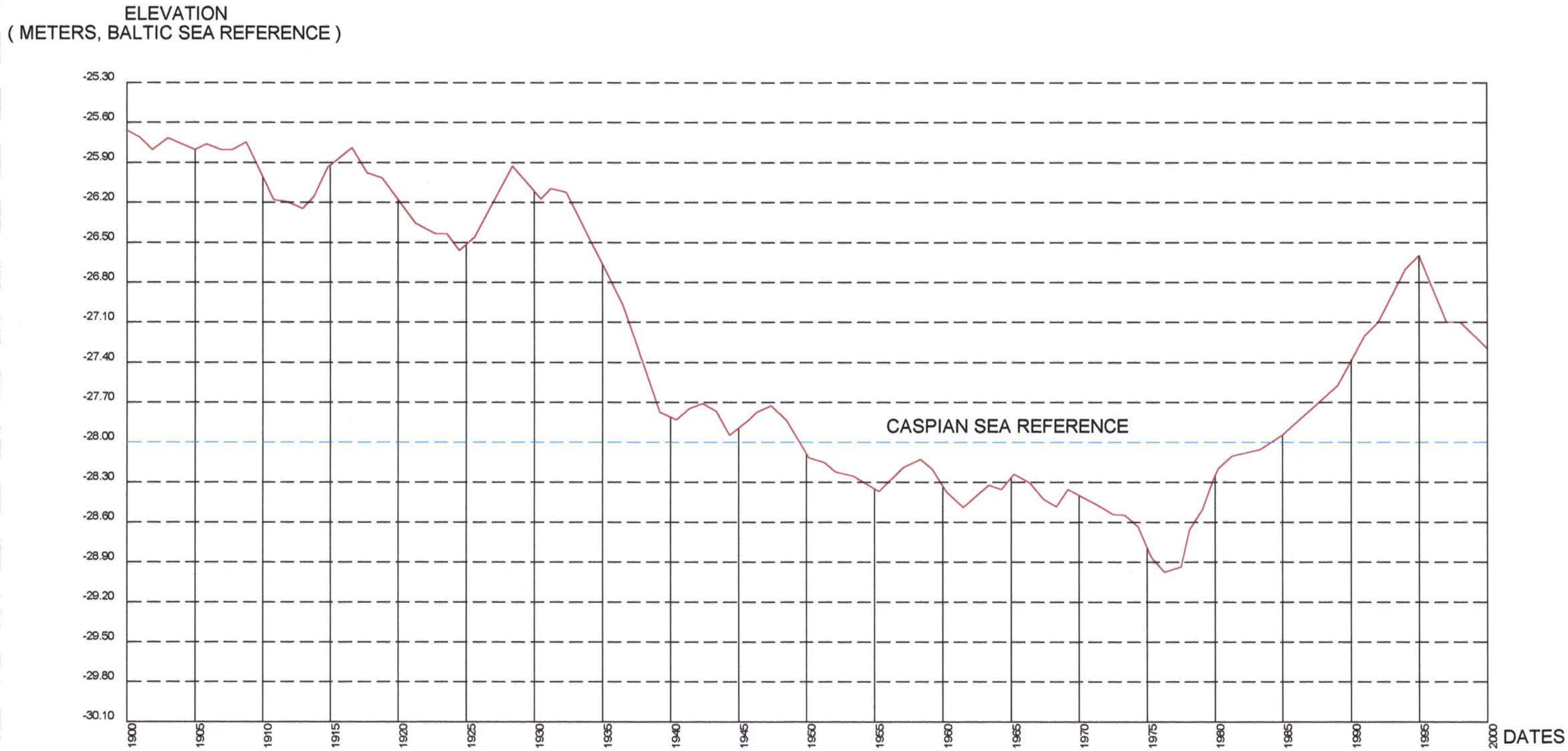


ROSE OF CURRENTS IN THE CHANNEL MOUTH



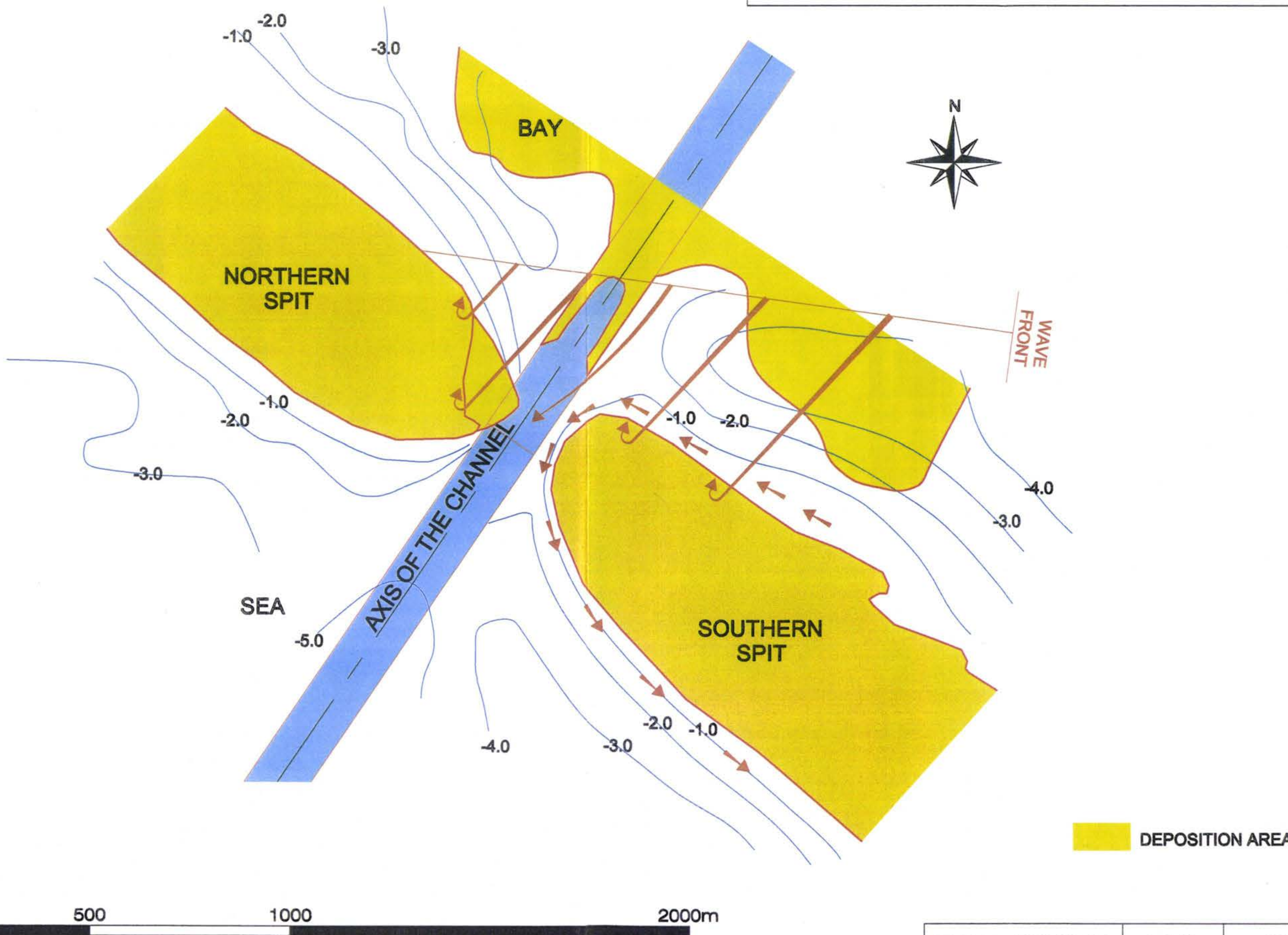
ECO 90313 U	FIG	003	A

VARIATION OF CASPIAN SEA LEVEL

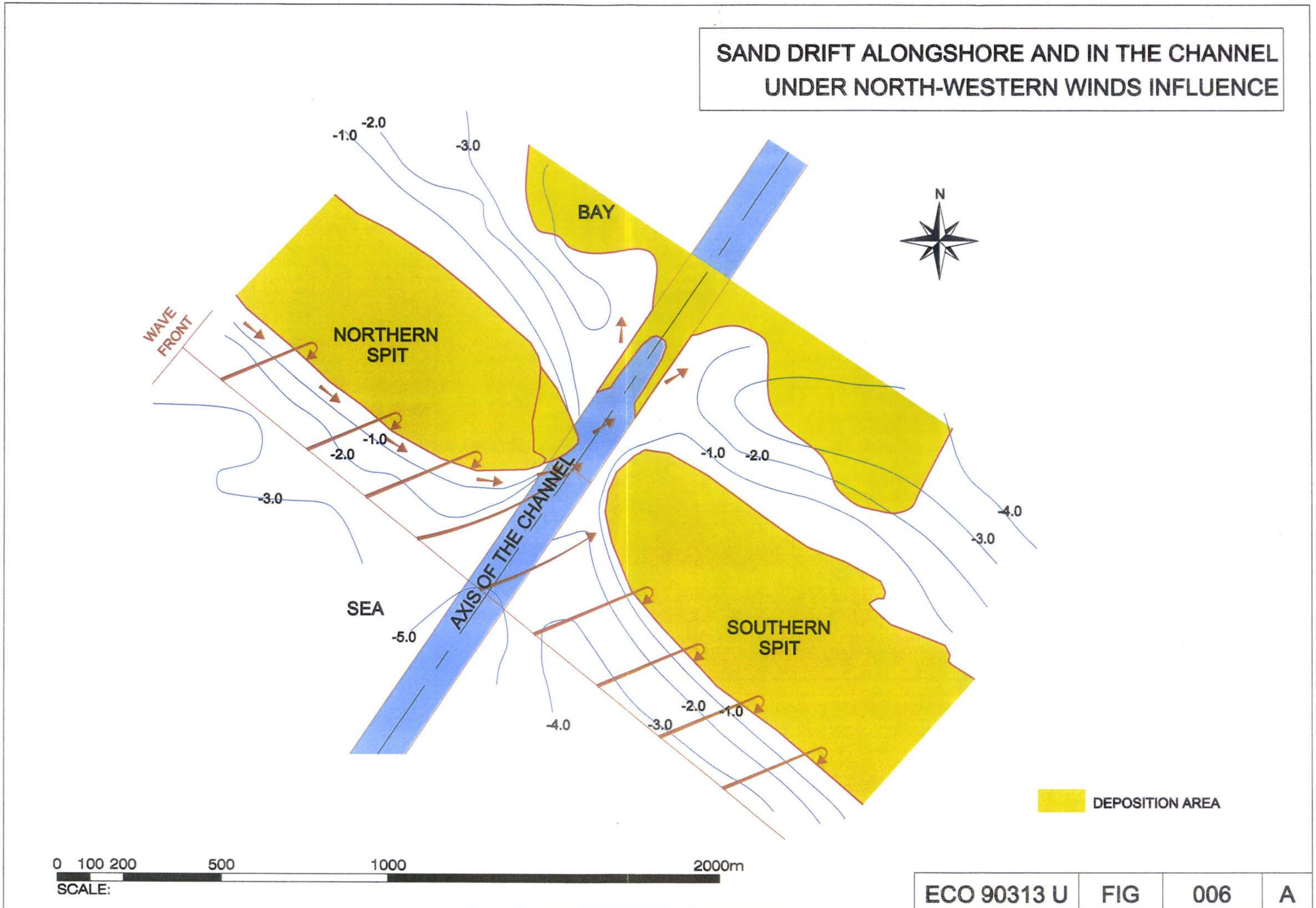


ECO 90313 U	FIG	004	A

SAND DRIFT AND DEPOSITIONAL TRENDS UNDER EASTERN WIND CONDITIONS



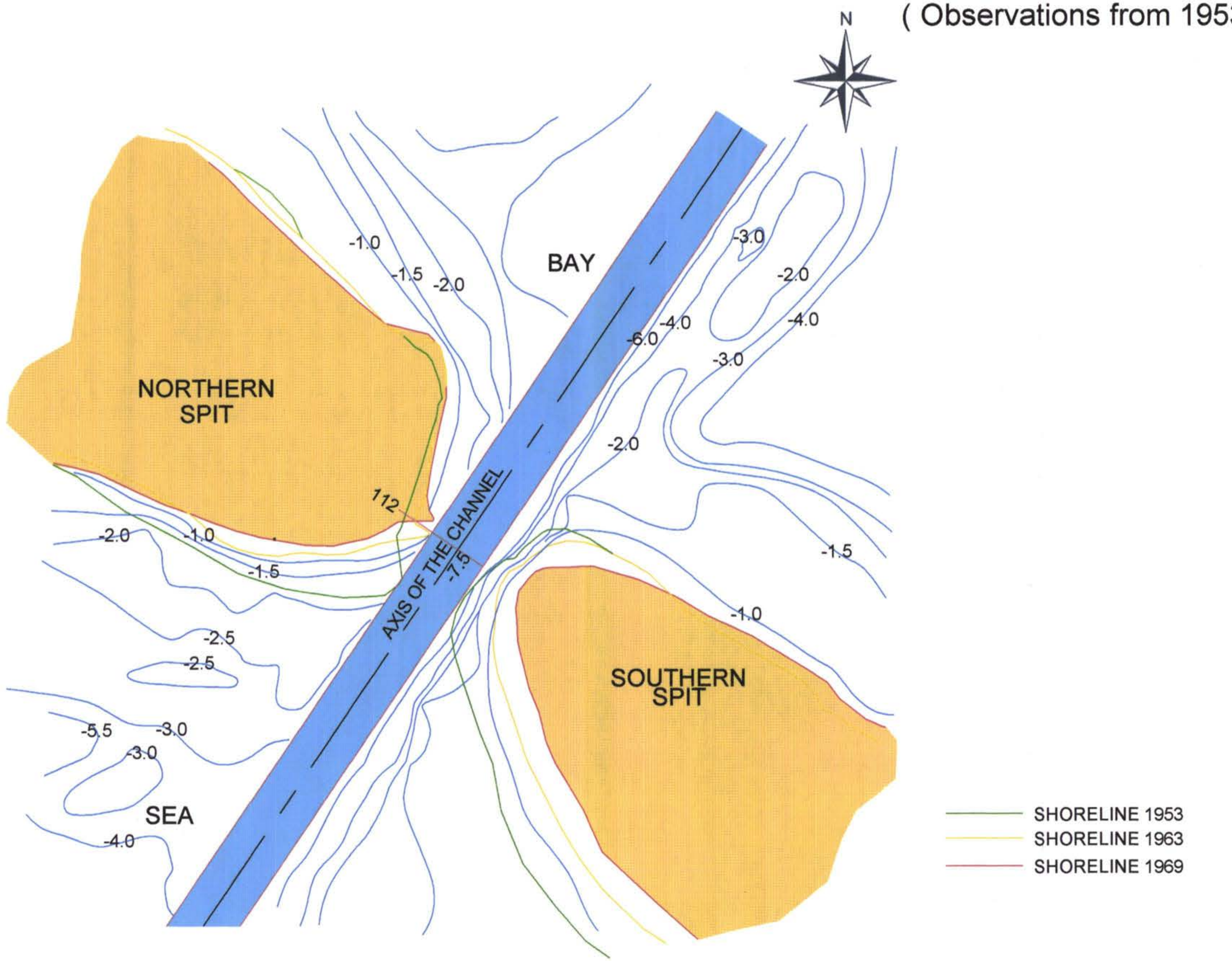
ECO 90313 U	FIG	005	A



ECO 90313 U	FIG	006	A

EVOLUTION OF SHORELINE ALONG BOTH PARTS OF SPIT IN THE CHANNEL AREA

(Observations from 1953 to 1969)

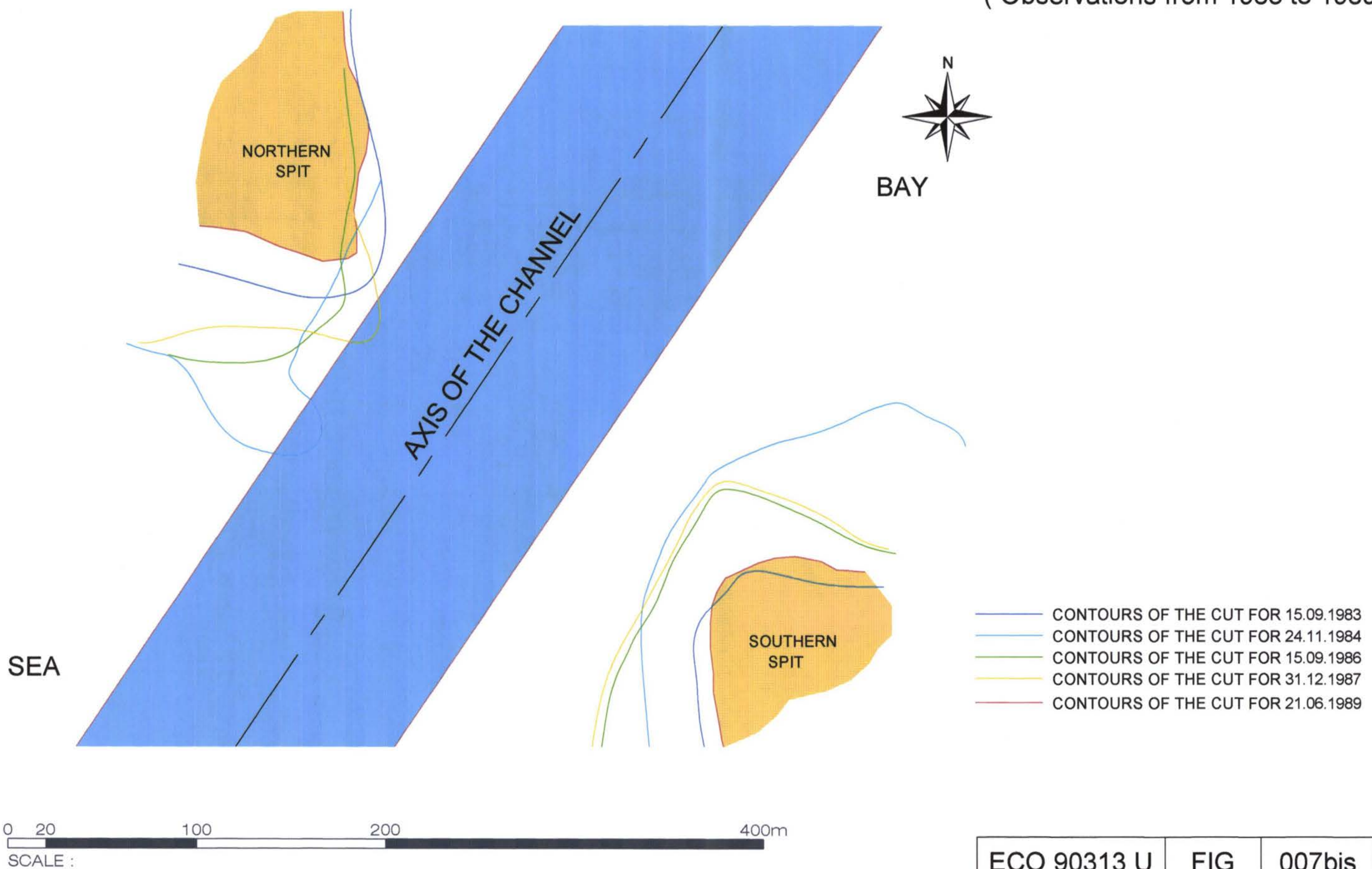


0 100 200 500 1000 2000m
SCALE:

