Traceca Corridor

Traffic and Feasibility Studies - TNREG 9803

Module D :

Navigation Channel for Turkmenbashi Port

Inception report

September 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

Local Operator

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Mr. André Merrien, Team Leader for Module D

Date of report : 23 September 2000

Reporting period : Inception phase, starting from mid-August 2000

Author of report : André Merrien

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TACIS [Task Manager]	[name]	[signature]	[date]

Table of contents

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 by mid-December 2000	

2. Analysis of module D at the end of September 2000

2.1 Project context

Contract on the services for the Traffic and Feasibility Studies Project (TNREG 9803) was signed by Tacis and Bceom on 30 August 1999. The whole project consists of the following five modules:

- Module A Traffic database and general forecasts
- Module B New Caspian Sea shipping services
- Module C Redevelopment of Aktau Ferry Terminal
- Module D Navigation channel for Turkmenbashi Port
- Module E Transport of crude oil and oil products on the Caspian Sea

Module A is the main project module. It started in November 1999. An inception report was produced in January 2000, whilst the first progress report was issued in June 2000. The global transport database is still under preparation; first sets of forecasts should be made available at the end of year 2000.
Module B activities started in April 2000. A specific inception report was produced in July 2000.
Module C started in September 1999 and was completed in May 2000. It produced a feasibility study and a tender dossier allowing to launch rehabilitation works at the Aktau Ferry Terminal. The works contract is about to be signed.
Module D activities began in August 2000. This module is scheduled to be completed by mid-December 2000.
Lastly, module E started at the end of March 2000. The related inception report was issued in June, followed in August 2000 by a technical report regarding forecasts of regional oil flows.

The port of Turkmenbashi is on the southern branch of the Traceca route. As it is located at the northern end of a large bay, it is connected to the open sea via a long channel (10 nautical miles as overall length). The bay is shallow and the channel was excavated by dredging operations; its mouth was artificially opened through a narrow peninsula.

2.2 Main problems and deficiencies

The main access to the Turkmenbashi port suffers three major deficiencies:

- The channel is subject to overall siltation, with higher degree in the mouth area where waves are more active than within the bay. Although very little maintenance dredging was carried out in the past years, water depths are still sufficient since the Caspian Sea level sharply rose from 1977 through 1995, and is still standing on the high side (see following table). In case the water level carries on dropping, water depth problems will become very serious.

- Navigation aids are in poor condition and would require additional equipment. Several lateral buoys are missing, most lights are out of order (buoy lights and on-shore beacon lights), 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 so narrow that vessels cannot sail through the mouth under strong wave conditions; such circumstances happen approximately 60 days each year (in that case vessels simply wait or sail around the southern end of the peninsula).

Caspian sea levels

Notes:

. Daily fluctuations usually don't exceed a few centimetres, whilst yearly fluctuations may reach +/- 20 cm
. Levels below are yearly averages

Year	1900	1930	1956	1977	1991	1992	1993	1994	1995	1997	1998	1999
Sea Level (m, BSL)	-25.7	-26.5	-28.5	-29.1	-27.2	-27.1	-26.9	-26.7	-26.6	-27.1	-27.1	-27.2
Sea Level (m, Caspian System *)	2.3	1.5	-0.5	-1.1	0.8	0.9	1.1	1.25	1.4	0.9	0.9	0.8

* Caspian System zero is located 28 m below Baltic System zero

2.3 Situation of local operator

TML is a state enterprise under the direct responsibility of the Cabinet of Ministers. It covers a wide range of activities mainly consisting of the operation of:

- Turkmenbashi port, including the shipyard, the ferry terminal and the Ufra oil terminal;
- Bektash port;
- Cheleken port;
- Okarem port;
- and four dry cargo vessels of about 3000 dwt each (TML ordered a new tanker, 5400 to 7500 dwt, to be built in Turkey for delivery in 2001 - maximum draft of this tanker will be 4.6 m).

As such, TML is responsible for Turkmenbashi port channel operation, safety and maintenance.
TML owns a bucket dredger built in Ukraine in 1993, operating with two self-propelled dump barges of 400 m3 each. This equipment was only used a few times, at the channel mouth and at the elbows. TML plans to use it again by the end of 2000 for local dredging in the main basin.
The port also owns a survey boat equipped with an echo-sounder (under repair) and a small vessel which should be able to lift the buoys.
Upon request vessels entering the channel can receive pilotage assistance.

The harbour master is able to satisfactorily control navigation in the port basins but, as far as the channel is concerned, he can only visually control the stretches which are close to the port and use his VHF radio to communicate with vessels sailing in the remote parts of the channel.

Apart from the purchase of the new tanker, which is covered by a loan granted by the Islamic Bank, TML has undertaken a large-scale rehabilitation project financed by an EBRD loan, aiming at reconstructing most of the berths, buildings and yards. The reconstruction is currently starting and is scheduled to last two years.

2.4 Target groups

Improvement of the navigation channel would benefit to all shipping companies which vessels are calling or are likely to call at the port:

- The Caspian Shipping Company (CSC), based in Baku, belonging to the Republic of Azerbaijan. CSC, the major player on the Caspian Sea, owns 8 Dagestan ferries, 34 tankers and a large fleet of dry cargo vessels.
- The Turkmen Maritime Lines.
- The companies owning the five supply vessels based in Turkmenbashi (Dragon Oil and Petronas).
- The newly created Kazmortransflot, based in Aktau, belonging to the Republic of Kazakhstan; Kazmortransflot doesn't yet own any vessel but starts to charter tankers.
- The Khazar Shipping Company, an Iranian firm owning 3 to 4 dry cargo vessels and operating between Aktau/Turkmenbashi/Astrakhan and Iran.
- Volgotanker, a Russian company owning river-sea tankers carrying oil and oil products from the eastern shore of the Caspian Sea to Russian ports and to Iran as well.

The consultant is in the process of interviewing these companies and collecting data regarding their fleets. The essential parameter will be the vessel draught.

2.5 Staff mobilisation

Bceom's staff

André Merrien, acting as team leader for module D, paid a preliminary visit in Turkmenistan from 22 to 28 August. He was accompanied by Robert Gould, environmental expert, and by Georges Chaumaz, dredging expert. André Merrien came back to Turkmenistan on 16 September, together with Professor Louis-Robert Lafond, sediment transport expert, and Bernard Francou, port economist. The last expert will be Xavier Lefevre, navigation aid specialist, scheduled to arrive in Turkmenistan on 01 October 2000.

Local staff

All except the interpreter, the only local staff who is able to assist the consultant in Turkmenbashi belongs to TML. Fruitful co-operation has thus been settled with the engineers of the technical department, with the

harbour master and with the crews of the dredger and the survey boat (sediment sampling and water depth measurements were initialised with the support of this latter launch in September 2000).

Besides, Bceom is getting benefit from the agreement signed in August 2000 with the Azeri Caspmorniiproekt, within the scope of module E. Caspmorniiproekt is helping Bceom to collect data about the channel history and the past dredging practices.

3. Module D planning

3.1 Relation with other modules

Module D is closely connected with module B and module E, which both have to do with present and future vessel fleets operating in the Caspian Sea, all current users or potential users of the Turkmenbashi navigation channel.
As far as vessel draughts are concerned, it turns out that some tanker draughts can reach 7 m, under maximum loading conditions.

3.2 Relation with other projects

During the inception phase Bceom held valuable meetings with the EBRD as well as with the companies committed in the EBRD-financed Turkmenbashi port project (euro 30 million loan):

- Haskoning, who is implementing a Port Institutional Development Programme including operational support to TML, preparation of institutional reforms, development of improved commercial practices, assistance for setting up a new human resource policy, for improved consideration of environmental issues, etc. Technical assistance started in December 1999 and will last till beginning of year 2001.