ECO 90313 U	FIG	007	A

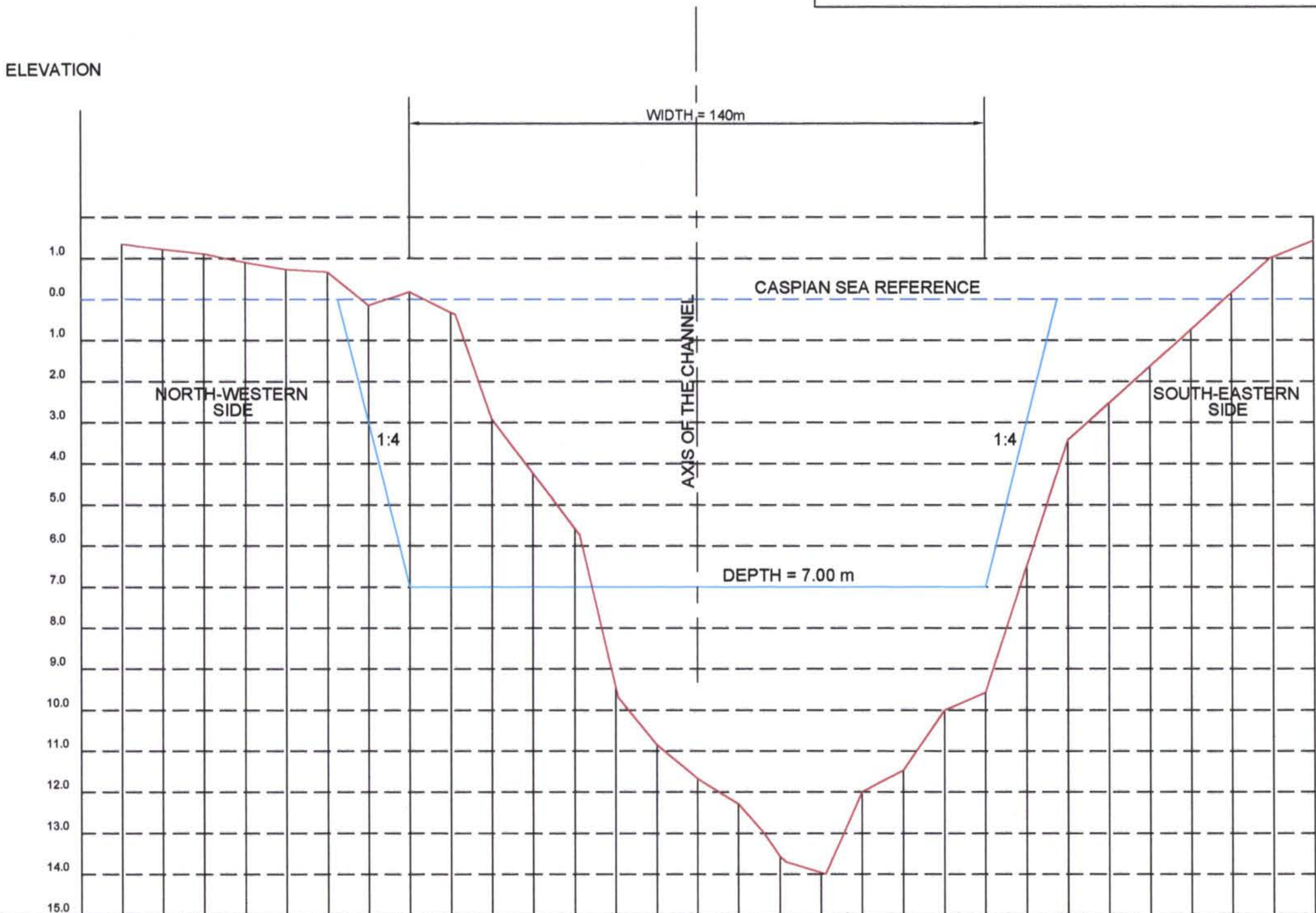
EVOLUTION OF SHORELINE ALONG BOTH PARTS OF SPIT IN THE CHANNEL AREA

(Observations from 1983 to 1989)



ECO 90313 U	FIG	007bis	A

TRANSVERSE PROFILE OF THE CHANNEL ALONG LINE 112 SHOWING THE INFLUENCE OF THE DRIFT (24 .11.1984)

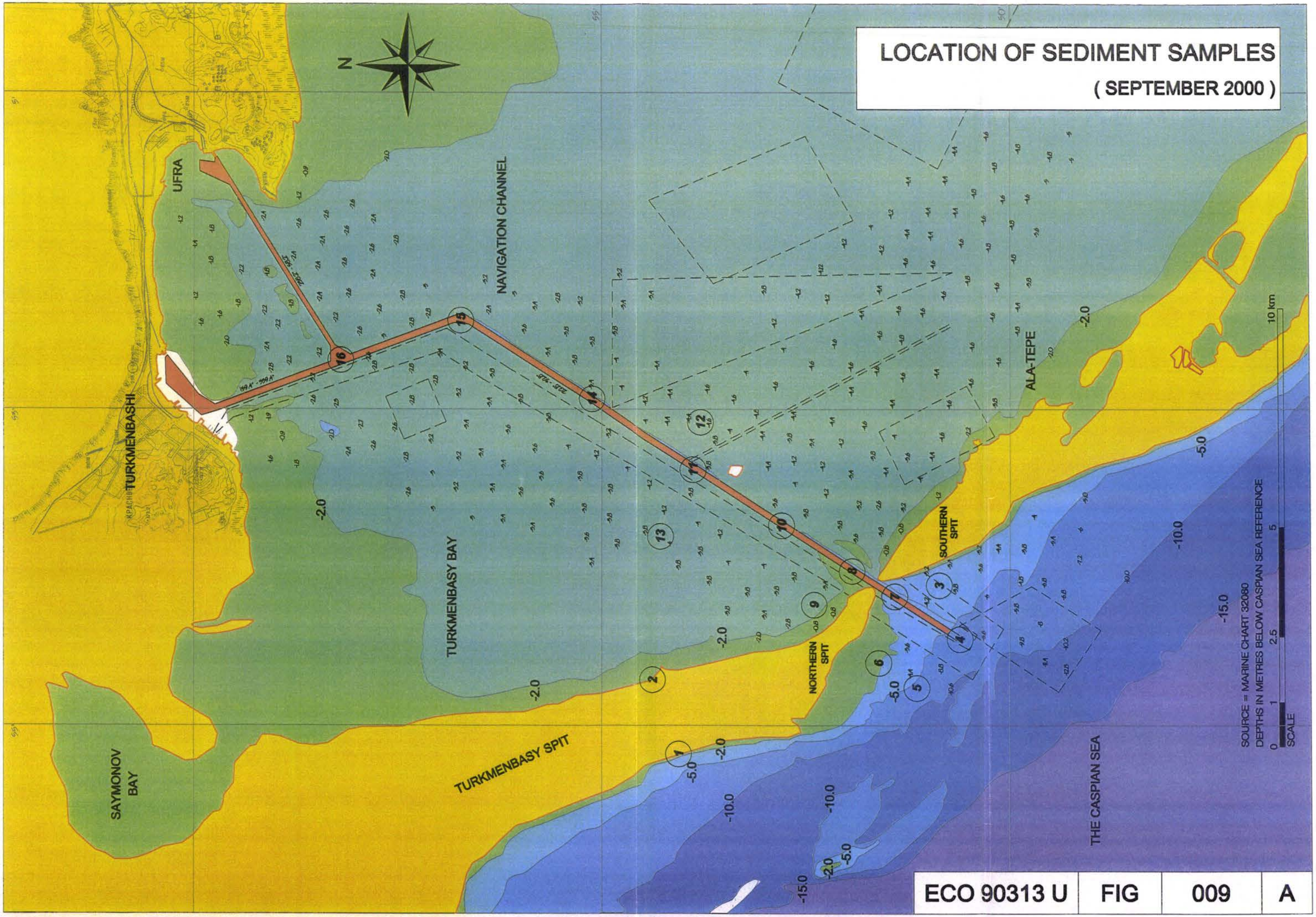


DISTANCE	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
RESULTS OF THE MEASUREMENTS					+0.4	+0.3	0.3	0.1	0.8	3.4	4.9	6.2	10.0	11.1	12.2

DISTANCE	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
RESULTS OF THE MEASUREMENTS	12.7	14.0	14.2	14.4	12.1	10.2	9.8	7.4	4.1						

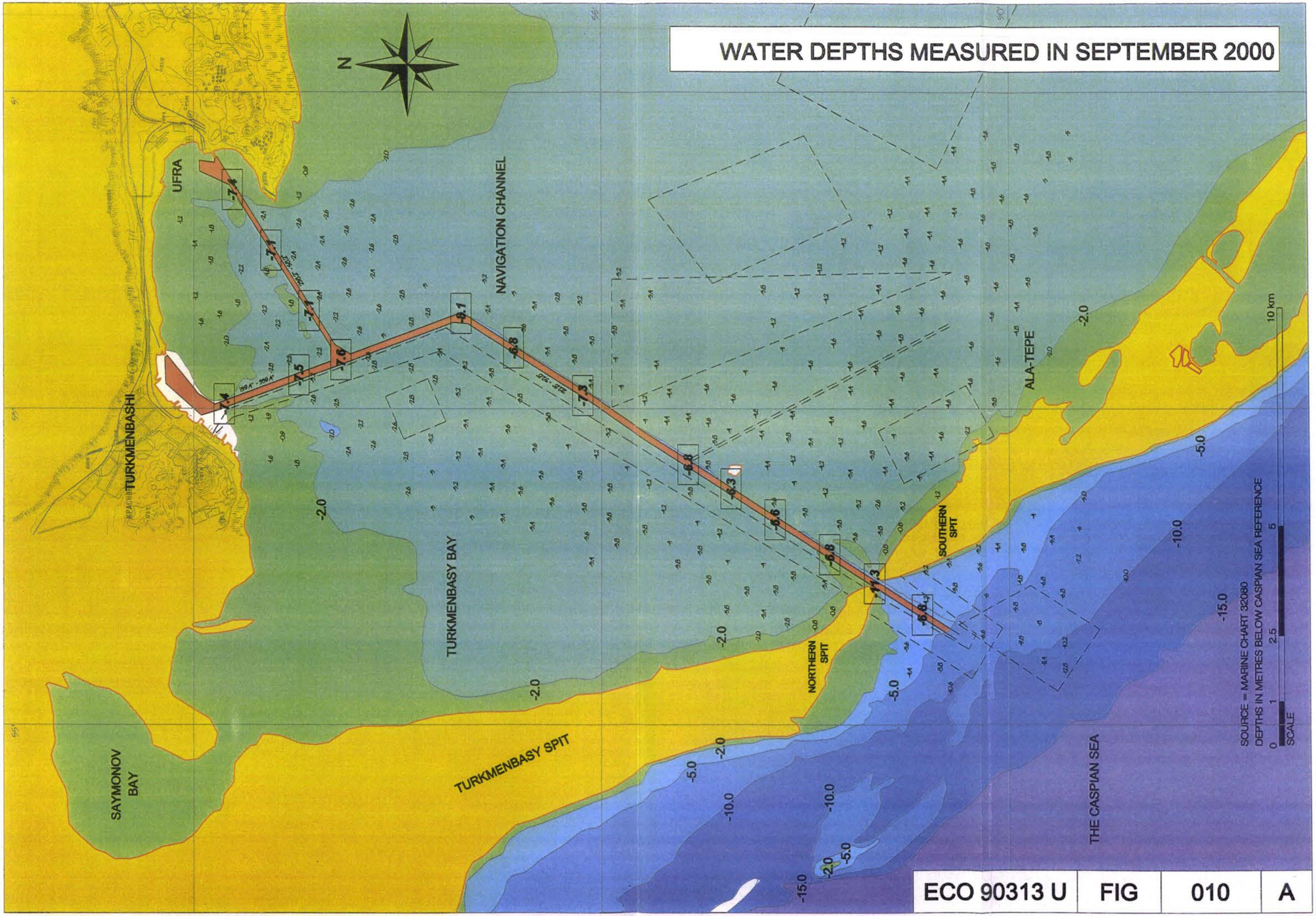
PROJECT PROFILE OF THE CHANNEL (LINE 112)

ECO 90313 U	FIG	008	A



LOCATION OF SEDIMENT SAMPLES
(SEPTEMBER 2000)
N
UFRA
TURKMENBASHI
NAVIGATION CHANNEL
TURKMENBASY BAY
ALA-TEPE
SOUTHERN SPIT
NORTHERN SPIT
TURKMENBASY SPIT
SAYMONOV BAY
THE CASPIAN SEA
SOURCE = MARINE CHART 32080
DEPTHS IN METRES BELOW CASPIAN SEA REFERENCE
SCALE
0 1 2.5 5 10 km
-2.0
-5.0
-10.0
-15.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
ECO 90313 U
FIG
009
A

WATER DEPTHS MEASURED IN SEPTEMBER 2000



ECO 90313 U	FIG	010	A

Annex 2

12 traffic tables

Ferry traffic in Turkmenbashi from 1993 to 2000 (in thousand tonnes)

	1993	1994	1995	1996	1997	1998		1999		2000 (8 months)
	export	**export**	**export**	**export**	**export**	**export**	**transit**	**export**	**transit**	**export**
	to Baku	**to Baku**	**to Baku**	**to Baku**	**to Baku**	**To Azer**	**via Baku**	**To Azer**	**via Baku**	**+ transit**
TOTAL FERRY OUT	**402,9**	**352,9**	**481,3**	**428,0**	**668,6**	**493,6**	**207,0**	**235,5**	**312,0**	**237,5**
cargo on rail cars	144,4	162,1	220,8	208,9	388,6	230,1	195,0	29,0	303,0	0,0
(of which: oil products)						*45,0*	*70,7*	*4,3*	*240,0*	n.i
cargo on trucks	64,6	46,8	94,6	89,3	47,1	10,0	12,0	11,0	9,0	n.i
cars	2,2	1,5	3,1	2,9	2,3	1,2	0,0	0,0		n.i
tares of rail cars	166,2	124,1	125,5	91,7	213,8	244,7		184,5		n.i
tares of trucks	25,5	18,4	37,3	35,2	16,8	7,6		11,0		n.i
	import	**import**	**import**	**import**	**import**	**import**	**transit**	**import**	**transit**	**import**
	from Baku	**from Baku**	**from Baku**	**from Baku**	**from Baku**	**from Baku**	**in**	**from Baku**	**in**	**+ transit**
TOTAL FERRY IN	**452,5**	**345,1**	**382,0**	**297,1**	**538,4**	**231,0**	**355,8**	**423,9**	**171,0**	**230,0**
cargo on rail cars	190,3	139,8	107,2	82,3	308,4	34,1	343,0	81,2	166,0	n.i
cargo on trucks	83,9	51,2	128,3	110,7	55,7	10,0	12,8	8,0	5,0	n.i
cars	2,3	1,4	3,5	3,0	1,2	0,5		0,4		n.i
tares of rail cars	145,3	134,0	96,0	64,8	157,3	180,1		329,3		n.i
tares of trucks	30,7	18,7	47,0	36,3	15,8	6,3		5,0		n.i

TOTAL FERRY IN/OUT	**855,4**	**698,0**	**863,3**	**725,1**	**1 207,0**	**724,6**	**562,8**	**659,4**	**483,0**	**467,5**
total cargo in / out	487,7	402,8	557,5	497,1	803,3	285,9	562,8	129,6	483,0	n.i
total tares	367,7	295,2	305,8	228,0	403,7	438,7	0,0	529,8	0,0	n.i

Transit in means the cargo carried on ferries from Baku but originated from other countries than Azerbaidjan
Transit out means the cargo carried on ferries to Baku but destined to other countries than Azerbaijan

General cargo traffic in Turkmenbashi from 1993 to 2000 (in thousand tonnes)

	1993		1994		1995		1996		1997		1998		1999		2000 (8 m.)
	export	transit	export	transit	export	transit	export	transit	export	transit	export	transit	export	transit	export
	total	out	total	out	total	out	total	out	total	out	total	out	total	out	+ transit
TOTAL OUT	**220,4**	**10,1**	**170,1**	**23,7**	**110,0**	**6,6**	**38,4**	**0,2**	**35,2**	**0,1**	**53,7**	**0,0**	**31,4**	**0,0**	**51,0**
salt	0,0	0,0	12,0	0,0	33,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,6
cotton	30,5	0,0	31,7	0,0	12,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
metals	0,0	7,7	11,2	21,3	11,5	3,5	10,3	0,2	6,0	0,0	5,6	0,0	0,0	0,0	0,0
machine and equipment	0,1	0,1	1,4	0,0	0,0	1,2	0,0	0,0	0,0	0,0	1,7	0,0	5,5	0,0	1,7
constr.materials in bulk	177,6	0,0	110,7	0,0	42,5	0,0	28,1	0,0	29,2	0,0	45,8	0,0	0,0	0,0	46,1
chemicals	5,9	0,7	0,0	0,0	10,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,2	0,0	
containers	0,0	1,6	1,2	2,1	0,7	1,8	0,0	0,0	0,0	0,1	0,6	0,0	0,0	0,0	
others	6,3	0,0	1,9	0,3	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	24,7	0,0	1,6
Domestic cargo traffic	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
	import	transit	import	transit	import	transit	import	transit	import	transit	import	transit	import	transit	import
	total	in	total	in	total	in	total	in	total	in	total	in	total	in	total
TOTAL IN	**165,2**	**2,0**	**18,9**	**1,1**	**140,8**	**4,4**	**71,4**	**0,1**	**89,4**	**0,0**	**79,4**	**0,0**	**116,7**	**2,1**	**74,9**
flour	2,3	0,0	0,0	0,0	76,0	0,0	31,6	0,0	29,7	0,0	0,0	0,0	0,0	0,0	0,1
metals	2,8	0,0	0,6	0,0	0,2	0,1	0,0	0,0	0,3	0,0	0,3	0,0	2,5	0,0	27,8
machine and equipment	1,2	0,0	2,2	0,1	3,9	1,2	6,7	0,1	4,0	0,0	12,1	0,0	9,0	2,1	12,8
transport vehicles	1,2	0,0	0,0	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	12,6	0,0	0,0
constr.materials in bulk	3,0	0,0	5,9	0,0	1,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4
other constr material	0,4	0,0	0,1	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,0	0,0
chemicals	10,7	0,0	2,5	0,0	4,9	0,0	1,2	0,0	1,9	0,0	12,8	0,0	12,5	0,0	0,2
containers	2,8	0,9	5,1	0,5	0,4	1,3	0,1	0,0	0,5	0,0	0,2	0,0	1,1	0,0	0,0
others (mainly sugar)	2,8	1,1	2,5	0,5	7,5	0,6	8,6	0,0	2,3	0,0	4,1	0,0	7,9	0,0	4,6
Domestic cargo traffic															
of which salt	138,0	0,0	0,0	0,0	46,4	0,0	23,2	0,0	50,7	0,0	49,9	0,0	70,5	0,0	29,0
other	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TOTAL IN / OUT	**397,7**		**213,8**		**261,8**		**110,1**		**124,7**		**133,1**		**150,2**		**125,9**
of which transit		**12,1**		**24,8**		**11,0**		**0,3**		**0,1**		**0,0**		**2,1**	

Oil traffic from 1993 to 1999 (in thousand tonnes)

	1993	1994	1995	1996	1997	1998	1999
	export	**export**	**export**	**export**	**export**	**export**	**export**
	total	**total**	**total**	**total**	**total**	**total**	**total**
TOTAL LIQUID OUT	**916,6**	**1 612,4**	**1 458,7**	**1 664,7**	**1 752,7**	**2 686,2**	**2 552,1**
Light products export	498,0	299,1	162,4	603,7	447,9	851,2	793,0
Dark products export	418,6	1 313,3	1 296,3	1 061,0	1 304,8	1 835,0	1 759,1
	import	**import**	**import**	**import**	**import**	**import**	**import**
	total	**total**	**total**	**total**	**total**	**total**	**total**
TOTAL LIQUID IN	**950,3**	**2 474,9**	**1 760,9**	**2 026,3**	**1 579,7**	**710,6**	**235,6**
Crude oil domestic	661,3	632,4	1 585,8	1 957,0	1 530,6	684,2	233,1
Light products import	232,7	482,7	165,8	31,5	35,2	26,4	2,5
Dark products import	56,3	1 359,8	9,3	37,8	13,9	0,0	0,0
TOTAL LIQUID BULK	**1 866,9**	**4 087,3**	**3 219,6**	**3 691,0**	**3 332,4**	**3 396,8**	**2 787,7**

OIL AND OIL PRODUCTS DISTRIBUTION			**(sample)**			
		1998	**1999**			
TOTAL IN		**710,5**	**235,5**			
Crude oil UFRA	IN					
from Okarem		670,3	228,5			
from Aladja		13,8	4,5			
Light products import	IN	26,4	2,5			
				Distribution in 1999		
TOTAL OUT				**to**	**to**	**to others**
Crude oil export	OUT	**597,9**	**1 822,6**	Iran	Caucasus	via Baku
from Okarem		142,1	615,2	0,0	135,9	479,3
from Cheleken		455,8	1 207,4	155,6	339,2	712,6
Crude oil to UFRA	OUT	**684,1**	**233,0**			
Oil products from UFRA	OUT	**2 686,2**	**2 552,1**		**Distribution**	
to central Asia		111,6	32,9			
to East Euro/Russia		63,8	46,2		1,81%	
to N-West Europe		123,4	81,2		3,18%	
to Mediterranean C		1 029,0	1 179,2		46,21%	
to Caucasus	115 via ferry	725,0	803,3	240 via ferry	31,48%	
to Iran /Turkey/Afg.		859,0	614,5		24,08%	
to others		1,0	51,7		2,03%	
Total out seaborne		**3 968,2**	**4 607,7**			
Total in seaborne		**710,5**	**235,5**			
TOTAL ALL PORTS		**4 678,7**	**4 843,2**			

TURKMENBASHI FERRY TERMINAL TRAFFIC SCENARIO: Pessimistic

IN 1000 TONNES

	1998	1998	1999	1999	TOTAL IN	TOTAL IN	TOTAL IN	BASE	growth	Total in				growth																
	import	transit	import	transit	1998	1999	2000 est.	TRAFFIC	rate	2 001	2 002	2 003	2 004	rate	2 005	2 006	2 007	2 008	2 009	2 010	2 011	2 012	2 013	2 014	2 015	2 016	2 017	2 018	2 019	2 020
Ferry in									in %					in %																
oil products	17,7	2,9	6,9	2,5	20,6	9,4		15	2,0%	15	16	16	16	2,0%	17	17	17	18	18	18	19	19	19	20	20	21	21	21	22	22
ore/ minerals/nat.fertilizers	7,7	11,1	64,5	12,5	18,8	77,0		50	2,0%	51	52	53	54	2,0%	55	56	57	59	60	61	62	63	65	66	67	69	70	71	73	74
rice/wheat	0,0	9,1	0,0	0,5	9,1	0,5		10	1,7%	10	10	11	11	1,7%	11	11	11	11	12	12	12	12	12	13	13	13	13	14	14	14
equipment	0,2	37,5	9,5	21,8	37,7	31,3		35	7,8%	38	41	44	47	2,0%	48	49	50	51	52	53	54	55	56	58	59	60	61	62	64	65
cars	3,0	4,2	1,1	0,1	7,2	1,2		5	7,8%	5	6	6	7	2,0%	7	7	7	7	7	8	8	8	8	8	8	9	9	9	9	9
Sawn timber/build materials	3,0	0,8	0,2	0,7	3,8	0,9		3	2,0%	3	3	3	3	2,0%	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4
food/beverages/soja beans	11,7	271,5	6,0	123,7	283,2	129,7		200	1,7%	203	207	210	214	1,7%	218	221	225	229	233	237	241	245	249	253	258	262	266	271	276	280
other	1,3	18,7	1,4	9,2	20,0	10,6		15	0,0%	15	15	15	15	1,0%	15	15	15	16	16	16	16	16	16	17	17	17	17	17	17	18
Total without tares	44,6	355,8	89,6	171,0	400,4	260,6	345,0	333	2,5%	341,1	349,4	358,2	367,3	1,7%	373,8	380,4	387,2	394,1	401,1	408,2	415,5	422,9	430,4	438,0	445,8	453,8	461,9	470,1	478,5	487,0
tares	186,4		334,3		186,4	334,3	n.i	250	2,5%	256	263	269	276	1,7%	280	285	290	295	300	305	310	315	321	326	332	337	343	349	355	361
Total IN with tares	231,0	355,8	423,9	171,0	586,8	594,9	n.i	583	2,5%	597,25	611,98	627,22	643,00	1,7%	654,20	665,61	677,21	689,01	701,03	713,25	725,69	738,35	751,24	764,34	777,68	791,26	805,07	819,13	833,43	847,99

	1998	1998	1999	1999	TOT OUT	TOT OUT	TOT OUT	BASE	growth	total out	total out	total out	total out	growth	total out	total out	total out	total out	total out	total out	total out	total out	total out	total out	total out	total out	total out	total out	total out	total out
	export	transit	export	transit	1998	1999	2000 est	TRAFFIC	rate	2 001	2 002	2 003	2 004	rate	2 005	2 006	2 007	2 008	2 009	2 010	2 011	2 012	2 013	2 014	2 015	2 016	2 017	2 018	2 019	2 020
Ferry out									in %					in %																
oil products	44,4	70,8	4,3	235,0	115,2	239,3		240	1,0%	242	245	245	247	1,0%	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
ore/minerals/fertlizers	0,5	4,8	0,1	0,1	5,3	0,2		4	2,0%	4	4	4	4	2,0%	4	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6
equipment	3,6	9,4	0,7	1,0	13,0	1,7		5	2,0%	5	5	5	5	2,0%	6	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7
cars	3,0	3,6	3,3	5,3	6,6	8,6		7	2,0%	7	7	7	8	2,0%	8	8	8	8	8	9	9	9	9	9	9	10	10	10	10	10
Building materials	181,3	0,0	20,6	0,2	181,3	20,8		100	2,0%	102	104	106	108	2,0%	110	113	115	117	120	122	124	127	129	132	135	137	140	143	146	149
Cotton	0,0	109,0	0,0	60,0	109,0	60,0		100	0,0%	100	100	100	100	0,0%	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
containers	0,0	0,3	0,1	0,8	0,3	0,9		1	2,0%	1	1	1	1	2,0%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
food and bever/consum goods	1,2	5,3	4,2	8,7	6,5	12,9		13	0,0%	13	13	13	13	0,0%	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
other	7,3	3,8	6,7	0,9	11,1	7,6		9	0,0%	9	9	9	9	0,0%	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Total without tares	241,3	207,0	40,0	312,0	448,3	352,0	356,3	479	0,9%	483,3	488,1	490,6	495,5	0,6%	500,5	503,3	505,9	508,6	511,3	514,1	517,0	519,9	522,8	525,9	528,9	532,1	535,3	538,5	541,9	545,3
tares	252,3	0,0	195,5	0,0	252,3	195,5	n.i	220	0,9%	222	224	226	228	0,6%	229	230	232	233	234	236	237	239	240	241	243	244	246	247	249	250
Total out	493,6	207,0	235,5	312,0	700,6	547,5	n.i	699	0,9%	705,2	712,0	716,4	723,2	0,6%	729,6	733,7	737,7	741,8	745,8	750,0	754,2	758,5	762,9	767,3	771,8	776,3	781,0	785,7	790,4	795,3

TOTAL IN AND OUT	TARES INCLUDED				1 287,4	1 142,4	n.i	1 282	1,6%	1 302,5	1 324,0	1 343,6	1 366,2	1,1%	1 383,8	1 399,3	1 414,9	1 430,8	1 446,9	1 463,3	1 479,9	1 496,9	1 514,1	1 531,6	1 549,5	1 567,6	1 586,0	1 604,8	1 623,9	1 643,3
TOTAL IN AND OUT	TARES EXCLUDED				848,7	612,6	701,3	812	1,5%	824,4	837,6	848,7	862,8	1,1%	874,3	883,7	893,1	902,7	912,4	922,3	932,4	942,7	953,2	963,9	974,8	985,8	997,1	1 008,6	1 020,3	1 032,2
Average shipload/call					2021	1702		2 000		2 000	2 000	2 000	2 000		2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000
number of Calls					420	360		406		412	419	424	431		437	442	447	451	456	461	466	471	477	482	487	493	499	504	510	516
number of ships' movements					837	720		812		824	838	849	863		874	884	893	903	912	922	932	943	953	964	975	986	997	1 009	1 020	1 032

TURKMENBASHI **TRAFFIC SCENARIO: Pessimistic**

GENERAL CARGO **IN 1000 TONNES**

	Average 3 years	Base Traffic	Growth Rate in %	2001	2002	2003	2004	Growth Rate in %	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
TOTAL DRY OUT	**53,9**	**57,3**	**2,9%**	**58,9**	**60,7**	**62,5**	**64,4**	**1,9%**	**65,6**	**66,9**	**68,2**	**69,6**	**70,9**	**72,3**	**73,8**	**75,2**	**76,7**	**78,2**	**79,8**	**81,3**	**83,0**	**84,6**	**86,3**	**88,0**
salt	0,8	1	0,0%	1,0	1,0	1,0	1,0	0,0%	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
cotton	0,0	0	0,0%	0,0	0,0	0,0	0,0	0,0%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
metals	1,9	2	2,0%	2,0	2,1	2,1	2,2	2,0%	2,2	2,3	2,3	2,3	2,4	2,4	2,5	2,5	2,6	2,6	2,7	2,7	2,8	2,9	2,9	3,0
machine and equipment	3,3	3,3	2,0%	3,4	3,4	3,5	3,6	2,0%	3,6	3,7	3,8	3,9	3,9	4,0	4,1	4,2	4,3	4,4	4,4	4,5	4,6	4,7	4,8	4,9
constr.materials in bulk	38,3	40	2,0%	40,8	41,6	42,4	43,3	2,0%	44,2	45,0	45,9	46,9	47,8	48,8	49,7	50,7	51,7	52,8	53,8	54,9	56,0	57,1	58,3	59,4
chemicals	0,4	1	2,0%	1,0	1,0	1,1	1,1	2,0%	1,1	1,1	1,1	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,4	1,4	1,4	1,5	1,5
containers	0,2	1	2,0%	1,0	1,0	1,1	1,1	2,0%	1,1	1,1	1,1	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,4	1,4	1,4	1,5	1,5
others	9,0	9	7,8%	9,7	10,5	11,3	12,2	2,0%	12,4	12,6	12,9	13,2	13,4	13,7	14,0	14,2	14,5	14,8	15,1	15,4	15,7	16,0	16,4	16,7
Domestic cargo traffic	0,0	0	0,0%	0,0	0,0	0,0	0,0	0,0%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Average 3 years	Base Traffic	Growth Rate in %					Growth Rate in %																
TOTAL DRY IN	**102,8**	**106,0**	**1,5%**	**107,5**	**109,1**	**110,7**	**112,3**	**1,7%**	**114,4**	**116,5**	**118,6**	**120,8**	**123,0**	**125,2**	**127,5**	**129,9**	**132,2**	**134,7**	**137,1**	**139,6**	**142,2**	**144,8**	**147,4**	**150,1**
flour	0,1	1	1,7%	1,0	1,0	1,1	1,1	1,7%	1,1	1,1	1,1	1,1	1,2	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,4	1,4	1,4
metals	14,8	14	2,0%	14,3	14,6	14,9	15,2	2,0%	15,5	15,8	16,1	16,4	16,7	17,1	17,4	17,8	18,1	18,5	18,8	19,2	19,6	20,0	20,4	20,8
machine and equipment	13,4	15	2,0%	15,3	15,6	15,9	16,2	2,0%	16,6	16,9	17,2	17,6	17,9	18,3	18,7	19,0	19,4	19,8	20,2	20,6	21,0	21,4	21,9	22,3
transport vehicles	4,2	4	2,0%	4,1	4,2	4,2	4,3	2,0%	4,4	4,5	4,6	4,7	4,8	4,9	5,0	5,1	5,2	5,3	5,4	5,5	5,6	5,7	5,8	5,9
constr.materials in bulk	0,2	0,5	2,0%	0,5	0,5	0,5	0,5	2,0%	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,7	0,7	0,7	0,7	0,7	0,7	0,7
other constr material	0,2	0,5	2,0%	0,5	0,5	0,5	0,5	2,0%	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,7	0,7	0,7	0,7	0,7	0,7	0,7
chemicals	8,5	9	2,0%	9,2	9,4	9,6	9,7	2,0%	9,9	10,1	10,3	10,5	10,8	11,0	11,2	11,4	11,6	11,9	12,1	12,4	12,6	12,9	13,1	13,4
containers	0,4	1	2,0%	1,0	1,0	1,1	1,1	2,0%	1,1	1,1	1,1	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,4	1,4	1,4	1,5	1,5
others (mainly sugar)	6,3	6	1,7%	6,1	6,2	6,3	6,4	1,7%	6,5	6,6	6,8	6,9	7,0	7,1	7,2	7,3	7,5	7,6	7,7	7,9	8,0	8,1	8,3	8,4
Domestic cargo traffic																								
of which salt	54,6	55	1,0%	55,6	56,1	56,7	57,2	1,7%	58,2	59,2	60,2	61,2	62,3	63,3	64,4	65,5	66,6	67,7	68,9	70,1	71,3	72,5	73,7	75,0
other	0,0	0	1,0%	0,0	0,0	0,0	0,0	0,0%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TOTAL DRY IN / OUT	**156,7**	**163,3**	**2,0%**	**166,5**	**169,8**	**173,2**	**176,7**	**1,8%**	**180,0**	**183,4**	**186,9**	**190,4**	**193,9**	**197,6**	**201,3**	**205,1**	**209,0**	**212,9**	**216,9**	**221,0**	**225,1**	**229,4**	**233,7**	**238,1**
Average shipload		1100		1100	1100	1100	1100		1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
Number of calls		148		151	154	157	161		164	167	170	173	176	180	183	186	190	194	197	201	205	209	212	216
Number of ships'movements		297		303	309	315	321		327	333	340	346	353	359	366	373	380	387	394	402	409	417	425	433

TURKMENBASHI — TRAFFIC SCENARIO: Pessimistic

OIL TERMINAL — IN 1000 TONNES

	1 998	1 999	2000 est.	2001	2002	Growth	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LIQUID CARGO						rate																		
	export	export	export	export	export	in %	export	export	export	export	export	export	export	export	export	export	export	export	export	export	export	export	export	export
	total	total	total	total	total		total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total
TOTAL LIQUID OUT	2 686,2	2 552,1	2 680,0	2 700,0	2 700,0	1,0%	2 727,0	2 754,3	2 781,8	2 809,6	2 837,7	2 866,1	2 894,8	2 923,7	2 953,0	2 982,5	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0
light products export	851,2	793,0																						
dark products export	1 835,0	1 759,1																						
total oil products export	2 686,2	2 552,1	2 680,0	2 700,0	2 700,0	1,0%	2 727	2 754	2 782	2 810	2 838	2 866	2 895	2 924	2 953	2 982	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000
(all destinations included)																								
	import	import	import	import	import		import	import	import	import	import	import	import	import	import	import	import	import	import	import	import	import	import	import
	total	total	total	total	total		total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total
TOTAL LIQUID IN	710,6	235,6	215,0	215,0	735,0	0,5%	742,5	750,1	757,7	765,5	773,3	781,2	789,2	797,2	805,4	813,6	814,0	814,4	814,7	815,1	815,5	815,9	816,3	816,8
Crude oil (domestic)	684,2	233,1	200,0	200,0	720,0	1,0%	727	734	742	749	757	764	772	780	787	795	795	795	795	795	795	795	795	795
Light products import)	26,4	2,5	15,0	15,0	15,0	2,0%	15	16	16	16	17	17	17	18	18	18	19	19	19	20	20	21	21	21
TOTAL LIQUID BULK TRADED	3 396,8	2 787,7	2 895,0	2 915,0	3 435,0	0,5%	3 470	3 504	3 540	3 575	3 611	3 647	3 684	3 721	3 758	3 796	3 814	3 814	3 815	3 815	3 816	3 816	3 816	3 817
total out seaborne**	2 686,2	2 552,1	2 680,0	2 700,0	2 700,0	0,5%	2 727,0	2 754,3	2 781,8	2 809,6	2 837,7	2 866,1	2 894,8	2 923,7	2 953,0	2 982,5	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0
total in seaborne	710,6	235,6	215,0	215,0	735,0	0,5%	742,5	750,1	757,7	765,5	773,3	781,2	789,2	797,2	805,4	813,6	814,0	814,4	814,7	815,1	815,5	815,9	816,3	816,8
TOTAL ALL PORTS	3 396,8	2 787,7	2 895,0	2 915,0	3 435,0	0,5%	3 469,5	3 504,3	3 539,5	3 575,1	3 611,0	3 647,3	3 683,9	3 720,9	3 758,3	3 796,1	3 814,0	3 814,4	3 814,7	3 815,1	3 815,5	3 815,9	3 816,3	3 816,8

**export products via ferries and land excluded

Average shipload crude oil	4614	4809	4800	4800	4800		4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800
Average shipload oil products	3363	3990	4000	4000	4000		4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
Number of ships crude oil	148	48	42	42	150		152	153	155	156	158	159	161	162	164	166	166	166	166	166	166	166	166	166
Number of ships oil products	779	704	670	675	675		682	689	695	702	709	717	724	731	738	746	750	750	750	750	750	750	750	750
Number of ships'movements	1855	1505	1423	1433	1650		1667	1683	1700	1717	1734	1752	1769	1787	1805	1823	1831	1831	1831	1831	1831	1831	1831	1831