- Posford Duvivier, who elaborated the port rehabilitation project and who is starting to supervise the construction works: upgrading the infrastructures, the superstructures, the port buildings and the handling equipment. Deepest future berths will be those of the ferry terminal, which will be dredged down to - 36 m BSL (i.e. 8 m below Caspian Chart Datum).

- The Turkish STFA Group, who currently starts implementing the port construction works. They are scheduled to last two years.

- Scott Wilson Kirkpatrick, which holds the Project Implementation Unit contract.

This ambitious project cannot be successful if the navigation channel is not upgraded.

On the other hand, Bceom reviewed several reports dealing with the port and the channel:

- Terms of Reference for Channel Improvement Studies, Ramboll, 1997 (the study was not implemented).
- Technical Design for Improvement of Krasnovodsk Channel, Caspmorniiproekt, 1990.
- Sediment Contamination Study, Caspmorniiproekt, 1990.
- Proposal for a new channel layout, Turkmenbashi Harbour Master, 1995.
- Design water levels for Baku and Turkmenbashi ferry terminals, DHI/Ramboll, 1996.

3.3 Proposed work plan after the inception phase

The following table shows the proposed work plan after the inception phase.

	October 2000		November 2000		December 2000		Personnel Input (working weeks) EU staff	Local staff
Evaluation of the existing situation								
Data collection	xxx						1	2
Site surveys	xxxxxx						2	6
Sediment sample analyses	xxxxx	xx					1	2
Reporting		xxxxxx					2	2
Maintenance and improvement recommendations								
Proposals for capital works		x	xxxxxxx	xxx			3	
Proposals for maintenance			xxxx	xxx			3	
Discussions				xx	x		1	
Reporting					xxxxx		2	
Total (in working weeks)							15	12

3.4 Constraints and risks

Main constraints are vessel draughts and sea water levels.
As for vessel draughts, although a few tankers can reach 7 m, a priori it doesn't look economical to design the future channel for a bigger draught than 4.6 m, which is that of the Dagestan ferries and of the future TML tanker.
Regarding sea levels, the most responsive study (ref. 6) predicts that until year 2050 sea level should remain within the -25 m to -30 m BSL range. However, taking into account -30 m would induce extensive dredging works and high siltation rates. The best way will probably consist in dredging the channel step by step, according to the changes of the water level. As long as the sea level remains high, and provided that TML dredger is operational, it doesn't make sense to excavate a very deep channel.

Another uncertainty is due to the fact it might be difficult to reach an agreement on the degree of safety for the improved channel. TML may claim that the channel is already almost adequate, whereas the CSC is strongly calling for much higher safety conditions. TML can also argue that, in case of bad conditions, vessels can sail along the old southern channel, to avoid the dangerous mouth; but this significantly lengthens sailing routes.

A connected risk is dealing with the capacity of shipping companies to accept and to bear the increase in channel fees that TML will have to levy in order to balance the cost of an improved channel.

* *

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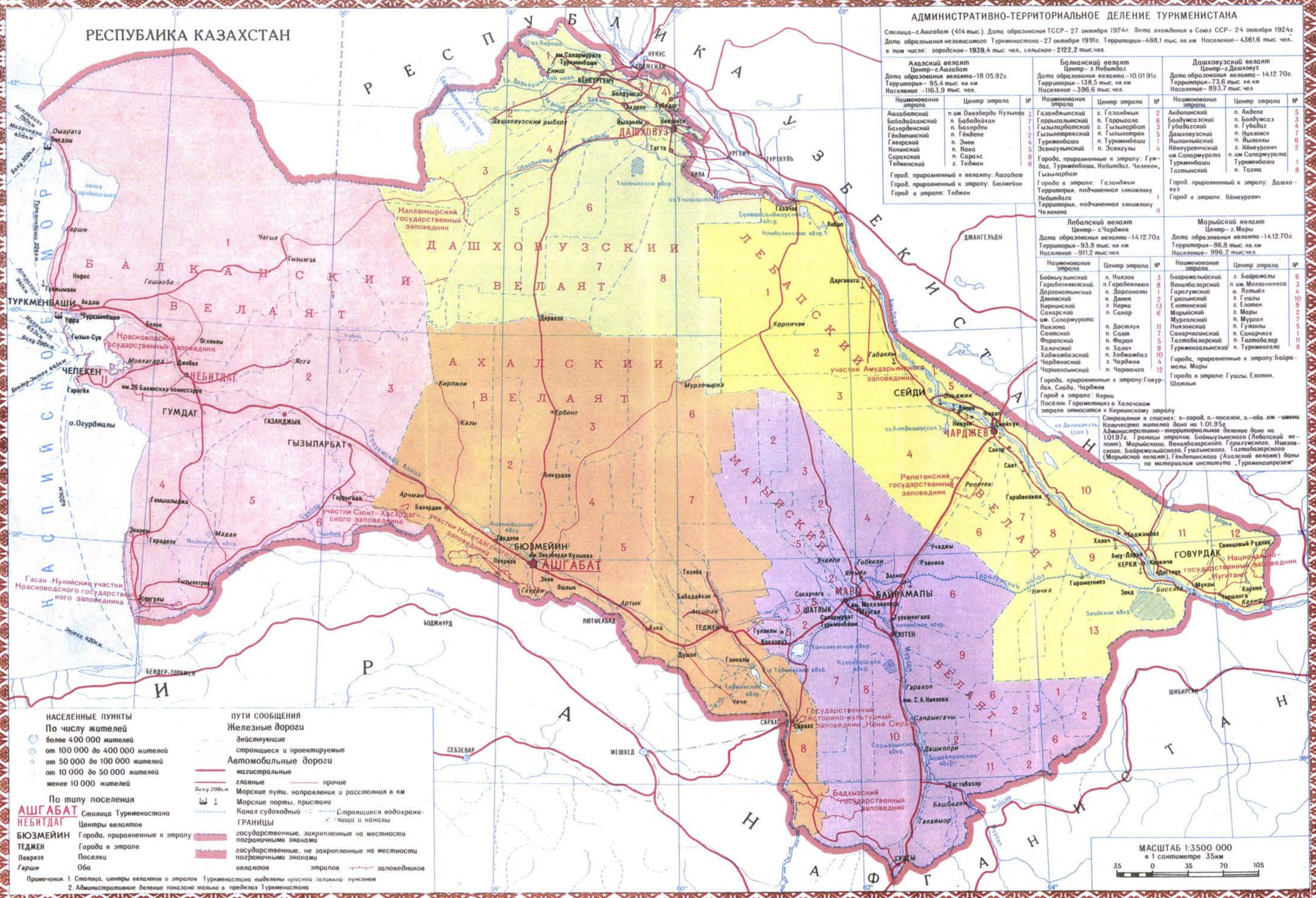
Enclosures: Annex 1 to Annex 8

Annex 1

maps



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Ахалский велаят
Центр–г.Ашгабат
Дата образования велаята–18.05.92г.
Территория– 95,4 тыс. кв.км
Население –1163,9 тыс. чел.

Наименование этрапа	Центр этрапа	№
Ашгабатский	п.им. Овезберди Кулыева	3
Бабадайханский	п. Бабадайхан	7
Бахерденский	п. Бахерден	1
Гёкдепинский	п. Гёкдепе	2
Гяверский	п. Знев	4
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Балканский велаят
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Население –396,6 тыс.чел.

Наименование этрапа	Центр этрапа	№
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Гаррыгалынский	п. Гаррыгала	6
Гызыларбатский	г. Гызыларбат	3
Гызылетрекский	п. Гызылетрек	5
Туркменбаши	п. Туркменбаши	1
Эсенгулынский	п. Эсенгулы	4

Города, приравненные к этрапу: Гумдаг, Туркменбаши, Небитдаг, Челекен, Гызыларбат
Города в этрапе: Газанджык
Территория, подчиненная хякимлику Небитдага I
Территория, подчиненная хякимлику Челекена II

Дашховузский велаят
Центр–г.Дашховуз
Дата образования велаята– 14.12.70г.
Территория–73,6 тыс. кв.км
Население– 893,7 тыс.чел.

Наименование этрапа	Центр этрапа	№
Акдепинский	п. Акдепе	5
Болдумсазский	п. Болдумсаз	3
Губадагский	п. Губадаг	4
Дашховузский	п. Ниязовск	7
Йыланлыйский	п. Йыланлы	6
Кёнеургенчский	г. Кёнеургенч	2
им.Сапармурата Туркменбаши	п. им.Сапармурата Туркменбаши	1
Тагтынский	п. Тагта	8

Город, приравненный к этрапу: Дашховуз
Город в этрапе: Кёнеургенч

Лебапский велаят
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Дата образования велаята–14.12.70г.
Территория–93,8 тыс. кв.км
Население –911,2 тыс.чел.

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Бойнуузынский	п. Ниязов	3
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Дарганатынский	п. Дарганата	1
Дяневский	п. Дянев	2
Керкинский	г. Керки	13
Сакарский	п. Сакар	6
им. Сапармурата Ниязова	п. Достлук	11
Саятский	п. Саят	7
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Чаршангынский	п. Чаршанга	12

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Город в этрапе: Керки
Посёлок Гараметниаз в Халачском этрапе относится к Керкинскому этрапу

Марыйский велаят
Центр– г.Мары
Дата образования велаята–14.12.70г.
Территория–86,8 тыс. кв.км
Население– 996,2 тыс.чел.

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Гушгынский	г. Гушгы	10
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Сакарчагинский	п. Сакарчяге	1
Тагтабазарский	п. Тагтабазар	11
Туркменгалынский	п. Туркменгала	9

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Города в этрапе: Гушгы, Елотен, Шатлык

Сокращения в списках: г–город, п.–поселок, о.–оба, им.–имени
Количество жителей дано на 1.01.95г.
Административно-территориальное деление дано на 1.01.97г. Границы этрапов: Бойнуузынского (Лебапский велаят), Марыйского, Векилбазарского, Гарагумского, Ниязовского, Байрамалыйского, Гушгынского, Тагтабазарского (Марыйский велаят), Гёкдепинского (Ахалский велаят) даны по материалам института „Туркменгипрозем"

РЕСПУБЛИКА КАЗАХСТАН
РЕСПУБЛИКА УЗБЕКИСТАН
ИРАН
АФГАНИСТАН
КАСПИЙСКОЕ МОРЕ
БАЛКАНСКИЙ ВЕЛАЯТ
ДАШХОВУЗСКИЙ ВЕЛАЯТ
АХАЛСКИЙ ВЕЛАЯТ
ЛЕБАПСКИЙ ВЕЛАЯТ
МАРЫЙСКИЙ ВЕЛАЯТ
АШГАБАТ
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ТУРКМЕНБАШИ
ЧЕЛЕКЕН
ГУМДАГ
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БЮЗМЕЙИН
ТЕДЖЕН
БАЙРАМАЛЫ
КЁНЕУРГЕНЧ
ГОВУРДАК
СЕЙДИ
ШАТЛЫК
КЕРКИ
ГУШГЫ
Красноводский государственный заповедник
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Государственный историко-культурный заповедник „Нове Серах"
Национальный государственный заповедник Кугитанг
участки Амударьинского заповедника
участки Сюнт-Хасардагского заповедника
участки Копетдагского заповедника
Гасан-Кулийский участки Красноводского государственного заповедника

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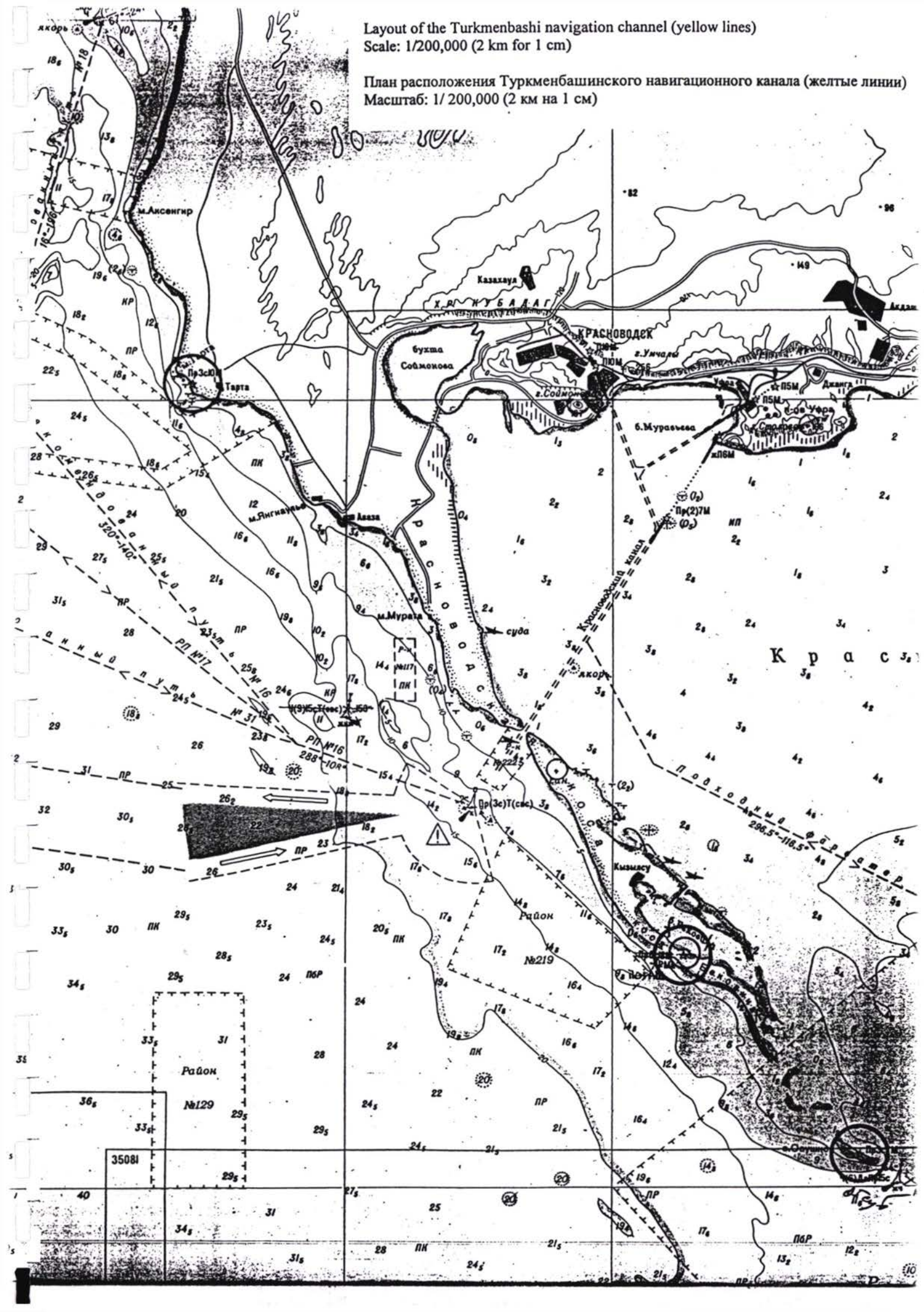
По числу жителей
более 400 000 жителей
от 100 000 до 400 000 жителей
от 50 000 до 100 000 жителей
от 10 000 до 50 000 жителей
менее 10 000 жителей
По типу поселения
АШГАБАТ Столица Туркменистана
НЕБИТДАГ Центры велаятов
БЮЗМЕЙИН Города, приравненные к этрапу
ТЕДЖЕН Города в этрапе
Певризе Поселки
Гаршн Оба
ПУТИ СООБЩЕНИЯ
Железные дороги
действующие
строящиеся и проектируемые
Автомобильные дороги
магистральные
главные
прочие
Баку 298км Морские пути, направления и расстояния в км
Морские порты, пристани
Канал судоходный
Строящиеся водохранилища и каналы
ГРАНИЦЫ
государственные, закрепленные на местности пограничными знаками
государственные, не закрепленные на местности пограничными знаками
велаятов
этрапов
заповедников
Примечания. 1. Столица, центры велаятов и этрапов Туркменистана выделены красной заливкой пунсонов
2. Административное деление показано только в пределах Туркменистана