TURKMENBASHI **TRAFFIC SCENARIO: Optimistic**

FERRY TERMINAL **IN 1000 TONNES**

	1998	1998	1999	1999	TOTAL IN	TOTAL IN	TOTAL IN	BASE	growth	Total in				growth							growth										
	import	transit	import	transit	1998	1999	2000 est.	TRAFFIC	rate	2 001	2 002	2 003	2 004	rate	2 005	2 006	2 007	2 008	2 009	2 010	rate	2 011	2 012	2 013	2 014	2 015	2 016	2 017	2 018	2 019	2 020
Ferry In									in %					in %							in %										
oil products	17,7	2,9	6,9	2,5	20,6	9,4		15	7,8%	16	17	19	20	5,0%	21	22	23	25	26	27	5,0%	29	30	31	33	35	36	38	40	42	44
ore/ minerals/nat.fertlizers	7,7	11,1	64,5	12,5	18,8	77,0		50	2,0%	51	52	53	54	2,0%	55	56	57	59	60	61	2,0%	62	63	65	66	67	69	70	71	73	74
rice/wheat	0,0	9,1	0,0	0,5	9,1	0,5		10	1,7%	10	10	11	11	3,0%	11	11	12	12	12	13	3,0%	13	14	14	14	15	15	16	16	17	17
equipment	0,2	37,5	9,5	21,8	37,7	31,3		35	10,0%	39	42	47	51	10,0%	56	62	68	75	83	91	2,0%	93	94	96	98	100	102	104	106	108	111
cars	3,0	4,2	1,1	0,1	7,2	1,2		5	10,0%	6	6	7	7	10,0%	8	9	10	11	12	13	2,0%	13	13	14	14	14	15	15	15	15	16
Sawn timber/build materials	3,0	0,8	0,2	0,7	3,8	0,9		3	7,8%	3	3	4	4	7,8%	4	5	5	5	6	6	2,0%	6	7	7	7	7	7	7	7	8	8
food/beverages/soja beans	11,7	271,5	6,0	123,7	283,2	129,7		200	1,7%	203	207	210	214	3,0%	220	227	234	241	248	255	3,0%	263	271	279	288	296	305	314	324	333	343
other	231,8	374,5	424,9	180,2	606,3	605,1		15	7,8%	16	17	19	20	7,8%	22	24	25	27	29	32	7,8%	34	37	40	43	46	50	54	58	62	67
Total without tares	**275,1**	**711,6**	**513,1**	**342,0**	**986,7**	**855,1**	**########**	**333**	**3,5%**	**344,1**	**356,0**	**368,5**	**381,9**	**4,5%**	**398,5**	**416,1**	**434,8**	**454,6**	**475,7**	**498,2**	**3,2%**	**513,5**	**529,4**	**545,9**	**563,0**	**580,8**	**599,2**	**618,4**	**638,3**	**659,0**	**680,6**
tares	180,6		329,7		180,6	329,7	n.i	250	3,5%	259	268	277	287	4,5%	287	300	313	328	342	358	3,2%	370	381	394	407	420	433	447	462	477	492
Total IN with tares	**455,7**	**711,6**	**842,8**	**342,0**	**1 167,3**	**1 184,8**	**n.i**	**583**	**3,5%**	**602,86**	**623,70**	**645,59**	**668,61**	**4,2%**	**685,33**	**715,92**	**748,19**	**782,25**	**818,22**	**856,23**	**3,2%**	**883,10**	**910,91**	**939,71**	**969,53**	**1 000,42**	**1 032,42**	**1 065,59**	**1 099,97**	**1 135,61**	**1 172,57**

	1998	1998	1999	1999	TOT OUT	TOT OUT	TOT OUT	BASE	growth	total out	total out	total out	total out	growth	total out	total out	total out	total out	total out	total out	growth	total out	total out	total out	total out	total out	total out	total out	total out	total out	total out
	export	transit	export	transit	1998	1999	2000 est	TRAFFIC	rate	2 001	2 002	2 003	2 004	rate	2 005	2 006	2 007	2 008	2 009	2 010	rate	2 011	2 012	2 013	2 014	2 015	2 016	2 017	2 018	2 019	2 020
Ferry out									in %					in %							in %										
oil products	44,4	70,8	4,3	235,0	115,2	239,3		240	5,0%	252	265	278	292	5,0%	306	322	338	350	350	350	0,0%	350	350	350	350	350	350	350	350	350	350
ore/minerals/fertlizers	0,5	4,8	0,1	0,1	5,3	0,2		4	5,0%	4	4	5	5	5,0%	5	5	6	6	6	7	2,0%	7	7	7	7	7	7	7	8	8	8
equipment	3,6	9,4	0,7	1,0	13,0	1,7		5	2,0%	5	5	5	5	2,0%	6	6	6	6	6	6	2,0%	6	6	6	7	7	7	7	7	7	7
cars	3,0	3,6	3,3	5,3	6,6	8,6		7	2,0%	7	7	7	8	2,0%	8	8	8	8	8	9	2,0%	9	9	9	9	9	10	10	10	10	10
Building materials	181,3	0,0	20,6	0,2	181,3	20,8		100	5,0%	105	110	116	122	5,0%	128	134	141	148	155	163	2,0%	166	169	173	176	180	183	187	191	195	199
Cotton	0,0	109,0	0,0	60,0	109,0	60,0		100	0,0%	100	100	100	100	2,0%	600	612	624	637	649	662	0,0%	662	662	662	662	662	662	662	662	662	662
containers	0,0	0,3	0,1	0,8	0,3	0,9		1	5,0%	1	1	1	1	5,0%	1	1	1	1	1	1	2,0%	1	1	1	1	1	1	1	1	1	1
food and bever/consum goods	1,2	5,3	4,2	8,7	6,5	12,9		13	2,0%	13	14	14	14	2,0%	14	15	15	15	16	16	2,0%	16	16	17	17	17	18	18	19	19	19
other	314,6	86,5	217,5	249,9	401,1	467,4		9	2,0%	9	9	10	10	2,0%	20	20	21	21	22	22	2,0%	23	23	23	24	24	25	25	26	26	27
Total without tares	**548,6**	**289,7**	**250,8**	**561,0**	**838,3**	**811,8**	**########**	**479**	**3,8%**	**496,5**	**515,3**	**535,0**	**555,7**	**14,2%**	**1 087,4**	**1 122,4**	**1 158,7**	**1 191,8**	**1 213,3**	**1 235,4**	**0,4%**	**1 239,8**	**1 244,4**	**1 249,0**	**1 253,8**	**1 258,6**	**1 263,5**	**1 268,5**	**1 273,7**	**1 278,9**	**1 284,2**
tares	245,9	0,0	184,5	0,0	245,9	184,5	n.i	220	3,8%	228	237	246	255	14,2%	292	333	381	395	410	426	0,4%	428	429	431	433	435	436	438	440	442	444
Total out	**794,5**	**289,7**	**435,3**	**561,0**	**1 084,2**	**996,3**	**n.i**	**699**	**3,8%**	**724,9**	**752,3**	**781,1**	**811,1**	**12,7%**	**1 379,2**	**1 455,7**	**1 539,5**	**1 587,1**	**1 623,6**	**1 661,4**	**0,4%**	**1 667,5**	**1 673,8**	**1 680,2**	**1 686,7**	**1 693,3**	**1 699,9**	**1 706,7**	**1 713,6**	**1 720,6**	**1 727,7**

TOTAL IN AND OUT	TARES INCLUDED				2 251,5	2 181,1	n.i	1 282	3,7%	1 327,7	1 376,0	1 426,7	1 479,7	9,3%	2 064,5	2 171,6	2 287,7	2 369,4	2 441,8	2 517,6	1,5%	2 550,6	2 584,7	2 619,9	2 656,2	2 693,7	2 732,4	2 772,3	2 813,6	2 856,2	2 900,3
TOTAL IN AND OUT	TARES EXCLUDED				1 825,0	1 666,9	########	812	3,7%	840,7	871,3	903,5	937,6	10,8%	1 485,9	1 538,4	1 593,4	1 646,4	1 689,0	1 733,6	1,3%	1 753,4	1 773,8	1 794,9	1 816,8	1 839,3	1 862,7	1 886,9	1 912,0	1 937,9	1 964,8
Average shipload					4345	4630		2 000		2 000	2 000	2 000	2 000		2 000	2 000	2 000	2 000	2 000	2 000		2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000
number of Calls					420	360		406		420	436	452	469		743	769	797	823	844	867		877	887	897	908	920	931	943	956	969	982
number of ships' movements					837	720		812		841	871	904	938		1 486	1 538	1 593	1 646	1 689	1 734		1 753	1 774	1 795	1 817	1 839	1 863	1 887	1 912	1 938	1 965

TURKMENBASHI **TRAFFIC SCENARIO: Optimistic**

GENERAL CARGO **IN 1000 TONNES**

				in 1000 tons																					
	Average	Base	Growth	2001	2002	2003	2004	Growth	2005	2006	2007	2008	2009	2010	Growth	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	3 years	Traffic	Rate					Rate							Rate										
			in %					in %							in %										
TOTAL DRY OUT	53,9	57,3	1,9%	58,4	59,5	60,6	61,7	4,2%	64,3	66,9	69,7	72,7	75,8	79,0	2,1%	80,6	82,3	83,9	85,7	87,4	89,2	91,1	93,0	94,9	96,9
salt	0,8	1	0,0%	1,0	1,0	1,0	1,0	2,0%	1,0	1,0	1,1	1,1	1,1	1,1	2,0%	1,1	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,4
cotton	0,0	0	0,0%	0,0	0,0	0,0	0,0	0,0%	0,0	0,0	0,0	0,0	0,0	0,0	0,0%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
metals	1,9	2	0,0%	2,0	2,0	2,0	2,0	2,0%	2,0	2,1	2,1	2,2	2,2	2,3	2,0%	2,3	2,3	2,4	2,4	2,5	2,5	2,6	2,6	2,7	2,7
machine and equipment	3,3	3,3	2,0%	3,4	3,4	3,5	3,6	2,0%	3,6	3,7	3,8	3,9	3,9	4,0	2,0%	4,1	4,2	4,3	4,4	4,4	4,5	4,6	4,7	4,8	4,9
constr.materials in bulk	38,3	40	2,0%	40,8	41,6	42,4	43,3	5,0%	45,5	47,7	50,1	52,6	55,3	58,0	2,0%	59,2	60,4	61,6	62,8	64,1	65,3	66,6	68,0	69,3	70,7
chemicals	0,4	1	0,0%	1,0	1,0	1,0	1,0	2,0%	1,0	1,0	1,1	1,1	1,1	1,1	2,0%	1,1	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,4
containers	0,2	1	2,0%	1,0	1,0	1,1	1,1	5,0%	1,1	1,2	1,3	1,3	1,4	1,5	5,0%	1,5	1,6	1,7	1,8	1,9	1,9	2,0	2,1	2,3	2,4
others	9,0	9	2,0%	9,2	9,4	9,6	9,7	2,0%	9,9	10,1	10,3	10,5	10,8	11,0	2,0%	11,2	11,4	11,6	11,9	12,1	12,4	12,6	12,9	13,1	13,4
Domestic cargo traffic	0,0	0	2,0%	0,0	0,0	0,0	0,0	2,0%	0,0	0,0	0,0	0,0	0,0	0,0	2,0%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Average	Base	Growth					Growth							Growth										
	3 years	Traffic	Rate					Rate							Rate										
			in %					in %							in %										
TOTAL DRY IN	102,8	106,0	5,0%	111,2	116,7	122,5	128,7	6,8%	148,7	156,2	164,2	172,6	181,6	191,1	2,7%	201,0	206,1	211,3	216,7	222,2	227,8	233,6	239,5	245,7	251,9
flour	0,1	1	1,7%	1,0	1,0	1,1	1,1	3,0%	1,1	1,1	1,2	1,2	1,2	1,3	3%	1,3	1,4	1,4	1,4	1,5	1,5	1,6	1,6	1,7	1,7
metals	14,8	14	7,8%	15,1	16,3	17,5	18,9	7,8%	20,4	22,0	23,7	25,5	27,5	29,7	2%	30,3	30,9	31,5	32,1	32,8	33,4	34,1	34,8	35,5	36,2
machine and equipment	13,4	15	7,8%	16,2	17,4	18,8	20,3	7,8%	21,8	23,5	25,4	27,4	29,5	31,8	2%	32,4	33,1	33,7	34,4	35,1	35,8	36,5	37,2	38,0	38,8
transport vehicles	4,2	4	7,8%	4,3	4,6	5,0	5,4	7,8%	5,8	6,3	6,8	7,3	7,9	8,5	2%	8,6	8,8	9,0	9,2	9,4	9,5	9,7	9,9	10,1	10,3
constr.materials in bulk	0,2	0,5	7,8%	0,5	0,6	0,6	0,7	7,8%	0,7	0,8	0,8	0,9	1,0	1,1	2%	1,1	1,1	1,1	1,1	1,2	1,2	1,2	1,2	1,3	1,3
other constr material	0,2	0,5	7,8%	0,5	0,6	0,6	0,7	7,8%	0,7	0,8	0,8	0,9	1,0	1,1	2%	1,1	1,1	1,1	1,1	1,2	1,2	1,2	1,2	1,3	1,3
chemicals	8,5	9	7,8%	9,7	10,5	11,3	12,2	7,8%	13,1	14,1	15,2	16,4	17,7	19,1	2%	19,5	19,8	20,2	20,6	21,1	21,5	21,9	22,3	22,8	23,3
containers	0,4	1	5,0%	1,1	1,1	1,2	1,2	5,0%	1,3	1,3	1,4	1,5	1,6	1,6	5%	1,7	1,8	1,9	2,0	2,1	2,2	2,3	2,4	2,5	2,7
others (mainly sugar)	6,3	6	1,7%	6,1	6,2	6,3	6,4	3,0%	20,0	20,6	21,2	21,9	22,5	23,2	3%	23,9	24,6	25,3	26,1	26,9	27,7	28,5	29,4	30,3	31,2
Domestic cargo traffic																									
of which salt	54,6	55	3,0%	56,7	58,3	60,1	61,9	3,0%	63,8	65,7	67,6	69,7	71,8	73,9	3%	76,1	78,4	80,8	83,2	85,7	88,3	90,9	93,6	96,4	99,3
other	0,0	0	0,0%	0,0	0,0	0,0	0,0	1,0%	0,0	0,0	0,0	0,0	0,0	0,0	2%	5,0	5,1	5,2	5,3	5,4	5,5	5,6	5,7	5,9	6,0
TOTAL DRY IN / OUT	**156,7**	**163,3**	**3,9%**	**169,5**	**176,1**	**183,1**	**190,4**	**6,0%**	**213,0**	**223,2**	**233,9**	**245,3**	**257,4**	**270,1**	**2,5%**	**281,6**	**288,3**	**295,2**	**302,3**	**309,6**	**317,0**	**324,7**	**332,5**	**340,5**	**348,8**
Average shipload				1 100	1 100	1 100	1 100		1 100	1 100	1 100	1 100	1 100	1 100		1 100	1 100	1 100	1 100	1 100	1 100	1 100	1 100	1 100	1 100
Number of calls				154	160	166	173		194	203	213	223	234	246		256	262	268	275	281	288	295	302	310	317
Number of ships'movements				308	320	333	346		387	406	425	446	468	491		512	524	537	550	563	576	590	605	619	634

TURKMENBASHI **TRAFFIC SCENARIO: Optimistic**

OIL TERMINAL **IN 1000 TONNES**

	1 998	1 999	2000 est	2001	2002	Growth rate in %	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	export total	export total	export total	export total	export total		export total	export total	export total	export total	export total	export total	export total	export total	export total	export total	export total	export total	export total	export total	export total	export total	export total	export total
TOTAL LIQUID OUT	2 686,2	2 552,1	2 680,0	2 700,0	2 700,0	3,0%	2 781,0	2 864,4	2 950,4	3 038,9	3 130,0	3 223,9	3 320,7	3 420,3	3 522,9	3 628,6	3 737,4	3 849,6	3 965,0	4 000,0	4 000,0	4 000,0	4 000,0	4 000,0
light products export	851,2	793,0																						
dark products export	1 835,0	1 759,1																						
total oil products export	2 686,2	2 552,1	2 680,0	2 700,0	2 700,0	3,0%	2 781	2 864	2 950	3 039	3 130	3 224	3 321	3 420	3 523	3 629	3 737	3 850	3 965	4 000	4 000	4 000	4 000	4 000
(all destinations included)																								
	import total	import total	import total	import total	import total		import total	import total	import total	import total	import total	import total	import total	import total	import total	import total	import total	import total	import total	import total	import total	import total	import total	import total
TOTAL LIQUID IN	710,6	235,6	215,0	215,0	735,0	1,7%	756,9	779,5	802,7	826,6	851,2	876,6	902,7	929,6	957,4	985,9	1 015,3	1 045,6	1 076,7	1 077,1	1 077,5	1 077,9	1 078,3	1 078,8
Crude oil (domestic)	684,2	233,1	200,0	200,0	720,0	3,0%	742	764	787	810	835	860	886	912	939	968	997	1 027	1 057	1 057	1 057	1 057	1 057	1 057
Light products import)	26,4	2,5	15,0	15,0	15,0	2,0%	15	16	16	16	17	17	17	18	18	18	19	19	19	20	20	21	21	21
TOTAL LIQUID BULK TRADED	3 396,8	2 787,7	2 895,0	2 915,0	3 435,0	1,7%	3 538	3 644	3 753	3 865	3 981	4 101	4 223	4 350	4 480	4 614	4 753	4 895	5 042	5 077	5 078	5 078	5 078	5 079
total out seaborne**	2 686,2	2 552,1	2 680,0	2 700,0	2 700,0	1,7%	3 559,0	2 864,4	2 950,4	3 038,9	3 130,0	3 223,9	3 320,7	3 420,3	3 522,9	3 628,6	3 737,4	3 849,6	3 965,0	4 000,0	4 000,0	4 000,0	4 000,0	4 000,0
total in seaborne	710,6	235,6	215,0	215,0	735,0	1,7%	756,9	779,5	802,7	826,6	851,2	876,6	902,7	929,6	957,4	985,9	1 015,3	1 045,6	1 076,7	1 077,1	1 077,5	1 077,9	1 078,3	1 078,8
TOTAL ALL PORTS	3 396,8	2 787,7	2 895,0	2 915,0	3 435,0	1,7%	4 315,9	3 643,9	3 753,0	3 865,5	3 981,3	4 100,6	4 223,4	4 349,9	4 480,3	4 614,5	4 752,7	4 895,1	5 041,8	5 077,1	5 077,5	5 077,9	5 078,3	5 078,8

** export products via ferries and land are excluded.

Average shipload crude oil	4614	4809	4800	4800	4800		4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800
Average shipload oil products	3363	3990	4000	4000	4000		4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
Number of ships crude oil	148	48	42	42	150		155	159	164	169	174	179	184	190	196	202	208	214	220	220	220	220	220	220
Number of ships oil products	779	704	670	675	675		695	716	738	760	783	806	830	855	881	907	934	962	991	1000	1000	1000	1000	1000
Number of ships'movements	1855	1505	1423	1433	1650		1700	1750	1803	1857	1913	1970	2029	2090	2153	2217	2284	2353	2423	2441	2441	2441	2441	2441