МАСШТАБ 1:3500 000
в 1 сантиметре 35км
35 0 35 70 105

Layout of the Turkmenbashi navigation channel (yellow lines)
Scale: 1/200,000 (2 km for 1 cm)

План расположения Туркменбашинского навигационного канала (желтые линии)
Масштаб: 1/ 200,000 (2 км на 1 см)



Annex 2

photographs

1. Bucket dredger in Turkmenbashi harbour

2. Southern edge of channel mouth (island side), from offshore

3. Western shore of the peninsula (sandy), north of the channel mouth

4. Eastern shore of the peninsula (mud and reeds), north of the channel mouth

Annex 3

harbour master's memo

A. V. TEREKHOV, HARBOUR MASTER OF TURKMENBASHI PORT

14 August 1995

Proposal for a New Channel Layout

In connection with the Caspian Sea level rise, currently there is erosion of the Turkmenbashi spit shore area, and as a result shore mouth navigation marks are destroyed and the protecting embankment is flooded. In this consequence it proceeded an intensive sand drift of the channel mouth with bottom narrowing and top widening. The top width amounted over 300 m in 1995, despite the designed profile should be 140 m.

The channel passing the Turkmenbashi spit (peninsula) is under permanent impact of longitudinal streaming of variable streamlines, arising due to sea-bay level variations.

Streamline and speed of water currents within the channel are not permanent and are able to vary during very short period of time (about one hour), depending on variation of value and mark of "sea-bay" levels.

The natural currents speed is able to run up to 1,5-2,0 m/sec or 3-4 knots, where they can be observed not only in the channel, within the spit area, but also in the sea and the bay areas, located on distance of 200-700 m from the spit body, depending on levels gap and wind force.

Maximum current speed from the sea to the bay run up to 2,6 m/sec or 5 knots and from the bay to the sea is 1,7 m/sec or 3 knots.

Owing to the spit erosion the sandbank formation is underway to the bay side on the left and right channel lips, which creates danger for vessels sailing at this area.

It is necessary to carry out periodical dredging works for provision of safe vessel sailing, which pass across the spit mouth.

Thus, intervals between dredging works at the area 102-103 of the Turkmenbashi Port were as follows:

03.1984-11.1985	20 months
12.1985-11.1986	10 months
11.1986-02.1987	3 months
03.1987-08.1988	17 months
11.1988-06.1989	7 months

Average rate of sand drifting is equal to 2475 m3 per month and average volume of dredging works at the channel are in the spit body of 700 m of distance is 29,700 m3.

Thereby, on condition of subsequent sea level rise in accordance with the forecast, the channel sand drifting across the Turkmenbashi spit straight at the spit area will increase each year. It conditions by permanent process of profile development of the channel mouth balance on the spit body and intensive intake of sand drifts, owing to the erosion of the spit shore area.

Caspmorniiproekt Marine Institute considers options of engineering structures as technical actions solving the problem of the channel mouth drifting protection in the spit body.

Directly on the channel at the mouth area across the spit, there are two options of these structures under consideration: so called "outbreast pocket" and "sawcuts-traps".

Out of the channel mouth bounds it is possible to make use of drifting protection structures such as an embankment or by means of shore blocking, including formation of man-made island.

Above options will require considerable financial and operational expenditures.

Therefore, it is needed to carry out a large scope of research and investigation works for a final selection of optimal option of actions for sand drifting reduction of the channel mouth in the spit body.

In addition to engineering structures for the channel mouth sand-drifting protection, it is necessary to revamp navigation aids facilities of the channel stretch 1: to protect the channel slopes in the spit mouth by stationary marks, to install 7 buoys, to implement a revamp of leading marks, which do not currently meet the safety requirements of channel sailing.

I offer my own option: to change the direction of the Turkmenbashi channel, to join stretch 2 (city stretch) of the channel, starting from buoy No. 19 with the access waterway up to buoy No. 158, which will considerably allow to reduce financial and operational expenditures for the maintenance and provide vessels sailing safety passing along the channel and waterway with bilateral traffic during 24 hours per day.

The buoys of the stretch No. 1 in the number of 18 units will be removed as well as 4 buoys of the stretch No. 4 of the access waterway, totally 22 buoys.

The leading beacons of the stretch No. 1, which were erected in 1940, will be removed, the backward leading beacon was improved in 1943, the forward leading beacon in 1959, and at present time the leading beacons do not ensure vessels sailing safety passing along the channel stretch No. 1. It is necessary to improve these leading beacons.

The length of the channel city stretch is 3.2 miles or 5.9 km, the city stretch extension of the newly formed channel of length 7.8 miles or 14.4 km, as a result, the total waterway extension is reduced by 2.4 miles or 4.4 km.

4 buoys and town leading beacons will ensure the vessels sailing safety passing along the new channel.

Anchor mooring safety will be ensured under unfavourable weather for all vessel types at the areas No.78 and No. 85.

For dredging works implementation in the newly formed channel it will not require any necessity for research and investigation works conduction.

Taking into consideration, that presently at the area of the newly formed channel there is no current, thus an overhaul dredging period duration will take over 5 years, and dredging works implementation expenditures will be completely warranted during this period.

At the same time, for vessels sailing safety passing along the mouth, it is needed to carry out annual repair dredging works of volume approximately 250-300 thousand/m3.

Thus, in February-May 1995, dredger NARVA implemented dredging works in the volume of 300,000 m3, which costed 300,000,000 Roubles and 236,090,000 Manats.

In addition, after the channel digging the spit mouth will be closed, and it will create favourable conditions for Turkmenbashi Bay environmental improvement, as under north-west and north winds across the mouth, water comes into the bay together with sand drifts, and this water is polluted by oil products.

Annex 4

terms of reference by Ramboll

CONSULTANCY SERVICES FOR THE SAFE CONTROL OF THE TURKMENBASHI PORT ACCESS CHANNEL

TERMS OF REFERENCE

1. INTRODUCTION

The Turkmenbashi Port is the only sea deep-water port in Turkmenistan and the important gateway to and from Turkmenistan for sea transportation. The sea junction provision between Baku and Turkmenbashi ports is the decision element in the TRACECA transport corridor, which connects Europe and Caucasus with Central Asian countries. Within the TACIS/TRACECA Program, financing by the EC, there are trade support actions under implementation and port structures rehabilitation plans under preparation in this corridor during last years.

There are two access channels to the Port situated in the Turkmenbashi Bay. The Northern Channel has 22 km of length and the Southern Channel has 35 km of length. The Northern Channel and parts of the Southern Channel are deep channels, which are currently exposed to heavy sand drifts. The average sand drifts values concerning only the Northern Channel reach about ... million/m3. Current navigating conditions are very alarm due to absence of proper dredging works implementation as well as provision of navigational aids for last years. Criticality of this problem was not too substantial until present time, partly due to the Caspian Sea level rise during last years and partly due to "urgency" of dredging works, but mainly due to sediment reserve of 2-3 m, provided by nature itself. Current situation is critical, as sea level rise has stopped and "buffer" stock in different parts of the channel system has elapsed, and if no actions undertakes, navigation on the channel system will become menacing. Taking into account above conditions, necessity to more corresponding and effective approach plan of the channel system provision becomes apparent.

Navigation and environmental impact safety are aspects of rising international regard, which directly link to location, provision and process of navigation system like present one. These aspects are especially relative to Turkmenbashi, which has long access channels with mixed transport of different dimensions and different categories of vessels, such as cargo vessels, ferries, tankers, etc. Current navigation safety can be critically doubtful taking into account such combination of update sea maps absence, vessel-port connections with respect to cargo and limited sediment.

In reply to above, it is proposed the present study aiming examination of different important aspects of safe navigational access channel provision to the Turkmenbashi Port. In addition to the actions plan proposal for adequate approach to the channel system provision, the study must determine and propose plans of other actions implementation for provision of continuous and safe navigation access to the Turkmenbashi Port.

2. PURPOSES

In accordance with general purposes of provision of continuous and safe navigation access to the Turkmenbashi Port, the specific purposes of the study are as follows:

- To propose an action plan for adequate and economical approach of the channel system provision.
- To define actions for navigating operations assurance, according to international safety standards and propose its implementation strategy

3. SCOPE OF WORKS

The study can be separated into 4 parts and include the following terms:

Part 1. Determination of the Existing Situation and Environment

- Collection of existing sea maps and layouts to specify the Bay geography and the sea-side part of the channel system
- Collection of existing information to define the existing natural conditions (water levels, winds, streams, currents, waves, geological conditions, temperature)
- Bathimetric investigation of the harborage, including access channels and shores, draft investigation maps
- Investigations of sand drifts, including sampling from the sea-bed and obstruction materials at strategic spots
- Investigations of currents (and waves) at strategic spots, simultaneously with sampling of obstruction materials
- Investigation and on-site review of all navigation buoys and marks
- Determination of acting operating instructions and usability of access channels and study of narrow accesses and potential risk coefficient (wrecks records/recent experience)
- Determination of service and available port equipment for vessels support during channels passing (pilot service, vessel traffic service, pilot vessels, radio connection facilities, etc.)
- Description of existing vessel traffic at the port system (types, dimensions, speed, navigating collections, quantity, time, traffic)
- Collection of available data regarding dredging works (old records, spot and method of spoil piling, costs, available facilities, relating authorities)
- Determination of environmental study, including samples analyses
- Determination of pile spot of spoil, including spoil samples analyses

Part 2. Requirements to Access Channels to the Turkmenbashi Port System in Future

- To prepare traffic forecast in the port complex in future
- Corresponding international recommendations towards channels layouts and maneuvering basins and their consequences
- Corresponding international recommendations towards navigating operations (SOLAS) and their consequences
- Project water level

Part 3. Renewal of Navigation Access Channels

- Revision of channels system layouts
- Revision of auxiliary navigation aids, buoys and marks
- Revision of operational practice of channels usage
- Revision of port-vessel service
- Determination of proposed possible actions for the renewal with respect to operation safety, cost, benefit, environmental impact
- Draft of possible execution strategy for each recommended action, including description of necessary additional studies, investigations and other technical support

Part 4. Plan of Access Channels Assurance

- Preparation of hydrological computer model for imitation of drift aspects and test of this model using existing information
- Drift estimation of channels and basin under impact of water level alteration
- Determination of corresponding and environmentally sound alternatives of dredging strategy (replacement of traffic scheme, replacement dredging depth, replacement dredging works interval time, creation of buffer zones, creation of sea breakwaters, etc.)
- Analyzing of alternatives and proposal of more effective strategy, taking into account water level alteration
- Determination of corresponding technical alternatives for buoys and marks erection and offer an erection type based on more reliable and effective decision, relating to cost
- Preparation of computer program of provision and investigation (including instruction), based on coordinated strategy, giving to the Port administration a detailed and updated provision program, program of detailed investigation, detailed instruction of actions in case of investigation discrepancies to provision program, e.g. sand drifts are more than expected on parts of access channels

- Installation of a computer and the program at the Port administration and provide initial training, using the program. It is necessary to add that proposed system is able to be used for other infrastructures and port facilities as well, such as general port provision system

4. PROJECT SCHEDULE

The study will be carried out in close cooperation with the Turkmenbashi Port and donor organizations. All actions on sites are to be planned with local authorities and port representatives.

The preliminarily proposed time schedule is as follows:

- **Part 1.** Determination of existing situation and environment (including investigations) - after 4 months
- **Part 2.** Requirements to the access channels to the Turkmenbashi Port system in future - after 5 months
- **Part 3.** Renewals of the navigation access channels - after 6 months
- **Part 4.** Provision plan of the access channels - after 8 months

5. OUTPUT

All investigation reports, documents and maps are to be submitted in 4 copies in Russian language to the Port and 2 copies in English language to the Donor.
Printouts of proposed computer provision program for the Port are to be in Russian language.

6. SUPPORT OF LOCAL AUTHORITIES

Local Port Administration is proposed to render the following support:

- to act on behalf of coordinator between the Consultant and the Port/local authorities
- to make available all reports, maps, investigations and other base information, relating to the study
- to make available a suitable vessel, including a crew and provisions for implementation of different investigations and surveys
- to conduct necessary coordination and recommend local companies dealing with investigations if needed

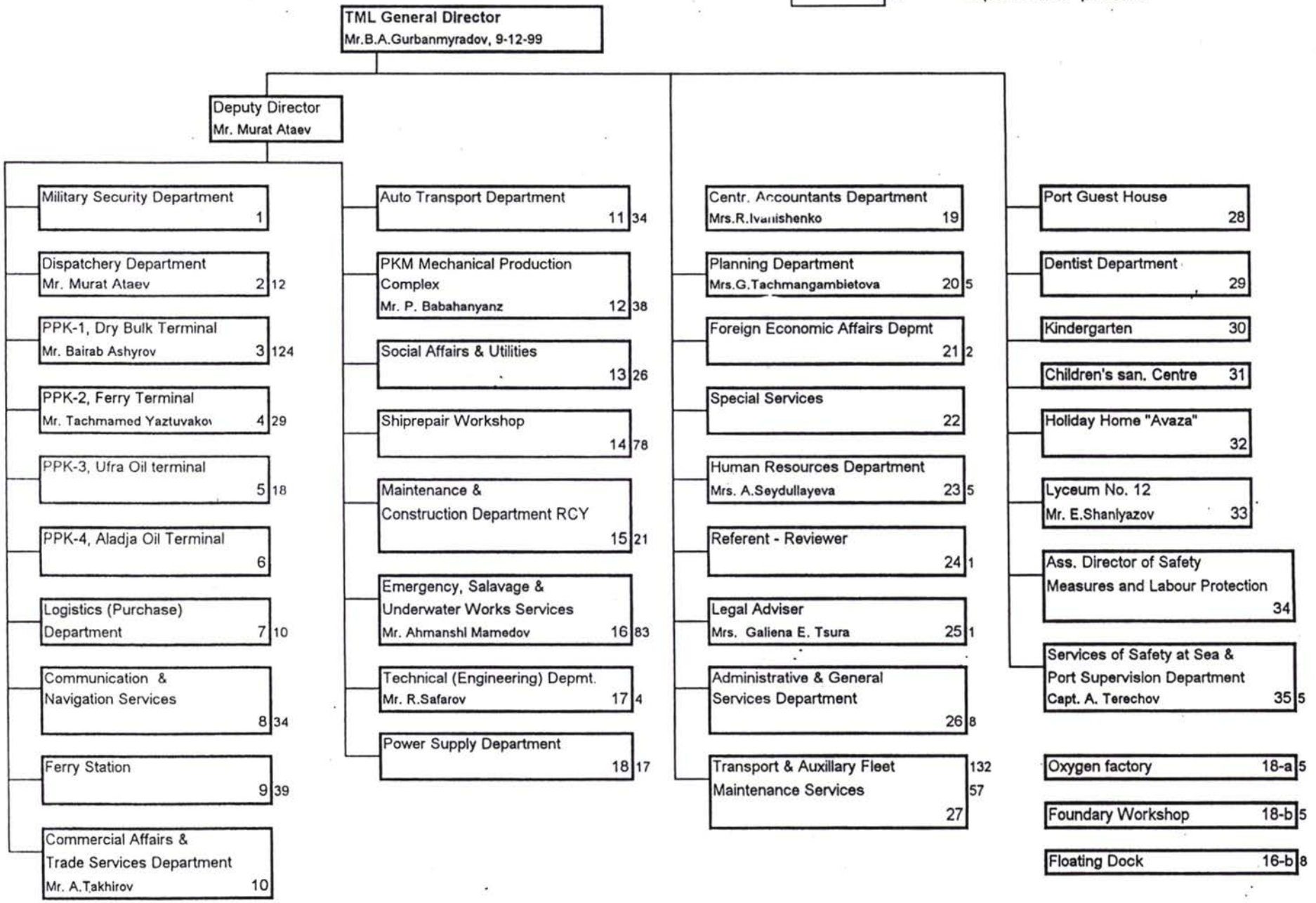
Above support will be non-repayable for the Consultant