FERRY TERMINAL **TURKMENBASHI** **IN 1000 TONNES** **TRAFFIC SCENARIO: Medium**

	1998 import	1998 transit	1999 import	1999 transit	TOTAL IN 1998	TOTAL IN 1999	TOTAL IN 2000 est.	BASE TRAFFIC	growth rate in %	Total in 2 001	2 002	2 003	2 004
Ferry In													
oil products	17,7	2,9	6,9	2,5	20,6	9,4		15	7,8%	16	17	19	20
ore/ minerals/nat.fertlizers	7,7	11,1	64,5	12,5	18,8	77,0		50	2,0%	51	52	53	54
rice/wheat	0,0	9,1	0,0	0,5	9,1	0,5		10	1,7%	10	10	11	11
equipment	0,2	37,5	9,5	21,8	37,7	31,3		35	7,8%	38	41	44	47
cars	3,0	4,2	1,1	0,1	7,2	1,2		5	7,8%	5	6	6	7
Sawn timber/build materials	3,0	0,8	0,2	0,7	3,8	0,9		3	7,8%	3	3	4	4
food/beverages/soja beans	11,7	271,5	6,0	123,7	283,2	129,7		200	1,7%	203	207	210	214
other	231,8	374,5	424,9	180,2	606,3	605,1		15	0,0%	15	15	15	15
Total without tares	**275,1**	**711,6**	**513,1**	**342,0**	**986,7**	**855,1**	**########**	**333**	**2,8%**	**342,1**	**351,6**	**361,6**	**372,1**
tares	180,6		329,7		180,6	329,7	n.i	250	2,8%	257	264	272	279
Total IN with tares	**455,7**	**711,6**	**842,8**	**342,0**	**1 167,3**	**1 184,8**	**n.i**	**583**	**2,8%**	**599,13**	**615,89**	**633,32**	**651,45**

	growth rate in %	2 005	2 006	2 007	2 008	2 009	2 010	growth rate in %	2 011	2 012	2 013	2 014	2 015	2 016	2 017	2 018	2 019	2 020
Ferry In																		
oil products	2,0%	21	21	21	22	22	23	2%	23	24	24	25	25	26	26	27	27	28
ore/ minerals/nat.fertlizers	2,0%	55	56	57	59	60	61	2%	62	63	65	66	67	69	70	71	73	74
rice/wheat	1,7%	11	11	11	11	12	12	3%	12	13	13	13	14	14	15	15	15	16
equipment	2,0%	48	49	50	51	52	53	2%	54	55	56	58	59	60	61	62	64	65
cars	2,0%	7	7	7	7	7	8	2%	8	8	8	8	8	9	9	9	9	9
Sawn timber/build materials	2,0%	4	4	4	4	4	5	2%	5	5	5	5	5	5	5	5	5	6
food/beverages/soja beans	1,7%	218	221	225	229	233	237	3%	244	251	259	266	274	283	291	300	309	318
other	2,0%	20	20	21	21	22	22	2%	23	23	23	24	24	25	25	26	26	27
Total without tares	**2,0%**	**383,6**	**390,5**	**397,7**	**404,9**	**412,3**	**419,8**	**2,6%**	**430,7**	**441,9**	**453,3**	**465,1**	**477,2**	**489,6**	**502,4**	**515,5**	**529,0**	**542,8**
tares	2,0%	279	285	291	297	303	309	2,6%	317	325	334	342	351	361	370	380	390	400
Total IN with tares	**1,9%**	**662,97**	**675,63**	**688,53**	**701,68**	**715,09**	**728,75**	**2,6%**	**747,69**	**767,13**	**787,09**	**807,58**	**828,61**	**850,21**	**872,37**	**895,13**	**918,49**	**942,47**

	1998 export	1998 transit	1999 export	1999 transit	TOT OUT 1998	TOT OUT 1999	TOT OUT 2000 est	BASE TRAFFIC	growth rate in %	total out 2 001	total out 2 002	total out 2 003	total out 2 004
Ferry out													
oil products	44,4	70,8	4,3	235,0	115,2	239,3		240	2,0%	245	250	250	250
ore/minerals/fertlizers	0,5	4,8	0,1	0,1	5,3	0,2		4	5,0%	4	4	5	5
equipment	3,6	9,4	0,7	1,0	13,0	1,7		5	2,0%	5	5	5	5
cars	3,0	3,6	3,3	5,3	6,6	8,6		7	2,0%	7	7	7	8
Building materials	181,3	0,0	20,6	0,2	181,3	20,8		100	2,0%	102	104	106	108
Cotton	0,0	109,0	0,0	60,0	109,0	60,0		100	0,0%	100	100	100	100
containers	0,0	0,3	0,1	0,8	0,3	0,9		1	5,0%	1	1	1	1
food and bever/consum goods	1,2	5,3	4,2	8,7	6,5	12,9		13	2,0%	13	14	14	14
other	314,6	86,5	217,5	249,9	401,1	467,4		9	2,0%	20	20	21	21
Total without tares	**548,6**	**289,7**	**250,8**	**561,0**	**838,3**	**811,8**	**########**	**479**	**1,7%**	**497,1**	**505,2**	**508,8**	**512,1**
tares	245,9	0,0	184,5	0,0	245,9	184,5	n.i	220	1,7%	224	228	231	235
Total out	**794,5**	**289,7**	**435,3**	**561,0**	**1 084,2**	**996,3**	**n.i**	**699**	**1,7%**	**720,9**	**732,8**	**740,2**	**747,5**
TOTAL IN AND OUT	TARES INCLUDED				2 251,5	2 181,1	n.i	1 282	2,2%	1 320,0	1 348,7	1 373,6	1 399,0
TOTAL IN AND OUT	TARES EXCLUDED				1 825,0	1 666,9	########	812	2,2%	839,2	856,8	870,4	884,2
Average shipload					2021	1702	ni	1715		2000	2000	2000	2000
Number of calls					903	979	ni	473		420	428	435	442
Number of ships'movements					1806	1959	ni	946		839	857	870	884

	growth rate in %	total out 2 005	total out 2 006	total out 2 007	total out 2 008	total out 2 009	total out 2 010	growth rate in %	total out 2 011	total out 2 012	total out 2 013	total out 2 014	total out 2 015	total out 2 016	total out 2 017	total out 2 018	total out 2 019	total out 2 020
Ferry out																		
oil products	2,0%	250	250	250	250	250	250	0,0%	250	250	250	250	250	250	250	250	250	250
ore/minerals/fertlizers	2,0%	5	5	5	5	5	5	2%	6	6	6	6	6	6	6	6	7	7
equipment	2,0%	6	6	6	6	6	6	2%	6	6	6	7	7	7	7	7	7	7
cars	5,0%	8	8	9	9	10	10	2%	10	11	11	11	11	11	12	12	12	12
Building materials	2,0%	400	408	416	424	433	442	2%	450	459	469	478	488	497	507	517	528	538
Cotton	2,0%	300	306	312	318	325	331	0%	331	331	331	331	331	331	331	331	331	331
containers	5,0%	1	1	1	1	1	1	5%	1	1	1	1	1	1	1	1	2	2
food and bever/consum goods	2,0%	14	15	15	15	16	16	2%	16	16	17	17	17	18	18	19	19	19
other	2,0%	20	20	21	21	22	22	2%	23	23	23	24	24	25	25	26	26	27
Total without tares	**13,3%**	**1 003,6**	**1 018,9**	**1 034,5**	**1 050,5**	**1 066,8**	**1 083,5**	**1,0%**	**1 093,6**	**1 103,8**	**1 114,3**	**1 125,0**	**1 135,9**	**1 147,1**	**1 158,4**	**1 170,0**	**1 181,8**	**1 193,9**
tares	13,3%	267	302	342	348	354	360	1,0%	364	367	371	375	379	382	386	390	394	398
Total out	**11,6%**	**1 270,3**	**1 321,1**	**1 377,0**	**1 398,8**	**1 421,0**	**1 443,7**	**1,0%**	**1 457,4**	**1 471,3**	**1 485,5**	**1 499,9**	**1 514,6**	**1 529,5**	**1 544,7**	**1 560,1**	**1 575,8**	**1 591,8**
TOTAL IN AND OUT (TARES INCLUDED)	7,6%	1 933,3	1 996,7	2 065,5	2 100,5	2 136,1	2 172,5	1,6%	2 205,1	2 238,5	2 272,6	2 307,5	2 343,2	2 379,7	2 417,0	2 455,2	2 494,3	2 534,3
TOTAL IN AND OUT (TARES EXCLUDED)	9,2%	1 387,1	1 409,4	1 432,2	1 455,4	1 479,1	1 503,3	1,5%	1 524,2	1 545,7	1 567,6	1 590,1	1 613,1	1 636,7	1 660,8	1 685,5	1 710,8	1 736,7
Average shipload		2000	2000	2000	2000	2000	2000		2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Number of calls		694	705	716	728	740	752		762	773	784	795	807	818	830	843	855	868
Number of ships'movements		1 387	1 409	1 432	1 455	1 479	1 503		1 524	1 546	1 568	1 590	1 613	1 637	1 661	1 686	1 711	1 737

TURKMENBASHI **TRAFFIC SCENARIO:** **Medium**

IN 1000 TONNES

GENERAL CARGO																									
	Average	Base	Growth	2001	2002	2003	2004	Growth	2005	2006	2007	2008	2009	2010	Growth	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	3 years	Traffic	Rate					Rate							Rate										
			in %					in %							in %										
TOTAL DRY OUT	**53,9**	**57,3**	**1,9%**	**58,4**	**59,5**	**60,6**	**61,7**	**4,2%**	**64,3**	**66,9**	**69,7**	**72,7**	**75,8**	**79,0**	**2,1%**	**80,6**	**82,3**	**83,9**	**85,7**	**87,4**	**89,2**	**91,1**	**93,0**	**94,9**	**96,9**
salt	0,8	1	0,0%	1,0	1,0	1,0	1,0	2,0%	1,0	1,0	1,1	1,1	1,1	1,1	2,0%	1,1	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,4
cotton	0,0	0	0,0%	0,0	0,0	0,0	0,0	0,0%	0,0	0,0	0,0	0,0	0,0	0,0	0,0%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
metals	1,9	2	0,0%	2,0	2,0	2,0	2,0	2,0%	2,0	2,1	2,1	2,2	2,2	2,3	2,0%	2,3	2,3	2,4	2,4	2,5	2,5	2,6	2,6	2,7	2,7
machine and equipment	3,3	3,3	2,0%	3,4	3,4	3,5	3,6	2,0%	3,6	3,7	3,8	3,9	3,9	4,0	2,0%	4,1	4,2	4,3	4,4	4,4	4,5	4,6	4,7	4,8	4,9
constr.materials in bulk	38,3	40	2,0%	40,8	41,6	42,4	43,3	5,0%	45,5	47,7	50,1	52,6	55,3	58,0	2,0%	59,2	60,4	61,6	62,8	64,1	65,3	66,6	68,0	69,3	70,7
chemicals	0,4	1	0,0%	1,0	1,0	1,0	1,0	2,0%	1,0	1,0	1,1	1,1	1,1	1,1	2,0%	1,1	1,2	1,2	1,2	1,2	1,3	1,3	1,3	1,3	1,4
containers	0,2	1	2,0%	1,0	1,0	1,1	1,1	5,0%	1,1	1,2	1,3	1,3	1,4	1,5	5,0%	1,5	1,6	1,7	1,8	1,9	1,9	2,0	2,1	2,3	2,4
others	9,0	9	2,0%	9,2	9,4	9,6	9,7	2,0%	9,9	10,1	10,3	10,5	10,8	11,0	2,0%	11,2	11,4	11,6	11,9	12,1	12,4	12,6	12,9	13,1	13,4
Domestic cargo traffic	0,0	0	2,0%	0,0	0,0	0,0	0,0	2,0%	0,0	0,0	0,0	0,0	0,0	0,0	2,0%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Average	Base	Growth					Growth							Growth										
	3 years	Traffic	Rate					Rate							Rate										
			in %					in %							in %										
TOTAL DRY IN	**102,8**	**106,0**	**4,3%**	**110,4**	**115,1**	**120,1**	**125,5**	**4,9%**	**142,9**	**147,4**	**152,1**	**157,0**	**162,0**	**167,2**	**2,9%**	**176,7**	**181,5**	**186,4**	**191,5**	**196,7**	**202,0**	**207,5**	**213,1**	**218,9**	**224,9**
flour	0,1	1	1,7%	1,0	1,0	1,1	1,1	3,0%	1,1	1,1	1,2	1,2	1,2	1,3	3%	1,3	1,4	1,4	1,4	1,5	1,5	1,6	1,6	1,7	1,7
metals	14,8	14	7,8%	15,1	16,3	17,5	18,9	2,0%	19,3	19,7	20,1	20,5	20,9	21,3	3%	21,9	22,6	23,3	24,0	24,7	25,4	26,2	27,0	27,8	28,6
machine and equipment	13,4	15	7,8%	16,2	17,4	18,8	20,3	5,0%	21,3	22,3	23,4	24,6	25,9	27,1	2%	27,7	28,2	28,8	29,4	30,0	30,6	31,2	31,8	32,4	33,1
transport vehicles	4,2	4	7,8%	4,3	4,6	5,0	5,4	5,0%	5,7	6,0	6,3	6,6	6,9	7,2	2%	7,4	7,5	7,7	7,8	8,0	8,2	8,3	8,5	8,7	8,8
constr.materials in bulk	0,2	0,5	7,8%	0,5	0,6	0,6	0,7	5,0%	0,7	0,7	0,8	0,8	0,9	0,9	2%	0,9	0,9	1,0	1,0	1,0	1,0	1,0	1,1	1,1	1,1
other constr material	0,2	0,5	7,8%	0,5	0,6	0,6	0,7	2,0%	0,7	0,7	0,7	0,7	0,7	0,8	2%	0,8	0,8	0,8	0,8	0,8	0,9	0,9	0,9	0,9	0,9
chemicals	8,5	9	7,8%	9,7	10,5	11,3	12,2	2,0%	12,4	12,6	12,9	13,2	13,4	13,7	2%	14,0	14,2	14,5	14,8	15,1	15,4	15,7	16,0	16,4	16,7
containers	0,4	1	2,0%	1,0	1,0	1,1	1,1	5,0%	1,1	1,2	1,3	1,3	1,4	1,5	5%	1,5	1,6	1,7	1,8	1,9	1,9	2,0	2,1	2,3	2,4
others (mainly sugar)	6,3	6	1,7%	6,1	6,2	6,3	6,4	3,0%	20,0	20,6	21,2	21,9	22,5	23,2	3%	23,9	24,6	25,3	26,1	26,9	27,7	28,5	29,4	30,3	31,2
Domestic cargo traffic																									
of which salt	54,6	55	1,7%	55,9	56,9	57,9	58,8	3,0%	60,6	62,4	64,3	66,2	68,2	70,3	3%	72,4	74,5	76,8	79,1	81,4	83,9	86,4	89,0	91,7	94,4
other	0,0	0	0,0%	0,0	0,0	0,0	0,0	1,0%	0,0	0,0	0,0	0,0	0,0	0,0	2%	5,0	5,1	5,2	5,3	5,4	5,5	5,6	5,7	5,9	6,0
TOTAL DRY IN / OUT	**156,7**	**163,3**	**3,5%**	**168,8**	**174,6**	**180,7**	**187,2**	**4,7%**	**207,1**	**214,3**	**221,8**	**229,6**	**237,7**	**246,2**	**2,7%**	**257,3**	**263,8**	**270,4**	**277,1**	**284,1**	**291,2**	**298,6**	**306,1**	**313,8**	**321,7**
Average shipload				1 100	1 100	1 100	1 100		1 100	1 100	1 100	1 100	1 100	1 100		1 100	1 100	1 100	1 100	1 100	1 100	1 100	1 100	1 100	1 100
Number of calls				153	159	164	170		188	195	202	209	216	224		234	240	246	252	258	265	271	278	285	292
Number of ships'movements				307	317	329	340		377	390	403	418	432	448		468	480	492	504	517	530	543	557	571	585

TURKMENBASHI TRAFFIC SCENARIO: Medium

OIL TERMINAL IN 1000 TONNES

	1 998	1 999	2000 est	2001	2002	Growth	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
						rate																		
	export	export	export	export	export	in %	export	export	export	export	export	export	export	export	export	export	export	export	export	export	export	export	export	export
	total	total	total	total	total		total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total
TOTAL LIQUID OUT	2 686,2	2 552,1	2 680,0	2 700,0	2 700,0	2,0%	2 754,0	2 809,1	2 865,3	2 922,6	2 981,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0
light products export	851,2	793,0																						
dark products export	1 835,0	1 759,1																						
total oil products export	2 686,2	2 552,1	2 680,0	2 700,0	2 700,0	2,0%	2 754	2 809	2 865	2 923	2 981	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000	3 000
(all destinations included)																								
	import	import	import	import	import		import	import	import	import	import	import	import	import	import	import	import	import	import	import	import	import	import	import
	total	total	total	total	total		total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total	total
TOTAL LIQUID IN	710,6	235,6	215,0	215,0	735,0	0,5%	749,7	764,7	780,0	795,6	811,5	811,8	812,2	812,5	812,9	813,2	813,6	814,0	814,3	814,7	815,1	815,5	815,9	816,4
Crude oil (domestic)	684,2	233,1	200,0	200,0	720,0	2,0%	734	749	764	779	795	795	795	795	795	795	795	795	795	795	795	795	795	795
Light products import)	26,4	2,5	15,0	15,0	15,0	2,0%	15	16	16	16	17	17	17	18	18	18	19	19	19	20	20	21	21	21
TOTAL LIQUID BULK TRADED	3 396,8	2 787,7	2 895,0	2 915,0	3 435,0	0,5%	3 504	3 574	3 645	3 718	3 793	3 812	3 812	3 813	3 813	3 813	3 814	3 814	3 814	3 815	3 815	3 816	3 816	3 816
total out seaborne**	2 686,2	2 552,1	2 680,0	2 700,0	2 700,0	0,5%	3 505,0	2 809,1	2 865,3	2 922,6	2 981,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0	3 000,0
total in seaborne	710,6	235,6	215,0	215,0	735,0	0,5%	749,7	764,7	780,0	795,6	811,5	811,8	812,2	812,5	812,9	813,2	813,6	814,0	814,3	814,7	815,1	815,5	815,9	816,4
TOTAL ALL PORTS	3 396,8	2 787,7	2 895,0	2 915,0	3 435,0	0,5%	4 254,7	3 573,8	3 645,2	3 718,2	3 792,5	3 811,8	3 812,2	3 812,5	3 812,9	3 813,2	3 813,6	3 814,0	3 814,3	3 814,7	3 815,1	3 815,5	3 815,9	3 816,4

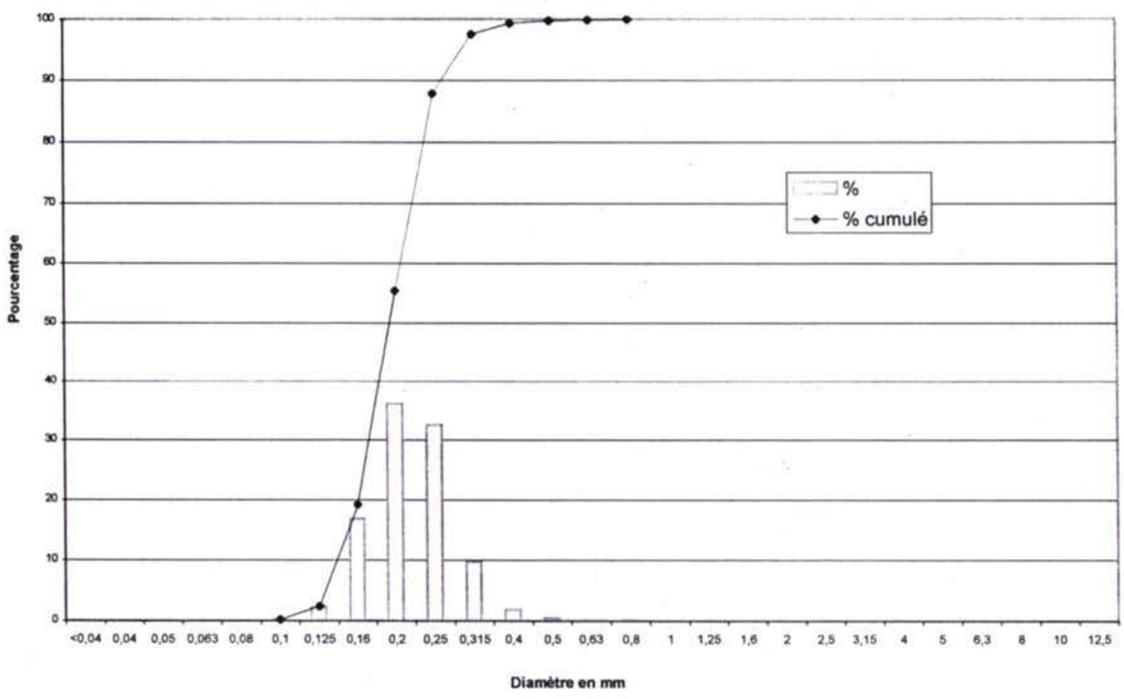
** export products via ferries and land are excluded.