Annex 5

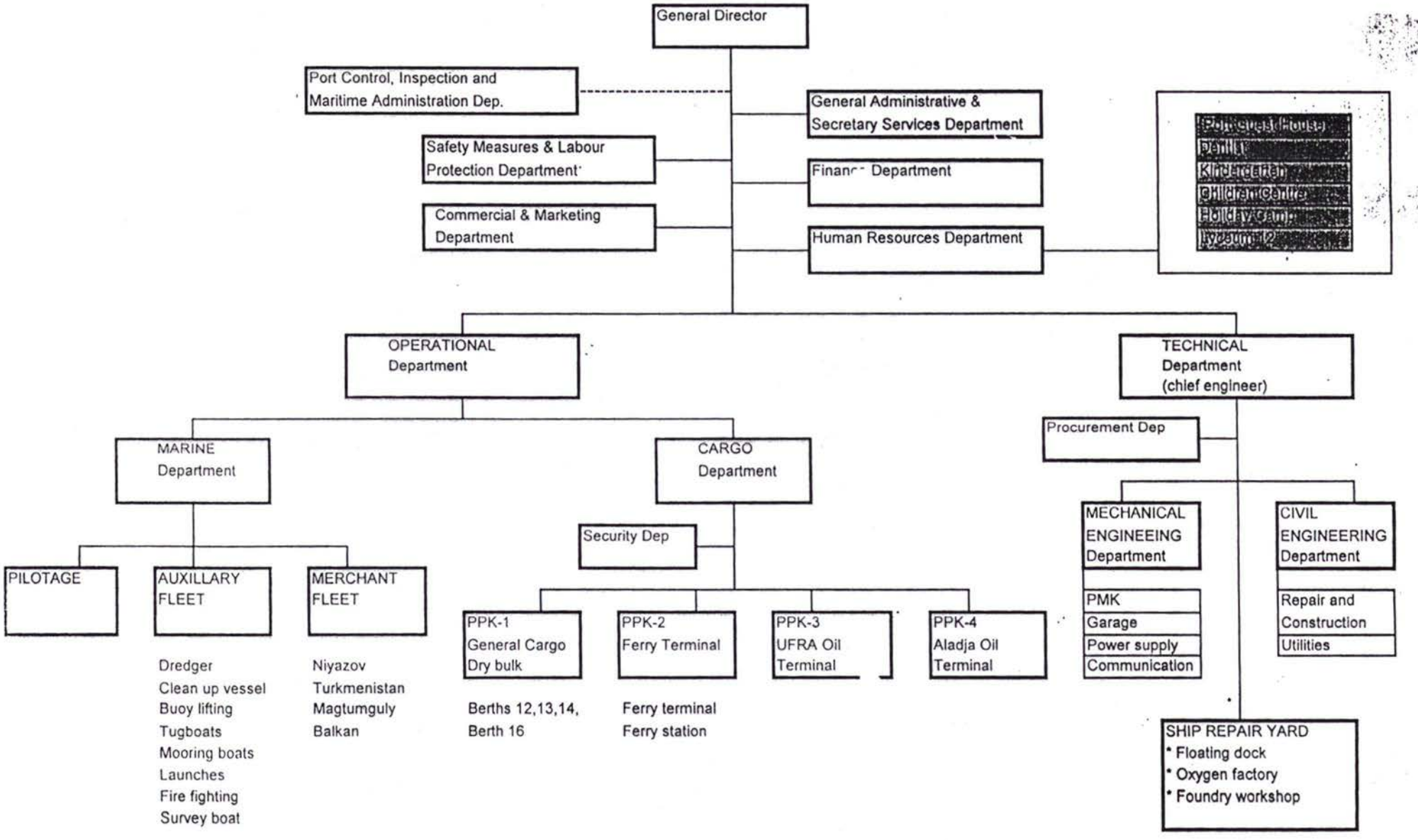
TML organisation charts

Figure 1. The organization of Turkmen Maritime Lines as per December 1999

1 23 sequence nbr. / personnel



The proposed organisation structure of Turkmen Maritime Lines



Annex 6

project terms of reference

Terms of Reference

Module D - Navigation Channel for Turkmenbashi Port

1. Introduction

The main access to the port is via an excavated channel, which is reportedly of insufficient depth, and poorly marked for the safe operation of vessels. The deepest draft vessels which regularly use the channel at the Caspian Shipping Company ferries (4 to 4.5 m). Occasionally tankers of deepest draft use the channel, and access by this type of vessels may increase in the future (reportedly 7 m). The port is equipped to carry out its own dredging maintenance. According to reports this equipment is not ideal, but adequate.

The problem of draught, if it is in fact serious, could be compounded by a lowering of the Caspian sea level. Considerable variations in the sea level are a historic fact. In recent years the continuation of operation of the ports has been jeopardised by rising water levels, but in the past year a contrary tendency has been manifest. No deterministic methodology for the prediction of future sea levels has been discovered. For the design of port improvement works currently planned, a stochastic method was applied. The EBRD is already committed to invest substantially in the port, which will impose a financial burden on the port as long as the loan remains outstanding. There is no desire to invest in further works or equipment unless it is fully justified. However, the navigation channel is vital to the survival of the port. Preliminary technical commentaries on this problem have been prepared by consultants. A clear indication of the risks, technical solutions, and costs of assuring uninterrupted future port operations is now required.

2. Rationale and Objectives

Overall Objectives

The overall objectives of this module are to ensure the continued accessibility of navigation to the Port of Turkmenbashi.

Project Purpose

The module should:

- carry out field investigations and report on the siltation regime of the port access channel;
- propose a maintenance plan to assure the security of navigation to the port.

Results

The project should deliver a detailed annual or periodic maintenance plan using as far as possible equipment owned by the port, or to be contracted, under a reasonable maintenance budget given the ports 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 channels;
- the costs of and dispositions for routine maintenance of the channel;
- investment recommendations, or explanation why no investment is required.

The module should deliver an investment plan, detailing whatever large or small capital works or

equipment procurements are necessary to assure the overall objectives.

3. Risks and Assumptions

Several uncertainties are included in the background to this project. Different versions of consultants' and operators' commentaries exist, of the degree of severity of the problem of siltation, and navigational marking, for the access channel to Turkmenbashi port, and of the need or not for a sophisticated computer based study and maintenance plan to be developed. Given the difficult experience of previous TRACECA projects with sophisticated specialist software, these TOR choose to avoid such methodology altogether, whatever their technical merits. Previous consultants' commentaries do not make it clear whether the port will be able to carry out channel maintenance under their own maintenance budget or not. There would appear little risk that this project cannot clarify the matter, but beneficiaries could disagree of the findings, with vessel operators calling for higher factors of safety, and port authorities claiming that the channel is adequate.

4. Main Components

Geographic Focus

The beneficiary of this module is the Cabinet of Ministers of Turkmenistan, represented by the Vice-Prime Minister for transport and the management of the Port of Turkmenbashi. Vessels of the Caspian Sea Shipping Company are the most frequent callers at the port, and their involvement in the project is also necessary.

Determination of the Existing Situation and Environment

- Review of previous consultants' reports and mission notes.
- Collection of existing charts and maps to describe the geography of the bay and 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 channels (pilot service, pilot vessels, radio equipment,...).
- Appraisal of past and present dredging practice, available equipment, staff, contractual arrangements, management practice, budget, suitability of locations for disposal of dredged materials,...).
- Identification of alternatives options for carry out dredging operations.
- Past, present and forecast traffic and revenues for the port (from Module A).
- Analysis of the possible impact of fluctuating water levels for the Caspian Sea.
- Comparison between actual situation and international norms.
- Relevance of international standards in so far as concerns Turkmenbashi port access, including draught parameters, lighting requirements etc.

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 ports 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.

Annex 7

technical proposal methodology

METHODOLOGY

MODULE D : NAVIGATION CHANNEL FOR TURKMENBASHI PORT

Task D1. Determination of the Existing Situation

Objective

The aim of this task is to get an accurate understanding of all channels parameters and pending problems: water depths, channel width, curves layout, siltation rates, navigation safety, operational procedures, dredging practices and maintenance costs.

Methods and Activities

- **Review of previous consultants' reports :**

The objective is to take advantage of all works already performed by consultants who were appointed to assess problems regarding Turkmenbashi channel, either in the field of bathymetry, or hydraulics, or geology, or dredging equipment and dredging practices, or evolution of mean sea level, navigation aids or vessel fleets. All related reports will be collected either in the Port or in the Cabinet of Ministers of Turkmenistan, then analysed. As far as possible, the authors will be interviewed in order to complement the contents of the reports.

- **Collection of existing charts and maps**

Since the sea bed is permanently changing in the area of the channel, it is of utmost importance to collect charts and maps reporting as many situations as possible, including the situation of the area before channel excavation. This will enable to compute siltation rates in various conditions. Dates of all charts and maps will be thoroughly analysed in order to correlate siltation periods with meteorological conditions.

Besides, as nautical maps also show navigation marks, this collection will provide a clear understanding of the existing and the past navigation aid systems. Several kinds of charts will be gathered: those of the British Admiralty Office, former USSR charts and, if existing, Turkmen charts. The consultant will also pay attention to symbols related to sea bed materials ("s" for sand, "m" for mud, etc.).

The concerned areas will be the port approaches, the bay of Turkmenbashi, the channel zone, the turning basins and the port basins. Scales should range from 1:25,000 (for general charts) to 1:1000 or 1:500 for detailed maps.

If available, old photos will also be gathered, especially aerial ones.

- **Collection of existing data regarding natural conditions**

Natural conditions are essential because they directly influence behaviour and performance of the channel. For example, siltation is the result of transportation of fine sediment by waves or by currents. Following existing data will be collected:

- Hydraulics: tide ranges (low, medium and high ranges), mean sea levels (according to general behaviour of the Caspian sea), currents (directions and speeds), refracted waves (directions, significant heights and directions, according to several return periods and to seasonal variations). Currents should be measured ones whilst waves can be measured or computed by mathematical refraction programmes.
- Winds: directions and speeds, to compute short crested waves and local currents. Wind data is usually available in airports, if not in meteorological centres.
- Geology and sediment: small scale geological maps will first provide general information about the area, to be then complemented by local charts and by soil samples from the sea bed. Furthermore, it will be useful to know which kind of sediment was dredged. Required parameters are mineral and organic components, grain sizes and cohesion.

- **Spot checks and surveys**

The aim of this sub-task is make local surveys of channel characteristics in order to cross check and eventually to complement most of the information previously collected about the channel. The consultant will focus on the following:

- Bathymetry: a set of cross-sections will be gauged by the mean of a portable echo-sounding equipment. Cross-sections will be selected in areas of high siltation rates.
- Sea bed soil: samples will be collected in plastic bags by underwater diving (Mr. André Merrien is a licensed diver), then analysed (sieve dimensions, cohesion of fine soils).
- Currents: spot estimates will be performed.

Results will be compared to pre-existing data. In case serious deviations are found, it will be advisable to launch more complete surveys, for instance an updated bathymetric campaign.

- **Survey of channel markings**

All channel buoys, fixed beacons, lights and radar systems will be checked by the consultant in order to confirm or to correct the information collected in the archives: locations, colours, alignments, elevations and characteristics. Conditions of markings will also be checked: paintings, corrosion, lamps, power feeding systems, etc. Moreover, the consultant will evaluate the efficiency of channel navigation aids, more particularly at night or by low visibility conditions (rain or fog). This task will require several sea trips.

- **Interviews with vessel operators and pilots**

Interviewing operators of vessels calling at the port as well as port pilots will enable the consultant to:

- Complement his opinion regarding channel safety (grounding and collisions risks) and efficiency of channel markings.
- Gather any information related to congestion and waiting times
- Get acquainted with pilotage and tugging procedures.
- Collect updated data regarding vessel sizes (lengths, beams and draughts), vessel types, propelling equipment and manoeuvring capability.
- Get accurate information about transported cargoes and hazardous goods.

It is understood that the main vessel operator is the Caspian Sea Shipping Company.

- **Identification of operational guidelines**

The consultant will identify all operational guidelines and practices regarding vessel operation and channel maintenance.

As far as vessel operation is concerned, he will collect following data:

- Maximum sizes of acceptable vessels (overall lengths, beams and draughts)
- Announcement procedures required before entering the channel
- Criteria for accepting or rejecting access to channel
- Priority rules according to vessel classes
- Speed limits
- Visibility and meteorological constraints

Regarding channel maintenance, the objective is to clearly understand applicable rules and practices for controlling and maintaining water depths: bathymetry surveying fleet and equipment, surveying schedules, criteria for launching dredging campaigns, dredging fleet, dredging capacity (in cubic meters per hour) and dumping sites. The consultant will also carefully compare current guidelines with actual practices.

- **Identification of port services and related equipment**

Port services related to channel operation are pilotage and VHF radio assistance.

The consultant will first identify current regulation for pilotage: types and sizes of vessels which are subject to pilotage, announcement time limits, waiting areas, pilot working hours, pilot crews, pilotage charges, types and numbers of pilot boats. If vessels are sometimes tugged during channel navigation, the consultant will gather similar information regarding tugging services.

As a second step, VHF radio assistance procedures and equipment will be identified, including staff number and staffing organisation as well as spoken languages.

Lastly, the consultant will check whether the port is properly equipped to face any vessel casualty likely to happen in the channel: fleet of tug boats, rescue boats, fire fighting units and pollution fighting equipment.

- **Appraisal of dredging practice and dredging equipment**

Following the preliminary assessment carried out in the course of task 1.7, at this current stage the consultant will thoroughly investigate dredging practices and dredging equipment in the port. To this end he will collect detailed information and provide relevant comments regarding:

  - Ruling criteria applicable for deciding to launch a dredging campaign (regular time intervals, insufficient water depths, availability of dredgers, etc.) and management procedures.
  - Dates of past dredging operations, comparison between bathymetries before and after operations, quantities and identification of dredged material.
  - Dredging vessels, barges, barge tugs, floating pipe-lines (including crew staffing, performances, adequacy to soil material and working conditions).
  - Contractual arrangements (is the dredging equipment permanently in the port or not, is it owned by the port itself or by another entity, which are the ruling contracts ?).
  - Costs of operations and costs of fleet maintenance (if owned by the port).
  - Location of dumping areas and adequacy with regard to re-siltation (if material is dumped too close to the channel it may come back quickly) and with regard to environment protection.

- **Identification of alternative options for dredging operations**

The purpose is to prepare part of improvement recommendations by identifying alternative options in the fields of:

  - Water depth control methods and frequency of campaigns
  - Criteria for launching dredging operations
  - Dredging profiles (depths and widths to be reached after dredging)
  - Dredging equipment
  - Dumping areas, either offshore or on land
  - Contractual issues (should the port own the equipment or should the port commission dredging contractors, or should another strategy be suggested ?)