Average shipload crude oil	4614	4809	4800	4800	4800		4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800
Average shipload oil products	3363	3990	4000	4000	4000		4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
Number of ships crude oil	148	48	42	42	150		153	156	159	162	166	166	166	166	166	166	166	166	166	166	166	166	166	166
Number of ships oil products	779	704	670	675	675		689	702	716	731	745	750	750	750	750	750	750	750	750	750	750	750	750	750
Number of ships'movements	1855	1505	1423	1433	1650		1683	1717	1751	1786	1822	1831	1831	1831	1831	1831	1831	1831	1831	1831	1831	1831	1831	1831

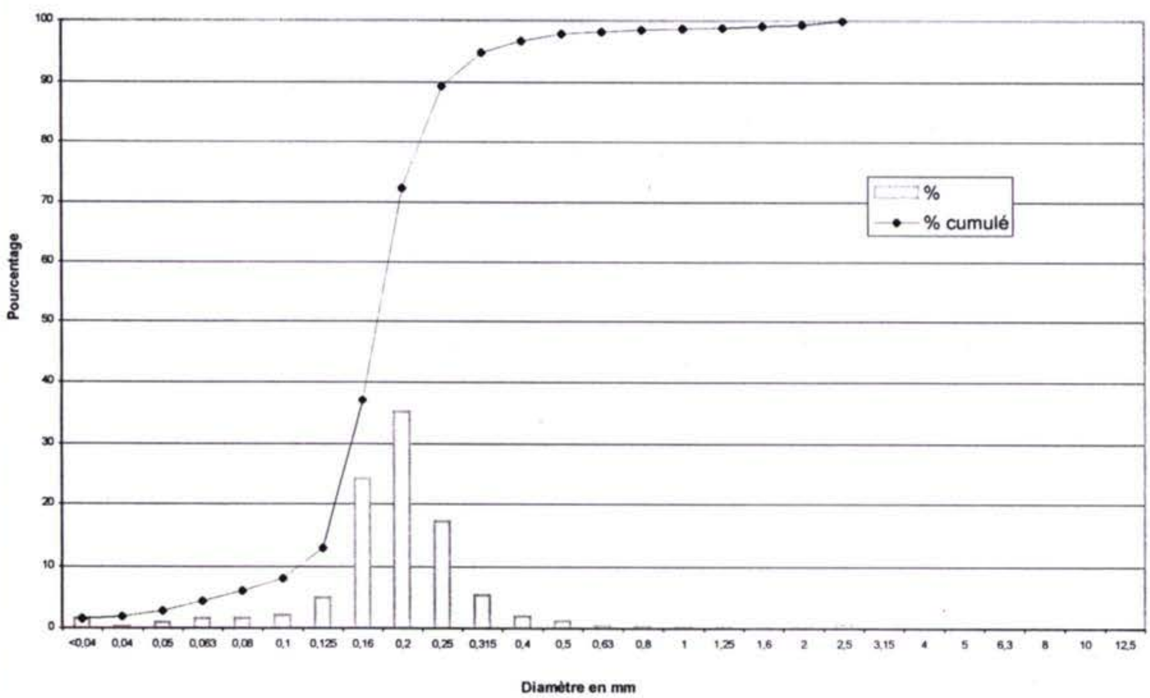
Annex 3

10 sediment analysis sheets

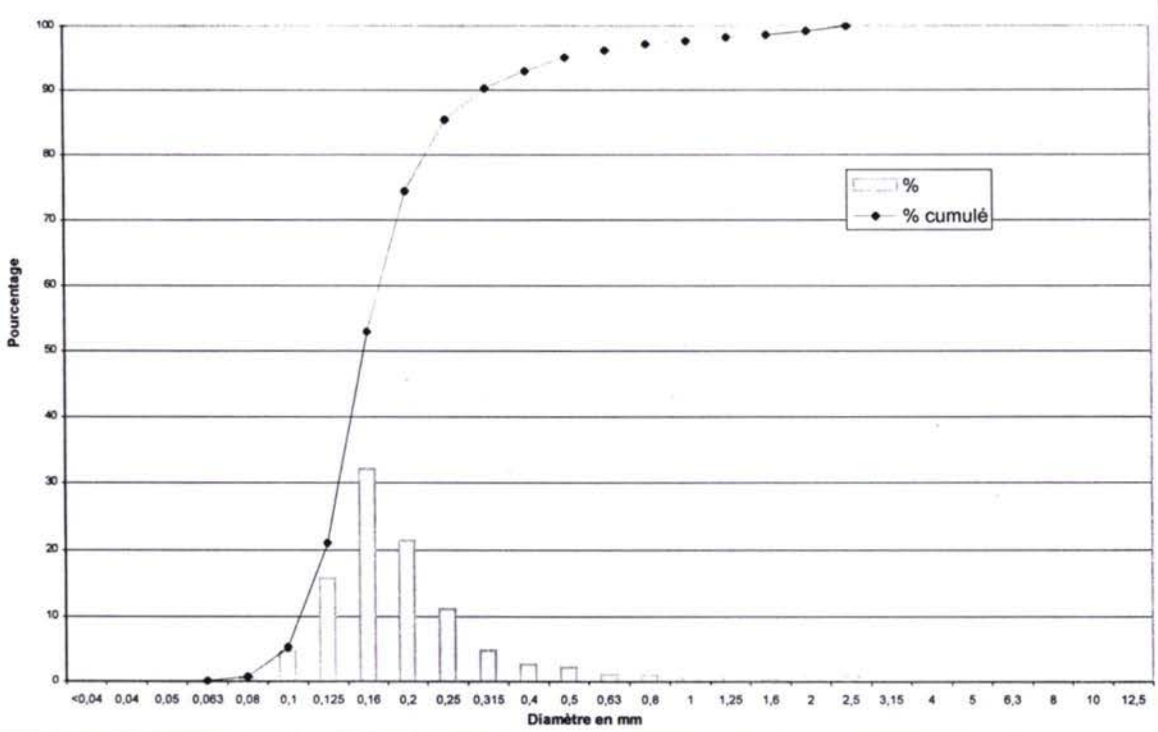
Turkmenbasy - échantillon n°1 (sample 1)



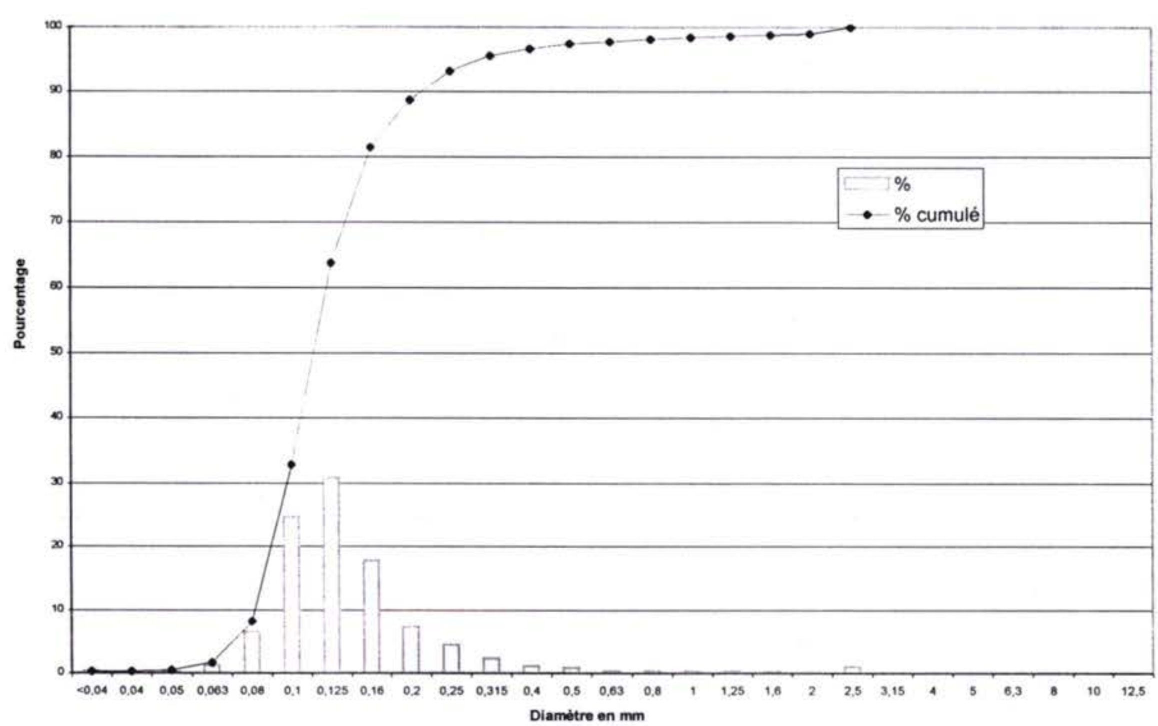
Turkmenbasy - échantillon n°2

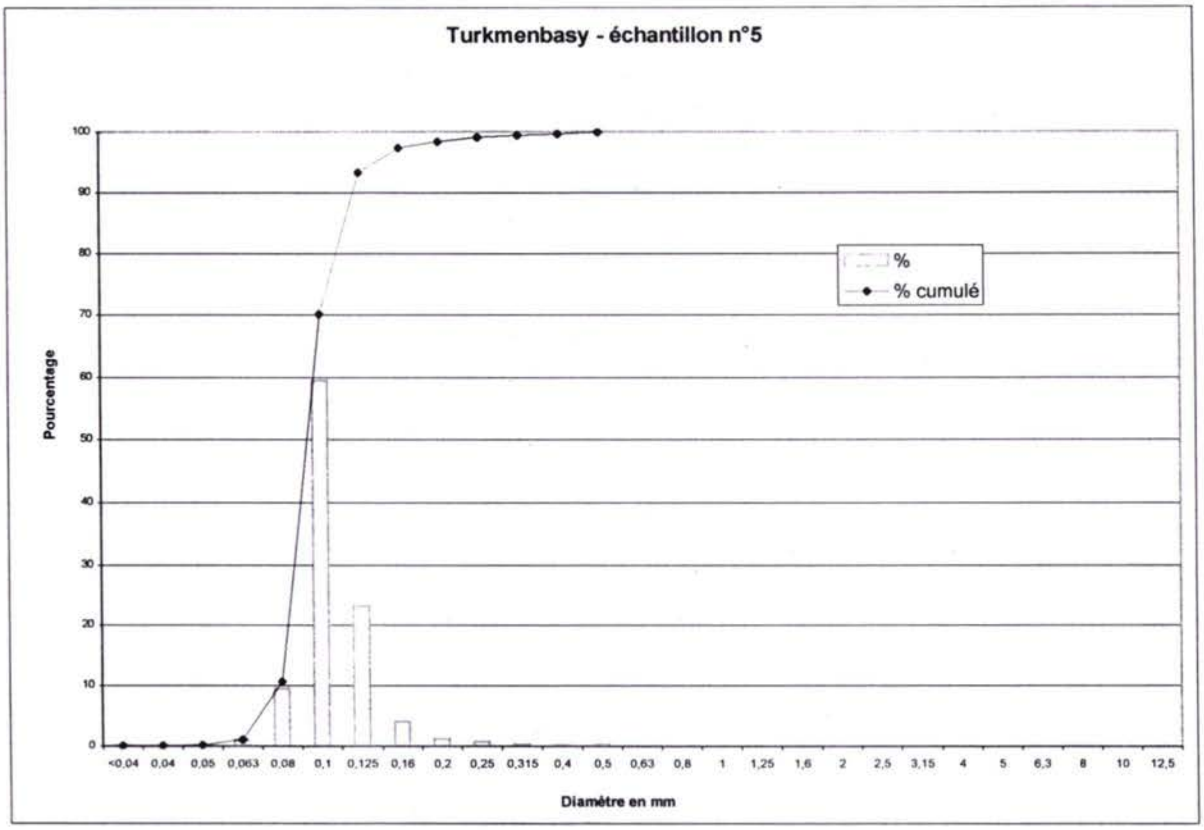


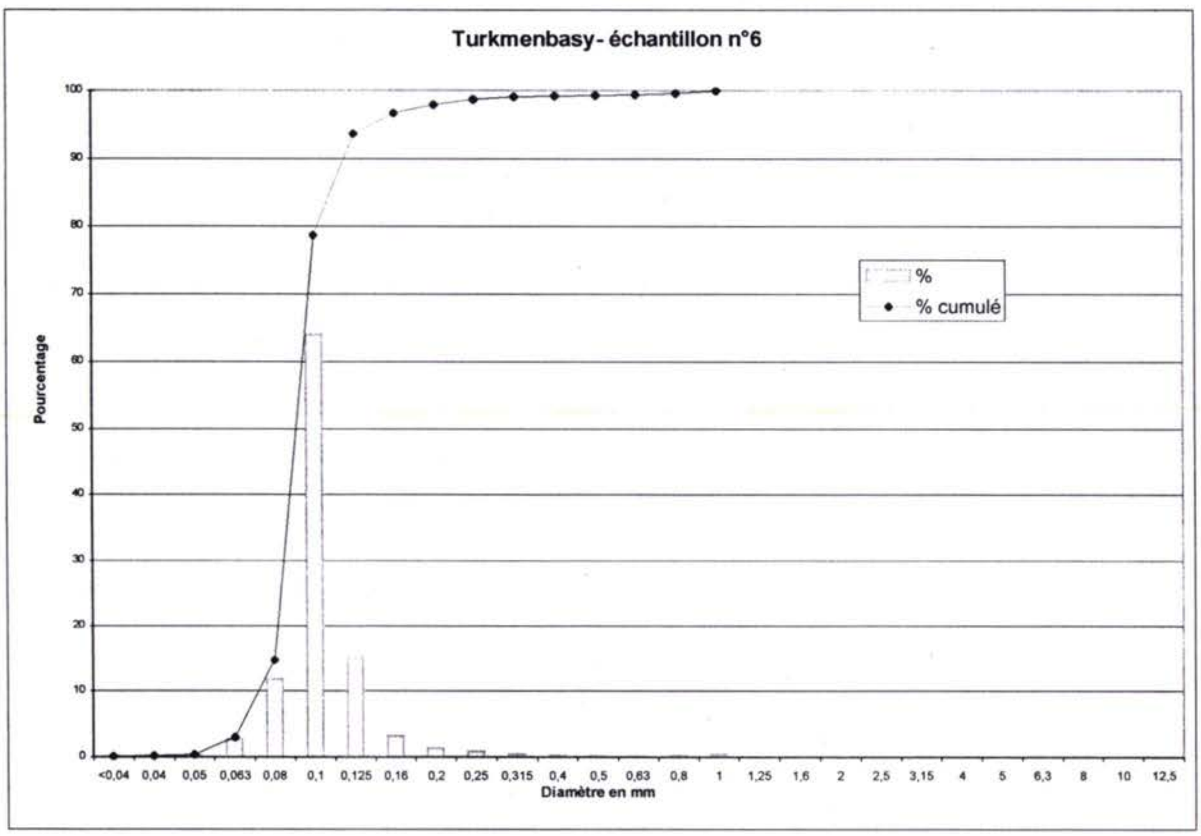
Turkmenbasy - échantillon n°3



Turkmenbasy - échantillon n°4




Turkmenbasy - échantillon n°5
%
% cumulé
Pourcentage
Diamètre en mm
<0,04 0,04 0,05 0,063 0,08 0,1 0,125 0,16 0,2 0,25 0,315 0,4 0,5 0,63 0,8 1 1,25 1,6 2 2,5 3,15 4 5 6,3 8 10 12,5