- **Past, present and forecast traffic and revenues**

Channel maintenance usually entails very costly operations for port authorities. Therefore profitability of such operations can only be obtained if channel traffic reaches a certain threshold and provided that channel fees charged to vessels are high enough. This is the reason why the consultant will need to take into consideration traffic levels and port revenues (traffic data will be provided by Module A of the study). He will then be able to assess whether channel dues currently balance dredging costs and be ready to suggest financial improvement measures.

- **Impact of fluctuating sea water level**

Although no accurate method is currently available to predict future variations of the Caspian sea water level, the consultant will identify all major phenomena responsible for level changes (flows of incoming fresh water, evaporation rates, etc.) and he will analyse past records of mean sea levels in various areas of the Caspian sea. Together with scientists who have worked for long on this issue the consultant will draw fluctuation trends for the coming years, in order to carefully assess the risk of loss of water depth in the channel.

- **International channel standards**

As a first step, the consultant will compare Turkmenbashi channel parameters with the most recent international guidelines and standards regarding port channels, mainly those issued by PIANC (Permanent International Association for Navigation Congresses) and by IAPH (International Association for Ports and Harbours). As an input, traffic data and vessel dimensions will be used. Comparison results will focus on channel width, water depth and curve radiuses, as well as navigation aids. Should deviations be found, the consultant will evaluate to which extend some of them are acceptable and, for the other ones, he will suggest improvement recommendations.

Inputs

- Previous consultants' reports
- Existing charts and maps
- Existing data regarding natural conditions
- Current operational means and rules
- Vessel traffic data

Expertise required and planned effort (elapsed time in man-months):

- Main responsible: Port and Hydraulics Engineer (0.4 m-m)
- Participant: Sediment Transport Expert (0.5 m-m); Dredging Engineer (0.4 m-m); Navigation Aids Expert (0.4 m-m); Financial Analyst (0.3 m-m); Environmental expert (0.3 m-m).

*Begin :*n month 10
Duration : two months

Outputs

- Updated and comprehensive charts of channel (water depths, accurate layout, condition of navigation aids
- Siltation rates and controlling factors
- Weaknesses regarding safety, sailing procedures and dredging practices

Task D2.	*Maintenance and Improvement Recommendations*

Objective

On the basis of all statements and weak points highlighted in the course of task D1, the aim of this task is to provide improvement recommendations in the fields of water depth maintenance, navigation safety, management procedures, environment protection and financial related issues.

Methods and Activities

- **Review of the adequacy of the channel system**

Since Turkmenbashi port channel was excavated its bottom is artificially deeper than the surrounding sea bed and therefore siltation is unavoidable. However, the consultant will investigate possibilities to improve the channel system in order to decrease rates of maintenance dredging:

  - By reviewing the channel layout (for instance, orientation of channel axis with regard to wave and current directions is very important). Siltation rates will be computed according to hydraulic conditions and to geological data for both existing layout and improved layout.
  - By building underwater dikes along the channel borders.
  - By increasing the width of the channel or its dredge level in order to provide a certain reserve for siltation.
  - By improving the channel markings (buoys, beacons and lights).
  - By upgrading other navigation aids, including a proposal of radar based Vessel Traffic Management System (VTMS).

Protecting the channel by breakwaters would probably be ideal, but probably far too costly.

- **Improvement of operational practices for channel navigation**

On the basis of information collected during the first stage, including casualty statistics, the consultant will provide recommendations for improving following procedures:

  - Announcement procedures required from vessels before entering the channel
  - Assignment to anchorage waiting area
  - Criteria for accepting or rejecting access to channel
  - Priority rules according to vessel classes
  - Application of speed limits within the channel
  - Dedicated procedures in case of bad weather conditions (low visibility or strong wind)
  - Pilotage procedures (vessels requiring pilotage, pilot crews and pilot vessels)
  - Tugging procedures within channel boundaries
  - VHF radio assistance (staff qualification, working hours, etc.)
  - Assistance procedure in case of collision or grounding (rescue boats, fire-fighting vessels, pollution fighting equipment)

While elaborating such recommendations, costs of port services and costs of vessel operation will be taken into consideration.

- **Review the capability of the port to correctly maintain the channel**

According to all information collected beforehand the consultant will provide his opinion regarding the port capability to properly maintain the channel. This opinion will rely on adequacy of:

  - Water depth controlling equipment and operational staff
  - Dredging equipment (appropriateness to characteristics of sea bed soil, age and condition of dredger)
  - Dredging management policy

- Budget resources

Besides, maintenance results in terms of channel depths will be an important criterion.

- **Recommendations for maintenance policy**

Should any gap appear in the field of channel maintenance policy, the consultant will elaborate an action plan aiming at erasing it. Basically, recommendations should cover the following main areas:

- Port organisation and management of water depth maintenance
- Dredging contractual issues (Which share of maintenance works is to be achieved by the port itself ? Which other shares should be sub-contracted ? To which contractors ?)
- Planning of water depth control operations
- Criteria selection for launching dredging campaigns
- Principles for selecting dumping areas (adequacy with regard to re-siltation and to environmental protection)
- Financial balancing of maintenance costs (budget estimates will be supplied and will be related to other port expenditures and to port revenues, especially channel dues).

Financial issues will carefully consider current EBRD investment programme in the port of Turkmenbashi.

- **Recommendations for capital works and for equipment procurement**

Recommendable capital works and equipment procurement will be drafted and estimated by the consultant. They may cover any of the following items:

- Modification of the channel layout to comply with international standards
- Construction of underwater dikes to decrease siltation rates
- Creation of a protected land dumping site for dredged material
- Additional navigation aids or replacement of markings
- Vessel Traffic Management System
- Procurement of new dredging equipment
- Supply of water depth controlling equipment, including modern position systems using land based beacons

Related costs will be estimated, as well as expected financial savings and environmental benefits. Financial rates of return will be computed and sensitivity tests will be performed, according to variations of traffic levels and to variations of channel dues.

- **Outline specification for equipment procurement**

For any recommended new equipment the consultant will draft outline technical specification providing:

- Sizes, material, colours, light characteristics of channel markings
- Radar locations, ranges, accuracy and related computerised management system
- For any dredging equipment, dredging principle (vacuum system, cutter base, buckets, etc.), dredging rates, supporting vessels and barges, pipe lines, etc.
- Regarding bathymetry control, specification for water depth measurement units, positioning systems and computerised data processing.

Inputs

- All outputs from task D1
- Western European practices regarding port channel maintenance
- Recent development in the field of dredging equipment
- Specification related to modern Vessel Traffic Management Systems (VTMS)

Expertise required and planned effort (elapsed time in man-months):

- Main responsible : Port and Hydraulics Engineer (0.6 m-m)
- Participant: Sediment Transport Expert (0.5 m-m); Dredging Engineer (0.6 m-m); Navigation Aids Expert (0.6 m-m); Financial Analyst (0.7 m-m); Environmental expert (0.7 m-m).

Begin : month 12.
Duration : two months

Output : A set of improvement measures for:

- Maintenance of water depths (including procurement of new equipment)
- Revision of channel layout (curve short cuts, etc.)
- Navigation safety (markings, lights, radar control)
- Environmental protection (dumping areas)
- Financial equilibrium of channel maintenance operations

Annex 8

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
• IMDG	International Maritime Dangerous Goods Code
• km	kilometre
• Krasnovodsk	former name of Turkmenbashi
• m	metre
• m2	square metre
• m3	cubic metre
• MARPOL	International Convention for Prevention of Marine Pollution
• Mt	Million tonnes
• TML	Turkmen Maritime Lines
• ToR	Terms of Reference
• Traceca	Transport Corridor Europe-Caucasus-Asia
• USD	United States dollar
• VHF	Very High Frequency (radio system for short range communications)

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STAFF LIST

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4. OTHER STAFF

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