Turkmenbasy- échantillon n°6
%
% cumulé
Pourcentage
Diamètre en mm
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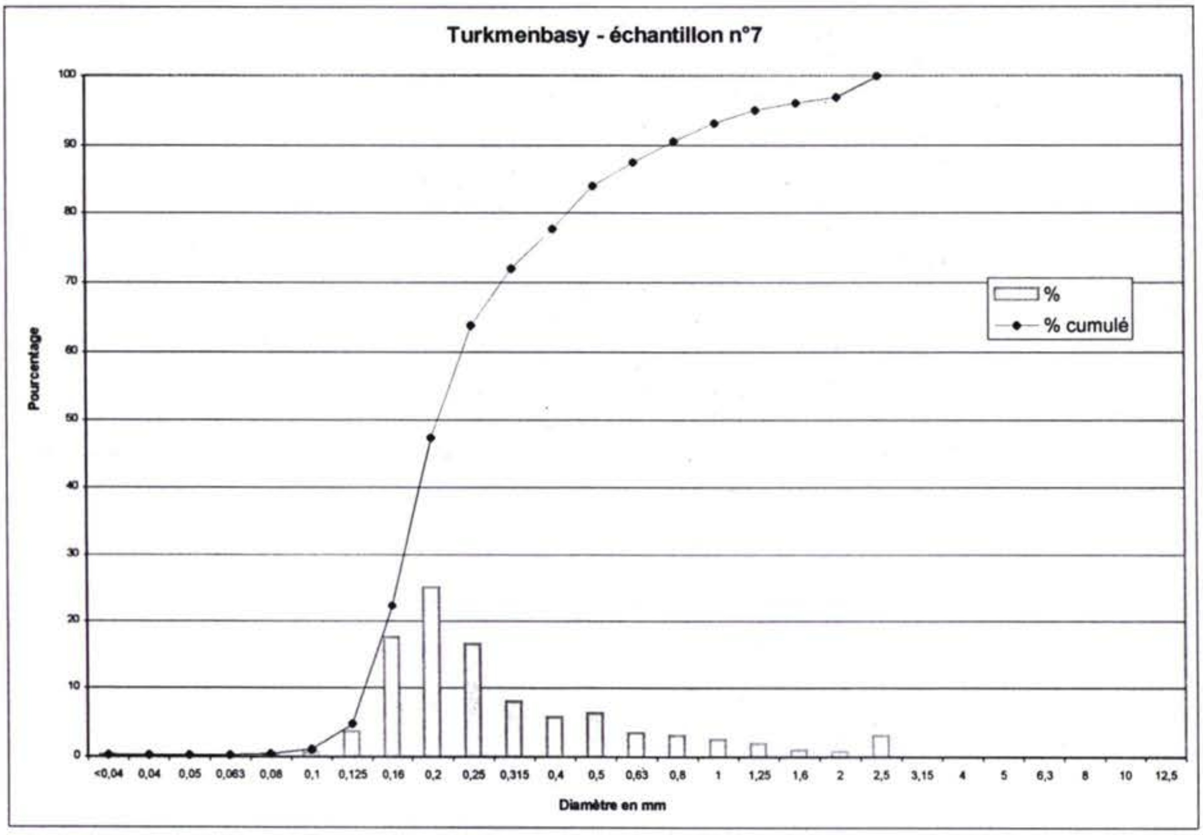
Turkmenbasy - échantillon n°7
Pourcentage
Diamètre en mm
%
% cumulé
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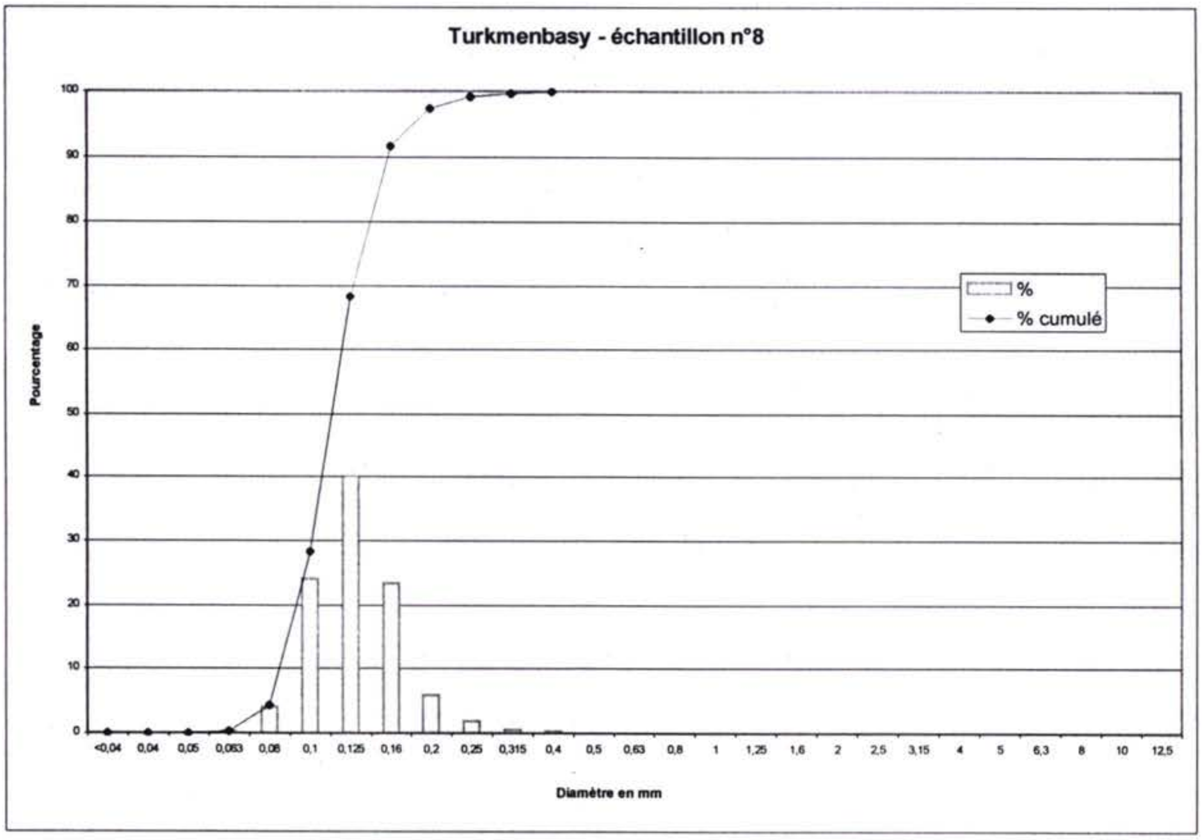
Turkmenbasy - échantillon n°8
Pourcentage
Diamètre en mm
%
% cumulé
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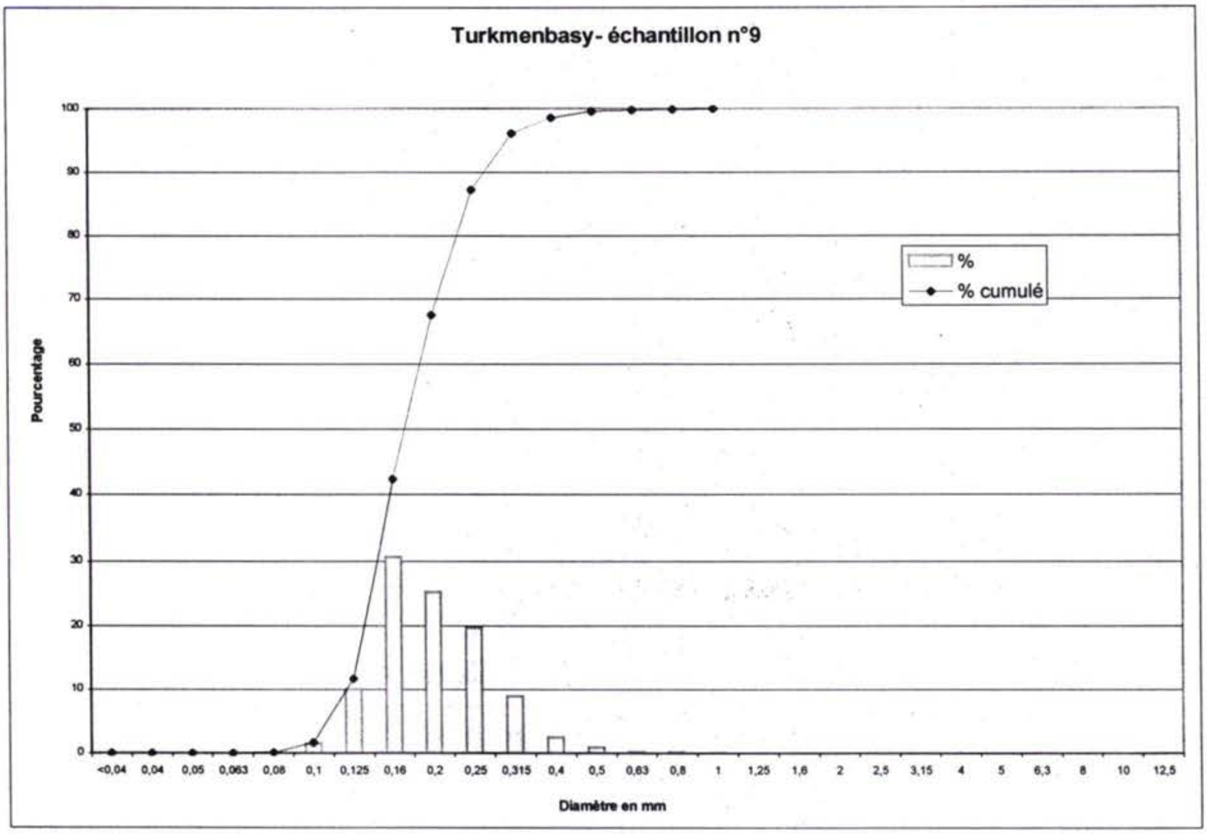
Turkmenbasy- échantillon n°9
%
% cumulé
Pourcentage
Diamètre en mm
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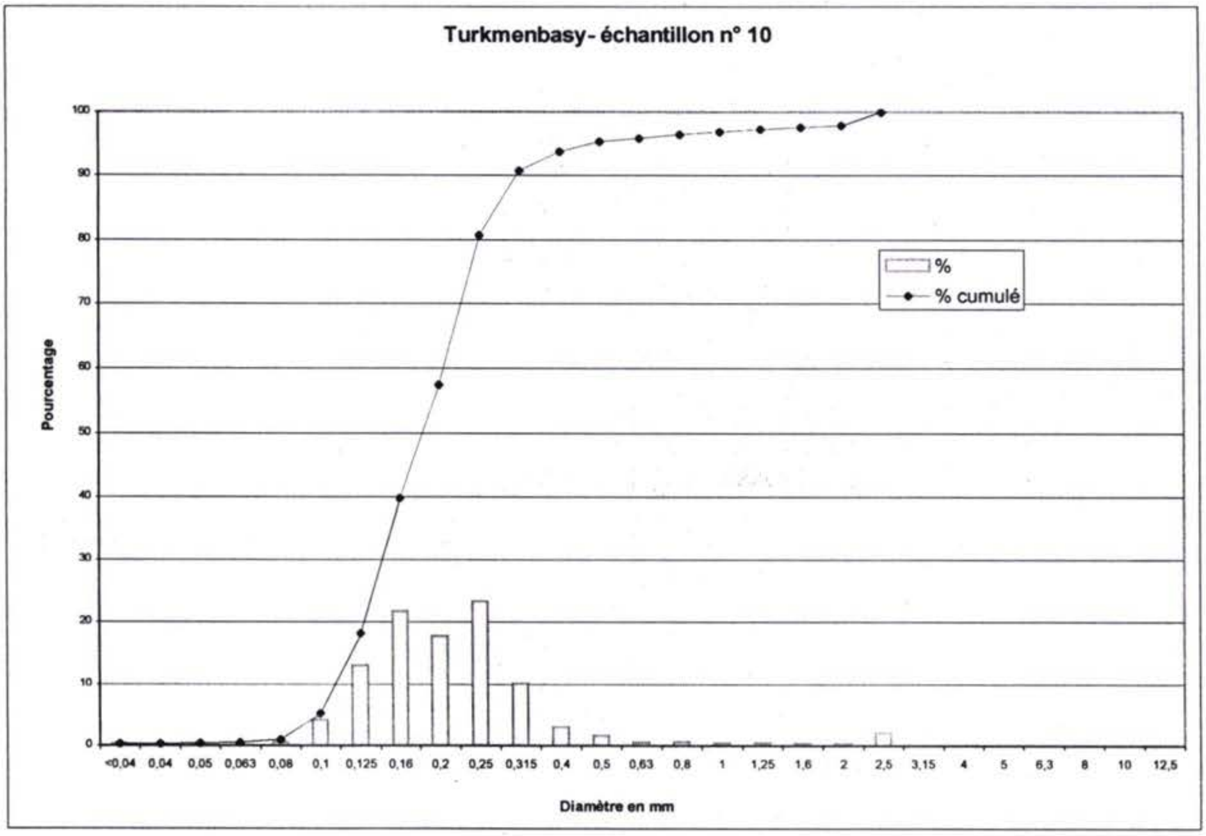
Turkmenbasy- échantillon n° 10
%
% cumulé
Pourcentage
Diamètre en mm
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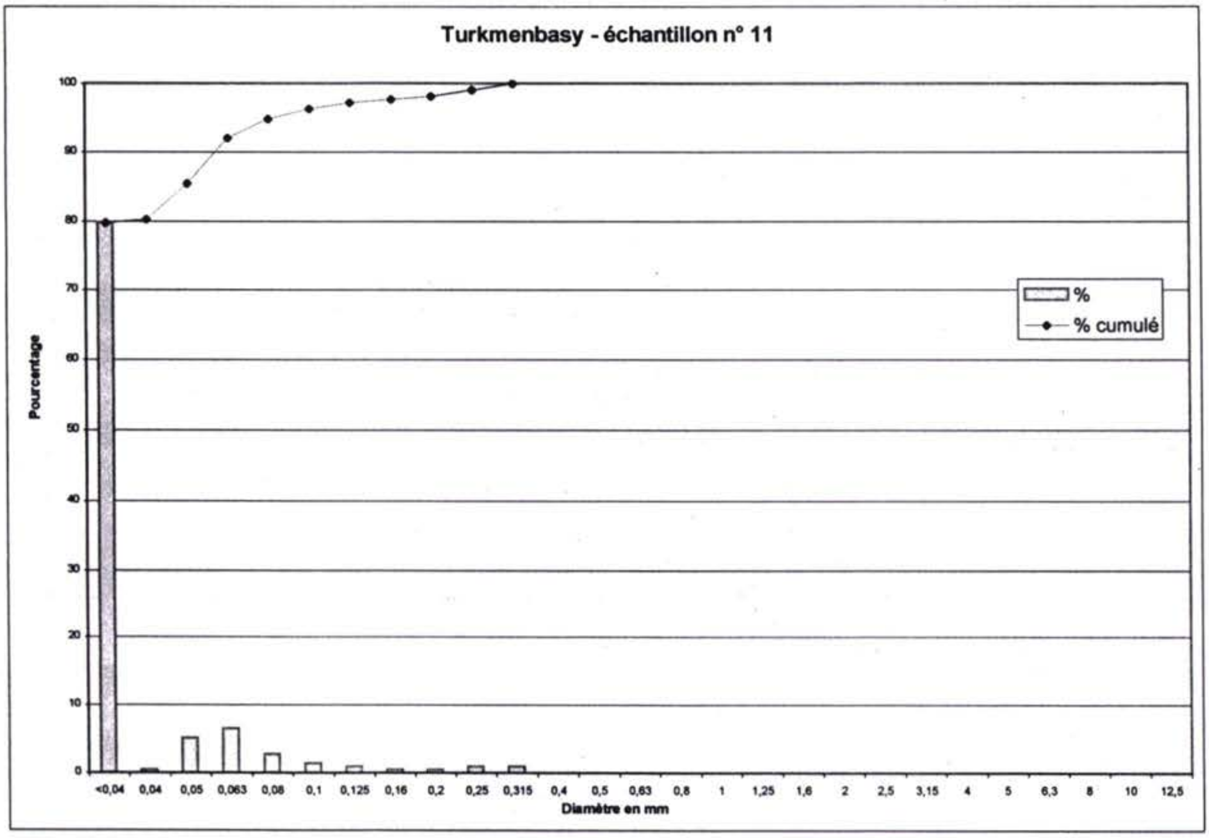

Turkmenbasy - échantillon n° 11
Pourcentage
% cumulé
%
Diamètre en mm
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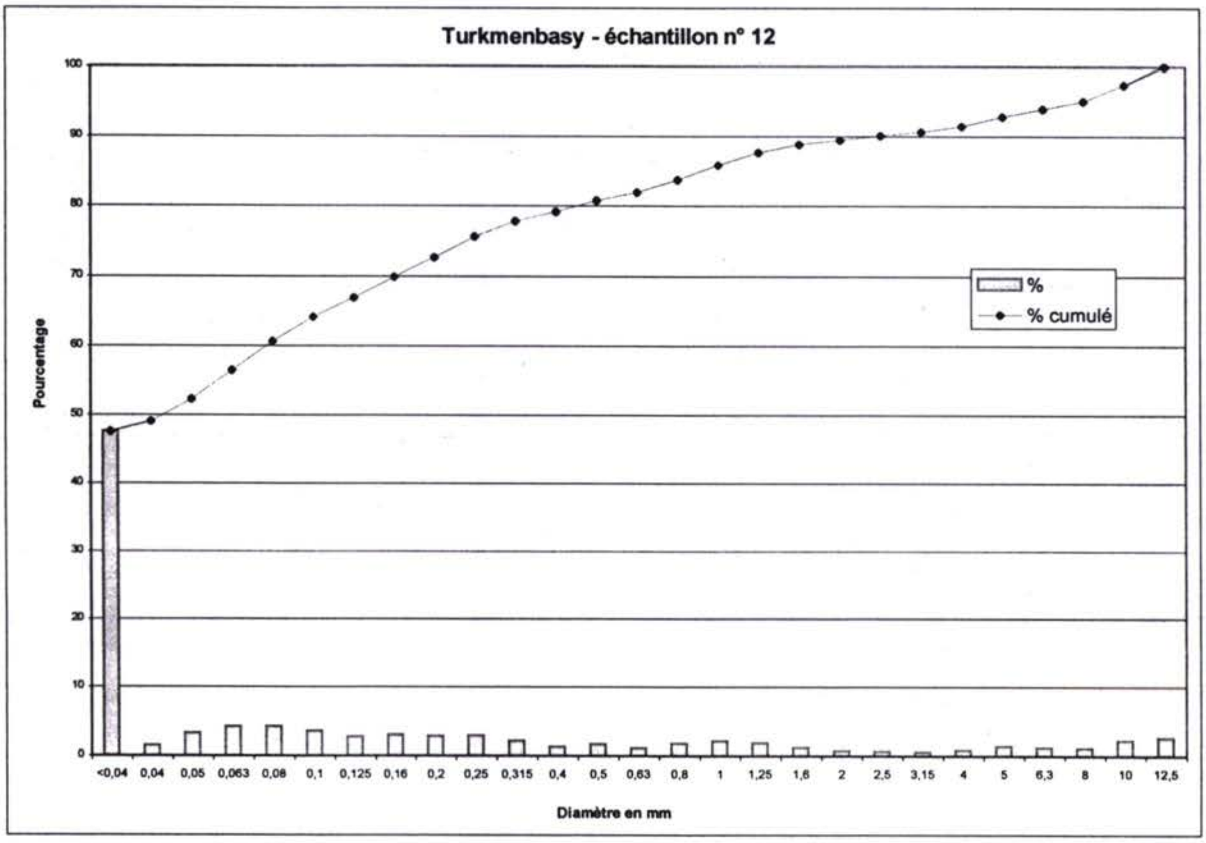

Turkmenbasy - échantillon n° 12
Pourcentage
%
% cumulé
Diamètre en mm
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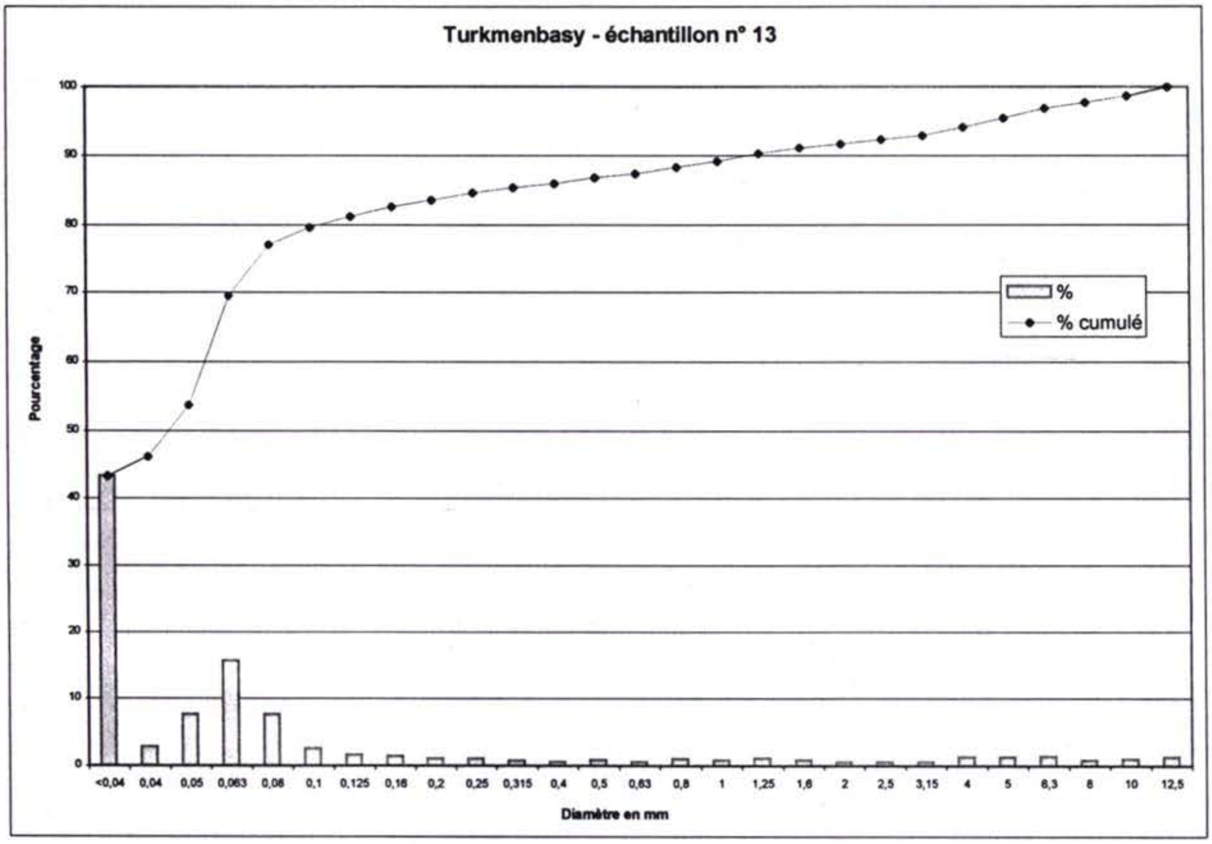
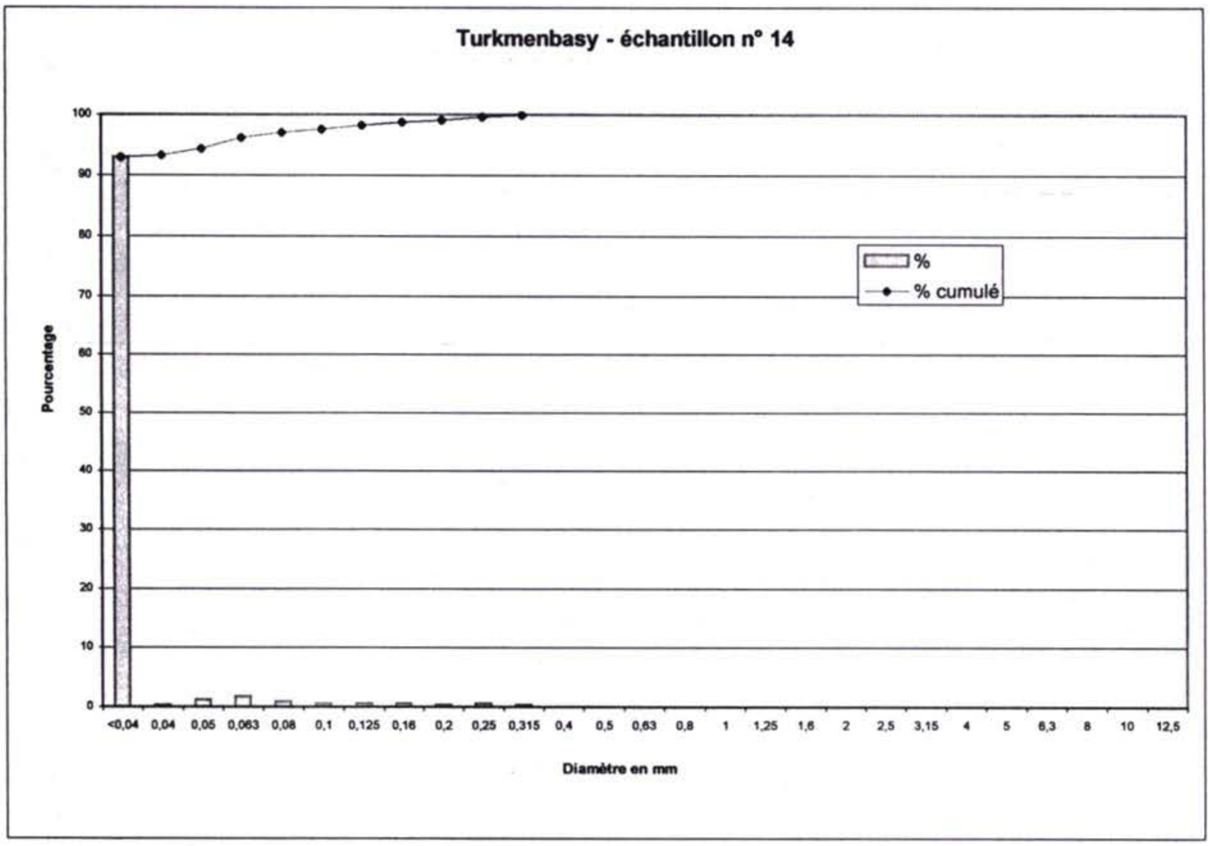
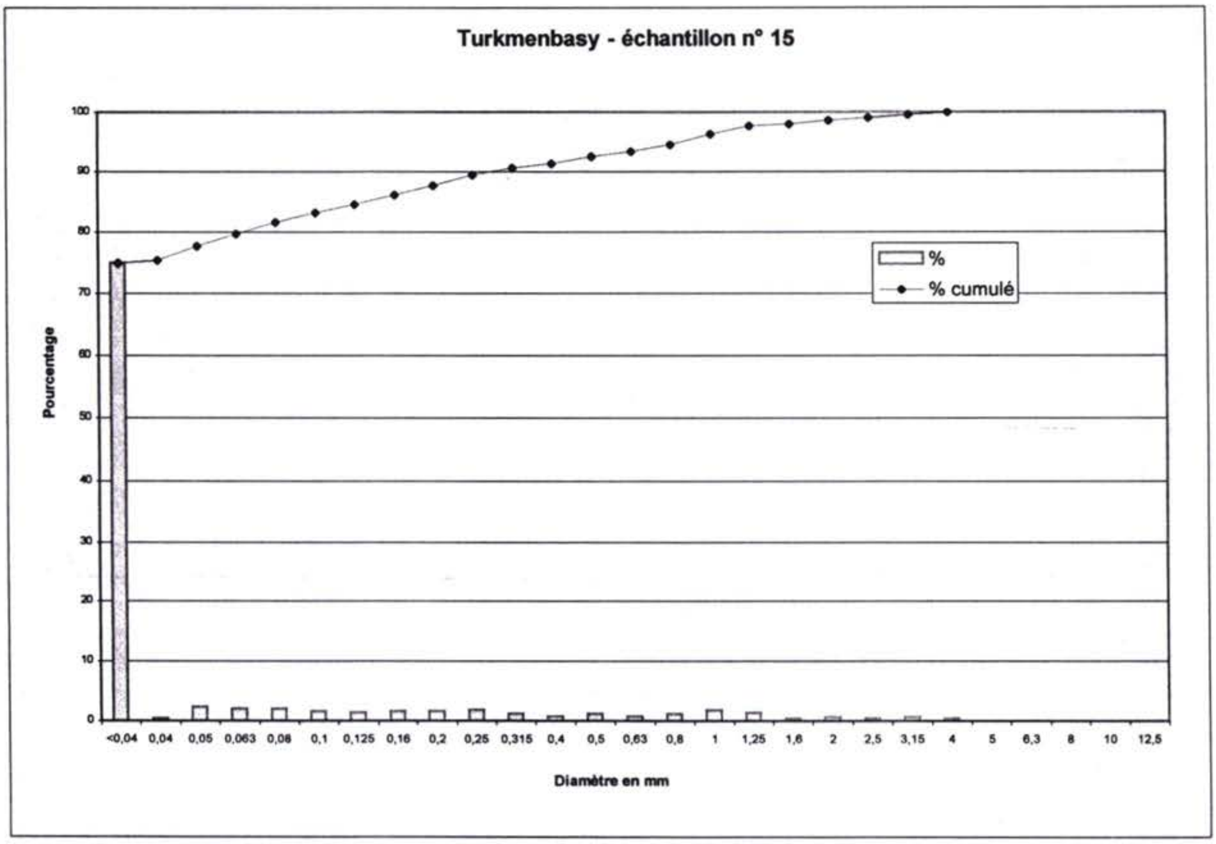
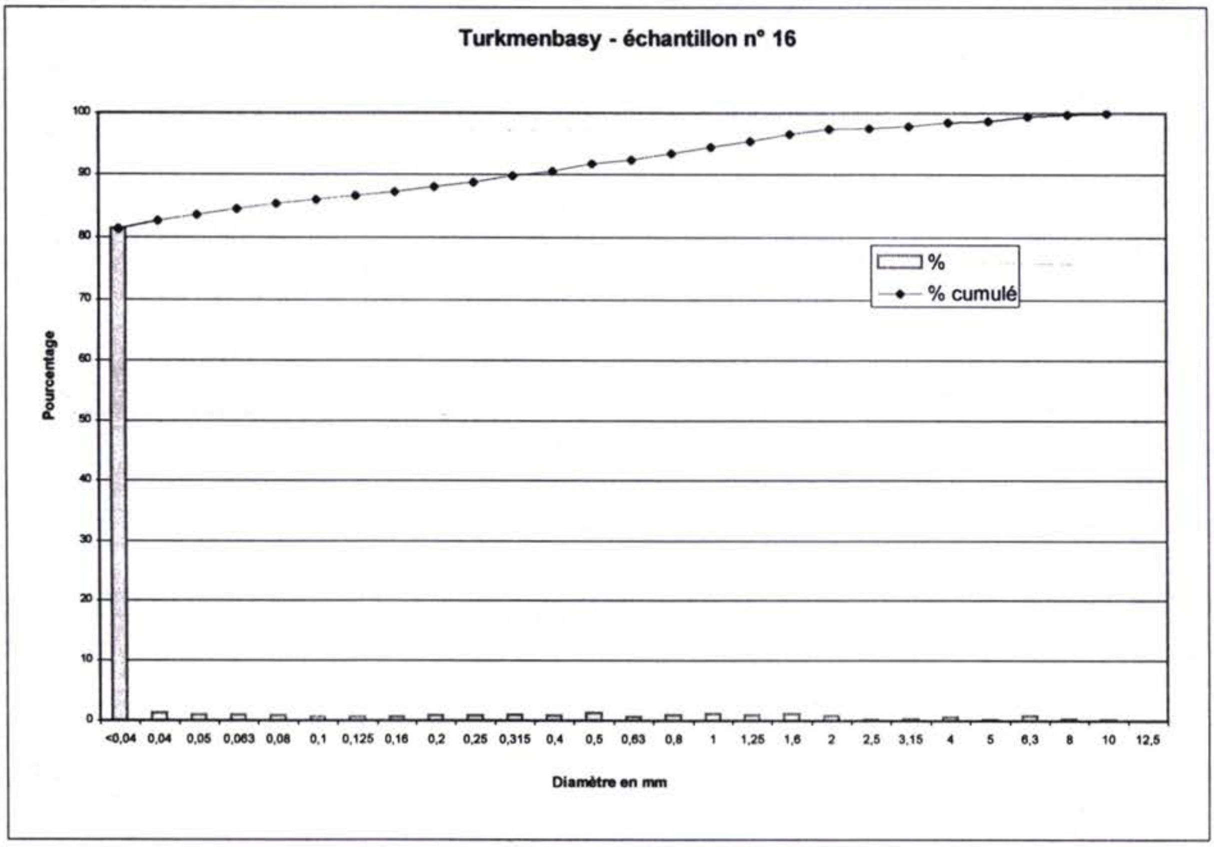

Turkmenbasy - échantillon n° 13
Pourcentage
Diamètre en mm
%
% cumulé
<0,04
0,04
0,05
0,063
0,08
0,1
0,125
0,16
0,2
0,25
0,315
0,4
0,5
0,63
0,8
1
1,25
1,6
2
2,5
3,15
4
5
6,3
8
10
12,5


Turkmenbasy - échantillon n° 14
Pourcentage
Diamètre en mm
%
% cumulé
<0,04
0,04
0,05
0,063
0,08
0,1
0,125
0,16
0,2
0,25
0,315
0,4
0,5
0,63
0,8
1
1,25
1,6
2
2,5
3,15
4
5
6,3
8
10
12,5



Turkmenbasy - échantillon n° 15
Pourcentage
100
90
80
70
60
50
40
30
20
10
0
%
% cumulé
<0,04 0,04 0,05 0,063 0,08 0,1 0,125 0,16 0,2 0,25 0,315 0,4 0,5 0,63 0,8 1 1,25 1,6 2 2,5 3,15 4 5 6,3 8 10 12,5
Diamètre en mm

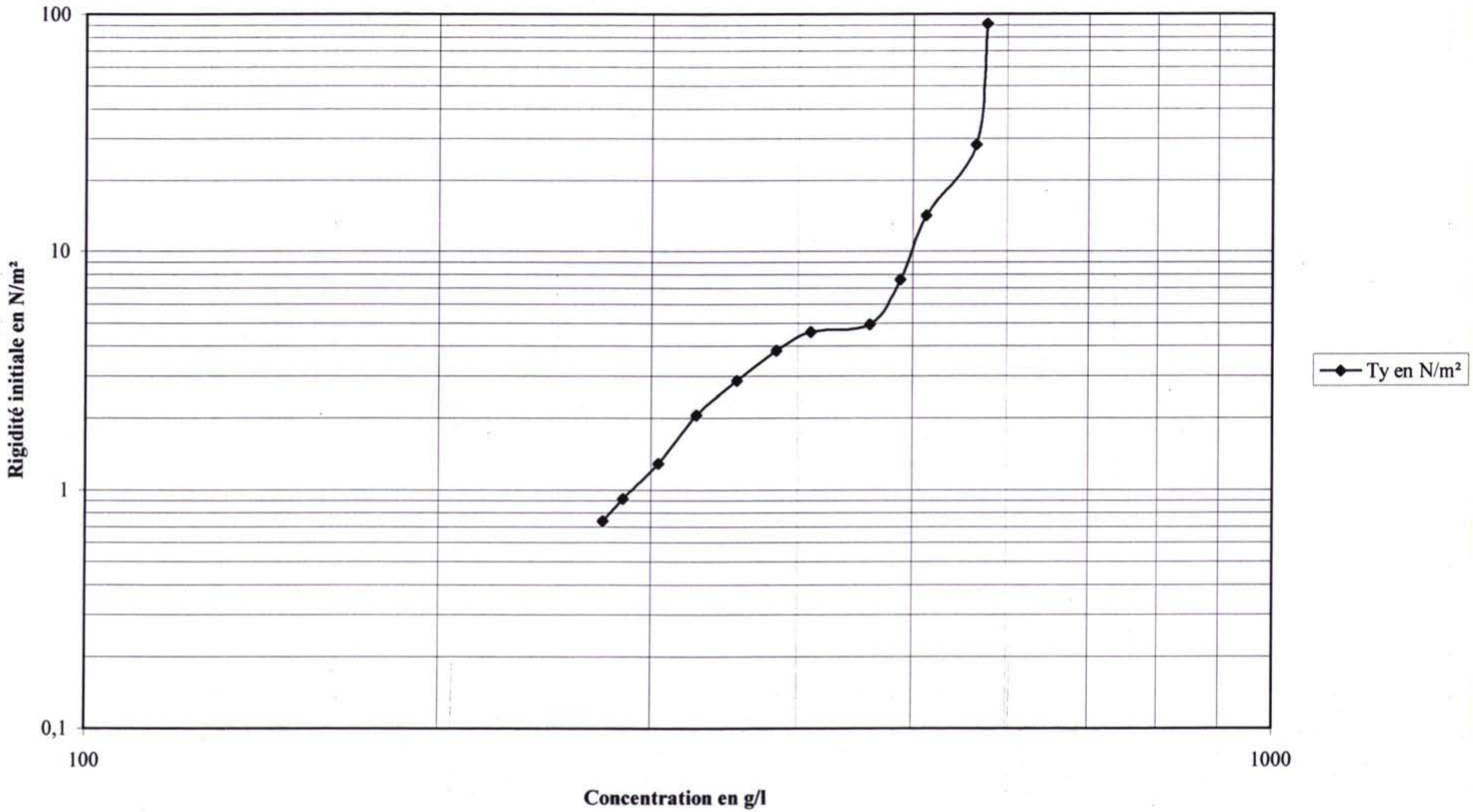


Turkmenbasy - échantillon n° 16
Pourcentage
100
90
80
70
60
50
40
30
20
10
0
%
% cumulé
<0,04 0,04 0,05 0,063 0,08 0,1 0,125 0,16 0,2 0,25 0,315 0,4 0,5 0,63 0,8 1 1,25 1,6 2 2,5 3,15 4 5 6,3 8 10 12,5
Diamètre en mm

Turkmenbasy

N° échantillon	% <40µm	% C organique éch. brut
(sample)		% organic material
11	79,81	5,902
12	47,59	5,111
13	43,24	3,71
14	92,98	5,734
15	75	4,954
16	81,31	4,537

Rigidité initiale en N/m² - échantillon n°16 - Port de Turkmenbasy



Annex 4

abbreviations & acronyms, references, staff list

ABBREVIATIONS & ACRONYMS

• BSL	Baltic Sea Level
• cm	centimetre
• CSC	Caspian Shipping Company
• CSL	Caspian Sea Level
• dwt	dead weight tonnage
• EA	Environmental Assessment
• EBRD	European Bank for Reconstruction and Development
• EIA	Environmental Impact Assessment
• g	gram
• GNP	Gross National Product
• IMDG	International Maritime Dangerous Goods Code
• km	kilometre
• Krasnovodsk	former name of Turkmenbashi
• l	litre
• m	metre
• m2	square metre
• m3	cubic metre
• MARPOL	International Convention for Prevention of Marine Pollution
• Mt	Million tonnes
• NM	Nautical mile
• TML	Turkmen Maritime Lines
• ToR	Terms of Reference
• Traceca	Transport Corridor Europe-Caucasus-Asia
• TSA	Turkmen Sea Administration
• TSS	Traffic Separation Scheme
• USD	United States dollar
• VHF	Very High Frequency (radio system for short range communications)
• VTS	Vessel Traffic Service

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